Agenda
City Council
Meeting

City Council Chambers
Historic City Hall, 830 Boonville

Ken McClure, Mayor

Zone Councilmembers	**General Councilmembers**
Vacant Seat, Zone 1	Heather Hardinger, General A
Abe McGull, Zone 2	Craig Hosmer, General B
Mike Schilling, Zone 3	Andrew Lear, General C
Matthew Simpson, Zone 4	Richard Ollis, General D

Upcoming Council Meeting Agenda
April 4, 2021 6:30 p.m.

Speakers must sign up with the City Clerk to speak to a Council Bill on the agenda.

Speakers must sign up with the City Clerk no later than 5:00 p.m. the Friday before the meeting to speak to an issue not on the agenda. Citizens wishing to submit comments to City Council may do so using the citizen comments form.

Speakers are to limit their remarks to three to five minutes based on City Council's policy regarding the number of speakers.

Note: Sponsorship does not denote Council member approval or support.

1. **ROLL CALL.**
2. **APPROVAL OF MINUTES, MARCH 7, 2022 CITY COUNCIL MEETING**

2. **APPROVAL OF MINUTES: MARCH 7, 2022 CITY COUNCIL MEETING AND MARCH 21, 2022 CITY COUNCIL MEETING.**

Documents:

03-07-22.PDF
03-21-22.PDF

3. **FINALIZATION AND APPROVAL OF CONSENT AGENDAS. CITIZENS WISHING TO SPEAK TO OR REMOVE ITEMS FROM THE CONSENT AGENDAS MUST DO SO AT THIS TIME.**

4. **CEREMONIAL MATTERS.**

5. **CITY MANAGER REPORT, POLICE CHIEF REPORT, AND RESPONSES TO QUESTIONS RAISED AT THE PREVIOUS CITY COUNCIL MEETING.**

6. **SECOND READING AND FINAL PASSAGE. Citizens Have Spoken. May Be Voted On.**

7. **Council Bill 2022-072 (Simpson)**

A special ordinance authorizing the Director of Planning and Development to accept the dedication of public streets and easements to the City of Springfield, as shown on the Cluster Preliminary Subdivision Plat of Reed Avenue Cottages, generally located at 4423 South Reed Avenue, upon the applicant filing and recording a final plat that substantially conforms to the preliminary plat; and authorizing the City Clerk to sign the final plat upon compliance with all the terms of this Ordinance. (Staff recommends that City Council accept the public streets and easements.) (By: Katy A. St. George Revocable Trust; 4423 South Reed Avenue; Preliminary Plat of Reed Avenue Cottages)

Documents:

2022-072.PDF

8. **Council Bill 2022-073 (Ollis)**

A general ordinance adopting an updated version of the "Flood Control and Water Quality Protection Manual" to include a water quality requirement for redevelopment in accordance with the City's Municipal Separate Storm Sewer System permit and other technical updates and clarifications to stormwater design standards; and amending Springfield City Code, Chapter 96, 'Storm Water,' Article I. 'Flood Control and Water Quality Protection,' and Article III. 'Land Disturbance Activity', to make changes consistent with the updated Manual.

Documents:

2022-073.PDF

9. **Council Bill 2022-074 (McGull)**

A general ordinance amending the Springfield Land Development Code, Article III, 'Zoning Regulations,' Division 5, 'Supplemental District Regulations,' Section 36-472, 'Stream Buffers.' (Staff and Planning and Zoning Commission both recommend approval.)

Documents:

2022-074.PDF

10. **RESOLUTIONS. Citizens May Speak. May Be Voted On.**

11. **Council Bill 2022-076 (McGull)**

A resolution designating the Calhoun Orchard Estate, located at 836 South Delaware Avenue, as a Historic Site on the Springfield Historic Register.

Documents:

2022-076.PDF

12. **EMERGENCY BILLS.**

13. **PUBLIC IMPROVEMENTS.**

14. **GRANTS.**

15. **AMENDED BILLS.**

16. **COUNCIL BILLS FOR PUBLIC HEARING. Citizens May Speak. Not Anticipated To Be Voted On.**

17. **Council Bill 2022-077 (Simpson)**

A general ordinance amending the Springfield Land Development Code, Section 36-306, 'Official zoning map and rules for interpretation,' by rezoning approximately 10.23 acres of property generally located at 1616 East Bradford Parkway and 3811 and 3813 South Weller Avenue from Planned Development No. 117, 5th Amendment, and Planned Development No. 363 to Planned Development No. 379; and adopting an updated Official Zoning Map. (Planning and Zoning Commission and Staff recommend approval.) (By: EWR Springfield Cambium, LLC & EWR Springfield Cambium II, LLC; 1616 E. Bradford Pkwy and 3811 & 3813 South Weller Avenue; Planned Development No. 379.)

Documents:

2022-077.PDF

18. **Council Bill 2022-078 (McGull)**

A general ordinance amending the Springfield Land Development Code, Section 36-306, 'Official zoning map and rules for interpretation,' by rezoning approximately 1.04 acres of property generally located at 1310 East St. Louis Street from R-HD, High-Density Multifamily Residential District, with Conditional Overlay No. 123, to GR, General Retail District; and adopting an updated Official Zoning Map. (Staff and Planning and Zoning Commission both recommend approval.) (By: Urban Village Living LLC; 1310 East St. Louis Street; Z-5-2022.)

Documents:

2022-078.PDF

19. **Council Bill 2022-079 (Simpson)**

A general ordinance amending the Springfield Land Development Code, Section 36-306, 'Official zoning map and rules for interpretation,' by rezoning approximately 1 acre of property generally located at 404, 420, and 424 East Sunshine Street from R-SF, Single-Family Residential District, to LB, Limited Business District, with Conditional Overlay District No. 207; establishing Conditional Overlay District No. 207; and adopting an updated Official Zoning Map. (Planning and Zoning Commission recommends denial and staff recommends approval.) (By: Reding Management and Redic, LLCs; 404, 420, & 424 E. Sunshine Street; Z-1-2022 w/Conditional Overlay District No. 207.)

Documents:

2022-079.PDF

20. **Council Bill 2022-080 (Simpson)**

A special ordinance granting Conditional Use Permit No. 461 for the purpose of permitting eating and drinking establishment use group, including drive-in, pick-up window, or drive-thru facilities, as a conditional use within the LB – Limited Business District, generally located at 404, 420, and 424 East Sunshine Street. (Planning and Zoning Commission recommends denial and staff recommends approval.) (By: Reding Management and Redec, LLCs; 404, 420, & 424 E. Sunshine Street; Conditional Use Permit 461.)

Documents:

2022-080.PDF

21. **FIRST READING BILLS. Citizens May Speak. Not Anticipated To Be Voted On.**

22. **Council Bill 2022-082 (Hardinger)**

A special ordinance approving the plans and specifications for the Division Street Roadway Improvements – National Avenue to Glenstone Avenue project; accepting the bid of Hartman and Company, Inc., in the amount of $4,689,870.65 for said project; authorizing the City Manager, or his designee, to enter into a contract with such bidder; and amending the Fiscal Year 2021-2022 budget for the Department of Public Works in the amount of $1,100,000.00 to appropriate reserves of the 1/8-cent Transportation Sales Tax for said project.

Documents:

2022-082.PDF

23. **PETITIONS, REMONSTRANCES AND COMMUNICATIONS.**

24. **NEW BUSINESS.**

The Public Involvement Committee recommends the following appointment to the Planning and Zoning Commission: Eric Pauly with term to expire January 1, 2024.

Refer the topic of e-scooters from the Community Involvement Committee to the Plans and Policies Committee.

25. **UNFINISHED BUSINESS.**

26. **MISCELLANEOUS.**

27. **CONSENT AGENDA – FIRST READING BILLS. See Item #3.**

28. **Council Bill 2022-083 (Hosmer)**

A special ordinance amending Special Ordinance 27630, which declared the necessity of acquiring by condemnation the final easements for the purpose of constructing and maintaining sanitary sewers in the Chestnut South Lift Station Relief Sewer Project, to correct the legal description of a perpetual sanitary sewer easement.

Documents:

2022-083.PDF

29. **CONSENT AGENDA – ONE READING BILLS. See Item #3.**

30. **Council Bill 2022-084 (Schilling)**

A resolution acknowledging the appointments made by Greene County and the Republic School District to the Tax Increment Finance Advisory Commission

Republic School District to the Tax Increment Finance Advisory Commission.

Documents:

2022-084.PDF

31. **CONSENT AGENDA – SECOND READING BILLS. See Item #3.**

32. **BOARD CONFIRMATIONS.**

Confirm the following appointments to the Citizens Advisory Committee for Community Development: O'Brien Daniels with term to expire May 1, 2024; Krista Peryer with term to expire May 1, 2022.

Confirm the following appointments to the Citizens Tax Oversight Committee: Christopher Upton with term to expire May 1, 2023; Tammy Adu and Erin Gray with terms to expire May 1, 2022; Duane Keys and Ray Lampert with terms to expire May 1, 2024.

Confirm the following reappointments to the Landmarks Board: Layne Hunton and Jan Preston with terms to expire November 1, 2024.

Confirm the following reappointments to the Personnel Board: Michael Ramos and Tyler Tooley with terms to expire March 1, 2025.

Confirm the following appointment to the Public Building Corporation: Paul Monroe with term to expire September 1, 2027.

Confirm the following appointments to the Springfield – Greene County Environmental Advisory Board: Carol Hutcheson and Laura McCaskill with terms to expire October 1, 2024.

33. **END OF CONSENT AGENDA.**

34. **ADJOURN.**

Persons addressing City Council are asked to step to the microphone and clearly state their name and address before speaking.

All meetings are recorded.

In accordance with ADA guidelines, if you need special accommodations when attending any City meeting, please notify the City Clerk's Office at 864-1443 at least three days prior to the scheduled meeting.

March 7, 2022
Springfield, Missouri

The City Council met in regular session March 7, 2022, in the Council Chambers at Historic City Hall. The meeting was called to order by Mayor Ken McClure. Mayor McClure acknowledged the situation in Ukraine and all impacted. A moment of silence was observed.

Roll Call

Present: Mike Schilling, Matthew Simpson, Craig Hosmer, Richard Ollis, Andrew Lear, Heather Hardinger, Abe McGull, and Ken McClure. Absent: None. Vacant Seat: Zone 1.

Minutes

The minutes of the February 22, 2022, City Council Meeting were approved as presented.

Consent Agenda

The consent agenda was approved as presented.

CEREMONIAL MATTERS.

Marlon Graves was sworn in for the Police Civilian Review Board.

City Manager Report

Jason Gage, City Manager, provided an update on the City Council Zone 1 Vacancy. Mr. Gage noted those wishing to serve on City Council can now apply for the Zone 1 seat through the City Clerk's Office during normal business hours (8 a.m. – 5 p.m.) until 5 p.m. on March 11.

Mr. Gage noted the Springfield Fire Department defeated the Springfield Police Department 10-3 in the third annual charity hockey game in front of a sell-out crowd at Jordan Valley Ice Park and the teams raised $7,300 for the Greene County 100 Club. Mr. Gage further noted the Springfield Police Department team led the annual "Polar Plunge" last Saturday to raise money for Special Olympics. The event had approximately 200 volunteers from all over the community and raised almost $75,000.

Mr. Gage noted Fire Chief David Pennington was one of 29 participants in the Homeland Security Executive Leaders Program who graduated at a February 3rd ceremony at the Center for Homeland Defense and Security, Naval Postgraduate School in Monterey, California. He further noted the program provides a unique educational opportunity for senior-level homeland security/public safety leaders who are at the forefront of the nation's homeland security mission.

Mr. Gage provided an update on the Springfield Art Museum. Mr. Gage noted the Springfield Art Museum received a $5 million lead gift for its 2028 Campaign from The Sunderland Foundation of Overland Park, Kansas, and with this gift, the Museum has raised nearly $9 million to date toward the $25 million campaign.

Mayor McClure expressed his congratulations to the Art Museum.

Police Chief Report

Paul Williams, Police Chief, noted there are currently 25 recruits in the Police Academy and three recruits in the lateral academy. Six participants are approved for the August class, and an additional 24 have signed up for testing. Chief Williams added the department had seven retirements and one resignation in February. The Police Department currently has 50 vacancies for police officers and 17 vacancies for records clerks.

Chief Williams provided an update on the Springfield Police Department (SPD) Spring 2022 Crime report. The report compares crimes in 2021 to 2020. He noted overall reported crime was down 7%, property crimes were down 11%, and crimes against persons increased 3.5%. Chief Williams further noted motor vehicle theft, vehicle parts theft, and vandalism increased and efforts will be made to decrease these crimes. Chief Williams noted aggravated assault and weapons violations increased. Chief Williams added a short video will be released every two weeks in effort to facilitate citizen engagement, for awareness and prevention.

Chief Williams reported there were six municipal arrests last week, and the average number of municipal prisoners is approximately fifteen per week. He noted there have been 45 arrests for municipal warrants; 69 warrants were served, and 169 warrants have been resolved.

Councilman McGull expressed his appreciation for efforts the SPD has made to eliminate vacancies in the department. He asked if there is a limit on lateral hires to the police force. Chief Williams responded the goal is to have 3 lateral hires, however there is no limit.

Councilman Ollis asked if the fifty vacancies include the current academy class. Chief Williams responded the recruits are included in department numbers, leaving the department 75 officers short in the field. Mr. Ollis complimented Chief Williams on the plan to rehire retired officers and on accomplishments of the Warrant Task Force.

Mayor Pro Tem Simpson asked if Chief Williams anticipates any of the seven February retirees to be utilize the rehire program. Chief Williams responded he does anticipate some or all of the retirees will apply.

Councilman Hosmer asked if action can be taken to further incentivize officers and non-sworn staff to stay with the department. Chief Williams responded the plan in place does allow incentives for officers to stay. Chief Williams noted the plan will be revisited to determine if anything additional can be done to increase retention. Chief Williams further noted starting pay for non-sworn staff was increased, and the hiring timeline was decreased.

Councilman McGull asked for an update on the nationwide recruiting campaign. Chief Williams noted feedback has not yet been reviewed for this campaign.

The following bills appeared on the agenda under Second Reading Bills.

Southwest Missouri Council of Governments: loan packaging and processing

Sponsor: Simpson. Amended Council Bill 2022-043.

A special ordinance authorizing the City Manager, or his designee, to enter into a contract with the Southwest Missouri Council of Governments to provide loan packaging and processing.

An opportunity was given for citizens to express their views on the amendment only. With no appearances, the public hearing was declared closed.

Amended Council Bill 2022-043. Special Ordinance 27661 was approved with the following vote: Ayes: Hosmer, Ollis, Lear, Hardinger, McGull, Schilling, Simpson, and McClure. Nays: None. Absent: None. Abstain: None. Vacant Seat: Zone 1.

Brody Corners Tax Increment Financing Plan

Sponsor: Simpson. Council Bill 2022-052.

A special ordinance approving the Brody Corners Tax Increment Financing Plan, establishing a redevelopment area, designating the redevelopment area as a blighted area, making other required findings for the redevelopment plan, designating a developer of record for the redevelopment plan, approving a redevelopment agreement with the developer; and directing staff to implement the redevelopment plan.

Councilman Schilling noted there is a revised plat for review at the next Planning and Zoning Commission meeting and asked how that affects the proposed bill. Susan Istenes, Director of Planning and Development, responded the plat in question will only be reviewed by Planning and Zoning Commission for consideration and approval. The plat in question will not be presented to City Council.

Council Bill 2022-052. Special Ordinance 27662 was approved with the following vote: Ayes: Ollis, Lear, Hardinger, McGull, Schilling, Simpson, and McClure. Nays: None. Absent: None. Abstain: Hosmer. Vacant Seat: Zone 1.

Redevelopment Project for the Brody Corners Tax Increment Financing Plan

Sponsor: Lear. Council Bill 2022-053.

A special ordinance approving a Redevelopment Project for the Brody Corners Tax Increment Financing Plan and initiating tax increment financing therein.

Councilman Schilling asked for clarification on the proposed. Mr. Gage noted the proposed is specific to the redevelopment project only. Mr. Schilling expressed his belief the project is needed to get rid of the existing abandoned trailer court.

Council Bill 2022-053. Special Ordinance 27663 was approved with the following vote: Ayes: Ollis, Lear, Hardinger, McGull, Schilling, Simpson, and McClure. Nays: None. Absent: None. Abstain: Hosmer. Vacant Seat: Zone 1.

Historic Flag

Sponsor: McClure. Council Bill 2022-048.

A special ordinance designating the official City flag adopted in 1938 as the Historic City Flag.

Council Bill 2022-048. Special Ordinance 27664 was approved with the following vote: Ayes: Hosmer, Ollis, Lear, Hardinger, McGull, Schilling, Simpson, and McClure. Nays: None. Absent: None. Abstain: None. Vacant Seat: Zone 1.

The following item appeared on the agenda under Resolutions.

Ukraine Resolution

Sponsor: City Council. Council Bill 2022-056.

A resolution condemning Russian aggression in Ukraine.

Jason Gage, City Manager, provided a brief overview of the proposed. Councilman Hosmer asked if the City has prepared for the possibility of any refugees from Ukraine. Mr. Gage responded he will follow up on this question.

Mayor Pro Tem Simpson expressed his thanks to the City Manager for the proposed.

Councilman Hosmer read the resolution in its entirety.

An opportunity was given for citizens to express their views. With no appearances, the public hearing was declared closed.

Council Bill 2022-056. Resolution 10618 was approved with the following vote: Ayes: Hosmer, Ollis, Lear, Hardinger, McGull, Schilling, Simpson, and McClure. Nays: None. Absent: None. Abstain: None. Vacant Seat: Zone 1.

Short-Term Rental Type 2 Permit: 3236 East Wayland

Sponsor: Hosmer. Council Bill 2022-057.

A resolution granting a Short-Term Rental Type 2 Permit for the property located at 3236 East Wayland Street for the purpose of allowing the establishment of a Short-Term Rental Type 2 pursuant to Section 36-473 of the Land Development Code.

Daniel Neal, Senior City Planner, gave a brief overview of the proposed. Mr. Neal noted Short-Term Rental Type 2 are rented for less than 30 consecutive days, are not owner-occupied, must be in Residential Single Family (R-SF) or Residential Townhouse (R-TH) zoning districts, have a 500-foot notification and neighborhood meeting, and are not permitted on a block face with fewer than four residential structures unless approved by City Council. He further noted the proposed property is zoned Single Family Residential, is on a short block face, and a neighborhood meeting was held January 17, 2022. 75 notices were mailed; two adjacent property owner's signatures were acquired, and one additional property owner protested.

Councilman Lear asked if the incorrect signature received was from an adjacent property in which the current owner was deceased and the future owner of the

property was the one who signed creating an incorrect signature. He also asked if the block face issue would be the only remaining issue had the signature been correct. Mr. Neal answered affirmatively to both questions.

Councilman Ollis expressed thanks for the added step of mailing protest petitions. He asked why the process of bringing the application to City Council was implemented given the property does not meet the short block face rule. Mr. Neal noted properties on a short block face must be presented to City Council for consideration.

Councilman McGull expressed his appreciation for the updated language on the protest petition. He asked how much notice the property owners had to return the petition. Mr. Neal responded ten days.

Councilman Hosmer asked if the applicant met the 55% rule for adjacent owner consent. Mr. Neal answered the applicant did not. Councilman Hosmer expressed his opinion the regulations were put in place as a reasonable rule and exceptions are becoming greater than the rule.

Councilman Schilling asked if the department keeps track of property being acquired for short term rentals. Mr. Neal responded they have not noticed a trend to date noting there has been an increase in applications for short term rentals. He noted there have been 26 this year, and there are currently 210 short term rentals in operation.

Mayor Pro Tem Simpson expressed his appreciation for the added language in the form. He asked if there have been any block face exceptions to date. Mr. Neal responded there have not.

An opportunity was given for citizens to express their views.

Hannah Bartley, property owner, addressed City Council. Ms. Bartley noted a short term rental option would not have been pursued if they had known the short face block was an issue. Ms. Bartley noted the plan for the property was short term rental only and the property was previously a long term rental. Mr. Simpson asked if the surrounding houses are rentals. Ms. Bartley expressed her belief that two of the houses are. Ms. Bartley noted she lives in Nixa, Missouri.

With no further appearances, the public hearing was declared closed.

Council Bill 2022-057 failed with the following vote: Ayes: Lear. Nays: Hosmer, Ollis, Hardinger, McGull, Schilling, Simpson, and McClure Absent: None. Abstain: None. Vacant Seat: Zone 1.

Jefferson Avenue Footbridge: RAISE Grant

Sponsor: Hardinger. Council Bill 2022-058.

A resolution authorizing the City Manager or his designee, to apply for up to $8,000,000 in grant funds from the United States Department of Transportation Rebuilding American Infrastructure with Sustainability and Equity Grant Program to fund the improvements for the Jefferson Avenue Footbridge Rehabilitation Project.

Martin Gugel, Assistant Director of Public Works, provided a brief overview of the proposed. Mr. Gugel noted the department has sought additional funding options due to bids that were higher than originally anticipated, and the department is asking permission to apply for the grant. Mr. Gugel noted the application is a good fit for the grant, and the department will continue to seek other funding sources, as well.

Councilman Ollis thanked Mr. Gugel for exploring funding options and asked for clarification on the bids being deemed unresponsive. Mr. Gugel responded neither contractor could meet the goal and for the rebid the goal may have to be reset to be attainable.

Mayor Pro Tem Simpson asked if a local match is required given the grant application is for 100%. Mr. Neal responded no match is required, and this grant focuses on disadvantaged zones, making the proposed eligible for 100%.

Anita Cotter, City Clerk, noted Abby Glenn provided written comments which were distributed to all councilmembers. Ms. Glenn expressed her support for the Jefferson Avenue Footbridge noting it is a historical marker of the City and vital to economic opportunity for Springfield's Northside.

An opportunity was given for citizens to express their views. With no appearances, the public hearing was declared closed.

Council Bill 2022-058. Resolution 10619 was approved with the following vote: Ayes: Hosmer, Ollis, Lear, Hardinger, McGull, Schilling, Simpson, and McClure. Nays: None. Absent: None. Abstain: None. Vacant Seat: Zone 1.

EMERGENCY BILLS.

PUBLIC IMPROVEMENTS.

GRANTS.

AMENDED BILLS.

The following items appeared on the agenda under Public Hearing.

Rezoning: 1218, 1226, 1238 East Pacific: GM to R-TH

Sponsor: Ollis. Council Bill 2022-059.

A general ordinance amending the Springfield Land Development Code, Section 36-306, 'Official zoning map and rules for interpretation,' by rezoning approximately 0.30 acres of property generally located at 1218, 1226, and 1238 East Pacific Street from GM, General Manufacturing, to R-TH, Residential Townhouse, with Conditional Overlay District No. 209; establishing Conditional Overlay District No. 209; and adopting an updated Official Zoning Map. (Staff and Planning and Zoning Commission both recommend approval.)

Councilman Ollis moved to table Council Bill 2022-059 until the April 18, 2022, City Council meeting. The motion was seconded by Councilman McGull and approved with the following vote: Ayes: Hosmer, Ollis, Lear, Hardinger, McGull, Schilling, Simpson, and McClure. Nays: None. Absent: None. Abstain: None. Vacant Seat: Zone 1.

Rezoning: County Plot District No. 1014 to R-SF

Sponsor: Simpson. Council Bill 2022-060.

A general ordinance amending the Springfield Land Development Code, Section 36-306, 'Official zoning map and rules for interpretation,' by rezoning approximately 0.24 acres of property generally located at 3817 East San Poppi Court from County Plot Assignment District No. 1014 to R-SF, Single-Family Residential District; and adopting an updated Official Zoning Map. (Staff and Planning and Zoning Commission both recommend approval.)

Susan Istenes, Director of Planning and Development, provided a brief overview of the proposed. Ms. Istenes noted the plan would allow the applicant to build a structure, which includes a deck, and change the rear yard setback from fourteen to twenty feet on their lot which is part of a subdivision.

Councilman Lear asked if zoning has been changed from County to City on most properties in the location. Ms. Istenes noted most properties at this location are still under County zoning.

An opportunity was given for citizens to express their views.

Kelly Rhoades, the property owner, addressed City Council. Mr. Rhoades noted he has a building plan in which one corner of the deck reaches the fourteen foot setback. The property opens to common area. Mr. Rhoades requests City zoning to allow for the twenty foot setback.

Councilman Lear noted the buffer is from a common area. He further noted the City may review changing zoning in the remaining areas of the subdivision to City zoning. Jason Gage, City Manager, noted a review would be needed as areas are generally rezoned as they are annexed.

Mayor Pro Tem Simpson asked if zoning requirements can be enforced if the City has not yet annexed the property. Mr. Gage noted legally the current zoning can be enforced, but there may be incompatibilities. He further noted the issue should be reviewed.

Councilman Ollis asked if there are other areas of the City where there is County zoning inside the City. Mr. Gage noted this item will be followed up on.

With no further appearances, the public hearing was declared closed.

Rezoning: 838 East Walnut

Sponsor: Schilling. Council Bill 2022-061.

A general ordinance amending the Springfield Land Development Code, Section 36-306, 'Official zoning map and rules for interpretation,' by rezoning approximately 0.29 acres of property generally located at 838 East Walnut Street from GI, Government and Institutional District, to R-HD, High Density Multi-Family Residential District, with Conditional Overlay District No. 208; establishing Conditional Overlay District No. 208; and adopting an updated Official Zoning Map. (Staff and Planning and Zoning Commission both recommend approval.)

Susan Istenes, Director of Planning and Development, provided a brief overview of the proposed. Ms. Istenes noted the rezoning changes the property from Government and Institutional District to High Density Multi-Family Residential District. She further noted the property will be limited to 11 dwelling units per acre.

Councilman Schilling asked if the historic designation remains with the property even though it is being converted for other use. Ms. Istenes answered affirmatively.

An opportunity was given for citizens to express their views.

Billy Kimmons, a representative for the applicant, addressed City Council. Mr. Kimmons noted the request is to allow for residential use and the property is intended to be used as a primary residence.

With no further appearances, the public hearing was declared closed.

The following items appeared on the agenda under First Reading Bills.

Merit System Rules and Regulations: City Health Care Plan

Sponsor: McGull. Council Bill 2022-062.

A general ordinance amending the Springfield City Code, Chapter 2, Article III, Division 1, Section 2-91, known as the Merit System Rules and Regulations ("Merit Rules"), by amending Merit Rule 25.1 (City Health Care Plan) regarding the Plan's reserves policy.

Darla Morrison, Director of Human Resources, gave a brief overview of the proposed. Ms. Morrison noted the proposed would allow amendments to the Health Care Plan parameters. Ms. Morrison introduced Segal Consultant representatives, Mitch Bramstaedt, Lead Consultant, and Tom Wyszomirski, Actuarial Work Specialist, to present the proposed.

Mr. Bramstaedt noted the City Health Plan is very stable due to efficient management of the plan. He further noted this stability is in part a result of the allowance of increases if the reserves drop below 6 months and the risk sharing contract with Mercy hospital. He added the proposed changes would update current statutory language to ensure reserves remain stable and adhere to modest annual increases or plan changes.

Tom Wyszomirski noted without changes to the reserve policy, adjustments would not be allowed until reserves drop below 6 months, causing the plan to need dramatic changes to remain solvent. He further noted proposed changes to the plan would allow the plan to have reserves up to the year 2030. The language would allow adjustments to price if needed.

Ms. Morrison added the plan adds a mechanism that evaluates the ratio of expenses to income.

Councilman Ollis expressed his thanks to Ms. Morrison for being proactive and being a good steward of the health plan. Mr. Ollis asked if the cost of specialty drugs has driven up the claim costs. Ms. Morrison noted it is a factor, but not the sole factor.

Councilman McGull asked if the City Manager has discretion for plan changes. Ms. Morrison noted there would be discretion under the new plan.

Councilman Lear asked who members of the Health Plan Committee are. Ms. Morrison noted there are various members on the Committee, including management, employees, and Union representatives, and noted she will send more detailed information to City Council.

Councilman Hosmer asked what employees currently pay for dependent coverage. Ms. Morrison noted employees pay 100% of dependent coverage.

An opportunity was given for citizens to express their views. With no appearances, the public hearing was declared closed.

Ozarks Empire Fair: Subrecipient Agreement

Sponsor: Lear. Council Bill 2022-063.

A special ordinance authorizing the City Manager, or his designee, to enter into an agreement with the State of Missouri, Office of Administration, for the purpose of accepting funds appropriated by the General Assembly for the benefit of the Greene County Agricultural Society d/b/a the Ozarks Empire Fair because the funds cannot be disbursed from the Office of Administration directly to the Ozarks Empire Fair; authorizing the City Manager, or his designee, to enter into a subrecipient agreement with the Ozarks Empire Fair Foundation for the funds appropriated by House Bill 19, Section 19.405, Fiscal Year 2022 for the benefit of the Ozarks Empire Fair; and amending the budget of the City of Springfield for Fiscal Year 2021-2022 in the amount of $5,000,000.

Rhonda Lewsader, City Attorney, provided a brief overview of the proposed. Ms. Lewsader noted the proposed would authorize the City Manager, or his designee, to enter into a recipient agreement with the Office of Administration, and a subrecipient agreement with the Ozarks Empire Fair Foundation to disperse funds in the amount of $5,000,000.

Kent Hyde, a representative of the Fair Board, addressed City Council. Mr. Hyde noted the funds will be used for a multi-purpose arena.

An opportunity was given for citizens to express their views. With no appearances, the public hearing was declared closed.

The following items appeared on the agenda under Petitions, Remonstrances, and Communications.

Tim Winters did not appear to address City Council.

Paul Marshall did not appear to address City Council.

Margaret Clarke addressed City Council. Ms. Clarke expressed her belief sober living homes exist but do not adhere to zoning regulations. She noted sober living homes can have up to ten people, can be placed into any location, and are federally protected. Ms. Clarke added there are several sober living homes in her neighborhood.

Rusty Worley addressed City Council. Mr. Worley provided an update on the downtown area. He noted examples such as the Discovery Center being awarded a $1,000,000 grant for their work during COVID-19, Springy Jeans becoming a top vintage online retail store in the country, An Art Collective on Walnut Street leasing a new space across the street, Billiards reopening, and the 505 Project having over 500 units with a $50,000,000 investment to revitalize a previously blighted area. Mr. Worley expressed his enthusiasm for the World Fishing Fair and the Grant Street Parkway project. Mr. Worley noted he is chair of the Neighborhood Advisory Council and their nuisance property work group will bring forth recommendations in the future.

NEW BUSINESS.

UNFINISHED BUSINESS.

MISCELLANEOUS.

CONSENT AGENDA – FIRST READING BILLS.

The following items appeared under Consent Agenda – One Reading bills.

Local Violent Crime Prevention Grant

Sponsor: Lear. Council Bill 2022-064.

A special ordinance authorizing the City Manager, or his designee, to accept the Local Violent Crime Prevention Grant in the amount of $13,699 from the State of Missouri, Department of Public Safety; amending the budget for the Police Department for Fiscal Year 2021-2022 in the amount of $13,699; and declaring this bill qualifies as a one reading bill pursuant to Charter Section 2.16(25).

Council Bill 2022-064. Special Ordinance 27665 was approved with the following vote: Ayes: Hosmer, Ollis, Lear, Hardinger, McGull, Schilling, Simpson, and McClure. Nays: None. Absent: None. Abstain: None. Vacant Seat: Zone 1.

Environmental Epidemiology Study

Sponsor: Lear. Counicl Bill 2022-065.

A special ordinance authorizing the City Manager, or his designee, to accept $36,000 in grant funds from the Missouri Department of Health and Senior Services to be utilized for reimbursement of costs related to participating in a statewide COVID-19 Environmental Epidemiology study and to enter into necessary agreements to carry out the grant; amending the budget of the Department of Environmental Services Clean Water Enterprise Fund for Fiscal Year 2021-2022; and declaring this bill qualifies for approval in one reading.

Council Bill 2022-065. Special Ordinance 27666 was approved with the following vote: Ayes: Hosmer, Ollis, Lear, Hardinger, McGull, Schilling, Simpson, and McClure. Nays: None. Absent: None. Abstain: None. Vacant Seat: Zone 1.

CONSENT AGENDA – SECOND READING BILLS.

END OF CONSENT AGENDA.

Motion to Adjourn

Mayor Pro Tem Simpson moved to adjourn. Councilwoman Hardinger seconded the motion, and it was approved by the following vote. Ayes: Ollis, Lear, Hardinger, Schilling, Simpson, and McClure. Nays: Hosmer and McGull. Absent: None. Abstain: None. Vacant Seat: Zone 1.

Anita J. Cotter

Anita J. Cotter, CMC/MRCC
City Clerk

Prepared by
Michelle Brown

March 21, 2022
Springfield, Missouri

The City Council met in regular session March 21, 2022, in the Council Chambers at Historic City Hall. The meeting was called to order by Mayor Ken McClure. Mayor McClure acknowledged Joplin Police Officers Ben Cooper and Jake Reed who lost their lives in the line of duty along with Officer Rick Hershey who was wounded in the incident. Mayor McClure noted the loss of Officer Christopher Walsh two years ago. Mayor McClure called for thoughts for wisdom and discernment for President Zelenski and the Ukrainian people.

Roll Call

Present: Mike Schilling, Matthew Simpson, Craig Hosmer, Richard Ollis, Andrew Lear, Heather Hardinger, Abe McGull, and Ken McClure. Absent: None. Vacant Seat: Zone 1.

Minutes

The minutes of March 7, 2022, City Council Meeting will be considered at the April 4 City Council Meeting.

Consent Agenda

The consent agenda was approved as presented.

CEREMONIAL MATTERS.

City Manager Report

Jason Gage, City Manager, noted the City's recommendations for annual United States Department of Housing and Urban Development (HUD) program funds are available for public review through 5 p.m. April 6 at Springfield-Greene County Library branches within the City limits, or via the City's website. He further noted it is estimated approximately $1.6 million will be available in Community Development Block Grant (CDBG) funding and approximately $1 million in Home Investment Partnerships Program (HOME) funding for fiscal year 2022.

Mr. Gage provided a reminder that City staff and Forward SGF Comprehensive Plan consultants Houseal Lavigne Associates will present an update to the City Council at a workshop March 22 at the Springfield Art Museum Community Room. He noted the presentation will include a discussion regarding the Comprehensive Plan, and a recording will be available for public viewing at cityview.springfieldmo.gov.

Mr. Gage provided an update on the Bass Pro 50th Anniversary and World's Fishing Fair. He noted the event was last held in 1988 and attracted 250,000 people with attendance expected to be double this year. He further noted the five-day event will run from March 30 through April 3 and feature exhibitions, vendors, seminars, concerts, sales, and more. Mr. Gage added economic impact for this event is estimated at $80 million, and Springfield is proud to be the world headquarters of Bass Pro Shops. More details about traffic management can be found at springfieldmo.gov/worldsfishingfair, and event details can be found at basspro.com.

Mr. Gage noted the Springfield Park Board has activities and accolades to share and has provided a summary to City Council.

Councilman Schilling asked what measures will be taken to notify citizens about street closures for the Bass Pro event. Mr. Gage responded digital boards, public announcements, website information, and news releases will be utilized.

The following bills appeared on the agenda under Second Reading Bills.

Rezoning: County Plot District No. 1014 to R-SF

Sponsor: Simpson. Council Bill 2022-060.

A general ordinance amending the Springfield Land Development Code, Section 36-306, 'Official zoning map and rules for interpretation,' by rezoning approximately 0.24 acres of property generally located at 3817 East San Poppi Court from County Plot Assignment District No. 1014 to R-SF, Single-Family Residential District; and adopting an updated Official Zoning Map. (Staff and Planning and Zoning Commission both recommend approval.) (By: Tamra Rhoades; 3817 E. San Poppi Court; Z-2-2022.)

Councilman Ollis expressed his opinion the proposed is a great example of getting City zoning within the city limits.

Council Bill 2022-060. General Ordinance 6712 was approved with the following vote: Ayes: Hosmer, Ollis, Lear, Hardinger, McGull, Schilling, Simpson, and McClure. Nays: None. Absent: None. Abstain: None. Vacant Seat: Zone 1.

Rezoning: 838 East Walnut

Sponsor: Schilling. Council Bill 2022-061.

A general ordinance amending the Springfield Land Development Code, Section 36-306, 'Official zoning map and rules for interpretation,' by rezoning approximately 0.29 acres of property generally located at 838 East Walnut Street from GI, Government and Institutional District, to R-HD, High Density Multi-Family Residential District, with Conditional Overlay District No. 208; establishing Conditional Overlay District No. 208; and adopting an updated Official Zoning Map. (Staff and Planning and Zoning Commission both recommend approval.)

Council Bill 2022-061. General Ordinance 6713 was approved with the following vote: Ayes: Hosmer, Ollis, Lear, Hardinger, McGull, Schilling, Simpson, and McClure. Nays: None. Absent: None. Abstain: None. Vacant Seat: Zone 1.

Merit System Rules and Regulations: City Health Care Plan

Sponsor: McGull. Council Bill 2022-062.

A general ordinance amending the Springfield City Code, Chapter 2, Article III, Division 1, Section 2-91, known as the Merit System Rules and Regulations ("Merit Rules"), by amending Merit Rule 25.1 (City Health Care Plan) regarding the Plan's reserves policy.

Council Bill 2022-062. General Ordinance 6714 was approved with the following vote: Ayes: Hosmer, Ollis, Lear, Hardinger, McGull, Schilling, Simpson, and McClure. Nays: None. Absent: None. Abstain: None. Vacant Seat: Zone 1.

Ozarks Empire Fair: Subrecipient Agreement

Sponsor: Lear. Council Bill 2022-063.

A special ordinance authorizing the City Manager, or his designee, to enter into an agreement with the State of Missouri, Office of Administration, for the purpose of accepting funds appropriated by the General Assembly for the benefit of the Greene County Agricultural Society d/b/a the Ozarks Empire Fair because the funds cannot be disbursed from the Office of Administration directly to the Ozarks Empire Fair; authorizing the City Manager, or his designee, to enter into a subrecipient agreement with the Ozarks Empire Fair Foundation for the funds appropriated by House Bill 19, Section 19.405, Fiscal Year 2022 for the benefit of the Ozarks Empire Fair; and amending the budget of the City of Springfield for Fiscal Year 2021-2022 in the amount of $5,000,000.

Council Bill 2022-063. Special Ordinance 27667 was approved with the following vote: Ayes: Hosmer, Ollis, Lear, Hardinger, McGull, Schilling, Simpson, and McClure. Nays: None. Absent: None. Abstain: None. Vacant Seat: Zone 1.

The following items appeared on the agenda under Resolutions.

Initiate Annexation: 1610 and 1620 North Le Compte Road

Sponsor: Ollis. Council Bill 2022-066.

A resolution declaring an intent to initiate annexation of approximately 9.5 acres of private property, generally located at 1610 and 1620 North Le Compte Road, and referenced as Annexation A-1-2022, into the City of Springfield. (Staff recommends approval.)

Susan Istenes, Director of Planning and Development, provided a brief overview of the proposed. Ms. Istenes noted the intent is to annex and rezone the property for future manufacturing and retail. The proposed is supported by the Comprehensive Plan, city services can be provided, and the property owner has petitioned the City to request the annexation. Ms. Istenes added the proposed is an intent to annex to begin the process.

An opportunity was given for citizens to express their views. With no appearances, the public hearing was declared closed.

Council Bill 2022-066. Resolution 10620 was approved with the following vote: Ayes: Hosmer, Ollis, Lear, Hardinger, McGull, Schilling, Simpson, and McClure. Nays: None. Absent: None. Abstain: None. Vacant Seat: Zone 1.

Initiate Annexation: 5100 West State Highway EE

Sponsor: Hardinger. Council Bill 2022-067.

A resolution declaring an intent to initiate annexation of approximately 24.8 acres of public property, generally located at 5100 West State Highway EE and including 1.5 acres of public right-of-way for North Haseltine Road, which is referenced as Annexation A-2-2022, into the City of Springfield. (Staff recommends approval.)

Susan Istenes, Director of Planning and Development, provided a brief overview of the proposed. Ms. Istenes noted the intent is to annex the property, and the owners have petitioned the City requesting the annexation. Ms. Istenes further noted the property owners do not wish to initiate a rezoning.

Councilman Ollis asked why the property owners do not wish for the property to be rezoned. Ms. Istenes responded the reason in unclear, but the City can initiate rezoning. Ms. Istenes will follow up.

An opportunity was given for citizens to express their views.

Kevin Barnes, Director of Resource Management for Greene County, addressed City Council. Kevin Barnes noted the request for annexation is to provide fire services to the property. Mr. Barnes added they are not opposed to rezoning. Mr. Barnes noted the property was carefully considered so they can be a good neighbor. He cited the improvements that have been made to date and views the development as a partnership with Springfield.

With no further appearances, the public hearing was declared closed.

Mayor Pro Tem Simpson expressed his belief rezoning should be reviewed.

Council Bill 2022-067. Resolution 10621 was approved with the following vote: Ayes: Hosmer, Ollis, Lear, Hardinger, McGull, Schilling, Simpson, and McClure. Nays: None. Absent: None. Abstain: None. Vacant Seat: Zone 1.

Grant Application: Apprenticeship Building America: $3,000,000

Sponsor: Lear. Council Bill 2022-068.

A resolution authorizing the City Manager, or his designee, to apply for a grant from the U.S. Department of Labor's Employment and Training Administration for the Apprenticeship Building America grant program in the amount of up to $3,000,000 to be utilized to perform approved grant activities.

Sally Payne, Director of Workforce Development, provided a brief overview of the proposed. Ms. Payne noted the grant is a four-year grant and would encourage public/private partnerships that work with underserved populations for the apprenticeship programs.

An opportunity was given for citizens to express their views. With no appearances, the public hearing was declared closed.

Council Bill 2022-068. Resolution 10622 was approved with the following vote: Ayes: Hosmer, Ollis, Lear, Hardinger, McGull, Schilling, Simpson, and McClure. Nays: None. Absent: None. Abstain: None. Vacant Seat: Zone 1.

Grant Application: Apprenticeship Building America: $6,000,000

Sponsor: Schilling. Council Bill 2022-069.

A resolution authorizing the City Manager, or his designee, to apply for a grant from the U.S. Department of Labor's Employment and Training Administration for the Apprenticeship Building America grant program in the amount of up to $6,000,000 to be utilized to perform approved grant activities.

Sally Payne, Director of Workforce Development, provided a brief overview of the proposed. Ms. Payne noted the grant would allow the City to be an apprenticeship hub for partnerships and best practices.

An opportunity was given for citizens to express their views. With no appearances, the public hearing was declared closed.

Council Bill 2022-069. Resolution 10623 was approved with the following vote: Ayes: Hosmer, Ollis, Lear, Hardinger, McGull, Schilling, Simpson, and McClure. Nays: None. Absent: None. Abstain: None. Vacant Seat: Zone 1.

EMERGENCY BILLS.

PUBLIC IMPROVEMENTS.

The following items appeared on the agenda under Grants.

Epidemiology and Laboratory Capacity Enhancing Detection Expansion Grant

Sponsor: Lear. Council Bill 2022-070.

A special ordinance authorizing the City Manager, or his designee, to accept an Epidemiology and Laboratory Capacity Enhancing Detection Expansion grant from the Federal Department of Health and Human Services and Centers for Disease Control and Prevention in the amount of $1,400,359 for use by the Springfield-Greene County Health Department; amending the Fiscal Year 2021-2022 budget in the amount of $1,400,359 for the purpose of appropriating the grant funds; and declaring that this bill qualifies for approval in one reading.

Jon Mooney, Assistant Director of Health, provided a brief overview of the proposed. Mr. Mooney noted the grant would allow the department to expand its epidemiology and laboratory capacity. Mr. Mooney expressed his belief that COVID-19 is ongoing. He further noted the funds would be added to the current budget for Fiscal Year 2021-2022.

Mayor Pro Tem Simpson asked if there is any evidence of the BA.2 variant in the community. Mr. Mooney responded sewershed system tracking has shown the variant has been present in the community for approximately six weeks.

An opportunity was given for citizens to express their views. With no appearances, the public hearing was declared closed.

Council Bill 2022-070. Special Ordinance 27668 was approved with the following vote:

Ayes: Hosmer, Ollis, Lear, Hardinger, McGull, Schilling, Simpson, and McClure. Nays: None. Absent: None. Abstain: None. Vacant Seat: Zone 1.

Local Public Health Disparities Initiatives grant: $574,599.56

Sponsor: Schilling. Council Bill 2022-071.

A special ordinance authorizing the City Manager, or his designee, to accept a Local Public Health Disparities Initiatives grant from the Federal Department of Health and Human Services and Centers for Disease Control and Prevention in the amount of $574,599.56 for use by the Springfield-Greene County Health Department; amending the Fiscal Year 2021-2022 budget in the amount of $574,599.56 for the purpose of appropriating the grant funds; and declaring that this bill qualifies for approval in one reading.

Jon Mooney, Assistant Director of Health, provided a brief overview of the proposed. Mr. Mooney noted the funding will allow for expansion of health services for education and accessible services to combat the challenges of COVID-19.

An opportunity was given for citizens to express their views. With no appearances, the public hearing was declared closed.

Council Bill 2022-071. Special Ordinance 27669 was approved with the following vote: Ayes: Hosmer, Ollis, Lear, Hardinger, McGull, Schilling, Simpson, and McClure. Nays: None. Absent: None. Abstain: None. Vacant Seat: Zone 1.

AMENDED BILLS.

The following items appeared on the agenda under Public Hearing.

Motion to Suspend Rules

Mayor Pro Tem Simpson moved to suspend the rules and consider items 25 and 26, which are Council Bill 2022-073 and Council Bill 2022-074 respectively, before considering item 23, which is Council Bill 2022-072. The motion was seconded by Councilman McGull and approved by the following vote: Ayes: Hosmer, Ollis, Lear, Hardinger, McGull, Schilling, Simpson, and McClure. Nays: None. Absent: None. Abstain: None. Vacant Seat: Zone 1.

The following items appeared on the agenda under First Reading Bills.

Update: Flood Control and Water Quality Protection Manual

Sponsor: Ollis. Council Bill 2022-073.

A general ordinance adopting an updated version of the "Flood Control and Water Quality Protection Manual" to include a water quality requirement for redevelopment in accordance with the City's Municipal Separate Storm Sewer System permit and other technical updates and clarifications to stormwater design standards; and amending Springfield City Code, Chapter 96, 'Storm Water,' Article I. 'Flood Control and Water Quality Protection,' and Article III. 'Land Disturbance Activity', to make changes consistent with the updated Manual.

Errin Kemper, Director of Environmental Services, provided a brief overview of the proposed. Mr. Kemper noted the proposed will update the Flood Control and Water Quality Protection Manual which is the framework for how stormwater is managed. Mr. Kemper further noted a Stormwater Technical Committee was formed over a year ago. He added feedback was provided on the manual, comments were solicited from 14 stakeholders, and the proposed changes were posted on the website with an explanation video. Changes to the manual would apply to new developments and redevelopments. The new standard would require redevelopments to capture the first half-inch of runoff whereas new developments are required to capture the first inch. Some redevelopments would qualify to utilize a "Fee In Lieu Of."

Councilman Lear noted the City is in redevelopment mode. Mr. Lear asked if it is the choice of the developer to pay a "Fee In Lieu Of" or if this at the discretion of the City. Mr. Kemper responded allowing "Fee In Lieu Of" is at the discretion of the City given certain conditions are met. Mr. Lear asked if water quality is preferred over parking. Mr. Kemper responded water quality is priority.

An opportunity was given for citizens to express their views. With no appearances, the public hearing was declared closed.

Amending Springfield Land Development Code: Stream Buffers

Sponsor: McGull. Council Bill 2022-074.

A general ordinance amending the Springfield Land Development Code, Article III, 'Zoning Regulations,' Division 5, 'Supplemental District Regulations,' Section 36-472, 'Stream Buffers.' (Staff and Planning and Zoning Commission both recommend approval.)

Carrie Lamb, Water Quality Compliance Officer, provided a brief overview of the proposed. Ms. Lamb noted the proposed is a result of comments received asking for reduced parking on redevelopment sites to facilitate meeting the water quality requirement. She added the proposed will amend the code to allow an applicant to seek a reduction in the parking requirement, when necessary, to meet water quality standards.

Mayor Pro Tem Simpson asked if access to sidewalks and walkability is reviewed when considering a reduction in parking requirements. Ms. Lamb deferred to the City Manager. Mr. Gage responded it depends on the code section and criteria reviewed.

Councilman Ollis asked if parking requirements are appropriate for each use. Mr. Gage responded the best time to review parking requirements for sufficiency is when the comprehensive plan is reviewed.

Councilman Lear asked if the maximum height a building can be increased is one floor while meeting the existing bulk plane requirement. Ms. Lamb answered affirmatively. Mr. Lear expressed his belief parking will become an issue as the City becomes more dense.

An opportunity was given for citizens to express their views. With no appearances, the public hearing was declared closed.

City Council then took up item – Council Bill 2022-072.

The following items appeared on the agenda under Public Hearing.

Dedication of Public Streets and Easements: Reed Avenue Cottages

Sponsor: Simpson. Council Bill 2022-072.

A special ordinance authorizing the Director of Planning and Development to accept the dedication of public streets and easements to the City of Springfield, as shown on the Cluster Preliminary Subdivision Plat of Reed Avenue Cottages, generally located at 4423 South Reed Avenue, upon the applicant filing and recording a final plat that substantially conforms to the preliminary plat; and authorizing the City Clerk to sign the final plat upon compliance with all the terms of this Ordinance. (Staff recommends that City Council accept the public streets and easements.) (By: Katy A. St. George Revocable Trust; 4423 South Reed Avenue; Preliminary Plat of Reed Avenue Cottages)

Susan Istenes, Director of Planning and Development, provided a brief overview of the proposed. Ms. Istenes noted the preliminary plat was approved on March 10, 2022, by the Planning and Zoning Commission, adding the role of City Council for the proposed is to vote on the dedication of public streets and easements to the City.

Mayor McClure asked for clarification regarding if the function of City Council for the proposed is administerial. Rhonda Lewsader, City Attorney, answered affirmatively. Ms. Lewsader noted the Planning and Zoning Commission is responsible for approving preliminary plats.

Mayor McClure asked for clarification regarding what happens if the proposed is not approved. Ms. Lewsader responded City Council is only to consider if the location is appropriate and meets the applicable ordinances. If not approved, the developer can seek a writ of mandamus through circuit court.

Mayor McClure asked Ms. Lewsader to define administerial vs. legislative function. Ms. Lewsader noted administerial function is an administrative act following guidelines set forth in the code, and City Council complies with the code when conditions are met. A legislative function gives City Council discretion to consider what they would choose to do.

Councilman Ollis asked for clarification regarding approval of the plat. Mr. Ollis asked if the plat was previously approved by Planning and Zoning. Ms. Lewsader responded the preliminary plat was approved, and the proposed is to accept dedication of public streets and easements to the City. Councilman Ollis asked if this type of proposal is typically on the consent agenda. Ms. Lewsader responded the proposed would be appropriate for the consent agenda in many cases.

Councilman Lear asked if Planning and Zoning was responsible for approving the preliminary plat for the proposed. Ms. Lewsader responded Planning and Zoning

accepted the preliminary plat for the proposed. Councilman Lear asked if the applicant could take the issue to circuit court if the proposed failed. Ms. Lewsader answered affirmatively. Councilman Lear asked what options opponents to the proposed have to appeal the acceptance of the preliminary plat. Ms. Lewsader responded the opponents could seek a writ of mandamus.

An opportunity was given for citizens to express their views.

Patrick Platter addressed City Council. Mr. Platter spoke in opposition to the proposed. He noted he represents Old Ivy Homeowner's Association. Mr. Platter expressed his disagreement with the role City Council is to play in the proposed and to the interpretation of the subdivision regulations citing Section 36-237 and 36-226.

Greg Smith addressed City Council. Mr. Smith spoke in opposition to the proposed. He expressed his belief the roads in the area were not designed to sustain the increased traffic that would occur, noting increased traffic would make it more difficult for emergency vehicles to access the area.

Benjamin Shantz addressed City Council. Mr. Shantz spoke in support of the proposed. He noted the proposed is not a legislative act, is not a replan or redevelopment, and the scope of City Council's review is limited to the acceptance of public streets and easements.

Daniel Losco addressed City Council. Mr. Losco spoke in opposition to the proposed. He expressed his belief City Council has the authority to deny the proposed and feels the development is a bad idea. Mr. Losco asked City Council to closely review the plat.

Craig Bills addressed City Council. Mr. Bills spoke in opposition to the proposed. Mr. Bills noted adverse effects were shown to the Planning and Zoning Commission and expressed his belief several of the cluster development requirements have not been met for the proposed. Mr. Bills further noted the construction site for the plan has a small footprint which causes safety issues and damage to the area.

Jim Meadows addressed City Council. Mr. Meadows spoke in support of the the proposed. Mr. Meadows expressed his belief there are four factors of importance to the issue: increase in housing stock, economic development, environmental sustainability, and encouraging developers and individuals to take risk.

Larry Keith Bratvold addressed City Council. Mr. Bratvold spoke in opposition to the proposed. He expressed his belief the municipal ordinances are municipal laws. Mr. Bratvold expressed his belief the Planning and Zoning Commission passed the plat through as if it were a regular subdivision.

Bruce Adib-Yazdi addressed City Council. Mr. Adib-Yazdi spoke in opposition to the proposed. He expressed his belief this is not a rezoning case. Mr. Adib-Yazdi added cluster developments can happen well but feels the proposed does not, and the development does not improve the area. He expressed his belief the ordinance is subjective and badly written.

Riley Shantz addressed City Council. Mr. Shantz spoke in support of the proposed. Mr. Shantz is a representative of the development team for the property. He expressed his belief the property currently has a blighted structure and feels the plan will improve the property.

Karen Baker addressed City Council. Ms. Baker spoke in opposition to the proposed. Ms. Baker expressed her belief Planning and Zoning did not do its due diligence, and the ordinance is poorly written. She noted receiving 118 signatures from neighbors opposed to the development. Ms. Baker expressed her belief the development is not a proper transition between single family homes and more intense districts.

Shanda Moore addressed City Council. Ms. Moore spoke in opposition to the proposed. She expressed her family's opposition to the cluster project on South Reed Avenue. Ms. Moore expressed her opinion the project was presented as a cluster development meant to enhance the area but does not accomplish that task. Ms. Moore noted there were non-compliant items relayed to the Planning and Zoning Commission which were ignored. Ms. Moore requested the issue be sent back to Planning and Zoning.

Debbie Hart addressed City Council. Ms. Hart spoke in support of the proposed as a representative of the project development team. Ms. Hart noted the importance of ordinances when a development team is reviewing a property, and added this development is the density of a regular subdivision, creates housing opportunities, preserves one-third of the property as a nature buffer, and adds a nature trail.

Eric Washburn addressed City Council. Mr. Hart spoke in opposition to the proposed. He expressed his disappointment with the decision of Planning and Zoning to approve the plat and feels this development is a bad idea for the community and for Springfield.

Jared Davis addressed City Council. Mr. Davis spoke in support of the proposed. As a representative of Anderson Engineering, Mr. Davis noted the development is not located any closer to the neighboring houses than a single row of houses would be and added there have been other cluster developments in the City.

David Baker addressed City Council. Mr. Baker spoke in opposition to the proposed. He noted deeds from 1946 that stated anything built on Reed Avenue must be 75 feet from the road. Mr. Baker noted his opposition is for two reasons: the development does not fit the area as a transitional area, and the code needs to be rewritten.

David Aguirre addressed City Council. Mr. Aguirre spoke in support of the proposed. He noted he lives in the neighborhood and sees the development as an improvement. Mr. Aguirre noted he does not support the homeowner's association using reserve funds to hire attorneys to combat the issue.

With no further appearances, the public hearing was declared closed.

The following items appeared on the agenda under Petitions, Remonstrances, and Communications.

Tim Havens addressed City Council. Mr. Havens requested City Council designate $800,000 of the $8,000,000 Jefferson Avenue Footbridge grant to be used to provide one year of free bus fare for residents. Mr. Havens also expressed his belief individuals should boycott Koch Brothers products, as they conduct business with Russia. Mr. Havens requested official City Council support against these products. Mr. Havens noted this effort is to be in support of Ukraine.

Daniel Behlmann addressed City Council. Mr. Behlmann noted he is a representative of the Think Green group at Drury University. He added he is proud to be a part of a community that is forward thinking. Mr. Behlmann called for commitment to sustainable and renewable energy. He invited all of City Council to attend an expert panel on climate change. The event will be held at Drury University, Lay Auditorium, Friday April 1, 2022, at 6:30 p.m.

The following items appeared on the agenda under New Business.

Recommended The Public Involvement Committee recommends the following appointments to the Citizens Advisory Committee for Community Development: O'Brien Daniels with term to expire May 1, 2024; Krista Peryer with term to expire May 1, 2022.

Recommended The Public Involvement Committee recommends the following appointments to the Citizens Tax Oversight Committee: Christopher Upton with term to expire May 1, 2023; Tammy Adu and Erin Gray with terms to expire May 1, 2022; Duane Keys and Ray Lampert with terms to expire May 1, 2024.

Recommended The Public Involvement Committee recommends the following reappointments to the Landmarks Board: Layne Hunton and Jan Preston with terms to expire November 1, 2024.

Recommended The Public Involvement Committee recommends the following appointment to the Landmarks Board: Andrea Crawford with term to expire November 1, 2023.

Recommended The Public Involvement Committee recommends the following reappointments to the Personnel Board: Michael Ramos and Tyler Tooley with terms to expire March 1, 2025.

Recommended The Public Involvement Committee recommends the following appointments to the Planning and Zoning Commission: Eric Pauly with term to expire January 1, 2026; Shannon Bowers with term to expire January 1, 2024.

Recommended The Public Involvement Committee recommends the following appointment to the Public Building Corporation: Paul Monroe with term to expire September 1, 2027.

Recommended

The Public Involvement Committee recommends the following appointments to the Springfield – Greene County Environmental Advisory Board: Carol Hutcheson and Laura McCaskill with terms to expire October 1, 2024.

As per RSMo. 109.230 (4), City records that are on file in the City Clerk's office and have met the retention schedule will be destroyed in compliance with the guidelines established by the Secretary of State's office.

UNFINISHED BUSINESS.

MISCELLANEOUS.

CONSENT AGENDA – FIRST READING BILLS.

The following items appeared under Consent Agenda – One Reading bills.

General Aviation Terminal

Sponsor: McGull. Council Bill 2022-075.

A resolution declaring the intent of the City of Springfield to utilize the Construction Manager At Risk project delivery method as set forth in Purchasing Manual, 13-3.104(5)(c) for work on the remodel and expansion of the General Aviation terminal at Springfield-Branson National Airport; and setting forth selection criteria.

Council Bill 2022-075. Resolution 10624 was approved with the following vote: Ayes: Hosmer, Ollis, Lear, Hardinger, McGull, Schilling, Simpson, and McClure. Nays: None. Absent: None. Abstain: None. Vacant Seat: Zone 1.

CONSENT AGENDA – SECOND READING BILLS.

END OF CONSENT AGENDA.

Motion to Adjourn

Mayor Pro Tem Simpson moved to adjourn. Councilwoman Hardinger seconded the motion, and it was approved by the following vote. Ayes: Ollis, Lear, Hardinger, Schilling, Simpson, McGull and McClure. Nays: Hosmer. Absent: None. Abstain: None. Vacant Seat: Zone 1.

Anita J. Cotter

Anita J. Cotter, CMC/MRCC
City Clerk

Prepared by
Michelle Brown

One-rdg. _____
P. Hrngs. X
Pgs. 78
Filed: 03-15-22

Sponsored by: Simpson

First Reading: _____ Second Reading: _____

COUNCIL BILL 2022-072 SPECIAL ORDINANCE _____

AN ORDINANCE

AUTHORIZING the Director of Planning and Development to accept the dedication of public streets and easements to the City of Springfield, as shown on the Cluster Preliminary Subdivision Plat of Reed Avenue Cottages, generally located at 4423 South Reed Avenue, upon the applicant filing and recording a final plat that substantially conforms to the preliminary plat; and authorizing the City Clerk to sign the final plat upon compliance with all the terms of this Ordinance. (Staff recommends that City Council accept the public streets and easements.)

WHEREAS, an original Cluster Preliminary Subdivision Plat of Reed Avenue Cottages dated December 31st, 2021, is on file with the City's Department of Planning and Development; and

WHEREAS, on March 10th, 2022, the Planning and Zoning Commission of the City of Springfield, Missouri, conditionally approved the Cluster Preliminary Subdivision Plat of Reed Avenue Cottages, which is generally located at 4423 South Reed Avenue.

NOW, THEREFORE, BE IT ORDAINED BY THE COUNCIL OF THE CITY OF SPRINGFIELD, MISSOURI, as follows, that:

Section 1 – City Council hereby authorizes the Director of Planning and Development, on behalf of the City of Springfield, to accept the land, easements, and improvements dedicated to the City, as shown on the Cluster Preliminary Subdivision Plat of Reed Avenue Cottages, which is generally located at 4423 South Reed Avenue, as approved by the Planning and Zoning Commission. The original plat of Reed Avenue Cottages is on file in the Department of Planning and Development ("Approved Preliminary Plat"), a reduced version of which is attached hereto for general reference as "Exhibit B - Attachment 6." All of "Exhibit B," including attachments, is incorporated herein by this reference.

Section 2 – The Director of Planning and Development shall be authorized to

accept the land, easements, and improvements dedicated to the City, as shown on said plat, upon the applicant filing and recording a final plat in accordance with this Ordinance and the Subdivision Regulations of the City, which final plat shall substantially conform to the Approved Preliminary Plat, including those conditions described in “Exhibit B – Attachments 2,” and upon the Director of Public Works certifying to the Director of Planning and Development and the City Clerk that the public improvements have been made in accordance with City standards and specifications. Said public improvements shall not be accepted until the occurrence of all conditions referenced herein and in “Exhibit B”.

Section 3 – The final plat shall not be recorded until: (1) the public improvements relating to the Approved Preliminary Plat have been constructed according to the specifications of the City of Springfield, Missouri, and are approved by the Director of Public Works, and all engineering fees, permit fees, licenses, and other fees occasioned by or in connection with the construction of said improvements have been paid to the City; or (2) in lieu of the construction of the improvements, that the Applicant has filed with the City Manager, according to the terms of the Subdivision Regulations of the City, the prescribed financial assurances in a form acceptable to the City to ensure the construction of the improvements and the payment to the City of all engineering fees, permit fees, licenses, and other fees occasioned by, or which will be occasioned by, the construction of the improvements.

Section 4 – Upon compliance with all the requirements of this Ordinance, including the conditions described in “Exhibit B – Attachment 2,” the City Clerk is hereby authorized to endorse City Council’s approval upon the final plat pursuant to Section 445.030, RSMo., and such endorsement shall constitute the acceptance of the Public Improvements contained therein.

Section 5 – This Ordinance shall be in full force and effect from and after its passage.

Passed at meeting: _____

_____
Mayor

Attest: _____, City Clerk

Filed as Ordinance: _____

Approved as to form: Jill Burris, Assistant City Attorney

Approved for Council action: Jason A. Gage, City Manager

EXPLANATION TO COUNCIL BILL 2022 -072

FILED: 03-15-22

ORIGINATING DEPARTMENT: Planning and Development

PURPOSE: Authorizing the Director of Planning and Development to accept the dedication of public streets and easements to the City of Springfield, Missouri, as shown on the Cluster Preliminary Subdivision Plat of Reed Avenue Cottages, generally located at 4423 South Reed Avenue, upon the applicant filing and recording a final plat that substantially conforms to the preliminary plat; and authorizing the City Clerk to sign the final plat upon compliance with all the terms of this Ordinance. (Staff recommends that City Council accept the public streets and easements.)

BACKGROUND INFORMATION:

A. An original Cluster Preliminary Subdivision Plat of Reed Avenue Cottages dated December 31st, 2021 is on file in the Department of Planning and Development. A reduced version of which is included for general reference in Attachment 6.

B. The Planning and Zoning Commission held a public hearing on March 10th, 2022, and approved the Preliminary Plat by a vote of 5 to 2, subject to the following conditions:

1. All improvements shall be constructed in accordance with the "Design Standards for Public Improvements" of the Public Works Department and the maintenance and operation of such improvements shall be the responsibility of the developers unless approved by the Director of Public Works. All required sanitary sewer, street, sidewalk, and drainage plans shall be prepared in accordance with City standards and specifications and approved by the Director of Public Works.

2. All required street rights-of-way, drainage and utility easements and limitations of access shall be dedicated on the final plat.

3. The developer shall meet all city and state erosion control regulations prior to disturbing the soil.

4. It is determined that the public interest requires assurance concerning adequate maintenance of common space areas and improvements. The restrictive covenants, rules and bylaws creating the common ownership must therefore provide that if the owners of the Property Owners Association shall fail to maintain the common areas or improvements in reasonable order and condition in accordance with the approved plans, the City may, after notice

and hearing, maintain the same and assess the costs against the units or lots, per the Common Open Space and Common Improvement Regulations section of the Zoning Ordinance.

5. The developer shall be responsible for the relocation costs of any existing utility services and shall be responsible for clearing all utility easements of trees, brush, and overhanging tree limbs.

6. All other requirements which are necessary for this subdivision to be in compliance with the Subdivision Regulations.

All required improvements shall be the sole responsibility of the sub-divider. As prescribed by Section 36-233 of the Subdivision Regulations, the improvements shall be made or guaranteed by means of bond, escrow agreement, letter of credit or other appropriate security agreement. Release of the final plat for recording shall be withheld until the sub-divider has complied with this section.

Section 36-226 of the Subdivision Regulations requires that a final plat be submitted within two years of City Council's acceptance of the public streets and easements.

Attached for Council information is a sketch showing the location of the plat area, an exhibit showing the proposed plat, and a copy of the Planning and Development Department staff report to the Planning and Zoning Commission.

The *Growth Management and Land Use Plan* element of the *Comprehensive Plan* designates this area as Low-Density Housing. The proposed cluster development subdivision divides the property in a way that facilitates the development for attached housing, specifically single-family semi-detached dwellings. This development will contribute to the diversity of housing in the neighborhood and the preservation of natural features existing on the site. Based on renderings of the proposed buildings and site plan that was provided to city staff, we believe the proposed attached housing development is compatible with the single-family housing in the surrounding neighborhood and meets several design recommendations laid out in Objective 15 of the Land Use Plan, on page 18-56. The Major Thoroughfare Plan classifies South Reed Avenue as a Collector which supports the proposed land use.

REMARKS: Staff recommends approval.

Submitted by:

Jared Follin

Jared Follin, Associate Planner

Recommended by:

Brendan K. Griesemer, AICP
Assistant Director

Approved by:

Jason Gage,
City Manager

EXHIBITS:
Exhibit A, Record of Proceedings
Exhibit B, Development Review Staff Report

ATTACHMENTS:
Attachment 1, Department Comments
Attachment 2, Conditions of Plat Approval
Attachment 3, Standards for Cluster Development Approval
Attachment 4, Citizen comments
Attachment 5, Proposed Development Layout and Elevations
Attachment 6, Cluster Preliminary Subdivision Plat

EXHIBIT A

RECORD OF PROCEEDINGS
Planning and Zoning Commission – February 10, 2022

Preliminary Plat of Reed Avenue Cottages
4423 South Reed Avenue
Applicant: Katy A St. George Revocable Trust

Mr. Hosmer states that this is a request to approve a preliminary plat for a 22-lot residential subdivision located at 4423 South Reed Avenue. The applicant is proposing to subdivide 4.7 acres into a residential cluster development. The property is zoned R-SF Single Family Residential and will not change. Transportation Plan classifies Reed Ave as a collector and the proposed gated private Street for Old Ivy as a local roadway. The property is not located in a FEMA designated floodplain, stream buffer or sinkhole area and on-site stormwater detention will be required. The Comprehensive Plan identifies this area as Low-Density Housing.
Purpose of Cluster Developments:

- Improved living and working environments:
- Promote more economic subdivision layout;
- Encourage a variety of types of residential dwellings;
- Encourage ingenuity and originality in total subdivision and individual site design; and
- Preserve open space to serve recreational, scenic and public service purposes and other purposes, etc.

Cluster for R-SF Districts require lots sizes of at least 3,000. Modification of yard and lot requirements including minimum lot widths may be permitted. All such lot reductions shall be compensated for by an equivalent amount of land in open space or common area and a proposed trail and common area of 34%. Mr. Hosmer gave an example: 6,000 sf is min R-SF District lot size therefore if lots are reduced to 3,000 sf then 3,000 sf is required in open space (common area). If Planning and Zoning Commission approves the preliminary plat and the City Council accepts public streets and easements, then the preliminary plat will be active for two (2) years. Staff recommends approval.

Mr. Doennig opened the public hearing.

Mr. Jared Davis, representing the applicant and noted that the property has a drop off with a stream in the back and this will allow for open spaces by pushing the homes to the front and allow for open spaces for the cluster and believes this is a thoughtful development and feels that it meets the needs of the community and here to answer any questions.

Mr. Colony asked if this is for only a Preliminary Plat and not a rezoning.

Mr. Davis noted that it will only be only 11 building on 22 platted lots with zero lot lines that it would be a nice development and gated.

Mr. Colony thinks that it is a “weird” location for this development.

Ms. Bruce asked about the occupancy of the development.

Mr. Davis noted that they would be 2 car garage, but not sure of anything else.

Mr. Dan Losco, 4442 S. English Ivy Avenue and is against the development. Believes that the cluster development allows them to be able circumvent the restriction on the single-family homes and will turn into a swamp in the back because there will be no access to it. He has issues on parking if no garages, emergency vehicle access width and traffic issues, and stormwater issues (between Swallow and Lark) that will allow runoff down the hill to the stream that

feeds into the area reservoir and this type of development does not fit in this area. He asked if any traffic and stormwater reports have been done and wants more answers from the builder before this goes forward.

Mr. Colony asked if they would present with more information and give the neighborhood a better if he would be against the development.
Mr. Losco said that there is not enough information and gave examples of possible problems.

Ms. Bruce mentioned the apartment complex in the area.

Mr. Losco noted that it is at the corner and Reed and Nature Way and if there is any rain there are problems, and against the homes in the cluster development.

Mr. Riley Shantz, 4462 S. Swedish Ivy Avenue is on the development team. The homes will be upscale patio homes with 2 car garages approximately 1500/1600 square feet and a nice compliment to the Olde Ivy subdivision and we will retain our own water detention. Believes the cluster development works due to the undevelopable land at the end and this will allow for green space and will have adequate setbacks.

Mr. Colony asked about it being a gated community and specific market type.

Mr. Shantz noted that he cannot speak to the specific market type at this time.

Mr. Eric Washburn, 2172 E. Cardinal Street stated that he did not get notification and so did no one else and is concerned that people are not aware that this happening. Opposes the development and asked if there was supposed to notification.

Mr. Hosmer noted that Preliminary Plats only needed to be posted, not a letter notification.

Mr. Craig Bills, 4441 Reed Avenue and lives next door and has concerns regarding the drop in the back and water detention and would like a hydraulic analysis on the area before any development and gave out examples of stormwater problems/damage in the neighborhood. He also mentioned that the area has an abundant of wildlife including deer, turkey, foxes, turtles, bats, hawks, birds and numerous native plants and grasses and believes this development is not compatible to the area and asks for expanded research and data collection for the wildlife (bats) and noted earlier development (Olde Ivy) and the oppositions that they had received.

Mr. Coltrin asked if Mr. Bills lived in the area before Olde Ivy was developed.

Mr. Bills stated that he was in the area when it was still dirt roads and trees.

Mr. David Baker, 4551 S. Reed Avenue and lives in the area. He voiced his concerns for the wildlife and believes that it is wrong development and asked about future cluster developments that may occur. His comments were on traffic, environment, storm water and the ecological destruction that this development may cause, and he also mentioned the 70' drop off from front to the back of the proposed development and asked if the street would be widened. This cluster development is not compatible to the area and is the wrong project.

Mr. Doennig closed the public hearing.

Mr. Jobe asked for clarification on the development as a subdivision and not a rezoning and if the parcel of land would current zoning allow the density of the surrounding neighborhood.

Mr. Hosmer noted that it could be 34 lots instead of 22 lots at the current zoning.

Mr. Coltrin asked if they could combine a couple of lots if they decide not to do small lots and when do projects that come into the City for traffic, stormwater and sanitary sewer review.

Mr. Hosmer noted that they look at it during preliminary stages and then during the design process.

Mr. Colony noted that the City said the development meets the harmony of the plan and does the staff have a way to measure the "harmony" of the surrounding area.

Mr. Hosmer noted that from a diversity of housing in single-family housing (multifamily to the north), but nothing between multifamily and single and that it is a problem – missing middle housing between high density and low density in our community.

Mr. Colony noted that it may be a need for the City.

Ms. Bruce asked about the "missing middle" and adjacent properties and what provisions, increased bufferyard or vegetation between the properties.

Mr. Hosmer said this is single family to singly family and how it is looked at in the code.

Mr. Coltrin asked about E. Sunshine and Lone Pine and the houses on the small lots and is that a cluster development.

Mr. Hosmer noted it may be a Planned Development but is not aware of it and noted the two cluster developments done in the City.

Mr. Lebeck noted section 36-361 and regarding the findings of the twelve elements and the staff has made determination that all have been met and staff has not found any concerns as 36-361 written and went over some of the determinations.

Mr. Hosmer noted that no concerns with staff report per 36-361 and verified with Mr. Lebeck's reading the determinations.

Mr. Colony again noted that the development does checks all of the boxes, but nothing in the reference code or staff review that nothing is relevant in the area and the lack of notice provided and would like additional review (landscaping, bufferyard, etc).

Mr. Hosmer noted that as long as the criteria is met, then staff would look for approval.

Mr. Doennig noted that the Planning and Zoning Commission can recommend denial.

Mr. Colony asked Jared Davis to come forward and answer about postponing the plat.

Mr. Davis would not be in agreement with postponement.

Mr. Jobe noted that number 3 on attachment 3 that the City has noted that it has not found on the use any adverse effect to the adjacent properties per staff report and if this a correct statement.

Mr. Hosmer noted that it is a correct statement.

Mr. Colony noted that a lot of comments were submitted and that there is a valid argument regarding the effect on the surrounding area.

Mr. Lebeck is also in agreement with Mr. Colony and believes that the information is vague and if we can do a motion for postponement in order to get more information and a better feel.

Ms. Burris went over some the criteria and there is a provision in Section 36-361(5)(b) to request modifications.

Mr. Lebeck is asking for a postponement and cited Robert Rules.

Ms. Burris noted that the Commission members can request a postponement.

COMMISSION ACTION:
Mr. Lebeck motioned to **postpone** for Preliminary Plat of Reed Avenue Cottages (4423 South Reed Avenue) to the March 10, 2022, Planning and Zoning meeting. Mr. Colony seconded the motion. Ayes: Doennig, Knuckles, Colony, Bruce, and Lebeck. Nays: Coltrin and Jobe. None. Abstain: None. Absent: Broekhoven.

Bob Hosmer, AICP
Planning Manager

RECORD OF PROCEEDINGS
Planning and Zoning Commission – March 10, 2022

Preliminary Plat of Reed Avenue Cottages
4423 South Reed Avenue
Applicant: Katy A St. George Revocable Trust

COMMISSION ACTION:
Mr. Knuckles motioned to **reopen** the Preliminary Plat of Reed Avenue Cottages (4423 South Reed Avenue). Mr. Lebeck seconded the motion. Ayes: Doennig, Coltrin, Knuckles, Colony, Bruce, Jobe, and Lebeck. Nays: None. Abstain: None. Absent: Broekhoven.

Mr. Hosmer states that this is a request to approve a preliminary plat for a 22-lot residential subdivision located at 4423 South Reed Avenue. This agenda item was postponed at the last PZ meeting. The property is zoned R-SF Single Family Residential and this will not change. The R-SF - Single-family residential district allows for Single-Family semi-detached dwellings within a Cluster Development i.e., one patio home on one lot. The R-SF District does not allow duplexes. Cluster Developments for R-SF Districts require lots sizes have at least 3,000 square feet. The code allows for modifications of yard and lot requirements including minimum lot width and lot reductions shall be compensated for by an equivalent amount of land in open space/ common area. Example: 6,000 sf is min R-SF District lot size therefore if lots are reduced to 3,000 sf then 3,000 sf is required in open space (common area). Proposed trail and common area 34% open space and density at 5.84 dwelling units per acre and standard developments allow for 7 units/ac. The Comprehensive Plan identifies this area as Low-Density Housing and the Transportation Plan classifies Reed Ave as a collector with the extension of Old Ivy as a local private roadway. The property is not located in a FEMA designated floodplain, stream buffer or sinkhole area and stormwater detention will be required. The applicant and staff responses to the evidence presented to the 12 standards for cluster development are submitted in Attachment 3. Staff believes the evidence presented meets the standards for cluster developments. If Planning and Zoning Commission approves the preliminary plat and the City Council accepts public streets and easements, then the preliminary plat will be active for two (2) years. Staff recommends approval.

Mr. Colony asked if the retention area has an impact on the number of units per acre.

Mr. Hosmer noted no impact on units per acre, but other factors are included.

Mr. Doennig opened the public hearing.

Mr. Riley Shantz, 4462 South Swedish Avenue, noted 5.6 units per acre and had additional 2 meetings to give them more information and believe that all guidelines have been met. Cluster grouping preserves nature (open space) and the trees and this is unique housing and is in harmony with the Comprehensive Plan. He also noted that the price does not support other development and believes this is an improvement.

Mr. Jared Davis, 3213 S. West Bypass and went over a slideshow of features of the area and proposed development, noting preserving 34% of the lot and with a gated entry and walking trails.

Mr. John Lilley, 2391 E. Cardinal Street went over a packet of information/analysis (passed out to the Commission members) and highlighted certain areas of interest including lot and house sizes throughout the area and noted that other lots in neighborhood are just lots with no common area.

Mr. Trevor Edwards, 2218 E. Cardinal noted that this development would back up to his property and stated that he was not notified and believes the City has the wrong system in place for citizens on notification and asked about

future street development in the area and if would he be notified. He also commented on stormwater problems that he currently has and stated this is not an enhancement of the area.

Mr. Michael Pulscher, 2512 German Ivy, noted he was the Olde Ivy and The Vinings developer and said that they only clearcut where sidewalks would be placed. He questioned the numbers of lots and development and believes it has more density than his development.

Mr. Craig Bills, 4441 S. Reed Avenue, went over the standards for the development approval and noted Section 36-361, item 3, 4, and 12. He asks for a grading plan for stormwater and detention control and asks for a construction logistic plan with an encroachment and damage clause and believes that the development will dominate the area. He also went over additional concerns from items 3, 4, and 12.

Mr. Eric Washburn, 2172 E. Cardinal Street and noted Section 36-361, items, 3, 4 and 12 and went over his concerns and believes they are trying to place too many units in a small space as possible.

Mr. Derek Ankrom, for Katy A. St. George, 4423 S. Reed Avenue and believes the opposition is based on self-interest, he noted that Mr. Bills has offered to buy the property on numerous occasions. He also noted that he believes any opposition is based on misunderstanding and intentional misrepresentation to make the offers that he has made more appealing. He asks Commission not to be deceived and listen to recommendations of staff and the developer. Believes that if fits well with the guidelines, and is not a low income or row housing, which is smaller and suited for young professionals or small families,

Mr. Dan Losco, 4442 S. English Ivy, gave out examples of width of properties and variances of the back to the fence line and stated that they cannot keep the trees (clearcut 3 acres), and the impact will be severe and noted the possible 17-degree pitch of the driveways and cautioned this will cause problems in icy/snowy weather and this does impact the neighborhood negatively.

Mr. David Baker, 4551 S. Reed Avenue noted that this is wrong for the neighborhood and that it can produce 32,000 gallons of rain-off from the rooftops that will not slowed down due to lack of trees and would like to protect the existing neighborhood and gave out talking points of Section 36-361 and voiced his concerns.

Mr. Patrick Platter, 2144 E. Republic Street representing the Olde Ivy Subdivision and asks when the public is being protected with this development and noted the uniqueness of cluster developments. He said the developer must show where it will be better than what is typically allowed under normal zoning procedures. He noted the developer said it is not row housing, noting that it is rectangle lots and gave out sample of other areas of subdivisions where they are the same and this development is supposed to be better, which it is not, and they will not be able to fix concerns/problems once this is approved.

Mr. Ben Shantz, 2131 E. Cherryvale, representing the developer and want to clarify any concerns. He stated the Comprehensive Plan is very constructive with this development and noted that if Section 36-361 conditions have been met then the Commission's hands are tied. He also noted several letters and email are misconstrued and noted The Vinings as an (comparable example) of a unique development where they also donated land for recreation and scenic trails.

Mr. Bruce Adib-Yazdi, 1943 S. Holland, is a concerned citizen and looked at cluster development and noted that the stated purpose of the zoning code and believes it will not provide a total environment for better neighborhood. He also that the opinion of the Commission that if the proposed plan can be improved then it shall be modified or denied.

Mr. Larry Bratuod, 4515 S. English Ivy said he had four words to state "shall", "evidence", "establish", and "and" this will make the difference. He went over statements on the ordinances and gave out examples of where the developer did not meet the 12 standards for the cluster development.

Mr. Paula Schnoebelan, 4445 S. English Ivy and noted that this opposed to the project due to the high density in a low density area. She also noted that typical clusters are spread out, but this one has to be pushed up to the front of the lot and if this type of development is allowed and worries about other neighborhoods.

Ms. Shanda Moore, 2413 E. Old Ivy, proposed that this is 3 acres of row houses. Cluster developments are to be large open shared community and they put as many patio-homes in a small area and noted that due to the slope that the common area would not be accessible for people with disabilities. She also noted that HOA pay dues and how are they going to pay for the upkeep on the common area as these may turn into rentals and is opposed to the development and also worries about this type of development throughout the city.

Mr. Miles Ross, 2188 N. Affirmed, representing the Homebuilders of Greater Springfield noting that Springfield has a lack of housing. Stating that the process is important, and this development meets the criteria and should vote yes, he also voiced his concern for developers moving away from Springfield. He also mentioned affordable housing on the north side and the homeless problem.

Ms. Debbie Hart, 1520 E. Meadowmere Street, part of the development team and noted several misunderstandings and they are not trying to circumvent the process. This development shows how the property will be laid out and will still have to comply with the building process. Springfield has a senior tsunami and don't want apartment living but want to own their home and tried to be helpful to the neighbors showing floor plans and elevations and need to have new and inventive way to develop. The density complies, and they are preserving trees and offer a buffer for the neighborhood.

Mr. Lebeck thanked Ms. Hart for providing additional information. Has additional concerns for Section 36-361 and about a possible loophole in subsection B., and how is this "better" than what can be achieved under standard regulations.

Ms. Hart stated that it creates a common for use of individual owners that they do not have to maintain it and are still in the development process and this makes it a unique creation type of neighborhood with an area for outdoor space for people living there.

Mr. Lebeck asked if they cannot get to that "better" space without this type of particular development.

Ms. Hart believes that they do not because people come home, park in the garage and just go inside and also, they typically do not have a common area and this development is different and benefitting the people who chose to live there.

Mr. Jared Davis noted that it can be achieved under standard regulations and talked about how they could remove all the trees and fill in the stream and this is better than clearing out the property. In his opinion this is a better use of the property.

Mr. Colony about the statement for green space without the owners having to maintain, then who pay for the maintenance.

Ms. Hart, it will be a HOA and will be maintained.

Ms. Bruce asked about the common space for the slope/walking trail.

Mr. Jared Davis, trails vary greatly, and this path is just a plan and still in design/development. Some of common area may slope 10-20%.

Ms. Bruce asked if 20% would be maximum and what is the slope percentage from back of two to the end of the site.

Mr. Davis believes that 20% would be maximum, but it is still in design and does not slope percentage at this time.

Mr. Ron Baker, 5025 Shade Oaks Place, lives one mile south and asked about the t-intersection (instead of a cul-d-sac) in the cluster development and if the road could expand at a later date and what this entails and who proposed the t-intersection and possible development.

Mr. Hosmer noted that staff recommended the t-intersection and future connections (looking for connectivity to the south) and he does not know if and when the future development.

Mr. Doennig closed the public hearing.

Mr. Coltrin commented that the prevue of the Commission has gone beyond the scope of what to look at and noting that staff says it meets the 12 criteria. I appreciate if the follow Commission can remain on track knowing that it is difficult.

Mr. Colony commented that harmony is one of the things that is being one of the objectives somehow, we have missed the mark to keep the community in harmony.

COMMISSION ACTION:
Mr. Jobe motioned to **approve** for Preliminary Plat of Reed Avenue Cottages (4423 South Reed Avenue). Mr. Knuckles seconded the motion. Ayes: Doennig, Knuckles, Jobe, Coltrin, and Lebeck. Nays: Colony and Bruce. None. Abstain: None. Absent: Broekhoven.

Bob Hosmer, AICP
Planning Manager

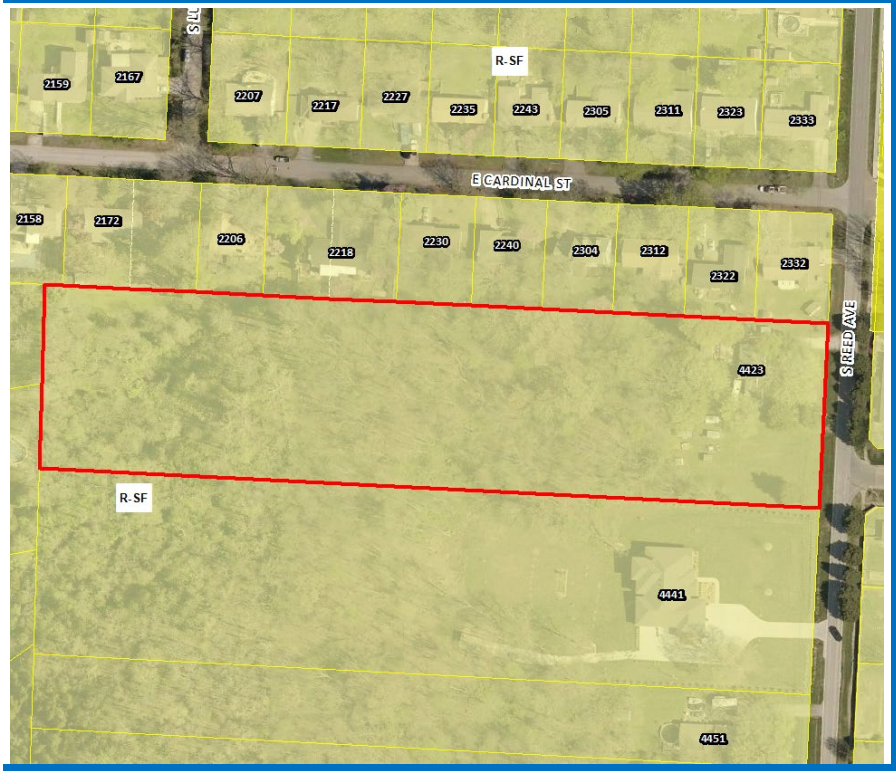
EXHIBIT B

Development Review Staff Report

CITY OF Springfield

PLANNING AND ZONING COMMISSION PUBLIC HEARING: FEBRUARY 10, 2022

CITY COUNCIL PUBLIC HEARING: MARCH 7, 2022



CASE: Preliminary Plat of Reed Avenue Cottages

ACRES: 4.74

LOCATION: 4423 South Reed Avenue

EXISTING LAND USE: Single-Family Home

APPLICANT: Katy A. St. George Revocable Trust

STAFF: Jared Follin, Associate Planner 417-864-1612

STAFF RECOMMENDATIONS: Approve w/Conditions

PROPOSED MOTION: Move to approve as submitted in the staff report. Required vote is a majority of those present (5 members are a quorum).

SUMMARY OF REQUEST:

The applicant is proposing a twenty-two (22) lot cluster subdivision plat named “Reed Avenue Cottages” to facilitate residential development on the property. As a cluster development, lot dimensions have been modified to allow for a minimum of 3,000 square feet and a reduction in lot width. This is compensated by an equal amount of open space proposed for the development.

FINDINGS FOR STAFF RECOMMENDATIONS:

1. The applicant’s proposal, with the conditions listed in *Attachment 2*, is consistent with the City’s *Subdivision Regulations*.
2. The applicant has provided sufficient evidence to the City’s cluster development standards. The applicant’s statements to the standards and the City’s response are found in *Attachment 3*.

SURROUNDING ZONING AND LAND USES:

	NORTH	SOUTH	EAST	WEST
ZONING	R-SF	R-SF	R-SF/R-TH	R-SF
LAND USE	Single-Family Residential	Single-Family Residential	Single-Family Residential	Single-Family Residential

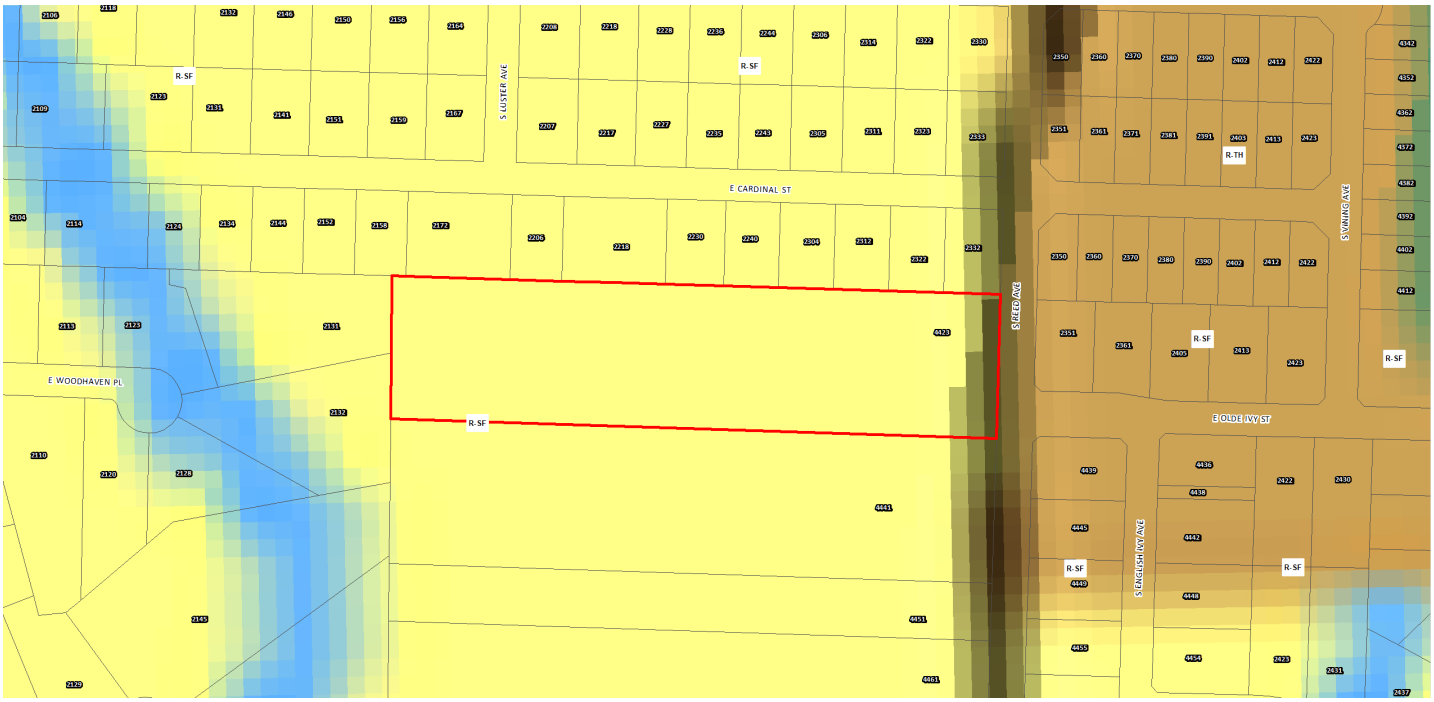
Development Review Staff Report

GOOGLE AERIAL OF LANDMARKS, BUSINESSES, AND ATTRACTIONS:

GOOGLE MAPS STREET VIEW:

Development Review Staff Report

GROWTH MANAGEMENT AND LAND USE PLAN:



- Low-Density Housing
- Medium or High Density Housing
- Medium Intensity Retail, Office or Housing
- High Intensity Retail, Office or Housing
- Greater Downtown
- Business Park
- Light Industrial, Office and Office-Warehouse
- General Industry, Transportation and Utilities
- Park
- School
- Golf
- Community-Public
- Urban Reserve Area
- Rural Area
- Greenway
- Parkway
- City Boundary
- Urban Service Area Boundary, Year 2020
- Urban Reserve Boundary, Year 2040

PROPERTY HISTORY:

The subject property was annexed into the City of Springfield in 1968. The property has not been subdivided by a Major Subdivision in the past.

PLANNING AND ZONING COMMISSION AUTHORITY:

Sec. 36-226. - Major subdivision review procedure.

(3) Preliminary plat.

(a) After participating in the pre-subdivision review with city staff, the subdivider may prepare a preliminary plat, together with supplementary material as prescribed in section 36-263.

(b) Copies of the preliminary plat and supplementary materials specified, together with a fee for administrative handling and processing in the amount prescribed by ordinance, shall be submitted to the director of planning and development with written application for approval. Upon determination that the application is complete, the director shall place the application on the agenda of the commission at a regular meeting not later than the second such meeting following the date of the filing of the application.

(c) The commission shall hold a public hearing on the preliminary plat. Notice of the public hearing shall be made in accordance with city ordinance and the rules of the commission.

(d) The commission shall review the preliminary plat and supporting material, recommendations from agencies or officials, and testimony and exhibits submitted at the public hearing. The commission shall approve, conditionally approve or disapprove the preliminary plat and if approved, the commission shall express its approval and state the conditions of such approval, if any, or if disapproved, shall express its disapproval and its reasons, therefore. In any case, a notation of the action taken, and the reasons, therefore, shall be entered in the records of the commission.

(e) If approved by the commission or approved with conditions acceptable to the applicant, then the director of planning and development shall forward the preliminary plat to the city council for its approval. Council shall determine if the land or easement proposed to be dedicated by the applicant for public use or if the public improvements shall be accepted by the city. If the city council determines that the location of the land to be dedicated for public use or the location of public improvements is appropriate and complies with applicable ordinances then the city council shall authorize the acceptance of the dedication of the land or easements upon the applicant filing and recording a final plat which substantially conforms to the preliminary plat and shall authorize the acceptance of the public improvements upon the director of public works certifying to the director of planning and development and the city clerk that the public improvements have been made in accordance with city standards and specifications.

(f) If approved with modifications which are not acceptable to the applicant or if disapproved, the director of planning and development shall attach to the plat a statement of reasons for such action and return it to the subdivider.

(g) Actions by the commission regarding the preliminary plat are final unless such action is appealed by the subdivider to the city council within 90 days of the action by the commission.

(h) Effective period of preliminary approval.

1. The approval of a preliminary plat shall be effective for a period of two years. The application for final plat approval must be submitted to the department of planning and development within the two-year period. Any plat not submitted within the two-year limit shall be null and void except as provided in subparagraph 2. below.
2. The planning and zoning commission may at its discretion and upon application by the subdivider extend the effective period of preliminary approval by two years, one time. All other submittals shall be considered a new preliminary plat and subject to applicable reviews.

ZONING ORDINANCE AND SUBDIVISION REGULATION STANDARDS:

CODE ITEM	REQUIREMENTS FOR SINGLE-FAMILY RESIDENTIAL (CLUSTER DEVELOPMENT)
Minimum Lot Size	3,000 square feet
Maximum Structure Height	35 feet or two and one-half stories above the finished grade
Front Yard Setback	15 feet
Side and Rear Setbacks	Side – 5 feet Rear – 10 percent of lot depth
Street Classification	South Reed Avenue – Collector East Olde Ivy Street (proposed) - Local
Sidewalks (Per Sec.36-471)	There is not existing sidewalk along the property frontage of S. Reed Avenue. Sidewalk is required to be constructed along S. Reed Avenue as part of the plat. The applicant has the option to apply to the ARC for approval to pay a fee in lieu of sidewalk construction. If approved, the fee must be paid prior to approval of the final plat. Sidewalk is also required to be constructed along one side of E. Old Ivy Street.
Open Space Requirement	Open space requirement is dependent on the extent of the lot reductions for the subdivision, where the amount of land for open space must be equivalent to the amount of land taken away from lots. The calculations showing equal compensation to open space can be found on drawing, in Attachment 4.

COMPATIBILITY WITH COMPREHENSIVE PLAN:

The *Growth Management and Land Use Plan* element of the *Comprehensive Plan* designates this area as Low-Density Housing. The proposed cluster development subdivision divides the property in a way that facilitates the development for attached housing, specifically single-family semi-detached dwellings. This development will contribute to the diversity of housing in the neighborhood and the preservation of natural features existing on the site. Based on renderings of the proposed buildings and site plan that was provided to city staff, we believe the proposed attached housing development is compatible with the single-family housing in the surrounding neighborhood and meets several design recommendations laid out in Objective 15 of the Land Use Plan, on page 18-56. The Major Thoroughfare Plan classifies South Reed Avenue as a Collector which supports the proposed land use.

STAFF COMMENTS:

1. The applicant is proposing to subdivide approximately 4.74 acres of property into a twenty-two (22) lot cluster development subdivision plat named “Reed Avenue Cottages” to facilitate a residential cluster development on the property. Single-family semi-detached dwellings are proposed to be built. Renderings and a layout of the proposed development can be found in Attachment 5.
2. Cluster developments allow lot dimensions to be reduced to a minimum of 3,000 square foot in R-SF zoning districts and a reduced minimum width. The smallest lot proposed is 3,864 square feet and the smallest width proposed is about 45 feet.
3. An equivalent amount of open space is being provided to compensate for the reduction of the lot sizes. The calculations showing equal compensation from lots to open space can be found on the drawing, in Attachment 4. Open space will be privately maintained by a neighborhood association. Covenants and restrictions will be reviewed and recorded along with the final plat.
4. The proposed internal street has been oriented to allow for potential future connections to the north and south. This street is an extension of East Olde Ivy Street and is proposed to be gated at the entrance. The street will be private.
5. Applicant and staff responses to the evidence presented to the standards for cluster development approval can be found in *Attachment 3.* Staff believes the evidence presented adequately meets the standards for cluster developments.
6. If Planning and Zoning Commission approves the preliminary plat, then the plat will be forwarded to City Council for acceptance of public streets and easements. An approved preliminary plat is active for two (2) years.
7. The proposed preliminary plat was reviewed by City departments and comments are contained in ***Attachment 1.*** Conditions of Approval are provided in ***Attachment 2.*** The evidence presented by the applicant and staff’s responses for the standards for cluster development approval can be found in ***Attachment 3.*** Citizen comments can be found

in ***Attachment 4*****.** Elevations and a layout of the proposed development can be found in **Attachment 5.** The Preliminary Plat drawing can be found in ***Attachment 6*****.**

PUBLIC NOTIFICATIONS:

The property was posted by the applicant at least 10 days prior to the public hearing.

DEPARTMENT COMMENTS:

ATTACHMENT 1

CITY UTILITES COMMENTS:
CU can extend Elec/Gas/Water and potentially SpringNet Fiber to the development per CU's extension policy. If street will be gated, the entire private ROW area will need to be dedicated as utility easement along with 10' on both sides. This can be updated on the final plat. If CU lighting is desired for the private street, additional construction costs will be incurred to provide the system and the lights will be billed monthly to the HOA/POA. CU can begin design when we receive construction plans/cad fill. A preliminary utility design meeting is recommended. Contact Josh @ 417-831-8816 to coordinate.

ENVIRONMENTAL SERVICES CLEAN WATER SERVICES DIVISION COMMENTS:
1. Public improvement plans will need to be designed and constructed according to city design standards for the sewer shown on the plat.
2. The public improvements must be approved and constructed or escrowed before any building permits can be issued according to city code section 98-12(b)(c) Private Construction of Public Improvements and section 98-14. - Assurance for completion of Public Improvements. If escrow of offsite sewer is allowed, the developer agrees that it is entirely their risk and that a C/O cannot be issued until said sewer is complete and accepted.
3. The horizontal alignment of the proposed sewer shown on the plat is acceptable. Additional review will be done when public improvement plans are submitted.

FIRE DEPARTMENT COMMENTS:
1. Fire access lane gates shall be 20 feet wide for single gates or not less than 12 feet wide if the roadway is divided. (2018 IFC D103.5) ----- Provide a Knox key switch for electric gates. Note on plans. (2018 IFC D103.5)
2. Two fire hydrants shall be installed - one between Lots 20 - 21 and the second between Lots 12 - 13. (2018 IFC Appendix C)
3. Fire apparatus turn around shall comply with 2018 IFC Appendix D103.

PUBLIC WORKS STORMWATER DIVISION COMMENTS:
The property is in the Thompson Branch drainage basin. The property is not located in a FEMA designated floodplain. Staff is not aware of flooding problems in the area. The city is not aware of a sinkhole at this location. A fee in lieu of on-site stormwater detention will not be allowed, and detention is required. The property is not in a stream buffer area. Please note that development of the property will be subject to the following conditions at the time of development: 1. Post development peak run-off rates shall not exceed pre-development peak run-off rates for the 1-, 10- and 100-year rain events. Any increase in impervious surfacing will require the development to meet current detention and water quality requirements per Chapter 4 Section 3 of the City's Flood Control and Water Quality Protection Manual – https://www.springfieldmo.gov/DocumentCenter/View/36063/Flood-Control-and-Water-Quality-Protection-Manual-?bidId= 2. If disturbing 1 acre or greater, water quality will also have to be provided per Chapter 10 Section 2 of the City's Flood Control and Water Quality Protection Manual. 3. Please keep in mind that more detailed stormwater calculations will have to be submitted before any permits can be approved per Chapter 4 Section 3.0 of the City's Flood Control and Water Quality Protection Manual. 4. A land disturbance permit will be required if disturbing 1 acre or greater per Chapter 4 Section 5 of the City's Flood Control and Water Quality Protection Manual. 5. Provide the following note on the plat: "The area shown hereon is not located in a storm sewer district as of the date of recording and may be subject to future assessment cost if included in future storm water benefit district deemed necessary resulting from problems created by surface water runoff. This is due to the fact that the surface water runoff is presently being accommodated by street and open drainage facilities." 6. Provide the following note on the plat: "All common areas shall be considered drainage easements. All Common Areas are to be maintained by the property owner's association. All drainage easements are to be maintained by the property owner." 7. The southern property line ditch stormwater system through Lots 1-8 needs to have a stormwater easement through each of these lots.

The property is in the **Thompson Branch** drainage basin. The property **is not** located in a FEMA designated floodplain. Staff **is not** aware of flooding problems in the area. The city is not aware of a sinkhole at this location. A fee in lieu of on-site stormwater detention **will not be allowed and detention is required.** The property **is not in a stream buffer area.**

Please note that development of the property will be subject to the following conditions at the time of development:

1. Post development peak run-off rates shall not exceed pre-development peak run-off rates for the 1-, 10- and 100-year rain events. Any increase in impervious surfacing will require the development to meet current detention and water quality requirements per Chapter 4 Section 3 of the City's *Flood Control and Water Quality Protection Manual* – https://www.springfieldmo.gov/DocumentCenter/View/36063/Flood-Control-and-Water-Quality-Protection-Manual-?bidId=

2. If disturbing 1 acre or greater, water quality will also have to be provided per Chapter 10 Section 2 of the City's *Flood Control and Water Quality Protection Manual*.

3. Please keep in mind that more detailed stormwater calculations will have to be submitted before any permits can be approved per Chapter 4 Section 3.0 of the City's *Flood Control and Water Quality Protection Manual*.

4. A land disturbance permit will be required if disturbing 1 acre or greater per Chapter 4 Section 5 of the City's *Flood Control and Water Quality Protection Manual*.

5. Provide the following note on the plat: "The area shown hereon is not located in a storm sewer district as of the date of recording and may be subject to future assessment cost if included in future storm water benefit district deemed necessary resulting from problems created by surface water runoff. This is due to the fact that the surface water runoff is presently being accommodated by street and open drainage facilities."

6. Provide the following note on the plat: "All common areas shall be considered drainage easements. All Common Areas are to be maintained by the property owner's association. All drainage easements are to be maintained by the property owner."

7. The southern property line ditch stormwater system through Lots 1-8 needs to have a stormwater easement through each of these lots.

PUBLIC WORKS TRAFFIC DIVISION COMMENTS:

1. No access from any lot is allowed to Reed Avenue.
2. Sidewalk is required to be constructed along the property frontage of Reed Avenue per Section 36-471 of city code. The applicant has the option to apply for approval to pay a fee in lieu of sidewalk construction through the ARC. If approved, the fee must be paid prior to approval of the final plat.
3. Sidewalk is required to be constructed along one side of E. Old Ivy.
4. Public Improvement Plans are required to be submitted for all public improvements. These must be submitted, approved and improvements constructed, or funds escrowed prior to approval of the final plat.
5. See Traffic Report Below

STREET CLASSIFICATION, RIGHT-OF-WAY, & JURISDICTION

City's Transportation Plan classifies S. Reed Avenue as a Collector roadway. The standard right-of-way width for S. Reed Avenue is 30-feet from the centerline. It appears 5-feet of additional right-of-way is needed along S. Reed Avenue. A survey is recommended to determine the exact amount of existing right-of-way. S. Reed Avenue is a city-maintained street.

DRIVEWAY ACCESS

There is currently one driveway access point onto the property from S. Reed Avenue that will need to be closed. E. Old Ivy Street is being constructed as part of this development. All access from the lots is required to be taken from E. Old Ivy Street. No access will be allowed to S. Reed Avenue.

SIDEWALK

There is not existing sidewalk along the property frontage of S. Reed Avenue. Sidewalk is required to be constructed along S. Reed Avenue as part of the plat. The applicant has the option to apply to the ARC for approval to pay a fee in lieu of sidewalk construction. If approved, the fee must be paid prior to approval of the final plat. Sidewalk is also required to be constructed along one side of E. Old Ivy Street.

IMPROVEMENTS

E. Old Ivy Street is shown as gated. This will require the road to be a Private Drive. The road must be constructed to City of Springfield Local Street standards which includes sidewalk on one side. A turn around meeting the City of Springfield Public Works Design Standards is also required to be constructed at the end of Old Ivy Street. Public Improvement Plans are required to be submitted, approved and improvements constructed, or funds escrowed prior to approval of the final plat.

TRAFFIC - TABLE 1: PLATTING DETAILS

	Street Name	Street Classification	On-Street Parking	Existing Street ROW From Centerline (ft)	Required Street ROW From Centerline (ft)
Street 1	S. Reed Avenue	Collector	No	25	30

CONDITIONS FOR APPROVAL:

ATTACHMENT 2

Staff recommends the Planning and Zoning Commission approve the Preliminary Plat, with the conditions listed below:

1. All improvements shall be constructed in accordance with the “Design Standards for Public Improvements” of the Public Works Department and the maintenance and operation of such improvements shall be the responsibility of the developers unless approved by the Director of Public Works. All required sanitary sewer, street, sidewalk, and drainage plans shall be prepared in accordance with City standards and specifications and approved by the Director of Public Works.

2. All required street rights-of-way, drainage and utility easements and limitations of access shall be dedicated on the final plat.

3. The developer shall meet all city and state erosion control regulations prior to disturbing the soil.

4. It is determined that the public interest requires assurance concerning adequate maintenance of common space areas and improvements. The restrictive covenants, rules and bylaws creating the common ownership must therefore provide that if the owners of the Property Owners Association shall fail to maintain the common areas or improvements in reasonable order and condition in accordance with the approved plans, the City may, after notice and hearing, maintain the same and assess the costs against the units or lots, per the Common Open Space and Common Improvement Regulations section of the Zoning Ordinance.

5. The developer shall be responsible for the relocation costs of any existing utility services and shall be responsible for clearing all utility easements of trees, brush, and overhanging tree limbs.

6. All other requirements which are necessary for this subdivision to be in compliance with the Subdivision Regulations.

If the request is recommended for denial by the Commission and the applicant requests City Council consideration, all the above conditions, plus any amendments made by the Planning and Zoning Commission, shall be included in the Council Bill.

STANDARDS FOR CLUSTER DEVELOPMENT APPROVAL

ATTACHMENT 3

Section 36-361. – Cluster Developments: Approval

A. No cluster development may be constructed except in accordance with a preliminary subdivision plat approved by the Planning and Zoning Commission under Chapter 36, Article II, subdivision regulations.

B. An approved preliminary subdivision plat for a cluster development shall provide for a total environment better than that which can be achieved under standard regulations. If, in the opinion of the planning and zoning commission, the proposed plan could be improved, with respect to the criteria listed below, by the reasonable modifications of the location of cluster open space or buildings or configurations of lots, streets and parking areas, the proposed plan shall be so modified or denied.

C. A permit for a cluster development shall be granted only if evidence is presented which establishes that:	**Applicant's response:**	**Staff response:**
1. The proposed development will be in harmony with the general purposes, goals, objectives and standards of the Springfield Comprehensive Plan, this article, and the subdivision regulations;	The City of Springfield's land use plan identifies this area as appropriate for low density housing. The proposed development is consistent with the City's purposes, goals, and objectives as outlined in the 2020 Comprehensive Plan. By way of example, the proposed development would create quality housing that is urban, compact, efficient, promotes the efficient land use, and creates a stronger sense of neighborhood (see Vision 20/20, p. 127). The makeup of the lot only allows a fraction of the lot to be developed responsibly. With the cluster development proposed we are keeping all other subdivision and zoning regs in place except for the minimum lot size. The remaining lot space will be preserved as open space/walking trail along the backside of and scattered throughout the development. The City's land use plan also identifies the area to the east as medium or high-density housing. The proposed use will limit the intensity of the development to be in line with low-density housing per City regulations.	The *Growth Management and Land Use Plan* element of the *Comprehensive Plan* designates this area as Low-Density Housing. The proposed cluster development subdivision divides the property in a way that facilitates the development for attached housing, specifically single-family semi-detached dwellings. This development will contribute to the diversity of housing in the neighborhood and the preservation of natural features existing on the site. Based on renderings of the proposed buildings and site plan that was provided to city staff, we believe the attached housing development is compatible with the single-family housing in the surrounding neighborhood and meets several design recommendations laid out in Objective 15 of the Land Use Plan, on page 18-56. The Major Thoroughfare Plan classifies South Reed Avenue as a Collector which supports the proposed land use.
2. The proposed building or use complies with all applicable regulations of this article except as modified pursuant to the authority of this section;	Correct. Residential semi-detached dwellings are proposed on the development in accordance with R-SF regulations. The "cluster" part of the code was chosen to be utilized to allow for the property to retain its character and leave the existing forest	Residential semi-detached dwellings are permitted in R-SF, in accordance with section 36-361, cluster developments.

	and drainageway near the rear (west side) of the property.	
3. The proposed building or use will not have a substantial or undue adverse effect upon adjacent property, the character of the neighborhood, traffic conditions, parking, utility facilities, and other matters affecting the public health, safety, and general welfare;	Neighboring properties have similar zoning and townhomes have been constructed recently on adjacent properties. The total number of units proposed is small and will not create any adverse impacts on the adjacent roadway network. The proposed buildings will be similar in style and overall cost per SF to the surrounding neighborhoods. A two-car garage will be provided along with a driveway setback 20' from the property line to allow guests to park in the driveway of each home. Traffic conditions will not be substantially affected by the proposed development (see response to No. 5 below).	The proposed buildings and uses will not have a substantial or undue adverse effect upon the adjacent property. The proposed development will have a similar density (4.6 dwellings units per acre) to the surrounding neighborhoods.
4. The proposed cluster development will be constructed, arranged, and operated so as not to dominate the immediate vicinity or to interfere with the development and use of neighboring property, in accordance with the applicable district regulations;	The proposed development will be gated and provide a quiet, exclusive neighborhood feel for its occupants. The development is consistent with surrounding neighborhoods. The property drops from east to west. Instead of seeing a dilapidated house, as it sits today, neighbors will see a manicured gated entrance along with a couple homes up near the road. As the site drops to the west neighbors will not even be able to see the homes as they drop over the hill. The proposed development consists only of single-story residences and will not result in a significant change in the surrounding skyline.	The proposed cluster development is consistent with development trends in the area.
5. The proposed cluster development will be served adequately by essential public facilities and services such as highways, streets, parking spaces, police and fire protection, drainage structures, refuse disposal, water and sewers, and schools; or the persons or agencies responsible for the establishment of the proposed use will provide adequately for such services;	Yes. The proposed use will only increase the AM peak hour traffic by 9 trips and the PM peak hour by 10 trips. The traffic impact is so minimal that the City's traffic impact worksheet does not even require a traffic study on the surrounding roadway network. The traffic impact is negligible. The gated entrance will also be lined up with the existing Old Ivy Street to prevent any conflicting turning movements. Turnarounds are provided for in the development to allow for adequate emergency vehicle access.	The proposed cluster development will be served adequately by all essential public facilities and services.
6. The proposed cluster development will not result in the destruction, loss, or damage of any natural, scenic, or historic feature of significant importance;	No historical features exist on-site. The purpose of deciding to pursue the cluster development was to be able to keep as much of the existing forest as possible. This site could have had a longer street section with the same	No historical features will be destroyed, lost, or damages by the proposed cluster development.

	number of lots but the whole site would have been stripped to make room for public infrastructure. The proposed development will limit this impact and allow the neighborhood to enjoy the scenic views and wildlife. The proposed development is specifically designed to preserve the stream on the west side of the property.	
7. Individual lots, buildings, streets, and parking areas are designed and situated to minimize alteration of the natural site features to be preserved;	Correct. The cluster subdivision was chosen as the best avenue to leave much of the grade along the back side of the property undisturbed. The back half drops off and City of Springfield design requirements would not allow us to design the road to follow the same slope. The "end" of the road was moved east and lot sizes reduced to allow the developer to keep the sites natural features intact. The principal reason for choosing the cluster development was to retain the character/scenic views of the site.	The proposed cluster development will preserve much of the natural features within the open space located at the west end of the property. Only two lots are proposed to be adjacent to this area.
8. The usability of cluster open space intended for recreation or public use is determined by size, shape, topographic and location requirements of the particular purpose proposed for the site;	Yes. There are a few different areas dedicated to open space to allow for a community feel to the development. The east open area will be landscaped to make it feel like a park as you enter the development. The space on the south side near the end of the road will be used for a community garden and pavilion for community gatherings. The west half of the property will include a detention/water quality basin to treat the runoff from the development before it enters the drainageway heading south. The remaining part of the property will be preserved to keep as many trees as possible to retain the scenic view of the property while also installing a trail to allow the residents to enjoy the wildlife and quiet nature of the property.	The proposed cluster developments open space has been determined by its purpose to preserve the natural features of the site and provide amenities to the residents.
9. Cluster open space shall include irreplaceable natural features located in the tract (such as, but not limited to, stream beds, significant stands of trees, individual trees of a significant size, and rock outcroppings);	Yes, significant trees and a dry creek are in place on the west side of the property. This drainageway is NOT large enough to qualify for the City's stream buffer requirement but it is a drainageway that the developers would like to keep natural as a selling point to future residents. Many old growth trees also exist in this forest and will be kept to allow for the trail to wind through a natural forest. The purpose of this development is not to	The proposed cluster development will preserve trees and drainageways within the proposed cluster open space at the west end of the property.

	shove more units than are needed on this lot. It has been shown that we could develop a similar number of lots while using the ENTIRE property but this would deforest the lot and require significant earthwork to develop this properly. This does not keep any natural features in place or preserve any character of the existing lot. The cluster development style was chosen to develop this lot responsibly.	
10. Cluster open space intended for a recreation or public use is easily accessible to pedestrians, which accessibility shall meet the needs of the handicapped and elderly;	Yes. Multiple areas have been provided as open space for the development, including park like landscaping, a community pavilion and garden, and walking trail. All will be easily accessible and known to the community as an amenity to the property. The portions of the community open space intended for recreational use (i.e. the pavilion, and community garden) will be constructed to be easily accessible for the disabled and the elderly.	The proposed open space has adequate frontage to public right-of-way and should be easily accessible.
11. Diversity and originality in lot layout and individual building design is encouraged to achieve the best possible relationship between development and the land; and	Yes. The diverse lot dimensions allow the site to preserve 1.62 acres (34%) of the site as open/community space. This space allows the lot to maintain its old growth forest and natural features. The proposed lot size also allows a 1,600+ SF home + 2-car garage.	The proposed cluster development provides diverse lot dimensions, which allow an equal amount of open space to be preserved.
12. Individual lots, buildings, and units are arranged and situated to relate to surrounding properties, to improve the view from and the view of buildings, and to lessen the land area devoted to motor vehicle access.	Correct. The lot has been allocated in such a way as to provide the number of units in the most efficient manner. The neighboring property to the northeast also constructed townhomes and this development will be comparable in price, square footage, and character. The construction of the proposed development of single-family homes will unquestionably relate to the surrounding properties—which are predominantly single-family homes. The proposed layout drastically reduces the amount of land area devoted to motor vehicle access and the lot shapes/sizes were determined by the size and shape of the entire parcel.	The proposed cluster development is consistent with development trends in the area and has been designed to lessen the area devoted to motor vehicle access.

ATTACHMENT 4

From: Personal
To: Zoning@springfieldmo.gov
Subject: Low income housing
Date: Thursday, February 10, 2022 8:32:08 AM

CAUTION This email originated from outside the organization. Do not open attachments or click links from sources you do not know and trust.

Hello, It's been brought to my attention that there's potentially low income housing going in next to my property. I live at 4501 South Reed and I'm not interested in that at all.

Thanks
Aaron Bingham
Sent from my iPhone

From: Bruce Adib-Yazdi
To: Zoning@springfieldmo.gov
Subject: Fwd: Preliminary Plat Of Reed Avenue Cottages 4423 South Reed Avenue
Date: Wednesday, February 9, 2022 1:48:30 PM

CAUTION This email originated from outside the organization. Do not open attachments or click links from sources you do not know and trust.

I am writing regarding item 11 on the February 10 Planning and Zoning Meeting.

> 11. Preliminary Plat Of Reed Avenue Cottages 4423 South Reed Avenue, Katy A. St. George Revocable Trust

I have reviewed the proposed plans and have several comments regarding the proposed Cluster Development. And while I am a proponent of higher density, diversity and quality of housing in our fair city, this proposal only accomplishes higher density on a property that is currently a wooded site, at the headwaters of a stream that feeds Thompson Creek and ultimately James River / Lake Springfield.

With that in consideration there are several components of the Cluster Development Ordinance that this proposed plan does not meet:

The purpose of a Cluster Development is to *permit a procedure that will result in improved living and working environments, promote an economic subdivision layout, encourage a variety of dwelling units, and encourage ingenuity and originality in total subdivision and individual site design*. This plan only provides for an economic subdivision layout.

It appears that technically the lot sizes, dimensions and setbacks meet all the specific mathematical requirements (unless of course there will be garages then the front setback needs to be 20')

But the proposed plan simply does not meet the fundamental spirit or intent of the Cluster Development criteria, and the layout will be detrimental to adjacent properties to the north and south - both visually and with regard to potential stormwater runoff.

Looking at the twelve approval criteria under 36-361.5c. :

> 1. The proposed development will be in harmony with the general purposes, goals, objectives and standards of the Springfield Comprehensive Plan, this article and the subdivision regulations; ***The project is incongruent with the surrounding properties - the Townhouse projects mentioned 'in the neighborhood' are zoned for TH and are adjacent to commercial or multi family properties. This proposed project is surrounded by detached single family dwelling units.***

2. The proposed building or use complies with all applicable regulations of this article except as modified pursuant to the authority of this section;

3. The proposed building or use will not have a substantial or undue adverse effect upon adjacent property, the character of the neighborhood, traffic conditions, parking, utility facilities, and other matters affecting the public health, safety and general welfare; ***This project will have substantial undue adverse effect on both the properties to the north and the south.***

4. The proposed cluster development will be constructed, arranged, and operated so as not to dominate the immediate vicinity or to interfere with the development and use of neighboring property, in accordance with the applicable district regulations; ***This project will is arranged such that it will dominate the properties to the north and the south with 400'-500' long wall of back facing structures.***

5. The proposed cluster development will be served adequately by essential public facilities and services such as highways, streets, parking spaces, police and fire protection, drainage structures, refuse disposal, water and sewers, and schools; or the persons or agencies responsible for the establishment of the proposed use will provide adequately for such services;

6. The proposed cluster development will not result in the destruction, loss, or damage of any natural, scenic, or historic feature of significant importance; ***This project will result in loss of at least 4 acres of wooded area at the head waters of a stream.***

7. Individual lots, buildings, streets, and parking areas are designed and situated to minimize alteration of the natural site features to be preserved; ***This project will result in significant alteration of the natural site features and grades.***

8. The usability of cluster open space intended for recreation or public use is determined by size, shape, topographic and location requirements of the particular purpose proposed for the site; ***The remaining open space created will be largely unusable by either the public or residents.***

9. Cluster open space shall include irreplaceable natural features located in the tract (such as, but not limited to, stream beds, significant stands of trees, individual trees of a significant size, and rock outcroppings); ***The open space will use the headwaters of teh stream as detention area, and remove significant stands of trees for development. Including those on the frontage of Reed, shown in lot 22.***

10. Cluster open space intended for a recreation or public use is easily accessible to pedestrians, which accessibility shall meet the needs of the handicapped and elderly; ***The proposed open space is not easily accessible and does not meet the needs of the handicapped or elderly.***

11. Diversity and originality in lot layout and individual building design is encouraged to achieve the best possible relationship between development and the land; and ***There is no diversity or originality in the lot layout, nor individual buildings.***

12. Individual lots, buildings, and units are arranged and situated to relate to surrounding properties, to improve the view from and the view of buildings, and to lessen the land area devoted to motor vehicle access. ***The buildings are not arranged to relate to surrounding properties, in fact the arrangement will be detrimental to the view to and from the proposed project.***

Beside all that...

Given the amount of grading that will be necessary for the proposed project, I'm not

sure if ANY of the trees except for a few in the NW corner will be preserved. By the time all the pads are set and detention is put in place, a very significant portion of this site will be ditsurbed and ultimately covered with homes all set as IDENTICAL attached duplexes, or 10' apart from each other.

The 10' rear yard setback, with no buffer required, will put the rear of these structures facing the adjacent lots in a row of about 400'-500' long olong the north and south adjacent to the back yard of other single family houses to the north, and side yard of a single family house to the south. . While detached SFR and Duplexes are exempt from that requirement because they *'rarely fail to comply with requirements set forth in the Landscape and Bufferyard section*' this is one of those rare cases where buffer yards should apply.

The storm water easement shown along the south property line, to be in that 10' rear yard, will be difficult, if not impossible to control given the amount of roof area and slope to the grade. Grading between the structures will also be very difficult and create unusable space between the houses.

The two lots at the west end of the project will need significant amount of grading to the west to make them work, or very large retaining walls.

The trail will be very steep and not accessible to the public or very accessible to residents. And the 'Common Area' on the west is really going to be consumed mostly with grading for the last two lots and detention.

As an architect, and a staunch proponent of diversity, density and quality housing, I am appalled at the level of insensitivity of the design and development of this tract of land, and encourage staff and planning commission to to simply reject this plan altogether.

--

Bruce Adib-Yazdi
bruce.adib.yazdi@gmail.com
1946 S. Holland Springfield MO 65807
417-848-6001 (cell)

From: Chuck Clore
To: Zoning@springfieldmo.gov
Subject: Development at 4423 S Read Avenue
Date: Wednesday, February 9, 2022 8:28:01 PM

CAUTION This email originated from outside the organization. Do not open attachments or click links from sources you do not know and trust.

Bob Hosmer, AICP
City of Springfield
Planning and Development
Development Review Office

Dear Board Members,

Development at 4423 S Read Avenue 65804

I have reviewed the proposal for the development of Reed Avenue Cottages and found it wanting. It appears they are planning to place twice as many dwellings on 4.74 acres than should be allowed. Approximately 20% of that space will be a retention basin and commons area.

Compressing 22 structures into less than 4 acres with minimal distance between and no yard must violate the low-density zoning. This may appear to be a very efficient use of space on paper but in reality, it is neither practical nor livable. Placing row housing in the midst of spacious single-family dwellings is not a good fit.

The additional traffic, 44 more vehicles daily accessing the new roundabout, will also tax the existing thoroughfares.

Please give these issues careful consideration.

Thank you.

Chuck & Judy Clore

Concerned neighbors on E Amory Court

--
chuckclore@mchsi.com
2319 E. Amory
Springfield, MO 65804

Cell: 417-429-7753

From: Craig Bills
To: Zoning@springfieldmo.gov
Subject: Development Project Located at 4423 S Reed Ave 65804
Date: Wednesday, February 9, 2022 5:45:07 PM

CAUTION This email originated from outside the organization. Do not open attachments or click links from sources you do not know and trust.

February 09, 2022

Bob Hosmer, AICP
City of Springfield
Planning and Development
Development Review Office

RE: Development Project Located at 4423 S Reed Ave 65804

Dear Chairman and Board Members

My Name is Craig Bills, my wife Mary of 49 years and I have lived on Reed Ave for over 14 years. We lived at 4629 S Reed Ave. on 7 acres for 10 years. Then we purchased a 5 acre plot at 4441 S Reed Ave and build our new home a little over 4 years ago. We sold our 34 year old home at 4629 to the Osbourne's who did a complete remodel and update at a cost of over $200,000.(estimated) Like most of the people in the neighborhood, we are not planning another move in our lifetime.

We are writing today to emphatically oppose the Development Project at 4423 South Reed Ave. This is not the right neighborhood to start subdividing the plots for small houses and little individual lot size.

This is a very nice quiet area that has lots of wildlife including, deer, foxes, bats, squirrels, ground hogs, rabbits, hawks, eagles, turtles, birds, etc. These animals are part of our life, this area is a sanctuary.

We like many in this area love the outdoors, that is why we moved here and then built new here.

These small "cottages" are basically ground level apartments, commonly know as "Row Housing", this housing project is not compatible with the neighborhood. We already only have one usable entrance and exit to the neighborhood, adding the additional traffic to the already taxed road would cause more problems than this type of development tries to resolve.

Such a high density development will greatly change the character of the low density neighborhood.

Many of us home owners might be willing to serve on a committee to assist with finding a mutually beneficial location for this project, a location with more room for expansion, favorable grade, and less disruption to the surrounding's. These are great projects, they just need to be done right.

This development is simply not compatible and is an unwelcome intrusion, it does not belong in this area, let along next to our new home.

The absolute best outcome is for the applicant to simply withdraw the application and move on.

Question: Would any of you welcome this development next to your home?

Thank you for your service to the community.

Craig & Mary Bills
4441 S Reed Ave
Springfield, MO 65804
417-861-2800

PS: While we were building our new home your department was very easy to work with and provided expert advise to us. Thank you!!

From: Dan
To: Zoning@springfieldmo.gov
Subject: Development project located at 4423 S Reed Ave 65804
Date: Thursday, February 10, 2022 10:56:10 AM

CAUTION This email originated from outside the organization. Do not open attachments or click links from sources you do not know and trust.

Dear Chairman and Board Members,

This email is to express my disproval with the proposed development project located at 4423 S Reed Ave 65804.

The row style housing with minimum square footage is not compatible with the neighborhood.

Please give this careful thought and understand the impact this could have on current home owners.

Thank you

Daniel B Dobbyn
2545 E German Ivy
Springfield, Mo 65804

Sent from Mail for Windows

From: Dan
To: Zoning@springfieldmo.gov
Subject: RE: Development project 4423 S Reed Ave 65804
Date: Thursday, February 10, 2022 11:50:02 AM

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Dear Chairman and board members

I am writing regarding my concerns with the proposed cluster development located at 4423 S Reed Ave 65804

The goal of the building department should be to protect the health, safety, and welfare of the general public and to create neighborhoods people would want to live in.

Building the cluster homes in this area would devalue the homes in this area.

It would cause congestion on Reed ave.

It would cause chaos and deterioration of the area, when there are not enough parking spaces for the cluster it would overflow into other neighborhoods.

Building this cluster in this area would set a precedence that could allow a cluster like this to be build in any area. There are homes in Springfield which also have 4 acres which would allow them to be replaced by 22 homes, I'm thinking a home next to hickey hills. If you would not allow 22 homes to be build on 4 acres near hickory hills you should not allow it here.

This cluster does not fit well within this area. There is not another cluster development like this in this area.

I have several issues with the proposed cluster. Because is it s cluster they do not have to follow the same standards as single family homes in the area.

They are reducing the width to 45 feet when the standard in this area is 50 feet

The set backs are also reduced from 25 feet to 15 feet.

The backyards of these houses will be 10 feet, this is not a backyard this is barely a patio width.

They are reducing the spacing between the houses to 0 and 10 feet between buildings.

There is nothing in the diagrams showing drainage or sewers for this cluster.

They are not showing that these homes will have garages, which will lead to having the street lined with parked cars, even If they have single car garages where will visitors park?

Accessibility for emergency vehicles, if the street is full of vehicles how can the emergency vehicles get in and out.

Drainage, there is a severe slope to the property, with the removal of all the green space at the top of the slope all the water will drain down and flood the houses at the bottom of the slope.

Was there a traffic analyses done with all the cars coming from olde ivy and new 22+ cars coming from this cluster.

The average lot size for this area is over .4 acres the average lot size for these homes is .1

or less.

I do not believe this cluster development is a good fit for this area and should be denied back on comparable homes in the area, the developer should look at the homes next door which is a single family home on the same amount of land. Putting 22 homes on the same amount of land next to one another is not appealing nor is a good fit.

Daniel Losco
4442 S English Ivy ave.

From: David Baker
To: Zoning@springfieldmo.gov
Subject: Development project located at 4432 S Reed Ave 65804
Date: Saturday, February 19, 2022 9:48:37 PM

CAUTION This email originated from outside the organization. Do not open attachments or click links from sources you do not know and trust.

Dear Chairman and Board Members,

My name is David Baker and I have the new build at 4551 S. Reed Ave. I am mad, sad, depressed, frustrated just to name a few feelings. At numerous times during the day you can currently lookout and see dear, wild turkeys, foxes, and other wild life.

This area is trending in a good way, people are rebuilding, remodeling and generally improving the area and this is in the opposite direction. Even if this were 22 residences/11 duplexes and all at the $500,000 price tag this is the wrong development in the wrong place.

Until January 2020 I lived at 1811 E. Notingham St, in Ravenwood South Subdivision and the whole reason we tore down the 1200 sq/ft house that was on S Reed and built a 3600 sq/ft house is because we liked the woods, wildlife and friendliness of this area. If this rezoning is allowed within 10 years at least 4 or 5 of the 4 or 5 acre tracks to the south will be developed into the same type this subdivision. At that point you are talking approximately (110 residences X 2 Cars) 220 cars coming and going each day. This will cause traffic issues, drainage issues, sewer issues and the complete crash of the environment because of the removal of trees and grass that absorb pollution and crate oxygen. I for one will sell and move away not because of the number of residences but because the total destruction of the ecosystem in this area beside of the absolute disappointment every time I drove by the development.
I have the property that abuts S.Luster Ave off of E Amory Dr.

From: David Baker
To: Zoning@springfieldmo.gov
Subject: Re-zoning of property at 4432 S Reed Ave
Date: Tuesday, February 8, 2022 7:46:39 PM

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Bob Hosmer, AICP
City of Springfield
Planning and Development
Development Review Office

RE: Development project located at 4432 S Reed Ave 65804

Dear Chairman and Board Members,

My name is David Baker and I live in the new house at 4551 S. Reed Ave. I have the property that abuts S.Luster Ave off of E Amory Dr and 5 lots down from the property that is up for rezoning.

I am mad, sad, depressed, and frustrated just to name a few feelings. At numerous times during the day you can currently look out and see deer, wild turkeys, foxes, and other wild life.

This area is trending in a good way. People are rebuilding, remodeling and generally improving the area and this proposal is in the opposite direction. Even if this were 22 residences / 11 duplexes in the $500,000 price range this is the wrong development in the wrong place.

Until January 2020 I lived at 1811 E. Nottingham St in Ravenwood South Subdivision and the whole reason we tore down the 1200 sq/ft house that was on S Reed and built a 3600 sq/ft house is because we liked the woods, wildlife and friendliness of this area. If this rezoning is allowed ,within 10 years at least 4 or 5 of the 4 or 5 acre tracks to the south will be developed into the same type as this subdivision. At that point you are talking approximately (110 residences X 2 Cars) 220 cars coming and going each day. This will cause traffic issues, drainage issues, sewer issues and irrevocable damage to the environment because of the removal of trees and grass that absorb pollution and create oxygen.

I will sell and move, not because of the number of residences or the value of the residences, but because it will totally destroy the ecosystem and destroy the quality of life in this area. You may call me at 417-299-1643 if you have any questions.

From: Dennis Geren
To: Zoning@springfieldmo.gov
Subject: Development project at 4423 S. Reed Ave. 65804
Date: Wednesday, February 9, 2022 1:55:07 PM

CAUTION This email originated from outside the organization. Do not open attachments or click links from sources you do not know and trust.

Mr. Bob Hosmer, AICP
City of Springfield
Planning and Development
Development Review Office

Dear Chairman and Board Members,

I am writing to express my concerns with the proposed development project at 4432 S. Reed Ave. 65804.

This project would change the character of the neighborhood from low density single family with an average lot size of 10,000 sq. ft. to high density average lot size of 4000 sq, ft.

This area has experienced high growth over the last 25 years with Olde Ivy single family homes and Vinings
luxury patio homes.These two developments both average greater than 2000 sq. ft. homes with significant lot sizes.

The trend for the already developed areas such as Old Southern Hills, Reed Ave. Amory St., Thompson Place, etc. is
to remove old structures and build new modern homes costing $350,000 each and/or remodels of over $100,000 and up.

This proposed project of row style housing with minimum square footage is not compatible with the neighborhood and current
trends.

Please give this careful thought and understand the impact this could have on current home owners.

Thank you for your consideration!

Regards,

Dennis and Linda Geren
4449 Swedish Ivy Ave.
Springfield, Mo. 65804

From: Don Smith
To: Zoning@springfieldmo.gov
Subject: Fwd: Preliminary Plat Of Reed Avenue Cottages 4423 South Reed Avenue
Date: Monday, February 21, 2022 5:15:25 PM

CAUTION This email originated from outside the organization. Do not open attachments or click links from sources you do not know and trust.

Feb. 21 2022

We are writing because of our concern over the. Preliminary Plat Of Reed Avenue Cottages 4423 South Reed Avenue, Katy
A. St. George Revocable Trust.

We are opposed to the project as it is proposed. Once something like this is in the neighborhood it will spread. There are many properties of similar size and topography on Reed road and in the Old Southern Hills neighborhood. Harris Woods was one such property that was developed without a zoning change and is a fine addition to the area. If this one is allowed I don't see how other property owners could be fairly denied similar developments. The roads in the area cannot handle this. We have lived here since 1969 and the only improvement to the roads has been the surface. There is ponding on Reed just north of this development. Some of the water from the east side of Reed Road drains across our property. Also some of Amory on the south side and all of the water on the north side cross our property. There has been no attempt to correct these issues not even a culvert to prevent ponding on Reed. Except for the better surface the roads are the same as they were when the area was not in the city. At a minimum Reed should be improved north of 4423 prior to allowing such a development.

This isn't just about this property but about all the other development that will happen as a result of this change. It will eventually destroy the very nature of our neighborhood.

Donald Smith and Maureen Smith
4618 S. Biloxi Ave

In addition I am concerned about the representation of the land use in the proposal. Specifically attachment 3 items number 7, 8 and 9. In 7 the applicant refers to the back side of the property which then becomes the back half. The staff comment uses the more appropriate western portion. In 8 the applicant uses the term back half. Staff uses no terms at all regarding the western portion which seems appropriate for this item. In 9 the term used by both applicant and staff is west half. I know that I have no knowledge of when the comments in attachment 3 were made. Perhaps they were before the plat was made that I see in attachment 5. But when I use the data on attachment 5 the total area of the common area / open space is 1.61 acres. Which is

only 34% of the 4.74. I am not implying intentional misrepresentation but what would have been wrong with the staffs first term western portion. I would like to see the staff be less likely to be accused of bias in favor of developers. The common space includes a 6000 sq. ft. piece that borders on Reed Road. The actual western portion according to the plat is only 29% of the property. A more accurate fraction would have been one third. The best word to have been used by staff is their original western portion. Especially if they had no access to attachment 5.

I apologize if this seems petty but it does make me question unconscious bias.

Donald Smith

Sent from Mail for Windows

From: doug1153@aol.com
To: Zoning@springfieldmo.gov
Subject: Redeveloment Project at 4423 S Reed Ave 65804
Date: Wednesday, February 9, 2022 9:56:46 AM

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February 09, 2022

Bob Hosmer, AICP
City of Springfield
Planning and Development
Development Review Office

I have had a chance to review the proposal of sub division on the 4+ acre lot located at 4432 Reed Ave.

I am taken aback to think someone could jam 22 apartment size cottages on such a small area and think it was a good idea. The neighborhood road cannot continue to accommodate more and more traffic from these developments.

This area is an established and well kept neighborhood. A project like this is not typical land use for this area. This neighborhood is primarily large family plots with a single family dwelling.

I am aware of several big cities that have allowed row housing that was not favorable. Usually because the high density was not compatible with the area it was tested in.
However, this type of row high density houses can work in areas that multiple structures can be removed and there is room for further growth within the development.

I would recommend that the developer look for an area near downtown Springfield for this project.

This project should be a huge success if established near campus and/or downtown.

A thought: Would YOU want this development in your neighborhood?

Thank you for your continued service to our community.

Doug Snodgrass
4439 S English Ivy
417-883-5385

From: Glenda Steinert
To: Zoning@springfieldmo.gov
Subject: Development project located at 4423 S. Reed Ave 65804
Date: Wednesday, February 9, 2022 10:21:30 AM

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February 09, 2022

Bob Hosmer, AICP
City of Springfield
Planning and Development
Development Review Office

After reviewing the proposal of sub division on the 4+acre lot, located at 4432 S. Reed Ave, I have concerns.

I can't see that anyone would benefit from an ill-conceived project, other than the developer.

Over crowding 22 small cottages on such a small area is not appealing to most homeowners. The neighborhood road is already so heavy with traffic it is difficult to back out of driveways and enter Reed Street from Olde Ivy street. Often traffic is at a stand still while cars are turning on and off adjoining streets. Additional cars added to such a small road space seems detrimental to traffic flow. The city would have to consider widening and repairing more streets.

This area is an established and well kept neighborhood. A project like this is not typical land use for this area. This neighborhood is primarily large family plots with a single family dwelling.

This type of row, high density houses can work in areas that multiple structures can be removed and there is room for further growth within the development. It isn't likely that additional land will ever be available for further development in this particular area, since most of the surrounding houses are newer and still in liveable/sellable condition.

I would recommend that the developer look for an area near downtown Springfield for this project.

This project should be a huge success if established near campus and/or downtown.

A thought: Would YOU want this development in your neighborhood?

Thank you for your continued service to our community.

Glenda Snodgrass
4439 S English Ivy

From: Gudrun Swann
To: Zoning@springfieldmo.gov
Subject: Development project
Date: Wednesday, February 9, 2022 2:17:11 PM

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Bob Homer, AICP
City of Springfield
Planning and Development
Development Review Office

RE: Development project located at 4423 S Reed Ave 65804

Dear Chairman and Board Members

This proposed project is not in the best interest of the area.

People that live here love the outdoors,the Springfield Nature Center, Lake Springfield, The Park, Restaurants, Farmers Park, etc. Most are educated professionals that have worked hard to enjoy their lifestyle. Most make great incomes, vote, go to church, and support the community. I would guess there will be a great deal of opposition. This development would not be favorable. This proposed project of row style housing with minimum square footage is not compatible with the neighborhood and current trends.

Please give this a careful thought, and understand the impact this could have on current home owners.

A thought: Would you want this development in your neighborhood?

Thank you for your continued service to our community.

Sincerely,

Gudrun R. Swann
4474 Irish Ivy
Springfield, MO 65804

Sent from my iPad

From: Gudrun Swann
To: Zoning@springfieldmo.gov
Subject: Development project
Date: Wednesday, February 9, 2022 2:02:54 PM

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Bob Hoster, AICP
City of Springfield
Planning and Development
Development Review Office

RE: Development project located at 4423 S Reed Ave 65804

Dear Chairman and Board Members

I have had a chance to review the proposal of sub division on the 4+ acres lot located at 4432 S Reed Ave.

I am taken aback to think someone could jam 22 apartment size cottages on such a small area and think this was a good idea. The neighborhood road cannot continue to accommodate more and more traffic from these developments.

This area is a established well kept neighborhood. A project like this is not typical land use for this area. This neighborhood is primarily large family plots with a single family dwelling.

I am aware of several bid cities that have allowed row housing that was not favorable. Usually because the high density was not compatible with the area it was tested in.
However this type of row high density house can work in areas that multiple structures can be removed and there is room for further growth within the development.

I would recommend that the developer look for areas near downtown Springfield for this project.

This project should be. Huge success if established near campus and / or downtown.

Sincerely,

Dr. James H. Swann

Sent from my iPad

From: Heather Barnett
To: Zoning@springfieldmo.gov
Subject: proposed development project at 4432 S. Reed Ave.
Date: Wednesday, February 9, 2022 11:14:26 AM

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To Whom it may concern,

I have had a chance to review the proposal of sub division on the 4+ acre lot located at 4432 S Reed Ave.

I am taken aback to think someone could jam 22 apartment size cottages in such a small area and think it was a good idea. The neighborhood road cannot continue to accommodate more and more traffic from these developments.

This area is an established, well kept neighborhood. A project like this is not typical land use for this area. This neighborhood is primarily large family plots with a single family dwelling.

I am aware of several big cities that have allowed row housing that was not favorable. Usually because the high density was not compatible with the area it was tested in. However this type of row high density house can work in areas with multiple structures can be removed and there is room for further growth within the development.

I would recommend that the developer look for areas near downtown Springfield for this project.

This project should be a huge success if established near campus and / or downtown.

--
Thanks,
Heather Barnett-Fagg

From: James Dickey
To: Zoning@springfieldmo.gov
Subject: Development project located at 4423 S Reed Ave 65804
Date: Thursday, February 10, 2022 11:16:11 AM

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Dear Chairman and Board Members

We are writing to express out opposition to the proposed development project at 4432 S Reed Ave 65804 for the following reasons:

1, The neighborhood roads are such they cannot continue to accommodate more and more traffic from existing developments.
2, The proposed project to construct row houses is not conducive to this neighborhood with large single family on large lots.
3. This area has already experienced high growth over the past several years with Olde Ivy single homes and Vinings luxury patio homes.

Please give this careful thought and understand the impact this could have on current home owners.

Sincerely,

Jim and Blanche Dickey
2467 E Olde Ivy St
Springfield, MO 65804

From: Jennifer Serfass
To: Zoning@springfieldmo.gov
Subject: Reed Ave Concern
Date: Wednesday, February 9, 2022 12:37:00 PM

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To whom it may concern,

I am writing to express my concerns with proposed development project at 4432 S Reed Ave 65804.

This project would change the character of the neighborhood from low density single family homes with an estimated average lot size of 10,000 sq ft to high density average lot size of 4,000 sq ft.

This area has experienced high growth over the last 25 years with Olde Ivy single family homes and Vinings luxury patio homes. These two developments both average greater than 2,000 sq ft homes with significant lot sizes.

The trend for the already developed areas such as Old Southern Hills, Reed Ave, Amory St. Thompson Place, etc is to remove old structures and build new modern homes costing $350,000 each and or remodels of over $100,000, and up.

This proposed project of row style housing with minimum square footage is not compatible with the neighborhood and current trends.

Please give this careful thought, and understand the impact this could have on current home owners.

Thank you,

Jennifer Serfass

Get Outlook for iOS

From: jennifer goschy
Subject: Development project location at 4423 S. Reed Ave 65804
Date: Thursday, February 10, 2022 6:52:18 AM

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Dear Chairman and Board members

I ask that you give this project great attention. The increase in traffic on Reed Ave, Swallow, Cardinal, and Nature Center Way, should be enough to squash this development. This entire neighborhood, as well as Old Ivy, and the newer development to the north of Old Ivy, should have received much more notice, and given the chance to speak. Traffic already backs up on Nature Center Way, and will on

From: Joel Serfass
To: Zoning@springfieldmo.gov
Subject: Reed Ave Concern
Date: Wednesday, February 9, 2022 7:47:43 PM

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To whom it may concern:

This proposed project is not in the best interest of the area.

People that live here love the outdoors, the Springfield Nature Center, Lake Springfield, The Park, Restaurants, Farmers Park, etc. Most are educated professionals that have worked hard to enjoy their lifestyle. Most make great incomes, vote, go to church, and support the community.

This development would not be favorable. I would guess there will be a great deal of opposition.

A Thought: Would you want this development in your neighborhood?

Thanks,

Joel Serfass

Sent from my iPhone

From: John Schnoebelen
To: Zoning@springfieldmo.gov
Subject: Reed Ave Cottages - 4432 S Reed Rd
Date: Wednesday, February 9, 2022 4:43:10 PM

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Bob Hosmer, AICP
City of Springfield
Planning and Development
Development Review Office

Dear Mr. Hosmer,
I live nearby the proposed development on Reed Rd and have concerns about the density and negative impact on our neighborhood and our property. Please consider a lower density project for this property to protect the integrity of the area.
Thank you,
John Schnoebelen

JOHN SCHNOEBELEN
jschnoeb@gmail.com

From: John Lilly
To: Zoning@springfieldmo.gov
Subject: Zoning for 4423 S Reed Ave. 65804
Date: Thursday, February 10, 2022 6:14:51 AM

CAUTION This email originated from outside the organization. Do not open attachments or click links from sources you do not know and trust.

Chairman and Board Members,

I recently purchased a patio home in the Vinings at Olde Ivy. The lot is 7,300 sq. ft. You will probably get quite a few emails from property owners in the Olde Ivy subdivision protesting against the proposed development at 4423 S Reed Ave. 65804. All of these property owners have overlooked one important fact. They don't own the property where the proposed development is located; therefore, they should have no input into the proposed development. If they want to stop the development, let them purchase the property.

All of the Board Members took an oath at the beginning of their appointment to support the Missouri Constitution. Article I, Section 2 of the Missouri Constitution states.

> That all constitutional government is intended to promote the general welfare of the people; that all persons have a natural right to life, liberty, the pursuit of happiness and the enjoyment of the gains of their own industry; that all persons are created equal and are entitled to equal rights and opportunity under the law; that to give security to these things is the principal office of government, and that when government does not confer this security, it fails in its chief design.

"The enjoyment of the gains of their own industry" means private property. Your job is to protect private property. If the Board fails to do that, then the Board fails in its chief design.

I support the property owner in doing with his land whatever he is able to do. If he wants to sell it to a developer that wants to subdivide the property into small lots for small homes, then that is his right. I support the proposal.

Dr. John Lilly
johnlilly97@gmail.com
Mobile: 417-766-1537

From: kbakerlex@aol.com
To: Zoning@springfieldmo.gov
Subject: Re zoning on Reed Ave
Date: Tuesday, February 8, 2022 7:53:29 PM

CAUTION This email originated from outside the organization. Do not open attachments or click links from sources you do not know and trust.

I am writing to express my opposition to the development project proposal at 4423 S Reed Ave 65804

We built a new home at 4551 S Reed Ave 2 years ago. We tore down the old existing house and have made substantial improvements to the property. This is in keeping with other properties that have undergone similar renovation. We moved here because we love the quiet, friendly neighborhood. It is inside city limits but feels somewhat like the country. We see deer almost every day and other wildlife such as foxes, turkeys and even a raccoon occasionally.

We are heartsick that further development such as this will strip our neighborhood of all these things. There will also be untold environmental damage to the land with tree removal and such which will cause drainage and soil erosion issues and will rob the wildlife of their habitat.

Thank you for your consideration of this important matter.

Sincerely,

Karen Baker

Sent from the all new AOL app for iOS

From: Kelly Weber
To: Zoning@springfieldmo.gov
Subject: Development project at 4423 south reed
Date: Wednesday, February 9, 2022 6:25:24 PM

CAUTION This email originated from outside the organization. Do not open attachments or click links from sources you do not know and trust.

Dear chairman and board members,
I am writing to express my concerns with proposed development project at 4432 S Reed Ave 65804.
This project would change the character of the neighborhood from low density single family homes with an estimated average lot size of 10,000 sq ft to high density average lot size of 4,000 sq ft.
This area has experienced high growth over the last 25 years with Olde Ivy single family homes and Vinings luxury patio homes. These two developments both average greater than 2,000 sq ft homes with significant lot sizes.
The trend for the already developed areas such as Old Southern Hills, Reed Ave, Amory St. Thompson Place, etc is to remove old structures and build new modern homes costing $350,000 each and or remodels of over $100,000, and up.
This proposed project of row style housing with minimum square footage is not compatible with the neighborhood and current trends.
Please give this careful thought, and understand the impact this could have on current home owners. Sent from my iPhone

From: Kelly Weber
To: Zoning@springfieldmo.gov
Subject: South reed development
Date: Thursday, February 10, 2022 7:10:23 AM

CAUTION This email originated from outside the organization. Do not open attachments or click links from sources you do not know and trust.

Dear chairman and board members,
I am writing to express my concerns with proposed development project at 4432 S Reed Ave 65804.
This project would change the character of the neighborhood from low density single family homes with an estimated average lot size of 10,000 sq ft to high density average lot size of 4,000 sq ft.
This area has experienced high growth over the last 25 years with Olde Ivy single family homes and Vinings luxury patio homes. These two developments both average greater than 2,000 sq ft homes with significant lot sizes.
The trend for the already developed areas such as Old Southern Hills, Reed Ave, Amory St. Thompson Place, etc is to remove old structures and build new modern homes costing $350,000 each and or remodels of over $100,000, and up.
This proposed project of row style housing with minimum square footage is not compatible with the neighborhood and current trends.
Please give this careful thought, and understand the impact this could have on current home owners.

Kelly Weber
417-861-5683

Sent from my iPhone

From: Kip Cunningham
To: Zoning@springfieldmo.gov
Subject: Reed Proposed development
Date: Wednesday, February 9, 2022 12:47:42 PM

CAUTION This email originated from outside the organization. Do not open attachments or click links from sources you do not know and trust.

Hello,
I live in Olde Ivy and won't be able to be at the meeting tomorrow night about the proposed development on Reed near the entrance of Olde Ivy Neighborhood.

While I thought what I was hearing it was surely a mistake, after Iooking at the plans, I'm in shock. 22 lots on a 5ace piece of land?
I am extremely opposed to this. The amount of traffic coming off or Reed would be increased dramatically, and there is already a flooding issue on reed every time it rains.

It's challenging enough going to and coming from work in that area and with an additional 22 households there, the problem will only increase.

We need to preserve that land around there since we are by the nature center, and adding more people and more cars isn't going to do anything to help the nature center.

I'm shocked that putting 22 homes on 5 acres is even up for discussion. I hope this plan is rejected.

Thank you.

J. Kip Cunningham
2405 E. Olde Ivy
Springfield MO 65804

Kip Cunningham
MotorWerks
417.832.8500
kip@motorwerks.net
www.motorwerks.net

From:	Larry Bratvold
To:	Zoning@springfieldmo.gov
Cc:	Larry Bratvold; DAVID BAKER; Craig Bills; jeralincoln@hotmail.com; Lizzie Roda; bruce.adib.yazdi@gmail.com
Subject:	RE: Proposed project at 4423 S Reed Ave, Springfield, MO 65804
Date:	Wednesday, February 9, 2022 4:43:07 PM

CAUTION This email originated from outside the organization. Do not open attachments or click links from sources you do not know and trust.

February 09, 2022 Zoning@Springfieldmo.gov

Bob Hosmer, AICP
City of Springfield
Planning and Development
Development Review Office

RE: Development project located at 4423 S Reed Ave 65804

Dear Chairman and Board Members:

My name is Larry Bratvold. My wife and I live in Olde Ivy and have lived there for 18 years. Our house backs up to Reed, and is about one block south of the proposed development. We go in and out of Olde Ivy Subdivision at the intersection of Olde Ivy and Reed, and have done so all these years. When we moved in 18 years ago, Olde Ivy was pretty much open land, lots of beautiful trees, and very few houses.

We raised our children in a larger home on multiple acres with more than 500 feet of trees down one side of the property. Our house was positioned 250 feet back from the road, nestled in the trees. What a wonderful feeling it was to turn up the driveway for so many years and "feel" the "feeling of home" in those surroundings.

When the children were gone, we moved to Stone Meadow in southwest Springfield which has an amazing nature area in the center of the development and houses with multi-acre lots across Weaver Road to the North. This fit with our desire to have a country feel, while living in a smaller, empty nester, home. When the Kansas Avenue Expressway extension was proposed to come very close to our house 20 years ago popped up, we looked for a development surrounded by homes on large pieces of acreage to give a country feel. We found what we were looking for in Olde Ivy and the area surrounding it, including the large lots with single family homes along Reed.

Although many opinions will be or have been expressed concerning the proposed project, and although I am an attorney in my 45th year of practice, my thoughts regarding the proposed project are neither legal nor technical. I have made my living talking to and counseling with people concerning their legacies, possibly as many as 5,000 families since Bratvold Law Firm opened its doors 42 years ago this month.

I work with my clients on a personal level learning how important the manner in which they will live out the sunset years is to them. Therefore, my concerns tend to run to the people who

have made this area their permanent home, who have invested time, money, and vision to build a feeling of "home" for this season of their life, especially senior, empty nesters like Kathy and me.

Throughout the course of our lives, as we marry, have children, raise children, and eventually determine what will be best for us in our senior years, we spend much time, effort, thoughts, and planning how we want to live out the final season of our lives. We eventually look for a place that fits our personalities, our needs, and makes us want to "come home" at the end of a hard day or after a short or long trip away from the place we call “home.” When we turn down our street or drive into our driveway, we want the feeling of fulfillment of a choice well made, of work well worth the effort, for our home. “Home" is as much a feeling as it is a place, a yard, or a structure. Our homes become an integral part of who we are. We want to feel like this is where we belong; this is "home."

We were drawn to this area of town in great part because of the open spaces, the trees, the deer, the turkeys, the rabbits, the groundhogs, and all the other critters that one finds with open spaces, large lots spotted by trees, and thick stands of trees. It is truly a delightful and special area.

When one takes a birds-eye view of the area, you are not surprised that people have invested $500,000 - $1,000,000 in homes to the west on two cul-de-sacs that back up to the proposed project site, why Craig and Mary Bills invested that type of money next door to the proposed project, why David and Karen Baker invested the same type of money a few houses to the south of the proposed project, and why there are so many other beautiful houses with large lots in the area.

It is also no surprise that residents of Olde Ivy have similar amounts of money invested in "forever homes" in which they intend to live out their days or raise their children. I have not taken a census of the Olde Ivy area demographics, but from walking in and around the neighborhood these 18 years, my judgment would be that a majority of residents are like Kathy and me, persons who have planned for their current homes to be the last stop on the railroad line of their lives.

When Olde Ivy developer, Michael Pulscher, proposed The Vinings Of Olde Ivy, I must confess I was surprised that he would go in that direction considering the value of his own home in Olde Ivy and the investments his friends and neighbors had made in the fabric of our local community. However, watching these upscale patio homes being built, who is buying them and moving in, it is apparent that The Vinings enhance the feel of the neighborhood, do not hurt property values, and do not diminish the quality of life of the neighborhood in the least.

On the other hand, what is proposed across the street from the intersection of Olde Ivy and Reed is shocking.

My little 5-year-old granddaughter, who will be in Kindergarten next year, brings home papers from her preschool that contain lines of objects with a question, "What does not belong?" We have all seen these. The child studies the lineup and circles the object that is out of place, that does not belong.

When I look at the site plans for the proposed project, that question, “What does not belong,”

comes immediately to mind, and anyone who has the least inkling of what this amazing, beautiful, part of our city has to offer (prior to this proposed project), knows immediately this project is completely out of place! It does not fit the neighborhood. It does not belong!

The proposed project will forever diminish the quality of life for the hundreds of us who have settled in for the long haul in a setting we chose after looking at many others, who have paid, and continue to pay, huge sums for taxes on our real estate and personal property to support the schools and infrastructure of the City and County. Permitting this project to come to fruition is unimaginable and would be a huge slap in the face to all of us who believe that the people we elect and their appointees to whom we entrust our property values and our quality of life, would force us to live next door to something so out of place, and so incongruent with the surroundings, as is this project.

If this project is approved, and we are forced to confront the appearance of this project every time we enter or exit Olde Ivy or travel south on Reed Avenue, we will have forever lost the "it's good to be home" feeling for which we have worked so hard to achieve for so long at great expense to all of us.

I respectfully request the proposed project not be approved.

Larry K. Bratvold

_____

Larry K. Bratvold

Feb.9. 2022

Bob Hosmer, AICP
City of Springfield
Planning and Development
Development and Review Office

RE: Development project located at 4423 S Reed Ave 65804

Dear Chairman and Board Members

We are writing to express our concern with the proposed development project at 4423 S Reed Ave 65804.

This project would change the character of the neighborhood from low density single family homes with an estimated average lot size of 10,000 sq ft to high density average lot size of 4,000 sq. ft.

This area has experienced high growth for 25 years. Houses are typically over 2000 sq. ft. on large lots.

This proposed project of row style houses with minimum sq ft isn't compatible with the existing surrounding neighborhoods.

Please give thought to how this project will affect current home owners.

Respectively submitted,

Lee and Joy Kimzey
2612 E Old Ivy St
Springfield, MO 65804

From: Lend A Hand
To: Zoning@springfieldmo.gov
Subject: Development project located at 4423 S Reed Ave 65804
Date: Thursday, February 10, 2022 1:50:24 PM

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Dear Chairman and Board Members,

I am writing with much concern and frustration about the development proposal at 4423 S Reed Ave. I live in this neighborhood and take pride in what I have worked hard for. This is a nice area with higher end homes that are not suited for 22 houses to me smashed onto 4 acres!!! The beauty of this area that many work hard to maintain will be ruined by such a development!
Maybe to you it is just a decision to pass or not to pass. Put yourself in the place of all of us. Would you want this built next to you?!?!? I beg that you refuse this and proposal and find a place more suitable for such a development.

Thank you for your time.

Get Outlook for iOS

From: Lizette Nene
To: Zoning@springfieldmo.gov
Subject: RE: Development Project located at 4423 S. Reed Ave. 65804
Date: Wednesday, February 9, 2022 10:31:21 PM

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Dear Chairman and Board Members,

I am writing to express my concerns with the proposed development project at 4432 S. Reed Ave. 65804.

This project would change the character of the neighborhood from low density single family homes with an estimated average lot size of 10,000 sq. ft. to high density with an average lot size of 4,000 sq. ft.

This area has experienced high growth over the last 25 years with Olde Ivy single family homes and Vinings luxury patio homes. These two developments both average greater than 2,000 sq. ft homes with significant lot sizes.

The trend for the already developed areas such as Old Southern Hills, Reed Ave., Amory St., Thompson Place, etc is to remove old structures and build new modern homes costing $350,000 each and or remodels of over $100,000, and up.

This proposed project of row style housing with minimum square footage is not compatible with the neighborhood and current trends. It would negatively affect home and property values in the area. Furthermore, this project would reduce the safety of the neighborhood by increasing traffic to the small neighborhood roads where many families with young children live.

Please give this careful thought and understand the impact this could have on current homeowners.

Respectfully submitted,
Lizette Nene

From: LOUANN VOGELMANN
To: Zoning@springfieldmo.gov
Subject: Dev Project on S Reed St
Date: Thursday, February 10, 2022 8:49:50 AM

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Dear Chairman and Board Members

I am very much against building this row style homes in a neighborhood of homes costing $350000 and more. Olde Ivy is a much sought after neighborhood with beautiful single family homes and luxury patio homes. The congestion on Reed street will be unacceptable. I hope the developer will consider doing this project in another area.
Thank you
Louann Vogelmann
Sent from my iPhone

From: Micah Osborne
To: Zoning@springfieldmo.gov
Subject: Development at 4423 S Reed Ave 65804
Date: Thursday, February 10, 2022 12:14:05 PM

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Dear Zoning Board Members,

I am writing to express my concern for the proposed development at 4423 S Reed Ave. This development if allowed to continue would significantly change the character of the neighborhood.

4 years ago my wife and I purchased the house at 4629 S Reed and completed a total remodel of the home. What drew us to the property was the location and how quiet the neighborhood is. The wooded lots are also a great place to see deer and other wildlife as they move between the lake and the Natures Center. Over the last number of years the neighborhood has seen a lot of positive changes. Many of the older homes have been purchased and either remodeled or torn down in order to build bigger, nicer homes. I believe this sort of revitalization should be encouraged. Re-zoning to allow higher density construction is not in the best interest of the neighborhood. From what I have see on the plans the development call for 22 units on 4 acres. This would greatly increase traffic on S Reed. This would also be compounded if the other 3 to 5 acre lots in the neighborhood follow. In addition the plan does not show garages, it would be a very bad move to allow 22-44 cars to park on the street each night.

Please carefully evaluate how this will impact the current home owners and those currently investing in the neighborhood.

Thank you for your service to the community, I know these decisions are not made lightly.

Micah Osborne
President and CEO

Stratum Nutrition

(417) 358-4822

stratumnutrition.com

View my profile on LinkedIn

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From: Mike Conrad
To: Zoning@springfieldmo.gov
Subject: Letter opposing sub division proposal at 4432 S Reed Ave 65804
Date: Wednesday, February 9, 2022 8:39:48 PM

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City of Springfield Zoning

To Whom it May Concern

I have had an opportunity to review the proposal of the sub division proposal on the 4+ acre lot located at 4432 S Reed Ave.

I am surprised to hear that someone could jam 22 small cottages on such a small tract of land in the middle of neighborhood that is comprised primarily of large family plots with single family dwellings.

The area around this proposed sub division, is a well-kept neighborhood with mature landscaping and access to outdoor area such as the Springfield Nature Center, Farmers Park, and Lake Springfield. This proposed sub division in no way fits in to the surrounding area and I can only imagine it will detract from the natural beauty of the surrounding neighborhoods. I feel this sub division would negatively impact home values and reduce the safety of area due to added vehicle traffic to the small neighborhood roads. Additionally, many people move to neighborhoods with more space and less congestion and don't feel 22 cottages on a 4+ acre lot will add to the quality of life in the surrounding area whatsoever.

This type of sub division is inappropriate for the quiet established surrounding neighborhoods and the small tract of land so many units would be built upon would be an eye-sore to all those living in the area.

Mike Conrad

2351 E. Old Ivy Street.

Mike Conrad
mbconrad15@yahoo.com

From: Paula Schnoebelen
To: Zoning@springfieldmo.gov
Subject: Proposed Development Plan-Reed Ave Cottages 4423 Reed Road
Date: Wednesday, February 16, 2022 9:21:47 AM

CAUTION This email originated from outside the organization. Do not open attachments or click links from sources you do not know and trust.

To Whom It Might Concern,

I live in Olde Ivy next to this proposed development and have concerns about the potential negative impact of this project on the neighboring properties. I am a proponent of development, but this smells like a ***high density, multi-family, 2-story townhouse development*** posing as a ***low density, residential single family home development***. According to the land use plan, this lot is zoned for low density residential single family homes not multi-family townhouses. The homes adjacent on all four sides are low density residential single family homes and will be adversely affected in value, view, traffic, and character among other things. The proposed plan is not appropriate for this lot and/or zoning. Please reject this plan.

Sincerely,

Paula Schnoebelen

From: Philip Rinkoski
To: Zoning@springfieldmo.gov
Subject: Preliminary plat of Reed Avenue Cottages
Date: Wednesday, February 9, 2022 7:27:51 PM

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Dear Chairman and Board Members:

My name is Phil Rinkoski. I live at 2459 East Olde Ivy street. My wife Patty and I have lived in the Olde Ivy neighborhood for over 12 years. We also had a family trust home here for 11 years. We have invested a great deal of time and money to assure that our house remains in excellent condition.

Our neighborhood has stringent covenants which help to assure that all homes and properties are kept in prime condition. We are so proud of our neighborhood and want to assure that our property values retain their status. There is also a concern in assuring that our neighborhood is safe and secure.

We are concerned with the development of the Reed Avenue Cottages. It appears as though the prices of the cottages will be extremely less then the homes in the Olde Ivy neighborhood and the other homes located on Reed Avenue, Cardinal, and Vining street. There is also a concern in our neighborhood with the traffic issues along Reed Avenue if the cottages were built. The proposed gates at the entrance will obstruct the traffic traveling on Reed Avenue.

It is vital that the City of Springfield takes in consideration the tax revenue that is generated by the Olde Ivy property owners. All that we want is help in assuring that our properties remain at their peak value. The development of a lower valued neighborhood of cottage homes will only adversely affect our property value.

Thank you for taking the time to consider my response regarding the proposed Reed Avenue Cottages.

Sincerely,

Philip Rinkoski

Sent from my iPhone

From: aarobob@mchsi.com
To: Zoning@springfieldmo.gov
Subject: Development project located at 4423 S. Reed Avenue
Date: Wednesday, February 9, 2022 11:32:51 AM

CAUTION This email originated from outside the organization. Do not open attachments or click links from sources you do not know and trust.

Dear Chairman and Board Members,
My name is Robert Lee Green. My wife Carol and I reside at 4625 South Biloxi Avenue. We have been here in a home we constructed on 2-1/2 acres 24 years ago. We like the area so much that we have invested in nine- 3-bedroom, 2-bath homes in the area. One at 2332 East Cardinal, one at 2323 East Swallow, one at 2306 East Swallow, One at 2245 East Swallow, one at 2332 East Lark. The above noted properties are in close proximity to the proposed row houses.

As I am sure you are aware, Reed Avenue, going South about 1/2 mile, turns in to Biloxi Avenue. Our home, 4625 Biloxi, is on the corner. We own a house at 4640 South Biloxi, one at 4641 South Biloxi and two on Thompson Place Street. One at 2340 Thompson Place and one at 2305 Thompson Place.

I tell you all this to say that the owner of 10 properties in the area that will be affected by this proposal is opposed to this development.

This project would change the character of the entire single-family neighborhood to one that might be found in a mostly urban setting.

My wife and I are in our 80's and not physically able to attend the Planning and Zoning meeting on Thursday evening. I hope my e-mail voice will be considered in making your decision on this matter.

Thank you for your service.

From: Dan Ronda
To: Zoning@springfieldmo.gov
Subject: Development Project located at 4423 S Reed Ave 65804
Date: Thursday, February 10, 2022 10:56:22 AM

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Dear Chairman and Board Members,

This email is to express my disproval with the proposed development project located at 4423 S Reed Ave 65804.

The row style housing with minimum square footage is not compatible with the neighborhood.

Please give this careful thought and understand the impact this could have on current home owners.

Thank you

Ronda L Dobbyn
2545 E German Ivy
Springfield, Mo 65804

Sent from Mail for Windows

From: Roxie Bollinger
To: Zoning@springfieldmo.gov
Subject: Development Project, 4400 block, S. Reed Ave, Springfield MO 65804
Date: Wednesday, February 9, 2022 7:28:35 PM

CAUTION This email originated from outside the organization. Do not open attachments or click links from sources you do not know and trust.

We have lived in the Olde Ivy subdivision for 17 yrs.

We are objecting to a proposed 22-cottage development in the above-named area.

Reed Ave is a 2-lane street that is quite busy already with Old Southern Hills & Olde Ivy residents, plus school buses, garbage trucks, delivery trucks, etc.

22 additional living spaces "could" equal 44 more residents & at least 22 more vehicles...this is concerning. Our backyard borders S. Reed Ave & we are experiencing "noise pollution", which we anticipate would increase with the development.

Also, property value would be of great concern.

Thank you.

Sincerely,

Jon & Roxie Bollinger
4555 English Ivy Ave
65804

From: Sue Fuller
To: Zoning@springfieldmo.gov
Subject: Bob Hosmer, AICP
Date: Thursday, February 10, 2022 11:08:17 AM

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City of Springfield
Planning and Development
Development Review Office

RE: Development project located at 4423 S. Reed Ave. 65804

Chairman and Board Members:

I would like to express my concerns with the proposed development project at 4432 S. Reed Ave. 65804.

This project would change the character of the neighborhood from low density single family homes with an estimated average lot size of 10,000 square feet to high density average lot size of 4,000 square feet.

The area has experienced high growth over the last 25 years with Olde Ivy single family homes and Vinings' luxury patio homes. These two developments both average greater than 2,000 square feet homes with significant lot sizes.

The trend for the already developed areas such as Old Southern Hills, Reed Ave, Armory St, Thompson Place, etc. is to remove old structures and build new modern homes costing $350,000 each and or remodels of over $100,000, and up.

The proposed project of row style housing with minimum square footage is not compatible with the neighborhood and current trends.

Please give this careful thought and understand the impact this could have on current home owners.

Thank you for taking the above into consideration when making your decision.

Best Regards,

Sue Fuller
4448 S. English Ivy Ave.
Springfield, MO 65804

From: Tyler Buzbee
To: Zoning@springfieldmo.gov
Subject: 4432 S Reed Ave 65804
Date: Tuesday, February 15, 2022 2:33:44 PM

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Bob Hosmer, AICP
City of Springfield
Planning and Development
Development Review Office

RE: Development project located at 4423 S Reed Ave 65804

Dear Chairman and Board Members

I am writing to express my concerns with the proposed development project at 4432 S Reed Ave 65804.

This project would change the character of the neighborhood from low-density single-family homes with an estimated average lot size of 10,000 sq ft to high-density average lot size of 4,000 sq ft.

This area has experienced high growth over the last 25 years with Olde Ivy single-family homes and Vinings luxury patio homes. These two developments both average greater than 2,000 sq ft homes with significant lot sizes.

The trend for the already developed areas such as Old Southern Hills, Reed Ave, Amory St. Thompson Place, etc is to remove old structures and build new modern homes costing $350,000 each and or remodels of over $100,000, and up.

This proposed project of row-style housing with minimum square footage is not compatible with the neighborhood and current trends.

Please give this careful thought, and understand the impact this could have on current homeowners.

Respectfully,

Tyler G. Buzbee, DDS
buzbeedental.com
W: 417.881.1388
C: 417.872.7046

We strive to make each patient experience the best possible! IF this was not the case, please contact me or the office so we can address any issues.

Please share your positive review on Facebook, Twitter, and Google!

From: ANN MARIE DAEHN
To: Zoning@springfieldmo.gov
Subject: RE: Development project: 4423 S. Reed Ave 65804
Date: Tuesday, March 1, 2022 12:58:45 PM

CAUTION This email originated from outside the organization. Do not open attachments or click links from sources you do not know and trust.

Hello,

I am writing to express my concerns about the proposed development at 4432 S. Reed Avenue.

I have 3 main areas of concern with this proposal:
1. Property values/change of neighborhood character
2. Impact on Traffic
3. Impact on the wildlife

As you may know, this neighborhood's identity is tied intimately to the nature center. Even the Farmer's Park development has given a nod to that with gardens, open spaces, the farmer's market and electric car charging. Yards are a decent size, trees are older and we have coexisted for many years with the deer, wild turkey, hawks, foxes, and other wildlife. It is a slippery slope to develop beyond this neighborhood's abilities. The Vinings has already pushed wildlife and amplified our flooding issues on Reed. Although there is yet another attempt to fix the traffic patterns around Glenstone/Republic/60/nature Center Way/Harvard, we can already see what adding the Vinings (which isn't even finished yet) has done to traffic in the neighborhood. This proposal would amplify the issue in very big ways. Our roads are barely 2-way streets, they flood regularly and plopping a high occupancy concrete jungle into the middle of traditional single family home area is a recipe for disaster for our neighborhood.

I hope you will thoughtfully consider that there are much better places for such a development and help us maintain a buffer around the nature center and its wildlife.

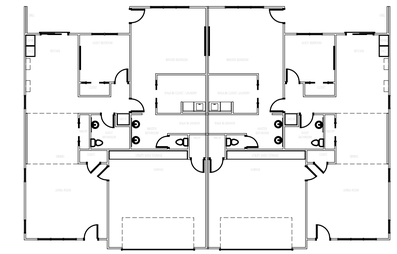
Respectfully,
Ann Marie Daehn
2305 E Amory
Springfield, MO 65804

ATTACHMENT 5

N

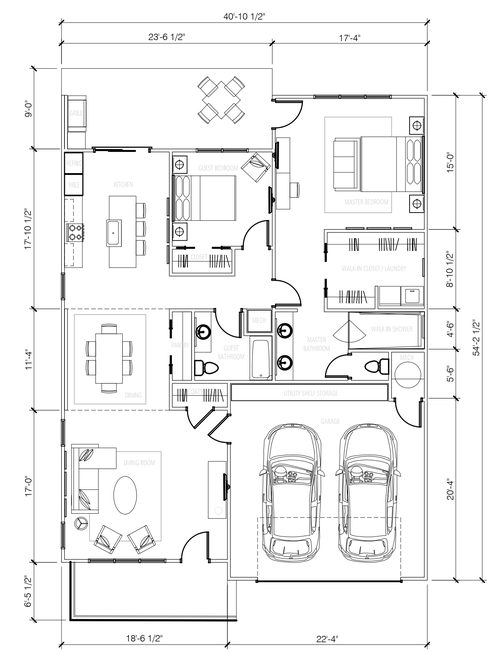
OVERALL PATIO COURT SITE PLAN

SCALE: 1"=60'-0"



TYPICAL PATIO HOME PLAN

SCALE: 1 /16" = 1'-0"



TYPICAL PATIO COURT UNIT PLAN

SCALE: 1 /8" = 1'-0"

1,562 sq ft : CONDITIONED SPACE
476 sq ft : GARAGE

PROPOSED PATIO COURT HOMES FOR:

REED COTTAGES CLUSTER DEVELOPMENT

SPRINGFIELD, MISSOURI

FEBRUARY 16, 2022

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DESIGN COLLECTIVE

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ATTACHMENT 6

REED AVENUE COTTAGES

BEING A PART OF THE SOUTHWEST QUARTER OF THE NORTHEAST QUARTER OF SECTION 17, TOWNSHIP 28 NORTH, RANGE 21 WEST, IN THE CITY OF SPRINGFIELD, GREENE COUNTY, MISSOURI. PRELIMINARY SUBDIVISION PLAT FOR A CLUSTER DEVELOPMENT

LOCATION SKETCH
SEC. 17, T-28-N, R-21-W
SCALE: 1"=2000'

MISSOURI ONE CALL SYSTEM, INC. 1-800-344-7483 STOP-CALL BEFORE YOU DIG!

PROPOSED CLUSTER SUBDIVISION
TOTAL UNITS: 22 UNITS
TOTAL ACREAGE: 4.74 ACRES
ROW AREA: 0.97 ACRE
NET AREA: 3.77 ACRES
CLUSTER DENSITY: 5.84 UNITS/ACRE
R-SF ALLOWED DENSITY: 7.26 UNITS/ACRE
COMMON AREA/OPEN SPACE: 1.61 ACRES
MIN LOT SIZE: 3,864 SF
MIN LOT SIZE ALLOWED IN R-SF: 3,000 SF

CURVE TABLE				
CURVE #	LENGTH	RADIUS	DIRECTION	CHORD
C1	52.04'	125.00	S50°26'27"E	51.67'
C3	14.75'	75.00	N81°23'07"W	14.73'
C2	48.74'	75.00	N57°07'54"W	47.89'
C4	19.15'	125.00	N82°37'52"W	19.13'
C5	49.16'	125.00	N66°58'28"W	48.85'
C6	37.51'	125.00	N47°06'37"W	37.37'
C7	22.53'	75.00	S47°07'16"E	22.45'
C8	41.26'	75.00	S71°29'26"E	40.75'

PARCEL LINE TABLE		
LINE #	LENGTH	DIRECTION
L1	14.16'	S42°20'40"E
L2	1.36'	S02°33'49"W
L3	7.67'	S87°15'09"E
L4	14.12'	N47°39'20"E
L5	5.00'	S87°01'03"E
L6	5.00'	S87°01'14"E

ZONING DATA

SUBJECT PROPERTY IS ZONED R-SF (SIGNAL FAMILY RESIDENTIAL DISTRICT).

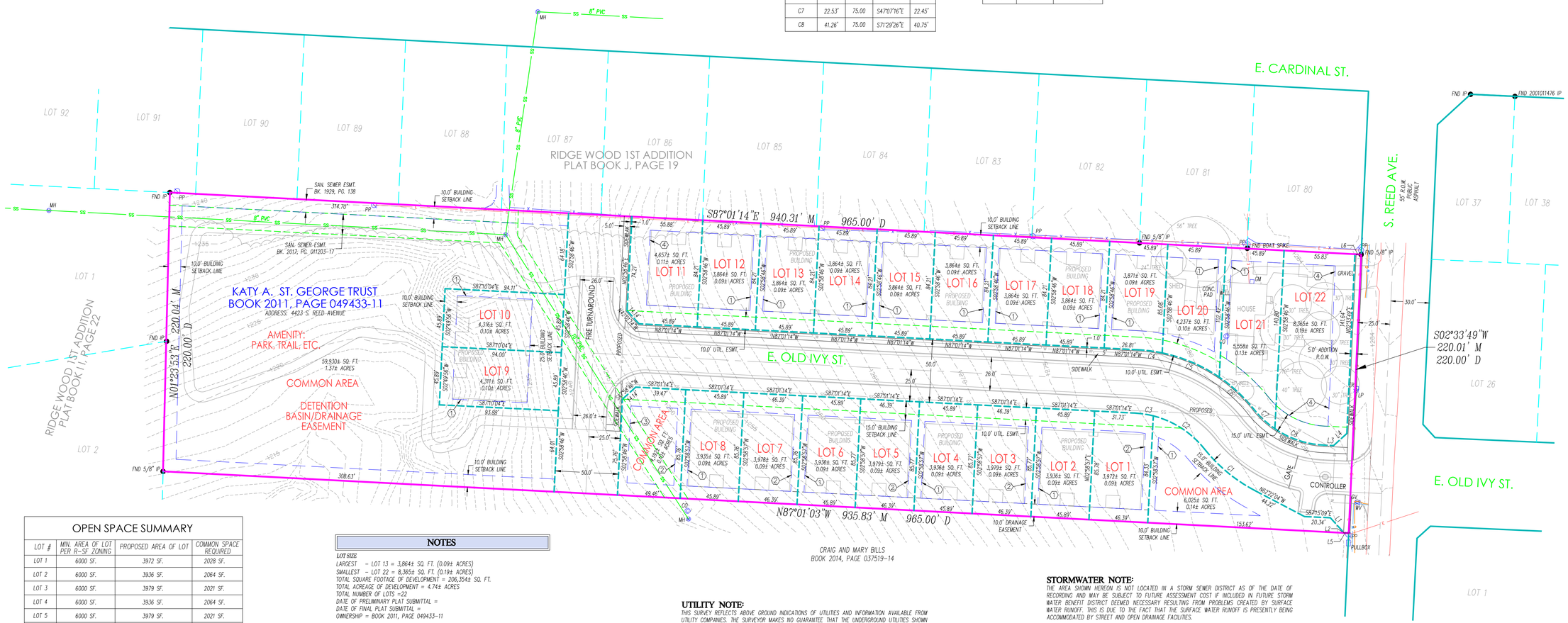
BUILDING SETBACK LINES:
FRONT YARD:
A) 25 FEET ALONG A STREET CLASSIFIED AS A COLLECTOR OR HIGHER CLASSIFICATION STREET OR AS REQUIRED BY SECTION 36-453.
B) 15 FEET ALONG A STREET CLASSIFIED AS A LOCAL STREET OR AS REQUIRED BY SECTION 36-453 (GARAGES SHALL BE SET BACK A MINIMUM OF 20 FEET).
C) THE FRONT YARD SETBACK MAY BE REDUCED BELOW THE MINIMUM REQUIRED ABOVE IF A CONDITIONAL USE PERMIT IS APPROVED IN ACCORDANCE WITH SECTION 36-363.

SIDE: 5 FEET OR AS REQUIRED BY SECTION 36-453, SUPPLEMENTAL OPEN SPACE AND YARD REGULATIONS.

REAR: TEN PERCENT OF THE LOT DEPTH, BUT MAY NOT BE LESS THAN 10 FEET NOR SHALL MORE THAN 20 FEET BE REQUIRED.

HOWEVER, IN NO EVENT MAY A STRUCTURE BE ERECTED CLOSER TO THE CENTERLINE OF AN EXISTING OR PLANNED STREET THAN AS PRESCRIBED BELOW.

STREET CLASSIFICATION	REQUIRED SETBACK FROM RIGHT-OF-WAY CENTER LINE
COLLECTOR (REED AVE.)	30 FEET PLUS REQUIRED YARD SETBACK



PREPARED BY
KENT R. PETERSON, PLS
ANDERSON ENGINEERING, INC.
3213 S. WEST BYPASS
SPRINGFIELD, MO. 65807

OWNER AND DEVELOPER
KATY A. ST. GEORGE
1320 S. OAK RUN PL.
SPRINGFIELD, MO. 65809

OPEN SPACE SUMMARY			
LOT #	MIN. AREA OF LOT PER R-SF ZONING	PROPOSED AREA OF LOT	COMMON SPACE REQUIRED
LOT 1	6000 SF.	3972 SF.	2028 SF.
LOT 2	6000 SF.	3936 SF.	2064 SF.
LOT 3	6000 SF.	3979 SF.	2021 SF.
LOT 4	6000 SF.	3936 SF.	2064 SF.
LOT 5	6000 SF.	3979 SF.	2021 SF.
LOT 6	6000 SF.	3936 SF.	2064 SF.
LOT 7	6000 SF.	3978 SF.	2022 SF.
LOT 8	6000 SF.	3935 SF.	2065 SF.
LOT 9	6000 SF.	4311 SF.	1689 SF.
LOT 10	6000 SF.	4316 SF.	1684 SF.
LOT 11	6000 SF.	4657 SF.	1343 SF.
LOT 12	6000 SF.	3864 SF.	2136 SF.
LOT 13	6000 SF.	3864 SF.	2136 SF.
LOT 14	6000 SF.	3864 SF.	2136 SF.
LOT 15	6000 SF.	3864 SF.	2136 SF.
LOT 16	6000 SF.	3864 SF.	2136 SF.
LOT 17	6000 SF.	3864 SF.	2136 SF.
LOT 18	6000 SF.	3864 SF.	2136 SF.
LOT 19	6000 SF.	3871 SF.	2129 SF.
LOT 20	6000 SF.	4237 SF.	1763 SF.
LOT 21	6000 SF.	5558 SF.	442 SF.
LOT 22	6000 SF.	8365 SF.	–
		TOTAL REQUIRED	40351 SF.
		TOTAL PROVIDED	70147 SF.

NOTES

LOT SIZE
LARGEST – LOT 13 = 3,864± SQ. FT. (0.09± ACRES)
SMALLEST – LOT 22 = 8,365± SQ. FT. (0.19± ACRES)
TOTAL SQUARE FOOTAGE OF DEVELOPMENT = 206,354± SQ. FT.
TOTAL ACREAGE OF DEVELOPMENT = 4.74± ACRES
TOTAL NUMBER OF LOTS =22
DATE OF PRELIMINARY PLAT SUBMITTAL =
DATE OF FINAL PLAT SUBMITTAL =
OWNERSHIP = BOOK 2011, PAGE 049433-11

METERS TO U.S. FEET CONVERSION 3.28083333 "GRID".

MAINTENANCE OF ANY AREA REFERRED TO AS DRAINAGE EASEMENT OR DRAINAGE DETENTION IS THE RESPONSIBILITY OF THE PROPERTY OWNER.

INSTALLATION OF IRON PINS ON ALL LOT CORNERS WILL BE COMPLETED UPON COMPLETION OF UTILITIES INSTALLATIONS.

NO ACCESS FROM ANY LOT IS ALLOWED TO REED AVENUE.

LEGEND OF SYMBOLS AND ABBREVIATIONS

(4)	INTERNAL ANGLE # (SEE TABLE)	WV	WATER VALVE
SS	SANITARY SEWER LINE	GV	GAS VALVE
E	OVERHEAD ELECTRIC	WM	WATER METER
G	GAS LINE	TR	TELEPHONE RISER
WS	WATER SERVICE	ER	ELECTRIC RISER
UT	UNDERGROUND TELEPHONE	RD	ROOF DRAIN
UE	UNDERGROUND ELECTRIC	TRANS	TRANSFORMER PAD
X	FENCE LINE	MH	SANITARY MANHOLE
	FIRE HYDRANT	RWM	RIGHT-OF-WAY MARKER
LP	LIGHT POLE	IP	FOUND IRON PIN
P.O.C.	POINT OF COMMENCEMENT	IP	SET IRON PIN
		P.O.B.	POINT OF BEGINNING
			GROUND LIGHT
		SET PM	PERMANENT MONUMENT
			TREELINE

LINE LABELS
MEASURED 100' M
DEED 100' D
RECORD 100' R

UTILITY NOTE:

THIS SURVEY REFLECTS ABOVE GROUND INDICATIONS OF UTILITIES AND INFORMATION AVAILABLE FROM UTILITY COMPANIES. THE SURVEYOR MAKES NO GUARANTEE THAT THE UNDERGROUND UTILITIES SHOWN COMPRISE ALL SUCH UTILITIES IN THE AREA, EITHER IN SERVICE OR ABANDONED. THE SURVEYOR FURTHER DOES NOT WARRANTY THAT THE UNDERGROUND UTILITIES SHOWN ARE IN THE EXACT LOCATION INDICATED, ALTHOUGH HE DOES CERTIFY THAT THEY ARE LOCATED AS ACCURATELY AS POSSIBLE FROM INFORMATION AVAILABLE. THE SURVEYOR HAS NOT PHYSICALLY LOCATED THE UNDERGROUND UTILITIES.

FLOOD NOTE

BY GRAPHIC PLOTTING ONLY, THIS PROPERTY IS IN ZONE X OF THE FLOOD INSURANCE RATE MAP, COMMUNITY PANEL NO. 29077C0344G, WHICH BEARS AN EFFECTIVE DATE OF DECEMBER 17, 2010 AND IS NOT IN A SPECIAL FLOOD HAZARD AREA. NO FIELD SURVEYING WAS PERFORMED TO DETERMINE THIS.

RECORD DESCRIPTION

BEGINNING AT THE NORTHWEST CORNER OF THE SOUTHWEST QUARTER (SW 1/4) OF THE NORTHEAST QUARTER (NE 1/4) OF SECTION SEVENTEEN (17), TOWNSHIP TWENTY-EIGHT (28), RANGE TWENTY-ONE (21), THENCE SOUTH 220 FEET, OR LESS, TO AN IRON PIN, THENCE EAST 965 FEET, MORE OR LESS TO THE WEST LINE OF THE ROAD AS NOW ESTABLISHED, THENCE NORTH 220 FEET, MORE OR LESS, TO AN IRON PIN SET, THENCE WEST 965 FEET, MORE OR LESS, TO THE POINT OF BEGINNING, IN GREENE COUNTY, MISSOURI, EXCEPT THAT PART TAKEN OR USED FOR ROADS. SUBJECT TO EASEMENTS, RESTRICTIONS, RESERVATIONS AND COVENANTS OF RECORD, IF ANY.

STORMWATER NOTE:

THE AREA SHOWN HEREON IS NOT LOCATED IN A STORM SEWER DISTRICT AS OF THE DATE OF RECORDING AND MAY BE SUBJECT TO FUTURE ASSESSMENT COST IF INCLUDED IN FUTURE STORM WATER BENEFIT DISTRICT DEEMED NECESSARY RESULTING FROM PROBLEMS CREATED BY SURFACE WATER RUNOFF. THIS IS DUE TO THE FACT THAT THE SURFACE WATER RUNOFF IS PRESENTLY BEING ACCOMMODATED BY STREET AND OPEN DRAINAGE FACILITIES.

ALL COMMON AREAS SHALL BE CONSIDERED DRAINAGE EASEMENTS. ALL COMMON AREAS ARE TO BE MAINTAINED BY THE PROPERTY OWNERS' ASSOCIATION. ALL DRAINAGE EASEMENTS ARE TO BE MAINTAINED BY THE PROPERTY OWNER.

SURVEYOR'S CERTIFICATE

KNOWN ALL MEN BY THESE PRESENTS:

THAT I, KENT R. PETERSON, DO HEREBY CERTIFY THAT THIS PLAT WAS PREPARED UNDER MY SUPERVISION FROM AN ACTUAL SURVEY OF THE LAND HEREIN DESCRIBED, PREPARED BY ANDERSON ENGINEERING, INC. DATED DECEMBER 23, 2021 AND SIGNED BY KENT R. PETERSON, PLS NO. 2659 AND THAT THE MONUMENTS AND LOT CORNER PINS SHOWN HEREIN WERE PLACED UNDER THE SUPERVISION OF KENT R. PETERSON, PLS NO. 2659 IN ACCORDANCE WITH THE MISSOURI MINIMUM STANDARDS FOR PROPERTY BOUNDARY SURVEYS. DATE OF LAST REVISION JANUARY 27, 2022.

ANDERSON ENGINEERING, INC. LC 62 BY:

STATE OF MISSOURI
KENT R. PETERSON
NUMBER LS-2659
PROFESSIONAL LAND SURVEYOR

KENT R. PETERSON, PLS NO. 2659

1-27-2022
DATE PREPARED

KEY NOTES
1. 5.0' BUILDING SETBACK LINE
2. 5.5' BUILDING SETBACK LINE
3. 7.0' BUILDING SETBACK LINE
4. 15.0' BUILDING SETBACK LINE

GRAPHIC SCALE
40 0 20 40 80 160
(IN FEET)
1 inch = 40 ft.

COA #000062

ANDERSON ENGINEERING
EMPLOYEE OWNED
ENGINEERS • SURVEYORS • LABORATORIES • DRILLING

3213 S. WEST BYPASS
SPRINGFIELD, MISSOURI 65807
PHONE (417) 866-2741
FAX (417) 866-2778

FIELD: CB
DRAWN: BAC
CHECKED: KRP
DATE: 12-23-2021
FIELD BK: N/A
JOB NO: 21SP10231

21SP10231PP
SHT. 1 OF 1 REV. _

One-rdg. _____
P. Hrngs. _____
Pgs. 417
Filed: 03-15-22

Sponsored by: Ollis

First Reading: _____ Second Reading: _____

COUNCIL BILL 2022-073 GENERAL ORDINANCE _____

AN ORDINANCE

ADOPTING an updated version of the "Flood Control and Water Quality Protection Manual" to include a water quality requirement for redevelopment in accordance with the City's Municipal Separate Storm Sewer System permit and other technical updates and clarifications to stormwater design standards; and amending Springfield City Code, Chapter 96, 'Storm Water,' Article I. 'Flood Control and Water Quality Protection,' and Article III. 'Land Disturbance Activity', to make changes consistent with the updated Manual.

WHEREAS, the City is required by its Municipal Separate Storm Sewer System ("MS4") permit to have a program to address water quality impacts in the stormwater design of both new development and redevelopment projects, for the protection of water quality in our community, and an effective ordinance to enforce same; and

WHEREAS, the current Flood Control and Water Quality Protection Manual (hereinafter "Manual") contains a water quality requirement for new development, but not for redevelopment projects; and

WHEREAS, City Staff worked with a Stormwater Technical Committee to prepare the proposed updated Manual for Council consideration, which includes a water quality requirement for redevelopment and other technical updates and clarifications to stormwater design standards, and provided a formal comment period to a broad cross-section of stakeholders; and

WHEREAS, the water quality requirement for redevelopment includes a 'fee in lieu' option in certain circumstances, and the currently approved Fee in Lieu of Stormwater Detention will be utilized until such time as a Fee in Lieu of Water Quality is adopted as part of the City's annual Fee Study; and

WHEREAS, pursuant to City Code Section 96-10, 'Flood control and water quality protection manual' the proposed, updated Flood Control and Water Quality

Protection Manual, as approved, will be kept on file with the office of the City Clerk; and

WHEREAS, changes to City Code Chapter 96, 'Storm Water,' are proposed for consistency with the updated Manual and to update enforcement provisions.

NOW, THEREFORE, BE IT ORDAINED BY THE COUNCIL OF THE CITY OF SPRINGFIELD, MISSOURI, as follows, that:

Section 1 – The updated, proposed version of the "Flood Control and Water Quality Protection Manual," attached hereto in its entirety as "Exhibit A," is hereby adopted, with a complete copy of the Manual to be kept in the office of the City Clerk.

Section 2 – The updated Flood Control and Water Quality Protection Manual shall be in full force and effect 30 days after passage of this Ordinance. Projects which have completed a predevelopment review within 180 days prior to passage of this Ordinance are exempt from complying with the additional water quality requirements in Chapter 10 Section 2.0 of the Flood Control and Water Quality Protection Manual adopted herein, provided stormwater plans are submitted within 180 days after passage of this Ordinance for the project defined in the scope of the predevelopment review. However, the project is still required to comply with all other requirements, including water quality standards in full force and effect at the time of plan submittal. Predevelopment reviews for rezoning or subdivision-related matters do not qualify as a 'project' for this exemption.

Section 3 – Springfield City Code, Chapter 96, 'Storm Water,' Article I. 'Flood Control and Water Quality Protection,' and Article III. 'Land Disturbance Activity' is hereby amended as set forth in "Exhibit B," which is attached hereto and incorporated herein by this reference as if set forth verbatim. NOTE: Underlined text in "Exhibit B" is to be added and ~~stricken~~ language is to be deleted.

Section 4 – Savings Clause. Nothing in this Ordinance shall be construed to affect any suit or proceeding now pending in any court, or any rights acquired or liability incurred, nor any cause or causes of action accrued or existing, under any act or ordinance repealed hereby, or shall any right or remedy of any character be lost, impaired, or affected by this Ordinance.

Section 5 – Severability Clause. If any section, subsection, sentence, clause, or phrase of this Ordinance is for any reason held to be invalid, such decision shall not affect the validity of the remaining portions of this Ordinance. City Council hereby declares that it would have adopted the Ordinance and each section, subsection, sentence, clause, or phrase thereof, irrespective of the fact that any one or more sections, subsections, sentences, clauses, or phrases be declared invalid.

Section 6 – This Ordinance shall be in full force and effect as of the date of passage, subject to Section 2 above.

Passed at meeting: _____

_____
Mayor

Attest: _____, City Clerk

Filed as Ordinance: _____

Approved as to form: _____, Deputy City Attorney

Approved for Council Action: _____, City Manager

EXPLANATION TO COUNCIL BILL 2022-073

FILED: 03-15-22

ORIGINATING DEPARTMENT: Environmental Services

PURPOSE: To obtain Council adoption of an updated version of the Flood Control and Water Quality Protection Manual (the "Manual") that includes a water quality requirement for redevelopment, as required by the City's Municipal Separate Storm Sewer System permit and includes other technical updates and clarifications to stormwater design standards; and amending the Springfield City Code, Chapter 96, "Stormwater" to make changes consistent with the updated Manual.

BACKGROUND INFORMATION: The City is required by its Municipal Separate Storm Sewer System ("MS4") permit to have a program and ordinance to address water quality in the stormwater design of both new development and redevelopment projects. The current water quality requirement, in the Manual, applies only to new development projects, which refers to sites that have not been previously developed. The proposed Manual change will require water quality measures on redevelopment projects, as defined in the Manual, that are removing and replacing existing impervious surface and disturbing one or more acres of land.

An option to pay a 'fee in lieu' of the water quality requirement for redevelopment is provided when there are extraordinarily difficult site conditions as further described in the Manual. The proposed water quality 'fee in lieu' structure and rates will be based on the updated Fee in Lieu of Stormwater Detention until such time as a Fee in Lieu of Water Quality is adopted as part of the City's annual Fee Study. The fees shall be used by the City to implement water quality improvements in the James River or Sac River watershed according to where the water quality measures would have been constructed.

The water quality requirement for redevelopment is the most significant change to the Manual. Other changes to the Manual include technical updates and clarifications to stormwater design standards. A summary of changes to the Manual is included in "Exhibit 1," attached hereto.

Additionally, minor changes are proposed to Springfield City Code, Chapter 96, "Storm Water" to update the language of certain enforcement provisions and to make changes consistent with the proposed updated Manual.

REMARKS: The Departments of Environmental Services and Public Works worked with a Stormwater Technical Committee composed of local engineers in preparing the proposed changes. Additionally, input was formally solicited from the following list of stakeholders: Watershed Committee of the Ozarks, James River Basin Partnership, Ozark Greenways, Community Partnership of the Ozarks, Springfield Contractors Association, Springfield-Greene County Environmental Advisory Board, Greater Ozarks

Audubon Society, White River Group of the Missouri Sierra Club, Missouri Society of Professional Engineers Ozark Chapter, Institute of Transportation Engineers Ozark Section, Springfield Chamber of Commerce Growth & Development Advisory Council, American Institute of Architects Springfield, Neighborhood Advisory Council, Minorities in Business. Also, the proposed changes, along with all stakeholder comments, were presented to City Council's Environmental Advisory Board ("EAB") for consideration. The stakeholder comments and a recommendation from EAB are attached hereto as "Exhibit 2."

Submitted by:

Carrie Lamb,
Water Quality Compliance Officer

Recommended by:

Errin Kemper,
Director of Environmental Services

Approved by:

Jason Gage,
City Manager

EXHIBIT 1

Flood Control and Water Quality Protection Manual
Summary of Proposed Changes

The City of Springfield has been working with a Stormwater Technical Committee on proposed changes to the Flood Control and Water Quality Protection Manual that are primarily technical updates and clarifications to stormwater design standards. The proposed water quality requirement for redevelopment sites in Chapter 10 is the most significant change. The following is a summary of the major changes in each chapter. This summary is intended to give an overview and does not include all minor changes.

Chapter 1 – Stormwater Drainage Principles

No changes were made to this chapter.

Chapter 2 – Authority and Law

Minor changes were made to this chapter to correct hyperlinks.

Chapter 3 – Stormwater Planning

Changes were made to Section 2.3.3 to require drainage and detention easements and documentation of maintenance responsibility between the developer and off-site landowner if modifying an existing off-site basin or constructing a new off-site basin to meet detention requirements.

Chapter 4 – Plan Submittal and Inspections

- Section 5.3 – Added language to explain the factors considered in the decision to require construction of detention basins prior to issuance of a building permit.
- Section 7.0 – Clarification that an operation and maintenance plan and agreement is required for both water quality and flood control detention stormwater control measures consistent with current City Code Chapter 96 and required for stormwater control measures used to meet zoning conditions in City Code Sec. 36-482(8)(b).
- Section 9.0 – Minor changes to as-built requirements.

Chapter 5 – Calculation of Runoff

- Minor changes were made to this chapter to correct hyperlinks.
- Section 2.0 – Updated precipitation data from Bulletin 71 to Atlas 14
- Section 5.1 – Updated USGS regression equations.

Chapter 6 – Streets, Inlets, and Storm Drains

Minor clarifications and corrections were made to this chapter.

Chapter 7 – Culverts and Bridges

Minor clarifications and corrections were made to this chapter.

Chapter 8 – Open Channels

- Section 4.1.6 – Clarifications regarding tree replacement when using buffer width averaging and for removal of dead, diseased, or invasive trees.

- Section 4.1.13 – Revised the language for mitigation of required stream buffers and the requirements for submittal of an alternative compliance request for consideration.

Chapter 9 – Detention for Flood Control

- City Code - Updated fee in lieu of detention rate table.
- Section 4.1 – Added language to allow for ponding in parking lots as part of the storage for the detention volume.
- Section 4.4 – Restricted the use of riprap in detention basins to only those locations where required to prevent erosion.
- Section 4.5 – Added requirement for maintenance access.

Chapter 10 – Water Quality

- Section 2.0 – Added water quality requirement for redevelopment sites, including a fee in lieu option for sites with extraordinarily difficult site conditions.
- Section 2.0 – Clarification on when exceptions may be made for not treating small areas of a site when water quality is provided for off-site drainage area.
- Section 7.0 – Clarification that an operation and maintenance plan and agreement is required for both water quality and flood control detention stormwater control measures consistent with current City Code Chapter 96, and required for stormwater control measures used to meet zoning conditions in City Code Sec. 36-482(8)(b).
- Section 8.3 – Clarification that vegetated filter strips shall not be used in areas where there will be vehicular traffic or heavy, routine pedestrian use.
- Pervious Pavement Changes:
    - Section 10.1 – Removed pervious asphalt as a pervious pavement option that may be acceptable on a case by case basis.
    - Section 10.3 – Changes to pervious pavement performance criteria including reduced maximum ratio of impervious area to pervious pavement, and increased thickness of rock storage when an underdrain is used. Added a minimum infiltration rate of 10 inches/hour for in-service pervious pavement that shall be tested in accordance with a frequency established as part of operation and maintenance plan requirements. Note: Some items appear as redline changes in this section but are existing requirements that were moved from Section 10.5 for ease of reading.
    - Section 10.4 – Added a threshold of 0.5 inches/hour for the existing subgrade infiltration rate to clarify when an underdrain is required. Changed the procedure for conducting infiltration soil testing.
    - Section 10.6 – Removed the general design procedure as it is not needed.
    - Section 10.7 – Removed requirement for a pre-construction meeting.
    - Section 10.8 – Reduced minimum infiltration rate for new pervious pavement from 200 inches/hour (currently in Section 12.6.6.3) to 100 inches/hour. Removed documentation of pervious concrete density and void content testing as part of the as-built submittal.
    - Section 11.5 – Changed contractor qualifications for permeable interlocking concrete pavers from required to recommended.
    - Section 12.2 – Removed plan notes that are covered by ACI 522.1-13.

    - Sections 12.3 and 12.4 – Removed these sections as they are covered by ACI 522.1-13.
    - Section 12.5 – Added language that if pervious concrete contractor qualifications in this section differ from ACI 522.1-13, this section shall govern. Note: The qualifications are more stringent in ACI 522.1-13.
    - Section 12.6 – Removed this section as it is covered by ACI 522.1-13.
- Bioretention Changes:
    - Replaced typical drawing with a new drawing showing sections with and without an underdrain.
    - Section 13.3.1 – Added a threshold of 0.5 inches/hour for the existing subgrade infiltration rate to clarify when an underdrain is required. Changed the procedure for conducting infiltration soil testing.
    - Section 13.3.2 – Reduced the maximum velocity for larger flows passing through bioretention.
    - Section 13.3.3 – Revised to no longer allow volume to be counted in the bioretention soil mix as this layer may still be saturated when the next rain event occurs for frequent events. Specified maximum porosity of 0.4 for gravel layer, consistent with studies of porosity testing of specified rock size.
    - Section 13.3.3 – Increased allowable slope to 3:1 for side slopes.
    - Section 13.3.3 – Changed equation for minimum surface area of filter bed, consistent with the common design procedure used in other communities in Missouri.
    - Section 13.3.4 – Specified a minimum thickness of bioretention soil mix for sections without an underdrain.
    - Section 13.3.5 – Modified the thickness of graded filter and gravel layers for an overall reduction.
    - Section 13.3.7 – Clarified requirement and definition for pretreatment.
    - Section 13.3.9 – Added planting plan requirements.
    - Section 13.3.11 – Removed the design procedure as it is not needed.
    - Section 13.3.5 – Revised as-built procedure to require a survey of specified components as part of the as-built certification.
- Section 14.5 – Clarified that detention basins shall have a vegetated bottom and side slopes.
- Section 19.4 – Added requirement for inspection ports and cleanout access per manufacturer's recommendations for proprietary systems.
- Section 19.6 – Added outlet structure measurements and verification of location of inspection ports and cleanouts as part of the as-built certification for proprietary systems.

Chapter 11 – Sinkholes and Karst Features

A minor change was made to this chapter to correct a code reference.

Chapter 12 – Easements and Maintenance

- Section 2.0 - Added language to restrict the construction of buildings and other structures over the public stormwater system.

EXHIBIT 2

Springfield/Greene County Environmental Advisory Board

December 8, 2021

Ms. Carrie Lamb
City of Springfield Environmental Services

Subject: Support for Proposed Changes to the Flood Control and Water Quality Protection Manual

I am writing on behalf of the Environmental Advisory Board (EAB) to express our support for the proposed changes to the Flood Control and Water Quality Protection Manual as prepared by the City of Springfield Environmental Services and presented for stakeholder input from October 7, 2021 to December 3, 2021.

The EAB has followed the development of the proposed changes to the Flood Control and Water Quality Protection Manual throughout 2021. The EAB has invited Ms. Carrie Lamb to present on the proposed changes during our monthly public meetings on May 12, August 11, November 10, and December 8, 2021. We have reviewed comments received from the online form submittal regarding the proposed changes. The stakeholder input we have reviewed is overwhelmingly in support of the changes, specifically as the changes relate to the protection of water quality in our community.

The EAB has reviewed the proposed changes and determined that, 1) the proposed changes have been thoroughly researched and reviewed, with appropriate outreach to stakeholders and residents and consideration given to their input, 2) the proposed changes update technical references and provides more clarity for entities utilizing the plan, and 3) the changes are necessary and appropriate and represent a direct way that Springfield is committed to preserving water quality integrity.

The EAB recognizes the importance of flood control and water quality and supports the goals of the City's Department of Public Works Stormwater Engineering Division and the Department of Environmental Services Water Quality Division. Smart development that benefits both the economic growth and the environmental resources of the City is essential. We believe the proposed changes will meet this need for the future.

The EAB has nine members representing businesses and community groups and holds open public meetings throughout the year where environmental cleanups, new policies, planning, and redevelopment plans for specific projects are presented for input and discussed. Our members actively participate in meetings, and events related to environmental planning efforts and make recommendations to City Council. If this council bill is approved, we will continue to partner with the City as the primary community contact, provide input, recommend strategies, review studies and alternatives, and help disseminate information through the community.

Sincerely,

Barbara (Babs) Garcia
Chair, Environmental Advisory Board

From: noreply@civicplus.com
To: Milam, Kristen; Lamb, Carrie
Subject: Online Form Submittal: Proposed Water Quality Redevelopment Requirements Comment Form
Date: Friday, October 8, 2021 11:26:12 AM

CAUTION This email originated from outside the organization. Do not open attachments or click links from sources you do not know and trust.

Proposed Water Quality Redevelopment Requirements Comment Form

Proposed Water Quality Redevelopment Requirements Comment Form
The City of Springfield is soliciting stakeholder comments through 5 p.m. on November 5, 2021 on a proposed water quality requirement for redevelopment sites and other changes to the Flood Control and Water Quality Protection Manual. The City has been working with a Stormwater Technical Committee on changes to the manual that are primarily technical updates and clarifications to stormwater design standards. The proposed water quality requirement for redevelopment sites is the most significant change.

The following links provide information regarding the proposed changes:

- *Video presentation on proposed water quality requirement for redevelopment*
- *Summary of changes to the Flood Control and Water Quality Protection Manual*
- *Redline of changes to the Flood Control and Water Quality Protection Manual*

Please review the details of the proposed changes, then complete the form below to submit your comments.

For questions about this project, contact Water Quality Compliance Officer Carrie Lamb at clamb@springfieldmo.gov or 864-1996.

Your Name	Melanie Bach
Company / Organization	Galloway Village Neighborhood Association
Email Address for followup communication	gallowayvillage@gmail.com
Phone Number for	4176319173

followup communication	
What comments do you have regarding the proposed water quality redevelopment requirement and changes to the manual?	This proposal is a needed step to bring Springfield's water quality standards into compliance with national standards and those already in practice by other municipalities. This proposal will help Galloway Village directly by raising the water quality control measures required, especially when significant areas of greenspace are developed. Please vote in support of this proposal.

Thank you for your feedback!
For questions about this project, contact Water Quality Compliance Officer Carrie Lamb at clamb@springfieldmo.gov or 864-1996.

Email not displaying correctly? View it in your browser.

From: noreply@civicplus.com
To: Milam, Kristen; Lamb, Carrie
Subject: Online Form Submittal: Proposed Water Quality Redevelopment Requirements Comment Form
Date: Thursday, October 7, 2021 7:36:38 PM

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Proposed Water Quality Redevelopment Requirements Comment Form

Proposed Water Quality Redevelopment Requirements Comment Form
The City of Springfield is soliciting stakeholder comments through 5 p.m. on November 5, 2021 on a proposed water quality requirement for redevelopment sites and other changes to the Flood Control and Water Quality Protection Manual. The City has been working with a Stormwater Technical Committee on changes to the manual that are primarily technical updates and clarifications to stormwater design standards. The proposed water quality requirement for redevelopment sites is the most significant change.

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Please review the details of the proposed changes, then complete the form below to submit your comments.

For questions about this project, contact Water Quality Compliance Officer Carrie Lamb at clamb@springfieldmo.gov or 864-1996.

Your Name	Myra Scroggs
Company / Organization	Greater Ozarks Audubon Society
Email Address for followup communication	myrascroggs@sbcglobal.net
Phone Number for	4174256502

followup communication	
What comments do you have regarding the proposed water quality redevelopment requirement and changes to the manual?	GOAS is in favor of changes that further reduce pollutants from stormwater runoff. Including areas of redevelopment in the water quality requirements is a positive step and we support that proposal.

Thank you for your feedback!
For questions about this project, contact Water Quality Compliance Officer Carrie Lamb at clamb@springfieldmo.gov or 864-1996.

Email not displaying correctly? View it in your browser.

From: noreply@civicplus.com
To: Milam, Kristen; Lamb, Carrie
Subject: Online Form Submittal: Proposed Water Quality Redevelopment Requirements Comment Form
Date: Tuesday, November 9, 2021 4:33:30 PM

CAUTION This email originated from outside the organization. Do not open attachments or click links from sources you do not know and trust.

Proposed Water Quality Redevelopment Requirements Comment Form

Proposed Water Quality Redevelopment Requirements Comment Form
The City of Springfield is soliciting stakeholder comments through 5 p.m. on Dec. 3, 2021 on a proposed water quality requirement for redevelopment sites and other changes to the Flood Control and Water Quality Protection Manual. The City has been working with a Stormwater Technical Committee on changes to the manual that are primarily technical updates and clarifications to stormwater design standards. The proposed water quality requirement for redevelopment sites is the most significant change.

The following links provide information regarding the proposed changes:

- *Video presentation on proposed water quality requirement for redevelopment*
- *Summary of changes to the Flood Control and Water Quality Protection Manual*
- *Redline of changes to the Flood Control and Water Quality Protection Manual*

Please review the details of the proposed changes, then complete the form below to submit your comments.

For questions about this project, contact Water Quality Compliance Officer Carrie Lamb at clamb@springfieldmo.gov or 864-1996.

Your Name	Brent Stock
Company / Organization	James River Basin Partnership
Email Address for followup communication	BrentonStock@JamesRiverBasin.com
Phone Number for	(417) 836-8878

followup communication	
What comments do you have regarding the proposed water quality redevelopment requirement and changes to the manual?	We believe that the proposed requirements represent a reasonable and practical approach to balancing the economic/social need for site redevelopment with the need for water quality protection. Thank you for allowing the opportunity to offer our comments.

Thank you for your feedback!
For questions about this project, contact Water Quality Compliance Officer Carrie Lamb at clamb@springfieldmo.gov or 864-1996.

Email not displaying correctly? View it in your browser.

From: noreply@civicplus.com
To: Milam, Kristen; Lamb, Carrie
Subject: Online Form Submittal: Proposed Water Quality Redevelopment Requirements Comment Form
Date: Tuesday, November 2, 2021 8:52:10 AM

CAUTION This email originated from outside the organization. Do not open attachments or click links from sources you do not know and trust.

Proposed Water Quality Redevelopment Requirements Comment Form

Proposed Water Quality Redevelopment Requirements Comment Form
The City of Springfield is soliciting stakeholder comments through 5 p.m. on November 5, 2021 on a proposed water quality requirement for redevelopment sites and other changes to the Flood Control and Water Quality Protection Manual. The City has been working with a Stormwater Technical Committee on changes to the manual that are primarily technical updates and clarifications to stormwater design standards. The proposed water quality requirement for redevelopment sites is the most significant change.

The following links provide information regarding the proposed changes:

- *Video presentation on proposed water quality requirement for redevelopment*
- *Summary of changes to the Flood Control and Water Quality Protection Manual*
- *Redline of changes to the Flood Control and Water Quality Protection Manual*

Please review the details of the proposed changes, then complete the form below to submit your comments.

For questions about this project, contact Water Quality Compliance Officer Carrie Lamb at clamb@springfieldmo.gov or 864-1996.

Your Name	Stephen Telscher
Company / Organization	Sapp Design Associates
Email Address for followup communication	telscher@sdaarchitects.com
Phone Number for	4178779600

followup communication	
What comments do you have regarding the proposed water quality redevelopment requirement and changes to the manual?	I appreciate the information and the opportunity to comment on the proposed changes in advance of implementing them. Overall, I am in favor of these proposed changes and the reduced rainfall (1/2") factor for the redevelopment sites. We/I am not directly involved with very many projects of this nature (tight urban developed sites). My comment or request is that when off-site work/improvements are considered as part of the stormwater quality solution, that the design, documents, reviews, and approvals by all jurisdictions be treated as a single project; the on-site work reviewed by city/BDS and off-site (presumably on edges of city streets or in easements) reviewed by others and treated as a completely separate review and permit, process, etc... It will take a collaborative effort by all parties (Owner, A/E, City....) to make this work, especially on these tight urban sites.

Thank you for your feedback!

For questions about this project, contact Water Quality Compliance Officer Carrie Lamb at clamb@springfieldmo.gov or 864-1996.

Email not displaying correctly? View it in your browser.

From: Louise Wienckowski
To: Lamb, Carrie
Subject: Re: Proposed Water Quality Requirement for Redevelopment
Date: Thursday, October 28, 2021 1:35:37 PM

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Hello Carrie,

I'm writing to respond to your invitation to comment on the changes in the redevelopment requirements proposed for the Flood Control Manual. I sough Joe Pitts professional advice again on the technical aspects of this proposal. Based on his assessment, we are pleased to know there are stronger controls in the new manual that will additionally protect flood waters from pollutants and have to objections or questions.

Thank you for soliciting our opinion.

Louise Wienckowski, Chair
White River Group of the Missouri Sierra Club

> On Oct 7, 2021, at 11:23 AM, Lamb, Carrie <CLamb@springfieldmo.gov> wrote:
>
> Louise,
> I would like to invite the Sierra Club White River Group to participate in this stakeholder input opportunity. The City of Springfield is soliciting stakeholder comments through 5 p.m. on November 5, 2021 on a proposed water quality requirement for redevelopment sites and other changes to the Flood Control and Water Quality Protection Manual. The City has been working with a Stormwater Technical Committee on changes to the manual that are primarily technical updates and clarifications to stormwater design standards. The proposed water quality requirement for redevelopment sites is the most significant change. Review the proposed changes and submit comments.
>
> Thanks,
> Carrie Lamb
> Water Quality Compliance Officer
> City of Springfield
> 417-864-1996
> springfieldmo.gov/stormwater
> @SGF Environmental Services

From:	Joe Pitts
To:	Lamb, Carrie
Subject:	Changes to Water Quality Rules
Date:	Wednesday, October 27, 2021 7:07:15 PM
Attachments:	image001.jpg

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Hi Carrie,

I was asked to review the Changes to Rules for Redevelopment sites on behalf of the White River Group of the Sierra Club. The new rules appear to be stronger than the old version and in general will improve water quality in Springfield's receiving waters. Thank you for giving us the opportunity to comment on these new rules. I appreciate your professionalism and attention to detail which are evidenced by the final product.

Have a great rest of the week.

Best Regards,

Joe Pitts (Retired)

(4) Rules for Natural Systems
Everything is connected to everything else
Everything has to go somewhere
There is no free lunch
Nature Always Bats Last!

From: noreply@civicplus.com
To: Milam, Kristen; Lamb, Carrie
Subject: Online Form Submittal: Proposed Water Quality Redevelopment Requirements Comment Form
Date: Friday, December 3, 2021 11:27:22 AM

CAUTION This email originated from outside the organization. Do not open attachments or click links from sources you do not know and trust.

Proposed Water Quality Redevelopment Requirements Comment Form

Proposed Water Quality Redevelopment Requirements Comment Form
The City of Springfield is soliciting stakeholder comments through 5 p.m. on Dec. 3, 2021 on a proposed water quality requirement for redevelopment sites and other changes to the Flood Control and Water Quality Protection Manual. The City has been working with a Stormwater Technical Committee on changes to the manual that are primarily technical updates and clarifications to stormwater design standards. The proposed water quality requirement for redevelopment sites is the most significant change.

The following links provide information regarding the proposed changes:

- *Video presentation on proposed water quality requirement for redevelopment*
- *Summary of changes to the Flood Control and Water Quality Protection Manual*
- *Redline of changes to the Flood Control and Water Quality Protection Manual*

Please review the details of the proposed changes, then complete the form below to submit your comments.

For questions about this project, contact Water Quality Compliance Officer Carrie Lamb at clamb@springfieldmo.gov or 864-1996.

Your Name	Kelly Guenther
Company / Organization	*Field not completed.*
Email Address for followup communication	kellydguenther@gmail.com
Phone Number for	*Field not completed.*

followup communication	
What comments do you have regarding the proposed water quality redevelopment requirement and changes to the manual?	I am in support of the proposed water quality redevelopment requirement changes to the manual. The City is making good decisions regarding our water quality and this will help our community meet the MS4 requirements.

Thank you for your feedback!
For questions about this project, contact Water Quality Compliance Officer Carrie Lamb at clamb@springfieldmo.gov or 864-1996.

Email not displaying correctly? View it in your browser.

The Departments of Environmental Services and Public Works met with the Springfield Area Chamber of Commerce Growth & Development Advisory Council (GDAC) in November 2021, January 2022, and February 2022 to discuss the City's proposed water quality requirement for redevelopment sites and other changes to the Flood Control and Water Quality Protection Manual. Feedback from GDAC members included the following:

- General concern that the proposed water quality requirement will make redevelopment more difficult;
- Request for a fee in lieu option for sites where it is not feasible to meet the water quality requirement and language defining how feasibility will be determined;
- Concern about space constraints for meeting the water quality requirement and request for a reduction in the parking requirement to provide more space;
- Request for a grace period for the new water quality requirement for redevelopment.
- Concern that the current requirement for a no feasible alternatives analysis for stream buffer encroachment and mitigation is cumbersome, costly, and subjective to the reviewer.

In response, the City proposed the following changes:

- Water quality fee in lieu option on redevelopment projects in any area of the City where it is not reasonably feasible to meet the water quality requirement due to extraordinarily difficult site conditions, as further described in the proposed changes, including requirements for submittal of supporting documentation. This change is included in the updated Flood Control and Water Quality Protection Manual proposed for adoption.
- Proposed change to the zoning code to allow an off-street parking requirement reduction up to 20 percent in direct proportion to the area that is being used for the water quality stormwater control measure. The reduction would be reviewed and approved by the administrative review committee. This same reduction and process is currently allowed for sites required to meet stream buffers. This zoning amendment change is proposed as a separate council bill.
- Grace period policy included in the council bill adopting the water quality requirement for redevelopment and other changes to the manual: The ordinance shall be in full force and effect 30 days after passage. Projects which have completed a predevelopment review within 180 days prior to passage of this ordinance are exempt from complying with the additional water quality requirements in Chapter 10 Section 2.0 of the Flood Control and Water Quality Protection Manual adopted herein provided stormwater plans are submitted within 180 days after passage of this ordinance for the project defined in the scope of the predevelopment review. However, the project is still required to comply with all other water quality standards in full force and effect at the time of plan submittal. Predevelopment reviews for rezoning or subdivision-related matters do not qualify a project for this exemption.
- Revision of the language for mitigation of required stream buffers and the requirements for submittal of an alternative compliance request for consideration. This change is included in the updated Flood Control and Water Quality Protection Manual proposed for adoption.

EXHIBIT A

Flood Control and Water Quality Protection Manual

A Stormwater Design Guide for Development in Springfield.

CITY OF Springfield

Adopted April 2022

Flood Control and Water Quality Protection Manual

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Chapter 1 Stormwater Drainage Principles

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1.0 Overview

Sound stormwater system design and management are crucial components necessary to maintain sustainable drainage systems, minimize disturbance to existing drainage patterns, control flooding of property, structures, and roadways for design flood events, and minimize environmental impacts of stormwater runoff. Stormwater systems should be designed both to provide adequate surface drainage and to meet other important stormwater management goals, such as protection of water quality, stream channels, habitat, and groundwater. Above all else, stormwater management practices must strive to preserve and promote the general health, safety, and welfare of the public. Stormwater drainage is defined by watershed, not by governmental jurisdiction, and therefore requires cooperative efforts on a watershed basis to be implemented effectively. This chapter summarizes principles of stormwater management, identifies key data sources needed for stormwater management, provides an overview of planning approaches, and identifies floodplain management principles.

Sound stormwater drainage system management is consistent with several sections of the City of Springfield Field Guide 2030 – A Strategic Path to Springfield's Future.

2.0 Principles

Planning and development of urban stormwater drainage systems are guided by a set of underlying principles that are based on sound engineering practice and community objectives. Key guiding principles that are the foundation of the design criteria provided in this manual are summarized below.

2.1 Watershed Approach

1. **Stormwater Drainage Does Not Respect Governmental Boundaries and Is Affected by All Who Reside in the Watershed.** The watershed approach to stormwater management has been embraced by the U.S. Environmental Protection Agency (USEPA) and many other agencies and communities across the country. Stormwater system planning and implementation should include coordination with all affected agencies, communities, and neighborhoods within the watershed. The water resources of a watershed are affected by all who conduct activities within it; therefore, all should be a part of the process of caring for its water resources.
2. **A Stormwater Drainage System Is a Subsystem of the Total Urban Water Resource System.** Stormwater system planning and design for any new development must be compatible with watershed master plans and objectives and must be coordinated with plans for land use, open space, transportation, and other community objectives. Watershed master plans must consistently address stormwater quantity and quality issues, as well as regional issues.
3. **An Urban Storm Drainage System Should Be Regarded as a Natural Resource That Serves the Community with a Multi-Objective Purpose.** Natural urban drainage systems are a valuable natural resource in a community and play an important role in its overall quality of life. These areas should be protected and utilized to their full potential in this

regard through a multi-objective management strategy that includes flood protection, water quality enhancement, groundwater recharge, recreational opportunities, preservation of plant and animal habitat, creation of open spaces, and protection of natural features and amenities.

2.2 Conveyance and Storage

1. **Flooding Is Primarily a Space Allocation Problem.** The amount of stormwater runoff present at any given point in time in an urban watershed cannot be compressed or diminished. Open and enclosed storm systems serve both conveyance and storage functions. If adequate provision is not made for drainage space demands, stormwater runoff will conflict with other land uses, resulting in damage to public and private property and the impairment or disruption of other urban systems. In urban watersheds that have been developed without adequate stormwater planning, there is generally inadequate space available to construct detention storage facilities to reduce peak flows significantly along major waterways. Creation of adequate space to construct such storage facilities will generally require the removal of valuable existing facilities and is often not economically or socially feasible.
2. **Floodplains Should Be Preserved Wherever Feasible and Practicable to Maintain Naturally Occurring Stormwater Storage.** Nature has claimed and will reclaim a prescriptive easement for floods, via its floodplains, that cannot be denied without significant difficulty and cost. Floodplains serve as natural outfall areas for urban drainage, riparian corridors, and habitat for diverse ecological systems. Encroachment into floodplains should be avoided and should occur only after careful planning and engineering have been conducted so that the effects are fully recognized and minimized. Preservation of urban floodplains provides value to communities through flood hazard reduction, water quality enhancement, stream protection, habitat preservation, open space, linear parks, and recreational opportunities. When determining the width of floodplain to preserve, consideration should be given to the intended use of the floodplain and the dynamic nature of stream channels.
3. **Streams and Riparian Corridors Should Be Maintained As They Naturally Occur to the Maximum Extent Practicable.** Naturally occurring streams and waterways should be preserved in their natural state to the maximum extent practicable by the provision of stream setbacks and the minimization of floodplain filling. Providing buffers between valuable riparian corridors and urban development allows filtering of pollutants from urban runoff before it enters a stream. Consideration should be given to environmentally sensitive stream stabilization in areas where urbanization, altered hydrology, or soil characteristics result in unstable natural channel conditions. In certain cases, urban hydrologic conditions will require structural stabilization of streams to avoid degradation. These improvements should be completed in an aesthetic and environmentally sensitive manner.
4. **Every Urban Area Has a Minor and a Major Drainage System, Whether or Not They Are Actually Planned or Designed.** Generally, the minor and major drainage systems have distinctly different design criteria based on public health, safety and welfare, and economic

considerations. The minor drainage system is typically designed to accommodate moderate flooding. For minor drainage systems, local street flooding resulting from extreme, less frequent rainfall events may be permissible for short periods, as long as public health, safety, and welfare are protected, and structures are protected from inundation. Due to a greater potential threat to public health, safety, and welfare along major waterways, the major system will generally have a higher design standard to minimize the impacts of flooding from more severe, less frequent floods.

5. **Stormwater Drainage Systems Should Not Be Designed to Transfer Problems from One Location to Another.** Urbanization tends to increase downstream peak flows, runoff volumes, and runoff velocities. These changes can cause the capacity of inadequately designed downstream systems to be exceeded and can disrupt natural waterways. The impacts of new urbanization must be reduced through the use of structural and non-structural Best Management Practices (BMPs) that usually include stormwater detention. These may be constructed as either on-site or regional facilities based upon watershed master plans developed and maintained by government agencies. Consideration should be given to retrofitting stormwater controls as a part of redevelopment projects. Factors to consider include the size of the redevelopment project and its location within the watershed.
6. **Planning and Design of Stormwater Drainage Systems Should Place Public Health, Safety and Welfare, Protection of Property, and Traffic Safety above All Other Considerations.** The primary objective of all stormwater drainage design is the protection of public health, safety, and welfare. Stormwater systems should be designed to minimize the risk of loss of life. Consideration should be given to the potential for health risks associated with stormwater systems and runoff. Designs should minimize the risk of damage to both public and private property and minimize the risk of structure inundation. Streets are commonly used for collection of runoff and are the beginning of the minor drainage system. Streets and the minor drainage system should be designed for the safe and efficient movement of traffic to the maximum extent practicable. Consideration should be given to the benefits that the protection of the environment and water quality have on public health and welfare. Consideration should also be given to the importance of reducing erosion because of the potential for public and private property damage.
7. **The Stormwater Drainage System Should Be Designed for Sustainability and Must Receive Regular Maintenance.** Design of the stormwater drainage system should carefully consider the need for accessibility and maintenance to sustain adequate function, whether the facilities will be publicly or privately maintained. The major drainage system is more likely to be maintained by a public entity, whereas the minor system is more often maintained by a private entity. Parts of the major system that serve specific functions for private entities should be maintained by those private entities. Failure to provide proper maintenance reduces both the hydraulic capacity and pollutant removal efficiency of the system. Planning and design of drainage facilities should include consideration of scheduling of work crews and funding necessary to provide proper maintenance.

2.3 Onsite Controls

1. **A Stormwater Drainage System Should Be Designed Beginning with the Point of Discharge, Giving Consideration to Downstream Impacts and the Effects of Offsite Flows.** The location and method of discharge from the site must be determined with great care and in a reasonable manner that does not harm downstream or adjacent property. The engineer should evaluate the conveyance system downstream of each point of discharge from a new development to ensure that it has sufficient capacity to accept design discharges without adverse backwater or downstream impacts such as flooding, stream bank erosion, and sediment deposition. In addition, great care must also be taken in determining the method of acceptance, conveyance, and discharge of stormwater runoff flowing across the site and originating from off site.
2. **Design of Stormwater Drainage Systems Should Consider Existing Natural Forms and Features.** Every site contains natural features that characterize and contribute to its natural drainage system. Existing features such as natural drainageways, sinkholes, floodplains, vegetation, soils, geology, and slope affect existing runoff and drainage characteristics. Each development plan should include mapping and careful consideration of these natural features. Stormwater system design should preserve and enhance natural features to the maximum extent practicable. A well-designed stormwater system will improve the effectiveness of the natural system, rather than negate, replace, or ignore it.
3. **Developments Should Be Designed to Reduce Runoff Rates and Pollutant Loads to Minimize Negative Downstream Impacts to the Maximum Extent Practicable.** Federal and state laws now mandate that most urban areas, including Springfield, monitor water quality and require the application of stormwater BMPs to new developments and redevelopments. New impervious areas should be minimized and hydraulically disconnected to achieve maximum contact between runoff and vegetation, thereby maximizing infiltration and filtering of pollutants. Runoff should be routed in a manner that slows the speed of runoff leaving the site. Where determined to be appropriate, detention basins should be constructed to limit peak flow rates to predevelopment rates. While it is generally not practical to maintain predevelopment runoff volumes, stormwater BMPs should be used to the maximum extent practicable to minimize runoff volume.

3.0 Data Collection

In order to effectively implement sound stormwater drainage planning and management practices, the City must develop and maintain a strong base of hydrologic and geographical data. Following is a brief summary of key data requirements.

3.1 Rainfall

The two primary factors that contribute to the magnitude of a flood are rainfall and runoff response. The characteristics of rainfall that affect the magnitude of a flood are depth, duration, intensity, and location. These characteristics can be quantified for any given storm through the collection of rainfall data. Therefore, an essential component of a community's stormwater management program is the establishment of an adequate network of rainfall gauges to provide

valuable data when studying rainfall/runoff relationships. The type, number, and location of gauges should be determined based on the area to be monitored, the size and shape of the watersheds of interest, the meteorological and hydrologic characteristics of the community, and the resources available to the governmental agency. The City has a network of rain gages throughout the urban area that collect 15-minute data. This data can be accessed via the City's website at www.springfieldmo.gov/stormwater. Data collected by rain gauges can be supplemented by other sources, such as Doppler Radar data from the National Weather Service. More comprehensive rainfall data can also assist in the analysis of pollutant delivery to the stormwater system.

3.1.1 Data Collection Methods.

An adequate network of rainfall gauges can collect data both temporally and spatially to allow for quantification of depth, duration, intensity, and location. Generally, rainfall should be collected in time increments ranging from 5 to 15 minutes when being collected for the purpose of flood analysis. Longer time increments may be preferred for long data collection periods more typical of a pollutant load analysis. Spatial distribution of rain gauges should account for the localized nature of thunderstorms, which can be only a few square miles in size and cause severe localized flooding.

3.1.2 Classification of Rainfall.

With adequate spatial and temporal rainfall data, the frequency of any particular rainfall event can be classified with the use of accepted Depth-Duration-Frequency tables found in this manual. It is important to realize that determination of the frequency of a rainfall event does not necessarily translate to the same frequency of the resulting flood event. The relationship between these events is primarily a function of how closely the duration of rainfall compares to the response time of the affected watershed.

3.2 Storm Runoff and Flood Data

Runoff response is the other primary factor, in addition to rainfall, that contributes to the magnitude of a flood. Runoff response is characterized by total runoff volume and the lag time between rainfall and the resulting runoff. The many factors affecting runoff volume and lag time are complex and difficult to quantify with a high level of accuracy. Karst topography, common to southwest Missouri, can have a significant effect on runoff because of the numerous sinkholes, losing streams and springs in these areas. The many factors affecting runoff can be calculated or estimated by the experienced engineer using mathematical runoff models. However, limited accuracy of the available data and the necessity for engineering judgment to determine many of the factors can introduce significant margins of error to the results. The collection of detailed runoff data can improve the accuracy of and confidence in the results of mathematical models and should be completed to the degree feasible with available resources. Historical flood records can be a valuable check of the reasonableness of mathematical models. It is also advisable to compare the results of mathematical models to other equations and methods, including empirically based equations.

3.2.1 Data Collection Methods.

An adequate network of flow gauges distributed at key points of interest can collect data both temporally and spatially to allow for quantification of peak flow, total volume and lag time.

Specialized gauges can grab water samples at predetermined intervals throughout the storm to provide data for flow-weighted pollutant load calculations. Generally, flow data should be collected in time increments ranging from 5 to 15 minutes, depending on the size of the watershed. Gauges should be placed in areas of study for the purpose of assisting with runoff model calibration. Flow gauges require careful operation and maintenance to ensure quality data are collected; therefore, the number of gauges should be limited based on the availability of personnel and resources. In addition, plans should be made to deploy personnel during and after floods to obtain flood data such as high water marks and flood damage evidence. This information can also be useful when calibrating mathematical runoff models and quantifying flood frequencies.

3.2.2 Classification of Rainfall.

With adequate historical runoff data, the frequency of any particular flood event can be quantified with statistical methods. In most watersheds, detailed runoff data are not available for the purpose of making frequency determinations. In the absence of detailed runoff data, flood frequency determinations can be made by applying detailed rainfall data to hydrologic models. Models should be calibrated with runoff data that may be available, such as high water marks.

3.3 Geographical Data

Geographical data useful for developing stormwater runoff models should be continually gathered and maintained to improve model accuracy and increase the efficiency of designs. These data include aerial photos, elevation contours, soils, land cover, land use, zoning, karst features, etc.

3.4 Stormwater System Inventory Data

A stormwater system inventory should be continually developed and maintained to provide data for more detailed and accurate model development. Stormwater inventory data should include physical characteristics for all point features such as inlets and junction boxes, channels, pipes, culverts, bridges, detention basins, and sinkholes.

3.5 Geographic Information System

All data useful for stormwater runoff modeling and studies, including rainfall and runoff data, geographical data, and stormwater system inventory data, should be developed and maintained within a Geographic Information System (GIS) environment for use in stormwater planning studies and design.

4.0 Planning

Building upon sound drainage principles and a strong base of watershed data, watershed plans and project priorities can be developed. A brief overview of the City's approach to developing watershed plans and identifying priorities follows. More detailed information on planning is provided in Chapter 3.

4.1 Watershed Assessments.

Watershed assessments are comprehensive living documents summarizing the current state of a watershed as it relates to stormwater runoff. Such assessments should be developed and

maintained for watersheds in the Springfield Urban Services Area on a priority basis. The watershed assessment should include a compilation of known data about the watershed in a GIS database format, as well as a bound report comprising maps and text for use by government leaders, engineers, planners, architects, developers, and the general public. These assessments provide information necessary to develop a watershed plan. After a watershed plan has been completed, the watershed assessment should be updated periodically to document progress being made toward the goals and objectives of the watershed plan.

4.2 Watershed Plans

Watershed plans should be developed and maintained for each watershed on a priority basis. The goals and objectives of watershed plans should be developed based on the information collected in the watershed assessment, the principles in Section 2.0, public input, and professional guidance. Characteristics and problems unique to each watershed should be identified and possible alternatives to address each problem presented for public input. Based on the original goals and objectives developed by public input and professional guidance, a plan should be developed to address problems on a priority basis. Watershed plans can then be used to guide future project development and public education and involvement in the watershed as a part of the overall Stormwater Management Program. Watershed plans must take into account overall program priorities and issues that may exist in the larger, regional watershed.

4.3 Project Priority List

A current list of known stormwater problems should be maintained to support the development of watershed plans and a Citywide Project Priority List. Project priority rankings should consider the type, frequency, and severity of flooding, with the highest priority given to health, safety, and welfare issues. More specifically, priority shall be given to cases of significant risk of loss of life and significant risk of flooding of structures and major traffic thoroughfares.

4.4 Project Development, Construction, and Maintenance

As capital improvement needs are identified, efforts should be made to secure funds to design, construct, and maintain stormwater improvements. Funding initiatives should be sought at the federal, state, and local levels to meet both short- and long-term program needs. In accordance with the Citywide Project Priority List, watershed plans, and overall priorities of the Stormwater Management Program, projects will be developed, designed, and constructed as funds become available. Just as public education and involvement is important during development of the watershed master plan, continued communication with the public is important throughout the design and construction phases.

It is imperative that funding initiatives and project designs take into consideration long-term needs. Aspects to consider include mowing, tree maintenance and other vegetation management, sediment removal, and maintenance of structures. Long-term maintenance must be balanced with other objectives such as water quality, flood control, and aesthetics.

5.0 Management of Flood Hazard Areas

Proper management of flood hazard areas in a manner that protects the public health, safety, and welfare is a fundamental principle of storm drainage management and planning. The City's approach to minimizing and managing flood hazards is described below.

5.1 National Flood Insurance Program

The City is a participant in the National Flood Insurance Program (NFIP), which is administered by the Federal Emergency Management Agency (FEMA). As a participant, the City must maintain and enforce regulations meeting minimum requirements of the NFIP and restricting development in designated flood hazard areas shown on FEMA Flood Insurance Rate Maps (FIRMs). Federal requirements mandate that flood insurance be purchased for mortgaged properties within a FEMA flood hazard area. Because the City is an NFIP participant in good standing, all property owners in the City are able to obtain flood insurance for their property with premiums based on the flood hazard zones shown on the FIRM.

5.1.1 NFIP Minimum Requirements

The minimum requirements of the NFIP are designed to assess current flood risks of individual properties and develop appropriate flood insurance rates for those properties. Additional or modified requirements are necessary for more comprehensive regulation of developments in or near designated flood hazard areas. NFIP minimum requirements and additional or modified requirements for developments within the City include:

1. FIRM flood elevations are based on watershed development conditions at the time of the Flood Insurance Study (FIS). Depending on the amount of development in the watershed that has occurred since the FIS was completed or that may occur before the next FIS is completed, the FIS may reflect flood elevations that are lower than those for current or future conditions, which poses an unanticipated flood risk if not taken into account. Therefore, designs for development in or near flood hazard areas should anticipate maximum flood elevations from future development in the watershed and take into account flood hazards created since the last study.
2. NFIP regulations permit encroachment into the flood fringe area, provided that the Base Flood Elevation will not increase more than one foot. However, filling of flood fringe areas decreases floodplain storage, which results in a loss of peak flow attenuation, which in turn results in increased flood elevations. This effect of floodplain filling is not accounted for in the FIS determination of Base Flood Elevations and floodway widths. Therefore, fill should be permitted in floodplains only when it is shown there are no resulting impacts on adjacent properties.
3. NFIP studies are typically discontinued at a point where the watershed drainage area is one square mile. Most flood damage occurs upstream of flood hazard areas shown on a FIRM. Therefore, the City will develop and maintain City Flood Hazard Maps up to a drainage area of 40 acres in order to regulate development in or near these areas.

5.2 City Flood Hazard Areas

City Flood Hazard Areas are mapped and the maps are maintained as a part of a comprehensive stormwater management program. City Flood Hazard Maps are used to restrict development in or near Flood Hazard Areas. Maps are based on the same flood event as the FEMA FIS Base Flood and are enforceable through the City's floodplain ordinance. As discussed in Section 5.1, the watershed should be assumed to be fully developed based on current or anticipated zoning land uses to account for potential rises in flood elevations in the future. Encroachments into flood hazard areas should occur only when it can be shown that there are no impacts to adjacent properties from loss of floodplain storage and loss of peak flow attenuation. Minimum floor elevations should be set at least two feet higher than the Base Flood Elevation under fully developed watershed conditions based on anticipated zoning and land use and anticipated future developments. City Flood Hazard Areas extend up to a point where the drainage area is approximately 40 acres or as dictated by existing development and specific needs of the area.

5.3 Floodplain Acquisition

The City began the Voluntary Floodplain Acquisition Program after the floods of September 1993. In accordance with the findings of the Citizens' Stormwater Committee, the program is based on the principle of stopping the cycle of flooding, rebuilding, and flooding again. This goal is accomplished through the voluntary acquisition of flood-prone properties within floodplains, sinkholes, and other flood-prone areas after it has been determined that flood protection with stormwater improvements alone is not cost effective. Priority is given to buildings in floodways and residential properties with structures that have flooded and have a significant risk of flooding again.

Priority is also given to the acquisition of undeveloped floodplains in strategic locations that provide multipurpose beneficial uses to the community, such as storage for flood control and water quality enhancement, riparian corridors for enhanced habitat, stream protection, open space for linear parks and greenway trails, and water quality protection. Acquisition projects should be carried out in accordance with approved watershed plans. Continuation of the program will significantly reduce flood damages to property within the City, as well as provide multiple additional benefits to the community.

6.0 References

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Chapter 2 Authority and Law

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1.0 Overview

Stormwater regulation within the City of Springfield (City) is subject to legal controls imposed by federal and state statutes and administrative regulations, City ordinances, and common law principles adopted by the courts in cases involving civil liability. Laws and principles apply to both water quantity (flooding) and water quality (pollution). Generally, federal laws regulate floodplain management and water quality. Missouri statutory and administrative law applies to water quality, and Missouri common law applies to many cases involving the management of stormwater discharges. The City has adopted ordinances, found mostly in Chapter 96 of the City Code, that address both the water quantity and quality aspect of stormwater management.

2.0 Federal Law

Federal stormwater law regulates floodplain management and water quality. A brief summary of some of the federal acts that form the basis of federal law affecting stormwater design criteria follows.

2.1 Floodplain Management

2.1.1 National Flood Insurance Act, 1968

This Act established the National Flood Insurance Program (NFIP). The NFIP is a federal program enabling all property owners in participating communities to purchase flood insurance in states and localities that adopt floodplain management regulations to reduce the potential for future damages from flooding. Springfield entered the NFIP in 1989, enacting the required community floodplain management regulations. (See Section 4.3 for a summary of City regulations related to floodplain management.) Contact the Federal Emergency Management Agency (FEMA) or visit their website (www.fema.gov) for more information regarding the NFIP. See Chapter 8, Open Channels, of this manual for information regarding design criteria along major waterways.

2.2 Water Quality

2.2.1 Clean Water Act, 1972

Known originally as the Federal Water Pollution Control Act, the Clean Water Act is the cornerstone legislation of surface water quality protection in the United States. The Clean Water Act established the framework for the U.S. Environmental Protection Agency (USEPA) to regulate discharges of pollutants into the waters of the U.S. through the National Pollutant Discharge Elimination System (NPDES) program. More information about the Clean Water Act and the NPDES program can be found at the USEPA website (www.epa.gov).

2.2.2 Water Quality Act, 1987

The Water Quality Act amended the Clean Water Act to make the NPDES program applicable to stormwater, including discharges of municipal stormwater. The 1987 amendment requires municipalities to reduce pollutants in stormwater discharges to the Maximum Extent Practicable (MEP) through implementation of Best Management Practices (BMPs). The regulations established

a two-phase approach for requiring municipalities to obtain stormwater discharge permits, called Municipal Separate Storm Sewer System (MS4) permits. Municipalities with populations greater than 100,000 were designated "Phase I" cities with an earlier application requirement than smaller entities designated "Phase II." The City was designated a Phase I entity, and Greene County was designated a Phase II entity. More information about the Water Quality Act and BMPs can be found at the USEPA website.

2.2.3 Springfield MS4 Permit

In accordance with federal requirements, the City submitted an application for a Phase I MS4 permit in 1992 and 1993. The Missouri Department of Natural Resources (MDNR) issued the permit to Springfield in July 2002; it was the first MS4 permit issued in Missouri. MDNR issued a revised MS4 permit to Springfield in April 2017. Springfield's MS4 can be viewed on the MDNR web site. Under the mandatory permit, the City is required to develop a comprehensive stormwater management program to reduce the discharge of pollutants from the MS4 into area streams and water bodies to the MEP.

A required component of Springfield's Stormwater Management Program is the implementation of permanent BMPs, also known as Stormwater Control Measures (SCMs), in new developments, redevelopments and stormwater system improvement projects. The requirements and SCM details for new developments and redevelopments are discussed in Chapter 10, Water Quality.

The MS4 permit also requires the City to reduce discharges of pollutants from construction sites. To meet this requirement, the City has a land disturbance permitting program for sites that disturb one acre or greater and sites less than one acre that are part of a larger common plan of development. See Section 4.2.3 of this chapter for more information on the City's land disturbance requirements.

2.2.4 U.S. Army Corps of Engineers Section 404 Permits

Under Section 404 of the Clean Water Act, a permit is required from the U.S. Army Corps of Engineers (USACE) for dredge and fill activities within the waters of the U.S., including wetlands. More information can be obtained by contacting the USACE (www.usace.army.mil). Approximately the northern third of Springfield draining north to the Sac River is in the USACE Kansas City District. Approximately the southern two-thirds of Springfield draining south is in the USACE Little Rock District. See Chapter 8, Open Channels, for more information about when to contact the USACE regarding the possible need for a Section 404 permit and City requirements when a Section 404 permit must be obtained.

3.0 Missouri Surface Water Law

Missouri statutory and administrative regulations related to surface water are generally limited in application to water quality issues and are typically enacted as mandated by the federal Clean Water Act. Missouri Common Law has been developed by the state judiciary in court cases involving the civil liability of landowners in connection with the discharge or obstruction of surface water.

3.1 Clean Water Law

3.1.1 State Authority

The Missouri Clean Water Law is contained in the Missouri Revised Statutes (RSMo) Chapter 644, Water Pollution. The law is an extension of the federal Clean Water Act.

3.1.2 Water Quality Standards

The Missouri Water Quality Standards are contained in the Missouri Code of State Regulations, 10 CSR 20-7.031 Water Quality Standards, with this stated purpose:

> *This rule identifies beneficial uses of waters of the state, criteria to protect those uses and defines the antidegradation policy. It is developed in response to the Missouri Clean Water Law and the federal Clean Water Act, Section 303(1) and (2), which requires that state water quality standards be reviewed at least once every three years. These revisions are pursuant to the national goal of protection of fish, shellfish and wildlife and recreation in and on the water as outlined in Section 101(a) (2) of the Act.*

3.1.3 Section 303(d) List of Impaired Waters

As required by the federal Clean Water Act, the MDNR maintains a listing of impaired waters and identifies the probable reason that each impaired water does not meet state water quality standards. Special standards to address impairments may apply in watersheds with waters on the 303(d) list.

3.1.4 Total Maximum Daily Load (TMDL)

As required by the federal Clean Water Act, a TMDL must be developed by the MDNR for all impaired waters on the 303(d) list. Several Springfield-area waters are included on the 303(d) list, which the MDNR updates biannually.

See www.dnr.mo.gov for the most current 303(d) list and the status of TMDLs associated with these waters. A TMDL quantifies the maximum amount of the pollutant(s) causing the impairment that a water body can receive before it becomes impaired. A TMDL develops a framework for the watershed to reduce the amount of pollutant(s) in the water so it can meet Missouri Water Quality Standards and be removed from the 303(d) list. Special standards to implement provisions of the TMDL may apply in the watershed of the impaired receiving water.

3.1.5 Section 401 Water Quality Certification

The federal Clean Water Act gives authority to each state to issue a Section 401 Water Quality Certification for any activity requiring a Section 404 permit (see Section 2.2.4 of this chapter). When a Section 404 permit is required, a Section 401 certification must also be obtained from the MDNR. More information can be obtained by contacting the MDNR or viewing their website (www.dnr.mo.gov). See Chapter 8, Open Channels, for more information about City requirements when a 401 Certification must be obtained.

3.2 Common Law

Missouri case law governs civil liability of landowners in disputes involving the discharge or obstruction of surface water. The information provided in this section applies to the practice of discharging and disposing of surface water, rather than the use of it. A brief summary of doctrines that have developed under Missouri Common Law is provided in Sections 3.2.1– 3.2.7.

3.2.1 Civil Law Rule

Historically, this rule was founded on the natural flow of water. It gave upstream owners rights to discharge water to its natural course and made it unlawful for downstream owners to interrupt the natural flow of water.

3.2.2 Common Enemy Rule

Historically, this was the predominant rule followed by the courts. Its foundation was the assumption that surface water is the enemy of all. Every landowner possessed an unlimited and unrestricted legal right to control surface water without regard to the effects of such control on neighboring landowners.

3.2.3 Modified Common Enemy Rule

The Missouri courts adopted this rule in 1884. Under this doctrine, an upper landowner was required to exercise reasonable care in diverting surface water onto a lower landowner's property. However, the lower landowner was free to take unrestricted action to divert surface water coming on to his property from upstream, provided the action did not obstruct a natural watercourse.

3.2.4 Rule of Reasonable Use

In 1993, the Missouri Supreme Court abandoned the Modified Common Enemy Rule and adopted the Rule of Reasonable Use to determine civil liability in cases involving the diversion or obstruction of surface water, whether by an upper or lower landowner (Heins Implement Co. v. Mo. Hwy. & Trans. Commission, 859 S.W.2d 681 [Mo. 1993]). The court ruling stated that reasonableness of interference of flow of surface waters is a question of fact, to be determined in each case by weighing the gravity of harm to the plaintiff against the utility of the defendant's conduct.

In 1998, the Missouri legislature enacted a provision in Section 644.018 of the Missouri Revised Statutes specifying that in any case involving a flood prone area, if any defendant has obtained and fully complied with a permit from a local subdivision that has met the requirements of and is a participant in the NFIP, and the subdivision has jurisdiction over the area of dispute, then the proper permitting and compliance with all permit conditions shall be conclusive proof that the project meets any reasonable use test.

3.2.5 Classification of Flow

The courts have made a distinction between cases involving a watercourse, as opposed to cases involving merely surface water. It is important to recognize and define this distinction. Missouri courts have established the following definitions:

Watercourse *– A stream usually flowing in a particular direction, though it need not flow continually. It must flow in a defined channel, having a bed, sides, or banks, and usually discharge itself into some other stream or body of water. It must be something more than a mere surface drainage over the entire face of a tract of land, occasioned by unusual freshets or other extraordinary causes. It does not include the water flowing in the hollows or ravines in land, which is the mere surface water from rain or melting snow, and is discharged through them from a higher to a lower level, but which at other times are destitute of water. Such hollows or ravines are not in a legal contemplation watercourses.*

Surface Water *– That form or class of water derived from falling rain or melting snow or which rises to the surface in springs and is diffused over the surface of the ground while it remains in that state or condition and has not entered a natural water course. In addition, floodwaters exceeding the capacity and flowing out a watercourse may be considered surface waters.*

When proposing to develop a site, special attention should be given to whether runoff occurs as a watercourse or as surface water at various locations on the site. See Chapter 4, Plan Submittal, for policies regarding accepting off-site runoff, conveying it across a site, and discharging it downstream.

3.2.6 Dam Safety

Chapter 236 of the Missouri Revised Statutes covers regulation of dams with a height exceeding 35 feet. Any proposal for a dam with a height of 35 feet or more must comply with all state statutes.

3.2.7 Professional Responsibility

Professional Engineers, Architects, and Land Surveyors have a responsibility to provide for public safety, health and welfare. Missouri law regulating the practice of Professional Engineering, Architecture and Land Surveying is found in Missouri Revised Statutes, Chapter 327.

4.0 Springfield City Code, Ordinances, and Policies

Regulations regarding stormwater runoff are found in several locations in the City Code. Chapter 96 contains stormwater regulations related to watercourses, sinkholes, stormwater system improvements and connections, detention and water quality requirements for developments, land disturbance activities, and discharges of pollutants. Regulations related to management of floodplains designated by FEMA are found in Chapter 36 Land Development Code, Article II Subdivision Regulations and Article XVII Floodplain Management. Policies and practices are also found in the BMP Manual for Land Disturbance Activity, the General Conditions and Technical Specifications for Public Improvements, the Standard Drawing Details for Public Improvements, the Site Plan Design Guide and this manual. See the City's website to obtain these documents at www.springfieldmo.gov/stormwater. More information regarding key ordinances relevant to water quality and quantity is found in Sections 4.1 through 4.3.

4.1 Stormwater Quantity Control

4.1.1 Obstruction of Watercourses

City Code Chapter 96, Article I, Section 96-17 Obstruction of Watercourses Prohibited, makes it unlawful and a public nuisance for any person to block, obstruct, destroy, cover, fill or alter in any way a watercourse or any part thereof so as to cause damage to the property of other persons from surface water. It gives certain authority to the City to cause such actions to be corrected.

4.1.2 Land Development Adjacent to and Draining to Sinkholes

City Code Chapter 96, Article I, Division III Protection of Sinkholes and Other Karst Features prohibits the operation of motorized equipment in a sinkhole without a permit. The regulation specifies requirements for obtaining a permit to conduct such activity, requires the identification of sinkhole-related non-buildable areas, and specifies how such areas are to be determined. Certain stormwater calculations must be submitted for approval for any proposed development that drains to a sinkhole, and certain plan notes are required to be placed on the plans for any development that contains a sinkhole. The regulation gives certain authority to the City to require any violations of the ordinance to be corrected. See Chapter 11, Sinkholes and Karst Features, for more information regarding stormwater management and sinkholes.

4.1.3 Stormwater Detention

City Code Chapter 96, Article I, Division II Stormwater Infrastructure Design, Operation, and Maintenance adopts this manual and requires that development comply with the provisions herein. See Chapter 9, Detention, for more information regarding stormwater detention design and Chapter 12, Easements and Maintenance, for more information regarding easement requirements.

4.1.4 Acceptable Methods of Discharge

Consistent with Missouri Common Law, if a property has been modified to increase or change the amount, location, or character of discharge, the acceptable methods of discharge from that property are as follows:

1. To a public right-of-way;
2. To a recorded drainage easement, continuing to a public right-of-way or public drainage system; or
3. To a certified natural watercourse as defined by Missouri Common Law (see Section 3.2 of this chapter).

The amount, location, or character of the discharge shall not be such that the capacity of the downstream system is exceeded or downstream flooding is otherwise caused.

When none of the three options listed above are readily available, the development must be modified so that the amount, location or character of discharge is not changed or a downstream easement must be obtained. For more information regarding acceptable methods of discharge, see Chapter 4, Plan Submittal.

4.1.5 Requirements for Subdivisions

City Code Chapter 36 Land Development Code, Article II Subdivision Regulations, requires drainage improvements to be provided for all lots of a subdivision. It gives the Director of Public Works the authority to require construction or acceptable security of drainage and detention improvements in accordance with the Design Standards for Public Improvements prior to approval of the final plat. To prevent downstream flooding, the Director of Public Works may require construction of detention with no option for security.

4.1.6 Requirements for Building Plans

City Code Chapter 36 Land Development Code, Article III Zoning Regulations, Section 36-360 Site Plan Review provides the requirements for site plans associated with building permits. Site plans must provide the existing and proposed topography, all existing and proposed drainage features, a soil erosion plan, and any other information necessary to show compliance with all City codes and ordinances.

4.2 Stormwater Quality Control

4.2.1 Discharge of Pollutants

City Code Chapter 96, Article II establishes that it is unlawful to deposit or cause to be deposited any pollutants into waters of the City or State. Specific substances and activities considered pollutants are listed and permissible exemptions are given. Illicit connections to the stormwater system are specifically prohibited. The City is authorized to conduct inspections and enforce the regulations, as well as require a property owner to develop a Stormwater Pollution Prevention Plan. Violations are declared to be a public nuisance. See Chapter 10, Water Quality, for more information regarding design of stormwater control measures for water quality.

4.2.2 Water Quality Protection

City Resolution 8648 adopted the Water Quality Protection Policy for the Fulbright Spring, Pierson Creek and Sinkhole Watersheds. The resolution established a policy of implementing the recommendations of the 1995 Fulbright Spring Protection Study in each of these valuable watersheds that are community drinking water supply sources. City Code Chapter 96 Article I and the requirements in this manual replace this resolution. See Chapter 10, Water Quality, for more information regarding design of stormwater control measures for water quality.

4.2.3 Regulation of Land Disturbance Activity

City Code Chapter 96, Article III provides the City authority to require erosion and sediment control measures on land disturbance activities. The City is given authority to require any violations to be corrected.

4.3 Regulatory Floodplain

4.3.1 FEMA Floodplain Regulation

City Code Chapter 36 Land Development Code, Article XVII Floodplain Management provides for the adoption of floodplain maps approved by FEMA and establishes regulations regarding flood resistant construction for buildings in flood prone areas. Authority is given to the Director of Public

Works to interpret FEMA floodplain maps regarding flood boundaries and flood elevations. Requirements related to building in floodways and a procedure for variances and exceptions are provided.

4.3.2 Local Flood Area Regulation

City Code Chapter 36 Land Development Code, Article II Subdivision Regulations, Section 36-249 requires the City to protect, through adequate drainage or designation of open space, all developments in FEMA flood zones or other local flood hazard areas as designated by the Director of Public Works. Studies and mapping for local flood hazard areas are on file with the Stormwater Division.

5.0 References

Federal Emergency Management Agency Website (www.fema.gov)

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Missouri Code of State Regulations (sos.mo.gov/adrules/csr/csr.asp)

Missouri Department of Natural Resources Website (www.dnr.mo.gov)

Missouri Revised Statues (moga.mo.gov/statutesearch/)

U.S. Army Corps of Engineers Websites (St. Louis District: mvs.usace.army.mil/ and Kansas City District: nwk.usace.army.mil/)

U.S. Environmental Protection Agency Website (www.epa.gov)

Chapter 3 Stormwater Planning

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1.0 Overview

Stormwater drainage systems are an integral part of the urban community. It is imperative that runoff and drainage patterns be considered early in the design process for new developments before layout begins. Preliminary drainage planning is primarily a matter of space allocation. Good drainage planning results in lower-cost drainage facilities for the developer and the community, a more functional community infrastructure, and improved public health, safety, and welfare. Some of the benefits that result from a well-planned storm drainage system include:

- Minimized constrictions to conveyance and storage.
- Minimized increases in peak flows, diversions, improper discharges, and other actions that can potentially harm neighboring properties.
- Improved water quality and protection and enhancement of environmentally sensitive areas.
- Reduced street construction and maintenance costs.
- Reduced storm drainage system construction and maintenance costs.
- Reduced excavation, fill, and grading costs.
- Better building sites for homes or businesses.
- Improved aesthetics of overall development with more opportunities to make the storm drainage system a development amenity.
- Lower-cost open space and park areas and more recreational opportunities.

As watershed plans are completed and made available to the public, well-planned developments can be designed to adhere to the plans, which identify requirements for flood control, detention, and water quality management throughout a watershed.

A well-planned major drainage system can reduce or eliminate the need for underground storm sewers, and it can protect the urban area from extensive property damage, injury, and loss of life due to flooding. The major drainage system exists in a community, regardless of whether it has been planned and regardless of whether development is situated wisely with respect to it. Water will obey the law of gravity and flow downhill to seek its lowest level, regardless of whether buildings and people are in its way. The planning process can best serve the community by making sure that natural prescriptive easements are maintained along major drainage routes. Floodplain delineation and open space designations are key tools for effective major drainage system planning and can be applied to both small and large waterways.

A well-planned street and on-site drainage system is also critical to the overall effectiveness of flood control and water quality. Often, a subdivision or overall development master plan is filed in the Department of Public Works and/or Department of Planning and Development that governs how the drainage system of an individual lot should be designed. Planning for the proper location and sizing of inlets, pipes, detention basins, and Best Management Practices (BMPs) is necessary to effectively control downstream flooding and meet water quality requirements.

2.0 Drainage Planning Principles

Effective drainage planning is conducted in the context of the overall watershed and requires attention to major drainageways, the initial (streets and on-site) collection system, water quality best management practices (BMPs), transportation improvements, open space goals, and compliance with relevant permits. An overview of key considerations with regard to each of these factors is provided in this section, with more detail and criteria on specific topics developed in the remainder of this manual.

2.1 Watershed Plans

A watershed plan provides overall guidance for future actions and improvements for all or part of a developing watershed. The watershed plan is a road map of the steps necessary to achieve established goals within a watershed. Watershed goals are determined by examination of the overall drainage system, the context of the larger watershed, and public input. The goals may be determined by federal or state mandates such as pollutant discharge limits, Missouri Water Quality Standards, or a Total Maximum Daily Load (TMDL). Watershed planning may involve decisions regarding requirements for floodplain and open space management, regional detention or water quality improvements, requirements for new developments, opportunities for integration with recreation, means of accommodating conflicting utilities, and potential alternate uses for open channels, detention, and water quality facilities. Special considerations in areas of karst topography may also be needed. Watershed plans are unique and may result in different requirements in different watersheds. Master plans may cross jurisdictional boundaries requiring cooperation between governmental entities to achieve a common goal. To be effective, the master plan must have a consensus with thorough attention to engineering concepts and details so it is applicable for day-to-day use by local and regional governmental administrators. Preparing watershed plans helps to ensure the overall effort is coordinated with other predetermined objectives (ASCE and WEF 1992).

Early in the design of new developments, it must be shown that the drainage system and land use will adhere to any watershed plans. Watershed plans may set drainage requirements for new developments or retrofitting of redeveloping sites. If the watershed plan cannot be adhered to, the developer must show why it is not possible to do so.

2.2 Major Drainageways

Nature possesses, by prescription, an easement for the intermittent presence of runoff waters along floodplains and major drainageways. Humans can deny this easement only with great cost and difficulty. Encroachments upon or land modifications within this easement can have adverse effects both upstream and downstream. Major drainageways are generally defined as those having a contributing drainage area exceeding 40 acres. In these areas, land planners must establish floodplain boundaries and waterway setbacks to be contained within an easement in accordance with Chapter 12, Easements and Maintenance, of this manual. Under certain conditions, such as the presence of exceptional natural resources, major drainageways may be designated in areas with less than 40 acres of contributing drainage area. Major drainageways should generally be preserved when they exist in a natural condition, except where grade control, erosion protection, or restoration are needed. The practice of lining, straightening, narrowing, and filling major natural

waterways, such as wet and dry streams, is strongly discouraged. The practice of preserving natural waterways provides benefits such as water quality enhancement, preservation of natural floodplain storage, reduction of channel erosion, preservation of habitat, and opportunities for parks, greenway trails, and other recreational uses.

Major drainageways can consist of open channels or closed conduits, such as box culverts and large pipes. In general, open channels are strongly preferred to closed conduits. Open channels can include stabilized natural waterways, modified natural channels, or artificial channels with grass or other lining. The character of the major drainageways may change from reach to reach to account for neighborhood needs and environmental requirements. The design storm for the major drainage system is the 100-year (1 percent Annual Exceedance Probability [AEP]) rainfall for drainage areas one square mile or larger, and 25-year rainfall for drainage areas less than one square mile. Flows from the 100-year design storm must be contained within the drainage easement in all cases.

When planning a new development, a variety of drainage concepts should be evaluated prior to determination of the location of streets and lot layout. This is the point in the development process where the greatest impact can be made regarding the cost of the drainage facilities and how well they will perform. Developments should be designed around drainage patterns and existing topography to achieve the most efficient drainage system. The designer should begin by determining the location and width of existing waterways and floodplains. Streets and lots should be laid out in a manner that preserves the existing drainage system to the greatest extent practical. Constructed channels should only be used when it is not practical or feasible to use the existing waterway.

A preliminary estimate of the design flow rate is necessary to approximate the capacity and size of a channel or conduit (See Chapter 5, Calculation of Runoff). Proposals to modify major natural waterways should be submitted to the City for approval prior to detailed design. In such cases, it must be shown why it is not feasible to preserve the natural major drainageway.

Sections 2.2.1 through 2.2.3 identify important planning-level considerations for major drainageway planning, including factors related to open channel design, stream setback requirements, and floodplain regulations. Chapter 8, Open Channels, provides detailed discussion of open channels, including design criteria.

2.2.1 Open Channels

The use of open channels for major drainageways can have a significant advantage with regard to cost, capacity, the potential for recreational uses, aesthetics, environmental protection/enhancement, and potential for detention storage. Use of open channels in new developments typically falls under one of the following categories:

- Existing natural channels that are stable and expected to remain stable and are being preserved in a natural state.
- Existing natural channels that are not stable or are not expected to remain stable due to changes in the watershed and are therefore being stabilized with bioengineering methods.

- Existing or proposed semi-improved channels where there is some intervention, such as grading, but the channel appears to be natural and is lined with vegetation such as grass and trees.
- Existing or proposed improved channels with a natural lining, such as a trapezoidal grass channel that is mowed on a regular basis. An improved channel may include a small, concrete low-flow channel to reduce erosion and allow the grade to be maintained.
- Existing or proposed improved channels with a hard lining where concrete, rock, or other armoring makes up a significant part of the channel, such as rectangular or trapezoidal concrete or riprap channels.

The volume of storm runoff, peak discharge rate, and frequency of bank-full discharges from an urban area are usually significantly larger than under historic, undeveloped conditions (Leopold 1994; Urbonas 1980; ASCE and WEF 1992; WEF and ASCE 1998). The engineer must recognize that when natural channels begin to carry storm runoff from a newly urbanized area, the changed runoff regime will result in new and increased erosional tendencies. Careful hydraulic analysis of natural channels must be made to foresee and counteract these tendencies. In nearly all cases, some modification of the channel will be required to create a more stabilized condition to withstand changes to surface runoff created by urbanization. Typically, this involves construction of grade controls or drop structures at regular intervals to decrease the thalweg (channel invert) slope and control erosion. Bank and bottom stabilization may also be necessary. When site conditions are conducive, channels should be left in a condition as close to natural as feasible, subject to the requirement of demonstrated stability during the 25-year event. Extensive channel modifications should not be undertaken unless they are found to be necessary to avoid excessive erosion with subsequent sediment deposition and water quality deterioration.

Decisions related to using the existing channel or needed improvements to the channel include:

- Space availability within the development
- Existing and required channel capacity for flood control
- Condition of existing facilities
- Recent and expected changes in upstream runoff from the contributing watershed
- Physical characteristics of the natural channel such as slope, soil characteristics, and vegetative condition.

When feasible, it is preferred that natural channels be preserved or improved through bioengineering methods. If that is not feasible, improved grass channels are generally preferred to channels with a hard lining, except where necessary due to the physical or hydrologic characteristics of the site. The benefits of a stabilized natural channel can include:

- Lower flow velocities, resulting in longer concentration times and lower downstream peak flows
- Channel and adjacent floodplain storage that tends to decrease peak flows.
- Lower maintenance needs.
- Protection of riparian and aquatic habitat.

- A desirable greenbelt and recreational area that adds significant social benefits.

While recognizing the need for at least some stabilization measures to address the hydrologic changes caused by urbanization, the more an artificial channel resembles the character of a natural channel, the greater these benefits will be realized. See Chapter 8, Open Channels, for specific design criteria along major drainageways.

2.2.2 Stream Setbacks

Setbacks or buffer zones are areas to be left undisturbed along major drainageways that must be provided in accordance with standards given in Chapter 8, Open Channels. When the standard setback cannot be provided, additional BMPs may be acceptable to compensate for the lack of setback. In cases of a meandering channel, it may be necessary to provide additional setback or buffer zone beyond the minimum standard to account for future channel movement. Likewise, where a deep, incised channel exists, a buffer zone allowance should be provided for bank sloughing and future channel modification by creating a setback line computed at a bank slope of 4:1 (horizontal to vertical) measured from the bottom of the channel bank.

2.2.3 Floodplain Regulation

Floodplain regulation is a necessary action for a government to exercise its duty to protect the health, safety, and welfare of the public. The concept of the existence of a natural easement for the storage and passage of floodwaters is fundamental to the assumption of regulatory powers in a definable flood zone. Floodplain regulation must define the boundary of the natural easement and must delineate easement occupancy that will be consistent with public interests. Authority for floodplain regulation is described in Chapter 2, Section 4.3, and specific management requirements for floodplain regulation are described in Chapter 1, Section 5.0. The following types of maps can be referenced to identify flood-prone areas in the City for use in drainage planning:

- Federal Emergency Management Agency (FEMA) Floodplain Maps: An important tool to assist with good floodplain management is the FEMA floodplain map. The National Flood Insurance Act of 1968 established the National Flood Insurance Program (NFIP), which included a national floodplain mapping effort. Certain areas in the City have been designated as floodplains and are regulated as required by the NFIP. While these maps were created to indicate risk factors for determining appropriate flood insurance rate premiums, they are also useful for designating flood-prone areas. Any developer considering developing property in the City should obtain a copy of the FEMA floodplain map and understand the effects any floodplain may have on a proposed development.
- City Flood Hazard Area Maps: In addition to floodplains shown on the FEMA map, other flood-prone areas exist throughout the City along major drainageways and sinkholes, which are subject to City regulations for flood control. These areas may be mapped on City Flood Hazard Area Maps, which are another tool to assist the City and the public in identifying flood-prone areas. Developers should also refer to these maps and understand the effects a flood hazard area may have on a proposed development. Other flood-prone areas may exist in the City that are not shown on these maps. Engineering studies must be conducted to identify these areas prior to development.

2.3 Street and Site Drainage

Effective drainage planning also requires thorough attention to the initial or minor drainage system. This section provides a planning-level overview of key considerations for street and site drainage and on-site detention. Chapter 6, Streets, Inlets, and Storm Drains, should be referenced for detailed design criteria for streets, inlets, and storm drains, and Chapter 9, Detention for Flood Control, should be referenced for design criteria for detention for flood control.

2.3.1 Street Inlets and Pipes

Streets serve as part of the initial collection system in an overall drainage system. The objective of street drainage design is to reasonably minimize inconvenience to the traveling public, provide for safe passage of emergency vehicles during runoff from up to a 100-year event, and prevent the overflow of runoff from streets onto private property during runoff from up to a 100-year event. A well-planned street location and preliminary design can greatly reduce street drainage improvement construction costs. Pipes and boxes must be designed to convey the 25-year design flow. Inlets must be designed to limit spread based on the street classification. The design flows that must be considered include the 2-, 25-, and 100-year design flows. See Chapter 6, Streets, Inlets and Storm Drains, for more detailed design criteria.

2.3.2 Site Drainage

The initial collection system within a development may include curbs, gutters, inlets, swales, pipes, flumes, channels, open waterways, detention, and water quality BMPs. The collection system is critical to the protection of adjacent streets and properties from flooding. The objective of the site collection system is to completely collect and convey the 25-year design flow and protect properties adjacent to streets during runoff from up to the 100-year design flow. The combination of drainage improvements and surface grading must convey all runoff to the detention basin serving the site. Discharges from the site must connect directly to the existing drainage system where possible, as opposed to discharging to the street. Provision must be made to protect streets and sidewalks from flooding. Discharges to the street should not exceed the street design criteria and discharges across a sidewalk must protect the sidewalk from inundation up to the 2-year flow. Inlets should be properly selected for site conditions to minimize the possibility of clogging and the resulting potential for damage. Typical inlet types include curb opening inlets, open-side drop inlets, and grated inlets. See Chapter 6, Streets, Inlets, and Storm Drains, for more detailed design criteria.

2.3.3 Site Detention

Any development that increases runoff must address runoff through construction of on-site detention or other compensatory measure approved by the City. Detention for flood control is designed to prevent increases in peak flow from the 1-, 10-, and 100-year storms. On-site detention should be located at the low point(s) on the site and discharge to a public right-of-way, drainage easement, or certified natural surface water channel (as defined in the Missouri courts; also see Chapter 4, Plan Submittal). Detention facilities should be planned to match existing topography to minimize cut and fill, land disturbance, and environmental impacts. Aesthetics should be considered during design so that the facility complements surrounding land uses. Opportunities should be sought in all developments to create amenities with detention basins by utilizing

permanent pools, gentle slopes, landscaping, and trees and incorporating multi-purpose uses, such as recreation. Refer to Chapter 9, Detention for Flood Control, for design criteria. Any plan to address detention requirements through any method other than conventional on-site detention should be submitted to the City for review and comment at the preliminary planning stage. The City can advise as to the feasibility of any such plans. Acceptable alternatives to constructing on-site detention may include:

- Off-site Detention: The developer may seek opportunities to modify an existing off-site basin or construct a new off-site basin to meet detention requirements. A new off-site basin proposal must have the necessary drainage and detention easements between the off-site landowner and the developer documented, approved by the City, and recorded. If an existing off-site detention basin was not designed for the development, the off-site property owner must provide the required drainage and detention easements to the developer to modify and use the detention basin. Maintenance responsibility must be clearly defined. This can be a joint venture with other developers to provide regional detention if the proposed drainage and detention easements and maintenance responsibilities are documented, approved by the City, and recorded. It is a requirement of all off-site proposals that the necessary conveyance improvements between the development(s) and the detention basin be included as part of the improvement, and the necessary easements for such improvements are documented, approved by the City, and recorded.
- Payment in Lieu of Constructing Detention: In accordance with Chapter 96, Article I, Division 2 of the City Code, a payment in lieu of constructing detention may be acceptable if it can be shown that detention provides no downstream benefits. An application must be completed and submitted to the City prior to a payment in lieu of detention being accepted. These payments are generally not acceptable when downstream flooding problems are known to exist. The funds must be used for regional detention and conveyance improvements within the watershed.
- Constructing Downstream Improvements: A payment in lieu of constructing detention may be acceptable with the construction of certain downstream improvements. If the plan for downstream improvements is acceptable, the developer may apply the cost of constructing the improvements toward the cost of the payment in lieu of constructing detention.

In-line detention that collects off-site runoff should be avoided, particularly when the off-site runoff is greater than the on-site runoff. In these cases, the detention volume will likely be much greater than if the detention basin was an off-line basin collecting only on-site runoff. The larger the off-site area that drains through a detention basin, the less effective the basin is and the higher are basin construction costs due to increased volume requirements and control structure size. In addition, in-line detention basins along major drainageways may require a U.S. Army Corps of Engineers (USACE) Section 404 Permit. Therefore, it is preferred that detention be off-line with the waterway preserved in a more natural state.

Permanent pool detention basins are typically encouraged because of the potential water quality, aesthetic and habitat benefits they can provide. When designed and constructed properly, they can

be an amenity to both the development and the community. Refer to Chapter 9, Detention for Flood Control, for detailed design criteria for permanent pool detention areas.

Detention on or near the upstream portion of the site to reduce off-site peak runoff may be considered as an option to compensate for increased peak runoff from the site in cases where the low point of the site is not conducive to detention facilities. It must be shown that the total peak runoffs for the design storms at locations downstream of the site are no greater than pre-development conditions. Careful attention must be given to peak runoff timing, and a conservative design may be appropriate to assure peaks are not increased due to inaccurate modeling of the peak timing.

2.3.4 On-site Best Management Practices

Stormwater quality BMPs, also known as Stormwater Control Measures (SCMs) are required as specified in Chapter 10 to reduce impacts on downstream water quality and meet the requirements of the City's federally mandated Municipal Separate Storm Sewer System (MS4) permit. Planning for a new development or redevelopment should include consideration of how the site layout and design can reduce and disconnect impervious cover. Consideration should also be given to preservation of trees, natural vegetation, and soils, which provide infiltration and evapotranspiration benefits. Planning should also include determination of the SCMs to be used, which commonly include extended or wet detention, disconnecting impervious areas, pervious pavement, rain gardens and grass buffer strips, swales, and channels. Stormwater quality and quantity (rate and volume) are closely related and should be planned and designed concurrently. SCMs should also include open channel designs that both filter runoff and maintain long-term stability, thereby reducing pollutants and sediment. Chapter 10, Water Quality, provides design criteria for several common SCMs. Chapter 8, Open Channels, provides criteria for open channel designs that provide stable channel linings and reduce channel erosion and downstream sediment.

2.4 Transportation

Developments near major transportation features and facilities, such as highways, railroads, and airports, should closely investigate the effects of any stormwater conduits or structures related to the facility. Many flooding problems can be created by conduits or transportation-related structures, particularly by those that are older or inadequate. Many storm drainage problems can be avoided with cooperation and coordination between the developer or transportation agency and local governing authority over the drainage system. Culverts at highway or railroad embankments can cause drainage hazards such as excessive flooding upstream of the culvert or excessive flow velocity and erosion downstream of the culvert. These conditions should be investigated early in the planning process to determine what costs or limitations might be required. Proposals for new developments or improvements by transportation entities should be closely coordinated with the City to identify drainage issues, potential problems, and requirements.

2.5 Open Space

Floodplains are often excellent locations for community or neighborhood open space, particularly since the occasional flooding in these areas makes many developments unfeasible. In addition to reduction in flood risk to a community, leaving these spaces open can serve multiple purposes, such

as water quality and habitat enhancement, greenway trails, and other recreational uses. Additional open space adjacent to floodplains may be appropriate for a broader riparian and buffer corridor, larger scale recreational uses, or parks. The designer of new developments should consider these options for floodplains and consult the governing agency for any watershed plans that address land use along floodplains.

2.6 Required Permits

Planning for any new development must consider the need for city, county, state, and federal permits early in the planning process. This is particularly important when the development will involve construction along a major drainageway. Chapter 2, Authority and Law, provides an overview of laws and regulations that authorize these permits, and the most common permits related to stormwater runoff are listed below:

- Land Disturbance Permit: For sites within the City that will disturb one acre or greater, or sites that will disturb less than one acre but are part of a larger common plan of development, a Land Disturbance Permit must be obtained from both the City of Springfield Department of Environmental Services and the Missouri Department of Natural Resources (MDNR) before any land disturbance occurs. Information on obtaining a land disturbance permit from the City can be found at www.springfieldmo.gov/stormwater or by calling 417-864-1944. The land disturbance permit must be obtained prior to beginning any work on a site that will disturb one acre or greater, or will disturb less than one acre that is part of a larger common plan of development, including work under the permits specified below.
- Stormwater Permit: This permit is to ensure the development is in compliance with the criteria established in this manual and the Springfield City Code. To obtain the permit, calculations, plans, and specifications must be approved by the Stormwater Services Division of Public Works. Work within a sinkhole is also covered under this permit. See Chapter 11 for requirements when working within a sinkhole.
- Public Improvement Construction Permit: This permit to construct public drainage improvements is obtained from the Department of Public Works. To obtain the permit, there must be an approved set of construction plans and the inspection fees must be paid. Request for inspection should occur 48 hours prior to beginning construction.
- Building Permit: This permit to begin construction of a building, parking lot, or other facility is obtained from the Department of Building Development Services. To obtain the permit, the site plan showing drainage improvements must be approved by the Department of Public Works.
- Floodplain Development Permit: As described in Section 2.2.3 and Chapters 1 and 2, Springfield participates in the NFIP, which requires that the City administer the rules of the NFIP through floodplain regulation. Depending on the proposal and circumstances, various permits may be required when a structure or fill are proposed in the floodplain or floodway. An elevation certificate is required for any structure constructed in the floodplain.
- USACE Section 404 Permit: The purpose of the USACE Section 404 program is to ensure that the physical, biological, and chemical quality of the nation's water is protected from irresponsible and unregulated discharges of dredged or fill material that could permanently alter or destroy valuable water resources. Section 404 of the Clean Water Act requires

approval from the USACE prior to discharging dredged or fill material into the "Waters of the U.S." Waters of the U.S. include essentially all surface waters, such as all navigable waters and their tributaries, all interstate waters and their tributaries, all wetlands adjacent to these waters, and all impoundments of these waters. Any waterway with a permanent flow of water is generally considered a Water of the U.S. Some intermittent waterways also may be considered Waters of the U.S. Wetlands are areas characterized by growth of wetland vegetation (e.g., bulrushes, cattails, rushes, sedges, willows, etc.) where the soil is saturated during a portion of the growing season or the surface is flooded during part of most years. Wetlands generally include swamps, marshes, bogs, and similar areas.

Typical activities within Waters of the U.S. and adjacent wetlands that require Section 404 permits are:

- Site development fill for residential, commercial, or recreational construction.
- Construction of in-channel structures.
- Placement of riprap.
- Construction of roads.
- Construction of dams.
- Any grading within the channel of Waters of the U.S.

When activities of this type are proposed, the developer should contact the USACE to determine if a Section 404 Permit will be required and to identify major issues involved in obtaining the permit. The area in the City that is generally south of Division Street drains south to the White River and is in the USACE Little Rock District. The area in the City that is generally north of Division Street drains north to the Sac River and is in the USACE Kansas City District. The Section 404 Permit must be obtained prior to any construction permits being issued by the City.

Section 401 of the Clean Water Act allows the state to require a water quality certification along with each Section 404 Permit. The MDNR Section 401 Water Quality Certification cannot be issued until the Section 404 Permit has been issued.

Other permits, licenses, or authorizations may also be required by other federal, state, and local agencies; the issuance of a Section 404 Permit does not relieve the proponent from obtaining such permits, approvals, licenses, etc.

3.0 Development Review Process

3.1 Subdivisions

Early planning for a new subdivision should include arrangement of a Pre-subdivision Review Meeting through the Planning and Development Department. This meeting is critical to the development of an acceptable stormwater management plan that will be less likely to experience problems in the review process and will result in a more efficient and optimum stormwater design. At this meeting, major conceptual stormwater issues can be identified to help with development of a design that can maximize flood control and water quality protection and minimize project costs

and future conflicts and construction difficulties. Major design features that should be identified first are the preservation of and setbacks from major drainageways, the location and configuration of detention basins and water quality controls, trees, natural vegetation and soils to be preserved, and the location and configuration of streets and lots to preserve existing topography and reduce impervious cover. Any watershed plans affecting the development should be identified so that compliance approaches can be incorporated early in the design process. The developer should obtain a copy of the Preliminary Plat checklist and submittal requirements, as identified in Chapter 4, to begin preparation of acceptable stormwater reports and plat layout. This information can also be obtained from the Planning and Development Department.

Prior to submittal of the Preliminary Plat for a hearing before the Planning and Zoning Commission, all requirements listed in the preliminary plat checklist and comments from the Pre-subdivision Review Meeting must be addressed. After the Preliminary Plat has been approved by City Council, the developer must submit final stormwater reports and public improvement plans. Plans must be completed in accordance with this manual following the checklists and formats provided in Chapter 4, Plan Submittal.

After all public improvement plans have been filed and all public improvements have been constructed or escrowed by the developer, the Final Plat may be submitted for review to the Planning and Development Department. Constructed public stormwater improvements must be accepted by the City or escrow of the public stormwater improvements must be completed in accordance with the Preliminary Plat and City requirements. Stormwater Services will review the Final Plat to check for consistency with the approved construction plans regarding common areas and drainage easements that contain drainage improvements.

A common problem experienced in the design of subdivisions is that the layout fails to account for the natural forms and topography of the land. Figure 1 contrasts the differences between a development that preserves existing drainage patterns and closely follows the existing land forms, thereby reducing construction costs, compared with a development that does not consider the natural land forms, resulting in additional, unnecessary construction costs for the developer.

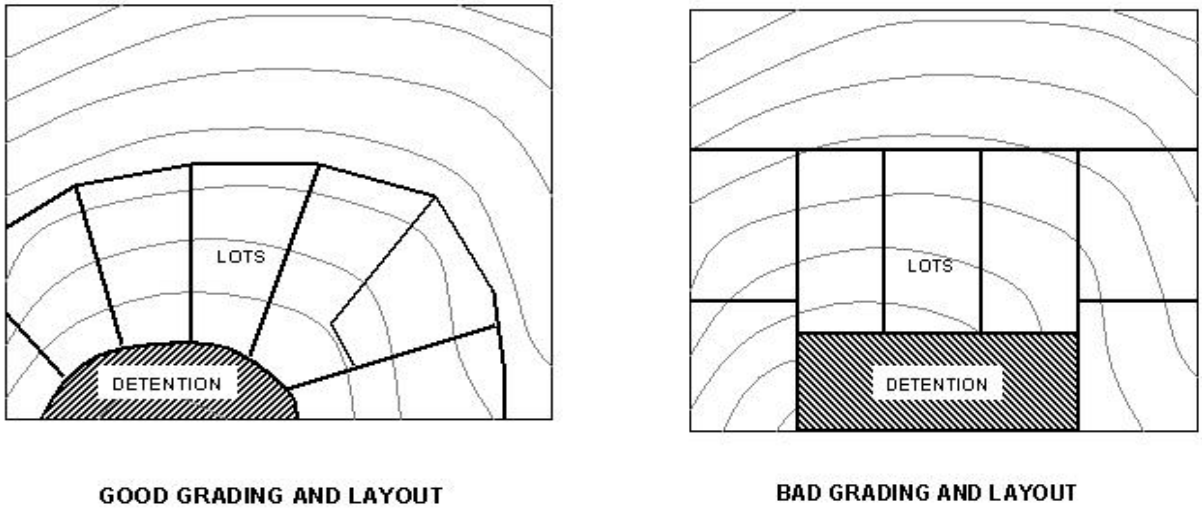

Figure 1. Examples of Good and Bad Grading and Lot Layout

3.2 Building Site Plans

Early stages of building site plan development should include review of this chapter to help identify major stormwater issues. A pre-application conference should be arranged through Building Development Services which will include review and identification of major stormwater issues by City staff. Sites that are part of a subdivision must adhere to the stormwater plan for the subdivision or provide additional engineering analysis to justify modification of the plan. The design process should begin with designing around drainage patterns, and identifying any trees, natural vegetation and soils to be preserved. The site design should also consider ways to reduce and disconnect impervious cover. If a detention basin is required, adequate space must be set aside to construct the facility. Drainage leaving the site must be in accordance with the subdivision plan, which typically specifies connecting directly to a public drainage system, as opposed to draining over the land surface to a street. Any necessary improvements to convey off-site runoff across the site, such as runoff originating from a public street or another property, must be designed and constructed as public improvements. Submitted building site plans must be reviewed and approved prior to issuance of a building permit. Plans will be reviewed in accordance with the Site Plan Design Guide and this manual. See Chapter 4, Plan Submittal, for more information about building site plan submittal requirements.

3.3 Zoning Changes

When a property owner petitions the Department of Planning and Development for a change of zoning on a particular property, stormwater and sinkhole reports must be submitted and approved, where applicable. These reports must be submitted and approved by Public Works if requested by City staff or the Planning and Zoning Commission due to concerns related to the rezoning. General requirements for change of zoning requests may be obtained from the Planning and Development Department, or Chapter 4, Plan Submittal. To discuss stormwater issues specific to a site, contact the Department of Public Works Stormwater Services Division.

3.4 Planned Developments

General requirements for a planned development are specified in Section 36-405 of the City Code.

3.5 Vacations

Vacations of public lands, rights-of-way, and alleys should be reviewed to determine whether the property contains a waterway or any other drainage with an off-site source. These areas must be dedicated as a public drainage easement as part of the vacation process.

4.0 References

American Society of Civil Engineers and Water Environment Federation (ASCE and WEF). 1992. *Design and Construction of Urban Storm Water Management Systems*. American Society of Civil Engineers Manuals and Reports of Engineering Practice No. 77 and Water Environment Federation Manual of Practice FD-20. New York: ASCE.

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Chapter 4 Plan Submittal and Inspections

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1.0 Overview

This Chapter defines the minimum plan submittal and inspection requirements for private and public stormwater improvements. A Stormwater Construction Plan Submittal Checklist is provided at the end of this Chapter to help ensure that all required items are submitted for review.

2.0 Stormwater Construction Plans

Stormwater construction plans shall be submitted for review and approval in accordance with Chapter 36 of the City's Land Development Code and Chapter 96 of the City Code of Ordinances. Stormwater construction plans shall include a Title Sheet, Site Plan, Grading Plan, Detention and/or Water Quality Stormwater Control Measure (SCM) Plan, Storm Drain Plan, Details Plan and an Erosion and Sediment Control Plan. Submitting a complete set of stormwater construction plans will help reduce permit review time and is essential to effectively communicate to contractors what the engineer intends to be constructed. Often, poor construction plans or poorly constructed stormwater improvements result in ineffective stormwater systems and flooding problems. Stormwater construction plans shall be prepared as follows:

2.1 Public Stormwater Improvement Plans

Any stormwater improvement project that serves multiple properties or routes stormwater runoff from one property across another is defined as a public stormwater improvement project. Public stormwater improvement projects will require the submittal of Public Stormwater Improvement Plans using Public Works Title Block. Public Stormwater Improvement Plans shall be prepared in accordance with this Manual and the requirements in Chapter 2 of the City of Springfield Design Standards for Public Improvements and Chapter 5 of the General Conditions and Technical Specifications for Public Improvements. These documents may be obtained from the Public Works Stormwater Engineering Division or downloaded from the City website.

2.2 Private Stormwater Improvement Plans

Any stormwater improvement project that serves only one property and does not extend onto another property is defined as a private stormwater improvement project. Private stormwater improvement projects will require the submittal of Private Stormwater Improvement Plans which must be designed to:

- Comply with detention and water quality requirements, per Chapters 9 and 10.
- Protect all structures from inundation and provide 2-feet of freeboard below any finished floor for the 100-year peak flow.
- Protect public streets from flooding, worsen flooding or cause the street to not meet the City's stormwater drainage criteria.
- Adequately discharge both onsite and offsite peak flows to a public right-of-way, drainage easement, or certified natural surface water channel.

3.0 Stormwater Report

A supplemental stormwater report that includes detailed drainage design computations must be submitted with stormwater construction plans. The stormwater report must include all details of the stormwater system including detention and water quality calculations and any other relevant hydraulic calculations required to ensure that the proposed stormwater system is designed in accordance with all City regulations. Stormwater calculations for predevelopment and post development conditions must be submitted for the 1, 10 and 100-year storm events to show that post development runoff peaks will not exceed predevelopment runoff peaks. All details of the routing procedure must be submitted with the report. Custom spreadsheets have been developed with this manual to assist in completion of the stormwater report. These spreadsheets may be downloaded from the City web site. At a minimum, stormwater reports shall include the information in the following sections.

3.1 Project Description and Background

Provide the development name, address and location along with any other relevant information to identify the specific location of said development such as nearest intersection or known landmark. State the type of development (i.e., Commercial Development, Residential Development, etc.), the overall size of the development, and if there are any plans for future development. State if there is any concentrated offsite stormwater runoff crossing the development and, if so, how the offsite runoff will be conveyed through the site. State if work is to be performed on a State or County Right-of-Way and provide written approvals from said agencies. State if site contains a sinkhole or is located in a sinkhole watershed. If so, provide a Sinkhole Evaluation Report in accordance with Chapter 11 of this manual. State if the development is located in the FEMA floodway or 1% annual floodplain and provide name of the receiving water body. A floodplain development permit will be required from the Building Development Services Department in accordance with the City's Floodplain Management Ordinance for any work in a FEMA floodplain. A jurisdictional determination and permit may also be required from the Unites States Army Corps of Engineers.

3.2 Detention Summary

State the existing and proposed percent of impervious surfacing for the site. If there is an increase in impervious surfacing, state which method the development will use to meet the City's stormwater flood control regulations (i.e., Existing Detention, Stormwater Detention Buyout, or Stormwater Detention Construction).

3.2.1 Existing Detention

If an existing stormwater detention facility was previously constructed to serve a development, it must be shown that the proposed development is in conformance with the original design criteria of the existing detention facility. Runoff from the proposed development must drain directly to the existing detention facility or drain through drainage easements and/or street right of way to the detention facility. If runoff from the proposed development exceeds the existing detention facility design criteria, additional detention must be provided in accordance with current stormwater regulations.

3.2.2 Stormwater Detention Buyout

A payment in lieu of constructing stormwater detention, also known as a "detention buyout", may be approved to meet detention requirements if the provisions of Chapter 9 of this manual are met. An Application for Payment in Lieu of Constructing Stormwater Detention must be submitted for consideration early in the design process to determine whether the detention buyout will be permitted. An Application for Payment in Lieu of Constructing Stormwater Detention may be obtained from the Public Works Stormwater Engineering Division or from the City web site at www.springfieldmo.gov/stormwater. When considering a detention buyout, peak flow rates from the site for both predevelopment and post development conditions will be considered as well as the downstream storm sewer capacity and flooding potential. Other factors may be considered based on the particular site. Downstream stormwater improvements may be required as a part of the approval for a detention buyout. The cost of downstream improvements may be credited toward the detention buyout cost if approved by the Director of Public Works. To receive this credit, the improvements must be a segment of the ultimate stormwater system for this location. Stormwater detention buyout funds will be used by the City to construct and maintain conveyance systems and regional detention basins within the drainage basin in which they are collected. A stormwater detention buyout must be paid prior to issuance of a building permit. If a detention buyout is not approved, detention must be provided on site.

3.2.3 Stormwater Detention Construction

If constructing a stormwater detention facility, provide a description of the facility (i.e., dry, wet) along with the facility location and the maximum amount of impervious surfacing the facility is designed to handle. State the design method used to size the detention facility (i.e., Tabular Method, Modified FAA Method or Hydrograph Method) and provide a summary of the proposed stormwater detention facility as follows:

3.2.3.1 Tabular Method

If using the Tabular Method to determine the required stormwater detention volume, a summary of the stormwater detention facility shall be provided as shown in Table 1.

Table 1. Tabular Method

	Area of Site (acres)	Impervious Area Added (%)	Required Detention Volume (cf)
Post Development			

3.2.3.2 Modified FAA Method

If using the rational formula based Modified FAA Method to determine the required stormwater detention volume, summarize the stormwater detention analysis as shown in Table 2.

Table 2. Modified FAA Method

	Catchment Area (acres)	Runoff Coefficient	Time of Concentration (minutes)	Average Outflow (cfs)	Required Detention Volume (cf)
Post Development					

3.2.3.3 Hydrograph Method

If using the Hydrograph Method to determine the required stormwater detention volume, provide a summary of the watershed data as shown in Table 3.

Table 3. Hydrograph Method

	Drainage Area (acres)	Cover Type	Soil Group	Curve Number	Time of Concentration (minutes)
Predevelopment Condition					
Post Development Condition					

For the Kinematic Wave or SCS Hydrograph Methods, a critical duration analysis shall be performed to determine the duration that maximizes peak runoff rates for the watershed. Provide a summary of the Critical Duration Analysis for predevelopment and post development peak flow rates for the 1, 10, and 100 year events. The duration that produces the highest peak flows shall be used for the detention facility design. A summary of the Critical Duration Analysis shall be provided as shown in Table 4.

Table 4. Critical Duration Analysis

Duration	Predevelopment Peak Flows (cfs)			Post Development Peak Flows (cfs)			Basin Maximum W.S.E.
	1 year	10 year	100 year	1 year	10 year	100 year	
30 min.							
1 hour							
2 hour							
3 hour							
6 hour							
12 hour							
24 hour							

Provide rainfall precipitation values used for the stormwater detention design as shown in Table 5.

Table 5. Rainfall Precipitation

Annual Exceedance Probability (AEP)	Rainfall Depth (inches)	Critical Duration (hours)
100 (1 year)		
10 (10 year)		
1 (100 year)		

Provide a summary of the detention basin predevelopment and post development peak flow rates, maximum elevations and storage volumes for the 1, 10 and 100 year storm events as shown Table 6.

Table 6. Detention Facility Summary

Return Period	Predevelopment Flow Rates (cfs)	Post Development Flow Rates (cfs)	Maximum W.S.E. (ft)	Storage Volume (cf)
1 year				
10 year				
100 year				

The top elevation of the detention facility and the amount of freeboard shall be stated to ensure that a minimum of one (1) foot of freeboard above the 100-year maximum elevation has been provided.

3.2.3.4 Emergency Overflow Spillway

An emergency overflow spillway will usually be needed in a detention basin to convey flows that exceed the primary outlet capacity or to direct overflows to a specific location. The SCS Type II, 24-hour storm event shall be used to design the emergency overflow spillway. If an emergency overflow spillway is needed, provide a summary of the spillway including the location, type, size and flow capacity.

3.3 Water Quality Summary

Proposed developments must comply with the water quality requirements in Chapter 10. Developments draining to a sinkhole must also comply with the water quality requirements in Chapter 11. All new impervious surfacing must convey runoff into the water quality facility. State what type of water quality SCMs will be constructed along with the required water quality volume.

3.4 Storm Drainage Collection and Conveyance System Summary

State how the development will collect and convey stormwater runoff. Provide a summary of the stormwater collection and conveyance system including the hydraulic method and design storm event used. State where the storm drainage system will discharge concentrated flows offsite (Public Right-of-Way, Drainage Easement or Certified Natural Surface Water Channel). Whenever possible, connect private drainage facilities to a public drainage system, which will require a public improvement plan or an excavation permit.

3.5 Stream Buffer Summary

Developments containing a natural channel with a drainage area of 40 acres or greater must comply with the stream buffer requirements in Chapter 8. State the category of stream and describe how the stream buffer requirements will be met.

4.0 Detailed Drainage Analysis

Provide detailed hydrologic and hydraulic stormwater computations in accordance with Chapters 5 thru 10 of this manual showing that the proposed stormwater facilities meet current City stormwater regulations. The analysis shall include the following information:

4.1 Calculation of Runoff

Stormwater runoff calculations shall be submitted in accordance with Chapter 5 of this manual. Provide Drainage Area Maps showing the overall drainage catchment areas for predevelopment and post development conditions.

The stormwater system design for a development shall take into account runoff from offsite areas. For flood control planning and modeling, effects of detention should be disregarded except for publicly owned and maintained facilities with storage dedicated in perpetuity.

4.2 Streets, Inlets and Storm Drains

Street, Inlet and Storm Drain designs shall be submitted in accordance with Chapter 6 of this manual. Calculations shall be provided to show that the proposed storm drainage system will not exceed the allowable drainage encroachment within public streets, provides allowable types, sizes and placement of inlets, and provides appropriate sizing and design of storm drains. Detailed street, inlet and storm drain computations shall be provided as follows:

4.2.1 Streets

Provide drainage calculations showing that the proposed stormwater collection system meets the 2-year and 100-year street inundation criteria and the 25-year conveyance and hydraulic grade line gutter criteria.

4.2.2 Inlets

State the design rainfall event and type of inlets to be constructed. Provide a Drainage Area Inlet Map showing catchment areas and peak flow for each inlet. Provide calculations showing that the proposed drainage inlets will have the hydraulic capacity to capture peak flows. Inlets must be

located to limit gutter flows to no more than 5 cubic feet per second (cfs) for the 2-year event and meet spread limitations based on the street classification. Inlets shall also be provided at all low points in the gutter grade or on the upstream side of intersections and crosswalks. Inlets in public streets shall be specified and constructed in accordance with the City of Springfield Standard Drawing Details for Public Improvements which may be obtained on the City web site. Other types of inlets including trench drains may be permissible if approved by the City. Private inlets may include other proprietary designs. The effects of inlet clogging must be taken into account. A fifty percent reduction in capacity shall be used for a single grate inlet and a ten percent reduction shall be used for a single curb opening inlet. A smaller reduction may be allowed in cases where multiple inlet units are accepted.

4.2.3 Storm Drains

State the design rainfall event. All public storm drains shall be designed to convey the 25-year storm event. Minimum and maximum velocities must be met in the 2 year and 100 year storm events. Provide pipe layouts and profiles showing location, pipe materials and sizes, slopes, lengths, vertical alignments and crossings with other utilities. Storm sewer reports shall be submitted showing pipe lengths, deflection angles, junction types, runoff coefficients, intensities, inlet areas, flow rates, slopes, upstream and downstream elevations, Manning's n values, minor losses, hydraulic and energy grade lines, and velocities. If using the Rational Method to calculate flow rates, antecedent moisture conditions shall be accounted for in the 25, and 100 year storm events. Storm Sewer Hydraulic Spreadsheets are available on the City web site to assist with pipe sizing calculations.

4.3 Culverts and Bridges

Culvert and Bridge design shall be submitted in accordance with Chapter 7 of this manual.

4.3.1 Culverts

Provide profiles of culverts showing the vertical alignment, slopes, lengths, velocities, hydraulic and energy grade lines, and end treatment. Culvert Hydraulic Spreadsheets are available on the City web site to assist with box culvert sizing calculations.

4.3.2 Bridges

Provide bridge dimensions, velocities, water surface profiles, backwater analysis, and freeboard.

4.4 Open Channels

Open Channel designs shall be submitted in accordance with Chapter 8 of this manual. Provide type of channel (i.e., Natural or Engineered), detailed profile and cross section, design flow rates and velocities, slope, freeboard, sediment loading, channel lining, outfall, and buffer zone information. Spreadsheets are available on the City web site to assist with the open channel calculations. Submit a stream buffer plan in accordance with Chapter 8.

4.5 Detention for Flood Control

Stormwater flood control shall be submitted in accordance with Chapter 9 of this manual. Provide hydraulic detention design calculations based on the following acceptable methods and criteria:

4.5.1 Tabular Method

The Tabular Method may be used to calculate the required volume of a detention basin or the required volume for payment in lieu of constructing detention for developments with less than 0.5 acres of new impervious area and detention volumes less than 5,000 cubic feet. Provide the overall site area and the percent of impervious area added. Use Table 2 in Chapter 9 to determine the required detention volume. Detention basin designs must include a low-flow orifice designed to discharge at the 1-year peak flow rate and be a minimum of 6 inches in diameter. An overflow spillway must also be included and designed to convey the 100-year post development flow rate above the required volume. A freeboard of 6 inches must be provided.

4.5.2 Modified FAA Method

The Modified FAA Method may be used to calculate stormwater detention requirements for developments with less than 2 acres of new impervious area and detention volumes less than 20,000 cubic feet. Provide the catchment area (A), runoff coefficient (C), time of concentration and rainfall intensities (I) for the predevelopment condition and calculate the allowable maximum peak outflow rate (Q_{po}). Provide a tabular spreadsheet with storm durations from 5 minutes to 180 minutes and associated rainfall intensities in Chapter 5. Using the rational formula based Modified FAA Method in Chapter 9, calculate inflow volumes, outflow adjustment factors, average outflow rates, outflow volumes and required storage volumes. The maximum storage volume calculated is the required storage volume for the detention facility. A Spreadsheet is available on the City web site to calculate the required detention volume using the Modified FAA Method.

4.5.3 Hydrograph Method

The Hydrograph Method shall be used to size detention facilities larger than 20,000 cubic feet. However, the Hydrograph Method may be used to determine stormwater detention requirements for any amount of new impervious area or volume of detention. Provide a Hydrograph Model of the proposed drainage system along with a summary table showing peak flow and storage volumes for the 1, 10, and 100 year storm events for the following conditions: existing, post-development un-detained, and post-development detained. Provide hydrograph reports for each predevelopment and post development event that shows the hydrograph type, storm frequency, drainage area, basin slope, total precipitation, storm duration, peak discharge, time to peak, hydrograph volume, weighted curve number, time of concentration, and distribution type. Provide an associated Pond Report showing the proposed stage/storage table, culvert/orifice structure information and weir structure information. Provide emergency overflow spillway calculations for the 24-hour, 100-year SCS Type II storm. Provide the associated hydrograph showing the drainage area, precipitation data, peak discharge, peak time and hydraulic volume data. A Spreadsheet is available on the City website to calculate the required detention volume using the Hydrograph Method.

4.5.4 Outlet Design

The hydraulic capacity of the various components of the outlet works (i.e., pipes, orifices, weirs) shall be determined using standard hydraulic equations. Single or multiple orifices may be used for low-flow control. Several types of weirs (i.e., Rectangular Sharp-Crested, Broad Crested, Slot and V-Notch) may also be used for flow control. Calculations shall be provided for the outlet works and shall include the effects of high tailwater when necessary.

4.6 Water Quality

Water quality calculations shall be submitted in accordance with Chapter 10 of this manual. Provide calculations showing the required Water Quality Volume for the site and the design calculations for the SCMs used to meet the water quality requirements. Spreadsheets are available on the City website to calculate the required Water Quality Volume and for design of the most common water quality SCMs. Using these spreadsheets will help reduce permit review time.

5.0 Permits

5.1 Land Disturbance Permit

A land disturbance permit must be obtained from both the City and the Missouri Department of Natural Resources (MDNR) for sites that disturb one or more acres and for sites that disturb less than one acre when part of a larger common plan of development or sale that will disturb a cumulative total of one or more acres over the life of the project. To obtain a permit from the City, a land disturbance permit application and stormwater pollution prevention plan (SWPPP) must be submitted to the Department of Environmental Services Water Quality Division for review and approval. A land disturbance permit must also be obtained from MDNR and included in the SWPPP. Upon approval of the SWPPP, the applicant will be notified to submit the required security, agreement, and permit fee. Prior to permit issuance, the applicant must schedule a pre-permit meeting with the Division. Following this meeting, the first phase of Best Management Practices (BMPs) can be installed. No other work is to occur other than what is needed to install the first phase of BMPs. The applicant must then schedule an initial Best Management Practice (BMP) inspection with the Division. If the initial BMP inspection is satisfactory, the permit is issued and work may begin. Termination of the permit requires 70% uniform perennial grass growth, removal of all temporary BMPs, and removal of all sources of pollution associated with construction. When the site is ready for permit termination, the applicant must submit a Request for Termination form and a Release of Securities application. Staff will conduct a termination inspection. If the permit termination inspection is satisfactory, the permit will be terminated and the security released.

5.2 Public Improvement Permit

Any stormwater improvement project that serves multiple properties or routes stormwater runoff from one property across another is defined as a public stormwater improvement project. Public stormwater improvement projects will require the submittal and approval of Public Stormwater Improvement Plans using Public Works Title Block. Once the Stormwater Construction Plans have been reviewed and approved, the developer will be notified to submit a signed, itemized bid for review. Upon approval of the bid, the applicant will be notified of the amount of the engineering and inspection permit fee. The engineering and inspection permit fee is a percentage of the amount of the construction cost from the approved bid. The engineering and inspection fee must be paid prior to the stormwater permit approval. The fee shall be made to the “City of Springfield” and can be paid on-line or on the 2nd Floor of the Busch Building located at 840 N. Boonville Avenue in Springfield, Missouri. After the engineering and inspection fee is paid, plans will be stamped and construction may begin. The public stormwater improvements must be constructed, inspected,

approved and operational prior to filing a final plat or issuance of a building permit. Alternatively, the final plat may be filed and building permits issued prior to construction of public stormwater improvements if an escrow is completed for the public improvements and a temporary plan is submitted, approved, and constructed that will provide for the conveyance and storage of stormwater during construction of the development without impacting adjacent properties. The escrow will not be returned until all public improvements are constructed, inspected, approved. An Application to Secure Public Improvements must be submitted for review and approval.

5.3 Stormwater Permit

A Stormwater (STM) permit is required for all private stormwater facilities, detention buyouts, and any work within a sinkhole or sinkhole watershed. The director of public works may require that certain stormwater improvements be constructed prior to issuance of a building permit when necessary to protect downstream properties from adverse stormwater impacts. Adverse impacts are defined as erosion and/or flooding caused by an increase in discharge, depth, or velocity or the discharge of pollutants, including sediment, downstream. The decision to require certain stormwater improvements to be constructed prior to issuance of the building permit will be based on the following factors:

- Size of the development
  - Is the site larger than one acre?
- Knowledge of existing stormwater problems downstream
  - Has the City received complaints about flooding or erosion from properties downstream?
- Existing stormwater facilities
  - Is there an existing detention basin on site?
  - Does the stormwater infrastructure downstream have capacity for frequent storm events (2-year)?
- Where the site drains
  - Does the site discharge onto another property or into City right of way?
- Sensitive area downstream
  - Does the site drain to a sinkhole?

In the event that it's infeasible to install stormwater improvements prior to issuance of the building permit, a phased approach is also permissible whereby a temporary plan may be submitted, approved, and constructed that will provide for the conveyance and/or storage of stormwater during construction of the development without impacting adjacent properties. Under this approach the building permit will be issued after all temporary stormwater controls shown on the approved plans are constructed and accepted. It may be permissible to issue a foundation permit in conjunction with installation of temporary stormwater controls. No certificate of occupancy will be issued until all permanent stormwater improvements are constructed, inspected, approved and operational.

5.4 Excavation Permit

An Excavation (EXC) permit is required when excavating in the right of way or when connecting private stormwater improvements to a public stormwater system and public stormwater improvements are not required. An excavation permit must be obtained from the Public Works Traffic Division located on the 1st Floor of the Busch Building at 840 N. Boonville Avenue, Springfield, Missouri prior to excavation. The excavation permit application may be obtained from the Traffic Division or from the City website.

5.5 Floodplain Permit

For any construction work in a FEMA Floodplain, a Floodplain (FLD) Development permit is required from Building Development Services (BDS) located on the 1st Floor of the Busch Building at 840 N. Boonville Avenue, Springfield, Missouri prior to approval of the stormwater construction plans. The Floodplain Development permit application may be obtained from BDS or from the City website.

5.6 United States Army Corps of Engineers Permit

A United States Army Corps of Engineers (USACE) Jurisdictional Determination may be required to determine if a Section 404 permit is needed for work in a stream or waters of the United States.

6.0 Easements

6.1 Drainage Easement

Drainage easement criteria shall be met in accordance with Chapter 12 of this manual. Drainage easements shall be provided when a private stormwater system is serving multiple properties or routes stormwater from one property across another. Drainage easements shall be shown on the construction plans and shall be of adequate size to contain the 100-year peak flow rate. If existing drainage easements are no longer needed, an Application for Relinquishment of Easement must be submitted to the Springfield Planning Department and approved by the Springfield Planning Commission. Proposed drainage easements shall be submitted to the Springfield Public Works Right-of-Way Division for review and approval using the appropriate standard drainage easement form. Once the proposed drainage easements have been reviewed and approved, signatures may be obtained and the documents returned to the City to be filed. All required drainage easements shall be obtained prior to construction plan approval.

6.2 Certified Natural Surface Drainage Channel

If runoff is proposed to discharge to a natural watercourse, a signed and sealed statement by a registered architect or engineer must be made on the plans certifying that runoff discharges to a natural watercourse as defined by state law. This letter must be sent by the architect or engineer of record and must be sealed, signed and dated by that professional. An example of an acceptable letter may be obtained from the Public Works Stormwater Engineering Division. A copy of all public correspondence shall be provided to the City.

7.0 Operation and Maintenance Plan and Agreement

An SCM operation and maintenance plan and agreement is required as a condition of stormwater permitting for construction of SCMs required to meet flood control detention requirements, water quality requirements, or zoning conditions in City Code Sec 36-482(8)(b). The SCM operation and maintenance plan and agreement must be prepared in substantial conformance with forms and templates provide by the City, and recorded with the Greene County Recorder of Deeds. Long-term operation and maintenance self-inspections and submittal of a self-inspection report is required annually. Self-inspections and reporting shall be conducted and submitted using the inspection forms provided by the City.

8.0 Construction Inspections

Public Works and Environmental Services staff will make periodic inspections of the construction of stormwater improvements and SCMs throughout the construction period, and require that any non-conformities with the plans be addressed. The contractor may be required to schedule inspections at certain milestones to allow inspection of key aspects of SCMs.

9.0 As-Built Requirements

When construction of stormwater improvements is completed, the Missouri-registered Professional Engineer of Record shall sign, seal, and submit the following as-built information:

- For flood control detention SCMs, an as-built survey of the SCM and outlet structure. Report shall include a table with the following information (at minimum) for each return period:
    - Volume
    - Peak Discharge Rate (comparing pre-project to as-built condition)
    - Water Surface Elevation
- For SCMs to meet water quality requirements or zoning conditions, an as-built certification and as-built survey as specified in Chapter 10.
- As-built surveys must reference the same vertical datum as the original design.

10.0 Final Inspection and Approval of Improvements

Upon receipt of the required as-built information, the Stormwater Engineering Division will review the same for substantial conformity with the plans. The Engineer of Record will be notified in writing of any deficiencies discovered during review of the as-built information. Upon correction of the noted deficiencies, the Engineer shall notify the City. Final approval of the improvements will be given upon approval of the as-built information.

Chapter 5 Calculation of Runoff

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1.0 Overview

Calculation of runoff is a critical step in the design of urban stormwater management facilities and conveyances. Runoff must be estimated accurately with a reasonable margin of safety to ensure protection of public health, safety and welfare, cost-effective designs, and protection of waterways and natural streams. Three acceptable methods of calculating runoff are presented in this chapter:

1. **Rational Method:** Acceptable for drainage areas less than 100 acres when only peak flow rates are needed. However, the City of Springfield (City) reserves the right to require the use of other methods (i.e., Kinematic Wave or Soil Conservation Service [SCS] Methods, discussed below) for drainage areas less than 100 acres, particularly in cases where land use in the watershed is non-homogeneous or areas of storage exist in the watershed. The SF-Rational Spreadsheet is provided with this manual to assist in peak runoff prediction using the Rational Method.
2. **Kinematic Wave Method:** Acceptable for any size watershed and appropriate for complex watersheds. This method shall be used with the Huff temporal rainfall distribution. The Kinematic Wave Method is the preferred method for most complex urban runoff conditions.
3. **SCS Unit Hydrograph Method:** Acceptable for any size watershed and appropriate for complex watersheds. This method shall be used with the Huff temporal rainfall distribution.

Hydrologic evaluation goes beyond the application of models to calculate runoff peak flow rates and volumes. As a part of hydrologic analysis, a reasonableness check should be conducted on computed peak flow rates and runoff volumes. Reasonableness checks may include methods of calculation such as the Rational Method, other hydrograph methods, or the United States Geological Survey (USGS) regression equations presented as an alternative method in Section 5.0. Other checks may include comparison of actual flood data or other flood studies that may have been conducted by the Federal Emergency Management Agency (FEMA), the U.S. Army Corps of Engineers (USACE), or the City.

2.0 Precipitation

For any of the acceptable calculation methods, it is necessary to define depth-duration-frequency relationships of rainfall. Precipitation data from the NOAA Atlas 14 Volume 8 Version 2, Precipitation-Frequency Atlas of the United States, Midwestern States (Sanja Perica, Deborah Martin, et. al 2013) shall be used for all runoff computations, as summarized in Table 1. For event durations that fall between values listed in the table, the user should use linear interpolation to determine the appropriate depth of precipitation.

2.1 Intensity-Duration-Frequency for the Rational Method

For Rational Method analysis, rainfall intensity in inches per hour must be determined from an event with a duration equivalent to the time of concentration. Table 1 and Table 2 provide depth and intensity values for various rainfall durations and frequencies in the Springfield area.

Table 1. Rainfall Depth-Duration-Frequency Relationships from NOAA Atlas 14 Volume 8 Version 2, Precipitation-Frequency Atlas of the United States, Midwestern States.

Duration	Depth of Precipitation (in)						
	1-year	2-year	5-year	10-year	25-year	50-year	100-year
5 min	0.38	0.43	0.53	0.61	0.72	0.81	0.90
10 min	0.55	0.63	0.77	0.89	1.05	1.18	1.31
15 min	0.67	0.77	0.94	1.08	1.28	1.44	1.60
30 min	0.98	1.14	1.39	1.60	1.89	2.12	2.34
1 hr	1.29	1.50	1.84	2.14	2.55	2.88	3.21
2 hr	1.60	1.86	2.30	2.67	3.21	3.64	4.08
3 hr	1.79	2.08	2.58	3.01	3.63	4.14	4.67
6 hr	2.19	2.51	3.09	3.60	4.35	4.97	5.64
12 hr	2.67	3.02	3.65	4.22	5.06	5.77	6.52
24 hr	3.16	3.60	4.35	5.01	5.98	6.77	7.60
48 hr	3.65	4.23	5.19	6.00	7.14	8.04	8.95
72 hr	4.01	4.63	5.65	6.51	7.70	8.64	9.59

Table 2. Rainfall Intensity-Duration-Frequency Relationships from NOAA Atlas 14 Volume 8 Version 2, Precipitation-Frequency Atlas of the United States, Midwestern States.

Duration	Intensity of Precipitation (in/hr)						
	1-year	2-year	5-year	10-year	25-year	50-year	100-year
5 min	4.56	5.16	6.36	7.32	8.64	9.72	10.80
10 min	3.30	3.78	4.62	5.34	6.30	7.08	7.86
15 min	2.68	3.08	3.76	4.32	5.12	5.76	6.40
30 min	1.96	2.28	2.78	3.20	3.78	4.24	4.68
1 hr	1.29	1.50	1.84	2.14	2.55	2.88	3.21
2 hr	0.80	0.93	1.15	1.34	1.61	1.82	2.04
3 hr	0.60	0.69	0.86	1.00	1.21	1.38	1.56
6 hr	0.37	0.42	0.52	0.60	0.73	0.83	0.94
12 hr	0.22	0.25	0.30	0.35	0.42	0.48	0.54
24 hr	0.13	0.15	0.18	0.21	0.25	0.28	0.32
48 hr	0.08	0.09	0.11	0.13	0.15	0.17	0.19
72 hr	0.06	0.06	0.08	0.09	0.11	0.12	0.13

2.2 Huff Temporal Rainfall Distribution

When using the Kinematic Wave Method or SCS Method for runoff computations, the Huff rainfall distribution shall be used for the temporal distribution. The Huff distribution is presented in Table 3 and is expressed as cumulative percentages of total duration and total rainfall accumulation. Different families of Huff distribution curves are applicable for different drainage areas. Table 3 is

applicable to drainage areas less than 10 square miles. For larger drainage areas, refer to the Rainfall Frequency Atlas of the Midwest (Huff and Angel 1992). Each family of curves consists of four storms (first-quartile, second-quartile, third-quartile, and fourth-quartile) that correspond to the quartile within the storm event when the bulk of the rainfall occurs. Storms with durations of 6 hours or less, 6 to 12 hours, 12 to 24 hours, and greater than 24 hours tend to be associated with the first-, second-, third-, and fourth-quartile storms, respectively (Huff and Angel 1992).

Table 3. Huff Distribution for Drainage Areas from 0 to 10 Square Miles

Cumulative Storm Time (%)	Cumulative Storm Rainfall (%) for Given Storm Type			
	First-Quartile (Duration ≤ 6 hours)	Second-Quartile (6 < Duration ≤ 12 hours)	Third-Quartile (12 < Duration ≤ 24 hours)	Fourth-Quartile (Duration > 24 hours)
0	0	0	0	0
5	16	3	3	2
10	33	8	6	5
15	43	12	9	8
20	52	16	12	10
25	60	22	15	13
30	66	29	19	16
35	71	39	23	19
40	75	51	27	22
45	79	62	32	25
50	82	70	38	28
55	84	76	45	32
60	86	81	57	35
65	88	85	70	39
70	90	88	79	45
75	92	91	85	51
80	94	93	89	59
85	96	95	92	72
90	97	97	95	84
95	98	98	97	92
100	100	100	100	100

2.3 Rainfall Duration

The rainfall duration selected for any of the acceptable methods should correspond to the maximum peak flow rate for the watershed being analyzed. For the Rational Method, the duration used for determining rainfall intensity from intensity-duration-frequency data in Table 2 should be equivalent to the time of concentration for the watershed, calculated as outlined below in Section 3.3. For the Kinematic Wave or SCS Hydrograph Methods, a critical duration analysis should be performed to determine the duration that maximizes peak runoff rates for the watershed being

analyzed. A critical duration analysis should involve applying the hydrograph-based methods to events with durations ranging from 30 minutes to 24 hours to determine the duration that produces the largest peak runoff rate for the watershed.

Guidelines for the minimum recommended storm duration based on watershed size are shown in Table 4. The guidelines are intended to preclude the use of short duration events that typically do not cover the corresponding watershed uniformly. The information in Table 4 should be considered as guidance for the minimum storm duration to use when calculating runoff and is not a replacement for a critical duration analysis.

Table 4. Guidelines for Minimum Storm Duration Based on Watershed Size

Watershed Size	Minimum Recommended Duration
< 160 acres	30 min
160 acres – < 1 sq. mi.	1 hr
1 sq. mi. – < 4 sq. mi.	2 hr
4 sq. mi. – < 8 sq. mi.	3 hr
8 sq. mi. – < 16 sq. mi.	6 hr
16 sq. mi. – < 32 sq. mi.	12 hr
> 32 sq. mi	24 hr

3.0 Rational Method

For urban watersheds of less than 100 acres that are not complex and do not have significant storage areas, it is acceptable to use the Rational Method to determine peak flow rates only. Due to its simplicity and inherent assumptions, it may not be appropriate for some applications. Different components of the Rational Method are explained in Sections 3.1 through 3.4. An example application of the Rational Method is presented in Section 7.1.

3.1 Rational Formula

The Rational Method is based on the Rational Formula:

$$Q = CiA \qquad \text{(Equation 1)}$$

In which:

Q = the maximum rate of runoff cubic feet per second (cfs)

C = runoff coefficient representing the fraction of rainfall that becomes runoff

i = rainfall intensity for a duration equal to the time of concentration (in/hr)

A = drainage area (acres)

The maximum rate of runoff, Q, has units of inches per hour times acres ([in/hr]*acre); however, since this rate of (in/hr)*acre differs from cfs by less than one percent, the more common units of cfs are used.

The general procedure for Rational Method calculations for a single watershed is as follows:

1. Delineate the watershed boundary and calculate its area.
2. Define and measure the flow path from the upper-most portion of the watershed to the design point.
3. Calculate the slope for the flow path.
4. Calculate time of concentration, tc (see Section 3.3).
5. Find the rainfall intensity, i, for the design storm using the calculated tc as the duration in Table 2.
6. Determine the runoff coefficient, C (see Section 3.4).
7. Calculate the peak flow rate from the watershed using Equation 1.

3.2 Assumptions

The basic assumptions made when the Rational Method is applied are:

1. The computed maximum rate of runoff to the design point is a function of the average rainfall rate for a duration equal to the time of concentration over the drainage area.
2. The depth of rainfall used is one that occurs from the start of the storm to the time of concentration. It has a level distribution over the duration of the rainfall, meaning the rainfall intensity is constant throughout the storm.
3. The maximum runoff rate occurs when the entire area is contributing flow. However, this assumption often should be modified when a more intensely developed portion of the watershed with a shorter time of concentration produces a higher rate of maximum runoff than the entire watershed with a longer time of concentration.

3.3 Time of Concentration

The time of concentration, tc, is defined as the time required for water to travel from the most hydraulically remote point in a watershed to the point of interest. When using the Rational Method, the rainfall duration used to determine intensity should typically equal the time of concentration of the drainage area. If a highly developed portion of the watershed produces a higher rate of runoff than the overall drainage area, then calculations should be based upon the flow length and path that results in a tc for the highly developed portion of the drainage area only (see example in Section 7.2 of this Chapter).

For urban areas, the time of concentration, tc, is typically calculated by breaking the flow path into reaches of overland flow, to, and travel time, tt, where tt is typically the travel time in the storm system, paved gutter or drainage channel. For non-urban areas, tc also consists of overland flow and time of travel components where to is typically much longer and tt is the time of travel in natural swales and waterways. Equation 2 represents the time of concentration for both urban and non-urban areas:

$$t_c = t_o + t_t \quad \text{(Equation 2)}$$

In which:

t_c = time of concentration (minutes)

t_o = overland flow time (minutes)

t_t = travel time (minutes)

A minimum tc of 10 and 5 minutes should be used for undeveloped and developed areas, respectively. Methods for calculating to and tt are presented in Sections 3.3.1 and 3.3.2, respectively.

3.3.1 Overland Flow Time

The Kerby-Hathaway equation for determining the overland flow time is:

$$t_o = 0.83\left(\frac{N_k L}{S^{0.5}}\right)^{0.47} \quad \text{(Equation 3)}$$

In which:

N_k = coefficient of roughness, presented in Table 5

L = overland flow length (ft), maximum of 500 feet for undeveloped areas and 300 feet for developed areas

S = average overland slope (ft/ft)

Table 5. Values of Nk for the Kerby-Hathaway Equation

Surface Type	Nk
Smooth impervious surface	0.05
Smooth bare packed soil, free of stones	0.10
Poor grass, cultivated row crops, or moderately-rough bare surfaces	0.20
Pasture or average grass cover	0.40
Deciduous timberland	0.60
Conifer timberland, deciduous timberland with deep forest litter, or dense grass cover	0.80

Conservative N_k values should be chosen to provide a safety factor for adequate design. When determining pre-development flows, a longer tc (larger N_k value) will result in conservative design. When determining post-development flows, a shorter t_c (smaller N_k value) will result in a more conservative design. Other methods of calculating overland flow time may be acceptable pending City approval.

3.3.2 Travel Time

For watersheds with overland and channelized flow, the time of concentration must be calculated including travel time, t_t, which is calculated using the hydraulic properties of the conveyance system. The Kirpich equation for calculation of the travel time is:

$$t_t = 0.0078\left(\frac{L}{S^{0.5}}\right)^{0.77} \qquad \text{(Equation 4)}$$

The Kirpich equation is most applicable for undeveloped watersheds with well-defined channels, bare-earth overland flow, or flow in mowed channels. The following adjustment factors are recommended for other conditions (Chow et al. 1988):

- For flow in natural grassed channels, multiply by 2.
- For overland flow on concrete or asphalt surfaces, multiply by 0.4.
- For concrete channels, multiply by 0.2.

3.3.3 Common Error in Calculating Time of Concentration

A common error when calculating time of concentration, tc, in partly urbanized drainage areas is to neglect checking the runoff peak resulting from only the developed part of the drainage area. This check is necessary because the runoff peak from only a lower portion of the drainage area or a highly impervious area may be larger than the runoff peak from the entire drainage area. When this condition exists, the drainage area should be broken into smaller, homogeneous sub-areas to calculate the critical tc.

3.4 Runoff Coefficient

The runoff coefficient, C, represents the percentage of rainfall that becomes runoff. The determination of C requires judgment and understanding on the part of the engineer and consideration of multiple hydrologic processes. Runoff coefficients for several land uses are provided in Table 6. In a non-homogeneous drainage area, C should be calculated as an area-weighted composite of the different land uses in the watershed.

Table 6 contains ranges of runoff coefficient values. The high end of the range shall be used when conservatively high runoff numbers are desirable. The low end of the range shall be used when conservatively low runoff numbers are desirable. Adjustments may be appropriate based on the hydrologic soil group.

The values in Table 6 are typical for storms with recurrence intervals of 2- to 10-years. They must be adjusted upward for less frequent recurrence intervals due to saturated soil conditions that typically occur during larger storms. Table 7 contains correction factors for the 25-, 50-, and 100-year events. To determine the appropriate runoff coefficient for these events, the runoff coefficient from Table 6 should be multiplied by the appropriate factor in Table 7.

Table 6. Runoff Coefficients Based on Surface Type for Rational Equation

By Surface Type—Use as Basis for Computation of Composite Runoff Coefficients			
Surface Type	**Runoff Coefficients**		
Asphalt, concrete pavement, roofs	0.95-1.0		
Gravel surfaces, compacted	0.85-0.95		
Gravel surfaces, not compacted	0.50-0.70		
Parks, golf courses, farms	0.10-0.20		
Lawns, pastures, hayfields			
Flat (<2% slopes)	0.10-0.15		
Average (2-7% slopes)	0.15-0.20		
Steep (>7% slopes)	0.20-0.30		
Woods	0.05-0.15		
Composite Coefficients for Single Family Residential Areas			
Average lot size, 1/4 acre	Flat (<2% slopes)	Average (2-7% slopes)	Steep (>7% slopes)
	0.35-0.45	0.40-0.50	0.45-0.55
Average lot size, 1/3 acre	Flat (<2% slopes)	Average (2-7% slopes)	Steep (>7% slopes)
	0.30-0.40	0.33-0.43	0.40-0.50
Average lot size, 1/2 acre	Flat (<2% slopes)	Average (2-7% slopes)	Steep (>7% slopes)
	0.25-0.35	0.30-0.40	0.36-0.46
Average lot size, 1 acre	Flat (<2% slopes)	Average (2-7% slopes)	Steep (>7% slopes)
	0.20-0.25	0.25-0.30	0.30-0.38
Average lot size, 3 acres	Flat (<2% slopes)	Average (2-7% slopes)	Steep (>7% slopes)
	0.10-0.20	0.16-0.24	0.25-0.33

Note: The ranges of C values presented in this table are typical for return periods of 2- to 10-years and assume average antecedent moisture conditions. Higher values are appropriate for larger design storms.

Table 7. Frequency Factors for the Runoff Coefficient (Debo and Reese 2002)

Recurrence Interval (years)	Adjustment Multiplier
25	1.1
50	1.2
100	1.25

Note: The ranges of C values presented in this table are typical for return periods of 2 to 10 years and assume average antecedent moisture conditions. Higher values are appropriate for larger design storms.

4.0 Hydrograph Methods

Hydrograph-based methods shall be used to calculate runoff for watersheds greater than 100 acres and smaller watersheds with complex hydrology, such as basins with land uses that are significantly non-homogeneous, or watersheds with alterations that affect runoff timing, such as

detention basins and railroad/highway culverts. Hydrograph-based methods have three primary components:

1. Loss model to determine excess precipitation (runoff): The SCS Curve Number Method is an acceptable loss model (Section 4.1).
2. Hydrograph transformation model to determine the shape of the hydrograph: Acceptable hydrograph transformation models include the Kinematic Wave Method and the SCS Unit Hydrograph Method (Sections 4.3 and 4.4 respectively). The Kinematic Wave Method is the preferred approach for complex urban areas, while the SCS Method is more applicable to less developed areas.
3. Channel routing model to lag and attenuate the hydrograph as it moves downstream: The Kinematic Wave Channel Routing Method is an acceptable method for hydrograph routing in channels (Section 4.5), whereas the Modified Puls Method is acceptable for detention pond routing (Chapter 9, Detention for Flood Control).

Due to the large number of computations involved in runoff calculations and routing, computer models are recommended. Software which allows user input of rainfall distributions and performs acceptable detention and channel routing routines is acceptable.

4.1 SCS Curve Number Loss Model

Sections 4.1.1 through 4.1.4 discuss key components of the SCS Curve Number Loss Model. The model requires these watershed characteristics: model area; flow path lengths, slopes, and flow path characteristics (i.e., overland, grassed channel, gutter); and land use types throughout the watershed (i.e., business, residential, agricultural). The watershed boundary and area should be determined from the most current and accurate topographic maps. A field investigation should be conducted to confirm watershed characteristics. For additional information, see the documentation for HEC-1, HEC-HMS, TR-55, or TR-20.

4.1.1 SCS Curve Number Runoff Equations

The SCS Curve Number method relates a calculated Runoff Curve Number (CN) to runoff, accounting for initial abstraction losses and infiltration rates of soils. The fundamental rainfall-runoff equations are as follows:

$$Q = \frac{(P - I_a)^2}{(P - I_a) + S} \qquad \text{(Equation 5)}$$

In which:

Q = runoff (in)

P = precipitation (maximum potential runoff) (in)

S = potential maximum watershed retention (in)

I_a = Initial abstraction (in)

Initial abstraction (I_a) is all losses before runoff begins. It includes water retained in surface depressions, water intercepted by vegetation, evaporation, and infiltration. Ia is highly variable but generally is correlated with soil and cover parameters. Through studies of many small agricultural watersheds, Ia is approximated by the following empirical equation:

$$I_a = 0.2S \qquad \text{(Equation 6)}$$

By removing Ia as an independent parameter, this approximation allows use of a combination of S and P to produce a unique runoff amount. Substituting Equation 6 into Equation 5 gives:

$$Q = \frac{(P - 0.2S)^2}{(P + 0.8S)} \qquad \text{(Equation 7)}$$

S is related to the soil and cover conditions of the watershed through the CN. CN has a range of 0 to 100, and S is related to CN by:

$$CN = \frac{1000}{(S + 10)} \qquad \text{(Equation 8)}$$

For a given CN and precipitation depth, the volume of runoff (in inches) can be calculated using Equations 7 and 8.

4.1.2 Runoff Curve Number Determination

The determination of the CN value for a watershed is a function of soil characteristics, hydrologic condition and cover, or land use. CN values for undeveloped and developed areas are provided in Table 8 and Table 9, respectively. For watersheds with multiple soil types or land uses, an area-weighted CN should be calculated. When significant differences in land use or natural control points exist, the watershed should be broken into smaller drainage areas for modeling purposes.

Soils are classified into hydrologic soil groups (HSGs) as an indicator of infiltration rate. The HSGs are A, B, C, and D, with A having the highest infiltration rate and D having the lowest, as defined in the USDA Manual, Urban Hydrology for Small Watersheds, Technical Release 55 (TR-55) (USDA NRCS 1986). The HSG and land cover are used in determining the CN value. See the United States Department of Agriculture (USDA) Web Soil Survey website to find the HSG's for a specific site in Springfield. The designer can build a customizable map containing soil data necessary to calculate CN by following the instructions at http://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm.

To minimize increases in post-development runoff volume and discharge of sediment, it is important to preserve natural soil profiles, minimize total land disturbance and minimize the consolidation of in-situ soils through compaction under the weight of heavy equipment. Following these practices can provide a cost savings in reduced grading, reduced infrastructure and detention and water quality treatment. For areas where the soil profile has been disturbed, the HSG should be adjusted up one level (i.e., from A to B, B to C, or C to D) unless it can be shown that the pre-development soil profile has been reestablished through soil amendments.

Table 8. Runoff Curve Number (CN) Values for Undeveloped Lands (USDA NRCS 1986)

Cover Description	Curve numbers for hydrologic soil group			
Cover type and hydrologic condition	**A**	**B**	**C**	**D**
Idle lands (not yet developed)				
Pasture, grassland, or range—continuous forage for grazing: Good condition (ground cover > 75% and only occasionally grazed)	39	61	74	80
Meadow—continuous grass, protected from grazing, and generally mowed for hay	30	58	71	78
Woods-grass (50%-50%) combination, orchard or tree farm Other combinations can be calculated as composite of pasture and woods Good condition	32	58	72	79
Woods Good condition (i.e., woods are protected from grazing, and litter and brush adequately cover the soil)	30	55	70	77
Farmsteads—buildings, lanes, driveways, and surrounding lots	59	74	82	86

Notes:

1. CN for use with SCS Unit Hydrograph Method for average runoff conditions (initial abstractions = 0.2 x Maximum Runoff Retention) (USDA NRCS 1986).
2. Typical cover condition in Springfield area is "good." "Fair" or "poor" condition must be demonstrated by engineer prior to City approval of associated CN adjustments.
3. This table is based on average antecedent soil moisture conditions. See Section 4.1.5 for further discussion.

4.1.3 Cover Types

Table 8 and Table 9 address most cover types, such as vegetation, bare soil, and impervious surfaces that are commonly encountered in urban areas. A number of methods exist for determining cover type. The most common are field reconnaissance, aerial photographs, and land use maps.

4.1.4 Hydrologic Condition

Hydrologic condition indicates the effects of cover type and treatment on infiltration and runoff and is generally estimated from density of plant and residue cover on sample areas. Good hydrologic condition indicates that the soil usually has a low runoff potential for a specific HSG, cover type, and treatment. Some factors to consider in estimating the effect of cover on infiltration and runoff are the canopy or density of lawns, crops, or other vegetative areas, and the amount of year-round cover and seasonal cover such as deciduous leaves. Typical cover condition in the Springfield area is good. In rare cases, a lesser amount of ground cover exists in a natural condition. Fair or poor condition must be demonstrated by the engineer prior to City approval of associated CN adjustments.

4.1.5 Antecedent Moisture Conditions

The index of runoff potential before a storm event is the Antecedent Moisture Condition (AMC). The AMC accounts for the existing degree of soil saturation at the beginning of a rainfall, therefore adjusting the CN to reflect more accurate runoff conditions. All values given in Table 8 and Table 9 represent AMC 2 (median moisture conditions) and should be used for design. Adjustments for

AMC 1 (dry conditions) and AMC 3 (wet conditions) can be made if appropriate (see USDA NRCS 1986, TR-55).

Table 9. Runoff Curve Number (CN) Values for Fully Developed and Developing Urban Areas (USDA NRCS 1986)

Cover description		Curve numbers for hydrologic soil group			
Cover type and hydrologic condition	**Average percent impervious area**	**A**	**B**	**C**	**D**
Fully developed urban areas (vegetation established)					
Open space (lawns, parks, golf courses, cemeteries, etc.):					
Good condition (grass cover > 75%)		39	61	74	80
Fair condition (grass cover 50% to 75%)		49	69	79	84
Poor condition (grass cover less than 50%)		68	79	86	89
Impervious areas:					
Paved parking lots, roofs, driveways, compacted gravel, etc. (excluding right-of-way)		98	98	98	98
Small open spaces within developments or ROW:		72	82	87	89
Streets and roads:					
Paved; curbs and storm sewers (including right-of-way)		90	93	95	97
Paved; open ditches (including right-of-way)		83	89	92	93
Gravel (including right-of-way)		76	85	89	91
Dirt (including right-of-way)		72	82	87	89
Urban districts:					
Commercial and business	85	89	92	94	95
Industrial	72	81	88	91	93
Residential districts by average lot size:					
1/8 acre or less (townhouses)	65	77	85	90	92
1/4 acre	38	61	75	83	87
1/3 acre	30	57	72	81	86
1/2 acre	25	54	70	80	85
1 acre	20	51	68	79	84
2 acres	12	46	65	77	82
Developing urban areas: Newly graded areas (pervious areas only, no vegetation)		77	86	91	94

Notes:

1. CN for use with SCS Unit Hydrograph Method for average runoff conditions (initial abstractions = 0.2 x Maximum Runoff Retention) (USDA NRCS 1986).
2. Typical cover condition in Springfield area is "good." "Fair" or "poor" condition must be demonstrated by engineer prior to City approval of associated CN adjustments.
3. This table is based on average antecedent soil moisture conditions. See Section 4.1.5 for further discussion.
4. Curve numbers provided for streets and roads are typical for residential or collector streets. Curve numbers for arterials and heavily developed areas should be calculated.
5. Curve numbers provided for urban districts are a typical composite of large areas. Curve numbers for individual sites should be calculated based on the proposed development.

4.2 Kinematic Wave Hydrograph Method

A hydrograph method must be used to calculate runoff for watersheds greater than 100 acres and smaller watersheds with complex hydrology. The Kinematic Wave Method is the preferred method for computing watershed runoff, particularly for urbanized watersheds. This overland flow hydrograph method is applied in conjunction with channel routing methods described in Section 4.4 to transform rainfall to runoff and route it to determine the hydrograph at the point of interest at the low point of the drainage area.

4.2.1 Fundamental Equations

To apply the Kinematic Wave Method to a typical watershed (Figure 1a), the watershed and its channel are conceptualized as shown in Figure 1b. In Figure 1b, the watershed is represented as two plane surfaces over which water runs until it reaches the channel. At a cross-section, the system resembles an open book, with the water running parallel to the text on the page (down the shaded planes) and then into the channel that follows the book's center binding. The Kinematic Wave Method represents behavior of overland flow on the plane surfaces. The model may also be used to simulate behavior of flow in the watershed channels as discussed in Section 4.4.

The momentum and continuity equations used in the Kinematic Wave Method are solved using finite difference methods. Details of the method are beyond the scope of this manual. These calculations are best performed using a computer program such as HEC-1 or HEC-HMS. For more background information on the derivation of the Kinematic Wave Method, refer to the HEC-1 or HEC-HMS User's Manual or other reference.

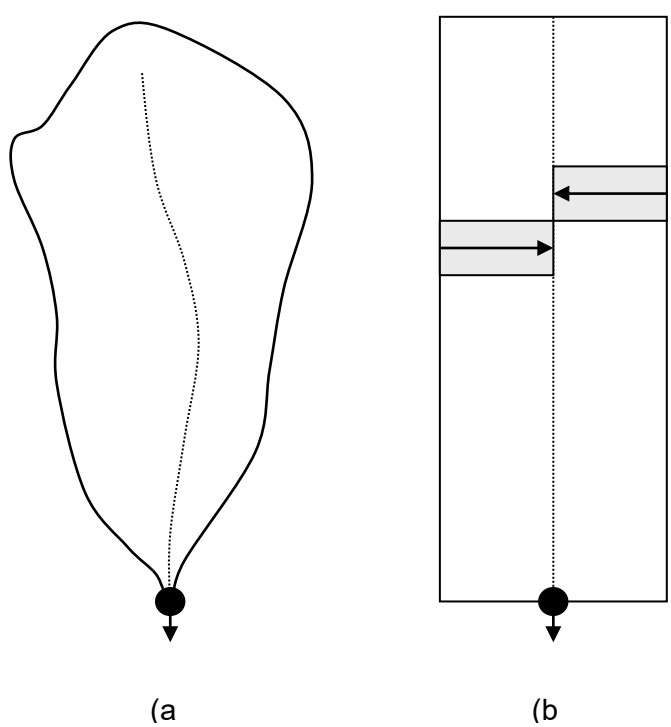

Figure 1. Kinematic Wave Representation of a Simple Watershed

4.2.2 Kinematic Wave Model Parameters

To determine runoff using the Kinematic Wave Method, the watershed must be modeled as a set of elements including:

- **Overland Flow Planes:** This model input describes one or two planes that contribute runoff to channels within the watershed. The combined flow from the planes is the total inflow to the watershed channels. Information that must be provided about each plane is listed in the "Overland Flow Panes" column of Table 10. To determine runoff from rainfall on these planes, the Kinematic Wave Overland Flow Method is applied.
- **Sub-collector Channels:** These are small feeder pipes or channels that convey water from street surfaces, rooftops, lawns, etc. Sub-collector channels might service a portion of a city block or housing tract with an area of 10 acres or less. Flow is assumed to enter the channel uniformly along its length. The average contributing area for each sub-collector channel must be identified as a part of model input. Information that must be provided about the sub-collector channels is listed in the "Collectors and Sub-Collectors" column of Table 10. The Kinematic Wave Channel Routing Method (Section 4.4) is applied to route flows through sub-collector channels.
- **Collector Channels:** These channels collect flow from sub-collector channels and convey it to the main channel. Collector channels might service an entire city block or housing tract, with flow entering laterally along the length of the channel. Similar to the sub-collector channels, the average contributing area for each collector channel must be identified. Information that must be provided about the collector channels is listed in the "Collectors and Sub-Collectors" column of Table 10. The Kinematic Wave Channel Routing Method (Section 4.4) is applied to route flow through collector channels.
- **Main Channel:** The main channel conveys flow from upstream sub-watersheds and flows that enter from the collector channels or overland flow planes. Information that must be provided about the main channel is listed under the "Main Channel" heading in Table 10.

Table 10. Required Input for Kinematic Wave Model

Parameter	Kinematic Wave Model Element		
	Overland Flow Planes	**Collectors and Sub-collectors**	**Main Channel**
Length	Typical length	Representative channel length	Channel length
Area	Area represented by plane	Area drained by channel	-
Slope	Representative Slope	Representative channel slope	Channel slope
Roughness	Overland flow roughness coefficient	Representative Manning's roughness coefficient	Representative Manning's roughness coefficient
Channel Geometry	-	Principle dimensions of representative channel cross-section; Description of channel shape	Principle dimensions of channel cross-section
Other	Loss model parameters (CN value)	-	Identification of upstream inflow hydrograph (if any)

The choice of elements to describe any watershed depends upon the configuration of the drainage system. The minimum configuration is one overland flow plane and the main channel. A more complex system may require two planes, sub-collectors, collectors, and the main channel. See Table 11 for a list of roughness coefficients for overland flow. For channel roughness coefficients refer to Chapter 8, Open Channels.

Table 11. Roughness Coefficients for Kinematic Wave Model

Surface Description	n
Smooth surfaces (concrete, asphalt)	0.013
Gravel	0.02
Fallow (no residue)	0.05
Cultivated soils:	
Residue cover ≤ 20%	0.06
Residue cover > 20%	0.17
Grass:	
Short grass prairie	0.15
Dense grasses*	0.24
Bermuda grass	0.41
Range	0.13
Woods:**	
Light underbrush	0.40
Dense underbrush	0.80

*Includes species such as weeping lovegrass, bluegrass, buffalo grass, blue grama, and native grass mixtures.

**When selecting n, consider cover to a height of approximately 0.1 ft. This is the only part of plant cover that will obstruct sheet flow.

4.3 SCS Unit Hydrograph Method

The SCS Unit Hydrograph Method is one of the methods appropriate for drainage areas larger than 100 acres and complex watersheds. While it is an acceptable method for any size drainage area, it is a lumped parameter model and may not be as preferable as the Kinematic Wave Method in many cases. The determination of the storm runoff hydrograph for a specified total rainfall using the SCS Method involves three primary steps:

1. Develop the unit hydrograph for the watershed, based on the watershed characteristics and time of concentration.
2. Determine the excess precipitation values using the CN value and rainfall values.
3. Calculate the storm runoff hydrograph by applying the excess precipitation values in Step 2 to the unit hydrograph values in Step 1.

Sections 4.3.1 through 4.3.3 describe the SCS Unit Hydrograph Method in more detail.

4.3.1 Time of Concentration

The time of concentration, tc, influences the shape and peak of the runoff hydrograph. The tc for a watershed is determined based on overland flow time, to, and travel time through the watershed's

hydrologic conveyance system, tt. Procedures for calculating tc are presented in Section 3.3 of this Chapter.

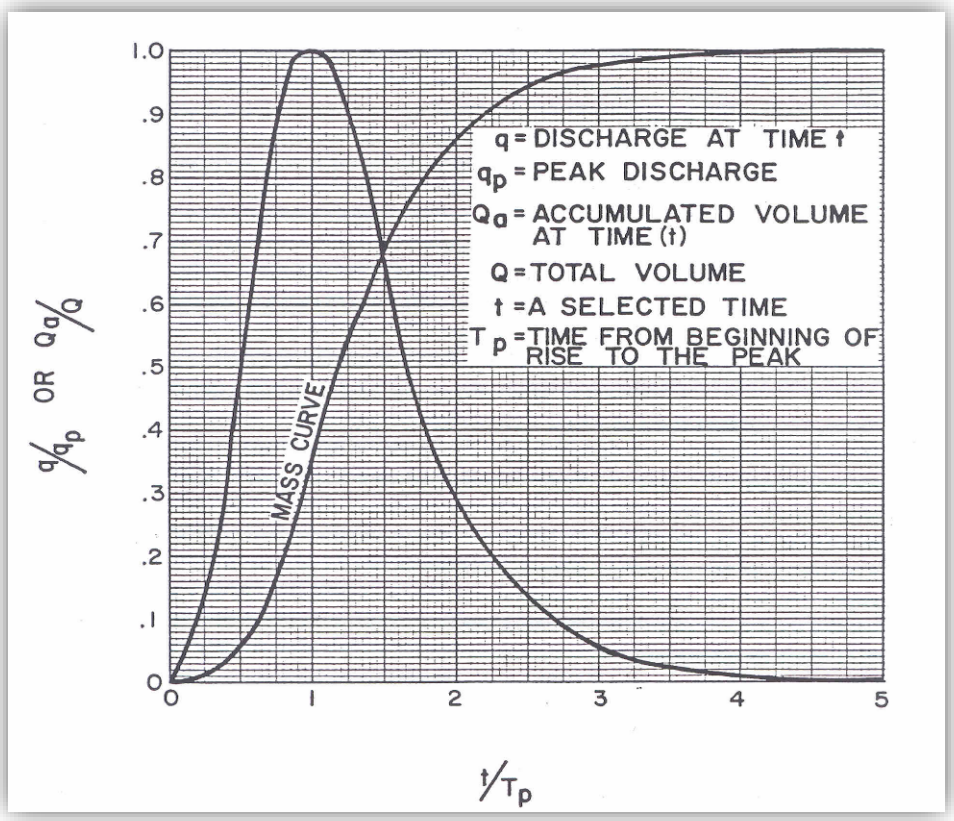

Figure 2. SCS Dimensionless Unit Hydrograph

4.3.2 Unit Hydrograph

A dimensionless unit hydrograph has been developed by the SCS based on the evaluation of a large number of natural unit hydrographs from various watersheds. The SCS dimensionless unit hydrograph is presented in Figure 2.

To determine the unit hydrograph for a specific watershed, the following relationships are used:

$$q_p = 484\frac{A}{T_p} \qquad \text{(Equation 9)}$$

$$T_p = \frac{\Delta D}{2} + 0.6t_c \qquad \text{(Equation 10)}$$

In which:

q_p = peak discharge (cfs)

A = watershed area (square miles)

T_p = time to peak (hours)

t_c = time of concentration (hours)

ΔD = duration of excess rainfall (hours)

484 = peaking factor related to the ratio of the unit hydrograph time base to the time to peak and unit conversions to provide q_p in units of cfs.

The unit hydrograph values are obtained by multiplying q_p and T_p for the selected duration of excess rainfall, ΔD. The duration of excess rainfall should be selected so that ΔD is approximately equal to $0.133t_c$.

4.3.3 Storm Runoff Hydrograph

The storm runoff hydrograph is determined by multiplying the excess precipitation values by the unit hydrograph values and summing the ordinates in a specific manner. The method is based on the following primary assumptions:

1. Discharge at any time is proportional to the volume of runoff
2. Time factors affecting the hydrograph shape are constant.

For more detailed theoretical discussion, refer to Section 4 of the SCS National Engineering Handbook (USDA SCS 1966). An example calculation using the SCS Unit Hydrograph Method is provided in Section 7.3.

4.4 Channel Routing of Hydrographs

For drainage areas larger than 100 acres or that are complex or non-homogeneous, sub-areas of homogeneous land use should be developed in the model. Hydrographs from each sub-area must be routed and combined to determine the hydrograph for the entire drainage area. The Kinematic Wave Channel Routing Method is the preferred method for this procedure, although other methods may be acceptable upon approval. Where appreciable hydrograph attenuation is anticipated due to storage effects along a reach, a method that explicitly accounts for channel storage effects, such as the Modified-Puls Method (presented in Chapter 9, Detention for Flood Control), may also be approved.

4.4.1 Kinematic Wave Channel Routing Method

The Kinematic Wave Channel Routing Method is used to route an upstream inflow hydrograph through a reach with known geometric characteristics. Theoretically, a flood wave routed by the Kinematic Wave Channel Routing Method is translated, but not attenuated, through a reach (although a degree of attenuation is introduced by the finite difference solution to the governing equations). The lack of significant peak attenuation during hydrograph translation is a fairly common characteristic of urban conveyances.

The theory of the Kinematic Wave Method presented in Section 4.3 for overland flow is also applicable to channel routing. This method is typically applied using software such as HEC-1 or HEC-HMS. Table 12 summarizes input parameters required for the Kinematic Wave Channel

Routing Method. Manning's roughness values should be selected in accordance with Chapter 8, Open Channels.

Table 12. Kinematic Wave Channel Routing Method Inputs

Input Parameter	Note
Length (ft)	Determine as actual length of flow path along thalweg.
Slope (ft/ft)	Calculate as change in elevation divided by channel length.
Manning's n	Determine according to Chapter 8, Open Channels.
Shape	Trapezoid, deep or circular. Trapezoidal can also be used for rectangular and triangular cross-sections by specifying appropriate side slopes and bottom width. Use deep channel when flow depth ≈ channel width.
Width or Diameter (ft)	Characteristic dimension (bottom width for trapezoidal; channel width for deep; and diameter for circular).
Side Slope (H:V) (ft/ft)	For trapezoidal channels only.
Minimum Number of Routing Increments	The minimum number of steps is related to the finite difference solution of the governing equations. The minimum number of routing increments is automatically determined by the program but optionally can be entered by the user (not recommended by City).

4.5 Reservoir Routing of Hydrographs

For watersheds with significant detention structures, the effects of routing hydrographs through facilities can have important implications on the timing of peak flow rates from sub-watersheds. Hydrologic modeling and analysis must account for the effects of detention by performing reservoir routing calculations. The criteria and methods for reservoir routing are presented in Chapter 9, Detention for Flood Control. Options for routing using common methods are included in HEC-1, HEC-HMS, TR-20, and many other commercially available hydrology software packages.

5.0 Alternative Methods

5.1 USGS Regression Equations

For urban watersheds larger than 100 acres, the engineer should compare the peak flow rate determined from the critical duration analysis with the peak flow rate calculated using the USGS regression equations in *The Estimation of the Magnitude and Frequency of Floods in Urban Basins in Missouri, 2010* (Southard 2010). These equations are summarized in Table 13 and are applicable for urban areas within Missouri that have drainage areas between 0.29 and 189 square miles and impervious areas between 2.3 and 46 percent. These equations do not apply when there is significant storage in the watershed. Although the resulting peak flow rates typically have a relatively high coefficient of variation, regression equations provide a useful reasonableness check for urban watersheds.

Table 13. USGS Regression Equations for Estimation of Peak Flows in Urban Areas (Southard 2010)

Recurrence Interval	USGS Regression Equation (Q = estimated peak flow rate [cfs], A = drainage area [mi2], I = impervious area in percent)
2-year	$Q_2 = 188DRNAREA^{0.599}10^{0.014IMPLNLCD01}$
5-year	$Q_5 = 352DRNAREA^{0.592}10^{0.011IMPLNLCD01}$
10-year	$Q_{10} = 484DRNAREA^{0.594}10^{0.010IMPLNLCD01}$
25-year	$Q_{25} = 671DRNAREA^{0.599}10^{0.008IMPLNLCD01}$
50-year	$Q_{50} = 826DRNAREA^{0.604}10^{0.008IMPLNLCD01}$
100-year	$Q_{100} = 991DRNAREA^{0.608}10^{0.007IMPLNLCD01}$
500-year	$Q_{500} = 1420DRNAREA^{0.619}10^{0.006IMPLNLCD01}$

6.0 Off-Site and Adjacent Runoff

The design of a drainage system should take into account the runoff from off-site and adjacent areas, recognizing their urban development potential. For hydrologic analysis, calculations for off-site areas should assume these areas are completely developed, even if they are undeveloped or have not yet reached their full development potential. For the purposes of calculations and modeling, land use for off-site areas should be based on City zoning and anticipated land use for these areas. For flood control planning and modeling, effects of detention should be disregarded except for publicly owned and maintained facilities with storage dedicated for perpetuity, unless otherwise approved by the City. Fully developed flows should be used for facility sizing and design. The City may request additional modeling including the effects of detention in the watershed, especially where timing of peak flow rates is a concern. See Chapter 8, Open Channels, and Chapter 9, Detention for Flood Control.

7.0 Examples

7.1 Rational Method

Find the 100-year peak flow rate for a 40-acre drainage area consisting of single-family residential land use with an average lot size of ¼ acre with good grass cover and maximum ground slope of about 2 percent. The upper 200 feet of the watershed is sloped at 2 percent, and the lower 1,100 feet is a grassed waterway sloped at one percent.

7.1.1 Determine Runoff Coefficient:

From Table 6, for single-family residential land use with ¼-acre lots, slope of 2 percent and 2- to 10-year rainfall, the runoff coefficient is 0.45. For a 100-year rainfall, this value must be multiplied by 1.25, resulting in a runoff coefficient of 0.56 (Table 7).

7.1.2 Determine tc:

Calculate the overland flow segment, to, with average grass cover (Nk = 0.40) using the Kerby-Hathaway formula (Equation 3):

$$t_o = 0.83\left(\frac{0.40 \cdot 200}{0.02^{0.5}}\right)^{0.47}$$

$$t_o = 16.3 \text{ minutes}$$

Calculate the travel time segment, using the Kirpich Formula (Equation 4):

$$t_t = 0.0078\left(\frac{1100}{0.01^{0.5}}\right)^{0.77}$$

$$t_t = 10.1 \text{ minutes}$$

From Equation 2:

$$t_c = 16.3 + 10.1$$

$$t_c = 26.4 \text{ minutes}$$

The Tc and PeakQ Worksheet in the SF-Rational Spreadsheet can also be used to calculate time of concentration.

7.1.3 Determine Rainfall Intensity:

Determine rainfall intensity, i, from Table 2 for a 100-year return interval. Since there is not an entry in Table 2 for t = 26 minutes, use linear interpolation with bounding values to determine i_{26min}:

$i_{15\ min}$ = *6.40 in/hr*

$i_{30\ min}$ = *4.68 in/hr*

$$i_{26\ min} = i_{30\ min} + \frac{(i_{15\ min} - i_{30\ min})}{(30-15)} \times (30 - 26)$$

$$i_{26\ min} = 4.68 + \frac{(6.40-4.68)}{(30-15)}(30\text{-}26)$$

= 5.14 in/hr

7.1.4 Determine Q_{100} from Equation 1:

Q = C*i*A = 0.56*5.14*40

Q_{100} = 115 cfs

7.2 Rational Method: Peak Flow from Portion of a Drainage Area

Find the 5-year peak flow rate at a point with a 15-acre drainage area, as shown in Figure 3. The lower portion of the watershed is a 12-acre parking area. The remainder of the watershed is a flat (slope < 2 percent) grassed area. Using the methods described in Section 3.3, it is determined the time of concentration for the entire watershed is 20 minutes and the time of concentration is 15 minutes for the parking lot only.

7.2.1 Determine Runoff Coefficients:

From Table 6, the appropriate runoff coefficient for a new asphalt parking lot is 1.0, and the runoff coefficient for a flat, grassed area is 0.15. A runoff coefficient for the entire watershed can be calculated by area-weighting of these runoff coefficients:

$$C_{watershed} = \frac{C_{asphalt} \cdot A_{asphalt} + C_{grass} \cdot A_{grass}}{A_{asphalt} + A_{grass}}$$

$$C_{watershed} = \frac{1.0 \cdot 12 + 0.15 \cdot 3}{12 + 3}$$

$$C_{watershed} = 0.83$$

The Weighted C Worksheet in SF-Rational Spreadsheet can also be used to calculate the runoff coefficient.

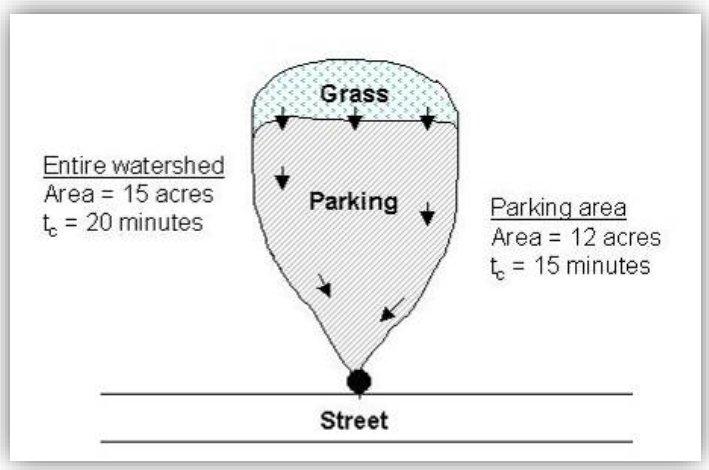

Figure 3. Example Watershed for Rational Method

7.2.2 Determine Rainfall Intensity:

From Table 2 for a 5-year return interval, rainfall intensities corresponding to tc = 15 and 30 minutes are 3.76 and 2.78 inches/hour, respectively. Since there is not an entry in Table 2 for t = 20 minutes, use linear interpolation with bounding values to determine i20 min:

$i_{15\,min}$ = *3.76 in/hr*

$i_{30\,min}$ = *2.78 in/hr*

$$i_{20\min} = i_{30\min} + \frac{(i_{15\min} - i_{30\min})}{(30-15)}(30-20)$$

$$i_{20\,min} = 2.78 + \frac{(3.76-2.78)}{(30-15)}(30-20)$$

= 3.43 in/hr

7.2.3 Calculate Peak Flow Rates:

Determine Q from Equation 1 or by using the Tc and PeakQ Worksheet in the SF-Rational Spreadsheet.

For the parking area only:

Q_5=1.0*3.76*12

= 45 cfs

For the entire watershed:

Q_5=0.83*3.43*15

= 43 cfs

The appropriate Q_5 to use for the design point is 45 cfs. Because of the shorter time of concentration (higher design rainfall intensity) and the higher runoff coefficient, the parking area alone will produce a higher peak runoff rate than the drainage area considered as a whole.

7.3 SCS Unit Hydrograph Method

Determine the 100-year, 2-hour peak flow rate for a watershed with the following characteristics:

Area = 1.2 square miles (767 acres)

HSG = C

Land uses:

- Residential (¼-acre lots)—267 acres
- Residential (½-acre lots)—300 acres
- Commercial—100 acres
- Park/open space (good)—100 acres

From methods given in Section 3.3,

tc = 45 minutes

7.3.1 Determination of Unit Hydrograph:

Select time interval such that:

$$\Delta D = 0.133 t_c$$

= 0.133 (45) = 5.99 minutes; use 6 minutes

From Equation 10:

$$T_p = \frac{6}{2} + 0.6(45)$$

= 30 minutes = 0.5 hours

From Equation 9:

$$q_p = 484\left(\frac{1.2}{0.5}\right)$$

= 1,162 cfs

Reading q/q_p and t/T_p values from Figure 2 and multiplying by the computed q_p value, develop the unit hydrograph shown in Table 14.

7.3.2 Calculate Excess Precipitation:

Calculate composite CN for watershed using Table 10 and HSG C:

Residential (¼ acre)—267 acres: CN = 83

Residential (½ acre)—300 acres: CN = 80

Commercial—100 acres: CN = 94

Park/open space (good)—100 acres: CN = 74

The composite CN can be calculated based on area weighting as follows:

$$CN_{composite} = \frac{(267 \cdot 83) + (300 \cdot 80) + (100 \cdot 94) + (100 \cdot 74)}{(267 + 300 + 100 + 100)}$$

= 82

Table 14. Example Unit Hydrograph Tabulation

t (min)	t/Tp	q/qp	q (cfs)
(1)	(2)	(3)	(4)
0	0.00	0.00	0
6	0.20	0.1	116
12	0.40	0.37	430
18	0.60	0.63	732
24	0.80	0.91	1057
30	1.00	1.00	1162
36	1.20	0.94	1092
42	1.40	0.88	1022
48	1.60	0.53	616
54	1.80	0.39	453
60	2.00	0.285	331
66	2.20	0.21	244
72	2.40	0.155	180
78	2.60	0.11	128
84	2.80	0.08	93
90	3.00	0.055	64
96	3.20	0.004	5
102	3.40	0.0025	3
108	3.60	0.002	2
114	3.80	0.0015	2
120	4.00	0.001	1

Column (1) Time elapsed in increments of ΔD (ΔD = 6 minutes, approximately equal to $0.133t_c$)
Column (2) = Col (1) / Tp (Tp = 30 minutes, calculated in example using equation RO-10)
Column (3) = Read from Figure 2 based on t/T_p value in Col (2)
Column (4) = q_p*Col (3) (q_p is calculated in example using equation RO-9).

7.3.3 Determine rainfall total and apply appropriate distribution:

From Table 1, the total rainfall for a 100-year, 2-hour event is 4.74 inches. A Huff first-quartile distribution should be used (Table 3) to develop Table 15.

7.3.4 Calculate S based on the CN value (using Equation 8):

$$82 = \frac{1000}{S + 10}$$

$$S = \frac{1000}{82} - 10$$

= 2.19 in

Using the tabulated precipitation values in Table 15, determine excess precipitation for each time period using Equation 7. Excess precipitation results for each time period are tabulated in Table 17.

Table 15. Example Precipitation Distribution

Cumulative Storm Time (%)	Cumulative Precipitation (%)	Storm Time (min)	Cumulative Precipitation (in)
(1)	(2)	(3)	(4)
0	0	0	0.00
5	16	6	0.76
10	33	12	1.56
15	43	18	2.04
20	52	24	2.46
25	60	30	2.84
30	66	36	3.13
35	71	42	3.37
40	75	48	3.56
45	79	54	3.74
50	82	60	3.89
55	84	66	3.98
60	86	72	4.08
65	88	78	4.17
70	90	84	4.27
75	92	90	4.36
80	94	96	4.46
85	96	102	4.55
90	97	108	4.60
95	98	114	4.65
100	100	120	4.74

Column (1) From Table 3
Column (2) From Table 3, First-Quartile
Column (3) = storm time; ΔD = 6 minutes per time step
Column (4) = 4.74*Col (2) (4.74 value from Table 1 for 100-year, 2-hour event)

7.3.5 Calculate Runoff Hydrograph:

The runoff hydrograph is calculated by multiplying the ordinates of the unit hydrograph by the excess precipitation for each time increment. This applies for all time increments in which there is excess precipitation to derive a hydrograph. These incremental hydrographs are lagged so the start of the incremental hydrograph corresponds to the time of the excess precipitation it represents. Incremental hydrographs are superimposed to derive the runoff hydrograph (Table 17).

Due to the extensive amount of time required to complete these computations by hand, an SCS Unit Hydrograph Method computation is typically completed through the aid of computer software such as TR-55, TR-20, HEC-1, or HEC-HMS.

Table 16. Example Excess Precipitation

Storm Time (min)	Cumulative Precipitation (in)	Accumulated Runoff (in)	Incremental Runoff (in)
(1)	(2)	(3)	(4)
0	0.00	0.00	0.00
6	0.76	0.04	0.04
12	1.56	0.38	0.34
18	2.04	0.68	0.29
24	2.46	0.97	0.30
30	2.84	1.26	0.29
36	3.13	1.48	0.22
42	3.37	1.67	0.19
48	3.56	1.83	0.16
54	3.74	1.99	0.16
60	3.89	2.11	0.12
66	3.98	2.19	0.08
72	4.08	2.27	0.08
78	4.17	2.35	0.08
84	4.27	2.43	0.08
90	4.36	2.52	0.08
96	4.46	2.60	0.08
102	4.55	2.68	0.08
108	4.60	2.73	0.04
114	4.65	2.77	0.04
120	4.74	2.85	0.08

Column (1) = storm time; ΔD = 6 minutes per time step
Column (2) = from Table 15, column 4.
Column (3) =((Col (2)-0.2*S)^2)/(Col (2) + 0.8*S) (S = 2.19, calculated using Equation 8).
Note if value in Col (2) is less than 0.2*2.19, Col (3) = 0
Column (4) =Col (3) Row (i) - Col (3) Row (i-1)

Table 17. Example Runoff Hydrograph Tabulation

Time (min)	Unit Hydrograph (cfs)	Excess Precip (in.) / Time (min)									Storm Hydrograph (cfs)
		0.041	0.34	0.29	0.3	0.29	0.22	0.19	0.16	...	
		6	12	18	24	30	36	42	48	...	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
0	0	0									0
6	116	5	0								5
12	430	18	39	0							57
18	732	30	146	34	0						210
24	1057	43	249	125	35	0					452
30	1162	48	359	212	129	34	0				782
36	1092	45	395	307	220	125	26	0			1116
42	1022	42	371	337	317	212	95	22	0		1396
48	616	25	347	317	349	307	161	82	19	0	1606
54	453	19	209	296	328	337	233	139	69	...	1648
60	331	14	154	179	307	317	256	201	117	...	1626
66	244	10	113	131	185	296	240	221	169	...	1543
72	180	7	83	96	136	179	225	207	186	...	1420
78	128	5	61	71	99	131	136	194	175	...	1287
84	93	4	44	52	73	96	100	117	164	...	1150
90	64	3	32	37	54	71	73	86	99	...	1028
96	5	0	22	27	38	52	54	63	72	...	917
102	3	0	2	19	28	37	40	46	53	...	820
108	2	0	1	1	19	27	28	34	39	...	751
114	2	0	1	1	2	19	20	24	29	...	687
120	1	0	1	1	1	1	14	18	20	...	628

Column (1) = storm time; ΔD = 6 minutes per time step
Column (2) = calculated q (column 4 from Table 14)
Column (3) through (11) = Excess precipitation (top value), from column 4 of Table 16 , for each time step (ΔD) multiplied by unit hydrograph values in column (2)
Column (12) = sum of columns (3) through (11); Note values shown reflect sum of routing beyond column (11)

7.4 Kinematic Wave Method

This example demonstrates conceptual model development and model input requirements for the Kinematic Wave Hydrograph and Channel Routing Methods for analysis of runoff for a proposed residential development. The preferred computer programs to perform the computations are HEC-1 or HEC-HMS. The 20-acre development will consist of ⅓-acre residential lots constructed in an area with HSG C soils. Figure 4 illustrates the example watershed and important input parameters.

7.4.1 Model Conceptualization:

Development of the Kinematic Wave hydrograph model requires the determination of the number of overland flow planes, main channels, collector channels, and sub-collector channels. For accurate modeling of urban areas, it is generally advisable to use two overland flow planes, one for pervious area in the watershed, the other for impervious area. This provides a more realistic model of rainfall-runoff from impervious areas than a model using a single overland flow plane that lumps pervious and impervious areas together. The overland flow plane conceptualization is illustrated in Figure 4.

It is also necessary to model a realistic flow network. For smaller drainage areas, a network consisting of a main channel and collector channels of representative cross-section, slope, length, and roughness will typically suffice. For larger watersheds, sub-collector channels, which feed into collector channels, should also be used. For this 20-acre drainage area, sub-collector channels are not necessary, so a network consisting of a main channel and collector channels will be used.

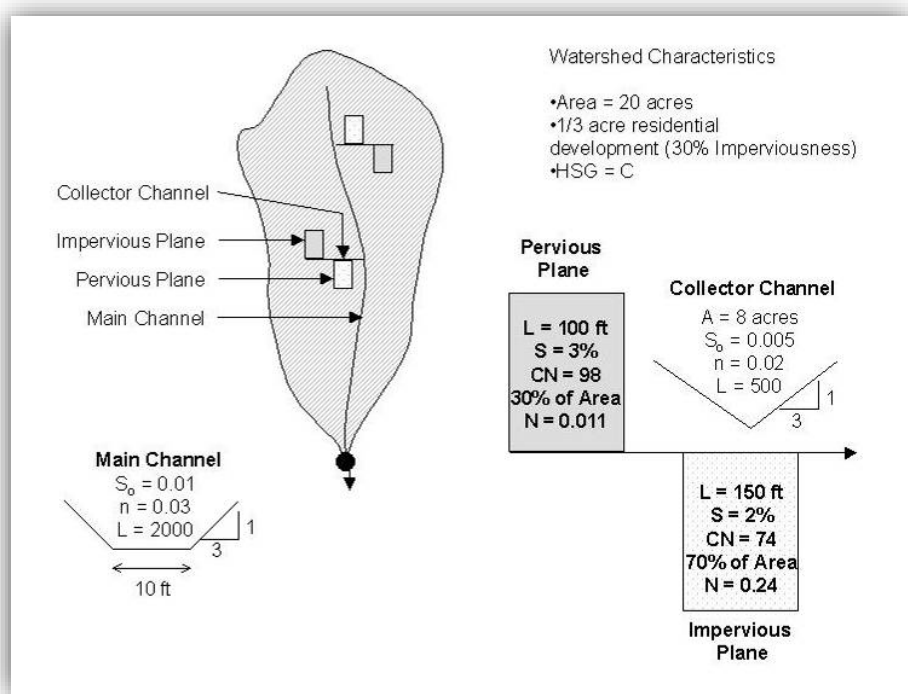

Figure 4. Example Watershed for Kinematic Wave Method

7.4.2 Overland Flow Planes:

For the overland flow planes, it is necessary to provide CN values. These can be selected for each plane from Table 9. For impervious area, a CN of 98 is appropriate; for pervious areas in a residential subdivision with restored soil profiles (HSG C matches pre-development HSG C) the appropriate CN is 74. The percent of the total drainage area associated with each plane should be determined from development plans. For preliminary calculations, the guidance in Table 9 can be used. In this case, with a ⅓-acre residential development, 30 percent of the area is assigned to the impervious plane, with the remainder assigned to the pervious plane.

Overland flow path length, slopes, and n values must be provided for each plane. Representative flow path lengths and slopes can be determined from the construction and grading plans of the development. Figure 4 quantifies these parameters for the example watershed. Table 11 can be used to determine n values. A value of n = 0.011 (smooth surfaces) is used for the impervious plane; a value of n = 0.24 (dense grass) is used for the pervious plane.

7.4.3 Channels:

Channel characteristics must be specified for collector channels and the main channel. Required inputs for channels are summarized in Table 10 and include representative cross-sectional geometry, flow path length, channel slope and Manning's roughness coefficient, n, for open channel flow. For each collector channel, the area tributary to the collector channel must be specified. Geometric parameters are determined from proposed construction and grading plans. Manning's n for open channels should be selected from Chapter 8, Open Channels, not from Table 11 in this Chapter. Required channel routing inputs for the Kinematic Wave model are presented on Figure 4.

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Chapter 6 Streets, Inlets, and Storm Drains

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1.0 Overview

This chapter contains design information and criteria for the design of urban stormwater collection and conveyance systems. This chapter specifies criteria for:

- The allowable drainage encroachment within public streets,
- Allowable types, sizing, and placement of inlets, and
- Sizing and design of storm drains.

The design procedures presented in this chapter are based upon fundamental hydrologic and hydraulic design concepts. Use of this chapter requires an understanding of the Rational Method for runoff hydrology (Chapter 5, Calculation of Runoff), open channel hydraulics (Chapter 8, Open Channels), and pipe hydraulics.

1.1 Design Storms

The stormwater system, at a minimum, shall commence at the point where the 2-year flow rate for fully developed conditions equals or exceeds 5 cubic feet per second (cfs) or street spread/depth limitations are exceeded. The following criteria apply to the design of streets, inlets, and storm drains:

- The 2-year flow rate shall be calculated for the fully developed conditions to show that street inundation criteria are met.
- The hydraulic grade line (HGL) for the 25-year flow shall not exceed the elevation of the gutter for a pipe system within public right of way or a drainage easement and shall not exceed channel capacity with a freeboard of 6 inches for an open channel.
- All street storm drains and channels shall be designed to convey the 25-year flow with fully developed conditions.
- Inlet, storm drain and channel capacity shall be designed so that the HGL from the 100-year flow under fully developed conditions meets street inundation criteria and all runoff is directed to the receiving detention basin or drainage system.
- Inlets and storm drains within parking lots shall be designed to limit ponding to 12 inches for a 100-year event.

In determining peak flow rates for design events for the design of streets, inlets, and storm drains, the effects of detention basins on adjacent properties may be accounted for if assurances that detention will be provided for perpetuity are provided and maintenance is assured. Assurances must typically be provided through recorded documents with land use restrictions and maintenance responsibilities properly noted.

2.0 Street Drainage

2.1 Allowable Inundation Depth and Spread

The purpose of limitations for inundation depth and spread is to ensure the safe travel of the public and emergency vehicle access. These limitations are based on the use classification of the street. The criteria used for inundation limitations are the minor storm event (2-year) and the major storm event (100-year). These criteria govern the design of the longitudinal street slope, inlet size, and inlet spacing. Table 1 presents city street inundation criteria. For collector and arterial streets, no flow shall pass through an intersection for a 25-year or lesser event.

Table 1. City of Springfield Inundation Criteria

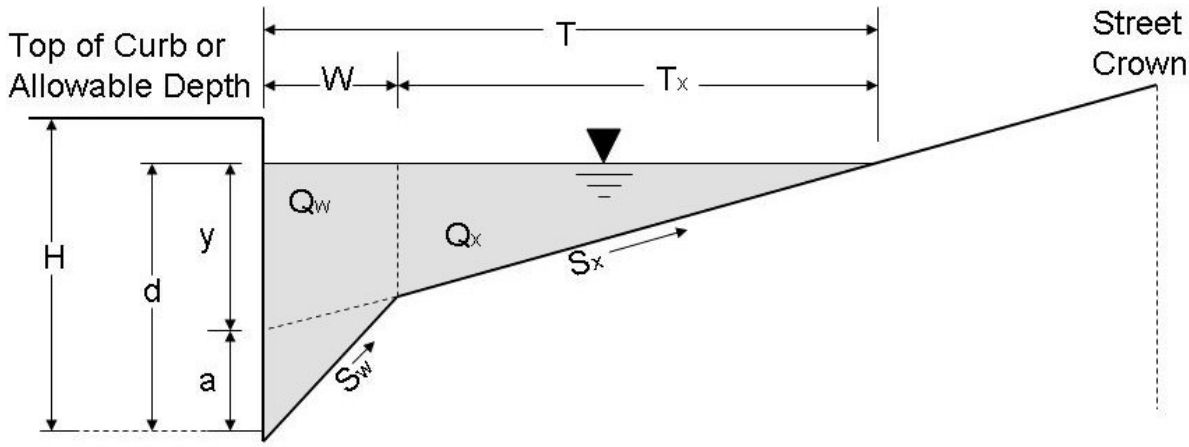
Street Classification	Minor Storm (2-year)	Major Storm (100-year)
Local	• No flow from one side of street to another • No curb overtopping • Inlets spaced for a maximum spread of 8 feet from curb face with one clear 10-foot travel lane	• No curb overtopping
Collector	• No flow from one side of street to another • No curb overtopping • Inlets spaced for a maximum spread of 8 feet from curb face with one 12-foot travel lane clear for residential collectors, and two 10-foot travel lanes clear for non-residential collectors	• No curb overtopping
Arterial	• No flow from one side of street to another • No curb overtopping • For secondary arterials, inlets spaced for a maximum 12-foot spread with two 12-foot travel lanes open. • For other arterials, inlets spaced for a maximum 6-foot spread with one full lane and one 8-foot lane clear in both directions	• No curb overtopping

2.2 Curb and Gutter Hydraulics

The required design standard for public streets includes curb and gutter. Complete standards for design and construction of streets and curb and gutter can be found in the City of Springfield, Missouri Design Standards for Public Improvements (Design Standards). The minimum allowable longitudinal slope for a public street is 0.5 percent. The maximum allowable longitudinal slope for a public street ranges from 5 to 10 percent, depending on street classification. Standard gutter width is 2 feet, with a depth of 2 inches, resulting in a gutter cross slope, Sw, of 0.0833 foot per foot (ft/ft). The standard cross slope, Sx, for a public street is ¼ inch per foot or approximately 2.1 percent. Gutter depression, a, in Figure 1, is 1.5 inches for typical Springfield street sections. A greater longitudinal slope results in higher velocities, less spread, and generally, higher inlet

efficiencies. Figure 1 shows a typical curb and gutter cross-section, with variables that are used in equations in subsequent sections.

Figure 1. Typical Curb and Gutter Cross-Section



For Springfield:

S_w = 0.0833 ft/ft, S_x = 0.021 ft/ft, a = 1.5 in

The street, curb and gutter, and inlets must be designed simultaneously to meet the street inundation criteria found in Table 1. Gutter flow and spread, T, can be determined using Manning's equation for open channel hydraulics (Chapter 8, Open Channels). Assuming the standard gutter and street cross-section found in the Design Standards, gutter flow can be determined by using Figure 2, Standard Gutter Spread.

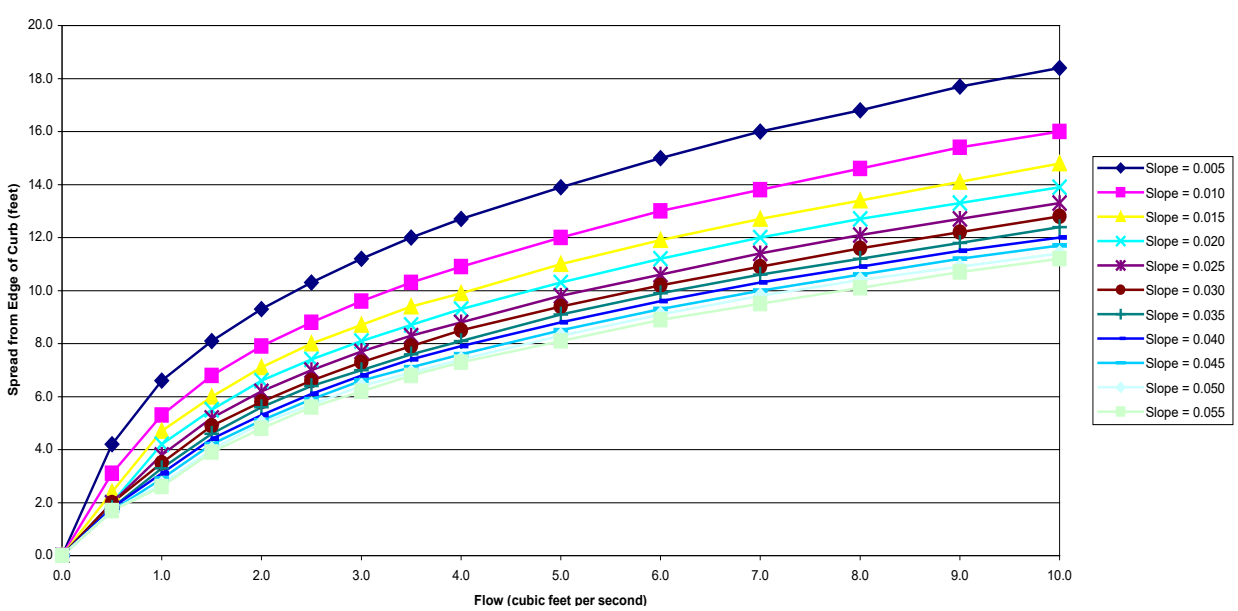


Figure 2. Standard Gutter Spread

2.3 Roadside Swales

Springfield's standard for public streets in new developments is a curb and gutter section with enclosed storm drains. Other street sections, such as roadside swale sections or other Low Impact Development (LID) designs, will be considered on a case-by-case basis. A subdivision variance will be required through the subdivision approval process, and generally, the developer or property owners association will be required to maintain all street rights-of-way and LID components. Alternative designs shall take into consideration topography and the proposed development and must adhere to the principles of containing the 100-year flow within the right-of-way or drainage easement and preventing erosion. Refer to Chapter 8, Open Channels, and Chapter 10, Water Quality, for more information on open channel hydraulics, grass swales, and LID techniques.

3.0 Inlets

Properly designed inlets are vital components of the urban stormwater collection and conveyance system. Inlets collect excess stormwater from the street, transition the flow into storm drains, and can provide maintenance access to the storm drain system. Inlets can be made of cast iron, steel, concrete, and/or pre-cast concrete and are installed on the edge of the street adjacent to the street gutter or in the bottom of a swale.

Roadway geometry often dictates the location of pavement drainage inlets. In general, inlets are placed at all low points (sumps or sags) in the gutter grade and on the upstream side of intersections, median breaks, pedestrian ramps, and crosswalks. The spacing of inlets placed in addition to those required by geometric controls is governed by the allowable inundation criteria given in Table 1.

Inlets shall not have a vertical opening greater than 6 inches. If a larger opening is used, a steel bar with a minimum diameter of ¾ inch shall be placed in the opening so there is no vertical opening greater than 6 inches.

3.1 Inlet Types

3.1.1 In Public Streets

There are three main inlet types per the City of Springfield, Missouri Standard Drawing Details for Public Improvements (Standard Drawing Details) for use in a public street:

- SS-3 Non-Recessed Curb Inlet.
- SS-5 Area inlet
- SS-6 Recessed curb opening inlet. This is the standard inlet for collector and arterial streets, but is often not suitable for residential areas with many driveways.

Other inlet types and combinations include grate inlets, recessed curb opening inlets with grates, and 4-foot curb opening inlets that are recessed and/or have a grate. Vaned grate inlets are permissible if reviewed and approved by the City, particularly in redevelopment areas where utilities, decorative sidewalk, planter trees, signs, etc., may prevent the practical placement of inlets and storm drains behind the curb. All grate inlets shall be bicycle safe.

3.1.2 Outside of Public Streets

Inlet types used outside of a public street include:

- Open Sided Drop Inlet or Area Inlet—Typically a 4-foot or larger square, concrete, off-street inlet, with openings on any or all sides to collect water in a ditch or collect water in an area sump.
- Grate Area Inlet—Typically used to collect runoff in a parking lot. May be used in grass areas with less than ¼ acre of drainage area due to clogging potential.

3.2 Hydraulic Evaluation

The hydraulic capacity of an inlet is dependent on the type of inlet (e.g., SS-3, SS-5, SS-6, or other) and the physical characteristics of the location (e.g., continuous grade or sump conditions, street cross slope, gutter geometry). The methodology for determining the hydraulic capacity of the standard inlets for continuous grade and sump conditions is described in Sections 3.2.1 and 3.2.2, respectively. The following general criteria apply when selecting inlet locations:

- Inlets must be located to limit gutter flows to no more than 5 cfs for the 2-year event and to meet spread limitations in Table 1.
- Inlets are required at all low points (sumps or sags) in the gutter grade and on the upstream side of intersections, median breaks, pedestrian ramps, and crosswalks. Flow cannot be directed across a street.

3.2.1 Curb Opening Inlets on a Continuous Grade

The inlet and storm drain system shall begin at or before the location where the 2-year flow equals 5 cfs. The capture efficiency of a curb opening inlet is dependent on the length of the opening, the depth of flow at the curb, the street cross slope, and the longitudinal gutter slope. Even the most efficient inlet design will often result in some inlet bypass; therefore, the inlet efficiency must be calculated so that the capture and bypass for each inlet can be determined. Many variables used in the equations below are shown in Figure 1. The efficiency, E, of a curb opening inlet on a continuous grade is calculated as:

$$E = 1 - \left(1 - \frac{L}{L_T}\right)^{1.8} \qquad \text{Equation 1}$$

for $L < L_T$, otherwise $E = 1.0$

In which:

L = design curb opening length (ft) (standard inlets are 7- and 3-ft lengths)

L_T = curb opening length required to capture 100 percent of gutter flow (ft)

To factor in gutter depression or for a curb opening inlet that is not recessed:

$$L_T = 0.6Q^{0.42}S_L^{0.3}\left(\frac{1}{nS_x}\right)^{0.6}$$

Equation 2

In which:

Q = gutter flow (cfs)

S_L = longitudinal street slope (ft/ft)

S_x = street cross slope (ft/ft)

n = Manning's roughness coefficient (typically 0.016 for a street cross-section with concrete curb and gutter and asphalt paving—see Chapter 8, Open Channels, for Manning's n values for other surfaces)

To factor in gutter depression or for a recessed curb opening inlet:

$$L_T = 0.6Q^{0.42}S_L^{0.3}\left(\frac{1}{nS_e}\right)^{0.6}$$

Equation 3

The equivalent cross-slope, Se, can be determined from:

$$S_e = S_x + \frac{a}{W}E_0$$

Equation 4

In which:

a = gutter depression (ft)

W = width of gutter below breakpoint in cross slope (recessed section width) (ft)

E_0 = ratio of flow in the recessed section of the gutter to total gutter flow determined by Manning's equation

$$E_0 = \frac{1}{1 + \dfrac{S_w/S_x}{\left[1 + \dfrac{S_w/S_x}{(T/W)-1}\right]^{8/3} - 1}}$$

Equation 5

In which:

S_w = gutter cross slope (ft/ft)

T = spread from edge of curb (ft)

A 10 percent clogging factor is assumed for a single curb opening inlet.

Example:

Given a longitudinal street slope of 3 percent and a design flow rate of 5 cfs, determine the efficiency of a single SS-3 curb opening inlet on grade. Determine the flow captured by the inlet and the carryover flow to the next inlet.

Based on the street longitudinal slope of 3 percent (SL = 0.030 ft/ft) and a flow rate of 5 cfs, the spread, T, can be determined from Figure 2 to be 9.4 feet.

For standard city streets the gutter cross slope, Sw, is 0.0833 ft/ft, the street cross slope, Sx, is 0.021 ft/ft, and the gutter width, W, is 2 feet. E_0 can be calculated using Equation 5, as follows:

$$E_0 = \frac{1}{1 + \frac{0.0833/0.021}{\left[1 + \frac{0.0833/0.021}{(9.4/2) - 1}\right]^{8/3} - 1}}$$

$E_0 = 0.60$

Given a gutter depression, a, of 1.5 inches (0.125 feet), the equivalent slope, Se, can be calculated using Equation 4:

$$S_e = 0.21 + \left(\frac{0.125}{2} \cdot 0.60\right)$$

Se = 0.0585 ft/ft

L_T, the total curb opening length required to capture the entire 5 cfs, can then be calculated from Equation ST-3 using a Manning's n = 0.016 for the concrete and pavement gutter and street cross-section:

$$L_T = 0.6 \cdot 5^{0.42} \cdot 0.03^{0.3} \left(\frac{1}{0.016 \cdot 0.0585}\right)^{0.6}$$

$L_T = 27.0$ feet

The efficiency of a single SS-3 curb opening inlet (L = 7 ft) can be calculated as follows:

$$E = 1 - \left(1 - \frac{7}{27}\right)^{1.8}$$

E = 0.42 or 42%

Therefore, without accounting for clogging, a single SS-3 inlet would be expected to capture about 42 percent of the flow, or 2.1 cfs, in this example. After applying a 10 percent clogging factor for a single curb opening inlet, the inlet would be expected to capture 1.89 cfs, with an actual efficiency of approximately 38 percent. Additional inlets would be required to deal with the carryover of 3.11 cfs (5.0 cfs – 1.89 cfs captured by the single SS-3 inlet).

3.2.2 Inlets Located in Sumps

Inlets must be placed in all street sumps. No street cross slope that directs drainage across a street at a sump is acceptable. Clogging of inlets in a sump can lead to hazardous driving conditions. Therefore, grate inlets alone should not be used in a sump. Single grate inlets must assume a 50 percent clogging factor.

Inlets in sumps function like weirs for shallow depths, but as the depth of stormwater increases, they begin to function like an orifice. The Federal Highway Administration (FHWA) (1979) provides guidance on the transition region based on significant testing. The hydraulic capacity of a curb opening inlet or a vaned grate inlet operating as a weir is expressed as:

$$Q_i = C_w L_w d^{1.5}$$

Equation 6

In which:

Q_i = inlet capacity (cfs)

C_w = weir discharge coefficient

L_w = weir length (ft), length of inlet opening acting as weir

d = flow depth (ft)

Table 2 provides values of C_w and L_w for various inlet types. Note that the expressions given for curb opening inlets without depression should be used for recessed curb opening inlets if L is greater than 12 feet.

The hydraulic capacity of a curb opening inlet or a vane grate inlet operating as an orifice is expressed as:

$$Q_i = C_o A_o \sqrt{2gd}$$

Equation 7

In which:

C_o = orifice coefficient

A_o = orifice area (square feet [ft2])

g = gravitational acceleration (32.2 ft/s2)

d = characteristic depth (ft) defined in Table 2

Values for A_o and C_o are provided in Table 2. The weir and orifice equations provided above are also applicable for other types of inlets (e.g., combinations, slots, etc.); however, coefficients for these other inlet types may vary from coefficients in Table 2.

Table 2. Sump Inlet Discharge Variables and Coefficients (Modified from Akan and Houghtalen 2002)

Weir Inlet Types	Cw	Lw[1]	Weir Equation Valid For	Definition of Terms
Curb opening inlet (SS-3, SS-6)	3.00	L	d < h	L = Length of curb opening h = Height of curb opening d = Depth of water at curb opening
Recessed curb opening inlet (SS-6)[2]	2.30	L +1.8W	d < h + a	W = Lateral width of recessed section a = Depth of curb depression
Vane Grate Inlet	3.00	L +2W	d < 1.79(Ao/Lw)	Ao = Clear opening area W = Width of grate
Orifice Inlet Types	**Co**	**Ao[3]**	**Orifice Equation Valid For**	**Definition of Terms**
Curb opening inlet (SS-3, SS-6) or recessed curb opening inlet (SS-6)[2]	0.67	hL	di > 1.4h	di = Depth of water at curb opening d = di – (h/2) h = Height of curb opening
Vane Grate Inlet	0.67	Clear opening area	d > 1.79(Ao/Lw)	d = Depth of water over grate Ao = Clear opening area

1 The weir length (Lw) should be reduced where clogging is expected.
2 If L > 12 feet, use the expressions for curb opening inlets that are not recessed.
3 The orifice area (Ao) should be reduced where clogging is expected.

3.2.3 Inlet Clogging

The effects of inlet clogging must be taken into account. A clogging factor must be selected based on the debris and trash condition on the street. During a storm event, street inlets are often loaded with debris by the first-flush runoff volume. To account for the resulting loss in capacity, a 50 percent reduction in capacity shall be used for a single grate inlet and a 10 percent reduction in capacity shall be used for a single curb opening inlet. Multiple inlet units are generally not acceptable in new construction; however, in such cases, a smaller reduction in total inlet capacity may be acceptable depending on configuration and conditions.

3.2.4 Plan and Calculation Submittals

It is important to carefully track runoff flow rates, bypassing flow rates, flow spreads, and other parameters related to gutter flow and inlet capacity for all design storms. Refer to Chapter 4, Plan Submittal, for submittal requirements, report formats, and submittal checklists.

4.0 Storm Drains

4.1 General

Storm drains convey runoff collected by the inlet system. The storm drain system includes inlets, pipes, channels, junctions, bends, outlets, and other appurtenances.

4.1.1 Horizontal Alignment

The following criteria apply to the horizontal alignment of storm drains:

- The horizontal alignment of storm drains shall be behind the curb unless site conditions or street geometry make it necessary to be under the street. The number of street crossings should be minimized.
- Storm drain alignment shall be straight with bends only at junction boxes, inlets, or manholes. See Section 4.1.4 for cases where bends may be allowed.
- Public storm drains outside of the right-of-way must be located within a drainage easement. Table 3 shows minimum easement widths. Additional width may be required based on depth of the storm drain and site-specific conditions. Refer to Chapter 12, Easements and Maintenance, for more information.
- Horizontal clearance between storm pipes and sanitary sewer and water lines shall generally be a minimum of 10 feet. Refer to the Design Standards for Public Improvements for complete sanitary sewer separation requirements and contact the appropriate utility for water line separation requirements.

Table 3. Minimum Easement Widths Required for Storm Drains

Inside Horizontal Dimension (inches)	Minimum Easement Width (ft)
12 – 24	10
> 24 – <48	15
48 – 72	20
Larger	To be determined

4.1.2 Vertical Alignment

The following criteria apply to the vertical alignment of storm drains:

- The storm drain shall have a design velocity range from a minimum of 2 ft/s for the 2-year event up to a maximum of 15 ft/s for the 100-year event.
- Vertical clearance between storm drains and sanitary sewer and water lines shall be 18 inches. In cases where 18 inches of vertical clearance cannot be attained, refer to the Design Standards for Public Improvement for complete sanitary sewer separation requirements and contact the appropriate utility for water line separation requirements.
- The minimum cover for storm drains is 12 inches and must be sufficient to withstand American Association of State Highway and Transportation Officials (AASHTO) HS-20 loading on pipe. Additional cover may be required according to manufacturer requirements.
- Vertical drops greater than 6 feet require a special design that addresses the need for structure protection and energy dissipation.

4.1.3 Pipes

Allowable pipe types and materials are listed in Chapter 5 of the *General Conditions and Technical Specifications for Public Improvements*. The allowable Manning's Roughness coefficient values for various pipe materials can be found in Table 4.

The minimum allowable pipe diameter in a public system is 15 inches or its equivalent in elliptical pipe. The minimum allowable slope for pipes less than 36 inches in diameter is 0.5 percent, and the maximum allowable slope is 15 percent, unless hydraulic conditions govern. When a pipe slope in excess of 15 percent is necessary, the pipe must be anchored and stabilized to ensure it will not fail. See Section 4.2 for additional information on hydraulics of storm drains.

Table 4. Roughness Coefficients for Various Materials

Material	n Value
Reinforced Concrete Culvert (pipe or box)	0.013
CMP 2-2/3 in. x ½ in. Annular Corrugations	0.024(1)
CMP 3 in. x 1 in. Annular Corrugations	0.027(1)
Structural Plate CMP 6 in. x 2 in. Annular Corrugations (5 ft. dia.)	0.033
Polypropylene Pipe	0.012
PVC (Private development only)	0.012
HDPE (Private development only)	0.012
(1) Manning's n for helically corrugated CMP may be less in certain conditions.	

4.1.4 Junction Boxes or Manholes

The primary functions of junction boxes include:

- Providing maintenance access.
- Serving as junctions when two or more pipes merge.
- Providing flow transitions for changes in pipe size, slope, and alignment.
- Providing ventilation.

The following criteria apply to bends and junctions:

- A standard junction box or manhole is required at all horizontal bends, grade changes, and changes in pipe size, shape, or material. Exceptions may be granted for pipes with a diameter greater than 36 inches that have other access within 300 feet.
- A bend within 3 feet of a junction or inlet box with access may be used to achieve a more perpendicular junction. In this case, the angle for pipes 24 inches and smaller may not exceed 60 degrees, and the angle for pipes larger than 24 inches may not exceed 45 degrees. See Figure 3 for clarification. In these situations it is preferable to use a manhole instead of a junction box.
- The distance between access points to the storm drain system shall not exceed 300 feet.
- Junction boxes shall be constructed as shown in SS-1 in the Standard Drawing Details.
- Manholes shall be constructed as shown in SS-2 in the Standard Drawing Details.

4.1.5 Bends and Transitions

In cases where bends and transitions are acceptable, it may be necessary to provide gradual transitions in size or alignment to minimize energy losses and potential for blockage. When bends are necessary, bends at pipe joints should generally not exceed 2 degrees or otherwise cause unacceptable head losses in the system. Transitions should be gradual and shall not decrease the

size of the pipe in the downstream direction. Special structures that control head losses to an acceptable level may be necessary for other transitions.

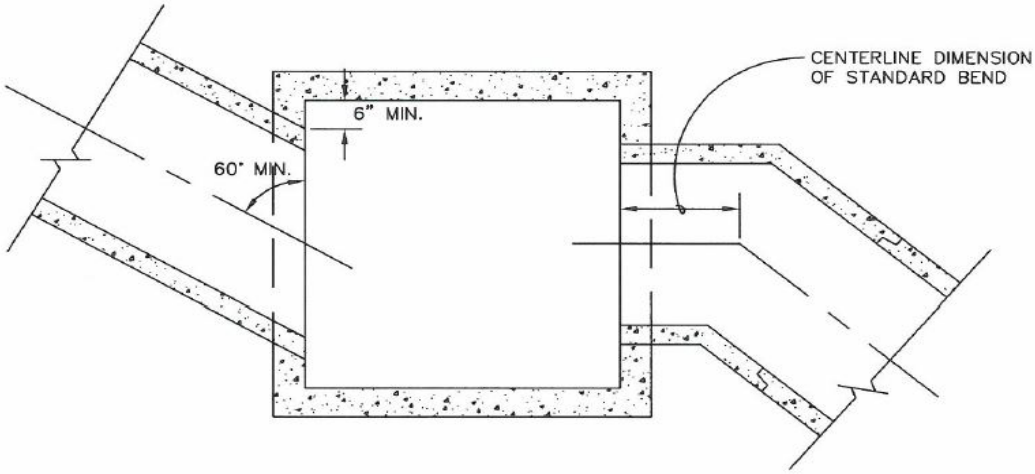


Figure 3. Typical Pipe Connection at Junction Structure

4.1.6 Outlets

Outlet structures are transitions from pipe flow into open channel flow or still water (e.g., ponds, lakes, etc.). The primary function of these structures is to minimize erosion in the receiving channel or water body. Generally, outlets from small pipes consist of riprap and shall extend a minimum of 5 times the pipe diameter downstream of the pipe and have a width of at least 3 times the pipe diameter. The riprap pad should be depressed 6 inches at the outfall. A standard detail for a riprap outlet is provided in the Standard Drawing Details. Refer to Chapter 7, Bridges and Culverts, and Chapter 8, Open Channels, for more information on outlet structures and riprap design.

4.1.7 Other Appurtenances

Examples of other specialized appurtenances include flow splitters and deflectors and flap gates. Flow splitters separate incoming flow and send it in two or more directions. Flow deflectors minimize energy losses in manholes, junction chambers, and flow splitters. Flap gates may be placed on outlets to prevent backflow in areas subject to high tailwater or flood flow. These are structures that require individual consideration and specialized design prior to City acceptance.

4.1.8 General Safety Requirements

The following safety criteria apply to all public storm drainage systems:

- Headwalls and wingwalls associated with storm drain outfalls shall include guardrails, handrails, or fencing in conformance with highway design safety standards and applicable building codes.
- Handrails shall be required in all areas where the drop from the headwall or wingwall exceeds 30 inches. See the Design Standards for Public Improvements for handrail design standards. Refer to AASHTO standards for safety rails along designated bikeways.

- Trash racks should be considered at all entrances to storm drains, based on location and site conditions. Refer to *Public Safety Guidance for Urban Storm water Facilities* (ASCE) for guidance. When used, inlet racks should have a minimum surface area of four times the open area of the culvert. Racks at outlets are generally discouraged.

4.2 Storm Drain Hydraulics

4.2.1 General

The design of a storm drain system requires data including topography, drainage boundaries, soil types, and locations of any existing storm drains, inlets, and junction boxes. Identification of the type and location of utilities to identify potential conflicts must be completed early in the design process. The drainage area to each inlet shall be identified and the design flows calculated to determine the necessary pipe capacity.

Once the storm drain system is designed, the hydraulic capacity shall be evaluated for the design storms using energy grade line (EGL) calculations starting at the downstream terminus of the system. Hydraulic grade line (HGL) calculations shall be performed for the design storms. All transitions, bends, entrance and exit conditions, tailwater conditions, and other losses shall be accounted for in HGL calculations.

4.2.2 Design Storm and Storm Drain Capacity

All storm drains shall be designed to convey the 25-year flow with the HGL no higher than the gutter of the street, and the HGL for the 100-year flow no higher than the top of curb. Spread inundation criteria shall be met for the 2- and 100-year flows, as shown in Table 1, and all runoff shall be directed to the downstream detention and/or drainage system appropriately. The allowable velocity range for pipes and concrete channels shall be a minimum of 2 ft/s for the 2-year event up to a maximum of 15 ft/s for the 100-year event. The initial check of pipe or channel capacity shall be determined using Manning's equation. Figure 4 relates depth of flow and pipe diameter to hydraulic parameters for circular pipes and may be used as a tool for sizing. Final design of pipes and channels may require further hydraulic analysis. Refer to Chapter 8, Open Channels, for additional information on the application of Manning's equation.

4.2.3 Hydraulic and Energy Grade Line Calculations

HGL calculations are required for all storm drain designs. The EGL is calculated using the principle of conservation of energy and the energy equation for open channel or pressure flow as follows:

For open channel flow:

$$z_1 + d_1 + \frac{V_1^2}{2g} = z_2 + d_2 + \frac{V_2^2}{2g} + h_L$$

Equation 8

For pressure flow:

$$z_1 + \frac{p_1}{\gamma} + \frac{V_1^2}{2g} = z_2 + \frac{p_2}{\gamma} + \frac{V_2^2}{2g} + h_L$$

Equation 9

Where:

z = elevation (gravity) head (ft)

d = depth of flow (ft)

V = velocity of flow (ft/s) = Flow (Q) / Area (A)

p/γ = pressure head (ft)

γ = unit weight of water (lbs/ft3)

g = gravitational acceleration (32.2 ft/s2)

h_L = head loss (ft) = $h_f + \Sigma h_m$

Where:

h_f = head loss due to friction (ft) from Equation 10

h_m = minor head loss (ft)

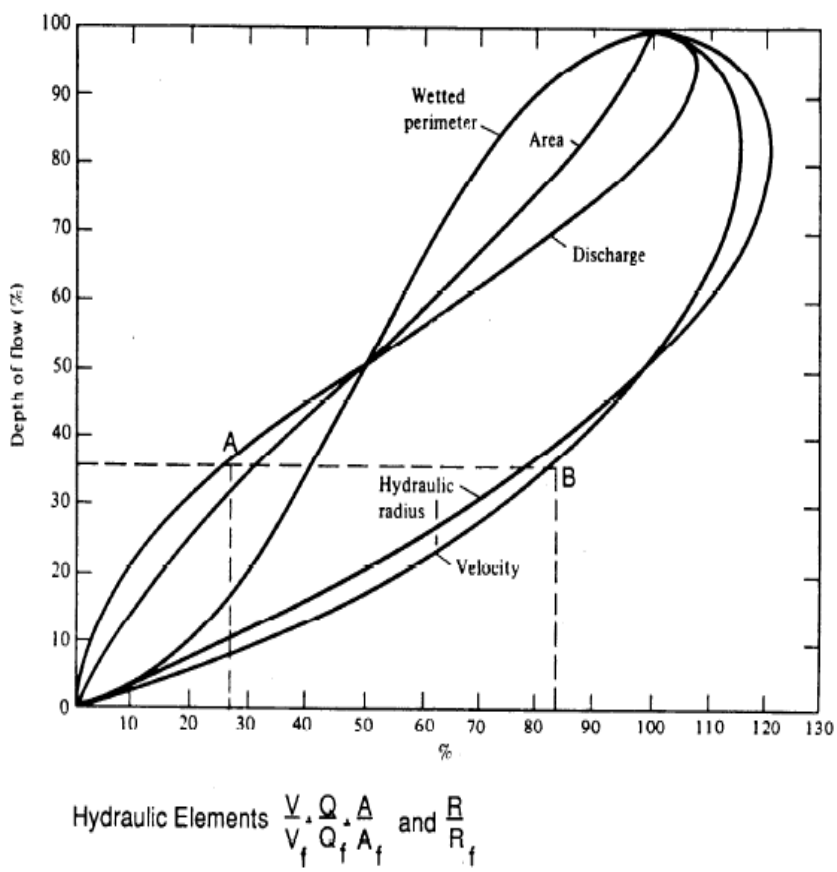


Figure 4. Hydraulic Characteristics of Circular Conduits (Chow 1959)

The HGL is calculated by subtracting the velocity head, $V^2/2g$, from the EGL. When the velocity is 0, the HGL and EGL are the same.

Head losses must be accounted for in the design of storm drains in order to calculate the HGL. The following sections describe methods for calculating head losses due to pipe friction, junction box and manhole structures, pipe junctions, transitions (contractions and expansions), and system outfalls (exit losses). Akan and Houghtalen (2003) provide a concise overview of head losses in storm drain systems, and the following sections are based upon their reference, which incorporates procedures developed by FHWA (1996). Thorough documentation of loss calculations, input parameter guidance, software tools, and example calculations are available from the FHWA (1996).

4.2.3.1 Head Loss Due to Pipe Friction

The friction loss, hf, due to flow resistance in a storm sewer is calculated as:

$$h_f = LS_f \qquad \text{Equation 10}$$

In which:

L = length of the sewer pipe (ft)

S_f = friction slope (ft/ft), typically taken as the bottom slope of the pipe, S_0, as a simplifying assumption for partially full, gravity flow storm sewers.

In addition to the energy losses due to friction in storm sewers, losses occur at transitions, bends, junctions, and other appurtenances. Many of the equations for estimating these losses have been determined empirically, and some variations should be expected based on site specific conditions. The following sections present general guidance for calculating energy losses for various storm sewer components.

4.2.3.2 Inlet and Manhole Losses

The energy loss encountered by flow in an incoming storm sewer is determined differently depending on whether the water in the manhole or junction submerges the incoming pipe invert. If the invert is above the water surface in the manhole, then the flow in the incoming pipe will not be affected by junction losses, and the outflow pipe is treated like a culvert (refer to Chapter 7, Culverts and Bridges). If the invert of an inflow pipe is below the water surface in a manhole, the head loss, h_{LM}, is:

$$h_{LM} = K_0 C_D C_d C_Q C_p C_B \frac{V_o^2}{2g} \qquad \text{Equation 11}$$

In which:

K_0 = initial loss coefficient

V_o = velocity in the outflow pipe (ft/s)

g = gravitational acceleration (32.2 ft/s2)

C_D, C_d, C_Q, C_p, and C_B = correction factors for pipe sizes (D), flow depth (d), relative flow (Q), plunging flow (p), and benching (B) (For more information, see Akan and Houghtalen 2003, FHWA 1996, and FHWA 1994.)

The initial loss coefficient for an incoming pipe is calculated using the following equation:

$$K_\theta = 0.1\left(\frac{b}{D_o}\right)(1-\sin\theta) + 1.4\left(\frac{b}{D_o}\right)^{0.15}\sin\theta$$ Equation 12

In which:

b = manhole or junction diameter (ft)

D_o = outflow pipe diameter (ft)

θ = the angle between the inflow and outflow pipes

The correction factor for pipe size, C_D, is significant only for high-pressure flow and is a function of the outflow pipe diameter, D_o, and the inflow pipe diameter, D_i:

$$C_D = \left(\frac{D_o}{D_i}\right)^3$$ Equation 13

This equation is used only when daho, the flow depth in the manhole or junction above the outlet pipe invert, is >3.2D_o. Otherwise, C_D = 1.0. The HGL elevation at the upstream end of the outflowing pipe can be used as an approximation of d_{aho}.

The correction factor for flow depth, C_d, is significant only for low-pressure or free surface flow. It is determined using the following equation:

$$C_d = 0.5\left(\frac{d_{aho}}{D_o}\right)^{0.6}$$ Equation 14

This equation should only be used when d_{aho}<3.2D_o. Otherwise, C_d = 1.0.

When three or more pipes enter the structure at approximately the same elevation, the correction factor for relative flow, C_Q, is calculated using the following equation:

$$C_Q = (1-2\sin\theta)\left(1-\frac{Q_i}{Q_o}\right)^{0.75} + 1$$ Equation 15

In which:

Q_i = flow rate of inflow pipe (cfs)

Q_O = flow rate of outflow pipe (cfs)

This equation is used if $h_p > d_{aho}$, where h_p = distance from the flow line of the higher elevation inlet pipe to the center of the outflow pipe. It is also used if a higher elevation flow plunges into an access hole that has both an inflow pipe and an outflow pipe in the bottom of the access hole. For other cases, $C_p = 1.0$.

The correction factor for benching, C_B, is 1.0 for flat benching configurations. See Akan and Houghtalen (2003) for correction factors if other benching configurations are used.

4.2.3.3 Pipe Junctions

Where a lateral pipe is connected to a larger trunk pipe without the use of a manhole, the head loss due to the junction, h_{Lj}, is calculated as follows:

$$h_{Lj} = \frac{Q_o V_o - Q_i V_i - Q_L V_L \cos\theta}{0.5g(A_o + A_i)} + \frac{V_i^2}{2g} - \frac{V_o^2}{2g}$$ Equation 16

In which:

V_i, V_o and V_L = velocities in the inflow, outflow and lateral pipes, respectively (ft/s)

Q_i, Q_o and Q_L = flow rates in the inflow, outflow, and lateral pipes, respectively (cfs)

A_i and A_o = cross-sectional area of flow in the inflow and outflow pipes, respectively (ft^2)

θ = angle between the inflow and outflow pipes

4.2.3.4 Transitions

The energy loss due to a gradual pipe expansion, h_{LE}, is calculated as follows:

$$h_{LE} = K_e \left(\frac{V_1^2}{2g} - \frac{V_2^2}{2g} \right)$$ Equation 17

In which:

K_e = expansion loss coefficient from Table 5

V_1 = velocity upstream of the expansion (ft/s)

V_2 = velocity downstream of the expansion (ft/s)

The energy loss due to a gradual pipe contraction, h_{LC}, is calculated as follows:

$$h_{LC} = K_c \left(\frac{V_2^2}{2g} - \frac{V_1^2}{2g} \right)$$ Equation 18

In which:

K_c = contraction loss coefficient

V_1 = velocity upstream of the expansion (ft/s)

V_2 = velocity downstream of the expansion (ft/s)

In general, $K_c = 0.5K_e$.

Table 5. Typical Values for Ke for Gradual Enlargement of Pipes in Nonpressure Flow

D_2/D_1	Angle of Cone						
	10°	20°	45°	60°	90°	120°	180°
1.5	0.17	0.40	1.06	1.21	1.14	1.07	1.00
3	0.17	0.140	0.86	1.02	1.06	1.04	1.00

Source: After FHWA (1996).

4.2.3.5 Bend Loss

The energy loss due to a bend, h_{LB}, is calculated as follows:

$h_{LB}=0.003\Delta\ (V_2/2g)$ Equation 19

In which:

V = velocity in bend (ft/sec)

Δ = angle of curvature in degrees

4.2.3.6 Exit Losses

The energy loss at a storm sewer system outlet, h_{LO}, is calculated using the following equation:

$$h_{LO} = \frac{V_o^2}{2g} - \frac{V_d^2}{2g}$$

In which:

V_o = velocity in the outlet pipe (ft/sec)

V_d = velocity in the downstream channel (ft/sec)

When a storm sewer discharges into a reservoir, $V_d = 0$. For discharge to an open channel, Manning's equation can be used to estimate, V_d, based on channel geometry and roughness.

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Chapter 7 Culverts and Bridges

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1.0 Overview

This chapter addresses the hydraulic function of culverts. The hydraulic function involves conveying surface water through embankments such as roadways and railroads. In addition to the hydraulic function, a culvert must support loads from construction equipment, highway, railroad, or other traffic. Therefore, culvert design involves both hydraulic and structural design considerations, though this chapter is focused strictly on the hydraulic aspects of culvert design.

Multiple factors have a bearing on the capacity and overall performance of a culvert. These include size, shape, material, as well as several other variables. Sizes and shapes of culverts may vary from small circular pipes to extremely large arch sections used in place of a bridge (see text box on Culvert Shapes).

The material selected for a culvert is dependent upon various factors, such as durability, structural strength, roughness, bedding condition, abrasion and corrosion resistance, and water tightness. The most commonly used culvert materials are steel (smooth and corrugated) and concrete.

The inlet configuration is another factor that significantly affects the performance of a culvert. The inlet may consist of a culvert barrel projecting from the roadway fill or mitered to the embankment slope. Other inlets have headwalls, wingwalls, and apron slabs or may have standard end sections of concrete or metal.

Culvert Shapes and Their Applications

Circular – Most common culvert shape, for general use.

Elliptical – Often used in lieu of circular pipe in situations where the available cover depth is limited.

Arch - Suitable for locations where less obstruction to a waterway is preferred and where foundations are adequate for structural support.

Box – Suitable for passing large flows and for a range of site conditions. A box or rectangular culvert lends itself more readily than other shapes to low allowable headwater situations since the culvert height may be decreased to satisfy the site constraints and the width (span) increased to accommodate flow capacity requirements.

A careful approach to culvert design is essential, both in new land development and retrofit situations, because culverts often significantly influence upstream and downstream flood risks, floodplain management, and public safety (Photograph 1).

Photograph 1. Public safety considerations for long culverts should be accounted for with designs such as this collapsible trash rack at a park-like setting.

In addition to the strict function of conveying flow, culverts can also be designed to provide added benefits, such as creating conditions upstream of the culvert that are suitable for wetland growth (Photograph 2).

Aesthetic considerations can also be incorporated into a design, such as visually integrating a culvert into the surrounding landscape (Photograph 3).

The information and references necessary to design culverts according to the procedure given in this chapter can be found in Hydraulic Design of Highway Culverts, Hydraulic Design Series No. 5 (FHWA 2005a). Examples of charts and nomographs from that publication are given in this chapter for some of the most common culvert requirements. For special cases and larger sizes, the FHWA publication should be used.

Photograph 2. Culverts can be designed to provide compatible upstream conditions for desirable wetland growth.

Photograph 3. Culverts can be integrated into the urban landscape without negative visual impact.

1.1 Required Design Information

The hydraulic design of a culvert involves analyzing the required performance of the culvert to convey flow through an embankment, such as a road. The designer must select a design flood frequency, estimate the design discharge for that frequency, and set an allowable headwater elevation based on the selected design flood and headwater considerations. These criteria are typically dictated by local requirements (see Section 1.1.1 for Springfield design criteria), although state and federal standards apply to relevant highway projects.

The culvert size and type can only be selected after certain design criteria have been determined, such as the design discharge, controlling design headwater, slope, tailwater, and allowable outlet velocity.

Design of a culvert includes determining the following:

- General planning issues
  - What is the design discharge?
  - How will the proposed culvert/embankment fit into the relevant major drainageway master plan, and are there multi-purpose objectives that should be satisfied?
  - Are there specific public safety issues related to the culvert location, such as the key question of whether or not to include a safety/debris rack? (See Photograph 1).
  - What are the impacts of various culvert sizes and dimensions on upstream and downstream flood risks, including the implications of embankment overtopping?
- Design considerations
  - Alignment, grade, and length of culvert.
  - Headwater depth, outlet velocity, tailwater conditions, and end treatment.

  - Amount and type of cover material required.
  - Culvert size and type.
- Detailed design considerations
  - Pipe material.
  - Need for protective measures against abrasion and corrosion and type of coating (if required).
  - Need for specially designed inlets or outlets.
- Other considerations
  - Structural and geotechnical considerations (beyond the scope of this chapter).

1.1.1 Design Discharge

The discharge used in culvert design is usually estimated on the basis of a preselected storm recurrence interval, and the culvert is designed to operate within acceptable limits of risk at that flow rate. The design recurrence interval should be based on the more restrictive criteria set forth in Table 1.

Table 1. Storm Recurrence Interval

Criterion	Criterion Value	Design Storm Recurrence Interval
Drainage area above culvert	Less than 1 square mile	25-year
	1 square mile or greater	100-year
Roadway Classification	Smaller than secondary arterial	25-year
	Secondary arterial or greater	100-year

Notes:

(1) For all roadways, culvert sizing should accommodate the design storm and also allow for 1 foot of freeboard below the sag in the roadway or below the low chord of a bridge structure, whichever results in a lower Water Surface Elevation (W.S.E.).

(2) For safety purposes, roadway culverts sized for the 25-year event should also be checked for the 100-year flow. If, during the 100-year event, flow overtops the roadway, then the velocity and depth must meet the following criterion:

V * D is less than or equal to 4

where:

V = Velocity of flow in water overtopping roadway (ft/sec)

D = Depth of flow overtopping roadway (ft)

If V * D is greater than 4, then the culvert capacity must be increased until V * D < 4 for the 100-year event.

1.1.2 Headwater Depth

Culverts frequently constrict the natural stream flow, which causes a rise in the upstream water surface. The elevation of the upstream water surface is termed *headwater elevation*. The *headwater depth* is measured from the invert of the culvert inlet to the water surface of the stream.

In selecting the design headwater elevation, the designer should consider the following:

- Headwater/Culvert Depth ratio (HW/D) should not exceed 1.5 unless there is justification and sufficient measures are taken to protect the culvert inlet (for example, a concrete headwall).
- Anticipated upstream and downstream flood risks, for a range of return frequency events.
- Hazard to human life and safety (caused by exceeding the design headwater elevation).
- Damage to the culvert and the roadway.
- Traffic interruption.
- Low point in the roadway grade line.
- Roadway elevation above the structure.
- Elevation at which water will flow to the next cross drainage.
- Relationship of headwater depth to the stability of the embankment that the culvert passes through.

The designer should verify that the watershed divides are higher than the design headwater elevations. In flat terrain, drainage divides are often undefined or nonexistent and culverts should be located and designed for the least disruption of the existing flow distribution.

1.1.3 Tailwater Depth

Tailwater is the flow depth in the downstream channel measured from the invert of the culvert outlet. It can be an important factor in culvert hydraulic design because a submerged outlet may cause the culvert to flow full rather than partially full.

A field inspection of the downstream channel should be made to determine whether there are obstructions that will influence the tailwater depth. Tailwater depth may be controlled by several factors, including the stage in a contributing stream, headwater from structures downstream of the culvert, reservoir water surface elevations, or other downstream features.

1.1.4 Outlet Velocity

The outlet velocity of a culvert, measured at the downstream end of the culvert, is usually higher than the maximum natural stream velocity. This higher velocity can cause streambed scour and bank erosion for a limited distance downstream from the culvert outlet. Most culverts require adequate outlet protection, and this is a frequently overlooked issue during design.

Permissible velocities at the outlet will depend upon streambed type, and the type of energy dissipation (outlet protection) that is provided. As a general rule, the velocity at the downstream edge of a project right-of -way or downstream constraint should not be greater than the pre-construction velocity. Velocities must be non-erosive to the existing channel; otherwise downstream improvements may be required.

If the outlet velocity of a culvert is too high, the velocity may be reduced by increasing the barrel roughness. If this does not provide a satisfactory reduction in outlet velocity, it may be necessary to incorporate some type of outlet protection or energy dissipation device.

Variations in shape and size of a culvert seldom have a significant effect on the outlet velocity. Slope and roughness of the culvert barrel are the principal factors affecting the outlet velocity.

2.0 Culvert Hydraulics

2.1 Key Hydraulic Principles

For the purposes of this review, it is assumed that the reader has a basic working knowledge of hydraulics and is familiar with the Manning's Equation (Equation 1), Continuity Equation (Equation 2), and Energy Equation (Equation 3):

$$Q = \frac{1.49}{n} A R^{2/3} S^{1/2} \qquad \text{(Equation 1)}$$

where:

Q = flow rate or discharge (cfs)

n = Manning roughness coefficient (unitless)

A = cross-sectional area of flow (sq ft)

R = hydraulic radius (ft)

S = longitudinal slope (unitless)

$$Q = v_1 A_1 = v_2 A_2 \qquad \text{(Equation 2)}$$

where:

Q = flow rate or discharge (cfs)

v = velocity (ft/sec)

A = cross-sectional area of flow (sq ft)

$$\frac{v^2}{2g} + \frac{p}{\gamma} + z + \text{losses} = \text{constant} \qquad \text{(Equation 3)}$$

where:

v = velocity (ft/sec)

g = gravitational acceleration (32.2 ft/sec2)

p = pressure (lb/ft2)

γ = specific weight of water (62.4 lb/ft3)

(Note: p/γ = pressure head or depth of flow)

z = height above datum (ft)

2.1.1 Energy and Hydraulic Grade Lines

The concepts of energy grade line (EGL) and hydraulic grade line (HGL), and related terms, are illustrated for closed conduit flow (Figure 1) and open channel flow (Figure 2).

2.1.1.1 Closed Conduit Flow

The energy grade line, also known as the line of total head, is the sum of velocity head $v^2/2g$, the depth of flow or pressure head p/ γ, and elevation above an arbitrary datum represented by the distance z. The energy grade line slopes downward in the direction of flow by an amount equal to the energy gradient H_L/L, where H_L equals the total energy loss over the distance L.

The hydraulic grade line, also known as the line of piezometric head, is the sum of the elevation z and the depth of flow or pressure head p/ γ.

Note that for pressure flow in closed conduits, p/ γ is the pressure head and the hydraulic grade line falls above the top of the conduit as long as the pressure relative to atmospheric pressure is positive.

Approaching the entrance to a culvert (see Point 1 in Figure 1), the flow is essentially uniform and the hydraulic grade line and energy grade lines are almost the same. As water enters the culvert at the inlet, the flow is first contracted and then expanded by the inlet geometry causing a loss of energy (Point 2). As normal turbulent velocity distribution is reestablished downstream of the entrance (Point 3), a loss of energy is incurred through friction or from resistance. In short culverts, the entrance losses are likely to be high relative to the friction loss. At the culvert exit (Point 4), an additional loss is incurred through turbulence as the flow expands and is retarded by the water in the downstream channel.

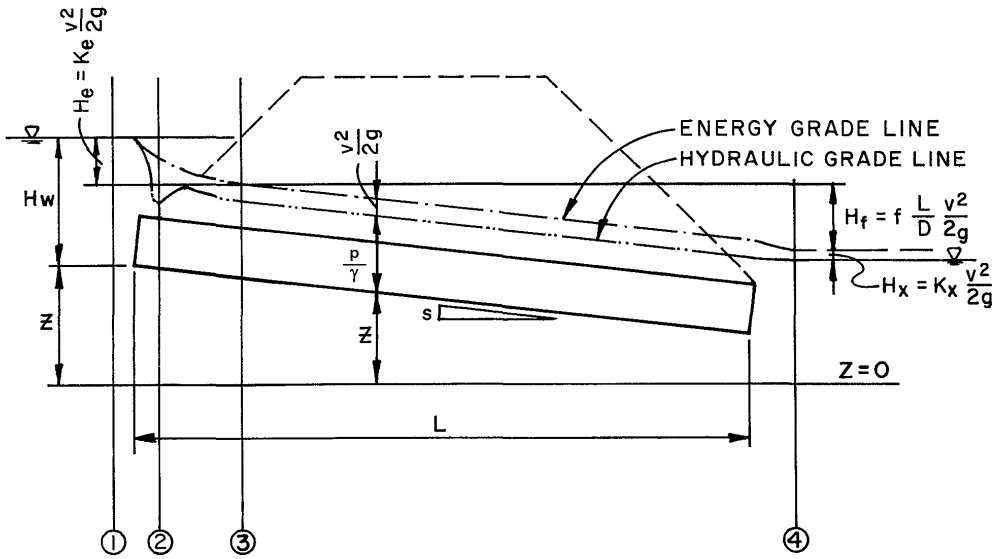

Figure 1. Illustration of Terms for Closed Conduit Flow

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2.1.1.2 Open Channel Flow

For open channel flow, the term p/ γ is equivalent to the depth of flow and the hydraulic grade line is the same as the water surface. Where open channel flow is established, the hydraulic grade line is the same as the water surface (Point 5 of Figure 2).

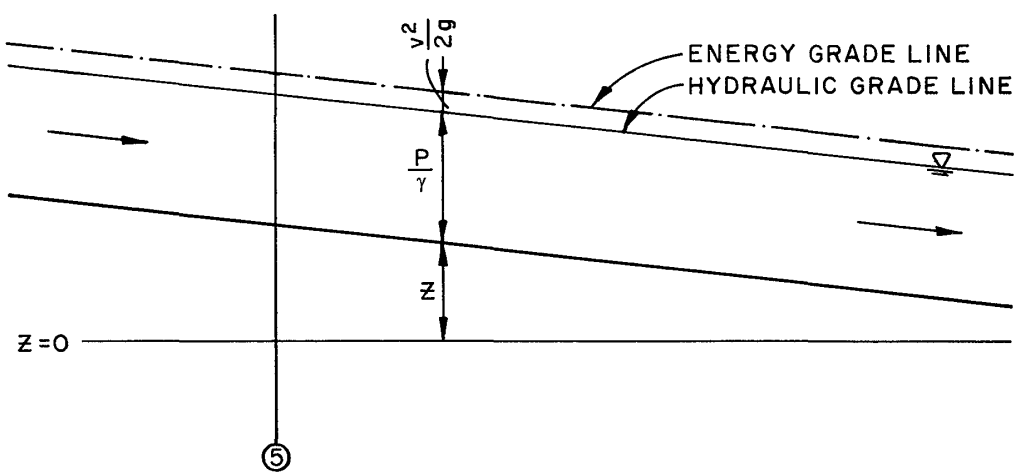


Figure 2. Illustration of Terms for Open Channel Flow

2.1.2 Inlet and Outlet Control

There are two basic types of flow conditions in culverts: (1) inlet control and (2) outlet control. For each type of control, a different combination of factors is used to determine the hydraulic capacity of the culvert. The determination of actual flow conditions can be difficult; therefore, the designer must check for both types of control and design for the most adverse condition.

Inlet Control

A culvert operates under inlet control when the flow capacity of the culvert is controlled at the inlet by these factors:

- Depth of headwater
- Inlet edge configuration
- Cross-sectional area
- Barrel shape (e.g., circular, elliptical, rectangular, etc.)

With inlet control, the culvert barrel usually flows only partially full. Inlet control for culverts occurs under two conditions:

Unsubmerged Inlet - The headwater depth is not sufficient to submerge the top of the culvert and the culvert invert slope is supercritical (Figure 3). This is the least common condition of inlet control.

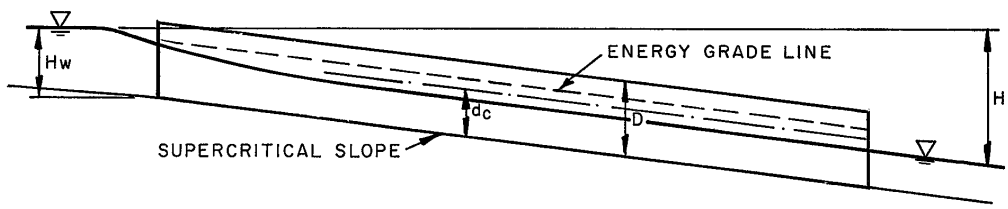


Figure 3. Inlet Control – Unsubmerged Inlet

Submerged Inlet - The headwater submerges the top of the culvert and the pipe does not flow full (Figure 4). This is the most common condition of inlet control.

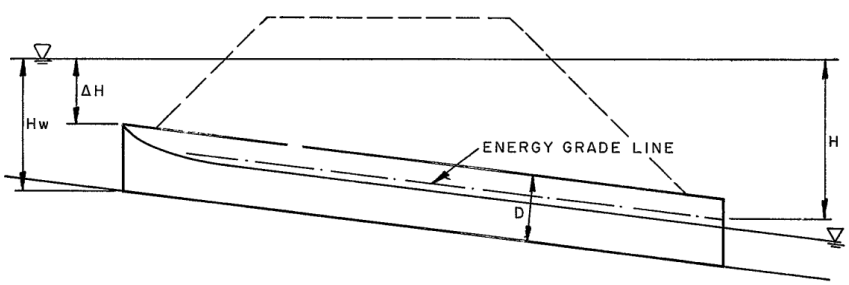


Figure 4. Inlet Control - Submerged Inlet

A culvert flowing under inlet control is defined as a "hydraulically short" culvert.

Outlet Control

If the headwater is high enough, the culvert slope sufficiently flat and the culvert sufficiently long, the control will shift from the inlet to the outlet. In outlet control, the discharge is a function of the inlet losses, the headwater depth, the culvert roughness, the culvert length, the barrel diameter, the culvert slope, the type of outlet and in some cases, the tailwater elevation.

With outlet control, culvert hydraulic performance is determined by the following factors:

- Depth of headwater
- Inlet edge configuration
- Cross-sectional area
- Culvert shape
- Barrel slope
- Barrel length
- Barrel roughness
- Depth of tailwater

Outlet control for culverts occurs under two conditions:

Partially Full Conduit - The headwater depth is insufficient to submerge the top of the culvert, and the culvert slope is subcritical, resulting in the culvert flowing partially full (Figure 5). This is the least common condition of outlet control.

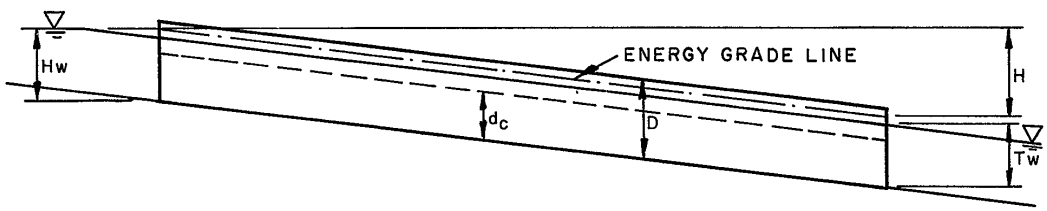


Figure 5. Outlet Control - Partially Full Conduit

Full Conduit - The culvert flows full along its length (Figure 6). This is the most common condition of outlet control.

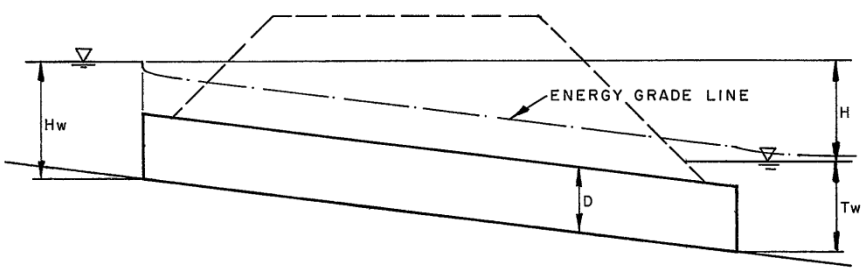


Figure 6. Outlet Control – Full Conduit

A culvert flowing under outlet control is defined as a "hydraulically long" culvert. With outlet control, factors that may affect performance appreciably for a given culvert size and headwater depth are barrel length, barrel roughness, and tailwater depth.

2.2 Energy Losses

In short conduits, such as culverts, the losses from the culvert entrance can be as important as the friction losses through the conduit. The losses that must be evaluated to determine the carrying capacity of a culvert are:

- Inlet or entrance losses (Section 2.2.1)
- Friction losses through the culvert (Section 2.2.2)
- Outlet or exit losses (Section 2.2.3)

2.2.1 Inlet Losses

For inlet losses, the governing equations are:

$$Q = CA\sqrt{2gH} \qquad \text{(Equation 4)}$$

and

$$H_e = K_e \frac{v^2}{2g} \qquad \text{(Equation 5)}$$

where:

Q = flow rate or discharge (cfs)

C = contraction coefficient (dimensionless)

A = cross-sectional area (ft2)

g = acceleration due to gravity, 32.2 (ft/sec^2)

H = total head (ft)

H_e = head loss at entrance (ft)

K_e = entrance loss coefficient (see Section 4.0, Table 2)

v = average velocity (ft/sec)

2.2.2 Friction Losses

Pipes Flowing Partially Full - Friction head loss for pipes flowing partially full can be determined from the Manning's equation reformulated to calculate head loss:

$$H_f = \left[\frac{29n^2L}{R^{4/3}}\right]\frac{v^2}{2g} \qquad \text{(Equation 6)}$$

where:

H_f= frictional head loss in culvert barrel (ft)

n = Manning roughness coefficient (unitless)

L = culvert length (ft)

R = hydraulic radius (= A/p)

A = cross-sectional area of culvert barrel (ft2)

p = wetted perimeter of barrel (ft)

v = average velocity (ft)

g = acceleration due to gravity, 32.2 (ft/sec2)

Pipes Flowing Full - Friction head loss for turbulent flow in pipes flowing full can be determined from the Darcy-Weisbach equation.

$$H_f = f\left(\frac{L}{D}\right)\left(\frac{v^2}{2g}\right) \qquad \text{(Equation 7)}$$

where:

H_f= frictional head loss (ft)

f = friction factor (obtained from Moody's diagram)

L = culvert length (ft)

D = pipe diameter (ft)

v = average velocity (ft)

g = acceleration due to gravity, 32.2 (ft/sec2)

2.2.3 Outlet Losses

For outlet losses, the governing equations are related to the difference in velocity head between: a) the pipe flow and b) the downstream channel at the end of the pipe. The downstream channel velocity is usually neglected, resulting in the outlet losses being equal to the velocity head of full flow in the culvert barrel, given by the following:

$$H_o = \frac{v^2}{2g} \qquad \text{(Equation 8)}$$

where:

H_o= outlet head loss (ft)

v= average velocity in culvert barrel (ft)

g = acceleration due to gravity, 32.2 (ft/sec2)

2.2.4 Total Losses

Combining the relationships for entrance loss, friction loss, and exit loss, the following equation for loss (i.e., difference in the headwater and tailwater elevations) is obtained:

$$H = \left[1 + K_e + \frac{29n^2 L}{R^{1.33}}\right]\frac{v^2}{2g} \qquad \text{(Equation 9)}$$

where:

H= difference in the headwater and tailwater elevations (ft)

K_e = entrance loss coefficient (unitless)

n = Manning roughness coefficient (unitless)

L = culvert length (ft)

R = hydraulic radius (= A/p)

A = cross-sectional area of culvert barrel (ft2)

p = wetted perimeter of barrel (ft)

v = average velocity (ft)

g = acceleration due to gravity, 32.2 (ft/sec2)

3.0 Culvert Sizing and Design

FHWA (2005) Hydraulic Design Series No. 5, Hydraulic Design of Highway Culverts, provides valuable guidance for the design and selection of drainage culverts. This circular explains inlet and outlet control and the procedure for designing culverts. Culvert design involves trial and error to determine the proper culvert size and involves the following steps:

- Select a culvert shape, type, and size with a particular inlet end treatment.
- Determine a headwater depth for both inlet and outlet control given the design discharge, the grade and length of culvert, and the depth of water at the outlet (tailwater).
- Compare the largest depth of headwater (as determined from either inlet or outlet control) to the design criteria. If the design criteria are not met, continue trying other culvert configurations until one or more configurations are found to satisfy the design parameters.

- Estimate the culvert outlet velocity. Determine if there is a need for any special features such as energy dissipators, riprap protection, fish passage, trash/safety rack, etc.

The hydraulic design of culverts can be achieved using several different methods, including the following described in this chapter:

- Capacity Charts (Section 3.1)
- Nomographs (Section 3.2)
- Computer Applications (Section 3.3)

3.1 Capacity Charts

Capacity charts can provide a good understanding of how culvert size requirements vary depending on multiple variables. Examples of capacity charts used to determine culvert size are shown in Figure 7. The upper chart is for culvert diameters from 18 to 36 inches and the lower chart is for culvert diameters from 36 to 66 inches. Refer to these charts in the following discussion.

Each chart contains a series of curves, which show the discharge capacity per culvert barrel in cfs for each of several sizes of similar culvert types, given various headwater depths (measured in feet above the culvert invert at the inlet).

Each culvert size is described by two lines: one solid and one dashed. The numbers associated with each line are the ratio of the culvert length, L, in feet, to 100 times the slope, s, in feet per foot (ft/ft) (100s). The solid line represents the division between outlet and inlet control. The dashed lines represent the maximum L/(100s) ratio for which the curves may be used without modification.

3.1.1 Culverts Under Inlet Control

For values of L/(100s) less than that shown on the solid line, the culvert is operating under inlet control. The headwater depth is determined from the L/(100s) value given on the solid line. The solid-line inlet-control curves are plotted from model test data. The dashed-line outlet-control curves were computed for culverts of various lengths with relatively flat slopes. Free outfall at the outlet was assumed; therefore, tailwater depth is assumed not to influence the culvert performance.

3.1.2 Culverts Under Outlet Control

For culverts flowing under outlet control, the head loss at the entrance is computed using the loss coefficients previously given, and the hydraulic roughness of the various materials used in culvert construction is taken into account in computing resistance loss for full or part-full flow. The Manning's n values for each culvert type range from 0.012 to 0.032.

Except for large pipe sizes, headwater depths on the charts extend to 3 times the culvert height. Pipe arches and oval pipe show headwater up to 2.5 times their height since they are used in low fills. The dotted line, stepped across the charts, shows headwater depths approximately twice the barrel height and indicates the upper limit of unrestricted use of the charts. Above this line the headwater elevation should be checked with the nomographs (see Section 3.2) or with computer programs (see Section 3.3). Also note, as stated in Section 1.1.2, the headwater/culvert Depth

(HW/D) ratio should not exceed 1.5 unless there is justification and sufficient measures are taken to protect the culvert inlet.

The headwater depth given by the charts is actually the difference in elevation between the culvert invert at the entrance and the total head; that is, depth plus velocity head for flow in the approach channel. In most cases, the water surface upstream from the inlet is so close to this same level that the chart determination may be used as headwater depth for practical design purposes. Where the approach velocity is in excess of 3.0 ft/sec, the velocity head must be subtracted from the curve determination of headwater to obtain the actual headwater depth.

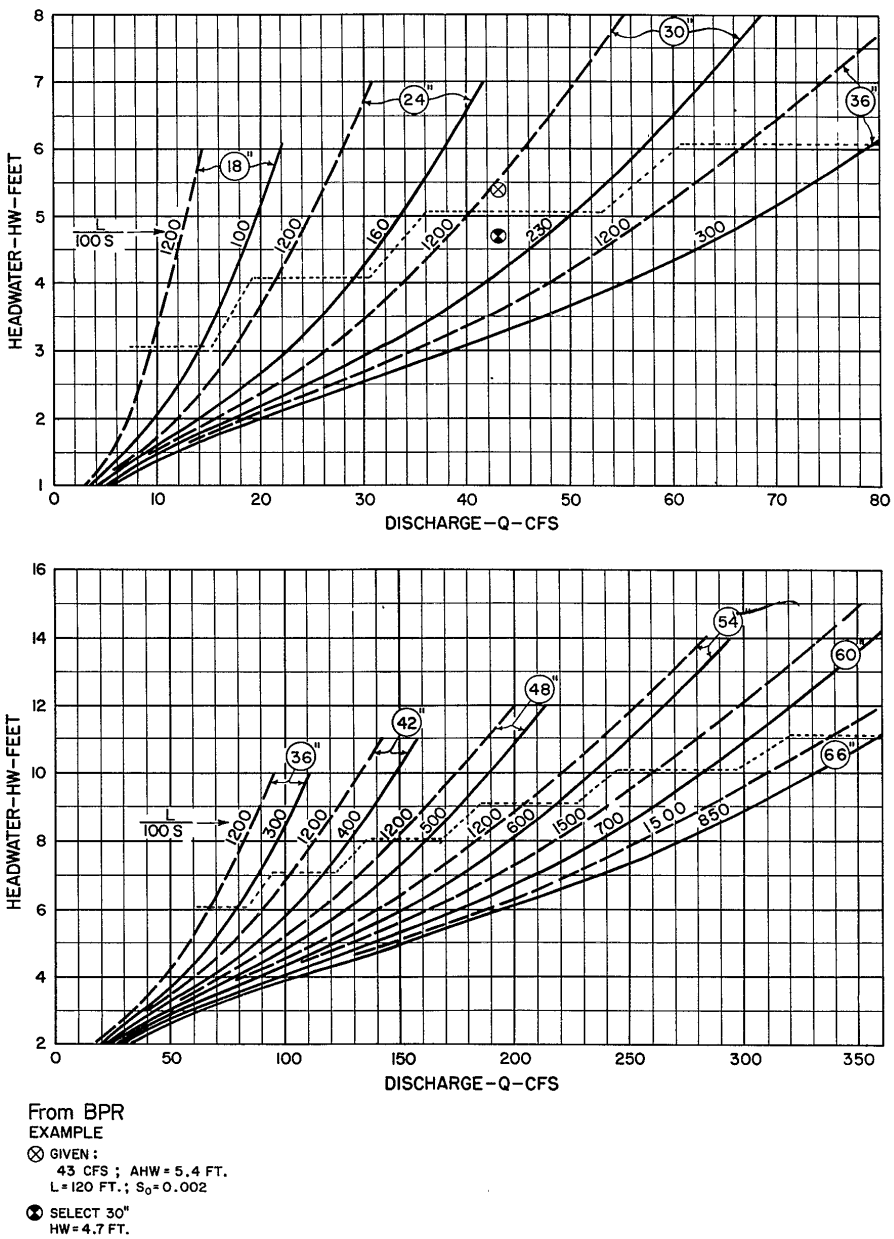


Figure 7. Culvert Capacity Chart - Example

3.1.3 Capacity Chart Procedure

The procedure for sizing the culvert is summarized below. Data can be compiled in the Design Computation Form shown in Figure 8.

- List design data: Q = flow or discharge rate (cfs), L = length of culvert (ft), allowable Hw = headwater depth (ft), s = slope of culvert (ft/ft), type of culvert barrel, and entrance.
- Compute L/(100s).
- Find the design discharge, Q in the appropriate capacity chart (refer to FHWA 2005a for capacity charts).
- Find the L/(100s) value for the smallest pipe that will pass the design discharge. If this value is above the dotted line in Figure 7, use the nomographs (from FHWA 2005) to check headwater conditions.
- If L/(100s) is less than the value of L/(100s) given for the solid line, then the value of Hw is the value obtained from the solid line curve. If L/(100s) is larger than the value for the dashed outlet control curve, then special measures must be taken, and the reader is referred to (FHWA 2005a).
- Check the Hw value obtained from the charts with the allowable Hw. If the indicated Hw is greater than the allowable Hw, then try the Hw elevation from the next largest pipe size.

3.2 Nomographs

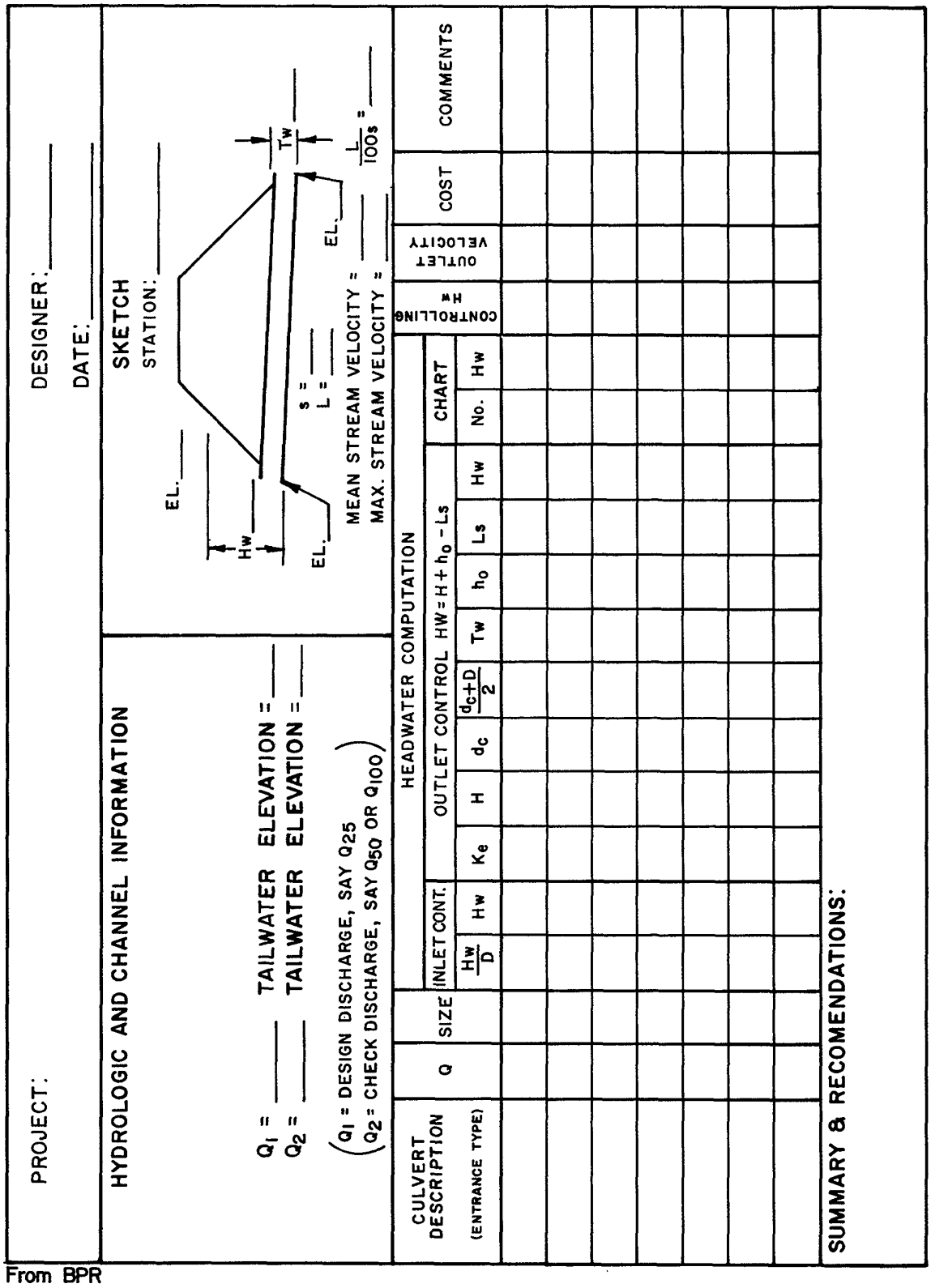
Examples of nomographs for designing culverts are presented in Figure 9 (Inlet Control Nomograph) and Figure 10 (Outlet Control Nomograph). The use of these nomographs is limited to cases where tailwater depth is higher than the critical depth in the culvert. A disadvantage of the nomographs is that they require trial and error, whereas the capacity charts are direct.

However, a disadvantage of the capacity charts is they can be used only when the flow passes through critical depth at the outlet. If the critical depth at the outlet is less than the tailwater depth, then the nomographs must be used. Both the capacity charts and the nomographs give the same results if either of the two methods are used.

3.2.1 Nomograph Procedure

The nomograph procedure for culvert design requires the use of both the inlet control and outlet control nomographs (refer to Figure 9 and Figure 10, respectively):

- List design data: Q (cfs), L (ft), invert elevations in and out (ft), allowable H_w (ft), mean and maximum flood velocities in natural stream (ft/sec), culvert type and entrance type for first selection.
- Determine a trial size by assuming a maximum average velocity based on channel considerations to compute the area, A = Q/V.
- Find Hw for trial size culvert for inlet control and outlet control. For inlet control (Figure 9), connect a straight line through D and Q to scale (1) of the H_w/D scales and project horizontally to the proper scale, compute H_w and, if too large or too small, try another size before computing H_w for outlet control.



From BPR

Figure 8. Design Computation for Culverts - Blank Form

- Next, compute the Hw for outlet control (Figure 10). Enter the graph with the length, the entrance coefficient for the entrance type, and the trial size. Connect the length scale and the culvert size scale with a straight line, pivot on the turning line, and draw a straight linefrom the design discharge on the discharge scale through the turning point to the head scale (head loss, H). Compute H_w from the equation:

$$Hw = H + h_o - Ls \qquad \text{(Equation 9)}$$

where:

H_w= headwater depth (ft)

H = head loss (ft)

h_o = tailwater depth or elevation at the outlet of a depth equivalent to the location of the hydraulic grade line (ft)

L = length of culvert (ft)

s = slope of culvert (ft/ft)

For T_w greater than or equal to the top of the culvert:

$h_o = T_w$

For T_w less than the top of the culvert:

$$h_o = \frac{(d_c + D)}{2} \text{ or } T_w \text{ (whichever is greater)} \qquad \text{(Equation 10)}$$

where:

h_0= critical depth (ft)

d_c= critical depth (ft)

D = culvert diameter(ft)

T_w= tailwater depth (ft)

If T_w is less than d_c, the nomographs cannot be used, see Hydraulic Design of Highway Culverts (FHWA 2005a) for critical depth charts.

Compare the computed headwaters and use the higher H_w to determine if the culvert is under inlet or outlet control. If outlet control governs and the H_w is unacceptable, select a larger trial size and find another H_w with the outlet control nomographs. Since the smaller size of culvert had been selected for allowable H_w by the inlet control nomographs, the inlet control for the larger pipe need not be checked.

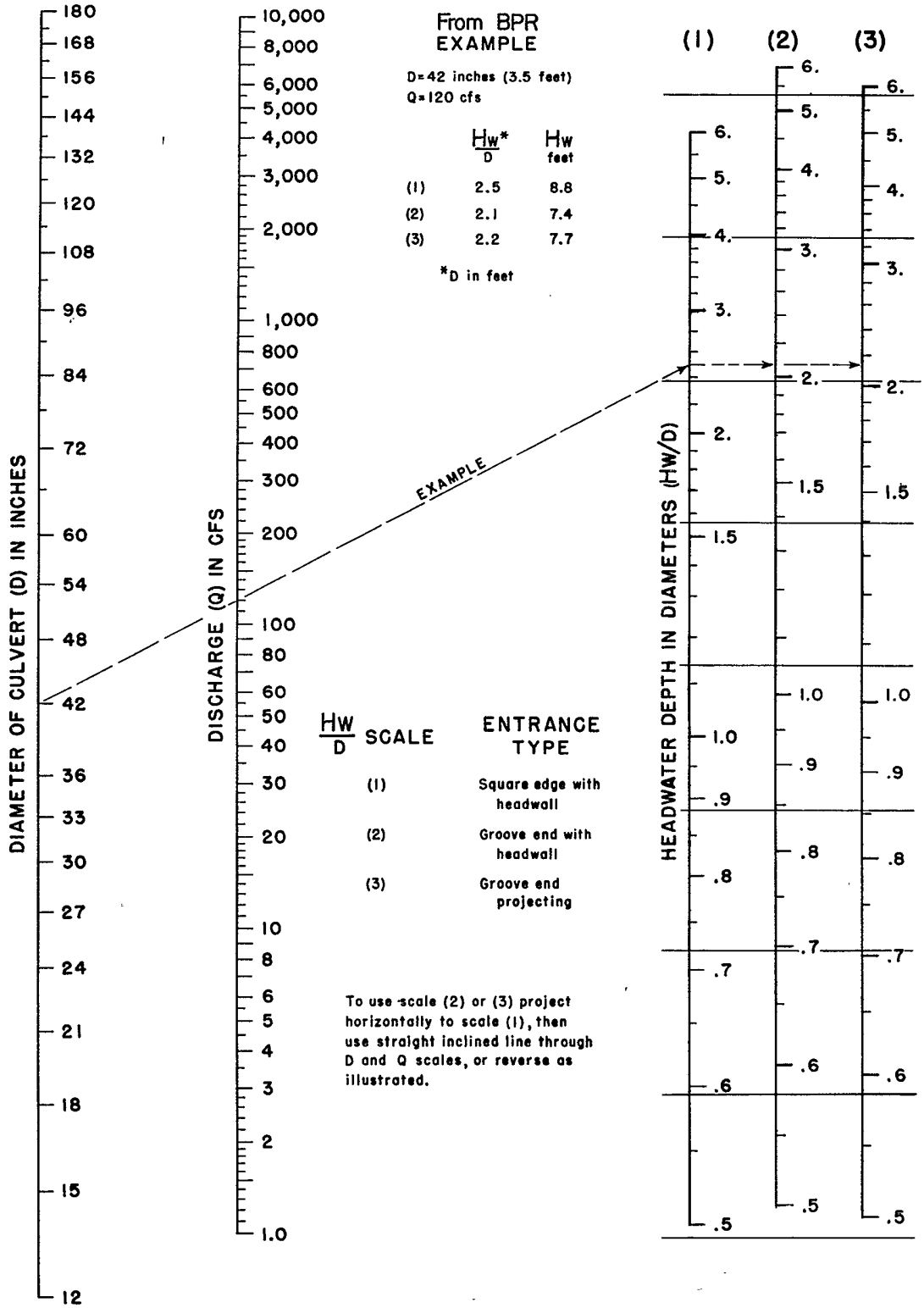


Figure 9. Inlet Control Nomograph - Example

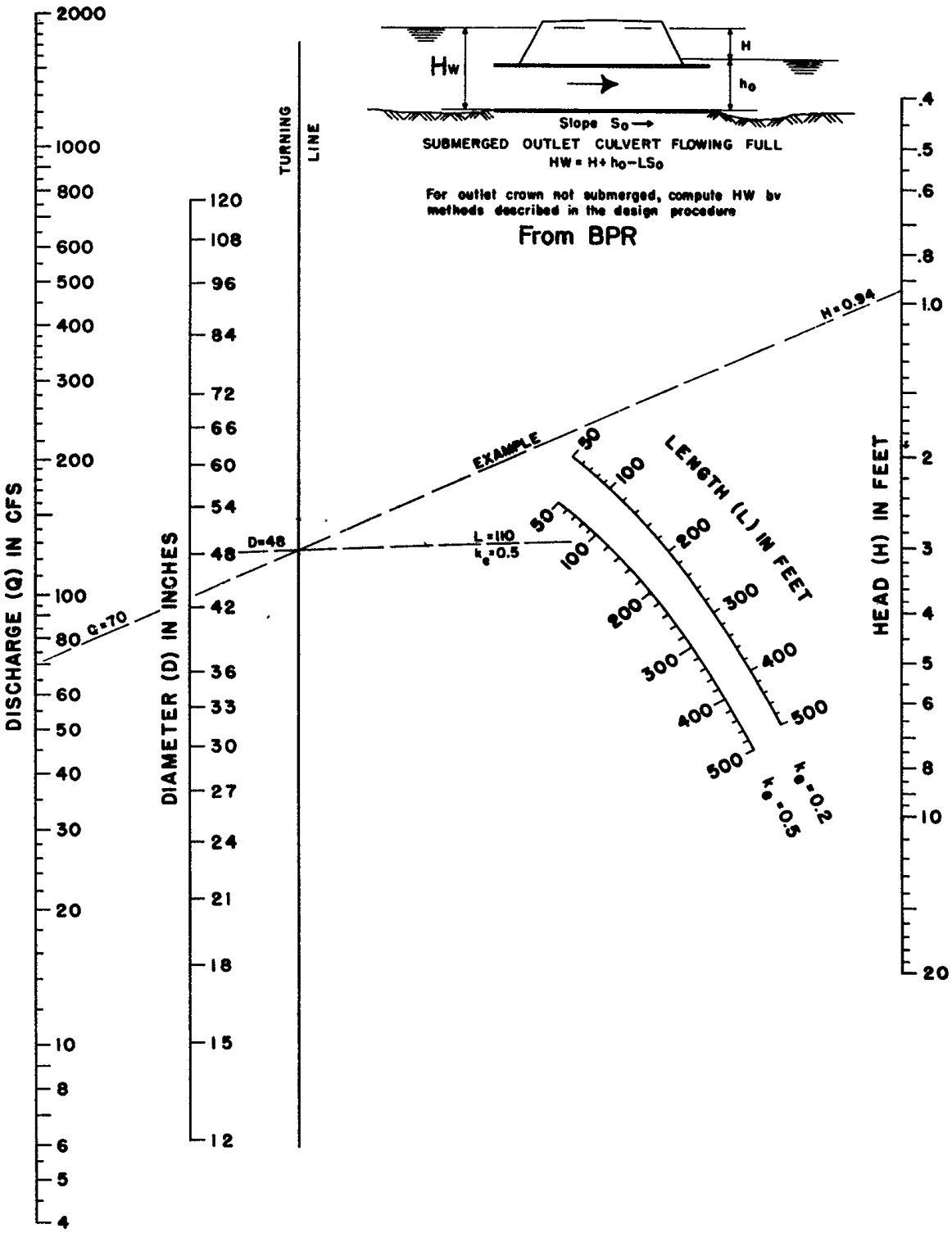


Figure 10. Outlet Control Nomograph - Example

3.3 Computer Applications

Although the nomographs discussed in Section 3.2 are still used on occasion, engineers increasingly use computer applications for culvert design. Examples of computer applications that are acceptable by the City for the hydraulic design of culverts are:

- City of Springfield spreadsheet application: "Sewer and Culvert Hydraulics.xls" https://www.springfieldmo.gov/2120/resources.html
- Federal Highway Administration (FHWA) HY-8 Culvert Analysis program (FHWA 2009): http://www.fhwa.dot.gov/engineering/hydraulics/software/hy8/
- U.S. Army Corps of Engineers Hydrologic Engineering Center - River Analysis System (HEC-RAS): http://www.hec.usace.army.mil/software/hec-ras/

In addition to the public domain computer applications listed here, numerous proprietary computer applications are also available for the hydraulic design of culverts. However, use of any proprietary applications must be approved by the City prior to their use.

3.4 Design Considerations

Because of problems that arise from topography and other considerations, the actual design of a culvert installation is more difficult than the simple process of sizing culverts. The information in the procedure for design are only guidelines, since the problems encountered are too varied and too numerous to be generalized. However, the actual process presented should be followed to ensure that a special problem is not overlooked. Several combinations of entrance types, invert elevations, and pipe diameters should be tried to determine the most economic design that will meet the conditions imposed by topography and engineering.

3.4.1 Design Computation Forms

The use of design computation forms is a convenient method to use to obtain consistent designs and promote cost-effectiveness. An example form was shown previously on Figure 8.

3.4.2 Invert Elevations

After determining the allowable headwater elevation, the tailwater elevation, and the approximate culvert length, invert elevations must be assumed. Scour is not likely in an artificial channel such as a roadside ditch or a major drainage channel when the culvert has the same slope as the channel. To reduce the chance of failure due to scour, invert elevations corresponding to the natural grade should be used as a first trial. For natural channels, the flow conditions in the channel upstream from the culvert should be investigated to determine if scour will occur.

3.4.3 Culvert Diameter

After the invert elevations have been assumed and using the capacity charts (e.g., Figure 7), design computation forms (e.g., Figure 8), and the nomographs (Figure 9 and Figure 10), the diameter of pipe that will meet the headwater requirements should be determined. Since small diameter pipes are often plugged by sediment and debris, it is recommended that pipe smaller than 18 inches not be used for any drainage where this Manual applies. Since the pipe roughness influences the culvert diameter, both concrete and corrugated metal pipe should be considered in design, if both will satisfy the headwater requirements.

3.4.4 Limited Headwater

If there is insufficient headwater elevation to obtain the required discharge, it is necessary to oversize the culvert barrel, lower the inlet invert, use an irregular cross section, or use any combination of the preceding to increase the discharge rate.

If the inlet invert is lowered, special consideration must be given to scour. The use of gabions or concrete drop structures, riprap, and headwalls with apron and toe walls should be investigated and compared to obtain a proper design.

3.4.5 Culvert Outlet

The outlet velocity must be checked to determine if significant scour will occur downstream during the major storm. If scour is indicated, which is frequently the case, refer to Section 5.0 of this chapter ("Protection Downstream of Culverts"). Inadequate culvert outlet protection is a common problem. Under-designing the amount of outlet protection is not recommended for economizing during design and construction because downstream channel degradation can be significant and the culvert outlet can be undermined.

3.4.6 Minimum Slope

To minimize sediment deposition in the culvert, the culvert slope must be equal to or greater than the slope required to maintain a minimum velocity. The slope should be checked for each design, and if the proper minimum velocity is not obtained, the pipe diameter may be decreased, the slope steepened, a smoother pipe used, or a combination of these employed to increase velocity.

4.0 Culvert Inlets

An often overlooked fact is that a culvert cannot convey any more water than can enter the inlet. Frequently, culverts and open channels are carefully designed with full consideration given to slope, cross section, and hydraulic roughness, but without regard to the inlet limitations. Culvert designs using uniform flow equations rarely carry their design capacity due to limitations imposed by the inlet.

The design of a culvert, including the inlet and the outlet, requires a balance between cost, hydraulic efficiency, purpose, and topography at the proposed culvert site. In situations where there is sufficient allowable headwater depth, a choice of inlets may not be critical, but where there are constraints such as limited headwater depth, erosion problems, or where sedimentation is likely, a more efficient inlet may be required to obtain the necessary discharge for the culvert.

Although the primary purpose of a culvert is to convey flows, a culvert may also be used to restrict flow. That is, a culvert can be used to discharge a controlled amount of water while the area upstream from the culvert is, for example, used for detention storage to reduce a storm runoff peak. For this case, an inefficient inlet may be the most desirable choice.

The inlet types described in this chapter may be selected to fulfill either of the above requirements depending on the topography or conditions imposed by the designer. The entrance coefficient, K_e,

as defined by Equation 5, is a measure of the hydraulic efficiency at the inlet, with lower values indicating greater efficiency. Entrance coefficients recommended for use are given in Table 2.

Table 2. Entrance Loss Coefficients

Type of Entrance	Entrance Coefficient, K_e
1. Pipe entrance with headwall	
Grooved edge	0.20
Rounded edge (0.15D radius)	0.15
Rounded edge (0.25D radius)	0.10
Square edge (cut concrete and CMP)	0.40
2. Pipe entrance with headwall & 45° wingwall	
Grooved edge	0.20
Square edge	0.35
3. Headwall with parallel wingwalls spaced 1.25D apart	
Grooved edge	0.30
Square edge	0.40
4. Special inlets (see Section 4.3)	
5. Projecting Entrance	
Grooved edge	0.25
Square edge	0.50
Sharp edge, thin wall	0.90

4.1 Projecting Inlets

Projecting inlets should not be used. Headwalls, wingwalls, and flared end sections should be used to maximize efficiency and minimize turbulence, head loss, and erosion.

4.2 Inlets with Headwalls

Headwalls may be used for a variety of reasons, including increasing the efficiency of the inlet, providing embankment stability, and providing embankment protection against erosion. The relative efficiency of the inlet varies with the pipe material used. Figure 11 illustrates a headwall with wingwalls.

4.2.1 Corrugated Metal Pipe

Corrugated metal pipe in a headwall is essentially a square-edged entrance with an entrance coefficient of approximately 0.4. The entrance losses may be reduced by rounding the entrance. The entrance coefficient may be reduced as follows:

- Reduce to 0.15 for a rounded edge with a radius equal to 0.15 times the culvert diameter
- Reduce to 0.10 for rounded edge with a radius equal to 0.25 times the diameter of the culvert

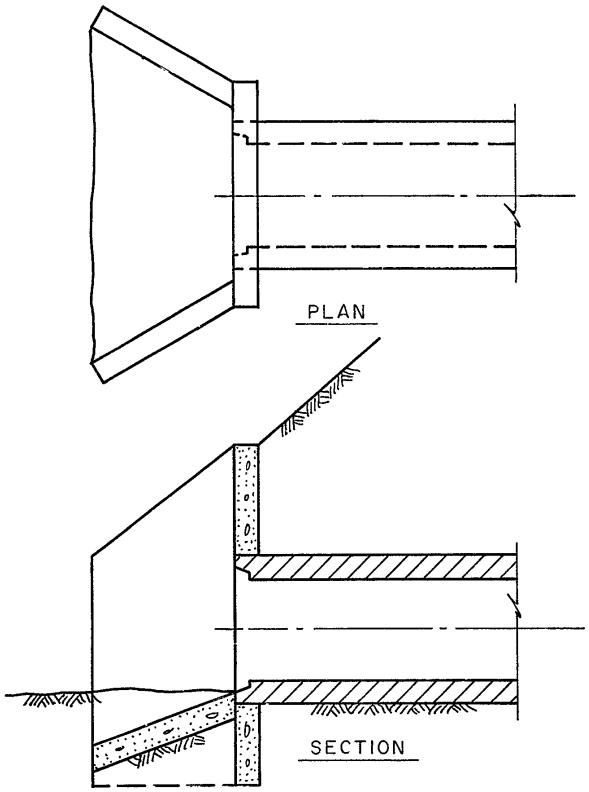


Figure 11. Inlet with Headwall and Wingwalls

4.2.2 Concrete Pipe

For tongue-and-groove or bell-end concrete pipe, little increase in hydraulic efficiency is realized by adding a headwall. The primary reason for using headwalls is for embankment protection and for ease of maintenance. The entrance coefficients for concrete pipe are:

- 0.2 (approximate) for grooved and bell-end pipe
- 0.4 for cut concrete pipe

4.2.3 Wingwalls

Wingwalls are used where the side slopes of the channel adjacent to the entrance are unstable and where the culvert is skewed to the normal channel flow. Little increase in hydraulic efficiency is realized with the use of wingwalls, regardless of the pipe material used and, therefore, the use should be justified for reasons other than an increase in hydraulic efficiency. Figure 12 illustrates several cases where wingwalls are used. For parallel wingwalls, the minimum distance between wingwalls should be at least 1.25 times the diameter of the culvert pipe.

4.2.4 Aprons

If high headwater depths are to be encountered, or if the approach velocity of the channel will cause scour, a short channel apron should be provided at the toe of the headwall. This apron should

extend at least one pipe diameter upstream from the entrance, and the top of the apron should not protrude above the normal streambed elevation.

Culverts with wingwalls should be designed with a concrete apron extending between the walls. Aprons must be reinforced to control cracking. As illustrated on Figure 12, the actual configuration of the wingwalls varies according to the direction of flow and will also vary according to the topographical requirement placed upon them.

For conditions where scour may be a problem due to high approach velocities and special soil conditions, such as alluvial soils, a toe wall is often desirable for apron construction.

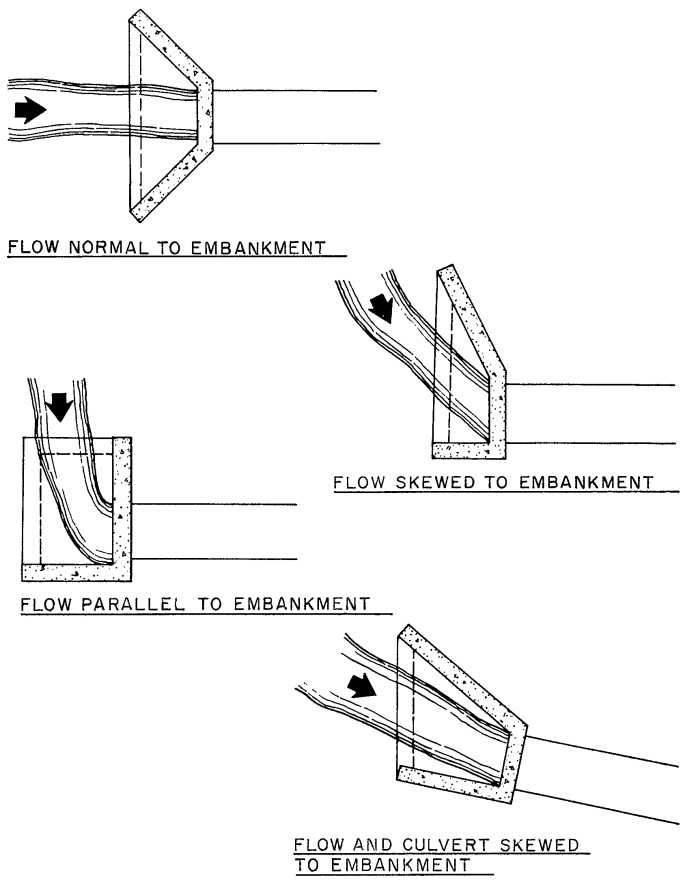


Figure 12. Typical Headwall-Wingwall Configurations

4.3 Special Inlets

There is a large variety of inlets other than the common ones described. Among the other types of special inlets are special end-sections, which serve as both outlets and inlets and which are available for both corrugated metal pipe and concrete pipe. Because of the difference in requirements due to pipe materials, the special end-sections are discussed separately, according to pipe material, in Sections 4.3.1 and 4.3.2. Mitered inlets are also discussed in Section 4.3.3.

4.3.1 Corrugated Metal Pipe

Special end-sections for corrugated metal pipe add little to the overall cost of the culvert and have the following advantages:

- Less maintenance around the inlet.
- Less damage from maintenance work and from accidents compared to a projecting entrance.
- Increased hydraulic efficiency. When using design charts, as discussed in Section 3.1, charts for a square-edged opening for corrugated metal pipe with a headwall may be used.

4.3.2 Concrete Pipe

As is the case with corrugated metal pipe, concrete special end-sections may aid in increasing the embankment stability or in retarding erosion at the inlet. They should be used where maintenance equipment must be used near the inlet or where, for aesthetic reasons, a projecting entrance is considered too unsightly.

The hydraulic efficiency of this type of concrete inlet is dependent on the geometry of the end-section to be used. Where the full contraction to the culvert diameter takes place at the first pipe section, the entrance coefficient, Ke, is equal to 0.5, and where the full contraction to the culvert diameter takes place in the throat of the end-section, the entrance coefficient, K_e, is equal to 0.25.

4.3.3 Mitered Inlets

The use of mitered inlets is predominantly with corrugated metal pipe and its hydraulic efficiency is dependent on the construction procedure used. If the embankment is not paved, the entrance, in practice, usually does not conform to the side slopes, giving essentially a projecting entrance with $K_e = 0.9$. If the embankment is paved, a sloping headwall is obtained with $K_e = 0.60$ and, by beveling the edges, $K_e = 0.50$.

Uplift is an important factor for a mitered inlet. It is not good practice to use unpaved embankment slopes where a mitered entrance may be submerged to an elevation one-half the diameter of the culvert above the top of the pipe.

4.3.4 Long Conduit Inlets

Inlets are important in the design of culverts for road crossings and other short sections of conduit; however, they are even more significant in the economical design of long culverts and pipes. Unused capacity in a long conduit will result in wasted investment. Long conduits are costly and require detailed engineering, planning, and design work. The inlets to such conduits are extremely important to the functioning of the conduit and must receive special attention.

Most long conduits require special inlet considerations to meet the particular hydraulic characteristics of the conduit. Generally, on larger conduits, hydraulic model testing will result in better and less costly inlet construction.

4.4 Improved Inlets

Inlet edge configuration is one of the prime factors influencing the performance of a culvert operating under inlet control. Inlet edges can cause a severe contraction of the flow, as in the case of a thin edge, projecting inlet. In a flow contraction, the effective cross-sectional area of the barrel may be reduced to about one-half of the actual barrel cross-sectional area. As the inlet configuration is improved, the flow contraction is reduced, thus improving the performance of the culvert.

A tapered inlet is a flared culvert inlet with an enlarged face section and a hydraulically efficient throat section. Tapered inlets improve culvert performance by providing a more efficient control section (the throat). However, tapered inlets are not recommended for use on culverts flowing under outlet control because the simple beveled edge is of equal benefit. The two most common improved inlets are the side-tapered inlet and the slope-tapered inlet (Figure 13). FHWA (2005a) *Hydraulic Design of Highway Culverts* provides guidance on the design of improved inlets.

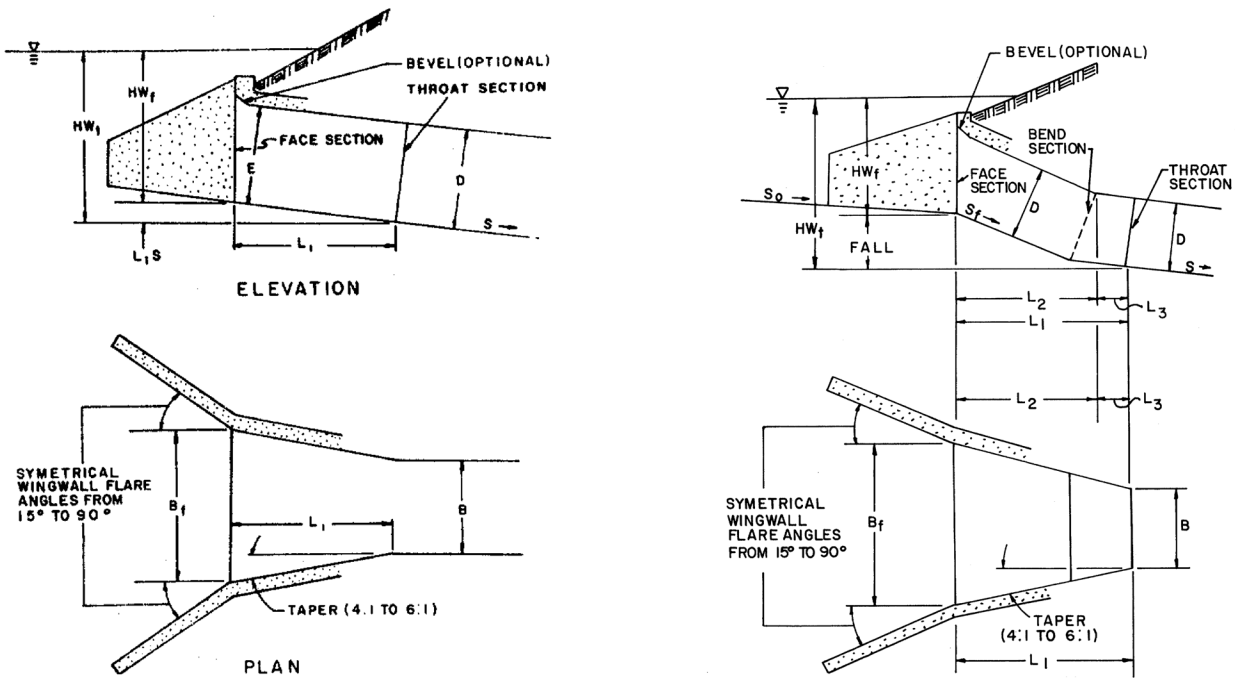


Figure 13. Side-Tapered and Slope-Tapered Improved Inlets

4.5 Inlet Protection

Inlets on culverts, especially on culverts to be installed in live streams, should be evaluated relative to debris control and buoyancy.

4.5.1 Debris Control

Accumulation of debris at a culvert inlet can result in the culvert not performing as designed. The consequences may be damages caused by inundation of the road and upstream property. The designer has three general options for addressing the problem of debris plugging a culvert:

- Retain the debris upstream of the culvert
- Attempt to pass the debris through the culvert
- Install a bridge to allow passage of debris past the embankment

If the debris is to be retained by an upstream structure or at the culvert inlet, frequent maintenance may be required. The design of a debris control structure should include a thorough study of the debris problem and should consider the following factors:

- Type of debris
- Quantity of debris
- Expected changes in type and quantity of debris due to future land use
- Stream flow velocity in the vicinity of culvert entrance
- Maintenance access requirements
- Availability of storage
- Maintenance plan for debris removal

Hydraulic Engineering Circular No. 9, *Debris Control Structures Evaluation and Countermeasures* (FHWA 2005b), should be used when designing debris control structures.

4.5.2 Buoyancy

The forces acting on a culvert inlet during flows are variable and indeterminate. When a culvert is functioning under inlet control, an air pocket forms just inside the inlet, which creates a buoyant effect when the inlet is submerged. The buoyancy forces increase with an increase in headwater depth under inlet control conditions. These forces, along with vortexes and eddy currents, can cause scour, undermine culvert inlets, and erode embankment slopes, thereby making the inlet vulnerable to failure, especially if deep headwater conditions are present.

In general, installing a culvert in a natural stream channel constricts the normal flow. The constriction is accentuated when the capacity of the culvert is impaired by debris or damage.

The large unequal pressures resulting from inlet constriction are, in effect, buoyant forces that can cause entrance failures, particularly on corrugated metal pipe with mitered, skewed, or projecting ends. The failure potential will increase with steepness of the culvert slope, depth of the potential headwater, flatness of the fill slope over the upstream end of the culvert, and the depth of the fill over the pipe.

Anchorage at the culvert entrance helps to protect against these failures by increasing the deadload on the end of the culvert, protecting against bending damage, and by protecting the fill slope from the scouring action of the flow. Providing a standard concrete headwall or endwall helps to counteract the hydrostatic uplift and to prevent failure due to buoyancy.

Because of a combination of high head on the outside of the inlet and the large region of low pressure on the inside of the inlet due to separation, a large bending moment is exerted on the end of the culvert, which may result in failure. This problem has been noted in the case of culverts under high fills, on steep slopes, and with projecting inlets. In cases where upstream detention

storage is necessary and headwater depth in excess of 20 feet is required to restrict discharge it is recommended to reduce the culvert size rather than use an inefficient projecting inlet.

4.6 Trash/Safety Rack

The use of typical gratings at inlets to culverts and long underground pipes should be considered on a case-by-case basis. While there is a sound argument for the use of gratings for safety reasons, field experience has clearly shown that when the culvert is needed the most, that is, during heavy runoff, normal gratings often become clogged and the culvert rendered ineffective. A general rule of thumb is that if it will be feasible to "see daylight" from one side of the culvert to the other, a trash/safety rack will not be needed. By contrast, at entrances to longer culverts and long underground pipes, a trash rack is necessary.

The trash/safety rack design process is a matter of working out the safety hazard aspects of the problem with care, defining them clearly, and then taking reasonable steps to minimize safety hazards, yet protecting the capability of the culvert to convey flow (Photograph 4).

Photograph 4. A small trash rack at culvert entrance will increase the risk of entrance plugging.

Generally, the most common aspect to consider in evaluating the safety hazard of a culvert or long underground pipe opening is the possibility of a person, especially children, being carried into the culvert by flowing water approaching the inlet. In reviewing hazards, it is necessary to consider depth and velocity of upstream flow, the fact that storm runoff occurs during unusually heavy rain storms when most people, particularly children, are indoors, the general character of the neighborhood upstream, the length and size of culvert, and other similar factors. Furthermore, in the event that someone is carried to the culvert with the storm runoff, the exposure hazard may in some cases be even greater if the person is pinned to the grating by the hydrostatic pressure of the water rather than being carried through the culvert. Large, sloped racks positioned well in front of the culvert entrance reduce the risk of pinning.

Where debris potential and/or public safety indicate that a rack is required, and if the pipe diameter is more than 24 inches, then the rack's open surface area must be, at an absolute minimum, four times larger. For smaller pipes, the factor increases significantly. For culverts larger than 24 inches (i.e., in the smallest dimension), in addition to the trash rack having an open area larger than five times the culvert entrance, the average velocities at the rack's face shall be less than two (2) feet per second at every stage of flow entering the culvert. The rack needs to be sloped no steeper than 3H:IV (the flatter the better) and have a clear opening at the bottom of 9 to 12 inches to permit debris at lower flows to go through. The bars on the face of the rack should be generally paralleling the flow and be spaced to provide 4 ½ to 5-inch clear openings between them.

Transverse support bars need to be as few as possible, but sufficient to keep the rack from collapsing under full hydrostatic loads.

The installation of trash racks at culvert outlets is strongly discouraged because debris or a person carried into the culvert will impinge against the rack, thus leading to pressurized conditions within the culvert, virtually destroying its flow capacity and creating a greater hazard to the public or a person trapped in the culvert than not having one.

4.6.1 Collapsible Gratings

The City of Springfield does not generally recommend the use of collapsible gratings. On larger culverts where gratings are found to be necessary, the use of collapsible gratings may be desirable. Such gratings must be carefully designed from the structural standpoint so that collapse is achieved with a hydrostatic load of perhaps one-half of the maximum backwater head allowable. Collapse of the trash rack should be such that it clears the waterway opening adequately to permit the inlet to function properly.

4.6.2 Upstream Trash Collectors

In lieu of a collapsible trash rack and where a safety hazard exists, a grating situated a reasonable distance upstream from the actual inlet is often satisfactory. This type of grating may be a series of vertical pipes or posts embedded in the approach channel bottom. If blocking of this grating occurs, the backwater effect causes water to flow over the top of the grating and into the culvert with only minimal upstream backwater effect. The grating must not be so high as to cause the water to rise higher than the maximum allowable elevation.

5.0 Protection Downstream of Culverts

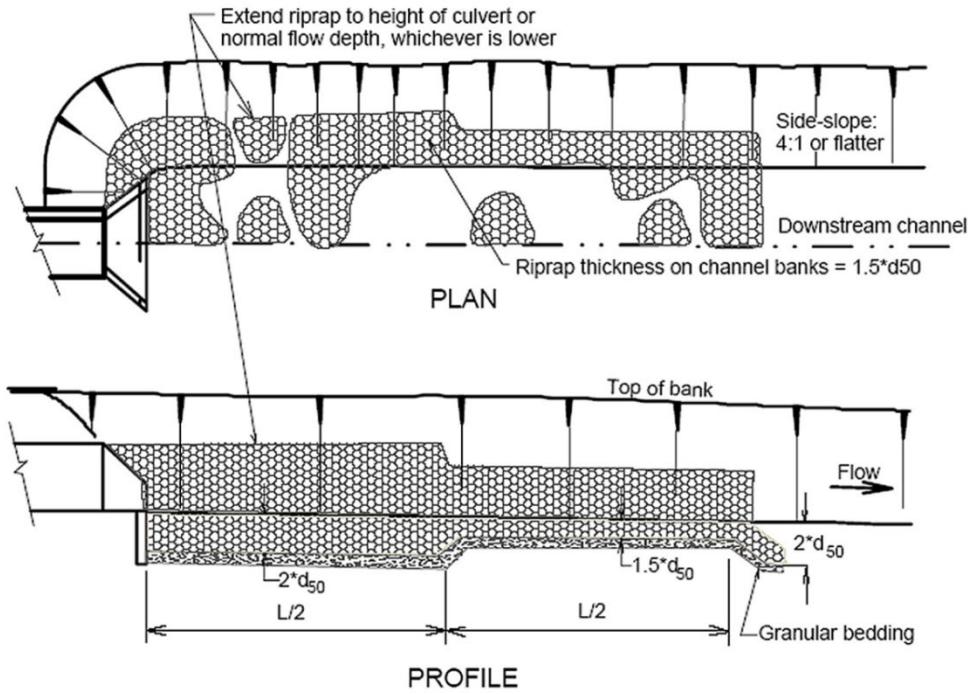
In this Section, two categories of erosion protection methods are addressed for the area downstream of culverts: 1) riprap erosion protection at locations downstream of culvert outlets that are in-line with major drainage channels (Section 5.1), and 2) energy dissipation structures (Section 5.2).

5.1 In-Line Riprap Protection

Scour resulting from highly turbulent, rapidly decelerating flow is a common problem at conduit outlets. The riprap protection suggested below is for outlets from conduits and culverts with outlet Froude numbers up to 2.5 (which is equivalent to Froude parameters of 14 $ft^{0.5}$/sec for circular culverts [Froude parameter = $Q/D_c^{2.5}$] or for rectangular culverts [Froude parameter = $Q/WH^{1.5}$], where: Q is the discharge (cfs), D_c is the diameter of a circular conduit (ft), and W and H are the width and height, respectively, of a rectangular conduit (ft)), and with the following conditions: conduit slopes parallel with the channel gradient and the conduit outlet invert flush with the riprap channel protection.

5.1.1 Configuration of Riprap Protection

Figure 14 illustrates typical riprap protection at the outlets of culverts and major drainageway conduits. The additional thickness of the riprap just downstream from the outlet is to assure protection from flow conditions that might precipitate rock movement in this region.



NOTES: 1. Headwall with wingwalls or flared end section required at all culvert outlets.
2. Cutoff wall required at end of wingwall aprons and end section.
Minimum depth of cutoff wall = 2*d50 or 3-feet, whichever is deeper.
3. Provide joint fasteners for flared end sections.

Figure 14. Culvert and Pipe Outlet Erosion Protection

5.1.2 Required Rock Size

The required rock size for erosion protection downstream from culvert outlets may be selected as follows, depending whether the culvert is circular or rectangular:

Circular culvert outlets

Refer to Figure 15 for sizing of rock erosion protection downstream from circular culverts.

Figure 15 parameters:

$Q/D_c^{1.5}$ (vertical axis)

Y_t/D_c (horizontal axis)

where:

Q = design discharge (cfs)

D_c = diameter of circular culvert (ft)

Y_t = tailwater depth (ft)

Figure 15 notes:

- Valid for Froude parameter for circular culvert ($Q/D_c^{2.5}$) = 6 or less
- In cases where Y_t is unknown or a hydraulic jump is suspected downstream of the outlet, use Y_t/D_c = 0.40.
- The rock size requirements shown on Figure 15 were determined assuming that the flow in the circular culvert is not supercritical. In cases where the flow is supercritical, calculate D_a using Equation 9 and substitute D_a for D_c for use in Figure 15:

$$D_a = \frac{(D_c + Y_n)}{2} \qquad \text{(Equation 11)}$$

in which the maximum value of D_a shall not exceed Dc, and where:

D_a = parameter to use in place of D in Figure 15 when flow is supercritical

D_c = diameter of circular culvert (ft)

Y_n = normal depth of supercritical flow in the culvert

Figure 15 basis:

Non-dimensional parametric equation for circular culverts (Steven, Simons, and Watts 1971 and Smith 1975):

$$\frac{\left(\frac{d_{50}}{D_c}\right)\left(\frac{Y_t}{D_c}\right)^{1.2}}{\left(\frac{Q}{D_c^{2.5}}\right)} = 0.023 \qquad \text{(Equation 12)}$$

Rectangular culvert outlets

Refer to Figure 16 for sizing of rock erosion protection downstream from rectangular culverts.

Figure 16 parameters:

$Q/WH^{0.5}$ (vertical axis)

Y_t/H (horizontal axis)

where:

Q = design discharge (cfs)

W = width of rectangular conduit (ft)

H = height of rectangular conduit (ft)

Figure 16 notes:

- Valid for for Froude parameter for rectangular culvert ($Q/WH^{1.5}$) = 8.0 or less
- In cases where Y_t is unknown or a hydraulic jump is suspected downstream of the outlet, use Y_t/H = 0.40.
- The rock size requirements shown on Figure 16 were determined assuming that the flow in the rectangular culvert is not supercritical. In cases where the flow is supercritical, calculate Ha using Equation 11 and substitute H_a for H for use in Figure 16:

$$H_a = \frac{(H + Y_n)}{2} \qquad \text{(Equation 13)}$$

in which the maximum value of H_a shall not exceed H, and where:

H_a = parameter to use in place of H in Figure 16 when flow is supercritical

H = height of rectangular culvert (ft)

Y_n = normal depth of supercritical flow in the culvert

The basis for Figure 16 (for rectangular culverts) is a non-dimensional parametric equation (Steven, Simons, and Watts 1971 and Smith 1975):

$$\frac{\left(\frac{d_{50}}{H}\right)\left(\frac{Y_t}{H}\right)}{\left(\frac{Q}{WH^{1.5}}\right)} = 0.014 \qquad \text{(Equation 14)}$$

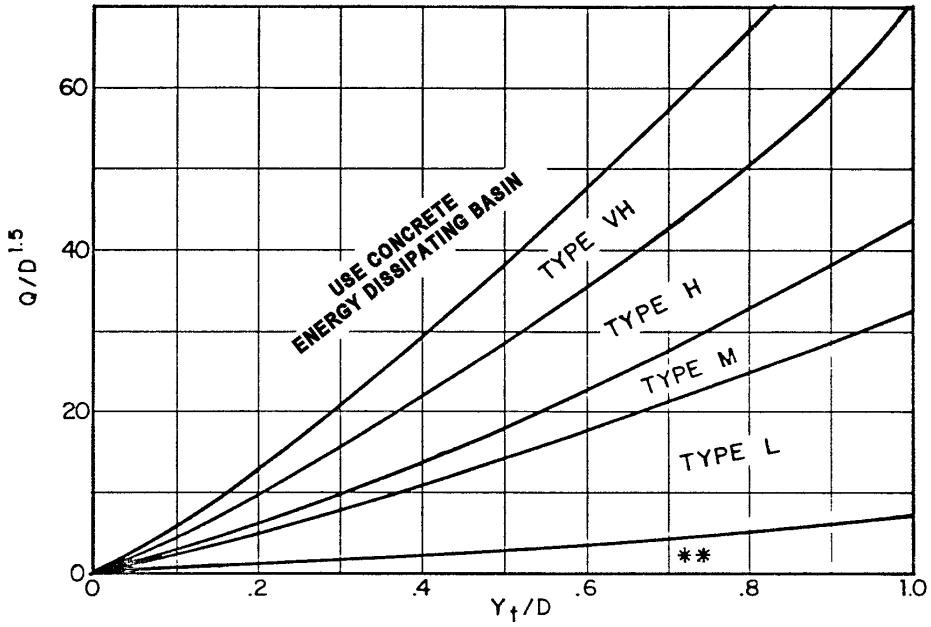
5.1.3 Extent of Protection

The length of the riprap protection downstream from the outlet depends on the degree of protection desired. If it is necessary to prevent all erosion, the riprap must be continued until the velocity has been reduced to an acceptable value. For purposes of outlet protection during major floods, the acceptable velocity is defined as 5.5 ft/sec for very erosive soils and at 7.7 ft/sec for erosion-resistant soils.

The rate at which the velocity of a jet from a conduit outlet decreases, once it has exited the culvert, is not well known. For the procedure recommended here, it is assumed to be related to the angle of lateral expansion, θ, of the jet. The velocity is related to the expansion factor, (1/(2tanθ)), which can be determined directly using Figure 17 or Figure 18 , assuming that the expanding jet has a rectangular shape:

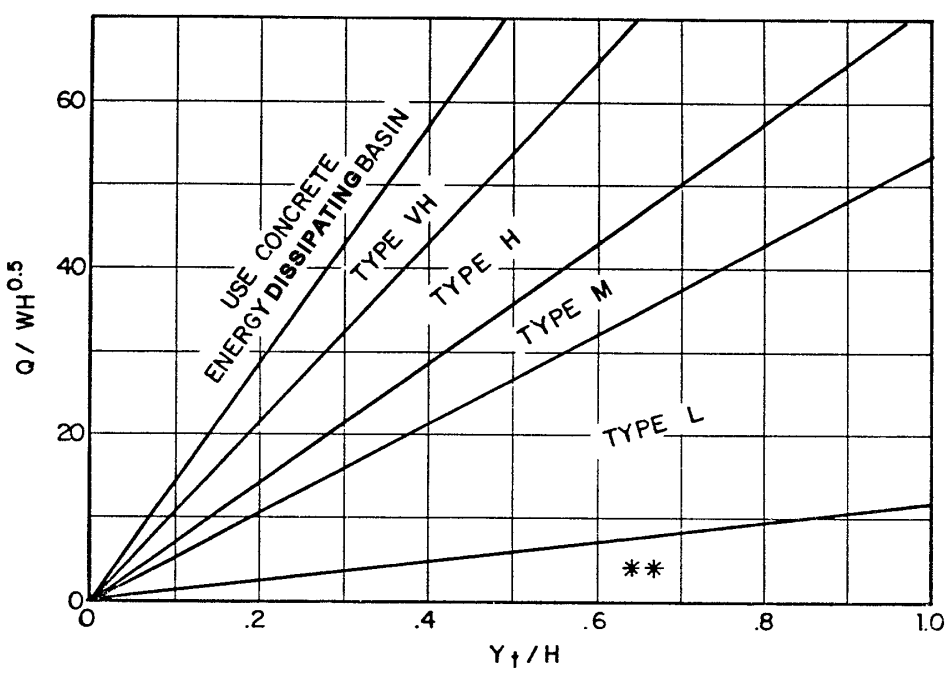
$$L_p = \left(\frac{1}{2\tan\theta}\right)\left(\frac{A_t}{Y_t} - W\right) \qquad \text{(Equation 15)}$$

where:



Use D_a instead of D whenever flow is supercritical in the barrel.
** Use Type L for a distance of 3D downstream.

Figure 15. Erosion Protection at Circular Conduit Outlet



Use H_a instead of H whenever culvert has supercritical flow in the barrel.
**Use Type L for a distance of 3H downstream.

Figure 16. Riprap Erosion Protection at Rectangular Conduit Outlet

L_p = length of protection (ft)

W = width of the conduit in (ft) (use diameter for circular conduits)

Y_t = tailwater depth (ft)

θ = the expansion angle of the culvert flow

and:

$$A_t = \frac{Q}{V} \qquad \text{(Equation 16)}$$

where:

Q = design discharge (cfs)

V = the allowable non-eroding velocity in the downstream channel (ft/sec)

A_t = required area of flow at allowable velocity (ft^2)

In certain circumstances, Equation 13 may yield unreasonable results. Therefore, specific requirements for parameter values are described below:

Circular Culverts

- L_p should not be less than 3 D_c
- L_p should not be greater than 10 D_c whenever the Froude parameter ($Q/D_c^{2.5}$) is less than 6.0.
- If the Froude parameter is greater than 6.0, increase the maximum L_p required by ¼ D_c for each whole number by which the Froude parameter is greater than 6.0.

Rectangular Culverts

- L_p should not be less than 3H
- L_p should not be greater than 10H whenever the Froude parameter ($Q/WH^{1.5}$) is less than 8.0.
- If the Froude parameter is greater than 8.0, increase the maximum L_p required by ¼ H for each whole number by which the Froude parameter is greater than 8.0.

5.1.4 Multiple Conduit Installations

The procedures outlined in Sections 5.1.1, 5.1.2, and 5.1.3 can be used to design outlet erosion protection for multi-barrel culvert installations by hypothetically replacing the multiple barrels with a single hydraulically equivalent rectangular conduit. The dimensions of the equivalent conduit may be established as follows:

- Distribute the total discharge, Q, among the individual conduits. Where all the conduits are hydraulically similar and identically situated, the flow can be assumed to be equally distributed; otherwise, the flow through each barrel must be computed.
- For all the culverts, compute the Froude parameter $Q_i/D_{ci}^{2.5}$ (circular conduit) or $Q_i/W_iH_i^{1.5}$ (rectangular conduit), where the subscript i indicates the discharge and dimensions associated with an individual conduit.
- If the installation includes dissimilar conduits, select the individual conduit with the largest value of the Froude parameter to determine the dimensions of the equivalent conduit.
- Make the height of the equivalent conduit, H_{eq}, equal to the height, or diameter, of the selected individual conduit.
- The width of the equivalent conduit, W_{eq}, is determined by equating the Froude parameter from the selected individual conduit with the Froude parameter associated with the equivalent conduit, (e.g., $Q/W_iH_{eq}^{1.5}$ is Froude parameter for equivalent rectangular conduit).

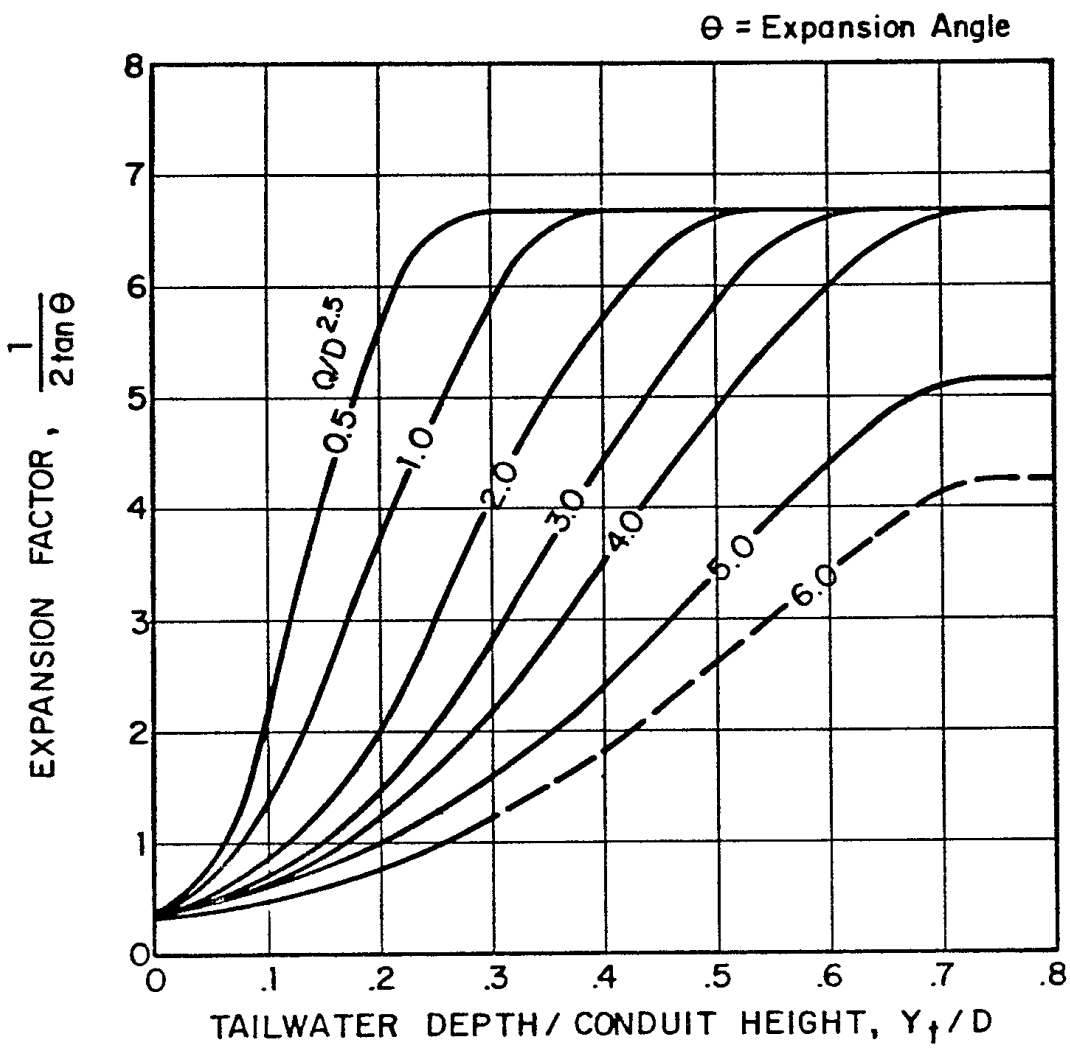


Figure 17. Expansion Factor for Circular Conduits

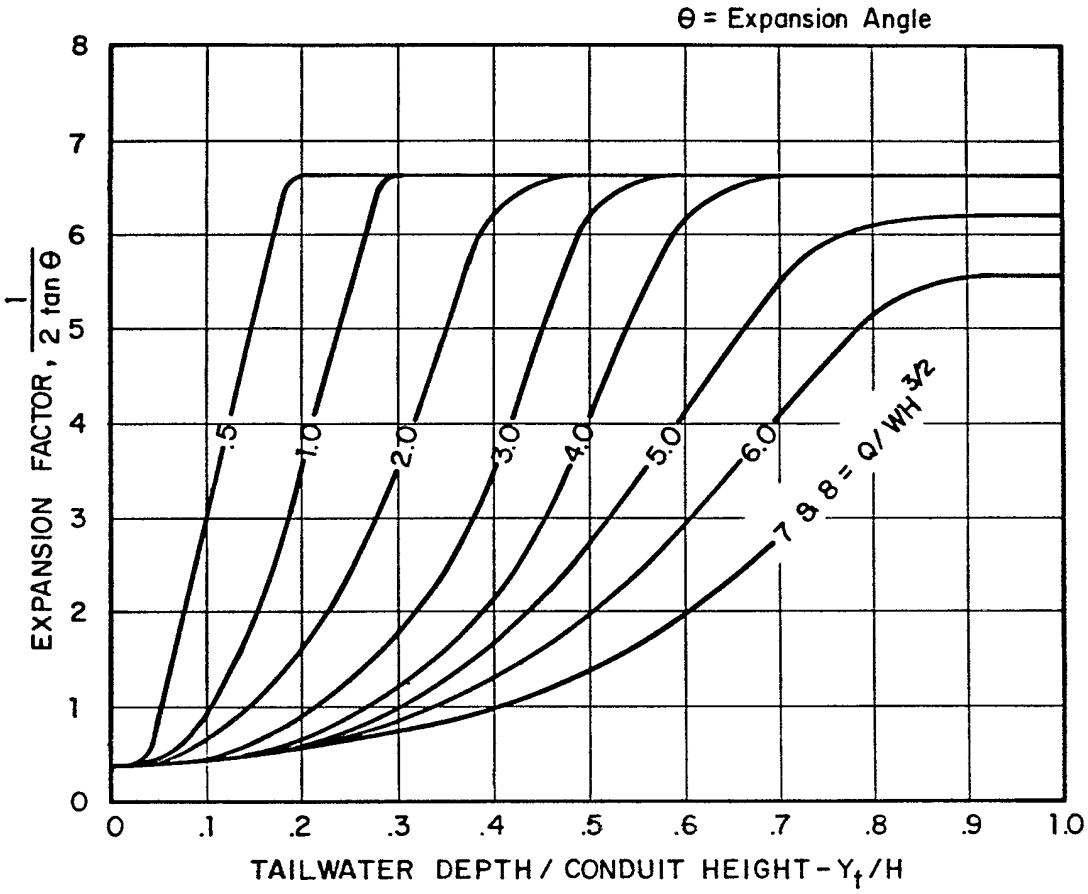


Figure 18. Expansion Factor for Rectangular Conduits

5.2 Energy Dissipation Structures

As described above in Section 5.1, rock protection downstream of conduit and culvert outlets is appropriate where moderate outlet conditions exist. However, in cases where high exit velocities or turbulence at culvert outlets will occur, the outlet structure must be designed to match the receiving stream conditions. Energy dissipation or stilling basin structures can provide a high degree of energy dissipation and are generally effective even with relatively low tailwater control. An energy dissipation structure should be considered if any of the following situations exist:

- High-energy dissipation efficiency is required, or where hydraulic conditions approach or exceed the limits for alternate designs (see Section 5.1);
- Low tailwater control is anticipated; or
- Site conditions dictate use of an energy dissipation structure, such as public use areas, where plunge pools and standing water are unacceptable because of safety and appearance, or at locations where space limitations direct the use of a concrete structure.

Types of energy dissipation structures addressed in this section include:

- Impact Stilling Basins (Section 5.2.1)

- Pipe Outlet to Baffle Chute (Section 5.2.2)
- Low Tailwater Basin (Section 5.2.3)

Longer conduits with large cross-sectional areas are designed for significant discharges and often with high velocities requiring special hydraulic design at their outlets. Here, dam outlet and spillway terminal structure technology is appropriate (USBR 1987). Type II, III, or IV stilling basins, submerged bucket with plunge basin energy dissipators and slotted-grating dissipators can be considered when appropriate to the site conditions. For instance, a plunge basin may have applicability where discharge is to a wet detention pond or a lake.

5.2.1 Impact Stilling Basin

Design standards for an impact stilling basin are based on the USBR Type VI basin, commonly referred to as an impact dissipator or conduit outlet stilling basin. The Type VI basin is a relatively small structure that produces highly efficient energy dissipation characteristics without tailwater control. The original hydraulic design reference by Beichley (1971) presents further model research and includes modifications to the hydraulic design. Additional structural details are provided in Aisenbrey, et al. (1974) and Peterka (1984).

The Type VI basin is designed to operate continuously at the design flow rate. The use of this outlet basin is limited only by structural and economic considerations.

Energy dissipation is accomplished through the turbulence created by the loss of momentum as flow entering the basin impacts a large overhanging baffle. At high flow, further dissipation is produced as water builds up behind the baffle to form a highly turbulent backwater zone. Flow is then redirected under the baffle to the open basin and out to the receiving channel. A check at the basin end reduces exit velocities by breaking up the flow across the basin floor and improves the stilling action at low to moderate flow rates.

The generalized design configuration shown in Figure 19 (Figure 20 for pipe diameters less than or equal to 36 inches) consists of an open concrete box attached directly to the conduit outlet. The width, W, is determined as a function of the Froude number (using Figure 21). The sidewalls are high enough to contain most of the splashing during high flows and slope down to form a transition to the receiving channel. The inlet pipe is vertically aligned with an overhanging L-shaped baffle such that the pipe invert is not lower than the bottom of the baffle. The end check height is equal to the height under the baffle to produce tailwater in the basin. The alternate end transition (at 45 degrees) is recommended for grass-lined channels to reduce the overall scour potential just downstream of the check.

The standard USBR design has been modified herein for urban applications to allow drainage of the basin bottom during dry periods. The impact basin can also be adapted to multiple pipe installations. Such modifications are discussed; however, it should be noted that modifications to the design may affect the hydraulic performance of the structure. Model testing is advised for significant changes to the design.

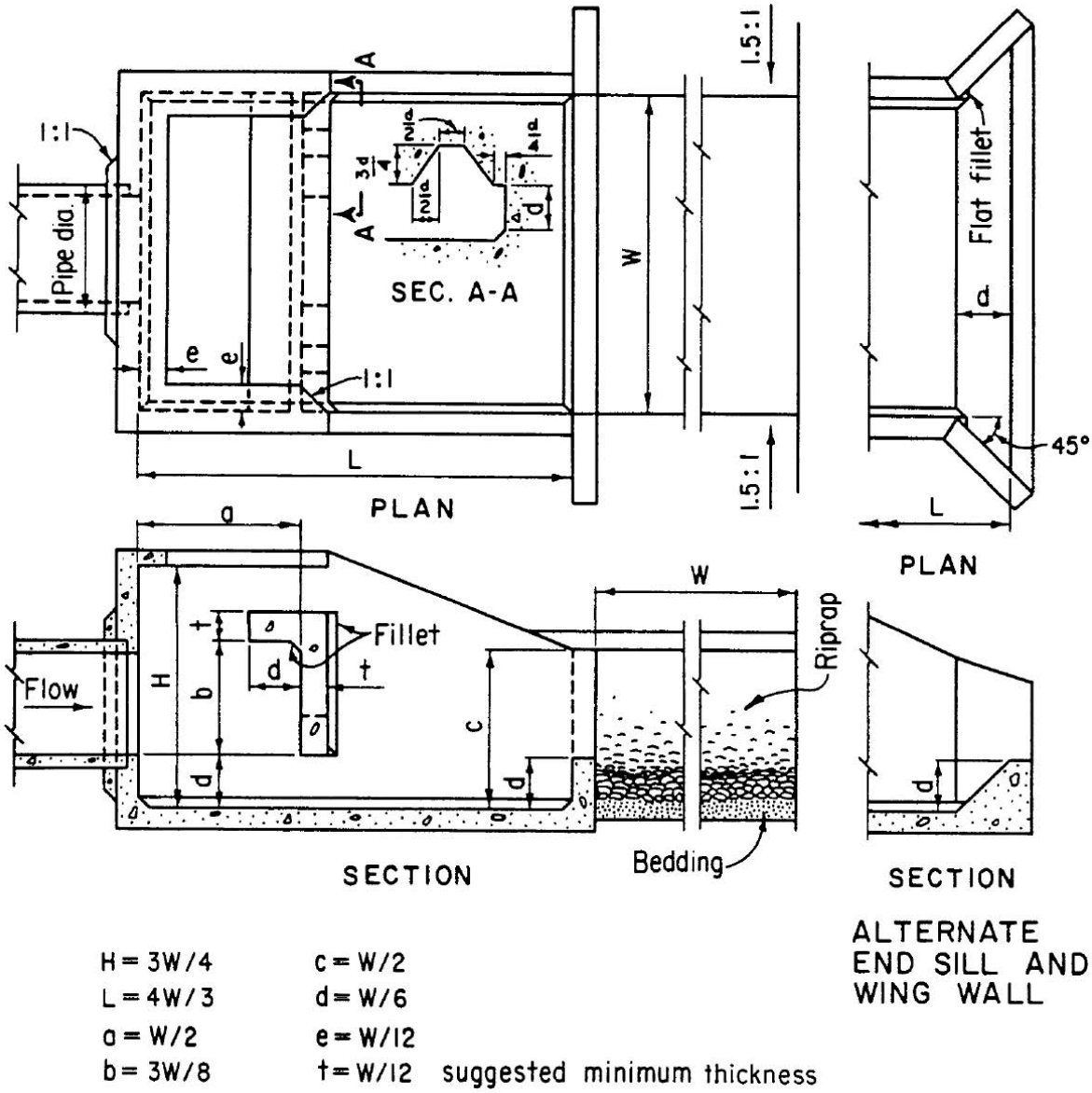


Figure 19. General Design Dimensions Impact Stilling Basin (USBR VI)

Impact Stilling Basin - Low-Flow Modifications

The standard impact stilling basin design will retain a standing pool of water in the basin bottom that is generally undesirable from an environmental and maintenance standpoint. This situation should be alleviated where practical by matching the receiving channel low-flow invert to the basin invert (see Figure 20).

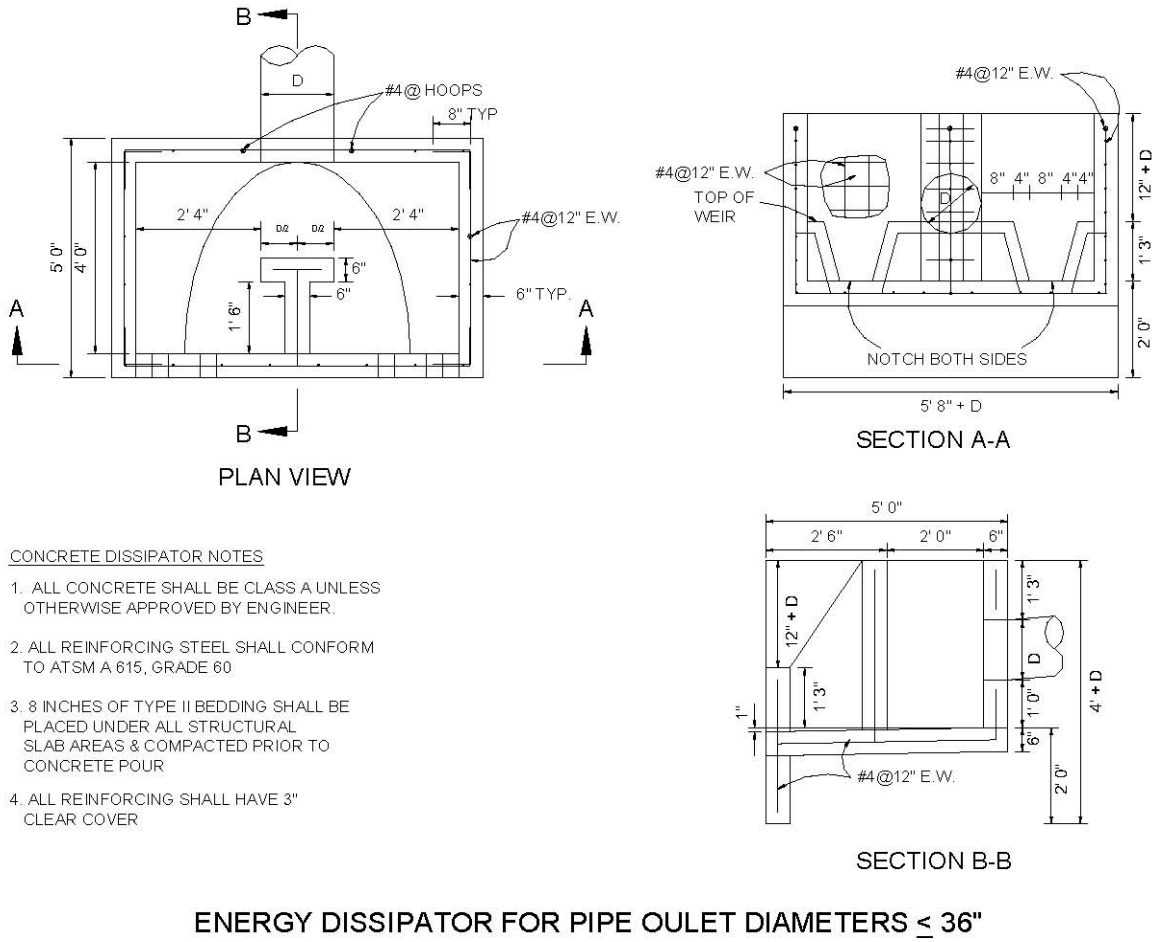
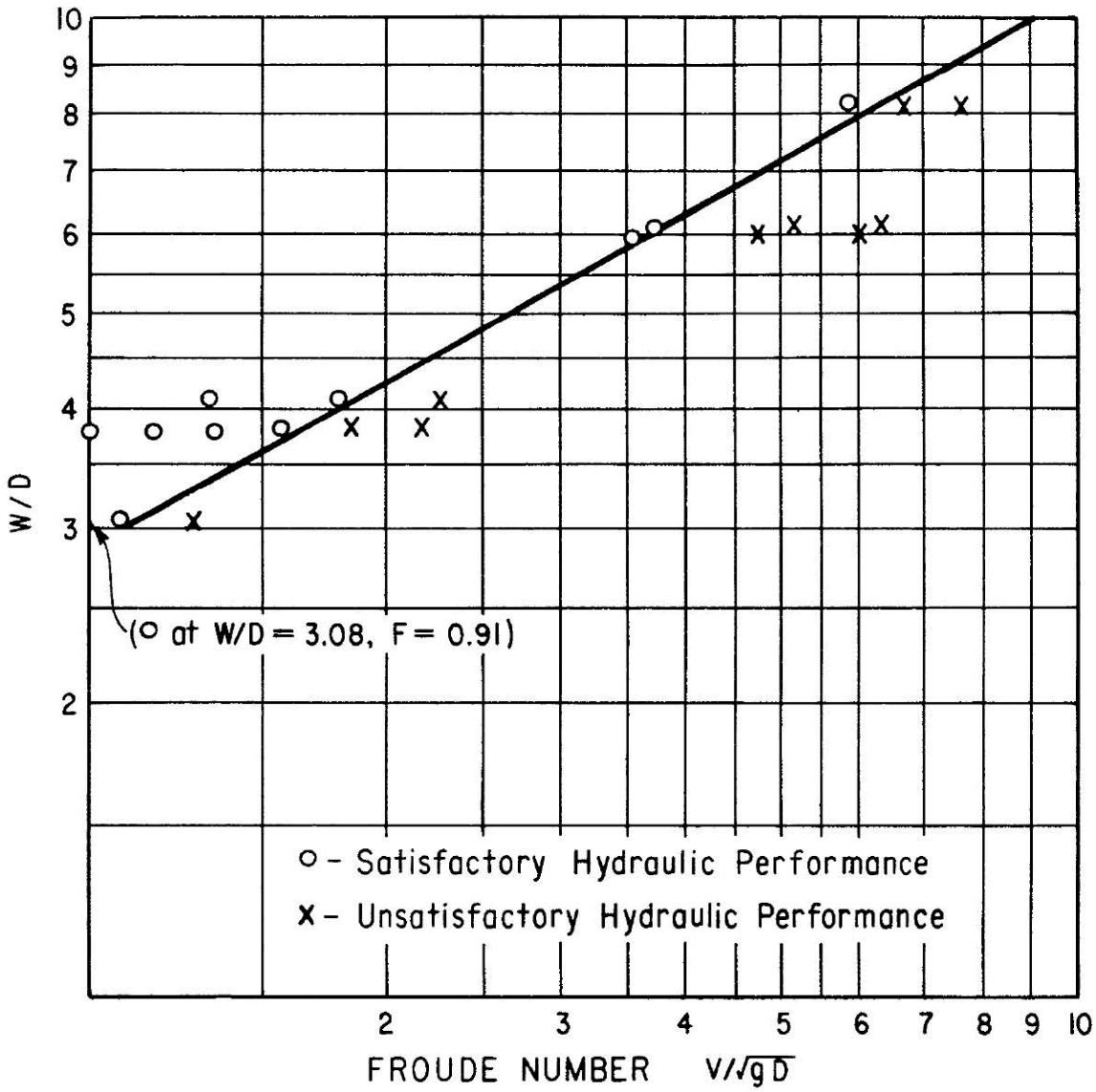


Figure 20. Modifications of Impact Stilling Basin to Allow Basin Drainage

A low-flow gap is extended through the basin end check wall. The gap in the check should be as narrow as possible to minimize effects on the check hydraulics. This implies that a narrow and deeper (1½- to 2-foot) low-flow channel will work better than a wider gap section. The low-flow width should not exceed 60 percent of the pipe diameter to prevent the jet from short-circuiting through the cleanout notches.

Low-flow modifications have not been fully tested to date. Caution is advised to avoid compromising the overall hydraulic performance of the structure. Other configuration ideas are possible, including locating the low-flow gap at one side (off center) to prevent a high velocity jet from flowing from the pipe straight down the low-flow channel. The optimal configuration results in continuous drainage of the basin area and helps to reduce the amount of siltation.



"W" is the inside width of the basin.
"D" represents the depth of flow entering the basin and is the square root of the flow area at the conduit outlet.
"V" is the velocity of the incoming flow.
The tailwater depth is uncontrolled.

Figure 21. Basin Width Diagram for an Impact Stilling Basin (USBR VI)

Impact Stilling Basin - Multiple Conduit Installations

Where two or more conduits of different sizes outlet in proximity, a composite impact stilling basin structure can be constructed to eliminate common walls. This can be somewhat awkward since each basin "cell" must be designed as an individual basin with different height, width, etc.

Where possible, a more economical approach is to combine storm sewers underground, at a manhole or vault, and bring a single, combined pipe to the outlet structure.

For two conduits of the same size, the outfalls may be combined into a single basin similar to Figure 20. If the design width for each pipe is *W*, the combined basin width for two pipes would be 1.5*W*. Where the flow is different for the two conduits, the design width is based on the higher flow.

The effect of mixing and turbulence of the combined flows in the basin has not been thoroughly model-tested to date. It is suggested that no wall be constructed to separate flow behind the baffle, thereby allowing greater turbulence in the combined basin.

Remaining structure dimensions are based on the design width of a separate basin *W*. If the two pipes have different flow, the combined structure is based on the higher Froude number. Use of a handrail is suggested around the open basin areas where safety is a concern. Access control screens or grating, where necessary, are separate design considerations.

Impact Stilling Basin - General Design Procedure

- Determine the design hydraulic cross-sectional area just inside the pipe, at the outlet. Determine the effective flow velocity, V, at the same location in the pipe. Assume depth and compute the Froude number = $D = (A_{sect})^{1/2}$ ar $\frac{V}{(gD)^{1/2}}$
- The entrance pipe should be turned horizontally at least one pipe diameter equivalent length upstream from the outlet. For pipe slopes greater than 15 degrees, the horizontal length should be a minimum of two pipe diameters.
- Determine the basin width, *W*, by entering the appropriate Froude number and effective flow depth into Figure 21. The remaining dimensions are proportional to the basin width according to Figure 19. The basin width should not be oversized since the basin is inherently oversized for less than design flows. Larger basins become less effective as the inflow can pass under the baffle.
- Structure wall thickness, steel reinforcement, and anchor walls (underneath the floor) should be designed using accepted structural engineering methods. Note that the baffle thickness, t_b, is a suggested minimum. It is not a hydraulic parameter and is not a substitute for structural analysis. Hydraulic forces on the overhanging baffle may be approximated by determination of the hydraulic jet force at the outlet:

$$F_j = 1.94\ V_{out} Q_{des} \qquad \text{(Equation 17)}$$

where:

F_j = hydraulic jet force (lbs)

Q_{des} = maximum design discharge (cfs)

V_{out} = velocity of the outlet jet (ft/sec)

- Type "M" rock riprap should be provided in the receiving channel from the end check to a minimum distance equal to the basin width. The depth of rock should be equal to the check height or at least two (2) feet. Rock may be buried to finished grades and planted as desired.
- The alternate end check and wingwall shown in Figure 19 are recommended for all grass-lined channel applications to reduce the scour potential below the check wall.
- Ideally, the low-flow invert matches the floor invert at the basin end and the main channel elevation is equal to the top of the check. For large basins where the check height, *d*, becomes greater than the low-flow depth, dimension *d* in Figure 19 may be reduced by no more than one-third. It should not be reduced to less than two (2) feet. This implies that a deeper low-flow channel (1.5 to 2.0 feet) will be advantageous for these installations. The alternate, when *d* exceeds the trickle flow depth, is that the basin area will not drain completely.
- A check section should be constructed directly in front of the low-flow notch to break up bottom flow velocities. The length of this check section should overlap the width of the low flow by about one (10 foot. The general layout for the check modifications is shown in Figure 20.

5.2.2 Pipe Outlet to Baffle Chute

The baffle chute developed by the USBR (1958) has also been adapted for use at pipe outlets. This structure is particularly well suited to situations with large conduit outfalls and at outfalls to channels in which some future degradation is anticipated. As mentioned previously, the apron can be extended at a later time to account for channel degradation. Generally, this type of structure is only cost effective if a grade drop is necessary below the outfall elevation.

Figure 22 illustrates a general configuration for a baffled outlet application for a double box culvert outlet. In this case, an expansion zone occurs just upstream of the approach depression. The depression depth is designed as required to reduce the flow velocity at the chute entrance. The remaining hydraulic design is the same as for a standard baffle chute using conditions at the crest to establish the design. The same crest modifications are applicable to allow drainage of the approach depression, to reduce the upstream backwater effects of the baffles, and to reduce the problems of debris accumulation at the upstream row of baffles.

Flow entering the chute should be well distributed laterally across the width of the chute. The velocity should be less than critical velocity at the crest of the chute. To ensure low velocities at the upstream end of the chute, it may be necessary to provide a short energy dissipating pool. The sequent or conjugate depth in the approach basin should be maintained to prevent jump sweep-out, but the basin length may be considerably less than a conventional hydraulic jump basin since the primary purpose of this pool is only to reduce the average entrance velocity. A basin length of twice the sequent depth will usually provide ample basin length. The end check of the pool may be used as the crest of the chute as shown in Figure 22.

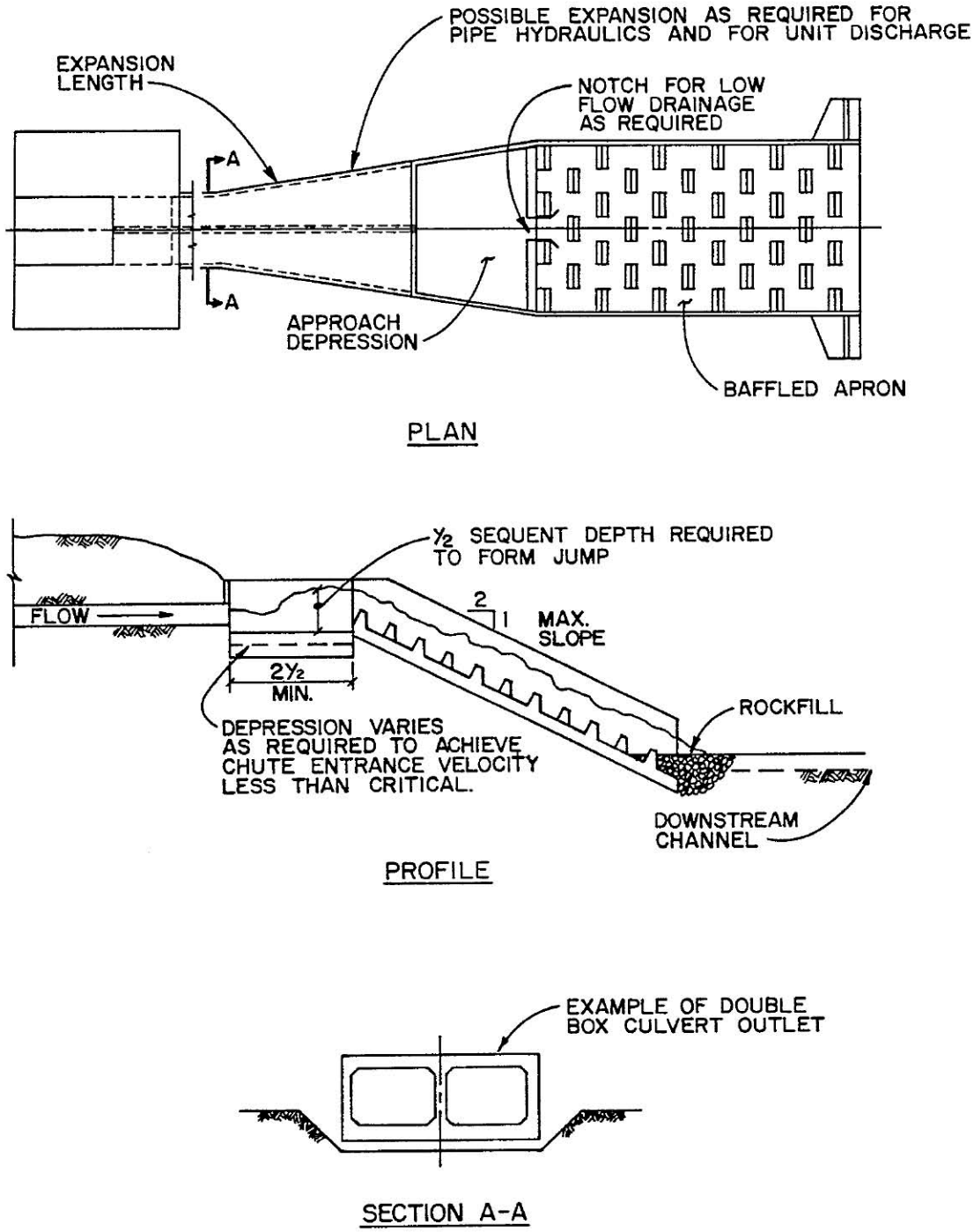
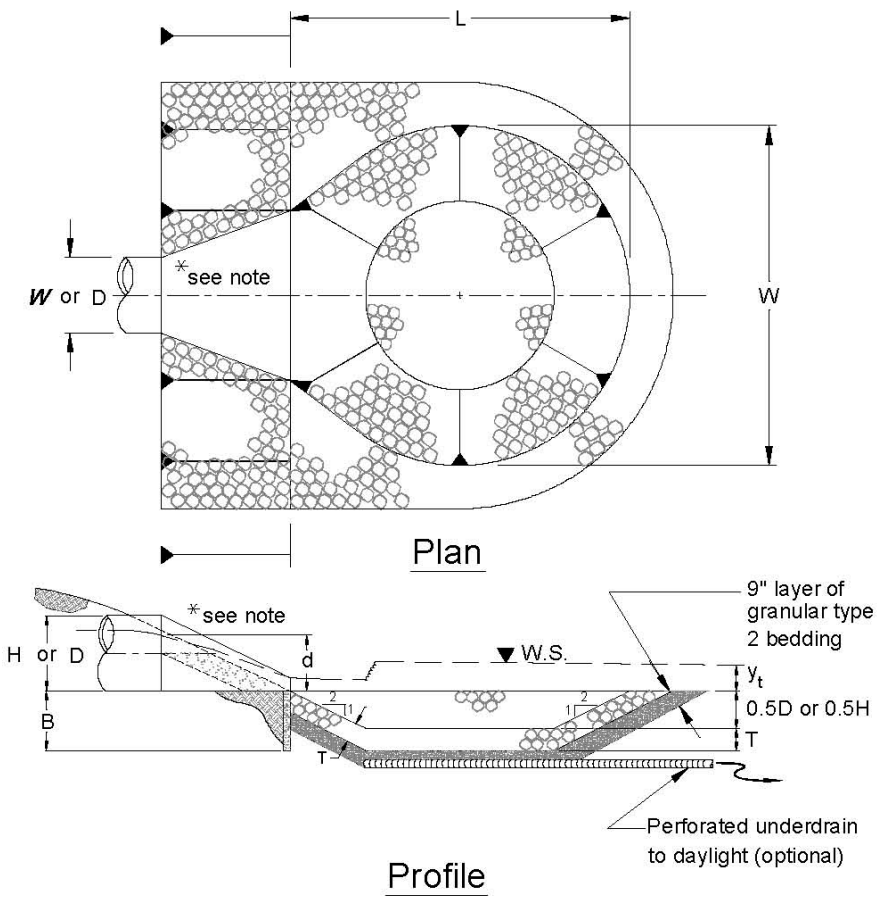


Figure 22. Baffle Chute Pipe Outlet

5.2.3 Low Tailwater Basin

The design of low tailwater riprap basins for storm sewer pipe outlets and some culverts is necessary when the receiving channel may have little or no flow and uncontrolled pipe velocities would create erosional problems in the channel. Design references are provided in Figure 23 through Figure 26.



* Note: For rectangular conduits use a standard design for a headwall with wingwalls, paved bottom between the wingwalls, with an end cutoff wall extending to a minimum depth equal to B

Figure 23. Low Tailwater Riprap Basins for Storm Sewer Pipe Outlets— Low Tailwater Basin at Pipe Outlets (Stevens and Urbonas 1996)

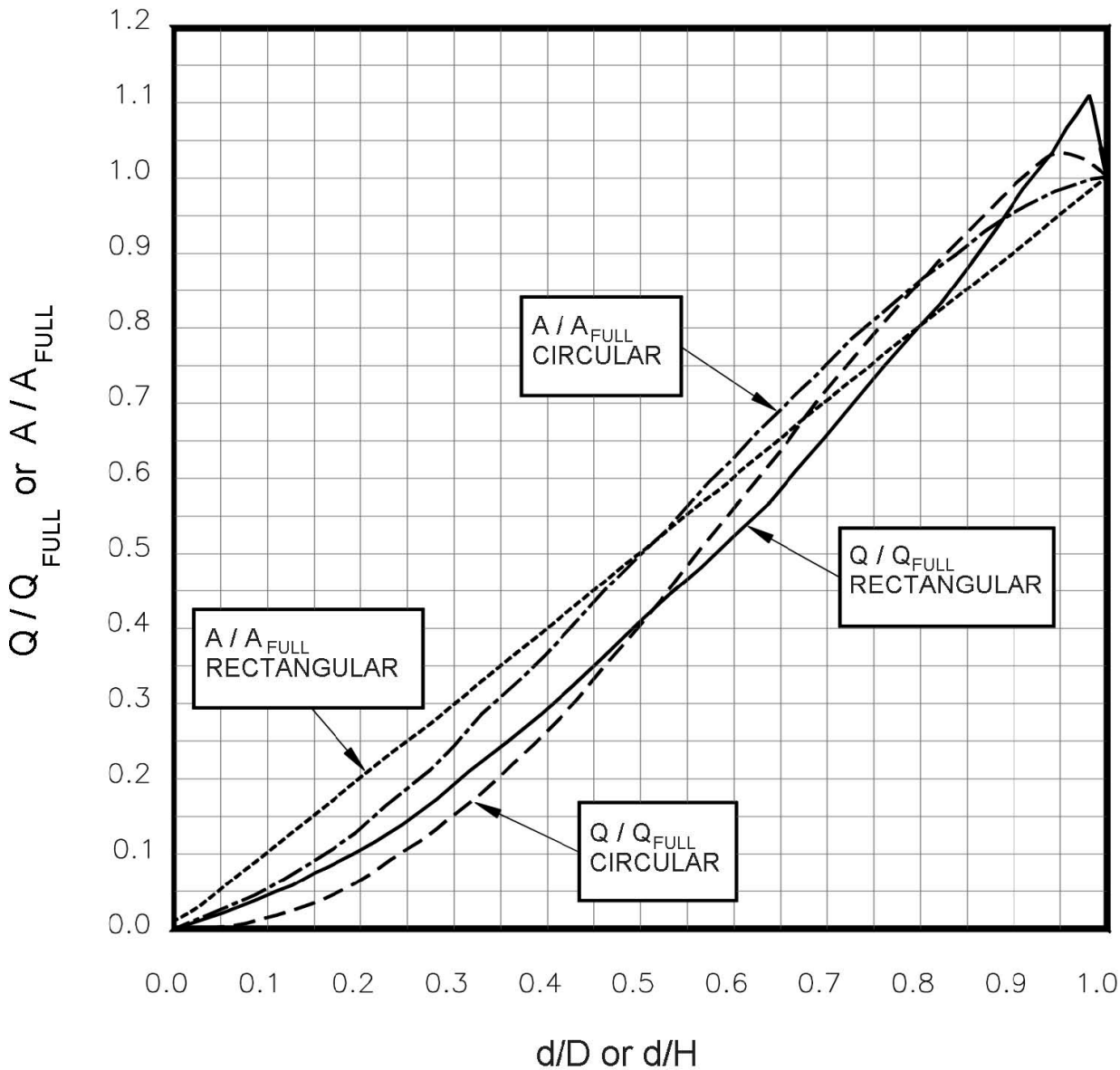


Figure 24. Low Tailwater Riprap Basins for Storm Sewer Pipe Outlets— Discharge and Flow Area Relationships for Circular and Rectangular Pipes (Ratios for Flow Based on Manning's n Varying With Depth) (Stevens and Urbonas 1996)

Low Tailwater Basin Objective

By providing a low tailwater basin at the end of a storm sewer conduit or culvert, the kinetic energy of the discharge is dissipated under controlled conditions without causing scour at the channel bottom. Photograph 5 shows a representative low tailwater basin.

Photograph 5. Upstream and downstream views of a low tailwater basin protecting downstream wetland area. Burying and revegetation of the rock would blend the structure better with the adjacent terrain.

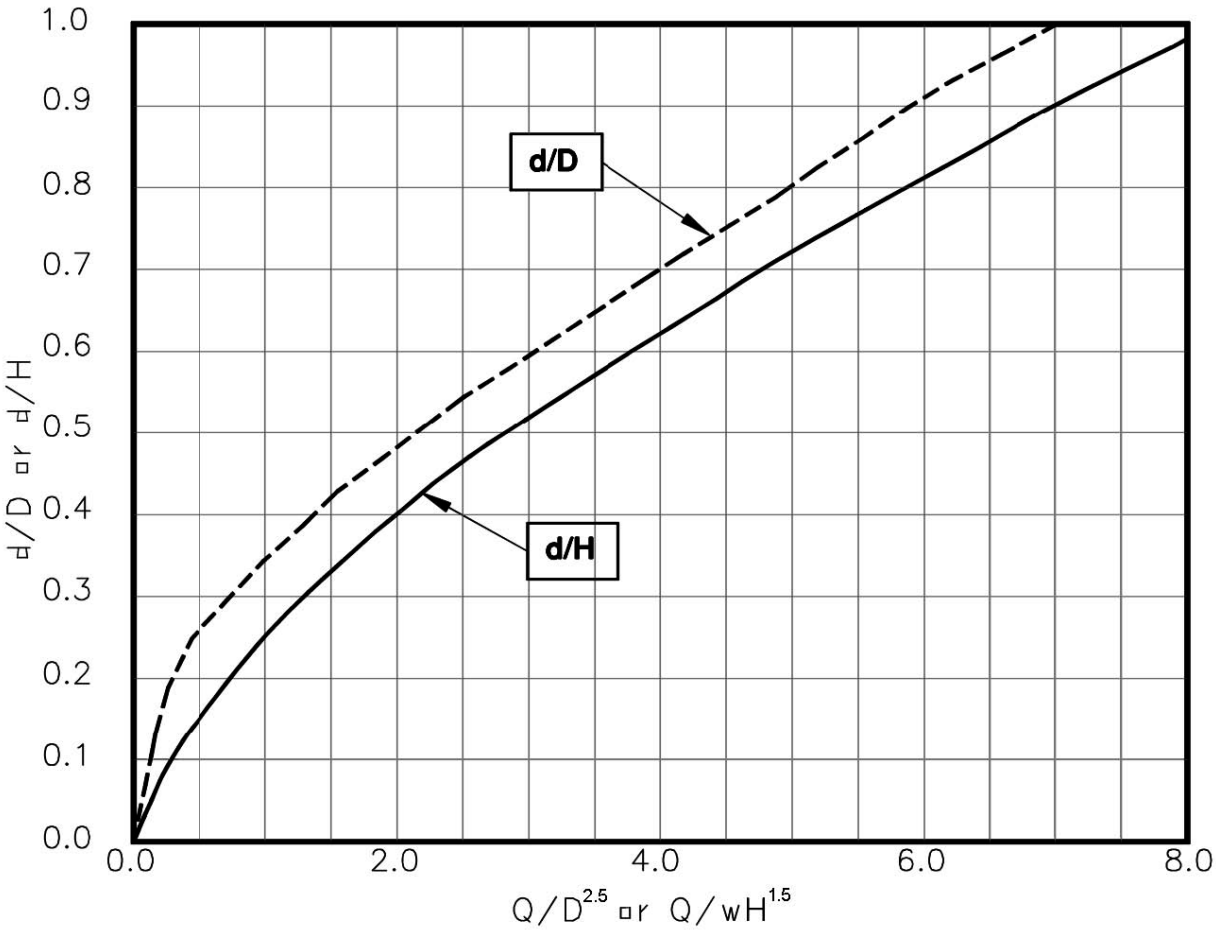


Figure 25. Low Tailwater Riprap Basins for Storm Sewer Pipe Outlets— Brink Depth for Horizontal Pipe Outlets (Stevens and Urbonas 1996)

Photograph 5. Upstream and downstream views of a low tailwater basin protecting downstream wetland area. Burying and revegetation of the rock would blend the structure better with the adjacent terrain

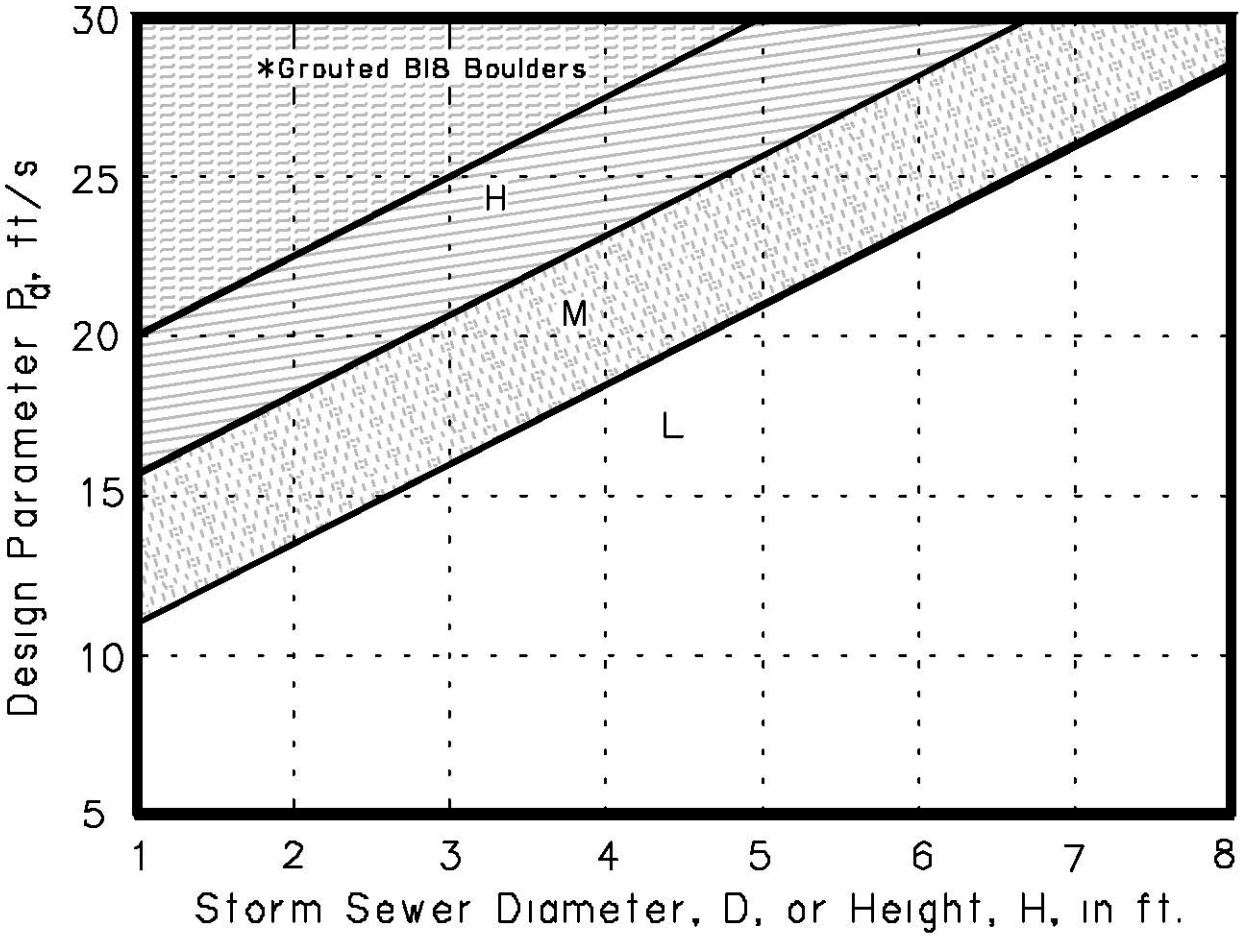


Figure 26. Low Tailwater Riprap Basins for Storm Sewer Pipe Outlets— Riprap Selection Chart for Low Tailwater Basin at Pipe Outlet (Stevens and Urbonas 1996)

Low Tailwater Basin – General Design Procedure

For storm sewers, low tailwater is defined as being equal to or less than ⅓ of the storm sewer conduit height, that is:

$$y_t \leq \frac{D}{3} \quad \text{or} \quad y_t \leq \frac{H}{3} \qquad \text{(Equation 18)}$$

where:

yt = tailwater depth at design

D = diameter of circular pipe (ft)

H = height of rectangular pipe (ft)

Determining Flow Depth and Velocity of Storm Sewer Pipe Outlets

The first step in the design of a scour protection basin at the outlet of a storm sewer is to find the depth and velocity of flow at the outlet. Pipe-full flow can be found using Manning's equation and the pipe-full velocity can be found using the well-known and standard continuity equation. Namely,

$$Q_{full} = \frac{1.49}{n} A_{full} \left(R_{full}\right)^{2/3} S_o^{1/2}$$

(Equation 19)

where:

Q_{full} = pipe full discharge at its slope (cfs)

n = Manning's n for the pipe full depth

A_{full} = cross-sectional area of the pipe (ft2)

S_o = longitudinal slope of the pipe (ft/ft)

R = hydraulic radius of the pipe flowing full (ft)

[$R_{full} = D/4$ for circular pipes, $R_{full} = A_{full}/(2H + 2w)$ for rectangular pipes, where D = diameter of a circular conduit, H = height of a rectangular conduit, and w = width of a rectangular conduit (ft)]

Then,

$$V_{full} = Q_{full} / A_{full}$$

(Equation 20)

where:

V_{full} = flow velocity of the pipe flowing full (ft/sec)

The normal depth of flow, d, and the velocity at that depth in a conduit can be found with the aid of Figure 24 as follows: Using the known design discharge, Q, and the calculated pipe-full discharge, Q_{full}, find the value of Q/Q_{full} on Figure 24 (vertical axis) and the corresponding d/D (for circular pipe) and d/H (for rectangular pipe) on the horizontal axis.

Compare the value of d/D (or d/H) obtained from Figure 24 with the value obtained from Figure 25 based on the Froude parameter ($Q/Dc^{2.5}$ [for circular culvert] or $Q/WH^{1.5}$ [for rectangular culvert], see Section 5.1].

Choose the smaller of the two ratios determined from Figure 24 and Figure 25 (for d/D or d/H) to calculate the flow depth at the end of the pipe, namely:

$$d = D\left(d/D\right) \quad \text{or} \quad d = H\left(d/H\right)$$

(Equation 21)

Again, refer to Figure 24 and use the smaller *d/D* (or *d/H*) ratio to find the A/A_{full} ratio. Use this to calculate the area of flow at the end of the pipe, namely,

$$A = \left(A/A_{full}\right)A_{full}$$ (Equation 22)

where:

A = area of the design flow in the end of the pipe (ft2)

Finally,

$$V = Q/A$$ (Equation 23)

where:

V = design flow velocity at the pipe outlet (ft/sec)

Q = design discharge (cfs)

A = cross-sectional area of discharge (ft2)

Riprap Size

Based on the design velocity calculated using Equation 21, use Equation 21 to find the size and type of the riprap to use in the scour protection basin downstream of the pipe outlet (i.e., B18, H, M or L). First, calculate the riprap sizing design parameter, P_d:

$$P_d = \left(V^2 + gd\right)^{1/2}$$ (Equation 24)

where:

P_d = riprap sizing design parameter (unitless)

V = design flow velocity at pipe outlet (ft/sec)

g = acceleration due to gravity = 32.2 ft/sec2

d = design depth of flow at pipe outlet (ft)

For riprap sizing, use the design parameter (P_d) with Figure 26. When the riprap sizing design parameter indicates conditions that place the design above the Type H riprap line in Figure 26, use B18, or larger, grouted boulders. An alternative to a grouted boulder or loose riprap basin is to use the standard USBR Basin VI, as described in Section 5.2.

After the riprap size has been selected, the minimum thickness of the riprap layer in the basin is determined:

$$T = 1.75D_{50}$$ (Equation 25)

where:

T = riprap layer thickness (ft)

D_{50} = the median size of the riprap (see Table 3)

Table 3. Median Size of Riprap (D_{50})

Riprap Type	D_{50}—Median Rock Size (inches)
L	9
M	12
H	18
B_{18}	18 (grouted)
VH	24

Basin Length

The minimum length of the low tailwater basin, shown as "L" on Figure 23, is defined as the greater of the following lengths:

For circular conduit:

$$L = 4D \quad \text{or} \quad L = (D)^{1/2}\left(\frac{V}{2}\right)$$ (Equation 26)

For rectangular conduit:

$$L = 4H \quad \text{or} \quad L = (H)^{1/2}\left(\frac{V}{2}\right)$$ (Equation 27)

where:

L = basin length (Figure 23)

H = height of rectangular conduit

V = design flow velocity at outlet

D = diameter of circular conduit

Basin Width

The minimum width, *W*, of the basin downstream of the pipe's flared end section is determined as follows:

For circular conduit:

$$W = 4D$$ (Equation 28)

For rectangular conduit:

$$W = w + 4H$$ (Equation 29)

where:

W = basin width (Figure 23)

D = diameter of circular conduit

w = width of rectangular conduit

Other Design Requirements

All slopes in the pre-shaped riprap basin are 2:1 (H:V).

Provide pipe joint fasteners and a structural concrete cutoff wall at the end of the flared end section for a circular pipe or a headwall with wingwalls and a paved bottom between the walls. The depth of the cutoff wall for both is calculated as follows:

For circular pipe:

$$B = \frac{D}{2} + T$$ (Equation 30)

For rectangular pipe:

$$B = \frac{H}{2} + T$$ (Equation 31)

where:

B = cutoff wall depth

D = diameter of circular conduit

T = riprap thickness (from Equation 23)

The riprap must be extended up the outlet embankment's slope to the mid-pipe level.

6.0 Large Conduits and Bridges

The design criteria described above in this Manual are for culverts that will be routinely designed in the City of Springfield (i.e., pipe, culverts with diameters less than or equal to 48 inches). For other applications, such as large circular or large rectangular culverts, or bridge hydraulics, the reader is directed to the following references:

6.1 Large Circular Culverts or Large Rectangular Culverts

- *Open Channel Hydraulics* (Chow 1959). This is a classic reference that is applicable since large culverts frequently function hydraulically as open channels.
- Federal Highway Administration *Hydraulic Design of Highway Culverts*, Hydraulic Design Series No. 5 (FHWA 2005a). This is the same standard reference used for the hydraulic design of smaller culverts.

6.2 Bridges

- *Hydraulics of Bridge Waterways* Hydraulic Design Series No. 1(FHWA 1978). This is a good basic reference.
- *Design Manual for Engineering Analysis of Fluvial Systems for the Arizona Department of Water Resources* (SLA 1985). This is a prime reference on hydraulics and the three-level sediment transport analysis, with examples.
- American Association of State Highway and Transportation Officials, *Highway Drainage Guidelines* (AASHTO 2007). Chapter 7 of this document, the *Hydraulic Analysis for the Location and Design of Bridges* , provides a good overview of this topic.
- *Technical Advisory on Scour at Bridges* (FHWA 1988). This presents information similar to bridge hydraulics references 2 and 3 above, but in a workbook format, but in a simplified format.

7.0 Design Example

The following example problem illustrates the culvert design procedures using the FHWA nomographs and using the Culvert Spreadsheet application.

7.1 Project Description

A culvert is needed to convey surface water under an embankment that will be constructed in a new residential development near Springfield, MO. According to preliminary field surveys, the natural channel invert elevation is 1200 feet at the inlet, 1198 feet at the outlet, and the horizontal length of the culvert under the embankment will be 95 feet. To ensure adequate freeboard, consistent with city risk mitigation policies and to satisfy all relevant federal and state standards, the maximum allowable headwater elevation for this culvert site is 1205 feet (five feet above the inlet invert elevation). Hydrologic calculations for the catchment area yield peak flows of 20 cfs for the 5-year event and 35 cfs for the 100-year event.

Based on inspections of the downstream channel, the calculated tailwater depths for these flows are 2.5 feet for the 5-year event and 3.0 feet for the 100-year event.

Culvert inlet types to be considered in the evaluation are square edge with headwall (K_e=0.4) and groove end with headwall (K_e=0.2).

Objective:

Determine the circular concrete culvert size that will satisfy the hydraulic design requirements. Use: 1) hand calculations (using the FHWA nomographs), and 2) an automatic spreadsheet application. Investigate various culvert diameters, inlet types, and outlet velocities.

Given:

- $Q_{5\text{-}yr}$ = 20 cfs
- $Q_{100\text{-}yr}$ = 35 cfs
- Culvert L = 95 feet
- Maximum allowable headwater elevation is 1205.0.
- Culvert invert elevations (at natural channel elevation): 1200.0 (inlet) and 1198.0 (outlet).
- Tailwater depth computed: 2.5 feet (5-year storm) and 3.0 feet (100-year storm).
- Culvert slope = 2 ft/95 ft = 0.021 ft/ft

Solution: [1]

Step 1. Using basic data given above, fill in design computation form (see Figure 27 below).

Step 2. Set invert elevations of culvert inlet and outlet to the invert elevations of the natural channel to avoid scour. Compute s and $L/(100s)$.

Step 3. Start with an assumed culvert size for the 5-year storm by adopting a velocity of 6.5 ft/sec. Inputting the given discharge, Q, and the adopted velocity, v, in the continuity equation ($Q = VA$, Equation 2), the culvert area is computed: A = 20 cfs/6.5 ft/sec = 3.1 ft^2, which equates to a culvert diameter, D = 24 inches.

Step 4. For this example, two inlets are considered: square edge with headwall (K_e = 0.4) and groove end with headwall (K_e = 0.2). Also, assume concrete pipe will be used with a Manning's n of 0.012 (Note: the City recommends a minimum n of 0.013; however, 0.012 is used in this example to correspond to the FHWA nomograph.)

[1] Disclaimer: The actual design of a culvert installation involves additional engineering judgment, and is more difficult than the simple process of sizing a culvert. Problems that may be encountered are too varied and too numerous to create a generalized design process appropriate for every situation. Many other factors are important for the successful design of a safe, cost-effective culvert. These factors include: the amount and type of cover and vegetation, public safety issues (trash racks, etc.), pipe coatings and sealants, fish passage issues, multipurpose objectives, available construction techniques, cost, and protection against abrasion and erosion – not to mention structural and geotechnical considerations. This example is intended to illustrate some of the basic design steps for a simple, inlet-controlled, circular concrete pipe embankment culvert that will be constructed without modification of the natural grade. Design engineers are advised to use the automatic design tools and nomographs with caution and, for all but the simplest designs, to refer to the FHWA Publication on the Hydraulic Design of Highway Culverts (FHWA 2005a).

Step 5. Using the inlet control nomograph (Figure 28), the ratio of the headwater depth to the culvert diameter (H_w/D) is 1.47 for the square edge and 1.32 for the groove end. Thus, based on a culvert diameter of 2.0 feet, the inlet control headwater depths are 2.94 feet (for the square edge) and 2.64 feet (for the groove end).

Step 6. The outlet control headwater depth is determined using the method described in Section 3.0. The head is determined from the nomograph (Figure 29). The resulting outlet control headwater depths are 2.13 feet for the square edge and 1.90 feet for the groove end inlet.

Step 7. Comparing the headwater depths for inlet control (2.94 feet and 2.64 feet) and outlet control (2.13 feet and 1.90 feet) shows that the culvert is inlet controlled with either inlet configuration. Furthermore, the calculated headwater depths are less than the allowable headwater depth. These results can also be determined using the UD-Culvert Spreadsheet (spreadsheet results shown on Figure 30).

Step 8. The next step is to evaluate the culvert for the 100-year flow of 35 cfs and tailwater depth of 3.0 feet. Using the same procedure, the culvert continues to be inlet controlled with the square-edge inlet and switches to outlet control with the more efficient groove-end inlet. However, both of the calculated headwater depths exceed the allowable headwater depth (5.0 ft) and, consequently, are not viable alternatives.

Step 9. Increase the pipe diameter to 27 inches and repeat the process. The resulting headwater depths meet the criteria (i.e., are less than the allowable headwater depth of 5.0 ft).

Step 10. Compute outlet velocities for each acceptable alternate.

Step 11. Compute cost for each alternate.

Step 12. Make recommendations.

From BPR

PROJECT: Drainage Criteria Manual
Culvert Design Example

DESIGNER: _____

DATE: _____

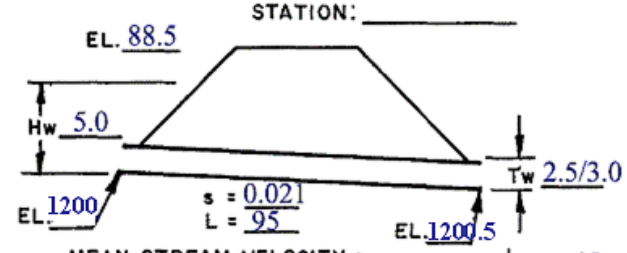
HYDROLOGIC AND CHANNEL INFORMATION

Q_1 = 20 cfs TAILWATER ELEVATION = 1200.5
Q_2 = 35 cfs TAILWATER ELEVATION = 1200

(Q_1 = DESIGN DISCHARGE, SAY Q_{25}
Q_2 = CHECK DISCHARGE, SAY Q_{50} OR Q_{100})

SKETCH

STATION: _____



MEAN STREAM VELOCITY = _____
MAX. STREAM VELOCITY = _____
$\frac{L}{100s}$ = 45

CULVERT DESCRIPTION w/ Headwall (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION: INLET CONT. $\frac{Hw}{D}$	INLET CONT. Hw	OUTLET CONTROL HW = H + h_o − Ls: K_e	H	d_c	$\frac{d_c+D}{2}$	Tw	h_o	Ls	Hw	CHART No.	CHART Hw	CONTROLLING Hw	OUTLET VELOCITY	COST	COMMENTS
RCP w/ sq edge	20	24	1.47	2.94	0.4	1.63	0.80	1.40	2.5	2.5	2.0	2.13			2.94	6.4		Inlet Control
RCP w/ groove	20	24	1.32	2.64	0.2	1.40	0.80	1.40	2.5	2.5	2.0	1.90			2.64	6.4		Inlet Control
RCP w/ sq edge	35	24	3.08	6.16	0.4	4.90	0.96	1.48	3.0	3.0	2.0	5.90			6.16	11.1		Inlet Control HW>allowable
RCP w/ groove	35	24	2.50	5.00	0.2	4.40	0.96	1.48	3.0	3.0	2.0	5.40			5.40	11.1		Outlet Control HW>allowable
RCP w/ sq edge	35	27	2.03	4.57	0.4	2.85	1.01	1.63	3.0	3.0	2.0	3.85			4.57	8.8		Inlet Control
RCP w/ groove	35	27	1.71	3.85	0.2	2.50	1.01	1.63	3.0	3.0	2.0	3.50			3.85	8.8		Inlet Control

SUMMARY & RECOMENDATIONS: Choose 27-inch RCP to pass the 100-year flow within the allowable headwater.
Either entrance type will work; allow cost to determine.
Design outlet protection based on velocity of 8.8 ft/sec.

Figure 27. Design Computation Form for Culverts (Example 6.1)

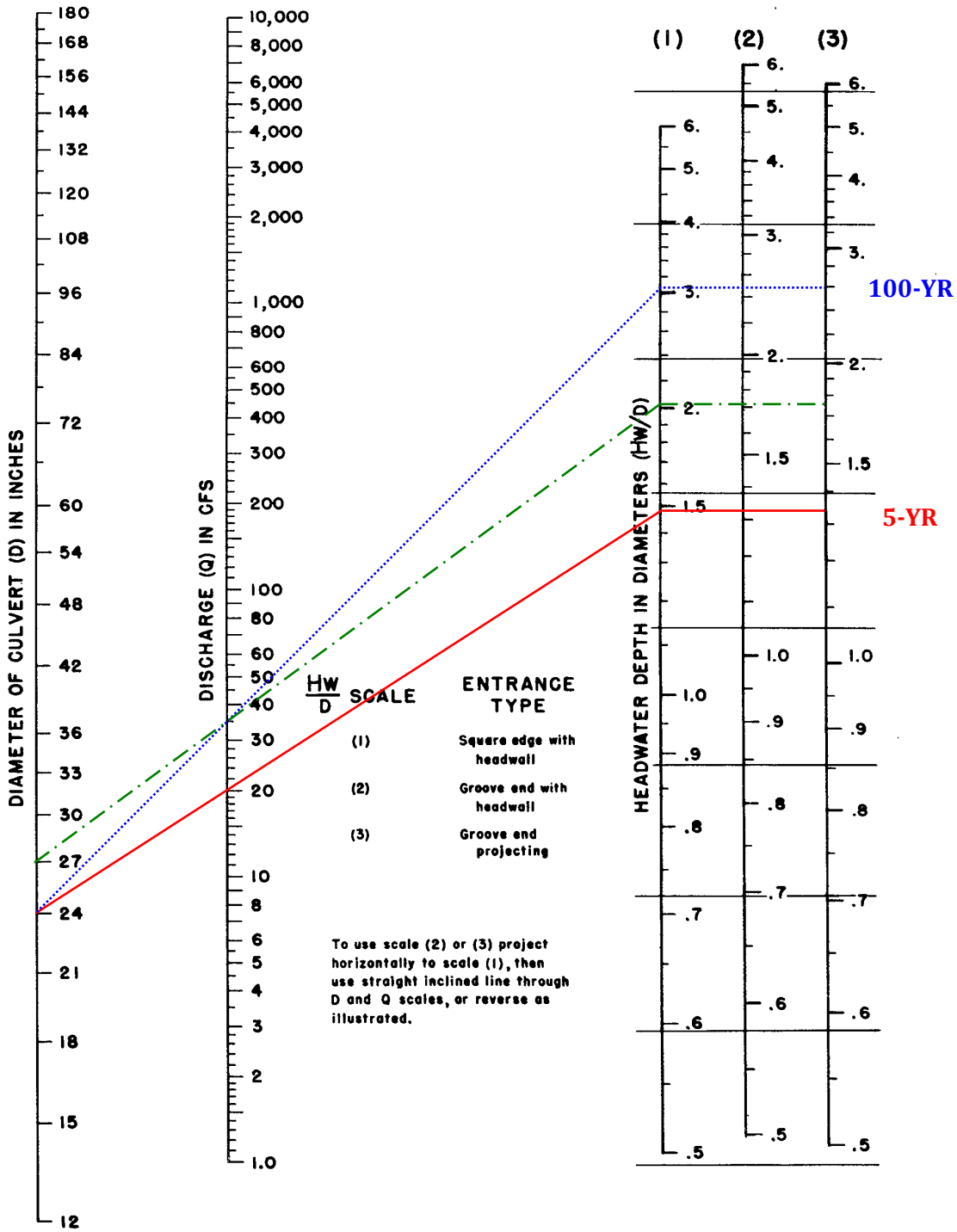


Figure 28. Headwater Depth for Concrete Pipe Culverts with Inlet Control (Example 6.1)

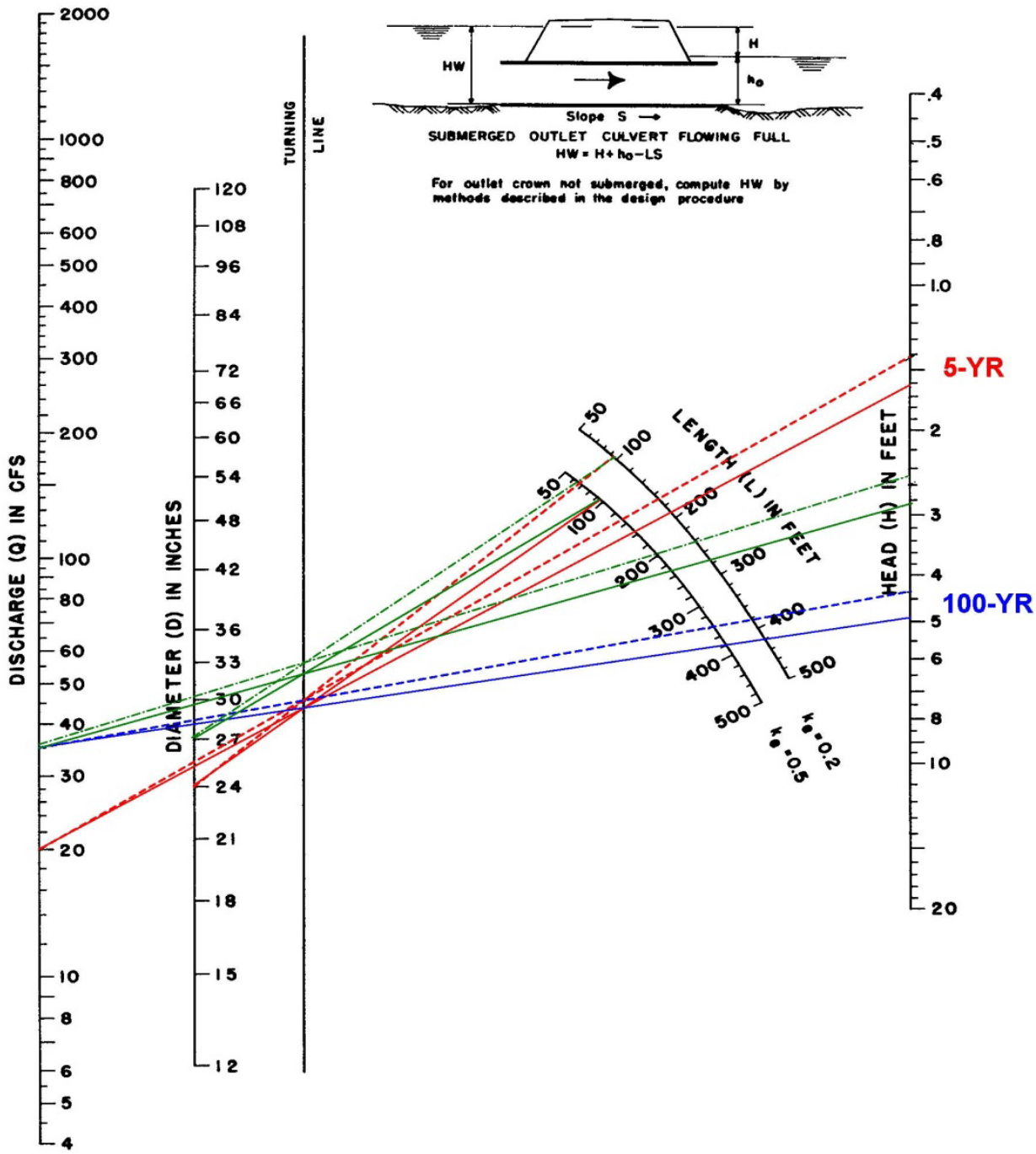
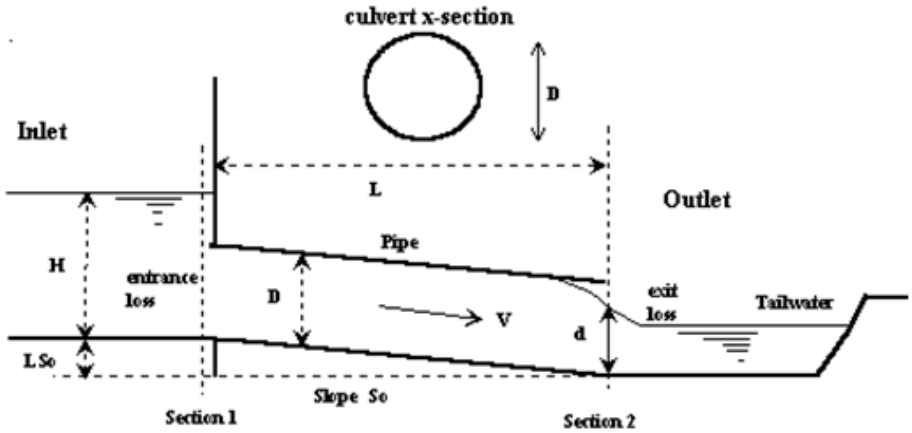


Figure 29. Head for Concrete Pipes Flowing Full (Example 6.1)

Headwater Depth For Circular Culvert

Project: Springfield Drainage Crteria Manual
Pipe ID: Example



Design Information (input)

Design Discharge	Q =	20.0	cfs
Pipe Diameter	D =	24.00	inches
Inlet Edge Type (choose from pull-down list)	Inlet Type =	Square End with Headwall	Square End
Inlet Invert Elevation	I_e =	83.50	ft
Outlet Invert Elevation	O_e =	81.50	ft
Pipe Length	L =	95.0	ft
Manning's Roughness n-value	n =	0.012	
Bend Loss Coefficient	K_b =	0.00	
Exit Loss Coefficient	K_x =	0.00	
Tailwater Water Surface Elevation	El. Y_t =	84.00	ft

Calculations (output)

Pipe Cross Sectional Area	A_o =	3.14	sq ft
Culvert Slope	S_o =	0.0211	ft/ft
Normal Flow Depth	Y_n =	1.07	ft
Critical Flow Depth	Y_c =	1.61	ft
Headwater Depth by Inlet Control			
Headwater Depth by Inlet Control	HW-inlet=	2.92	ft
Headwater Depth by Outlet Control			
Tailwater Depth for Design	d =	2.50	ft
Friction Loss Coefficient over Culvert Length	K_f =	1.00	
Sum of All Loss Coefficients	K_s =	1.50	
Headwater Depth by Outlet Control	HW-outlet=	2.07	ft
Design Headwater Depth	HW=	2.92	ft
HW/D Ratio =	HW/D=	1.46	

Figure 30. Example Problem Using Design Spreadsheet - Head for Concrete Pipe Culverts Flowing Full (n = 0.012)

8.0 Checklist

Criterion/Requirement	✓
Culvert diameter should be at least 18 inches.	
HW/D ratio should not exceed 1.5 unless justified and adequate measures are implemented to protect embankment.	
Evaluate the effects of the proposed culvert on upstream and downstream water surface elevations.	
When retrofitting or replacing a culvert, evaluate the changes in the upstream and downstream flood hazard.	
Review any proposed changes with local, state, and federal regulators.	
When a culvert is sized such that the overlying roadway overtops during large storms, check the depth of cross flow with the Streets, Inlets and Storm Drains chapter.	
Provide adequate outlet protection in accordance with Section 5.0 of this chapter.	

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Chapter 8 Open Channels

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1.0 Overview

Natural and engineered open drainage channels are generally the primary component of the modern major conveyance system. The use of open systems and their integration into the existing topography is strongly preferred to the use of closed or lined systems, and early planning is necessary to accomplish this objective. When present, natural channels are the preferred system for managing stormwater. In areas of new development and infrastructure improvements, a channel is regarded as natural if it has the capacity to adjust either its bed or banks in response to changes in flow or sediment load. In areas being redeveloped, streams that have been previously disturbed are considered natural if they possess a free boundary capable of adjusting to changes in flow. Often, hydromodification in the watershed necessitates an engineered naturalized channel where contact with soil and vegetation occurs but the ability of the stream to meander is limited.

This chapter provides an overview of the open channel planning and design process, including the initial submittal and permitting steps, types of open channel design options, design principles, design criteria for both natural and engineered channels, and design steps for different hydraulic structures. Small grade control structures are addressed in a separate section at the end of the chapter. Design illustrations are presented at the end of the chapter along with examples to demonstrate the design process. The SF-Channels Spreadsheet can be used to aid design of open channels and is used in the examples in this chapter.

1.1 Open Systems Requirements

One of the principles of sound urban stormwater management is the practice of preserving floodplains and natural channels associated with major waterways. In situations where it is not feasible to utilize the natural system of channels and floodplains, it is preferable for engineered systems to be open and vegetated where possible, rather than enclosed or concrete-lined. The community benefits of this policy include:

- Improved downstream flood protection due to preservation of naturally occurring floodplain storage, soil and plant absorption, and reduced velocities
- Protection of upstream reaches from accelerated erosion caused by actions in adjacent reaches
- Enhanced water quality
- Improved public safety
- Generally lower construction cost than hard improvements
- More aesthetic value to neighborhood and community
- More open space
- Recreational opportunities for neighborhood and community
- Improved habitat and biodiversity
- Lower long-term maintenance costs
- Generally enhanced flood control that exceeds design storm requirements due to wide and shallow geometry

When planning for open channels to serve a development, many important factors must be considered, such as:

- Public safety
- Permitting
- Cost, including capital expenses, operations, maintenance, and replacement
- Right-of-way, access, and existing utilities
- Protection of existing natural channels and their riparian corridors
- The engineered channel and drainage easement for the design storm under full watershed development conditions and maximum potential peak flow.
- Sediment budgets, including conditions with upstream construction activity and providing for sediment transport competency.[1]
- Watershed or development master plans.
- Existing or anticipated stream instabilities or meandering, particularly at the interface between natural and engineered channels.
- Appearance.
- Integration into community, including impact on property values.

Photo 1. A well planned major drainageway provides biological diversity, recreational opportunities, and aesthetic benefits in addition to flood conveyance.

See Chapter 3, Section 2, Drainage Planning Principles, for additional information. Photograph 1 shows a well-planned waterway within a development.

1.2 Submittal Requirements

Detailed open channel plan submittal requirements and design submittal checklists are provided in Chapter 4, Plan Submittal. In summary, submittals must include detailed drawings, background calculations, and supporting information, including:

- Detailed plan and profile at the appropriate scale (profile shall include flow line and the top of each bank or channel wall).
- Water surface profiles (25- and 100-year).
- All design flow rates.
- All design velocities.
- Channel lining details, including seed and plant selection for vegetated channels.
- Buffer delineation.
- For natural channels, the completed geomorphic exhibit and channel stability matrix.

[1] Sediment transport competency – the ability of the channel to carry the sediment delivered to it without degrading or aggrading the channel bed

- Evidence that relevant federal and state permits have been obtained and associated requirements have been met.

Water surface profiles shall be calculated using open channel methods discussed in this chapter and backwater calculation methods found in Chapter 7, Bridges and Culverts.

1.3 Permits

Construction in or adjacent to a waterway may require several federal, state, and local permits. See Chapter 3, Section 2.6, Required Permits, for more information. Altering any waterbody or waterway, either wet or dry, requires contact with the U.S. Army Corps of Engineers (USACE) to determine if the waterbody or waterway is jurisdictional under Section 404 of the Clean Water Act. In addition, a Section 401 permit may be required from the Missouri Department of Natural Resources (MDNR). All correspondence with the USACE and MDNR, jurisdictional determinations, required permits, and supporting documentation must be submitted to the City.

All planned construction within a floodplain as shown on the Federal Emergency Management Agency (FEMA) Flood Hazard Maps requires a Floodplain Development Permit from the City. Additional permits may be required from FEMA and any and all correspondence, required permits, and supporting documentation must be submitted to the City.

1.4 Maintenance

All major drainageways and open channels shall be designed to allow regular maintenance. The designer shall consider access requirements for equipment necessary to maintain or replace walls, boulders, concrete mats, gabions, turf reinforcement mats (TRMs), etc. The responsible party must be financially and technically capable of providing long-term maintenance of facilities, including those that utilize concrete, grass, or other bioengineered configuration. Additional information regarding maintenance can be found in Chapter 12, Easements and Maintenance.

1.5 Safety

Public safety shall be the paramount consideration when designing open channel systems. Representative issues that must be considered include channel configurations that limit the risk of a fall into the channel and channel hydraulic designs that minimize the risk of hazardous conditions, such as high velocities and “reverse rollers” that can entrap a person downstream from a low head dam. All vertical walls greater than 3 feet in height shall have a safety fence or handrail if the wall is located where the public may be in close proximity. Warning signs may be necessary in areas with high risk. Channels that do not have vertical walls shall be designed with side slopes of 3H:1V or flatter to allow for safe exit from the channel. In cases where this is not feasible, riprap slopes may have a slope of 2H:1V. All slopes that are to be maintained by motorized mowers shall be graded to 3H:1V or flatter. Slopes of 4H:1V or flatter are preferred for safety and aesthetic reasons.

2.0 Types of Open Channels

This manual addresses two basic channel types: natural and engineered. Natural channels are drainageways initially formed by nature and are capable of adjusting their bed and banks in response to changes in flows or sediment delivery. Engineered channels, in contrast, do not adjust to changing conditions in the same manner as natural channels. Types of engineered channels include, in order of preference: naturalized, vegetated, channels with manufactured linings, riprap-lined, and concrete-lined. Engineered channels can take various forms such as single-stage, two-stage, and channels with composite materials. The most commonly used engineered channel types are addressed in Section 2.2, and different channel forms are discussed in Section 2.3. Standard design details can be found at the end of this chapter. Prior to choosing channel types in new developments, the designer shall consult with the City regarding master plans, regulations, and other constraints to assist in a sound and acceptable design. This is imperative so that preliminary layouts and space allocations will be adequate for drainage.

2.1 Natural Channels

Natural channels, as implied, are drainageways formed by nature. These channels exist in a state of dynamic equilibrium and have the inherent ability to adjust their bed or banks in response to changes in flow or sediment load. Natural channels also exist in constant interaction with their bordering vegetation. It is the ability of natural channels to self-manage that distinguishes natural channels from engineered channels and requires distinctly different management criteria. The ability to self-form and self-manage renders natural channels as the most efficient type of drainageway.

Photo 2. Stable natural channel with riparian buffer.

The general rule for development near natural drainageways is to adhere to the following principles, in order of preference:

- Avoidance.
- Minimize impacts.
- Mitigate impacts.

Generally, the importance of drainageway protection increases with the size of the watershed. Avoidance along drainageways with a watershed area greater than one square mile is critical to water resource protection and should be followed with little exception. Where the contributing watershed area is less than one square mile there may exist more flexibility in protection and where there exists smaller watershed areas of less than 40 acres, protection is encouraged but not required. See Section 4.0 of this chapter for more information regarding the protection of natural channels. It is difficult, if not impossible, to replicate all natural channel attributes in an artificial channel. For this reason, it is usually preferable to leave natural channels and adjacent riparian vegetation intact whenever feasible. An exception may be granted for pre-existing conditions where meander would damage existing facilities or the watershed has experienced hydromodification such that the

natural channel is no longer stable and requires engineered channel stabilization. Specific design criteria and guidelines for natural channels are provided in Section 4.0.

2.2 Engineered Channels

Where an engineered channel is the preferred option, the choice of channel type and alignment must consider a variety of multi-disciplinary factors, including:

- The influence of channel alterations on the stability and ecological integrity of the adjacent unaltered reaches
- Hydraulic considerations such as existing and future design flows and velocities, channel slope, available right-of-way, site topography, upstream and downstream conditions, and basin sediment yield
- Structural considerations such as seepage and uplift forces, anticipated shear stresses, and adjacent loads, such as buildings
- Environmental considerations such as municipal, county, state, or federal requirements, riparian zones, adjacent environmental hazards, existing perennial streams and wetlands, existing habitat, and wildlife and watershed objectives
- Sociological considerations such as neighborhood character, street and traffic patterns, neighborhood social issues, public safety, pedestrian and bicycle traffic, recreational needs, and right-of-way corridor needs
- Practical considerations such as cost, availability of material, and areas for wasting fill.
- Maintenance considerations such as life expectancy, repair and reconstruction needs, regular maintenance needs, proven performance, accessibility, and regulatory constraints to maintenance

Photo 3. Naturalized waterways using grade control structures provide long-term structural integrity and diverse ecology.

The primary engineered channel types are described below in Sections 2.2.1 through 2.2.6. Specific design criteria and guidelines for engineered channels are provided in Section 5.0.

2.2.1 Naturalized Channels

Naturalized channels are previously manipulated channels that are restored to some degree of natural form, process, and function. Naturalized channels are not completely natural. Stream restoration, reclamation, and rehabilitation are all terms commonly used to describe the process of naturalizing a channel. In disturbed urban systems, complete restoration is not achievable; however, many of the physical processes associated with natural flows of water and sediment can be approximated and the ecological functions improved compared to purely artificial channels.

Naturalized channels provide channel storage, protect and restore the surface-groundwater connection, slow velocities, and provide various multiple-use benefits, including wildlife habitat

and aesthetic values. Continuity of sediment transport, control of applied shear stress through channel geometry and hydraulic roughness, and use of natural materials are characteristics of naturalized channels. In naturalized channels, high shear stresses are commonly managed by energy dissipation features, such as riffles and pools, rather than using artificial channel linings. Proper selection of plant materials is critical for channel performance. The design of naturalized channels is a multidisciplinary exercise requiring expertise in fluvial geomorphology, aquatic biology, ecology, and other life sciences, as well as civil engineering. These designs are complex and site specific and, therefore, detailed design standards are not covered in this manual. Design teams with the necessary training and experience are encouraged to develop naturalized channels in situations where natural channels do not exist or cannot be preserved.

2.2.2 Vegetated Channels

Vegetated channels lined with turf grass or native plants are traditional engineered channels with a vegetative lining. These channels are distinct from naturalized channels although both incorporate vegetated linings. Geomorphic principles of river process and function, as well as most life sciences, play a much smaller role in the design of vegetated channels than in naturalized channels. Vegetated channels can provide channel storage, reduced velocities and shear stresses, aesthetically pleasing open spaces, and various multiple-use benefits. Vegetated channels in urbanizing watersheds may require grade control structures to reduce velocities and prevent degradation of the vegetative liner. Low-flow areas may need to be armored or otherwise stabilized to prevent erosion.

More stable and attractive facilities are typically achieved when sod or plant plugs are used rather than seed and mulch, particularly in the lower part of the channel that is inundated more often. The choice of vegetation is dependent on the frequency, depth and duration of inundation, as well as water quality, habitat, and aesthetic considerations. Some settings require a highly groomed, manicured look where turf grass is desirable. However, traditional turf is energy intensive and requires frequent mowing, irrigation, and fertilizing, which may adversely affect water quality. Alternative turf types such as low-maintenance fescue or buffalo grass provide the benefits of conventional turf with less maintenance. When the channel bed is likely to be inundated for more than 12 to 24 hours during frequent rain events, the designer should consider inundation-tolerant sedges and rushes for the bed and grasses for the slopes.

Where a manicured appearance is less of a requirement, the channel vegetation can include a more diverse selection of native plants including trees, forbs, grasses, and small shrubs. In all cases, the hydraulic roughness of the lining is an important part of the design. Although certain types of vegetation, such as shrubs, increase roughness and reduce channel capacity more than other types, designers are encouraged to account for the higher roughness and use it as a design element. For example, increased hydraulic roughness can be designed to direct scouring flows away from the toe of a slope and toward the channel centerline to reduce the risk of erosion. The roughness of the vegetation throughout its life cycle must be considered as well as the influence of roughness on channel capacity. In addition to stabilizing the channel, a diverse plant palette of native vegetation provides water quality benefits, desirable habitat, and aesthetic benefits.

Photo 4. Engineered grass-lined drainageway with rock-lined, low-flow channel, natural components and community recreation uses.

Photo 5. A large drainageway with a reinforced sod channel lining to maintain stability and enhance water quality.

Photo 6. A steep, small grass-lined channel in a residential area reinforced by a TRM to maintain stability.

2.2.3 Channels with Manufactured Liners

Conditions may exist where a vegetated channel is desirable, but flows and velocities exceed the allowable conditions for a vegetated channel without reinforcement. The designer should consider reducing the applied stress by increasing hydraulic roughness in the channel, including energy dissipation structures, or adjusting channel geometry, as well as lining materials. Often, by applying these measures, the applied stress can be reduced to a degree that significantly reduces or eliminates the need for channel lining.

When flow conditions still exceed allowable conditions for vegetated channels, a manufactured liner may be appropriate. It may only be necessary to use these liners in the channel bed and lower banks. Liners can provide some of the benefits of vegetated channels, while remaining stable under high velocity conditions. Representative liner types include gabions, interlocked concrete blocks, concrete revetment, mats, modular blocks, reinforced sod, and various types of permanent TRMs. These liners are often proprietary, and new products are continually being introduced. Each type

of channel lining must be scrutinized for its merits, applicability, ability to meet other community needs, long-term integrity, maintenance needs, and costs. Specific design criteria for manufactured liners are provided in Section 5.7.

When considering gabions, it is especially important to evaluate the right-of-way constraints and costs of replacement. If there is a possibility that the bed could degrade, gabions shall not be used to line channel banks because of the high risk of gabion collapse, rupture, or toppling.

2.2.4 Riprap-lined Channels

Riprap-lined channels can offer a compromise between vegetated channels and concrete-lined channels in terms of capacity, design velocities, cost of construction, and environmental impact. However, riprap-lined channels shall be used only when it can be shown that a naturalized or vegetated channel is not feasible.

Riprap may be appropriate in short channel sections with a very steep slope, or as an energy dissipater or spreader at outfalls. Riprap may also be useful along sections of channels susceptible to erosion, such as outer banks of bends where applied stresses preclude the use of other materials. Other applications for riprap may be at transitions in geometry where turbulence may occur.

Photo 7. A small channel stabilized with riprap and vegetation.

Riprap must be carefully designed to ensure it will not fail or induce a failure in an adjacent unarmored section. As with all engineered channels, the interface between reaches of differing hardness and hydraulic roughness must be accounted for in channel design.

Injecting grout into the voids of large riprap or filling the voids with soil and plantings to create a composite matrix is often desirable. Unless the riprap is more than 2.5 feet thick, it is practical and inexpensive to vegetate the toe of the bank with live stakes[2] of willow, some dogwood species, and buttonbush. The vegetation helps stabilize the riprap and improves the aesthetics, habitat, and water quality of the channel.

Many factors govern the size of rock necessary to resist the forces tending to move the riprap. For the riprap itself, this includes the size, weight, and shape of the individual rocks, gradation of the stones, blanket thickness, type of bedding under the riprap, and slope of the riprap layer. Hydraulic factors affecting riprap include the water velocity, current direction, eddy action, waves, and hydraulic uplift forces. Refer to Section 5.7.4 for more information regarding riprap design details. Riprap failures result from a wide variety of factors including, but not limited to: undersized

[2] Live stake – a woody cutting of a plant capable of developing roots and shoots directly from the cutting. Live stakes are typically 3 to 4 feet long and ½ to 1 ½ inches in diameter. Stakes are driven into the soil or soil/rock matrix at least ¾ of their length and must be installed while dormant

individual rocks in the maximum size range; improper gradation of the rock, which reduces interlocking of individual particles; lack of rock angularity; toe scour that undermines the riprap; non-uniform placement of riprap with windows of undersized or gap-graded rock; flat and elongated rocks that do not interlock; settlement of sub-grade; geotechnical failures; ice and debris impacts; failure of filter fabric resulting from poor installation; failure to consider stress concentrators, such as curvature and contraction of the channel; and improper bedding for the riprap, which allows leaching of channel particles through the riprap blanket.

2.2.5 Grouted Boulder Channels

If properly designed and constructed, a grouted boulder channel can provide the appearance of a natural channel with rock outcroppings and can be an aesthetically pleasing option to concrete and riprap channels. Grouted boulder channels are particularly useful for lining low-flow channels and steep banks.

Photo 8. Grouted boulder channel and drop structures.

Grouted boulders provide a relatively impervious channel lining which is less subject to vandalism than ordinary riprap and which requires less routine maintenance because of reduced silt and trash accumulation. The appearance of grouted boulders is enhanced by exposing the tops of individual stones and by cleaning the projecting rocks with a wet broom immediately after the grouting operation. It is also recommended that grouted boulders on channel banks and outside of frequent flow areas be at least partly buried with topsoil and revegetated. Boulders used for riprap shall meet all the properties of rock for ordinary riprap, and rock of uniform size shall be used. Rock properties are discussed in Section 5.7.4, Rock Sizing.

2.2.6 Concrete-lined Channels

Concrete-lined channels are generally discouraged compared to more natural solutions, although in some circumstances they may represent the best solution when considering all factors. Photo OC-10 shows an example of a retrofit project where a decorative retaining wall channel was used due to the close proximity to the street and mature trees, and the desires of the homeowners wanting a manicured look with low regular maintenance. These designs may include concerns such as public safety, aesthetics, long-term replacement cost and downstream impacts on habitat and water quality. **In new developments, concrete channels will not be permitted unless it is shown that channel options utilizing more natural materials are not feasible.** In general, proper planning will avoid the need for concrete-lined channels, though in certain circumstances they may be necessary. Examples of concrete-lined channels are shown in Photograph 9 and Photograph 10.

Photo 10. Trapezoidal concrete channel.

Photo 9. Rectangular channel constructed of concrete and modular blocks.

Conditions that may justify the use of concrete channels include hydraulic, topographic, or right-of-way constraints. A common hydraulic constraint requiring a concrete-lined channel is the need to convey high velocity flows within a restricted area. When a concrete lining is necessary, it must be designed to withstand the various forces and actions that can cause damage to the lining. If supercritical flow will exist, the channel must be lined with continuously reinforced concrete. More aesthetic alternatives to plain concrete should also be considered, such as modular block walls, stamped concrete, or a natural stone facing over a reinforced concrete wall. In addition to these considerations, the designer is also responsible for managing the interface with the upstream and downstream channels to prevent erosion and channel degradation.

2.3 Channel Forms

In contrast to the discussions of specific channel types in Sections 2.2.1 through 2.2.6, this section addresses the broader issues of different channel cross-section forms and the application of different channel linings within the cross-section.

2.3.1 Two-Stage Channels

Many natural channels maintain a two-stage cross-section, particularly at meanders. A two-stage cross-section is an efficient way to manage energy and prevent rapid or excessive channel adjustment. Typically, the lower stage conveys the base flow up to a discharge rate referred to as the channel-forming or bank-full discharge flow. The channel-forming flow has the greatest influence on channel size and shape over time. In undisturbed settings, this flow generally corresponds to the 1.5- to 2-year recurrence interval. At this stage, natural channels often form an internal floodplain to reduce stress associated with higher flows (see Figure 1). Internal floodplains are depositional features in a natural channel.

In disturbed urban systems with poor hydrologic control, the channel-forming discharge may occur many times in a year. The drastically increased frequency of the channel-forming flow is a major reason for the poor condition of many urban channels.

Designers of engineered channels may use the two-stage approach as well. The lower channel shall be sized to accommodate the channel-forming flow, while the larger channel may be sized to accommodate the desired design flow. Note that it is counterproductive to increase the dimensions

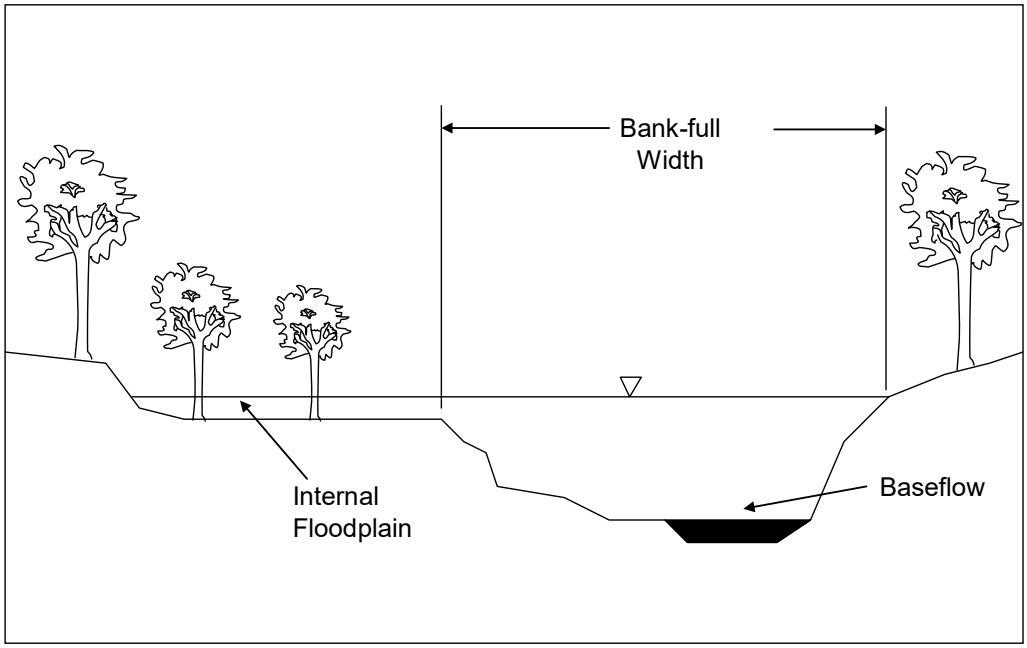


Figure 1. Cross-section of a two-stage channel with floodplain internal to the main channel.

of the low-flow channel in an attempt to increase channel capacity. When the low-flow channel is over-widened, the hydraulic slope effectively increases and the shear stress applied to the channel increases commensurately. Incision, or downcutting of the bed, then advances upstream, which liberates sediment to be deposited in the over-widened reach. When the over-widening is associated with a culvert or bridge, the sediment commonly deposits and consolidates in or immediately upstream of the culvert or bridge bay and reduces the capacity. Attempts to "maintain" the capacity by periodic sediment removal simply induce a new wave of incision and deposition.

Similarly, where an engineered channel will interface with a natural channel, it is extremely important to avoid over-widening the low-flow channel. By setting a channel width greater than the natural low-flow width, the designer may induce a draw-down curve upstream and induce incision or bank scour in the upstream channel. In addition to damage being caused to the upstream reach, liberated sediment will be deposited in the over-widened area downstream and may decrease needed flood capacity. Guidance on sizing a low-flow channel is provided in Section 5.9.

It is important to note that many two-stage channels do not maintain a two-stage cross-section throughout their length. Typically, the internal floodplain occurs at the inside of a meander and may decrease or disappear altogether in straight runs or transition points. Internal floodplains rarely occur on the outside of meanders.

Some geologically young channels, highly disturbed urban channels, or those dominated by gravel or bedrock may not form two-stage channels. If interfacing with a natural single-stage channel, it is reasonable to design a single-stage engineered channel, provided that the base width does not exceed that of the natural channel.

2.3.2 Composite Channels

Channel linings and cross-sections can, and often should, vary throughout a channel. The designer has the flexibility to use different materials and cross-sections as appropriate. For example, unless a vegetated channel experiences only brief inundation, the bed vegetation should be different from that on the bank. The designer is encouraged to optimize the benefits of vegetation in concert with other structural armor. By using vegetation as a structural material, dissipating energy at controlled points, and designing cross-sections to reduce stresses on the bed and banks, the designer can reduce, though rarely eliminate, the need for hard armor in the channel.

A composite channel under construction using articulated concrete blocks, TRM, sod, and seed/mulch is shown in Photograph 11. The same channel after being completed is shown in Photographs 12 and 13.

Photo 11. A large, retrofitted urban composite channel using articulated concrete blocks, TRM, sod, and seed/mulch during construction.

Photo 12. Urban composite channel from Photograph 11, shortly after construction.

Photo 11. Same location after 3 years of growth.

3.0 Open Channel Design Principles

Standard open channel analysis and design is based on fundamental assumptions of flow types and flow regimes. A brief discussion of these assumptions is provided to assist the designer in determining whether actual site conditions conform to these fundamental assumptions. Designs shall be completed by qualified professionals familiar with open channel hydraulics.

3.1 Types of Flow

Open channel flow is commonly characterized according to variability with respect to time and space using the following terms:

- Steady flow—conditions at any point in a stream remain constant with respect to time (Daugherty and Franzini 1977).
- Unsteady flow—flow conditions (e.g., depth) vary with time.
- Uniform flow—the magnitude and direction of velocity in a stream are the same at all points in the stream at a given time (Daugherty and Franzini 1977). If a channel is uniform and resistance and gravity forces are in exact balance, the water surface will be parallel to the bottom of the channel for uniform flow.
- Varied flow—discharge, depth, or other characteristics of the flow change along the course of the stream. For a steady flow condition, flow is termed rapidly varied if these characteristics change over a short distance. If characteristics change over a longer stretch of the channel for steady flow conditions, flow is termed gradually varied.

For the purposes of open channel design, flow is usually considered steady and uniform. For a channel with a given roughness, discharge, and slope, there is only one possible depth for maintaining a uniform flow. This depth is the normal depth. When roughness, depth, and slope are known at a channel section, there can only be one discharge for maintaining a uniform flow through the section. This discharge is the normal discharge.

3.2 Manning's Equation

Manning's equation describes the relationship between channel geometry, slope, roughness, and discharge for uniform flow:

$$Q = \frac{1.49}{n} A R^{2/3} S^{1/2} \qquad \text{(Equation 1)}$$

In which:

Q = discharge (cubic feet per second [cfs])

n = Manning's roughness coefficient

A = area of channel cross-section (ft2)

R = hydraulic radius (ft) = Area/Wetted Perimeter

S = channel bottom slope (ft/ft)

Manning's equation can also be expressed in terms of velocity by employing the continuity equation, $Q = VA$, as a substitution in Equation 1, where V is velocity (feet per second [ft/s]).

At channel bends, velocity will increase on the outside of the bend, increasing the risk for erosion. Higher design velocities at these locations may require an increase in the level of protection. The following equation shall be used to estimate velocity on the outside of bends when the channel centerline radius, r_c, divided by the water top width, T, is less than 8.0. When $r_c/T \geq 8.0$, no adjustment is needed.

$$V_a = (-0.147\frac{r_c}{T} + 2.176)V \qquad \text{(Equation 2)}$$

In which:

V_a = adjusted channel velocity along the outside of channel bends (ft/s)

V = mean channel velocity (ft/s)

r_c = channel centerline radius (feet)

T = Top width of water (feet)

Commercial software is commonly available to aid in the solution of Manning's equation to find flow capacity, velocity, and normal depth. The Normal and Critical Flow Analysis Worksheet in the SF-Channels Spreadsheet can be used to perform normal flow calculations. Example 1, provided at the end of this chapter, illustrates application of the Normal and Critical Flow Analysis Worksheet for calculation of normal depth for a trapezoidal channel.

It is imperative that the designer understand the limitations of Manning's equation and the assumption of uniform flow. When flow conditions in a channel are not characterized by uniform flow, Manning's equation is not appropriate for approximating flow conditions. Depending on the conditions, a culvert analysis or backwater calculation routine (using a program such as HEC-RAS or other method) may be necessary to accurately estimate flow conditions.

3.3 Manning's Roughness Coefficients

When applying Manning's equation, the choice of the Manning's roughness coefficient, n, is the most subjective parameter. Table 1 provides allowable maximum and minimum Manning's roughness coefficients to use for channel design.

The minimum roughness coefficient shall be used for channel design to check for sufficient channel lining stability (velocity check) and the maximum roughness coefficient shall be used to check for hydraulic capacity and to check the minimum velocity to prevent the occurrence of standing water (flow rate check). Refer to Section 5.1, Flow Rate; Section 5.2, Flow Regime; and Section 5.3, Velocity, for additional information on these topics. Average roughness coefficient values shall be used for broader applications, such as watershed modeling.

Table 1. Typical Manning's Roughness Coefficient (n) Values for Open Channels.

Channel Lining	Minimum	Average	Maximum
Earthen	0.020	0.025	0.030
Mowed grass	0.025	0.030	0.035
Grass-not mowed	0.030	0.035	0.040
Grass with brush/trees	0.040	0.050	0.060
Cobble bottom, grass/root side	0.030	0.040	0.050
Concrete-smooth	0.012	0.013	0.015
Concrete-rough	0.015	0.017	0.020
Riprap d_{50} 6 inches	0.032	0.035	0.038
Riprap d_{50} 9 inches	0.035	0.038	0.040
Riprap d_{50} 12 inches	0.038	0.040	0.042
Riprap d_{50} 18 inches	0.040	0.042	0.044
Riprap d_{50} 24 inches	0.042	0.044	0.047
Grouted boulders	0.025	0.032	0.040

Notes:

Values for average riprap roughness are based on Strickler Formula (USACE 1994).

Reference website:
http://www.publications.usace.army.mil/Portals/76/Publications/EngineerManuals/EM_1110-2-1601.pdf

Strickler Formula does not apply to grouted boulders.

Roughness coefficient values listed above do not apply to very shallow flow (where hydraulic radius will be less than or equal to 2 times the maximum rock size) where the roughness coefficient will be greater than indicated above.

Roughness coefficient values for natural channels are from Mays (2001).

For natural channels with floodplains and composite channels with multiple linings, Manning's roughness coefficient, n, is best estimated by the following equation:

$$n_c = \frac{n_L A_L^{5/3} / P_L^{2/3} + n_R A_R^{5/3} / P_R^{2/3} + n_M A_M^{5/3} / P_M^{2/3}}{A_L^{5/3} / P_L^{2/3} + A_R^{5/3} / P_R^{2/3} + A_M^{5/3} / P_M^{2/3}} \qquad \text{(Equation 3)}$$

In which:

n_c = Manning's n for the composite channel

n_L = Manning's n for the left overbank

n_R = Manning's n for the right overbank

n_M = Manning's n for the middle area (low flow)

A_L = Area of the left overbank

A_R = Area of the right overbank

A_M = Area of the middle area

P_L = Wetted perimeter of the left overbank

P_R = Wetted perimeter of the right overbank

P_M = Wetted perimeter of the middle area

This method of computing a composite roughness factor may be applied to all natural and engineered channels, including two-stage channels and channels with varying cross-sections and materials. The Analysis of Composite Channel Worksheet from the SF-Channels Spreadsheet may be used to calculate minimum and maximum values of Manning's n for a composite channel. Example 2, provided at the end of this chapter, illustrates application of the Analysis of Composite Channel Worksheet.

3.4 Froude Number and Flow Regime

Another important characteristic of open channel flow is the state of the flow, often referred to as the flow regime. Flow regime is determined by the balance of the effects of viscosity and gravity relative to the inertia of the flow. The Froude number, F_r, is a dimensionless number that is the ratio of inertial forces to gravitational forces that defines the flow regime. Flow regimes are characterized as critical, subcritical, or supercritical, based on Froude number, calculated as follows:

$$F_r = \frac{V}{\sqrt{gd}} \qquad \text{(Equation 4)}$$

In which:

F_r = Froude Number

V = mean velocity (ft/s)

g = acceleration of gravity = 32.2 ft/s^2

d = hydraulic depth (ft) = A/T, cross-sectional area of water/ top width of free surface

3.4.1 Critical Flow

Critical flow is defined as flow with F_r = 1.0. Flows with F_r near 1.0 are considered unstable and are likely to tend toward phenomena such as hydraulic jumps and standing waves, which are both highly turbulent and lead to a higher risk of erosion or structural failure. Designs that result in F_r near 1.0 (> 0.8 and < 1.2) shall be avoided by adjusting the design of the cross-section, roughness, and slope.

Critical velocity, V_c, can be calculated from the critical hydraulic depth, d_c. For a rectangular channel, the critical flow depth is equal to the critical hydraulic depth ($y_c = d_c$), and the critical flow velocity is:

$$V_c = \sqrt{gy_c}$$ (Equation 5)

In which:

V_c = critical velocity (ft/s)

g = acceleration of gravity = 32.2 ft/s^2

y_c = critical flow depth

In addition, the Normal and Critical Flow Analysis Worksheet from the SF-Channels Spreadsheet can be used to perform critical depth calculations.

3.4.2 Subcritical Flow

Subcritical flow is defined as flow with F_r < 1.0. These flows have the following characteristics relative to critical flows:

- Flow velocity is lower
- Flow depth is greater
- Hydraulic losses are lower
- Erosive power is less
- Behavior is easily described by relatively simple mathematical equations
- Surface waves can propagate upstream

Most stable natural channels have subcritical flow regimes. Consistent with the philosophy that the most successful artificial channels utilize characteristics of stable natural channels, major drainage design shall seek to create channels with subcritical flow regimes.

3.4.3 Supercritical Flow

Supercritical flow is defined as flow with F_r > 1.0. Supercritical flows shall be avoided wherever possible and have the following characteristics relative to critical flows:

- Flow velocity is higher
- Flow depth is less
- Hydraulic losses are higher
- Erosive power is greater
- Surface waves propagate downstream only

In cases where supercritical flow cannot be avoided, concrete linings shall be utilized (refer to Section 2.2.6). The channel must be designed to safely dissipate energy so that the discharge to the downstream reach is in a non-erosive, sub-critical condition. The design of channels with supercritical flow conditions is addressed in the Analysis of Steep (Supercritical Flow) Channel Worksheet in the SF-Channels Spreadsheet.

4.0 Natural Channel Protection Criteria

This section sets forth requirements for the protection of natural channels as a conveyance for stormwater, an ecological asset, and an amenity for the community. General design guidelines for utility crossings, bridges and culverts, and discharge outfalls, as they relate to natural channels, are also included in this section. Refer to Section 6.0, Hydraulic Structures, for the design of large and/or complex in-stream hydraulic structures.

The benefits of natural stream protection and the rationale for these requirements are presented in Chapter 1, Stormwater Drainage Principles and Chapter 3, Stormwater Planning. Unless otherwise provided for by local, state, or federal ordinance, regulation, or standards, existing natural streams shall be preserved and protected in accordance with this section. This applies to both newly developing and existing urban areas, including channels that have noncontiguous physical or structural modifications. Exceptions to this requirement may include intensely urbanized stream reaches that are experiencing significant erosion, locations where existing structures are being compromised by channel degradation, or for other compelling circumstances. Where natural streams are not preserved, reference should also be made to Chapter 6, Streets, Inlets, and Storm Drains; Chapter 7, Culverts and Bridges; and Section 5.0 of this chapter, Engineered Channel Design Criteria.

4.1 Stream Buffer Requirements

Natural channels, as defined in Sections 1.0 and 2.1 of this chapter may be ephemeral, intermittent, or perennial streams. Ephemeral streams flow only for hours or days following rainfall. Intermittent streams are defined as those which normally cease flowing for weeks or months each year. Perennial streams have continuous flow in parts of its stream bed all year round during years of normal rainfall. Natural stream channels should be preserved as continuous systems and not segmented on a project-by-project basis because the frequent intermixing of natural and man-made systems tends to degrade the function of both. Stream buffers (also called riparian buffers) are vegetated areas along and adjacent to streams where clearing, grading, filling, building of structures, and other activities are limited or prohibited. Stream buffers act as the "right-of-way" for the stream, and protect and enhance water quality and stream health in two primary ways: (1) reducing the amount of pollutants entering the stream in stormwater runoff flowing overland through the vegetated buffer; and (2) preserving and enhancing stream channel stability, in-stream habitat, and the stream's natural ability to process pollutants in stream flow (Sweeney and Newbold, 2014). This second category of benefits is often overlooked but is equally, if not more important than the first category (Sweeney and Blaine, 2007). In addition to water quality and stream health benefits, urban stream buffers provide many other community benefits, as described by Schueler (2000), including:

- Effective flood control;
- Reduction in small drainage problems and complaints;
- Protection of nearby properties from lateral movement of stream channels and stream bank erosion;
- Increased property values;
- Linear, connected open space for greenway trails; and

- Preservation of wildlife habitat.

Stream buffers are important not only for perennial streams, but for ephemeral and intermittent tributary streams as well. These smaller tributary streams comprise a significant portion of the overall stream network and their physical condition and ability to process pollutants affects downstream water quality in perennial streams, rivers, and lakes. Effective buffer widths vary based on the size of the stream.

4.1.1 Applicability and Buffer Widths

The stream buffer requirements herein shall apply to streams shown on the Stream Buffer Map (see http://maps.springfieldmo.gov/mapgallery/) for all new applications for land disturbance permits, building permits requiring site plan review, floodplain development permits, public improvements, preliminary plats, subdivisions, and zoning cases with the exceptions of those streams that do not meet the definition of a natural channel as defined in Sections 1.0 and 2.1. For designation of required buffer widths, streams are categorized based on contributing drainage area. Table 2 provides the stream categories and corresponding required buffer widths. Where a discernible top of bank exists, the stream buffer shall be measured from the top of bank of the bankfull stage of the active channel. If there is no clear top of bank, then the stream buffer shall be measured from the thalweg. Buffer widths shall meet or exceed the distances specified in Table 2. No clearing, grading, filling, or structures are allowed in stream buffer zones other than as authorized in Sections 4.1.4 and 4.1.5 and in accordance with an approved stream buffer plan. Zoning flexibilities and mitigation options for alternative compliance to minimize adverse impacts on the development are provided in Sections 4.1.12 and 4.1.13. On developments where stream buffers are preserved and utilized as a vegetated filter strip for meeting the water quality requirements in Chapter 10 and an application for a fee in lieu of constructing stormwater detention (detention buyout) has been approved by the City, the City shall waive the fee for the detention buyout.

The engineer should consider additional buffer width for less stable channels or special conditions to address water quality and ecological needs. The widths specified in Table 2 provide only moderate allowance for widening or migration in channels of average stability. Geotechnical studies are recommended if there is a risk of slope failure due to the condition of underlying soil or rock materials. If necessary, the buffer width should be expanded to contain the potential zone of failure as recommended by a qualified engineer. Additional buffer widths or buffer width averaging to accommodate steep slopes, wetlands, karst features, trees or other natural vegetation is encouraged.

Table 2. Stream Buffer Width Requirements.

Contributing Drainage Area (Acres)	Stream Category	Buffer Width (feet) (Measured Separately on Each Side of Stream)	
		Streamside Zone	Outer Zone
Greater than 4 square miles	A – large stream	50	50
1 to 4 square miles	B – small stream	40	40
160 to 640 acres (1 square mile)	C – large tributary	25	25
40-160 acres	D – small tributary	15	15

Note: Total buffer width is the sum of the widths of the Streamside Zone and the Outer Zone. For example, a buffer width along a large stream (Category A) would be 100 feet on both sides of the stream (200 feet total). The buffer width is measured from the top of bank of the bankfull stage of the active channel, or the thalweg if no discernible top of bank exists.

4.1.2 Stream Buffer Plan

All applications subject to the stream buffer requirements herein shall submit a stream buffer plan for review and approval. The stream buffer plan shall be at a scale no smaller than 1 inch = 100 feet and contain a minimum of the following:

- Existing topography with 1-foot contour intervals;
- Field-delineated, marked, and surveyed stream showing the top of bank (or the thalweg if no discernible top of bank exists) and the required streamside zone and outer zone widths from Table 2;

If requesting alternative compliance for required stream buffers in accordance with Section 4.1.13, the stream buffer plan shall include the following additional information to facilitate review of the request:

- FEMA floodway and floodplain zones;
- Wetlands within or adjacent to the required stream buffer zones;
- Slopes in excess of 15% within or adjacent to the required stream buffer zones;
- Karst features within or adjacent to the required stream buffer zones;
- Location of trees, either individual trees or groupings of trees, delineating the edges of the overall canopy;
- Location of any proposed structures or activities in the required stream buffer zones, in accordance with Sections 4.1.4 and 4.1.5.
- Proposed adjusted buffer zone widths and mitigation measures;
- Location, size, and species of trees six inches or greater in diameter (measured 4.5 feet above ground) that will be removed due to alternative compliance.
- Location, size, and species of trees to be planted elsewhere on the site to replace the trees removed due to alternative compliance, in accordance with Section 4.1.6.

4.1.3 Ownership and Recording

Stream buffers consisting of the stream and approved buffer zones shall be designated as a Stream Buffer Area on any replat, preliminary plat, or final plat in accordance with City Code Sec. 36-253, or recorded in a stream buffer easement. Alternatively, stream buffers may be dedicated to the City with the City's acceptance. The owner of a stream buffer area may also wish to pursue a conservation easement, which may provide tax benefits. In accordance with Chapter 12, Section 3.1, stream buffers in new subdivisions shall be located within a Common Area that is owned and maintained by a property owners association. Stream Buffer Areas designated on a plat shall be accompanied by the following plat note:

"Stream Buffer Areas are dedicated for the protection of stormwater runoff quality, stream preservation, and flood control. The property owner may fully use and enjoy the land within the Stream Buffer Area provided that such use is in accordance with Chapter 96 of the Springfield City Code, as amended, and the *Flood Control and Water Quality Protection Manual*, as amended. Maintenance, repair, and restoration, if necessary, of the Stream Buffer Area is the responsibility of the property owner and shall be conducted in accordance with the *Flood Control and Water Quality Protection Manual."*

4.1.4 Streamside Zone

The structures, practices, and activities permitted in the Streamside Zone of the buffer are limited to the following:

- Stream crossings for roads, drives, trails or other pedestrian paths, and utilities;
- Utility corridors if no feasible alternative exists;
- Trail corridors that are designed to minimize stream buffer impacts;
- Stormwater discharge structures in accordance with City-approved stormwater plans only if discharge further upland is not feasible;
- Vegetation management to maintain or improve native vegetation, including:
    - Removal of diseased, dead, or hazard trees;
    - Tree pruning in accordance with accepted arborist practices;
    - Selective spraying or mechanical removal of noxious or invasive vegetation consistent with accepted best practices;
    - Vegetation planting and seeding to improve the density, species, and diversity of native vegetation;
- Removal of trash;
- Removal of accumulated debris to maintain stream flow conveyance;
- Water quality monitoring and stream gauging;
- City-approved stream bank stabilization measures; and
- Maintenance of City-approved improvements, including utilities.
- Fences

The above structures, practices, and activities shall be accomplished using methods that minimize soil disturbance, clearing of vegetation, and use of motorized equipment.

4.1.5 Outer Zone

The structures, practices and activities permitted in the Outer Zone of the buffer are limited to the following:

- All uses permitted in the streamside zone;
- Stormwater control measures in accordance with City-approved stormwater plans only if it is not feasible to locate them outside (upland) of the stream buffer; and
- Managed lawns are permitted in the Outer Zone of stream categories B-D although property owners are encouraged to preserve or plant native vegetation to increase the benefits of the buffer. Existing, healthy trees must be preserved in managed lawn areas and property owners are encouraged to plant trees in managed lawn areas. Managed lawns in Outer Zones shall not be fertilized unless as recommended by a soil test. Use of pesticides/herbicides on managed lawns in Outer Zones is discouraged and if used, shall be in accordance with integrated pest management practices.

4.1.6 Forested Buffer Preservation and Restoration

Trees provide many environmental, economic, and social benefits. In recognition of these benefits, tree preservation and replacement is a goal in Springfield's Field Guide 2030 Strategic Plan. Trees are particularly beneficial along streams. Forested stream buffers provide increased benefits over non-forested buffers for stream health and ecosystem services, including stream stability, in-stream pollutant processing, and aquatic and terrestrial habitat (Sweeney and Blaine, 2007). A forested stream buffer is generally defined as having trees and shrubs that provide at least 60% uniform canopy cover (Pennsylvania DEP, 2010). The following requirements shall apply to required stream buffers:

- Alternative compliance for required stream buffers in accordance with Section 4.1.13 shall prioritize to the extent practicable the preservation of forested buffer areas over non-forested buffer areas.
- Trees six inches or greater in diameter (measured 4.5 feet above ground) that will be removed due to alternative compliance for required stream buffers shall be replaced with trees with a minimum caliper size of 1.5 inches and an average mature spread equal to or greater than the average mature spread of the removed trees. The replacement trees shall be species native to Missouri. Native plants and trees provide many benefits, and fostering their utilization within the community is a goal in Springfield's Field Guide 2030 Strategic Plan. Replacement trees shall be planted in remaining buffer zones or elsewhere on the site. Trees planted to meet the landscape requirements in the Zoning Ordinance shall not be counted toward this requirement. Replacement trees that die shall be replaced in a timely manner with trees meeting the size, spread, and species requirements. Planting replacement trees in remaining buffer zones shall not be counted as buffer reforestation mitigation under Section 4.1.13.
- Existing trees in the area being added to the buffer do not count for trees removed in the area being excluded from the buffer when using buffer width averaging mitigation under Section 4.1.13. If the area being added to the stream buffer exceeds the area being excluded (ex. 10,000 sq. ft. added for 7,000 sq. ft. excluded), existing trees in the additional area may

count for trees removed in the excluded area if all areas being added to the stream buffer are roughly equivalent in tree coverage.

- Section 4.1.4 allows removal of dead or diseased trees and invasive vegetation; therefore, it is not required to plant replacement trees for any dead, diseased, or invasive trees that will be removed due to alternative compliance for required stream buffers. A dead or diseased tree must be recommended for removal by a certified arborist to meet this requirement. Invasive trees must be on a list approved by the Director.
- Tree planting in stream buffer areas with minimal existing forest cover is strongly encouraged and can provide credit towards meeting the water quality requirement in Chapter 10 through the natural area restoration credit or the tree planting credit. Tree and shrub planting to achieve at least 60% uniform canopy cover is recommended.

The following is a list of recommended Missouri native trees and shrubs for stream buffers. This list is not meant to be all inclusive. Other Missouri native tree and shrub species may be suitable as well.

- Sandbar Willow (Salix interior)
- Buttonbush (Cephalanthus occidentalis)
- Deciduous Holly (Ilex decidua)
- Hazelnut (Corylus americana)
- Wild Plum (Prunus sp.)
- Ninebark (Physocarpus opulifolius)
- Witch Hazel (Hamemelis vernalis)
- Silky Dogwood (Cornus obliqua)
- False Indigo (Amorpha fruticosa)
- Spice Bush (Lindera benzoin)
- Black Chokeberry (Aronia melanocarpa)
- Rose Mallow (Hibiscus lasiocarpos)
- Sycamore (Platanus occidentalis)
- Bur Oak (Quercus macrocarpa)
- Bald Cypress (Taxodium distichum)
- Butternut (Junglans cinerea)
- Black Gum (Nyssa sylvatica)
- Persimmon (Diospyros virginiana)
- Paw Paw (Asimina triloba)
- Serviceberry (Amelanchier arborea)
- Tulip poplar (Liriodendron tulipifera)
- Shumard Oak (Quercus shumardii)
- Osage Orange (Maclura pomifera)
- White Oak (Quercus alba)

4.1.7 Stormwater Discharges

As specified in Section 4.1.4, stormwater discharge points of concentrated flow shall be located upland from Streamside and Outer Zones unless infeasible. Locating stormwater discharges inside buffer zones limits one of the two primary ways that stream buffers protect and enhance water quality, which is by reducing the amount of pollutants entering the stream in stormwater runoff flowing overland through the buffer. Locating stormwater discharges upland from stream buffers maximizes this water quality benefit and provides an opportunity to utilize the buffer area as a vegetated filter strip to meet water quality requirements (see Chapter 10). If locating stormwater discharge points inside buffer zones, they shall be designed to disperse the discharge to promote overland sheet flow, infiltration, and associated water quality benefits. Overland sheet flow should be routed to prevent short circuiting and maximize the flow path to the stream. The receiving buffer zone area shall be maintained in dense erosion-resistant vegetation of forest and/or grasses.

4.1.8 Natural Channel Disturbance or Intervention

Natural channel disturbance or intervention may occur if part of an approved stream buffer plan. If a channel is to be disturbed, the provisions of Section 4.2, Channel Assessment, shall be followed to determine what actions may be necessary. In cases where channel intervention is necessary, natural materials and vegetation should be used to the maximum extent practicable. A channel intervention is any action that alters the shape, strength, or roughness of bed, bank, or riparian vegetation. Installation of culverts, bridges, stormwater discharge points, and below-grade crossings that involve surface cuts constitute interventions. Necessary federal and state permits must be obtained when a channel intervention is planned (refer to Section 1.3).

4.1.9 Maintenance

Maintenance of stream buffers shall be the responsibility of the property owner or property owners' association, where one exists, unless otherwise approved by the City. Stream buffer zones shall be maintained in a dense, vegetated cover to minimize erosion. Vegetated cover shall consist of natural/native vegetation, preferably forest, or lawn/landscaping (in Outer Zones only). Maintenance activities shall be in accordance with Sections 4.1.4 and 4.1.5.

4.1.10 Water Quality Credits

In accordance with Chapter 10 of this manual, stream buffer areas can provide a natural area conservation credit to reduce the required Water Quality Volume (WQV), with the exception of any Outer Zones that are managed lawn. When meeting the criteria in Chapter 10, stream buffer areas can serve as vegetated filter strips to meet full or partial WQV requirements. The stream buffer area may be used as a natural area conservation credit or a vegetated filter strip, but not both.

4.1.11 Redevelopment and Engineered Streams

For redevelopment of a property where the stream is a natural or naturalized channel but all or a portion of the stream buffer area was previously developed, the stream and any existing undeveloped buffer area shall be preserved or mitigated through an approved stream buffer plan. Any developed portion of the Streamside Zone for Category A and B streams that is redeveloped shall be re-established or mitigated through an approved stream buffer plan. Redevelopment means projects that alter the "footprint" of an existing site or building in such a way that there is a disturbance of land. Redevelopment of individual single-family lots is exempt from the

requirement to re-establish or mitigate the Streamside Zone. In the event that any building or structure in the Streamside Zone of Category A and B streams is damaged or destroyed, by any means, to the extent of more than 75 percent of the replacement cost of the building or structure at the time such damage occurred, such building shall not be restored unless it shall meet the requirement to re-establish or mitigate the stream buffer through an approved stream buffer plan. When a building or structure in the Streamside Zone of Category A and B streams is partially damaged to the extent of 75 percent or less, the stream buffer does not have to be re-established or mitigated if the restoration of the building or structure is actually begun within 12 months after the date of such partial destruction and is diligently pursued to completion. This provision is intended to be consistent with zoning requirements for damaged or destroyed buildings in City Code Sec. 36-457. Redevelopment in existing developed portions of the Outer Zone is allowed. However, re-establishment of the Outer Zone is strongly encouraged and may provide an opportunity for off-site mitigation trading.

For development or redevelopment of a property where the stream does not meet the definition of a natural channel as defined in Sections 1.0 and 2.1 (i.e. the stream has been enclosed or converted to an engineered channel lining and will remain in that condition for the development project), stream buffer requirements do not apply. However, voluntary building setbacks are strongly encouraged, particularly if the City has a conceptual plan for a future stream channel restoration project. Voluntary setbacks should allow adequate space for a future project, as well as buffer area when possible. Public/private partnerships should be explored at the time of the development to restore the stream and buffer.

4.1.12 Zoning Flexibility

The following zoning options and flexibilities may be proposed by the applicant in accordance with the Zoning Regulations in order to meet stream buffer requirements while offsetting potential adverse impacts on the development yield of the property.

- Cluster development in accordance with the Zoning Regulations is encouraged as a means to maintain lot yield while complying with stream buffer requirements.
- Zoning flexibilities such as increased building height or reduced parking to protect stream buffers while maximizing use of the property in accordance with City Code Section 36-472 of the Zoning Regulations.

4.1.13 Alternative Compliance for Required Stream Buffers

To provide flexibility for unique site issues while complying with the general spirit and intent of the stream buffer requirements herein, the required stream buffer may be adjusted and mitigated with a showing of need. To submit an alternative compliance request for consideration by the Departments of Public Works and Environmental Services, the Engineer of Record must submit a letter and supporting documentation showing the need and proposed mitigation. The Engineer is encouraged to engage the City early in the development process and the submittal shall include a minimum of the following:

- A narrative letter addressing:
    - The reasons(s) adjustment of the required stream buffer is needed (e.g., unique site issues, including but not limited to, factors regarding access needs, shape of property, public infrastructure, consideration of other code requirements, etc.); and
    - Discussion of site layout(s) that were considered in an effort to meet the required stream buffer and why they are not feasible; and
    - Proposed mitigation in accordance with Section 4.1.13.1 for on-site mitigation or Section 4.1.13.2 for fee in lieu mitigation. On-site mitigation is preferred over fee in lieu mitigation. If fee in lieu mitigation is proposed, the narrative must justify why on-site mitigation is not feasible. Other mitigation options involving public and private partnerships may be considered.
- A proposed stream buffer plan showing adjusted stream buffers and mitigation. The stream buffer plan shall contain the elements listed in Section 4.1.2.

If the City determines that additional documentation is warranted to support the need for alternative compliance and proposed mitigation, the Engineer may be required, at the City's discretion, to provide a depiction of the site layout(s) that were considered in an effort to meet the required stream buffer, which show the full stream buffer requirements and their impact on proposed development.

If the request for alternative compliance is denied, the applicant may then appeal to the Directors of Public Works and Environmental Services as provided by City Code Section 96-6. In the event the Directors uphold the denial, further appeals may proceed in accordance with City Code Section 96-6.

4.1.13.1 On-Site Mitigation Options

1. Buffer Width Averaging - The buffer width may vary below the minimum width in one area and be expanded in another area, not to exceed two times the buffer width, provided the square footage of the buffer area is the same as what would have been provided to meet the buffer requirement.
2. Buffer Reforestation - In exchange for adjusting the buffer in one area, reforestation may be completed in another area of the buffer on-site. Stream buffer areas that qualify for reforestation mitigation credit are areas that currently have 20% or less canopy cover. Reforestation means implementation of a planting and maintenance plan to achieve at least 60% uniform canopy cover of trees and shrubs. The reforestation area must be equal to the area excluded from the stream buffer (i.e. 1 acre buffer reforestation for 1 acre of area excluded from the buffer). The planting and maintenance plan shall be prepared by a qualified landscape architect, licensed forester, or licensed arborist.
3. Equivalent Water Quality Stormwater Control Measures (SCMs) - In exchange for adjusting the buffer, SCMs that provide water quality benefits equivalent to the area excluded from the stream buffer and that are beyond what is required per Chapter 10 may be provided on-site. The Engineer of Record must propose equivalent SCMs, including justification of equivalency. Justification of equivalency should address the various ecological functions of the stream buffer including but not limited to evapotranspiration, infiltration, sediment and nutrient removal, and habitat. A plan for equivalent SCMs will typically need to utilize a

treatment train approach that incorporates vegetated SCMs that provide these multiple ecological functions. Providing additional water quality volume in an extended detention basin would not be considered equivalent. In general, stormwater control measures will only be considered as equivalent for adjustment into the Outer Zone. Adjustment into the Streamside Zone or into the stream itself has a greater impact on stream stability, habitat, and in-stream pollutant processing that generally cannot be compensated for through additional SCMs.

4.1.13.2 Fee in Lieu Mitigation Option

Payment of a fee in lieu of providing stream buffers will only be considered upon review and approval of a request for alternative compliance justifying why on-site mitigation is not feasible. The fee is 30 cents per square foot of area excluded from the required stream buffer, or an updated rate established in a schedule adopted by ordinance from time to time. The fees shall be used by the City for stream buffer preservation and improvement activities.

4.2 Channel Assessment (required for small and large streams defined in Table 2)

Prior to any intervention in or utilization of a natural channel (i.e., development occurring within the channel), the designer shall conduct a channel assessment according to the protocol described below. An exception may be granted in specific cases such as replacement of an existing structure or an encroachment determined by the City to have a minimal effect on the stream. The assessment is intended to protect the natural channel resources and demonstrate that the responsible designer has taken measures to assess and protect the channel and adjacent areas. The assessment protocol described here was specifically developed for designers who may not have training in river mechanics, fluvial geomorphology, or related disciplines. The purpose of the assessment is to enable the designer to identify and evaluate significant channel stability problems at the beginning of the project so that measures can be taken to ensure the channel remains stable. In the absence of major system-wide instability, the design proceeds according to the criteria presented in this section. See Figure 2, Common Features of Stream Meander Geometry.

The natural channel assessment includes completing a plan and profile exhibit of basic channel geomorphology (Section 4.2.1) and completion of the Channel Condition Scoring Matrix (Section 4.2.2). The channel assessment shall, at a minimum, address the channel for a length equivalent to twelve channel widths or one wavelength up- and down-channel of the area to be impacted by construction.

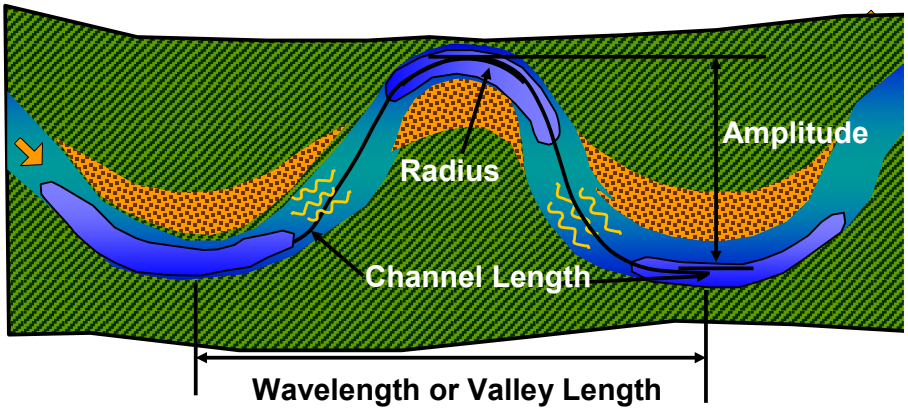


Figure 2. Common Features of Stream Meander Geometry.

4.2.1 Plan and Profile Exhibit

Except as modified by the City to better fit project needs, the plan and profile exhibit shall include these components:

- Ordinary high water mark
- Top of bank
- Topographic contours (maximum interval of 2 feet)
- "Bank-full" and 1 percent Annual Exceedance Probability (AEP) ultimate-conditions floodplain (see below)
- Thalweg, locations of riffles and pools, and spacing between riffles (see below)
- Exposed bedrock, areas of differing bed and bank soil or rock materials, and the d_{50} and shear stress ratio at each riffle (see below)
- Springs, sinkholes, gaining, or losing reaches
- Active scour and depositional areas, point bars, and islands
- Vegetation within the buffer zone, called out as mowed grass, mowed with trees, unmowed grass and plants, wooded, and bare. Trees greater than 6 inches in diameter within 25 feet of the top of bank shall be located individually or by group. The species of dominant trees shall be noted
- Meander length, wavelength, meander amplitude, bank-full width, and radius of curvature for each bend
- Total meander, valley length, and sinuosity for the reach
- Photographs of main channel, streamside vegetation, and each riffle, appropriately referenced to plan-view location

Additional detailed information related to the plan and profile exhibit for the channel assessment is outlined below:

- Planform Analyses and Inventory: The plan-view of the natural channel using aerial photographs or planning-level aerial survey shall be plotted at a scale of one inch equals 20

feet. A field survey of the entire reach study area is not required if topographic contours are used with intervals of no more than 2 feet.

- Bank-full Width, Depth, and Discharge: The geomorphic bank-full (or stream-forming) width, depth, and discharge shall be estimated using field indicators as detailed in Chapter 7 of *Stream Corridor Restoration Principles, Processes, and Practices* (2001). Briefly, field indicators of bank-full depth include internal floodplains or shelves, the lower limit of woody vegetation, the lowest persistent scour line, and in some cases, the flat tops of gravel bars. All of the applicable indicators shall be plotted on the profile sheet, and if the best-fit line of the indicators is parallel to the bed elevation, this elevation is a usable approximation of the bank-full elevation. Note: disturbed urban channels often do not have a consistent bank-full, or stream-forming, elevation. If field indicators are not used, bank-full flow shall be estimated as the 50 percent AEP flow under predevelopment conditions. The bank-full width and depth are estimated based on the dimensions of that flow through the existing channel. This assumption is intended to provide a rough upper estimate of the bank-full flow.
- Longitudinal Profile and Sections: The elevations of the profile along the thalweg shall be field surveyed to the nearest 0.1 foot. The following features shall be noted: riffles, pools, exposed bedrock, sinkholes, springs, and advancing headcuts (areas of bed elevation change that appear to be actively migrating upstream). The top of left and right bank and any field indicators of bank-full flow, such as limits of woody vegetation or top of point bars, shall be plotted at the correct elevation along the profile. The bank-full flow and 1 percent AEP ultimate flow profiles shall be plotted. One field cross-section shall be surveyed through each pool and riffle, and the depth and width of bank-full flow and 1 percent AEP ultimate conditions floodplain shall be shown on each section.
- Bed and Bank Materials Analyses: The type of rock exposed in the bed and banks shall be identified. Bank soils shall be reported by Uniform Soil Classification using the visual-manual procedures (ASTM D 2488-00). The median (d_{50}) particle size shall be determined using visual observation, grain size analysis of the surface layer, or the Wolman Pebble Count Method described in *Stream Corridor Restoration Principles, Processes, and Practices* (2001). A shear stress ratio shall be calculated for each riffle based on the applied shear at bank-full flow divided by the critical shear of the material in the riffle, using methods and tables described below. For coarse grain material, the d_{50} particle size shall be used.
- Critical Shear Stress Analysis: The shear stress ratio must be less than 1.0 at the farthest point of the drawdown curve of any channel intervention, in accordance with the guidelines below:

4.2.1.1 Shear Stress Ratio

The shear stress ratio is defined as:

$$\tau_o / \tau_c \qquad \text{(Equation 6)}$$

In which:

τ_o= average boundary shear stress (lbs/ft^2) (see Equation 7)

τ_c = critical shear stress (lbs/ft^2) (see Equation 8)

If bed and bank materials are distinct, then the shear stress ratio shall be calculated for each. If the shear stress ratio of either streambed or bank is greater than 1.0, the channel is prone to near-term adjustment, and any interventions shall be designed to prevent accelerated erosion. If the bed consists of rock that is prone to fracturing, slaking, or break-up, the median particle size shall be used for calculation of the ratio.

4.2.1.2 Average Boundary Shear Stress

The average applied shear stress, τ_o, may be calculated from the hydraulic data as follows:

$$\tau_o = \gamma R S_e \qquad \text{(Equation 7)}$$

In which:

τ_o = average boundary shear stress (lbs/ft^2)

γ = specific weight of water (62.4 lb/ft^3)

R = hydraulic radius at bank-full or stream-forming flow (flow area/wetted perimeter)

S_e = slope of energy grade line (averaged over several bends in the area of intervention)

The stream-forming flow may be assumed to be equivalent to the 2-year discharge under pre-disturbance conditions.

4.2.1.3 Critical Shear Stress

At the critical shear stress, τ_c, particles in the bed or bank are entrained and scour ensues. Shield's method is used for calculating the critical shear stress of spherical, non-cohesive particles, as follows:

$$\tau_c = \theta(\gamma_s - \gamma) d_{50} \qquad \text{(Equation 8)}$$

In which:

τ_c = critical shear stress (lb/ft2)

θ = Shield's parameter (0.06 for gravel to cobble, 0.044 for sand) (dimensionless)

γ_s = specific weight of sediment (160 lb/ft3)

γ = specific weight of water (62.4 lb/ft3)

d_{50} = median particle size in the surface layer of bed or banks (ft)

There are limited methods for calculating τ_c for fine-grained material. Field or laboratory testing generally determines the critical shear stress for these materials. The most widely available source is Chow (1988). More recently, the USDA Agricultural Research Service National Sedimentation Laboratory has developed computer software for calculating toe scour (ARS Bank-Toe Erosion

Model, "BSTEM", Version 5.2, 2010). Critical shear stress may also be determined from American Society of Civil Engineers (ASCE) and the Water Environment Federation (WEF) (1992), Figure 9.6, p. 335.

In lieu of calculated values, the τ_c from Table 4 may be used. Table 4 presents critical shear for sediment-laden water and where noted, clear water. The user must exercise judgment as to future conditions. Clear water values may be used below a heavily piped area, for concrete channels designed to contain the future flows, or immediately below a managed detention pond.

- Planform Ratios: Natural channels have generally predictable patterns in plan and profile. A channel with a planform substantially different than the norm may be exhibiting system-scale instability. The ratios listed in Table 3 shall be calculated, and those outside the typical range shall be noted. Natural channels are highly variable, and ratios outside these ranges do not necessarily indicate problems. Planform data must be considered as part of the larger evaluation.

A typical reach with the required plan and profile information is shown on Figure 3 and Figure 4.

4.2.2 Channel Condition Scoring Matrix

Using information summarized in Section 4.2.1, a channel condition scoring matrix shall be completed. The channel scoring matrix is provided in Table 5. Results of the channel scoring matrix are used to assess the condition of a natural channel, as follows:

- A total rating of 12 or lower indicates a channel of at least moderate stability and suggests the design guidance provided will typically be sufficient.
- A rating between 12 and 18 indicates some channel instability will be present that will require special measures to address those issues rated as poor in the assessment. Depending on the type and severity of instability noted, this may include adding energy dissipation or other structural measures.
- A rating greater than 18 typically indicates the channel will exhibit significant system-wide instability. In such cases, the designer must meet with the City to discuss how to proceed; it may be necessary for a qualified professional in fluvial geomorphology to conduct a detailed study of the causes of instability and make recommendations for structural measures to correct the stability problem.

Table 3. Planform Ratios

Ratio	Typical Range
Meander Length/Wavelength (sinuosity)	1.1 to 1.5
Meander Length/Bank-full Width	10 to 14
Radius of Curvature/Bank-full Width	2 to 5
Riffle Spacing /Bank-full Width	5 to 7

Table 4. Critical Shear Stresses for Channel Materials

Granular Material	Critical Shear Stress (τC) (pounds per square foot)
Boulders (100 cm) (39 in)	20.295
Boulders (75 cm) (30 in)	15.222
Boulders (50 cm) (20 in)	10.148
Boulders (25.6 cm) (11 in)	5.196
Riprap (6-8 in)	3.132
Cobbles (6.4 cm) (2.5 in)	1.299
Cobbles and shingles	1.100
Cobbles and shingles, clear water	0.910
Coarse sand (1 mm) (0.4 in)	0.015
Coarse gravel, noncolloidal (GW), clear water	0.300
Coarse gravel, noncolloidal (GW)	0.670
Gravel (2 cm) (0.78 in)	0.406
Fine gravel	0.320
Fine gravel, clear water	0.075
Fine sand (0.125 mm) (0.005 in)	0.002
Fine sand (0.125 mm) (SP) (0.005 in)	0.002
Fine sand (SW), (SP), colloidal	0.075
Fine sand, colloidal, (SW), (SP), clear water	0.027
Graded loam to cobbles, noncolloidal (GM)	0.660
Graded loam to cobbles, noncolloidal (GM), clear water	0.380
Graded silts to cobbles, colloidal (GC)	0.800
Graded silts to cobbles, colloidal (GC), clear water	0.430
Fine-Grained Material	**Critical Shear Stress (τc) (pounds per square foot)**
Resistant cohesive (CL), (CH)	1.044
Stiff clay, very colloidal (CL)	0.460
Stiff clay, very colloidal (CL), clear water	0.260
Moderate cohesive (ML-CL)	0.104
Ordinary firm loam (CL-ML)	0.150
Ordinary firm loam (CL-ML), clear water	0.075
Alluvial silts, colloidal (CL-ML)	0.460
Alluvial silts, colloidal (CL-ML), clear water	0.260
Alluvial silts, noncolloidal (ML)	0.150
Alluvial silts, noncolloidal (ML), clear water	0.048
Sandy loam, noncolloidal (ML)	0.075
Sandy loam, noncolloidal (ML), clear water	0.037
Silt loam, noncolloidal (ML)	0.110
Silt loam, noncolloidal (ML), clear water	0.048
Shales and hardpans	0.670
Other Materials	**Critical Shear Stress (τc) (pounds per square foot)**
Jute net	0.46
Plant cuttings	2.09
Well established dense vegetation to the normal low water	2.16
Geotextile (synthetic)	3.01
Large Woody Debris	3.13

Notes:
For non-cohesive soils, the table values are based on spherical particles and Shield's equation (see Equation OC-8).
For cohesive soils, the values are based on limited testing as reported in Chow (1988) and U.S. Department of Agriculture Agricultural Research Service (USDA ARS) (2004).
Material type abbreviations:

GW – Gravel, well graded	GC – Clayey gravel
SP – Sand, poorly graded	CL – Clay
SW – Sand, well graded	CH – Clay, high plasticity
GM – Silty gravel	ML – Silt

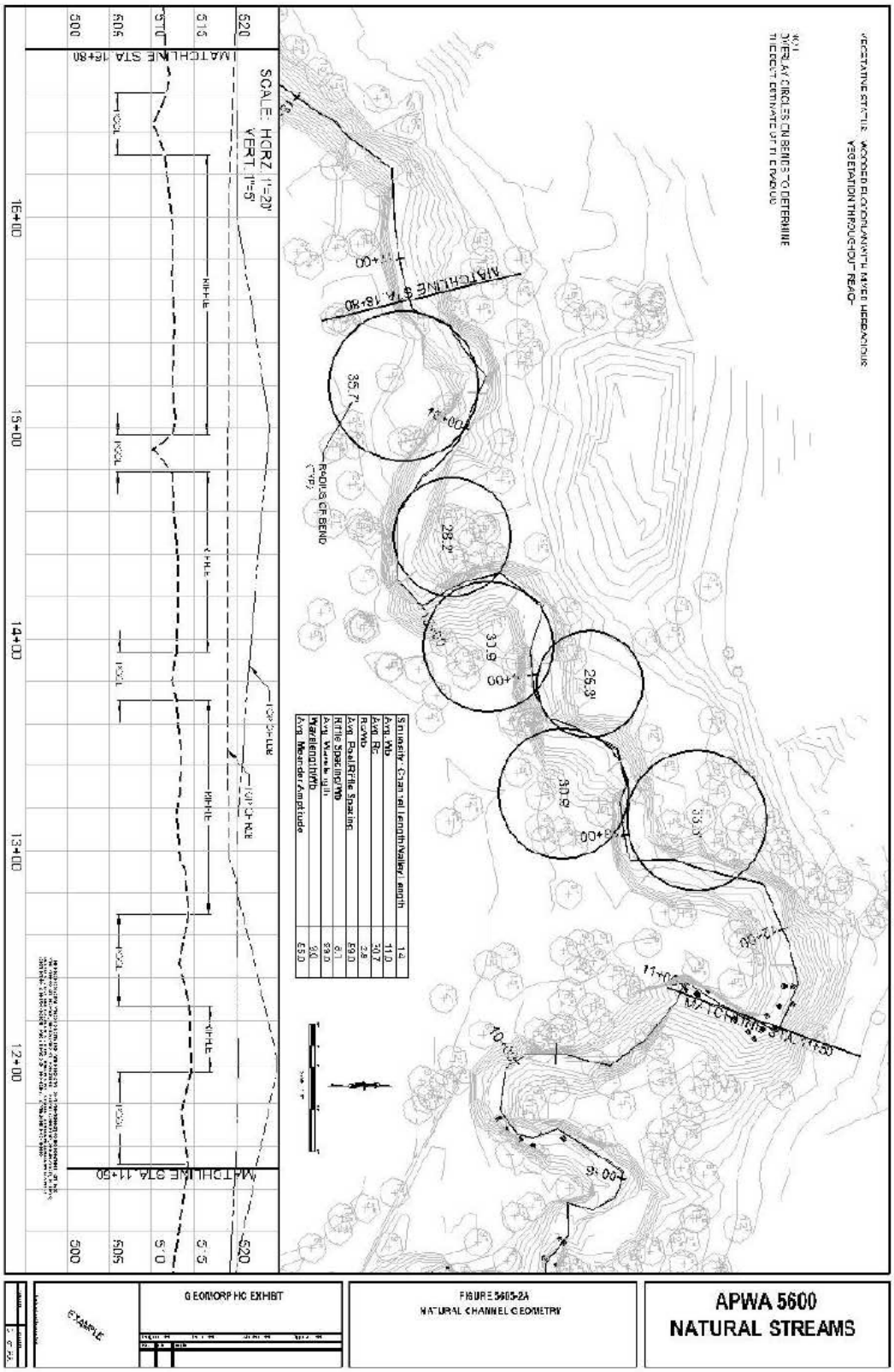


Figure 3. Natural Channel Assessment (Part 1)

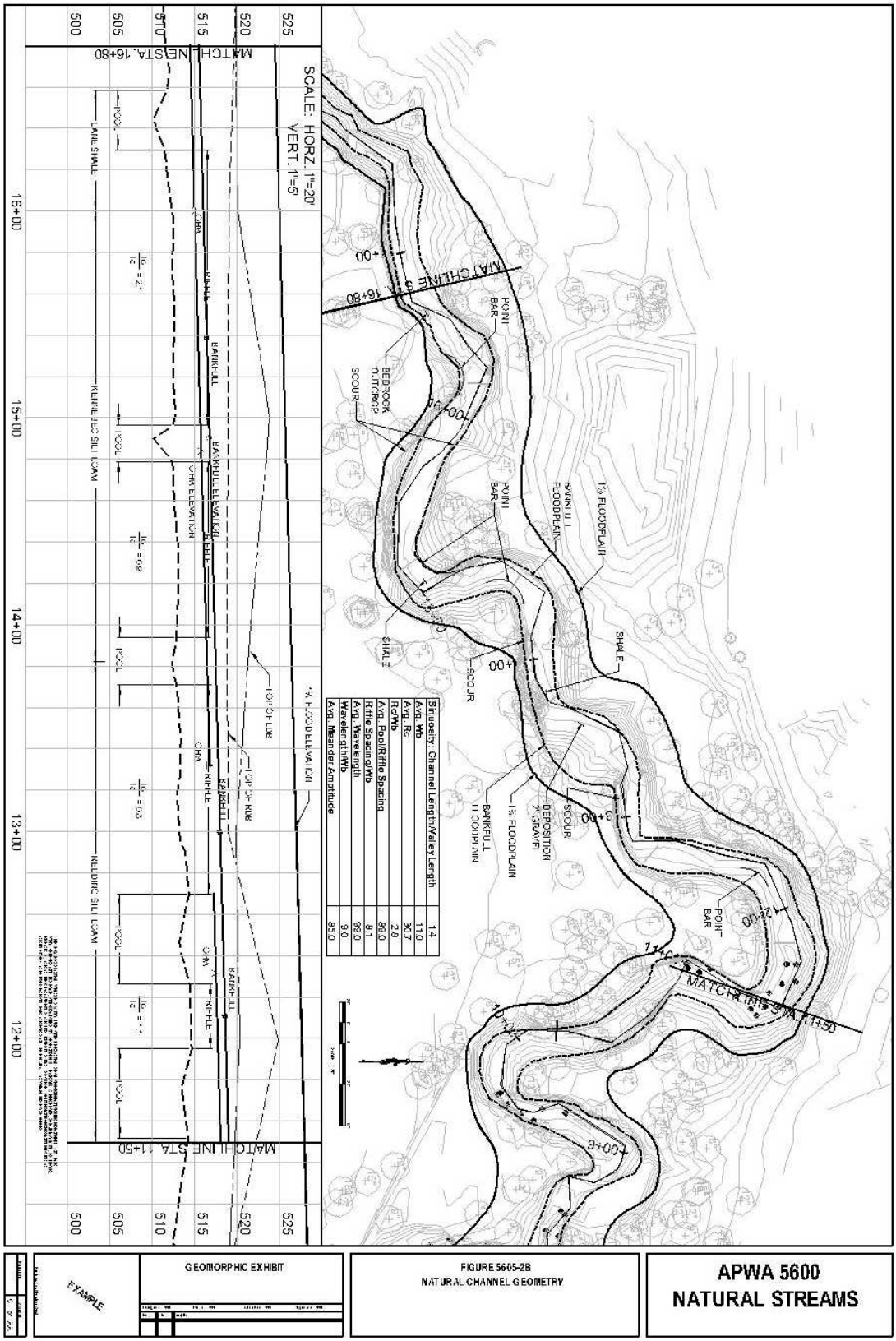


Figure 4. Natural Channel Assessment (Part 2)

Table 5. Channel Condition Scoring Matrix (adapted from Johnson et al. 1999)

Project: _____

Channel Name and Location: _____

Evaluated by: _____ Firm: _____ Date: _____

Stability Indicator	Good (1)	Fair (2)	Poor (3)	Score (S)	Weight (W)	Rating (S*W= R)
Bank soil texture and coherence	Cohesive materials, clay (CL), silty clay (CL-ML), massive limestone, continuous concrete, clay loam (ML-CL), silty clay loam (ML-CL), thinly bed limestone	Sandy clay (SC), sandy loam (SM), fractured thinly bedded limestone	Non-cohesive materials, shale in bank, (SM), (SP),(SW), (GC), (GM), (GP),(GW)		0.6	
Average bank slope angle	Slopes ≥2:1 on one or occasionally both banks	Slopes up to 1.7:1 (60°) common on one or both banks	Bank slopes over 60° on one or both banks		0.6	
Average bank height	Less than 6 feet	Greater than 6 and less than 15 feet	Greater than 15 feet		0.8	
Vegetative bank protection	Wide to medium band of woody vegetation with 70 - 90 percent plant density and cover. Majority are hardwood, deciduous trees with well-developed understory layer, minimal root exposure.	Narrow bank of woody vegetation, poor species diversity, 50-70 percent plant density, most vegetation on top of bank and not extending onto bank slope, some trees leaning over bank, root exposure common.	Thin or no band of woody vegetation, poor health, monoculture, many trees leaning over bank, extensive root exposure, turf grass to edge of bank.		0.8	
Bank cutting	Little to some evident along channel bends and at prominent constrictions, some raw banks up to 4 feet.	Significant and frequent. Cut banks 4 feet high. Root mat overhangs common.	Almost continuous cut banks, some over 4 feet high. Undercut trees with sod-root mat overhangs common. Bank failures frequent.		0.4	
Mass wasting	Little to some evidence of slight or infrequent mass wasting, past events healed over with vegetation. Channel width relatively uniform with only slight scalloping.	Evidence of frequent and significant mass wasting events. Indications that higher flows aggravated undercutting and bank wasting. Channel width irregular with bank scalloping.	Frequent and extensive mass wasting evident. Tension cracks, massive undercutting and bank slumping are considerable. Highly irregular channel width.		0.8	
Bar development	Narrow relative to channel width at low flow, well consolidated, vegetated, and composed of coarse bed material to slight recent growth of bar as indicated by absence of vegetation on part of bar.	Bar widths wide relative to channel width with freshly deposited sand to small cobbles with sparse vegetation.	Bar widths greater than ½ the channel width at low flow. Bars are composed of extensive deposits of finer bed material with little vegetation.		0.6	

Stability Indicator	Good (1)	Fair (2)	Poor (3)	Score (S)	Weight (W)	Rating (S*W= R)
Debris jam potential	Slight—small amounts of debris in channel. Small jams could form.	Moderate—noticeable debris of all sizes present.	Significant—moderate to heavy accumulations of debris apparent.		0.2	
Obstructions, flow deflectors (walls, bluffs) and sediment traps	Negligible to few or small obstructions present causing secondary currents and minor bank and bottom erosion but no major influence on meander bend.	Moderately frequent and occasionally unstable obstructions, noticeable erosion of channel. Considerable sediment accumulation behind obstructions.	Frequent and unstable causing continual shift of sediment and flow.		0.2	
Channel bed material, condition, consolidation, and armoring	Massive competent to thinly bedded limestone, continuous concrete, hard clay, moderately consolidated with some overlapping. Assorted sizes of particles, tightly packed and overlapped, possibly imbricated[3]. Small percentage of particles < 4 mm.	Shale in bed, soft silty clay, little consolidation of particles, no apparent overlap, moderate percentage of particles < 4 mm, knickpoints <200 mm.	Silt, weathered, thinly bedded, fractured shale, high slaking potential, very poorly consolidated, high percentage of material < 4 mm, knickpoints > 200 mm.		0.8	
Sinuosity[4]	1.2 ≤ Sinuosity ≤ 1.4	1.1 < Sinuosity < 1.2	Sinuosity < 1.1		0.8	
Ratio of radius of curvature (Rc) to channel width (Wb)	3 ≤ Rc/Wb ≤ 5	2 < Rc/Wb < 3, 5 < Rc/Wb < 7	2 < Rc /Wb, Rc /Wb > 7		0.8	
Ratio of pool – riffle spacing to channel width at elevation of 2-year flow	4 ≤ Length/Wb < 8	3 ≤ Length/Wb < 4, 8 < Length/Wb ≤ 9	3 < Length/Wb, Length/Wb > 9, unless long pool or run because of geologic influence		0.8	
Percentage of channel constriction	< 25%	26-50%	> 50%		0.8	
Sediment movement	Little to no loose sediment	Scour and/or deposition, some loose sediment	Near continuous scour and/or deposition and/or loose sediment		0.8	
					TOTAL	

[3] Imbrication: a deposition feature in which bed load is laid down in an overlapping pattern like fish-scales or shingles; the shingling is in the downstream direction. Natural channels imbricate to self-armor.

[4] Sinuosity: the degree of curvature of a channel. Strictly, sinuosity is the ratio of channel length to valley length and is usually measured over considerable distance. For the current purposes, sinuosity can be approximated as channel length/wavelength.

4.3 In-channel Construction Requirements

Construction in natural channels or their buffer zones shall conform to the general requirements of this section and to the appropriate specific requirements of the subsections that follow (Sections 4.3.1 through 4.3.6). In-channel construction shall generally be limited to infrastructure crossings and outfalls. All channel interventions shall be designed so that the function and stability of the adjacent reaches are preserved. The side slopes of banks where construction occurs shall be restored with vegetation. This section applies to large and small streams as defined in Table 2. Applicability to tributaries will be evaluated based on relative location to sensitive environmental features and site conditions.

4.3.1 Energy Management

An important consideration for the design engineer working on a natural channel is to evaluate and manage the energy throughout the reach of the project. The pre-project and post-project hydraulic and energy grade lines for the 1-, 10-, and 100-year storms shall be plotted. The region of a channel where in-stream construction causes a change in these grade lines is considered the zone of influence. Downstream from the construction region, the extent of the zone of influence shall be generally limited by energy dissipation and use of naturally occurring or constructed Newbury-style grade control. Grade control structures shall be designed to dissipate energy sufficiently to match the energy grade line of the project reach with that of the upstream and downstream adjacent reaches. Design criteria for energy dissipation and grade control structures are addressed in Section 6.0, Hydraulic Structures and Section 7.0, Small Grade Control Structures.

There should not be an increase in depth or velocity sufficient to threaten the channel bed or bank. Within the zone of influence, the energy of the flow on the channel shall be evaluated for the potential of excessive scour, deposition, initiation of headcuts, or other instability (i.e., consider the shear stress and energy grade line, and evaluate whether the applied shear is greater than the critical shear along the channel bed or bank). Upstream from the construction region, the limit of the zone of influence may extend a distance beyond the construction as a drawdown or backwater curve.

By deliberately designing hydraulic roughness, designers can dissipate scouring energy and guide it towards the channel thalweg. Thoughtful use of energy management structures can substantially reduce the need for channel armor. In most cases, spot usage of hard armor is not an advisable design approach because it may transfer the energy and damage elsewhere in the reach. Instead, the channel should be designed to dissipate the energy and alleviate the need for armor.

Boulder drop structures and shaped grade controls are especially useful for focusing flow to the channel thalweg and away from the banks. When using riprap for in-stream structures, the riprap should be staked with live vegetation such as shrub willow stakes at the toe of the slope and up the banks to lock the riprap in place and provide additional stage-dependent energy dissipation. When installing live stakes into riprap, the stakes must extend at least 12 inches into soil below the rock and extend roughly 12 inches above it. Since it is difficult to acquire live stakes longer than 48 inches, and it is also difficult to drive the stakes through more than 24 inches of rock, this is the practical limit of their use.

Streamside vegetation also provides energy management benefits and should be protected. The designer shall set the construction limits to not disturb riparian vegetation, except by permission from the City. Use of vegetation is recommended to increase bank resistance and minimize increases or abrupt changes in velocities. Vegetative bank or bed stabilization may be required in areas where increases in depth or velocity are necessary.

As mentioned in Section 1.3, wherever FEMA-regulated floodplains exist, the designer must adhere to the provisions of the National Flood Insurance Program (NFIP) and City floodplain management requirements. The water surface elevation of the design storm (100-year event) cannot be changed on adjacent properties unless there is an easement to do so. Any changes to the water surface elevation may require remapping of the floodplain in accordance with FEMA regulations. In addition, the designer must adhere to Section 404 permit requirements and, if necessary, obtain a permit from the USACE.

4.3.2 Sediment Transport Continuity

To maintain the ability of the channel to transport sediment, the minimum applied shear to the bed of the channel for the post-project condition should not be less than 90 percent of the minimum applied shear for the pre-project condition. This requirement applies to the zone of influence for the 1-, 10-, and 100-year flows for current and ultimate development conditions. For maximum allowable applied shear, the post-project condition shall not exceed the critical shear strength of either bed or bank.

4.3.3 Transitions

Abrupt changes in cross-section, strength of material, or hydraulic roughness tend to concentrate erosive forces and the designer must take particular care to avoid them. In-channel structures shall be designed to gradually blend into the natural channel and provide a smooth transition of both geometry and roughness. Robust vegetation such as live stakes is useful in managing a gradual transition from riprap to native bank material.

4.3.4 Discharge Outfalls

Discharge outfalls into natural open channels from enclosed conduits or constructed channels shall be designed depending on the type of outfall, as described below. Calculations to evaluate energy management and sediment continuity, as discussed in Sections 4.3.1 and 4.3.2, are not required for these outfalls; however, energy dissipation shall be provided at these locations to reduce increased shear stress caused by development in the watershed. For further discussion on calculations to evaluate energy management, refer to Chapter 6, Streets, Inlets, and Storm Drains.

4.3.4.1 Primary Outfalls

Primary outfalls are those where the majority of the main channel upstream is replaced by an enclosed system or constructed channel that discharges flow in line with the direction of the existing downstream segment. Energy dissipation shall be provided at the outlet to reduce velocities. Grade control downstream of the outlet and an energy dissipation device shall be provided to prevent undermining of the outfall by future headcuts. The alignment and location of the outfall and associated energy dissipation and grade control structures shall make a smooth transition into the downstream channel. A primary outfall occurs whenever the contributing

drainage area of the outfalls is greater than 50 percent of the total drainage area of the downstream channel.

4.3.4.2 Tributary Outfalls

Tributary outfalls are those which discharge to a downstream segment that has a separate drainage area larger than the tributary drainage area. Energy dissipation and transition to natural stream flow shall take place in the tributary, upstream of the confluence with the larger channel by a distance of at least one channel width. Newbury-style grade control structure(s) in the tributary upstream of the confluence shall be provided if the tributary flow line is higher than the adjoining channel or if future incision of the adjoining channel is anticipated. Tributary outfalls may be used in all situations of tributary flow.

4.3.4.3 Lateral Outfalls

Lateral outfalls are small outfalls that discharge into a natural stream at its embankment. Where possible, outfalls shall be located to enter on a riffle or from the inside of a bend. Outfall pipes may be oriented perpendicular to the flow of the stream only if the contributing drainage area of the outfall is less than 25 percent of that in the downstream channel; alternatively, the outfall should be angled downstream if possible. Outfalls shall be flush with or setback from the bank, with the invert of the outfall at or slightly below the top of the next downstream riffle. The bank shall be shaped to provide a smooth transition and protected with reinforced vegetation (preferred) or riprap.

If the lateral outfall is in a bend, it shall be set back from the existing bank a sufficient distance to account for future meander migration, and the transition shall be graded and reinforced with vegetated armoring.

4.3.4.4 Edge-of-Buffer Outfalls

Edge-of-buffer outfalls are addressed in the Section 4.1 text regarding natural channel buffer zones.

4.3.5 Culverts, Bridges, and Above-grade Crossings

4.3.5.1 Crossing Location

Crossings should generally be located on a riffle. If the width of the crossing is large relative to the length of the riffle, then Newbury-style grade control structures shall be provided at the riffles upstream and downstream to isolate the impact of the crossings.

4.3.5.2 Realignment of Channels

Realignment of channels to accommodate crossings and their approach should be avoided and minimized as much as possible. Designers proposing to realign a natural channel must thoroughly document the influence of this action on the upstream and downstream reaches. (Refer to Section 4.2 for natural channel assessment process). Any areas relocated shall have the banks stabilized with natural vegetation, and the designer shall reinforce the adjacent upstream and downstream riffles with Newbury-style grade control structures.

4.3.5.3 Bridges

For bridges, any multi-stage channel shape that exists upstream and downstream should be matched by the configuration of the bridge opening to minimize stream impacts. Additional cross-sectional channel area to convey the design flow shall be located above the elevation of the bank-full discharge.

4.3.5.4 Multi-Cell Pipe and Culvert Crossings

Multi-cell pipe and culvert crossings shall be designed to minimize impacts on streams and minimize maintenance requirements. For crossings that have a cumulative width larger than the bank-full width, certain guidelines apply to prevent build-up of sediment and loss of channel capacity. Those cells wider than the bank-full width shall have a flow line located at the lowest estimated bank-full depth. Alternatively, a weir wall or other structure, located upstream of the culvert opening, shall be installed with sufficient height to prevent access to the cell during flows less than bank-full flow. The weir wall shall be designed so that the hydraulic efficiency during the 100-year event conditions is not reduced.

4.3.5.5 Culverts

Culverts shall be designed so there is minimal backwater effect at all flows up to the 100-year discharge. Energy management and sediment transport continuity shall be checked (refer to Sections 4.3.1 and 4.3.2).

4.3.6 Below-grade Stream Crossings

4.3.6.1 Riffle Crossing

Below-grade stream crossings primarily involve utility pipelines. Crossings should generally be located at riffles or at Newbury-style grade control structures constructed at the riffle. Any necessary encasement of the utility line may be integrated with, or constructed in addition to, the grade control structure.

4.3.6.2 Pool Crossing

If riffle crossing is not feasible, the crossing should be in a pool that is protected by a downstream naturally occurring or Newbury-style grade control structure. The top of crossing elevation shall be at least 2 feet below the top of grade control. Crossings under pools shall not be armored directly, but shall be protected by downstream grade control at the next downstream riffle.

4.3.6.3 Orientation to Channel

Below-grade crossings shall be perpendicular to the stream whenever possible. If a perpendicular crossing is not feasible, the downstream Newbury-style grade control structure protecting the crossing shall be generally perpendicular.

4.3.6.4 Channel Alteration

Constriction or alteration of the pre-existing channel shape shall be avoided. If alteration occurs, sediment transport continuity and energy management shall be verified (refer to Sections 4.3.1 and 4.3.2). Streambanks shall be repaired using vegetative methods whenever possible. The hydraulic roughness of the repaired streambank should match that of the undisturbed streambanks.

4.3.6.5 Professional Judgment

Natural channels are complex, variable systems whose forms are shaped by local geology and climate. The standards discussed in this manual are based on generally accepted design principles. However, these guidelines may not be optimal or sufficient in all cases. Designs shall be completed by qualified professionals. Although the 100-year floodplain of a natural channel may, in many cases, be larger than the 100-year floodplain for an engineered channel, it is of the utmost importance to preserve or enhance the natural corridor. Such an approach is consistent with the ASCE Code of Ethics, which states: "Engineers shall hold paramount the safety, health, and welfare of the public and shall strive to comply with the principles of sustainable development in the performance of their professional duties."

5.0 Engineered Channel Design Criteria

This section provides design criteria for engineered open channels. Subjects addressed include: flow rate, flow regime, flow velocity, channel slope, channel curvature, and superelevation, freeboard, channel linings, channel cross-section, low-flow channels, and outfalls into channels. Each subject is explained in terms of its application to different channel types.

5.1 Flow Rate

The primary purpose of engineered open channels is to convey water safely and efficiently and to control flooding on adjacent properties. Where engineered channels are used, open channels shall be designed to convey the 25-year flow. Additionally, for all open channels, it must be shown that the 100-year flow will be contained within the drainage easement.

Design flows shall be calculated for fully developed watershed conditions based on current or anticipated zoning and land uses. The maximum potential roughness factor shall be used to ensure capacity is maintained. Upstream detention storage may be accounted for in design flow if the storage is currently being maintained and ownership and future maintenance responsibilities for the detention facility are clearly defined. Flow rate reduction due to storage will be accepted only if detailed modeling and detention basin routing have been completed. All design flows shall be determined using methods described in Chapter 5, Calculation of Runoff.

Low-flow channels should generally be designed to convey the 1-year flow, although site conditions may justify a varied design that requires City approval. Any existing perennial or intermittent base flows shall also be taken into account when designing low-flow channels.

5.2 Flow Regime

To protect channel stability and hydraulic performance, critical flow conditions shall be avoided. The Froude number, F_r, must be calculated for all unique sections of open channels for the 25-year flow. Calculating F_r for other frequency flows may be necessary to ensure channel stability. F_r must first be calculated using the minimum value of the Manning's roughness coefficient, n, found in Table 1 (Section 3.4).

In general, the maximum allowable value of F_r is 0.8. However, if values greater than 0.8 are necessary due to site constraints, the channel shall be designed so that the flow is supercritical,

with a F_r greater than 1.2. In such cases, the calculation should use the maximum value for Manning's roughness, found in Table 1 (Section 3.3). For supercritical flows, calculation of the conjugate depth is necessary and a well-accepted open channel hydraulics reference should be used. Designs with supercritical flows require use of a concrete channel lining. In addition, such designs must avoid all obstructions, transitions, and curvature. It must be shown how adjacent properties will be protected from flooding should a hydraulic jump occur.

Under certain conditions, values of F_r between 0.8 and 1.2 may be allowed, and the requirement to calculate conjugate depths may be waived. This exception applies to channels with a 25-year design flow of 20 cfs or less when no potential hazards exist.

5.3 Velocity

For an engineered open channel to function properly, the channel must be designed within a range of acceptable minimum and maximum values. Generally, maximum design velocity should be controlled through the use of grade controls, design slope, channel geometry, and channel roughness. Through proper planning of new developments and use of these design parameters, subcritical flows should be maintained, and in most cases, concrete channels should not be necessary.

Maximum velocities must be considered to minimize the potential for channel erosion and to protect channel stability. Maximum velocities shall be checked using the 25-year design flow and minimum roughness coefficient values. Maximum allowable velocities for channels with various types of linings are listed in Table 6.

Minimum velocity must be considered to ensure channels will have a reasonable capacity to transport sediment and avoid sedimentation. Minimum velocities shall be checked using the 2-year design flow and maximum roughness coefficient values. Minimum allowable velocities are listed in Table 6. If channel is being used as a stormwater control measure for water quality then the minimum velocity requirement will be waived.

Table 6. Design Velocity Limitations for Open Channels with Different Linings

Channel Type	Minimum Velocity (2-year check)	Maximum Velocity (25-year check)
Grass, seed, and mulch	2 ft/s	4 ft/s
Grass, sod	2 ft/s	6 ft/s
Grass, TRM	2 ft/s	8 ft/s
Grass, pre-vegetated TRM	2 ft/s	10 ft/s
Manufactured hard lining	4 ft/s	12 ft/s
Riprap	4 ft/s	12 ft/s
Concrete	4 ft/s	18 ft/s

Velocity in a simple, uniform channel can be estimated using Manning's equation. In complex channels with varied linings, geometry, and curvature, a steady state model such as HEC-RAS or

other generally accepted similar model shall be used to estimate velocities. When it is necessary to calculate velocities under non-uniform, varied or unsteady flow conditions, HEC-RAS (or other suitable programs approved by the City) must be properly configured. Only users familiar with modeling unsteady flow conditions should conduct modeling in such cases.

Open channel design should account for highly localized velocities at drops, expansions, contractions, and other structural controls (see Section 6.0, Hydraulic Structures). The effect of velocity and the selection of channel lining types are addressed in Section 5.7, Channel Linings.

5.4 Slope

5.4.1 Longitudinal Slope

The criteria for flow regime and flow velocity will generally determine acceptable longitudinal slope. Minimum slope criteria are specified to provide positive drainage with minimal ponding. Minimum slopes of channels with natural linings shall be 0.4 percent. For channels with concrete linings, minimum slopes shall be 0.2 percent.

Maximum slope criteria are defined to keep velocities within acceptable ranges. Maximum slopes are constrained by the allowable Froude number, F_r. As discussed in Section 3.4, designs that result in F_r near 1.0 (> 0.8 and < 1.2) shall be avoided by adjusting the design of the cross-section, roughness, and slope. In general, in cases where drainageways have F_r greater than 0.8, drop structures must be integrated into the design to control slopes and keep F_r within the acceptable range.

An important consideration when designing channel slope within natural channels or topography is sinuosity. Straightening of a natural channel inevitably results in an increase in slope. Conversely, for a constructed channel, a design incorporating meanders can be used to satisfy slope criteria and potentially reduce the number of grade control structures required.

5.4.2 Side Slopes

Channels with natural linings requiring mowing or regular maintenance shall have a side slope no steeper than 4H:1V, unless it can be shown that site conditions prohibit construction of a channel with these dimensions. In such cases, side slopes as steep as 3H:1V may be considered.

For concrete channels, non-vertical side slopes shall not have a slope steeper than 1H:1V, to allow for safe exit from the channel. An exception is allowed for short transitions between vertical and 1H:1V concrete channels.

For channels lined with materials other than concrete and when side slopes steeper than 3H:1V are necessary, slopes armored with riprap, geoweb, or other material may be considered on a case-by-case basis. The maximum allowable side slope using these types of materials shall be 2H:1V.

Factors to consider when determining side slopes include ease of maintenance, safety, and public acceptance, particularly in neighborhoods. A fence with a minimum height of 4 feet shall be installed at the top of any slope steeper than 1H:1V for channels with a depth of 3 feet or more,

where homes, streets, parking lots, buildings, or other facilities cause people to be in close proximity.

5.5 Curvature and Superelevation

As discussed in Section 5.4.1, sinuosity may be used to control velocity in conjunction with drops. Every design is site specific. The use of curvature in a channel design to flatten slope should be done only with careful consideration given to channel erosion and instability. Layout of small engineered channels should minimize the number of curves and the degree of curvature of any necessary curves. Curves shall only be used where it is shown they are necessary due to layout of the development or to create sinuosity and reduce longitudinal slope. Where curves are used, the centerline of curvature of the channel shall have a minimum radius of twice the top width of the design flow (25-year event), but not less than 100 feet.

Supercritical flow in an engineered open channel in an urban area may create hazardous conditions. Curvature shall not be used in a channel under these conditions. If curvature is proposed, it may be considered with an analysis of conjugate depths and potential hazards as outlined in Section 5.2, Flow Regime.

Velocities and depths are higher on the outside of open channel curves. This rise in water surface on the outside of a curve is referred to as superelevation. Superelevation must be calculated for all curves in open channels and accounted for in the design of the channel and freeboard. For subcritical flows, superelevation can be estimated by:

$$\Delta y = \frac{V^2 T}{2 g r_c} \qquad \text{(Equation 9)}$$

In which:

Δy = difference in water surface elevation between the inner and outer banks of the channel in the bend (resulting from superelevation) (ft)

V = mean flow velocity (ft/s)

T = top width of the channel under design flow conditions (ft)

g = gravitational constant = 32.2 ft/s^2

r_c = radius of curvature (ft)

Velocity shall be calculated utilizing minimum roughness coefficient values found in Table 1 (Section 3.3). When the ratio of the radius of curvature of the channel centerline to the top width of the channel is less than 8, the velocity of the flow along the outside of the bend shall be calculated using Equation 2. Because of this increase in velocity, it is often necessary to provide increased erosion protection along the outside of bends. Riprap shall be used when the velocity of the upstream reach for the 25-year storm is greater than 8 ft/s. (Riprap design information is provided in Section 2.2.4).

Increased erosion protection based on higher bend velocities shall apply to the outside half of the channel bottom and on the channel side slope for the entire length on the outside of the bend, plus a distance of two times the top width downstream of the bend. In cases where an outside bend in a grass-lined channel needs protection, riprap shall be covered, if possible, with soil and vegetation to provide a grassed-lined channel appearance. Buried riprap may lose vegetated cover in a major flood and require re-burial and revegetation.

5.6 Freeboard

The required freeboard for engineered open channels is dependent on the type of channel:

- For concrete channels, the required freeboard is 6 inches above the 25-year water surface.
- For other types of channel linings, the required freeboard is one foot above the water surface, except for channels where the 25-year flow depth is 12 inches or less; in such cases the channel shall have a freeboard of 6 inches above the 25-year water surface.

For all channel types, the 100-year water surface shall remain within the drainage easement.

It must be shown that the lowest enclosed space of all buildings is at least 2 feet above the 100-year water surface elevation at the upstream side of the building. Where the 100-year flow is less than 20 cfs, the required building elevation will be evaluated based on site conditions. Particular care in setting floor elevations shall be taken along channels existing within backwater conditions of existing or proposed culverts. In these cases, the water surface must be determined using the appropriate hydraulic analysis found in Chapter 7, Culverts and Bridges.

In cases where curves exist, freeboard must be above the water surface calculated by adding the superelevation, from Equation 7, to the normal water surface elevation. Where design conditions are supercritical in nature, the freeboard should take into consideration the conjugate depths from hydraulic jumps.

5.7 Linings

Typical lining options for engineered open channels are listed and summarized in Section 2.2. As discussed previously, channel linings using natural materials are preferred. Proper planning to provide enough space and to install structural controls is necessary to enable the use of open, vegetated drainage systems to the maximum extent practicable.

Allowable velocities associated with various types of channel linings are summarized in Table 6 (Section 5.3). Velocities can be controlled using a variety of design options, including grade control structures, wide or flat channel cross-sections, and increased channel roughness.

Design criteria for different types of engineered channel linings are provided in Sections 5.7.1 through 5.7.6.

5.7.1 Soil Bioengineered Lining

Soil bioengineering integrates native vegetation as a structural element of streambank stabilization. Whether used alone or in combination with inert natural or manmade materials, plants provide mechanical, hydrologic, and hydraulic benefits. Advantages of soil bioengineering may include:

- Effective protection of streambanks from scouring and overland flows
- Effective energy dissipation in the stream channel
- Protection of aquatic habitat and provision of mosquito control benefits through stream shading and supply of organic materials
- High terrestrial habitat values
- Substantial capacity for self-repair and simple, predictable maintenance
- High aesthetic values

Despite the significant reinforcement provided by soil bioengineering, these treatments should only be used in relatively stable channels or subsequent to systemic stabilization. Soil bioengineering is particularly useful for repairing disturbed banks after construction access or repairing local scour or erosion. Before attempting to reinforce a streambank using soil bioengineering, the designer shall determine whether the instability is caused by fluvial erosion processes or is the result of underlying geotechnical instability. If there is a weaker plane below the root zone, soil bioengineering will not reduce the risk of slope failure. Soil bioengineering alone is not appropriate in areas where rapid drawdown can occur, such as in a spillway or dam embankment. In accordance with the principles of NRCS (1996) and Gray and Sotir (1996), bioengineering projects shall:

- Be self-sustaining or reduce requirements for future human support
- Use native, living materials for restoration
- Restore the physical, biological, and chemical functions and values of streams or shorelines
- Improve water quality through reduction of temperature and chronic sedimentation problems
- Provide opportunities to connect fragmented riparian areas
- Retain or enhance the stream corridor or shoreline system

Guidelines for plants used in soil bioengineering in open channels include:

- Selection of plants and specifications for planting methods and soil amendments shall be prepared by a professional competent in the biological and stabilization properties of plants.
- Plants selected shall be appropriate to local conditions and be native varieties to the greatest extent practical. Evaluation of local conditions includes assessment of site microclimate, bank slope, soil composition, soil strength and fertility, type and condition of existing vegetation, proximity to existing infrastructure, soil moisture conditions, and likelihood of wildlife predation. Engineering factors influencing plant selection include frequency, height, and duration of channel inundation, near-bank shear stress, size and volume of bed load, as well as depth and frequency of scour.
- Plants may be either locally harvested or purchased from commercial nurseries. When harvesting, no more than 10 percent of a given stand may be removed, and no plant on the state rare or endangered species list may be harvested or damaged in harvesting operations. Plant material grown near the metropolitan area is adapted to local climatic conditions and is preferred over more remote sources. Some species such as red maple are

particularly sensitive to locale and may only be used if locally available. Seed, plant plugs, rhizomes, whips, live stakes, bare root, and container stock may be used. Turf grasses, noxious, or invasive species shall not be used. A wide variety of plant species shall be used to provide greater reliability to a design. For critical functions such as protection from toe scour, a minimum of three species should generally be employed.

5.7.2 Grass Lining

When it is not feasible to preserve a natural drainageway or construct a naturalized channel, the preferred method of conveyance is a grass-lined open channel. The design velocity in the channel will determine the type of grass lining to use (see Table 6 [Section 5.3] for allowable velocities for different types of grass linings). Design velocity should be controlled using grade control structures (see Section 6.0, Hydraulic Structures). Channels with relatively low design velocities may be seeded and mulched. If design velocities exceed the allowable for seed and mulch, the channel shall be sod, approved TRM, or approved reinforced sod installed up to the level of the 25-year water surface. Detailed installation specifications that meet or exceed the manufacturer's requirements must be provided to the City for approval. Maintenance specifications may be provided for approval in accordance with manufacturer's specifications and Chapter 12, Easements and Maintenance. A typical detail of an improved natural channel or composite channel is shown in Figure 5.

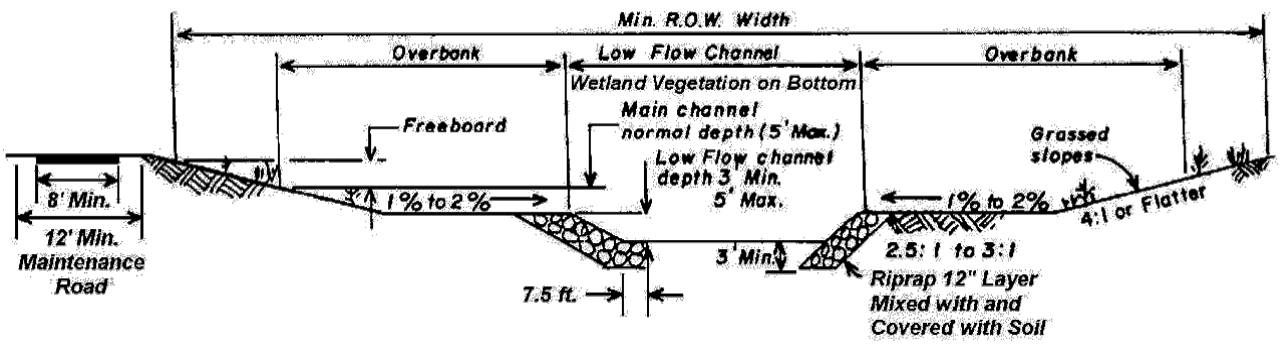


Figure 5. Typical Cross-section of an Improved Natural Channel or Composite Channel

Under bridges, vegetation can be difficult to grow and/or maintain. Therefore, beneath bridges, an erosion-resistant hard lining shall be used, with special care given to erosion protection at each end where the hard lining transitions to the vegetated channel.

Calculations for sizing a grass-lined channel using hydraulic equations from Section 3.0, Open Channel Design Principles, and criteria from Section 5.0, Engineered Channel Design Criteria can be performed using the Design of Trapezoidal Grass-lined Channel Worksheet of the SF-Channels Spreadsheet. For the design of a grass-lined channel with a low-flow channel, the Design of Composite Channel Worksheet of the SF-Channels Spreadsheet can be used. An example of this tool is provided in Example 2 at the end of this chapter.

5.7.3 Manufactured Hard Lining

Higher flow velocities may require a manufactured hard lining, such as articulated blocks, cabled concrete blocks, or other similar materials. Manufactured hard linings that allow for plant growth

and infiltration are preferred to impervious concrete channels. Allowable design velocities for manufactured hard linings are specified in Table 6 (Section 5.3). In cases where a manufactured hard lining is required, the channel is typically lined with an approved material up to the level of the 25-year water surface. Detailed installation specifications that meet or exceed the manufacturer's requirements must be provided to the City for approval. Maintenance specifications must be provided in accordance with manufacturer's specifications and Chapter 12, Easements and Maintenance.

5.7.4 Riprap Lining

Riprap lining should be used only when design constraints prevent the channel design velocity from falling within the allowable range for vegetated channels. Rock used for riprap shall be hard, durable, angular in shape, and free from cracks, overburden, shale, and organic matter. Neither breadth nor thickness of a single stone should be less than one-third its length, and rounded stone should be avoided. Criteria for rock sizing, thickness of riprap layer, and thickness of riprap bedding material are provided in the following subsections.

5.7.4.1 Rock Sizing

For channel slopes less than 5 percent, Equation 10, from the Federal Highway Administration (FHWA) Hydraulic Engineering Circular No. 15 (FHWA 2005), can be used to determine rock sizing for channel armoring. It relates the mean rock diameter used for rip rap to channel depth, channel slope, the Shield's parameter (a non-dimensional number used to calculate the initiation of motion of sediment in a fluid flow), and the specific gravity of the stone being used for riprap. (Note: for steeper channels, with longitudinal slopes greater than 5 percent, Equation 10 should not be solely relied upon and the reader should refer to FHWA 2005).

$$d_{50} \geq \frac{(SF)(d)(S)}{(F*)(SG-1)} \qquad \text{(Equation 10)}$$

In which:

d_{50} = mean rock diameter (ft)

SF = safety factor (unitless, greater than or equal to one) (see Table 7)

d = maximum channel depth (ft)

S = channel slope (ft/ft)

$F*$ = Shield's parameter (unitless) (see Table 7)

SG = specific gravity (unitless)

Equation 11 is based on assumptions related to the relative importance of several variables, including skin friction, form drag, and channel slope (FHWA 2005). However, skin friction and form drag can vary, resulting in variations of the Shield's parameter, which is usually linked to the particle's Reynold's number as defined below:

$$R_e = \frac{(V*)(d_{50})}{v} \quad \text{(Equation 11)}$$

In which:

R_e = Reynold's number

$V*$ = shear velocity (ft/sec) (see Equation 12)

d_{50} = mean rock diameter (ft)

v = kinematic viscosity of water (1.217 x 10^{-5} ft^2/sec at 60 deg F)

Shear velocity (V*) is defined as follows:

$$V* = \sqrt{gdS} \quad \text{(Equation 12)}$$

In which:

$V*$ = shear velocity (ft/sec)

g = gravitational acceleration (32.2 ft/sec^2)

d = maximum channel depth (ft)

S = channel slope (ft/ft)

A higher Reynold's number correlates with a higher Shield's parameter, as shown in Table 7.

Table 7. Selection of Shield's Parameter and Safety Factor

Reynolds Number	Shield's Parameter (F*)	Safety Factor (SF)
≤ 4 x 104	0.047	1.0
4 x 104 < Re< 2 x 105	Linear interpolation	Linear interpolation
≥ 2 x 105	0.15	1.5

A riprap classification can be selected that provides a d_{50} which is at least as large as the size calculated in Equation 10. Classification and gradation of ordinary riprap types are outlined in Table 8. Riprap types VL, L, and M, which are relatively small and light, should be buried with on-site topsoil and vegetated. For boulders, classification and size criteria are provided in Table 9.

Note that Equations 10 through 12 and Tables 8 through 10 are not intended for use in sizing riprap for culvert outlet protection or rundowns. References for sizing riprap for these applications are provided in Section 6.0, Hydraulic Structures.

Table 8. Classification and Gradation of Ordinary Riprap

Riprap Designation	Percent (%) Smaller Than Given by Weight	Intermediate Rock Dimension (inches)	d_{50} (inches)*
Type VL	70-100 50-70 35-50 2 -10	12 9 6 2	6**
Type L	70-100 50-70 35-50 2-10	15 12 9 3	9**
Type M	70-100 50-70 35-50 2-10	21 18 12 4	12**
Type H	70-100 50-70 35-50 2-10	30 24 18 6	18
Type VH	70-100 50-70 35-50 2-10	42 33 24 9	24

* d_{50} = mean particle size (intermediate dimension)

**Mix VL, L, and M riprap with 30 percent (by volume) topsoil and bury it with 6 or more inches of topsoil, all vibration compacted.

Table 9. Classification of Boulders

Boulder Classification	Nominal Size and (Range in Smallest Dimension of Individual Rock Boulders [inches])	Maximum Ratio of Largest to Smallest Rock Dimension of Individual Boulders
B18	18 [17-20]	2.5
B24	24 [22-26]	2.0
B30	30 [28-32]	2.0
B36	36 [34-38]	1.75
B42	42 [40-44]	1.65
B48	48 [45-51]	1.50

5.7.4.2 Riprap Thickness

The riprap blanket thickness shall be at least 1.75 times the d_{50} of the rock used. At the upstream and downstream termination of a riprap lining, the thickness shall be increased 50 percent for at least 3 feet to prevent undercutting.

5.7.4.3 Riprap Bedding

The long-term stability of riprap erosion protection is strongly influenced by proper bedding conditions. Many riprap failures are directly attributable to bedding failures. Properly designed bedding provides a buffer of intermediate-sized material between the channel bed and the riprap to prevent channel particles from being transported through the voids in the riprap. Bedding is required both along the side slopes and the channel bottom for a stable lining. Two types of bedding commonly used are granular bedding filter and filter fabric.

5.7.4.3.1 Granular Bedding

Two types of granular bedding gradations include:

- Type I bedding, which is designed to be the lower layer in a two-layer filter for protecting fine-grained soils. See Table 10 below for gradation requirements.
- Type II bedding, which is designed to be the upper layer in a two-layer filter. See Table 10 below for gradation requirements.

Table 10. Gradation Requirements for Granular Bedding

U.S. Standard Sieve Size	Percent (%) Passing Given by Weight	
	Type I	Type II
3 inches	---	90-100
$^3/_4$ inches	---	20-90
$^3/_8$ inches	100	---
#4	95-100	0-20
#16	45-80	---
#50	10-30	---
#100	2-10	---
#200	0-2	0-3

A bedding that uses Type I and Type II gradations in combination is adequate for most ordinary riprap and grouted riprap applications. Thickness requirements of bedding layers are specified in Table 11.

Table 11. Thickness Requirements for Granular Bedding

Riprap Designation	Minimum Bedding Thickness (inches)		
	Fine-Grained Soils*		Coarse-Grained Soils**
	Type I (lower layer)	Type II (upper layer)	Type II (one layer only)
VL (d_{50} = 6 in), L (d_{50} = 9 in)	4	4	6
M (d_{50} = 12 in)	4	4	6
H (d_{50} = 18 in)	4	6	8
VH (d_{50} = 24 in)	4	6	8

* May substitute one 12-inch layer of Type II bedding. The substitution of one layer of Type II bedding shall not be permitted at drop structures. Use of a combination of filter fabric and Type II bedding at drop structures is acceptable.

** Fifty percent or more retained on the #40 sieve.

A second method for establishing gradation requirements for granular bedding utilizes a procedure referred to as the Terzaghi-Vicksburg (T-V) design (Posey 1960, USACE 1970). The T-V filter criteria establish an optimum bedding gradation for a specific channel soil. Specifications for the T-V filter relate the gradation of the protective upper layer (filter) to that of the lower bed material (base) by the following equations:

$$d_{15(filter)} \leq 5d_{85(base)} \quad \text{(Equation 13)}$$

$$4d_{15(base)} \leq d_{15(filter)} < 20d_{15(base)} \quad \text{(Equation 14)}$$

$$d_{50} < 25d_{50(base)} \quad \text{(Equation 15)}$$

In which:

$d_{(filter)}$ = filter grain size

$d_{(base)}$ = base grain size

Application of channel side slope bedding is shown in Figure 6.

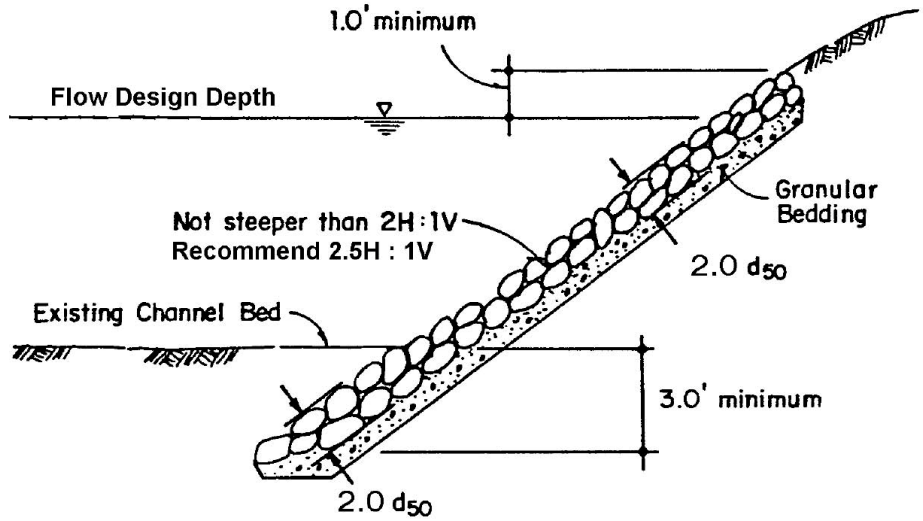


Figure 6. Riprap Channel Side Lining with Toe Protection

5.7.4.3.2 **Filter Fabric**

Filter fabric can serve as a workable supplement to granular bedding in many instances, provided it is properly selected, installed, and not damaged during installation. However, filter fabric is generally not a sole substitute for granular bedding because of several limitations. These include filter fabric's lack of capacity to provide filtering action lengthwise along the fabric, its relatively smooth surface which provides less resistance to stone movement, and its susceptibility to tears when riprap is placed directly upon it, which greatly reduce its effectiveness.

Recognizing its limits, filter fabric may be used in lieu of granular bedding under certain conditions:

- Riprap d_{50} less than 12 inches,
- Longitudinal channel slope less than 2 percent, and
- Channel side slopes no steeper than 3H:1V.

If these conditions are not met, the use of filter fabric must be as a supplement, not as a substitute, for granular bedding. Also, if riprap is placed directly on filter fabric, special care must be exercised during construction to place the rock in a manner that avoids tearing the fabric.

Where filter fabric is used, special care is required at drop structures and sloped channel drops where seepage forces may run parallel to the fabric and cause piping along the bottom surface of the fabric. Seepage parallel with the fabric must be reduced by folding the edge of the fabric vertically downward approximately 2 feet (similar to a cutoff wall) at 12-foot intervals along the installation, particularly at the entrance and exit of the channel reach. Filter fabric must be installed from downstream to upstream, with upstream fabric placed on top of downstream fabric and in accordance with manufacturer's specifications. Filter fabric has only a single equivalent pore opening between the channel bed and the riprap. Fine silt and clay can clog the openings and

prevent free drainage, increasing failure potential due to uplift. For this reason, a double granular filter is often more appropriate bedding for fine silt and clay channel beds.

5.7.5 Grouted Boulders

Grouted boulders provide a useful lining option for low-flow channels and steep banks. Grouted boulders shall be placed directly on subgrade. Full penetration of grout around the lower two-thirds of the rock is essential for successful grouted boulder performance. Grout shall be injected in a manner that minimizes air voids between the grout, subgrade, and boulders. Grout shall be injected with a grout pump and placed by lowering the grouting nozzle to the bottom of the boulder layer and building up the grout from the bottom up, while using a vibrator or aggressive manual rodding. Inject the grout to a depth equal to two-thirds of the boulders' heights, while keeping the upper one-third ungrouted and clean. Remove all grout splatters off the exposed boulder portion immediately after grout injection using wet brooms and brushes.

Technical specifications for grout mix and grout placement are provided with Figure 10.

5.7.6 Concrete Lining

Concrete lining shall be used only when design constraints prevent the channel design velocity from falling within the allowable range for vegetated channels. Generally, concrete channels should only be used for retrofitting in existing urban areas where space is constrained. Well-planned, new developments should not require the use of concrete-lined channels in nearly all cases.

All concrete lining shall be designed to withstand the anticipated hydrodynamic and hydrostatic forces. Trapezoidal channels shall have side slopes no steeper than 1H:1V. Concrete floors and sidewalls for trapezoidal channels shall have a minimum thickness of 6 inches and be reinforced with woven wire or fiber mesh concrete. Rectangular channels shall be structurally designed for all foreseeable loads. All walls shall have a minimum thickness of 6 inches with designed steel reinforcement. In addition, a fence or handrail is required along the top of all channel walls if the channel depth is 3 feet or more, and it is anticipated people will be in close proximity.

Concrete joints shall meet the following criteria:

- Channels shall be constructed of continuously reinforced concrete without transverse joints
- Expansion/contraction joints shall be installed where new concrete lining is connected to a rigid structure or to an existing concrete lining that is not continuously reinforced
- All joints shall be designed to prevent differential movement
- Construction joints are required for all cold joints and where the lining thickness changes. Reinforcement shall be continuous through the joint.

Calculations for sizing of a concrete-lined channel using hydraulic equations from Section 3.0 and criteria from this section can be completed using the Normal and Critical Flow Analysis Worksheet in the SF-Channels Spreadsheet.

5.8 Channel Cross-Section

The channel cross-section must be designed to achieve the desired flow capacity, design velocity, and depth limitations, as well as other objectives such as satisfying needs for wildlife habitat and open space. The most desirable cross-section is one that is relatively wide and primarily vegetated to provide benefits related to recreation, maintenance, safety, water quality, downstream impacts, and habitat.

The channel bottom width shall be designed to satisfy the hydraulic capacity of the cross-section, recognizing the allowable range of velocity, depth, and Froude number. For a given discharge, the bottom width can be calculated using the depth, velocity, and Froude number constraints given in this chapter.

For grass-lined channels, as discussed in Section 5.4.2, the channel shall have a maximum side slope of 4H:1V for safety and aesthetics. A minimum side slope of one percent shall be provided for positive drainage. When base flow is present or is anticipated as the drainage area develops, a trickle or low-flow channel shall be provided. See Section 5.9 for low-flow channel design.

For riprap-lined channels, as discussed in Section 5.7.4, the channel and other armored materials should have a preferred side slope of 3H:1V with a maximum side slope of 2H:1V. Where only the channel sides are to be lined, the riprap blanket shall extend at least 3 feet below the channel flow line, and the thickness of the blanket below the existing channel bed shall be increased to at least 3 times d_{50} to accommodate possible channel erosion.

Concrete-lined channels that are not rectangular shall have a maximum side slope of 1H:1V.

5.9 Low-flow Channels

Low-flow channels are necessary depending on the type of channel lining and the conditions that exist. A low-flow channel may be necessary under these conditions:

- Vegetated channels where:
  - Baseflow exists
  - High peak runoff from developed areas may cause erosion of vegetated areas
  - 1-year flow exceeds 5 cfs (for unreinforced grass only)
- All types of channel linings in locations where erosion could potentially occur, such as downstream of point discharges.

If conditions warrant a low-flow channel, the low-flow channel shall be designed to convey the 1-year flow under fully developed watershed conditions. Variations from this design must be justified by the hydrologic characteristics of the site.

Low-flow channel requirements vary by channel type, as listed below:

- In naturalized channels, low-flow channels typically are unlined. Depending on the projected stresses, riffle areas may require some reinforcement.
- In engineered grass-lined channels, riprap, boulders, or a soil-riprap mix for the low-flow channel lining can provide a stable, vegetated low-flow channel. Soil and riprap should be

mixed prior to placement for these low-flow channels. Vegetated portions of the channel can remain dry and easy to mow and maintain. Typical details of a grass-lined channel with a low-flow channel are shown in Figure 5.

- In engineered channels that are not grass-lined, low-flow channels may consist of riprap, boulders, or concrete, depending on site conditions.

5.10 Outfalls

Outfalls into channels must be designed with consideration given to the nature and condition of the receiving channel. Such outfalls shall be perpendicular to flow or directed downstream. Any protrusions of pipes or other structures into the channel must be trimmed flush with the main channel wall or bank.

Discharges into natural, vegetated, or reinforced vegetated channels shall be at the flow line, in a manner consistent with the channel outfalls for natural channels described in Section 4.3.4. Vegetated or reinforced vegetated channels are generally not capable of withstanding point discharges with high velocities, therefore, the incoming conveyance should be designed to minimize velocity. Energy dissipation, such as a headwall or riprap protection, shall be designed around the outfall to minimize bank, channel, or wall erosion. Energy dissipation in the main channel may be necessary to withstand the flows that occur there.

Discharges into channels lined with concrete or riprap generally require no special protection against erosion. Discharges into hard-lined channels should be a minimum of one foot above the flow line.

6.0 Hydraulic Structures

This manual does not provide detailed information related to the design of large hydraulic structures. In most cases where large and/or complex hydraulic structures are proposed, a preliminary meeting shall be held with City staff. If it is determined that the structure is necessary, it shall adhere to the criteria in this manual and shall be designed by a qualified professional in the design of hydraulic structures.

Specific types of hydraulic structures and suggested references for the designer are listed in Table 12. Although Table 12 is not intended to provide a complete list of hydraulic structure types or reference information, it does provide a general summary of suggested resources for a design engineer working on hydraulic structures. Full citations are provided in Section 9.0, References. For smaller, less complex drop structures, design information is provided in Section 7.0.

Table 12. Suggested Further References for Hydraulic Structures

Type of Hydraulic Structure	Suggested Reference Information
Channel Grade Control	General hydraulic analysis Chow (1959), Rouse (1949), USACE (1994), Henderson (1966), Barnes (1967), Bathurst, Li, and Simons (1979), Sabol (1982), Aisenbrey et al. (1978)
	Hydraulic jump Chow (1959), Little and Daniel (1981), Little and Murphey (1982), USACE (1994), Peterka (1984), Sandover et al. (1962)
	Seepage analysis Cedergren (1967), USBR (1987), Taylor (1967)
Conduit Outlet	Aisenbrey et al. (1974), Biechley (1971), Peterka (1984)
Transitions and Constrictions	Chow (1959), Rouse (1949), FHWA (2000)
Bends and Confluences	Chow (1959), Rouse (1949)
Rundowns	Chow (1959)
Energy Dissipators	Corry et al. (1975), Peterka (1984), Rhone (1977)
Riprap (Different Applications)	Riprap (multiple applications) Abt et al. (1977), Anderson (1968), Anderson et al. (1973), Hughes (1976), Li Simons Assoc. (1989), Maynord (1978), Maynord and Ruff (1987), Reese (1986), USACE (1994), Reese (1984), Stevens et al. (1976), Stevens (1981), U.S. Bureau of Public Roads (1967), US SCS (1976), Wittler and Abt (1988), NCHRP (2006)

7.0 Small Grade Control Structures

This section provides design criteria for relatively small grade control structures. Structures of this type are typically used to maintain acceptable velocities and flow characteristics in order to protect channel stability.

7.1 Small Grade Control Structures

Designs for small grade control structures are presented in this section for a maximum drop height of 2 feet for stable, grass channels that meet the design conditions listed in Table 13.

Table 13. Design Criteria for Small Grade Control Structures

Design Parameter	Criteria
25-year peak flow rate	200 cfs
Typical channel longitudinal slope	0.3 to 0.8 percent
Normal flow depth (maximum)	3 feet
Flow velocity (maximum)	6 ft/s
Froude number (maximum)	0.8
Geotechnical condition (assumed)	Moderate strength clay with chert

Design criteria presented in this section are for grade control structures in relatively small channels and are based on the assumptions that effects are minimal from channel curvature, unstable beds, other hydraulic structures, or other special conditions that require detailed analysis. It is the responsibility of the design professional to determine if these assumptions are met. In addition, grade control structure dimensions may require modifications to adjust the design to field conditions. Deviations from maximum height and flow criteria, or altering designs to have dimensions less than the minimum specified, require project-specific design and analysis. In all cases, the design professional is responsible for the structural integrity of the grade control structure.

The following five types of small grade control structures are described in this section:

- Grouted sloping boulder structure (Section 7.1.2).
- Vertical hard basin structure (Section 7.1.3).
- Sloping concrete structure (Section 7.1.4).
- Newbury-style structure (Section 0).
- Sculpted sloping structure (Section 7.1.6).

The process for selecting the most suitable type of small grade control structure for a specific application is described in Section 7.1.1.

7.1.1 Small Grade Control Structure Selection Process

7.1.1.1 Initial Evaluation Steps

Prior to selecting the most suitable type of grade control structure for the project, these initial evaluation steps must be completed:

- Define the representative channel design flows for the 25-year storm event. If the 25-year design storm flow rate is greater than 200 cfs, the small grade control structure design process described in this section is not appropriate. In such cases, designs for larger grade control structures (see Section 6.0, Hydraulic Structures) shall be developed. If the 25-year design storm flow rate is less than 200 cfs, then the 25-year design flow rate should be used as the basis for peak flow for the small grade control structure design. The channel

dimensions and longitudinal slope necessary to convey the 25-year design flow can then be approximated.

- Determine whether the channel has perennial or intermittent flow. If the channel has intermittent flow, then the Newbury-style structure is not suitable, and an alternative type of grade control structure should be selected.
- Evaluate preliminary grading requirements for the channel and grade control structures, taking into consideration the 2-foot limit on grade control structure heights when using the design criteria outlined in this section.

After completing the initial evaluation steps, the designer should refer to the evaluation criteria described in Section 7.1.1 to select the most suitable type of grade control structure for the site application.

7.1.1.2 Grade Control Structure Evaluation Criteria

Several factors should be taken into consideration to select the appropriate type of small grade control structure for a specific location. Primary considerations include:

- Public safety—Can the grade control structure convey the 25-year design flow without causing undue safety hazards (e.g., creation of reverse roller hydraulic condition that can potentially entrap a person)?
- Functional hydraulic performance of the structure—Can the grade control structure convey the design flow without damaging the structure or the downstream channel?

Secondary considerations include:

- Land use—Is the grade control structure compatible with its surroundings?
- Cost—Does the grade control structure represent the most economical option for channel grade control while simultaneously achieving other design objectives?
- Ecological impact—Is the amount of disturbed area caused by the grade control structure acceptable with respect to the habitat where the structure will be located? Will the completed structure provide habitat benefits and allow aquatic species to move longitudinally upstream and downstream through the structure?
- Aesthetics—Is the grade control structure aesthetically pleasing with respect to its surroundings? (Aesthetics are subjective and are best evaluated by a landscape architect with experience in drainage design.)
- Maintenance—Does the grade control structure have excessive maintenance requirements or costs relative to other grade control structures?
- Environmental permitting—Are there wetlands, habitat disturbance, or other concerns that require permitting for the grade control structure? (Soliciting expertise in environmental permitting is suggested in cases where such matters are a concern.)

Using the primary and secondary considerations listed above, the five types of small grade control structures described in Section 7.1 were evaluated. A summary of the evaluation is presented in Table 14 and a summary of the relative advantages and disadvantages of each structure type, based on the evaluation criteria, is provided in Table 15.

Table 14. Summary of Considerations for Selecting Small Grade Control Structure Type

Considerations for Grade Control Structure Design	Grade Control Structure Type				
	Grouted Sloping Boulder	Concrete Sloping	Vertical Hard Basin	Newbury-style	Sculpted Concrete
Primary Considerations					
Public Safety	More preferred for areas with high public usage.	Less preferred for areas with high public usage.	Less preferred for areas with high public usage, (though the potential for reverse rollers and backflow eddies is reduced with drop of 2 feet or less).	More preferred for areas with high public usage.	More preferred for areas with high public usage.
Functional Hydraulic Performance	Good layout option flexibility. Roughness effective for dissipating kinetic energy.	Maximum vertical drop limited by public safety concern.	Maximum vertical drop limited by public safety concern (see above).	Good flexibility of layout options. Roughness effective for dissipating kinetic energy.	Good flexibility of layout options.
Secondary Considerations					
Land Use (Contextual Design)	Provides natural channel appearance.	Best suited for urban setting.	Best suited for urban setting.	Provides natural channel appearance.	Provides natural channel appearance.
Cost	Costs comparable for all options.	Costs comparable for all options.	Costs comparable for all options.	Costs comparable for all options.	Costs comparable for all options.
Ecological Impacts	Creates larger footprint than vertical drop.	Creates larger footprint than vertical drop. Has no habitat or water quality benefits and may be detrimental.	Creates smallest footprint of any option. Has no habitat or water quality benefits and may be detrimental.	Provides refuge for macroinvertebrates and small fish, fish passage, simulates naturally occurring riffle. Provides refuge during flow event.	Creates larger footprint than vertical drop. Has no habitat or water quality benefits and may be detrimental.
Aesthetics	Natural-appearing, aesthetic option.	Less aesthetic relative to other options.	Less aesthetic relative to other options.	Natural-appearing, aesthetic option.	Natural-appearing, aesthetic option.
Maintenance	Potential for scour erosion at downstream end.	Potential for scour erosion at downstream end.	Sediment deposition in impact basin, scour erosion at downstream end of basin.	Little potential for scour erosion at downstream end.	Potential for scour erosion at downstream end.
Environmental Permitting	More disturbed area than other options.	More disturbed area than other options.	Less disturbed area than other options.	More disturbed area than other options. Simulates naturally occurring riffle. No concrete in stream. Supports terrestrial and aquatic species.	More disturbed area than other options.

Table 15. Summary of Relative Advantages and Disadvantages for Different Types of Small Grade Control Structures

	Grade Control Structure Type				
	Grouted Sloping Boulder	**Concrete Sloping**	**Vertical Hard Basin**	**Newbury-style**	**Sculpted Concrete**
Advantages	• Preferred in areas with high public usage • More aesthetic than vertical hard basin drop • Less maintenance	• Allows for sloped drop if boulders unavailable • Relatively straightforward to construct	• Can use if boulders unavailable • Smaller disturbance area than other structures	• Interstitial rock spaces provide refuge for macroinvertebrates and small fish • More aesthetic than vertical hard basin • Simulates natural riffle • Energy dissipation • Roller and eddies on ramp • No concrete /grout near stream • Not affected by freeze/ thaw like grouted structures • Preferred in areas with high public usage • Less maintenance • Allows for sloped drop if boulders unavailable • Relatively easy to construct • Naturalizes over time	• Preferred in areas with high public usage • Allows for sloped drop if boulders unavailable • More aesthetic than vertical hard basin drop
Disadvantages	• Larger disturbance area	• Larger disturbance area • Less aesthetic • Smooth concrete does not dissipate energy as effectively as rough surfaces, resulting in greater potential for scour at toe of structure	• Less preferred in areas with high public usage • Less visually aesthetic • Higher maintenance caused by scour at bottom of drop	• Shallow slope of rock ramp results in large footprint from structure • Live stake must be planted during dormant period • More difficult to achieve shape in very small streams.	• Requires contractor labor force with specialized skill and/or more field oversight by designer • Less energy dissipation than grouted boulders

Based on the information presented in Table 14 and Table 15, the designer can select the type of small grade control structure that is most suitable for the unique conditions at a specific project site.

7.1.2 Grouted Sloping Boulder Grade Control Structure

Grouted sloping boulder structures provide flexibility in terms of applicability for a range of channel types, from broad floodplains to narrow, incised channels. This type of structure has gained acceptance in areas where quality rock sources are located within reasonably close proximity. Boulders are generally available in sizes up to a maximum diameter of 18 inches. Larger boulders may be difficult to obtain; however, 18-inch diameter boulders should be sufficiently large, in most cases, for the small grade control structures described in this section.

The design criteria outlined below are for grouted sloping boulder structures with a drop of 2 feet or less. For grouted sloping boulder drops of more than 2 feet, a detailed hydraulic analysis shall be conducted, and the design process described in this section is not applicable. (Refer to Section 6.0, Hydraulic Structures).

7.1.2.1 Grouted Sloping Boulder Design Criteria

For channels where the design flow is within the acceptable limits for depth and velocity described in Section 7.1.1, design criteria for a grouted sloping boulder grade control structure with a drop height of 2 feet or less are summarized in Table 16.

Table 16. Design Criteria for Grouted Sloping Boulder Grade Control Structure

General Feature	Design Parameter	Parameter Value
Approach	Approach length (La)	8 feet (armored with grouted rock-see below for boulder sizing)
Boulders	Boulder sizing—nominal size	18 inches (acceptable range: 17 to 20 inches)
	Boulder placement—crest and cutoff	Grouted boulders must cover the crest and cutoff and extend downstream through the energy dissipating basin
	Boulder placement—through drop	Boulders must be carefully placed to create a stepped appearance, which helps to increase roughness.
	Boulder placement—basin end	Boulders must be placed at basin end to create a sill transition to downstream channel invert elevation.
Grout	Grout thickness (Dg)	½ mean diameter of boulders (Dr)
Crest	Crest width (minimum)	Minimum width same as upstream channel bottom width
Longitudinal slope of drop	Maximum slope	4H:1V (slopes flatter than 4:1 promote increased safety, enhanced structure stability, and improved appearance)
Basin Geometry	Basin length (Lb)	20 feet
	Basin width (B)	Same as crest width
	Basin depression	1 foot
Low-flow Zone (if necessary)	Upstream configuration	Trickle or low-flow channel should extend through the drop crest section

General Feature	Design Parameter	Parameter Value
	Downstream configuration	Trickle or low-flow channel protection should extend downstream from the main channel protection
	Trickle zone protection width below drop	Smaller of: i) 3 times trickle zone channel width, or ii) trickle zone channel width, squared
	Energy dissipation	Install large boulders in center basin zone to dissipate energy of high flow stream
Downstream channel	Downstream channel armoring	Buried riprap zone shall be installed for a minimum of 10 feet downstream of the drop basin sill

Note: Design guidelines contained in this table are for channels that meet the threshold criteria for maximum allowable flow depth and velocity.

7.1.2.2 Grouted Sloping Boulder Construction Concerns

The grouted sloping boulder grade control structures require significant construction control efforts. To achieve acceptable structural integrity, the quality of rock used and proper grouting procedure are key concerns.

Problems with rock density, durability, and hardness can vary widely for different locations. The rock shall be inspected at regular intervals to ensure it meets minimum physical dimensions, strengths, and weights as defined in the specifications.

Individual boulders shall be used that are all larger in diameter than the grout layer so that the contractor and the inspector can verify the grout depth and have grout placed directly to the subgrade. Individual boulders should be machine-placed one at a time in their final position. The best balance is to use boulders with twice the diameter of the grout thickness and with overall mass sufficient to offset uplift (taking into consideration a safety factor). This procedure also improves the overall appearance of the structure.

The condition of the subgrade and adequate seepage control are critical. The subgrade is frequently disturbed during rock placement, leaving a potential route for water piping. This condition should be controlled by good subgrade preparation, careful rock placement, and removal of loose materials. Absolutely no granular bedding or subgrade fill using granular materials shall be used because of the potential for piping.

With respect to grouting, the greatest potential inadequacy lies with grout that does not penetrate the voids fully between the rock and the subgrade, resulting in voids below the grout that act as a preferential pathway for water. Specifications regarding grout material and grout placement are provided in Figure 10.

7.1.2.3 Grouted Sloping Boulder Design Drawings

Design drawings for a grouted sloping boulder grade control structure are shown in Figure 7 through Figure 10.

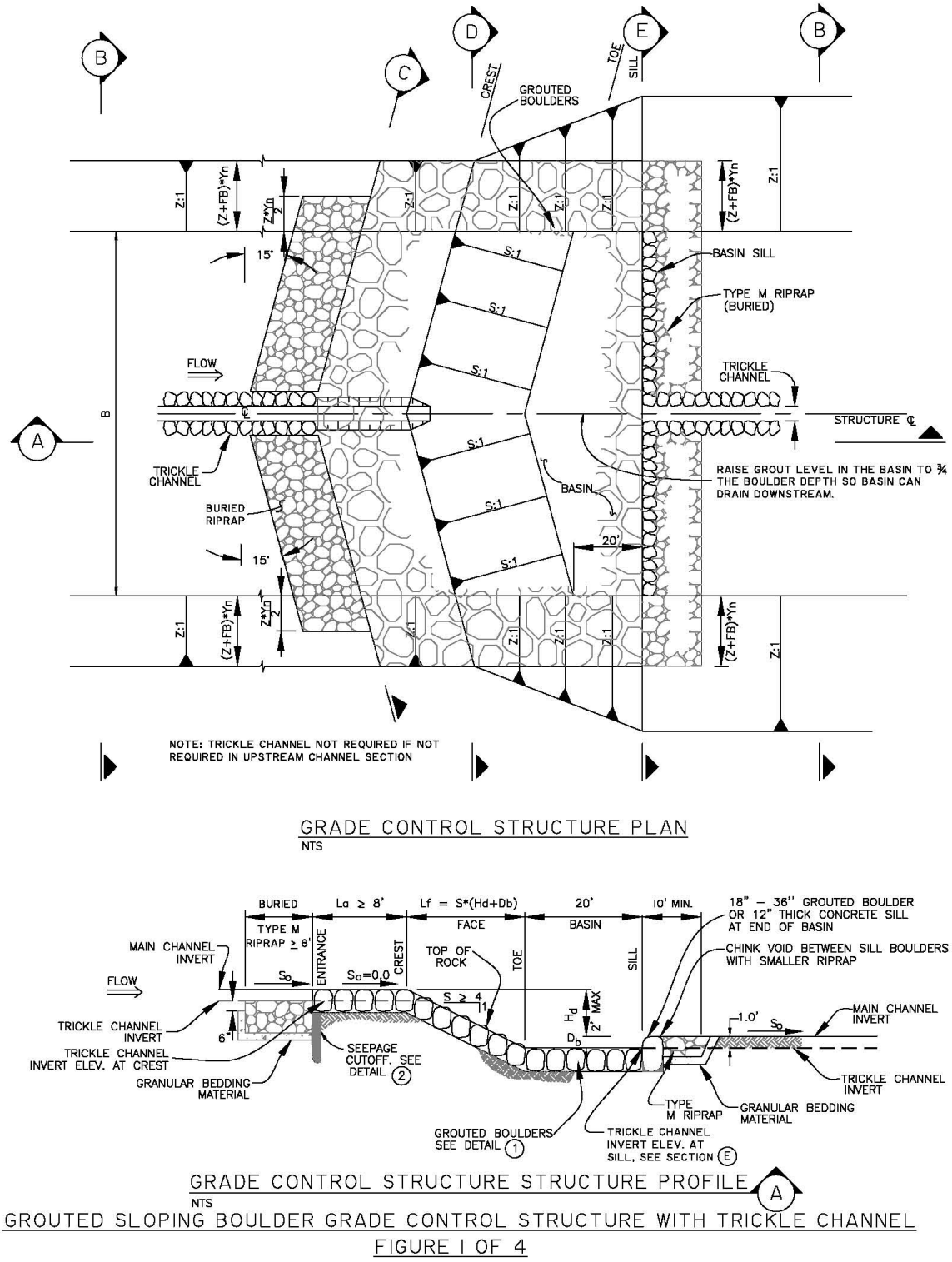


Figure 7. Grouted Sloping Boulder Grade Control Structure (1 of 4)

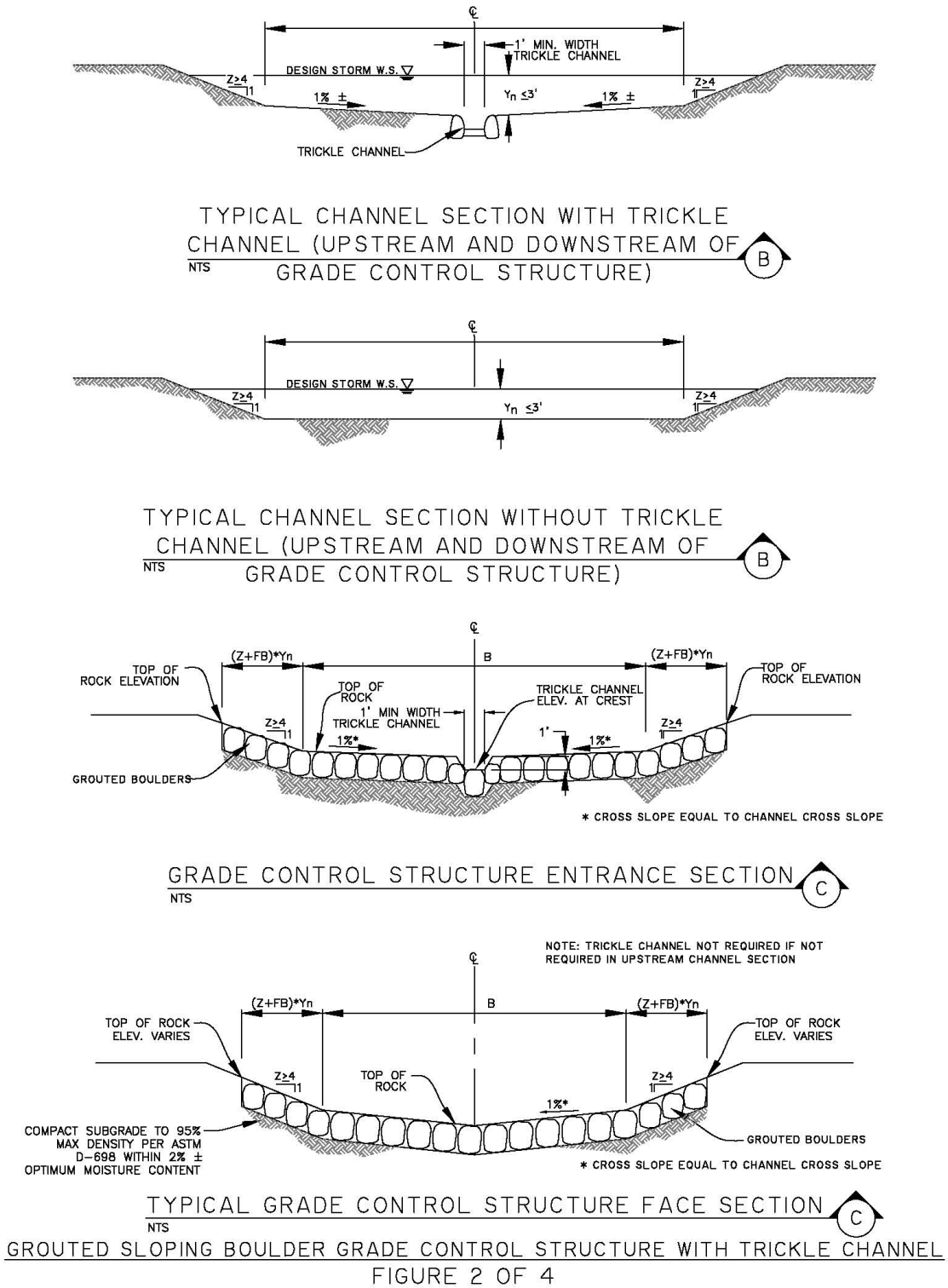


Figure 8. Grouted Sloping Boulder Grade Control Structure (2 of 4)

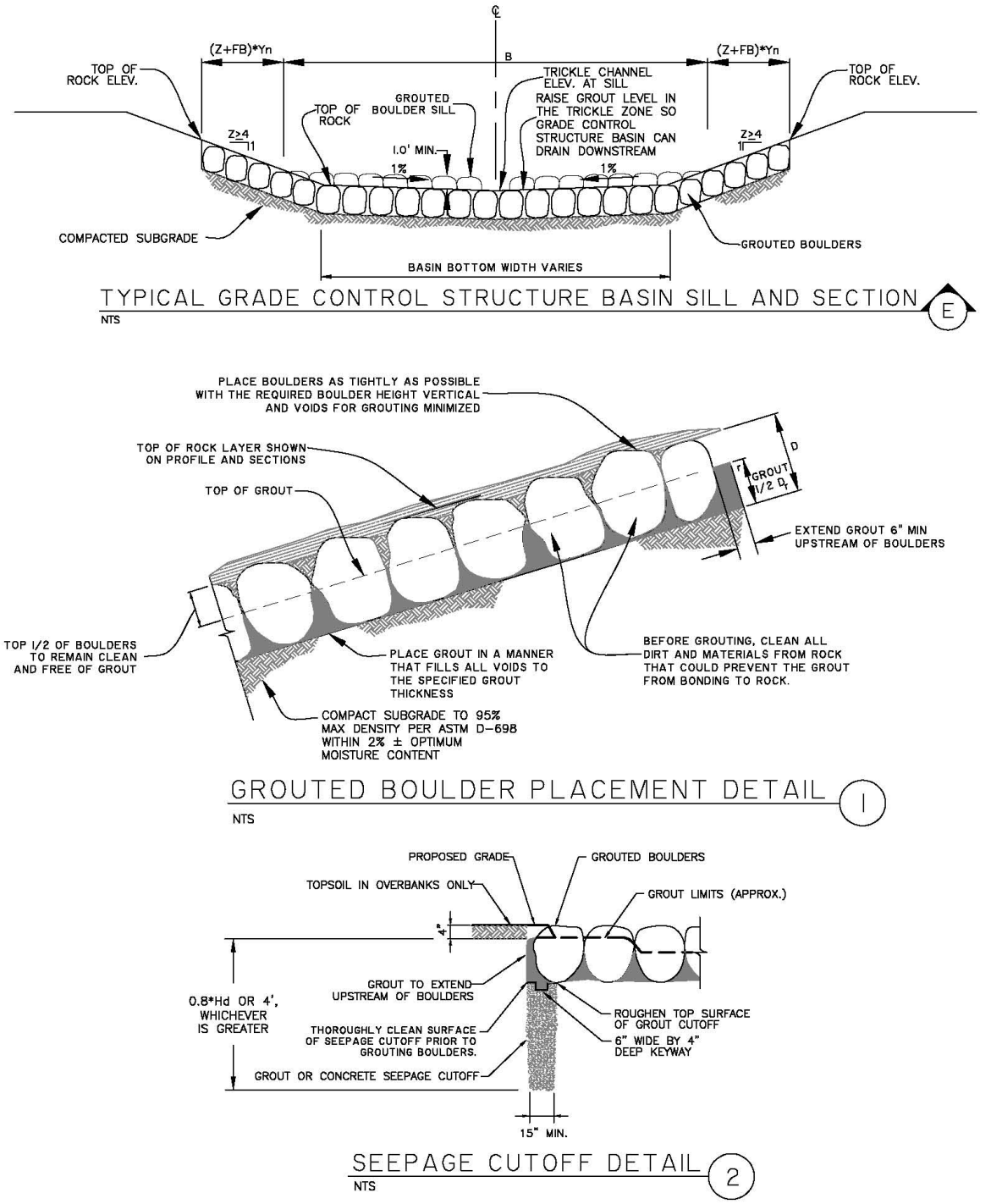


Figure 9. Grouted Sloping Boulder Grade Control Structure (3 of 4)

GROUT NOTES

Material Specifications

1. All grout shall have a minimum 28-day compressive strength equal to 4000 psi.
2. One cubic yard of grout shall have a minimum of six (6) sacks of Type II Portland cement.
3. A maximum of 25% Type F Fly Ash may be substituted for the Portland cement.
4. For Type A grout, the aggregate shall be comprised of 70% natural sand (fines) and 30% ⅜ -inch rock (coarse).
5. For Type B grout, the aggregate shall be comprised of ¾ -inch maximum gravel, structural concrete aggregate.
6. Type B grout shall be used in streams with significant perennial flows.
7. The grout slump shall be 4-inches to 6-inches.
8. Air entrainment shall be 5.5%–7.5%.
9. To control shrinkage and cracking, 1.5 pounds of Fibermesh, or equivalent, shall be used per cubic yard of grout.
10. Color additive in required amounts shall be used when so specified by contract.

Placement Specifications

1. All Type A grout shall be delivered by means of a low pressure (less than 10 psi) grout pump using a 2-inch diameter nozzle.
2. All Type B grout shall be delivered by means of a low pressure (less than 10 psi) concrete pump using a 3-inch diameter nozzle
3. Full depth penetration of the grout into the boulder voids shall be achieved by injecting grout starting with the nozzle near the bottom and raising it as grout fills, while vibrating grout into place using a pencil vibrator.
4. After grout placement, exposed boulder faces shall be cleaned with a wet broom.
5. All grout between boulders shall be treated with a broom finish.
6. All finished grout surfaces shall be sprayed with a clear liquid membrane curing compound as specified in ASTM C-309.
7. Special procedures shall be required for grout placement when the air temperatures are less than 40°F or greater than 90°F. Contractor shall obtain prior approval from the design engineer of the procedures to be used for protecting the grout.
8. Clean Boulders by brushing and washing before grouting.

GROUTED SLOPING BOULDER GRADE CONTROL STRUCTURE WITH TRICKLE CHANNEL
FIGURE 4 OF 4

Figure 10. Grouted Sloping Boulder Grade Control Structure (4 of 4)

7.1.3 Vertical Hard Basin Grade Control Structure

The vertical hard basin grade control structure provides design flexibility through the use of different components for the crest wall, hard basin, and low-flow or trickle channel. However, despite the flexibility of designs, vertical drops should be avoided where practical due the potential for turbulent hydraulic conditions and related maintenance, depending on the flow regime (ASCE and WEF 1992).

Photo 12. Vertical hard basin grade control structure.

A vertical grade control structure creates a jet of water that overflows the crest wall into the basin below. The jet hits the basin and is redirected horizontally in a supercritical mode until the specific force of the tailwater is sufficient to force the hydraulic jump. The turbulence of the hydraulic jump dissipates energy. Therefore, the basin shall be sized large enough to contain the supercritical flow and the associated turbulent zone of the hydraulic jump that can cause channel erosion. A rough basin is generally advantageous since increased roughness will result in a shorter, more economical basin. An example of a rough basin is shown in Photograph 14, with boulders placed in the basin to dissipate energy.

The design criteria outlined below are for vertical hard basin drops of 2 feet or less. Vertical drops greater than 2 feet raise safety concerns related to the potential for creating a hydraulic condition, known as a "reverse roller," that can form during certain flow conditions and entrap a person. Therefore, for vertical drops larger than 2 feet, a detailed hydraulic analysis shall be conducted (see Section 6.0, Hydraulic Structures) and the design process described in this section is not applicable.

7.1.3.1 Vertical Hard Basin Design Criteria

For channels where the design flow is within the acceptable limits for depth and velocity described in Section 7.1.1, design criteria for a vertical hard basin grade control structure, with a drop height of 2 feet or less, are summarized in Table 17.

7.1.3.2 Vertical Hard Basin Construction Concerns

Construction of an end sill in the hard basin is necessary to dissipate kinetic energy and reduce erosion effects at the transition between the basin and the downstream channel. However, even with an end sill, the transition area between the end of the basin and the downstream channel is susceptible to erosion. Armoring of the channel at the downstream end of the basin is necessary to minimize erosion effects. Buried riprap shall be placed for a minimum of 10 feet downstream of the drop basin sill.

7.1.3.3 Vertical Hard Basin Design Drawings

Design drawings for a vertical hard basin grade control structure are shown in Figure 11.

Table 17. Design Criteria for Vertical Hard Basin Grade Control Structure

General Feature	Design Parameter	Parameter Value
Approach	Approach length (L_a)	10 feet (armored with buried riprap)
Crest	Crest width (minimum)	Minimum width same as upstream channel bottom width
Basin geometry	Basin length (L_b)	25 feet
	Basin width (B)	Same as crest width
	Basin depression	1 foot
Basin sill (concrete)	Sill thickness	6 to 8 inches
Basin sill (grouted boulders)	Boulder sizing—nominal dimension	18 inches
	Grout thickness (D_g)	9 to 12 inches (Apply thicker grout at edges to direct flow to center. Cover grouted boulders on side slopes by filling to top of boulder with lightly compacted in-situ soil and capping with a minimum of 4 inches of topsoil. Vegetate buried surfaces with native grasses).
Trickle flow zone (if necessary)	Energy dissipater placement	Install large boulder or baffles in center zone to break up high flow stream-locate downstream from point where nappe hits basin and at least 10 feet from the basin end.
	Energy dissipater placement	Boulders used to dissipate energy shall be sized to project into the flow 0.6 to 0.8 times the critical depth.
Downstream channel	Downstream channel armoring	Buried riprap zone shall be installed for a minimum of 10 feet downstream of the drop basin sill.

Note: Design guidelines contained in this table are for channels that meet the threshold criteria for maximum allowable depth and velocity.

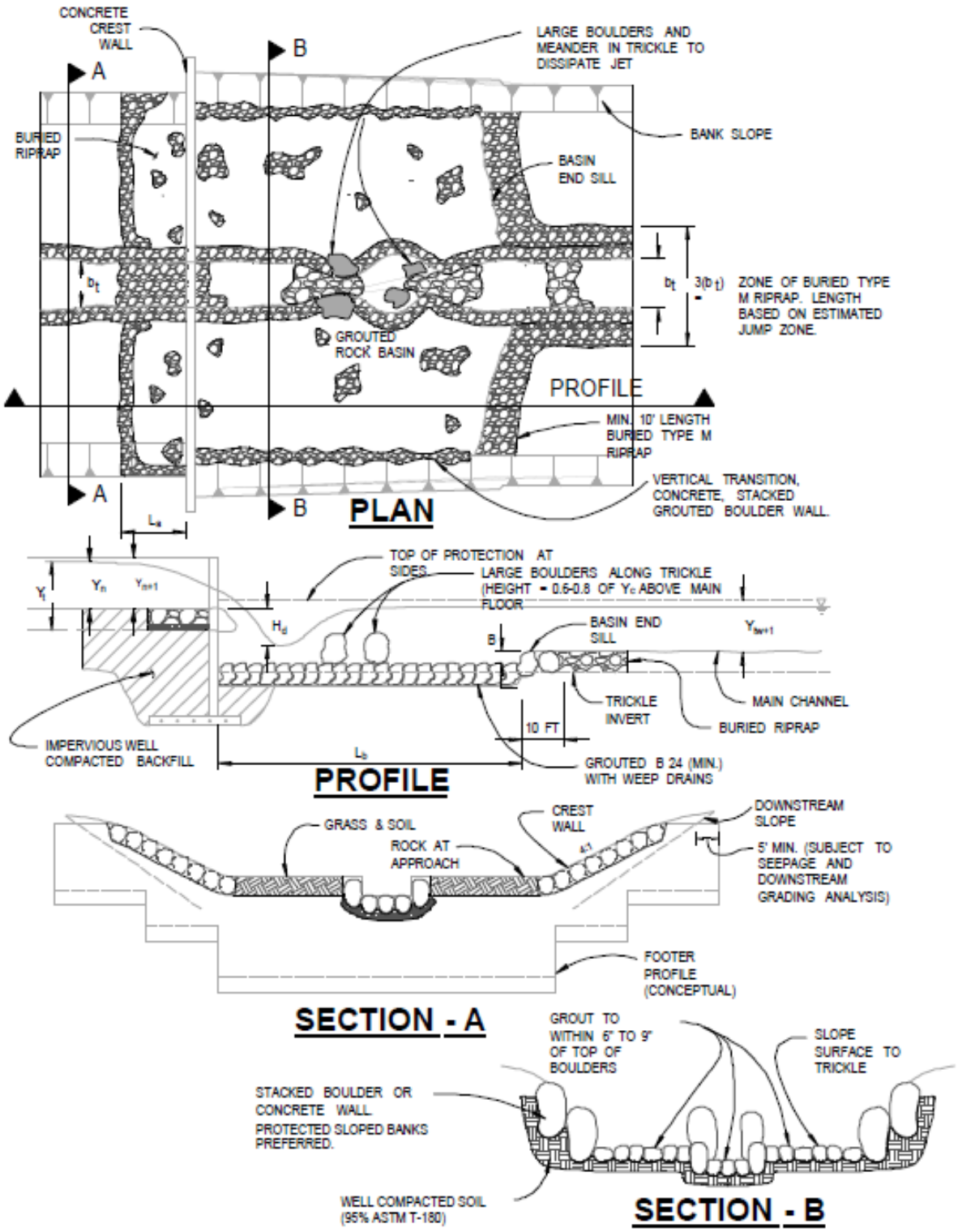


Figure 11. Vertical Hard Basin Grade Control Structure

7.1.4 Sloping Concrete Grade Control Structure

In areas where adequately-sized boulders are not available, a sloping concrete grade control structure provides an alternative to the grouted sloping boulder structure described in Section 7.1.2, although the smooth sloping concrete structure does not dissipate energy as effectively as the grouted boulders.

Photo 13. Sloping concrete grade control structure.

7.1.4.1 Sloping Concrete Grade Control Structure Design Criteria

For channels where the design flow is within the acceptable limits for depth and velocity described in Section 7.1.1, design criteria for a sloping concrete grade control structure, with a drop height of 2 feet or less, are summarized in Table 18.

7.1.4.2 Sloping Concrete Grade Control Structure Construction Concerns

The transition between the basin and the downstream channel is susceptible to scour and erosion. Armoring of this transition area is critical for reducing channel maintenance.

7.1.4.3 Sloping Concrete Grade Control Structure Design Drawings

Design drawings for a sloping concrete grade control structure are shown in Figure 12.

Table 18. Design Criteria for Sloping Concrete Grade Control Structure (with Drop Height of 2 Feet or Less)

General Feature	Design Parameter	Parameter Value
Approach	Approach length (L_a)	10 feet (armored with buried riprap)
Crest	Crest width (minimum)	Minimum width same as upstream channel bottom width
Longitudinal slope of drop	Maximum slope	4H:1V
Basin Geometry	Basin length (L_b)	20 feet
	Basin width (B)	Same as crest width
	Basin depression	1 foot
Low-flow zone (if necessary)	Upstream configuration	Trickle or low-flow channel should extend through the drop crest section
	Downstream configuration	Trickle or low-flow channel protection should extend downstream from the main channel protection
	Trickle zone protection width below drop	Whichever is smaller of: i) 3 times trickle zone channel width, or ii) trickle zone channel width, squared
	Energy dissipation	Install concrete baffles or large boulders in center basin zone to dissipate energy of high flow stream
Downstream channel	Downstream channel armoring	Buried riprap zone shall be installed for a minimum of 10 feet downstream of the drop basin

Note: Design guidelines in this table are for channels that meet the threshold criteria for maximum allowable depth and velocity.

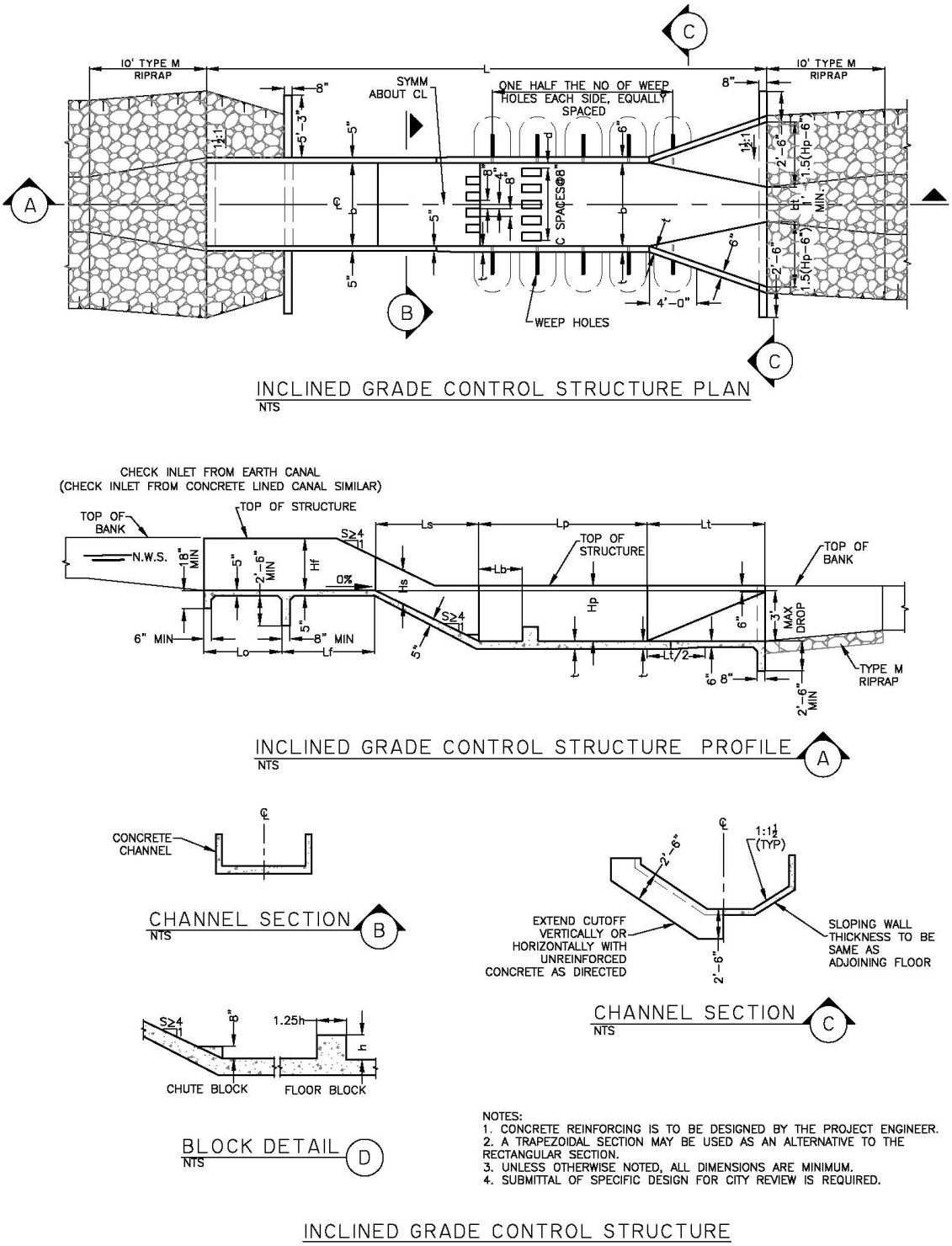


Figure 12. Sloping Concrete Grade Control Structure

7.1.5 Newbury-style Grade Control Structure

A Newbury-style grade control structure during and following construction is shown in Photographs 16 and 17.

Photo 14. Newbury-style grade control structure under construction.

Photo 17. Newbury-style grade control structure following construction.

A Newbury-style grade control is similar to a naturally occurring riffle in a cobble or gravel stream and is useful for both grade stabilization and energy dissipation. While the Newbury-style grade control structure was originally designed to promote fish passage, an added benefit of the structure is the space between rocks that provides refuge for macroinvertebrates and small fish. Similar to the riffle it simulates, the crest height of a Newbury-style grade control structure is close to the height of bank-full flow.

In plan view, the crest of a Newbury-style grade control structure forms an arch, with the open end facing downstream (see Figure 13). In section-view, the crest slopes from the banks to the thalweg. The crest shall be sufficiently keyed into the bed and banks of the channel to prevent flows from scouring under or around the ends of the grade control (see Table 19 for key depth specifications). Existing vegetation is preserved during construction to the extent possible.

Although the typical longitudinal channel slope for the small grade control structures described in this section ranges from 0.3 to 0.8 percent, Newbury structures can be used for channels with longitudinal slopes as steep as 2 percent.

The shape of a Newbury-style grade control structure directs the main flow path away from the banks and onto the downstream rock ramp (Photograph 17). A Newbury-style structure does not have to be symmetrical in either plan or section. By varying the shape, flow can be turned slightly to match the thalweg transitions through meanders. To facilitate proper flow patterns, the constructed upstream face shall not be flat. In general, since Newbury-style grade controls have a crest height of 2 feet or less, and a shallow slope on the downstream rock ramp (20H:1V), the hydraulic jump normally occurs on the tail ramp.

The upstream and downstream limits and sides of the Newbury structure above the bank-full elevation are live-staked to interlock the rock structure into the banks. Plant species and staking specifications are described in Table 19. In addition to interlocking with the rocks, the live stakes provide an effective transition between the natural bank and the rock structure. Further, the hydraulic roughness of the live stakes helps direct flow away from the banks, which minimizes scour at the rock-soil interface.

7.1.5.1 Newbury-style Grade Control Structure Design Criteria

For channels where the design flow is within the acceptable limits for depth and velocity described in Section 7.1.1, design guidelines for a Newbury-style grade control structure, with a drop height of 2 feet or less, are summarized in Table 19.

Table 19. Design Criteria for Newbury Grade Control Structure

General Feature	Design Parameter	Parameter Value
Rock	Size	For channels with longitudinal slope of 0.5 percent, rock d_{50} = 10 inches For channels with longitudinal slope of 0.8 percent, rock d_{50} = 12 inches Rock shall be well-graded and contain sufficient fines (approximately 30 percent) to fill voids
Crest	Side slopes	5H:1V to 10H:1V
	Streambank angle (normal soils)	80 degrees (see **Error! Reference source not found.** Figure 13) (angle can be decreased for less erosive soils, though designer should check potential for bank erosion)
	Key depth	1.5 D_{90} below the thickness of rock ramp (see rock sizing procedure following this table to calculate D_{90})
Downstream Rock Ramp	Slope	20H:1V
	Tail angle	80 degrees (see Figure 13) (angle can be decreased for less erosive soils, though designer should check potential for bank erosion)
Live stake plantings	Suitable plant types	Shrub willow, swamp or redosier dogwood, buttonbrush (Taller species, such as black willow, shall not be used)
	Stake length below grade	1 foot (minimum)
	Stake length above rock surface	1 foot (maximum)
	Stake angle	Approximately 15 to 20 degrees downstream (to prevent debris trapping)

Note: Design guidelines contained in this table apply to Newbury grade control structures in natural channels.

7.1.5.2 Newbury-style Grade Control Structure Rock Sizing Procedure

Structures shall be constructed from durable rock, sized using the USACE methodology for steep channels (USACE EM 1110-2-1601, page 3-8, Equation 3-5). Rock shall generally comply with the

requirements of riprap. Well-graded shotrock with sufficient fines to fill voids may be used. The use of filter fabric and uniform gradations of rock are discouraged in streambeds.

7.1.5.3 Newbury-style Grade Control Structure Construction Concerns

Grade control structure designs discussed in this chapter are for longitudinal slopes ranging from 0.3 to 0.8 percent. For steeper bed slopes, particularly if greater than 2 percent, Newbury-style structures shall not be used because of the necessity for near-continuous and unnecessary bed armoring. Other structures are more appropriate for steeper slopes (see Section 6.0, Hydraulic Structures).

Where possible, Newbury-style grade controls should be reinforced with live stakes at the downstream crest and edges of each structure. Live stakes shall be installed while dormant. Species selection criteria should include tolerance to inundation, scour, and bed load impact. Stoloniferous species (those capable of sending up shoots from shallow stems) are strongly preferred. Taller species, such as black willow, shall not be used as live stakes. Taller species do not provide sufficient hydraulic roughness at the bank toe to effectively dissipate energy.

7.1.5.4 Newbury-style Grade Control Structure Design Drawings

Design drawings for a Newbury-style grade control structure are shown in Figure 13.

7.1.6 Sculpted Sloping Grade Control Structure

Sculpted sloping grade control structures provide an aesthetically appealing option for channel grade control and can be used in situations where certain options for grade control, such as grouted sloping boulders, may not be feasible because of an inadequate supply of available materials.

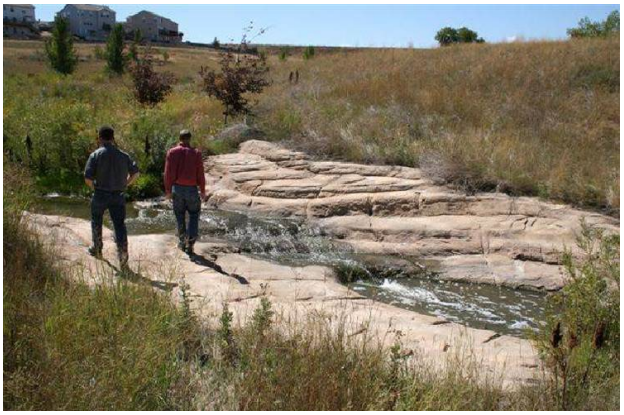


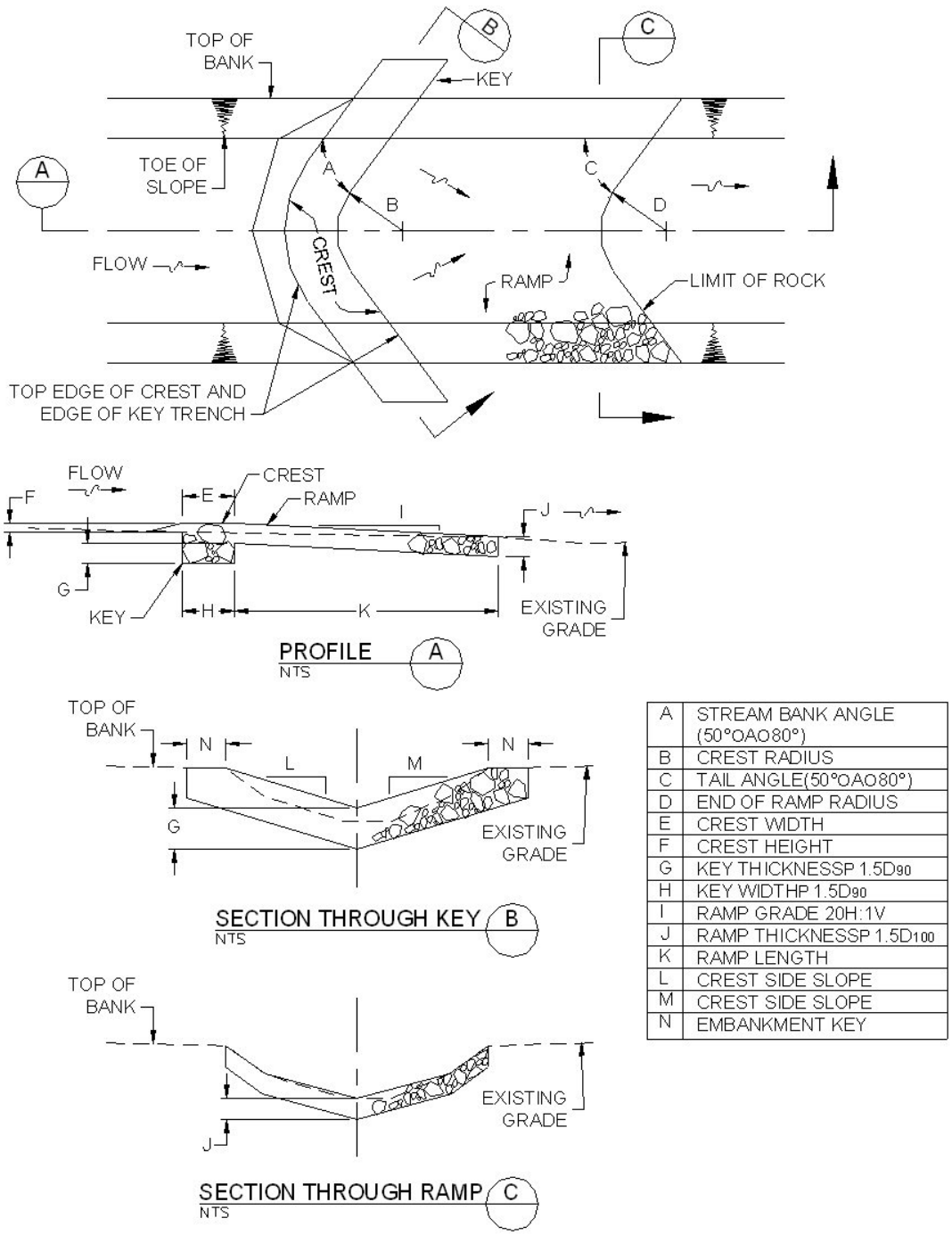
Photo 15. Sculpted sloping grade control structure designed to blend into landscape.

7.1.6.1 Sculpted Sloping Grade Control Structure Design Criteria

For channels where the design flow is within the acceptable limits for depth and velocity described in Section 7.1.1, design guidelines for a sculpted sloping grade control structure, with a drop height of 2 feet or less, are summarized in Table 20.

7.1.6.2 Sculpted Sloping Grade Control Structure Construction Concerns

Design of sculpted sloping grade control structures requires an understanding of local rock outcroppings. Consultation with a geologist or landscape architect, as necessary, is recommended. Construction of sculpted sloping grade control structures requires using a labor force with proper concrete forming and shaping skills to create a structure that is structurally sound and achieves the aesthetic objectives. Construction of a sculpted sloping grade control structure will require additional oversight by the designer to ensure the structure meets the design requirements.



A	STREAM BANK ANGLE (50°OAO80°)
B	CREST RADIUS
C	TAIL ANGLE(50°OAO80°)
D	END OF RAMP RADIUS
E	CREST WIDTH
F	CREST HEIGHT
G	KEY THICKNESSP 1.5D90
H	KEY WIDTHP 1.5D90
I	RAMP GRADE 20H:1V
J	RAMP THICKNESSP 1.5D100
K	RAMP LENGTH
L	CREST SIDE SLOPE
M	CREST SIDE SLOPE
N	EMBANKMENT KEY

Figure 13. Newbury Grade Control Structure

7.1.6.3 Sculpted Sloping Grade Control Structure Design Drawings

Design drawings for a sculpted sloping grade control structure are shown in Figure 14 and Figure 15.

Table 20. Design Guidelines for Sculpted Sloping Grade Control Structure

General Feature	Design Parameter	Parameter Value
Approach	Approach length (L_a)	10 feet (armored with buried riprap)
Crest	Crest width (minimum)	Minimum width same as upstream channel bottom width
Longitudinal slope of drop	Maximum slope	4H:1V
Basin Geometry	Basin length (L_b)	20 feet
	Basin width (B)	Same as crest width
	Basin depression	1 foot
Low-flow Zone	Configuration	No trickle or low-flow channel in sculpted sloping structure
Downstream channel	Downstream channel armoring	Buried riprap zone shall be installed for a minimum of 10 feet downstream of the drop basin

Note: Design guidelines contained in this table are for channels that meet the threshold criteria for maximum allowable depth and velocity.

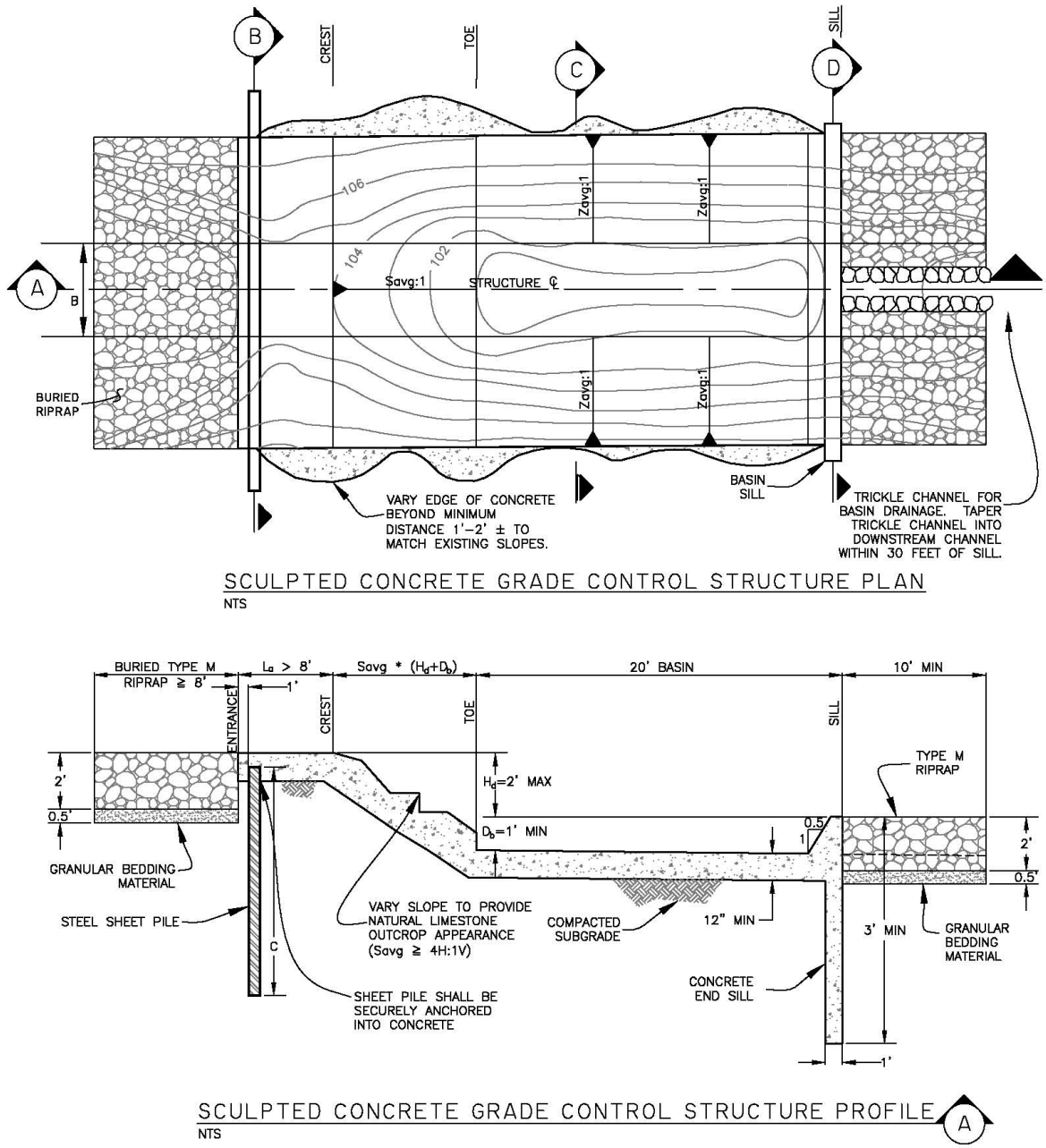
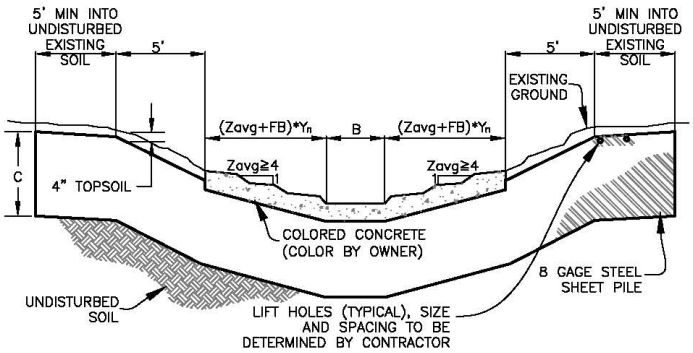
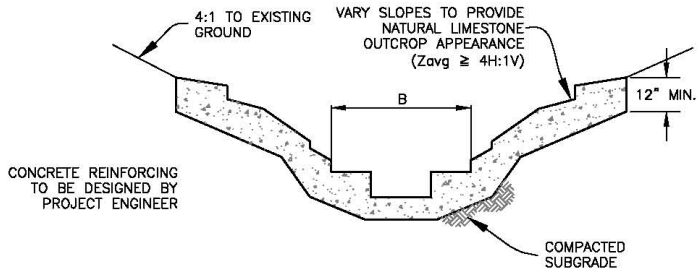


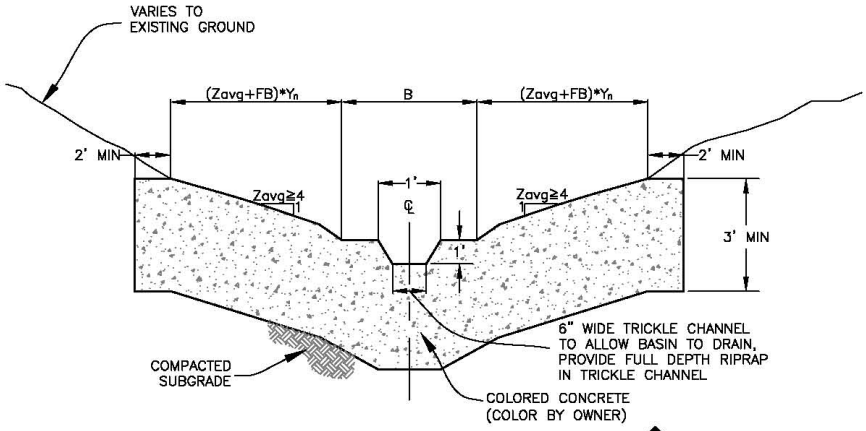
Figure 14. Sculpted Sloping Grade Control Structure (1 of 2)



STEEL SHEET PILE SECTION B
NTS



BASIN SECTION C
NTS



CONCRETE END SILL SECTION D
NTS

SCULPTED CONCRETE GRADE CONTROL STRUCTURE
FIGURE 2 OF 2

Figure 15. Sculpted Sloping Grade Control Structure (2 of 2)

8.0 Examples

8.1 Example 1. Normal Depth Calculation Using Normal and Critical Flow Analysis Worksheet

This example demonstrates use of the Normal and Critical Flow Analysis Worksheet in the SF-Channels Spreadsheet to determine the capacity and other relevant hydraulic parameters for a channel, given the channel's geometry and flow at normal depth.

8.1.1 Data Input

Channel characteristics and sizing constraints are entered into the "Design Information (Input)" section of the Normal and Critical Flow Analysis Worksheet. For this example, a grass-lined trapezoidal channel, channel characteristics and constraints are listed below:

8.1.1.1 Channel Characteristics:

S_o = channel invert slope (longitudinal slope) = 0.003 ft/ft (0.3%)

n = Manning's n (grass-lined channel, not mowed, average condition) = 0.035

(Note: Manning's n values are provided for different channel linings in the Design Info Worksheet of the SF- Channels Spreadsheet)

B = bottom width = 8 ft

$Z = Z_1 = Z_2$ = channel side slopes (left and right) = 4H:1V

8.1.1.2 Constraints:

F = freeboard height required = 2.0 ft

Y = design water depth (maximum allowable depth of flow in channel) = 5.0 ft

8.1.2 Results

Results of the analysis are displayed in the bottom half of the Normal and Critical Flow Analysis Worksheet (see sample worksheet on following page). Results include the following:

Channel flow capacity	655 cfs
Total bank height necessary	4.9 ft
(hydraulic depth + required freeboard)	
Flow regime	Subcritical (Fr = 0.48)
Flow velocity	4.68 ft/s

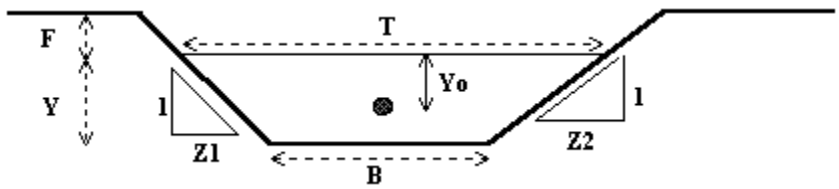
Note: The estimated velocity (4.68 ft/s) is above the maximum allowable velocity (4 ft/s) for a 25-year event for a grass-lined channel using seed and mulch. The designer must consider changing the channel geometry or using a lining (such as sod, with a maximum allowable velocity of 6 ft/s) for which the maximum allowable velocity will not be exceeded. In addition, the spreadsheet

should be re-run using a lower Manning's n value (e.g., 0.030, the minimum Manning's n for an un-mowed grass-lined channel) to assess whether the maximum velocity criterion is exceeded for the channel lining selected.

Normal Flow Analysis - Trapezoidal Channel

***** DRAFT *****

Project: Example OC-1
Channel ID: Sample



Design Information (Input)			
Channel Invert Slope	So =	0.0030	ft/ft
Manning's n	n =	0.035	
Bottom Width	B =	8.00	ft
Left Side Slope	Z1 =	4.00	ft/ft
Right Side Slope	Z2 =	4.00	ft/ft
Freeboard Height	F =	2.00	ft
Design Water Depth	Y =	5.00	ft

Clear all cells

Normal Flow Condtion (Calculated)			
Discharge	**Q =**	**655.24**	cfs
Froude Number	**Fr =**	**0.48**	
Flow Velocity	**V =**	**4.68**	fps
Flow Area	A =	140.00	sq ft
Top Width	T =	48.00	ft
Wetted Perimeter	P =	49.23	ft
Hydraulic Radius	R =	2.84	ft
Hydraulic Depth	D =	2.92	ft
Specific Energy	Es =	5.34	ft
Centroid of Flow Area	Yo =	1.89	ft
Specific Force	Fs =	22.49	kip

8.2 Example 2. Composite Section Calculation Using Composite Channel Worksheet

This example demonstrates use of the Design of Composite Channel Worksheet (in the SF-Channels Spreadsheet) to calculate channel cross-section geometry parameters for a composite channel consisting of:

- A low-flow channel with side slope protection for conveyance of frequent flows (up to 2-year).
- Vegetated overbanks to accommodate larger runoff events (up to the 25-year event).

8.2.1 Data Input

The grass-lined composite channel sizing is based on the following hydraulic design parameters entered into the "Design Information (Input)" section of the Design of Composite Channel Worksheet.

Q_{2yr} = 2-year discharge	300 cfs
Q_{25yr} = 25-year discharge	600 cfs
(for fully-developed, un-detained condition)	
Q_{lf} = design discharge for low-flow channel	200 cfs
Z_1 = low-flow channel left side slope	3H:1V
Z_2 = low-flow channel right side slope	3H:1V
N-min-lf = low-flow channel Manning's n (minimum)	0.03
N-max-lf = low-flow channel Manning's n (maximum)	0.04
Low-flow channel lining type	grass (sod)
Y_m = low-flow channel bank-full depth	2 ft
B_m = low-flow channel bottom width	4 ft
Longitudinal channel invert slope	0.005 ft/ft (0.5%)
Z_L = left overbank side slope	4H:1V
N-left-min = left overbank Manning's n (minimum)	0.03
N-left-max = left overbank Manning's n (maximum)	0.04
Left overbank channel lining type	grass (seed and mulch)
Z_R = right overbank side slope	4H:1V
N-right-min = right overbank Manning's n (minimum)	0.03

N-right-max = right overbank Manning's n (maximum)	0.04
Right overbank channel lining type	grass (seed and mulch)
Y_{ob} = overbank flow depth	1.5 ft
Left overbank width as a percentage of total overbank width	50%

8.2.2 Results

Results of the analysis are displayed in the bottom half of the Design of Composite Channel Worksheet (see sample worksheet following this text). Results include the following:

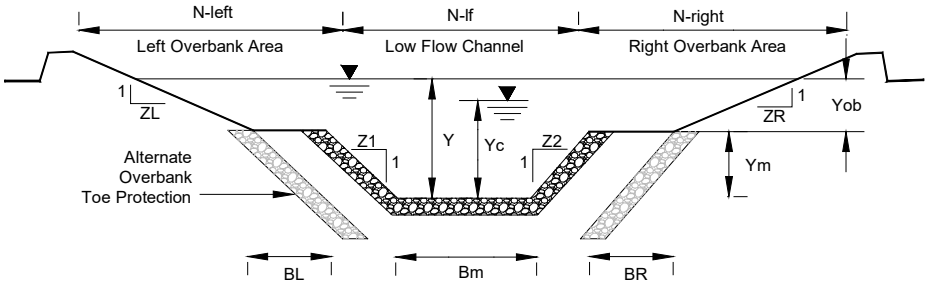
- The low-flow channel has the capacity to convey the 2-year flow at a depth not exceeding 2 feet.
- Flow is subcritical for all flow conditions evaluated. The $Fr < 0.8$, thereby satisfying Froude number criterion for non-erosive soils.
- Longitudinal channel invert slope ≥ 0.4 percent (the City criterion for recommended minimum slope to prevent ponding).
- Channel velocities are less than the allowable velocities for specified types of channel linings (low-flow channel and overbanks).
- 4H:1V side slopes permit maintenance of vegetated channel over banks.

Design of Composite Channel

*** DRAFT ***

Project: Example OC-2 (DRAFT)

Channel ID: Sample Channel



Design Information (Input)

2-Year Discharge - Total	Q-2yr =	300	cfs	Left Overbank Side Slope	ZL =	4	ft/ft
25-Year Discharge - Total	Q-25yr =	600	cfs	Left Overbank Manning's n (min)	n-min-L =	0.03	
Design Discharge - Low Flow Channel	Qlf =	200	cfs	Left Overbank Manning's n (max)	n-max-L =	0.04	
Low Flow Channel Left Side Slope	Z1 =	3	ft/ft	Left Overbank Channel Lining Type		seed and mulch, Vmax = 4 fps	
Low Flow Channel Right Side Slope	Z2 =	3	ft/ft	Right Overbank Side Slope	ZR =	4	ft/ft
Low Flow Channel Manning's n (min)	n-min-lf =	0.03		Right Overbank Manning's n (min)	n-min-R =	0.03	
Low Flow Channel Manning's n (max)	n-max-lf =	0.04		Right Overbank Manning's n (max)	n-max-R =	0.04	
Low Flow Channel Lining Type		sod, Vmax = 6 fps		Right Overbank Channel Lining Type		seed and mulch, Vmax = 4 fps	
Low Flow Channel Bank-full depth	Ym =	1.92	ft	Overbank Flow Depth Yob = (Y - Ym)	Yob =	1.47	ft
Low Flow Channel Bottom Width	Bm =	4.00	ft				
Longitudinal Channel Invert Slope	So =	0.005	ft/ft	Left overbank width as a % of total overbank width		50	%

Flow Condition (Calculated)

Channel Invert Slope **So = 0.0041 ft/ft**

Low Flow Channel Condition for Qd				**Middle Section Bank-Full Flow Condition for Q25**			
Channel Bottom Width	Bm =	26.15	ft	Low Flow Channel Bottom Width	Bm =	26.15	ft
Channel Normal Flow Depth	Ym =	1.92	ft	Top width	Tm =	37.67	ft
Top width	Tlf =	37.67	ft	Flow area	Am =	116.64	sq ft
Flow area	Alf =	61.27	sq ft	Wetted perimeter	Pm =	38.29	ft
Wetted perimeter	Plf =	38.29	ft	**Discharge** (based on max n)	**Qm =**	**584.61**	**cfs**
Discharge (based on max n)	**Qlf =**	**199.90**	**cfs**	Max Velocity check (based on min n)	Vm =	5.99	fps
Min Velocity check (based on max n)	**Vlf =**	3.26	**fps**	**Froude #** (based on min n)	**Frm =**	**0.65**	
Froude number (based on min n)	Fr-lf =	0.59		25-Yr. Critical Velocity (min n)	Vmc =	7.98	fps
				25-Yr. Critical Depth (min n)	Ymc =	2.27	ft

Left Overbank Flow Condition for Q25				**Right Overbank Flow Condition for Q25**			
Overbank Bench Width	BL =	0.00	ft	Overbank Bench Width	BR =	0.00	ft
Normal Depth in Overbanks	YLob =	1.47	ft	Normal Depth in Overbanks	YRob =	1.47	ft
Top width	TL =	5.88	ft	Top width	TR =	5.88	ft
Flow area	AL =	4.32	sq ft	Flow area	AR =	4.32	sq ft
Wetted perimeter	PL =	6.06	ft	Wetted perimeter	PR =	6.06	ft
Discharge (based on max n)	**QL =**	**8.23**	**cfs**	**Discharge** (based on max n)	**QR =**	**8.23**	**cfs**
Max Velocity Check (based on min n)	**VL =**	**1.96**	**fps**	**Max Velocity check** (based on min n)	**VR =**	**1.96**	**fps**
Froude # (based on min n)	**FrL =**	**0.49**		**Froude #** (based on min n)	**FrR =**	**0.49**	
25-Yr. Critical Velocity (min n)	VLc =	3.49	fps	25-Yr. Critical Velocity (min n)	VRc =	3.49	fps
25-Yr. Critical Depth in Overbanks (min n)	YLc =	0.75	ft	25-Yr. Critical Depth in Overbanks (min n)	YRc =	0.75	ft

Composite Cross-Section Bank-Full Flow Condition for Q25

Top width	**T =**	**49.43**	**ft**	**Discharge** (based on max n)	**Q =**	**601.06**	**cfs**
Channel Depth Y	**Y =**	**3.39**	**ft**	**Max Velocity check** (based on min n)	**V =**	**5.83**	**fps**
Flow area	A =	125.29	sq ft	Froude number (based on min n)	Fr =	0.68	
Wetted perimeter	P =	50.42	ft	25-Yr. Critical Velocity (min n)	Vc =	7.80	fps
Composite Manning's n (Calculated)	n-min =	0.030		25-Yr. Critical Depth in Overbanks (min n)	Yc =	2.32	ft
Composite Manning's n (Calculated)	n-max =	0.040					

Clear all cells

Click here for important information regarding the use of this spreadsheet

Click here for explanation of minimum and maximum Manning's n values

Click here for instructions on adjusting overbank widths

Click here for information regarding Velocity check and Froude number

NOTE:

The sum of QL + QR + Qm will slightly overestimate the total composite channel discharge, and will not equal Q. These element values are used, however, to estimate critical velocity and critical depth for design purposes.

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Chapter 9 Detention for Flood Control

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1.0 Overview

1.1 Detention Requirement

In accordance with the Springfield City Code, Chapter 36 Land Development Code, Section 250 and Chapter 96 Stormwater the detention requirements are as follows:

- **New development** - the post-development peak runoff rate shall be no greater than the pre-development peak runoff rate for the design storms listed in this chapter.
- **New Single Family Residential** - Lots created by a lot split that is not part of a subdivision which contains a regional detention basin must submit a $750 payment in lieu of constructing detention in accordance with Section 1.2.

In most cases, meeting this standard requires the design and construction of detention in accordance with the criteria contained in this chapter. Additional criteria for runoff treatment and reduction shall be met in accordance with Chapter 10, Water Quality. Detention basins shall be designed to be maintainable, enhance the environment, and provide aesthetic value to the community. Incorporation of multi-purpose uses including open space, recreation, and habitat is encouraged where appropriate. Credit will only be given for impervious surfaces which existed on the site within the previous five (5) years.

1.2 Fee in Lieu of Constructing Detention

In accordance with the Springfield City Code, Chapter 96 Stormwater, Section 96-16 Detention fee in lieu, when the developer's engineer can show that constructing a detention basin will provide no downstream benefits and no downstream drainage problems will be created or worsened, a payment in lieu of constructing detention may be acceptable. An Application for Payment in Lieu of Constructing Stormwater Detention shall be completed, signed, and sealed by a qualified design professional to be considered. In some cases, downstream improvements may be required. The costs of downstream improvements are generally eligible to be credited toward the cost of the payment in lieu of detention. On developments where stream buffers are preserved and utilized for meeting the water quality requirements in Chapter 10 and an application for a fee in lieu of constructing stormwater detention (detention buyout) has been approved by the City, the City shall waive the fee for the detention buyout. Where the additional impervious added is less than 500 square feet, no application for fee in lieu of detention shall be required.

1.3 Design Spreadsheets

The SF-Detention Spreadsheet included with this manual provides multiple worksheets to assist in design calculations. Worksheets are included to complete the following calculations:

- Detention volume using the Modified FAA (Federal Aviation Administration) Method for preliminary volume estimation.
- Detention volume using a hydrograph approach.
- Stage-Storage volume for triangular ponds, rectangular basins, elliptical ponds, and ponds with irregular geometry.

- Flow through horizontal and vertical orifices (inlet controls).
- Flow capacity of a riser (inlet control).
- Capacities of circular and box culverts (inlet vs. outlet control with tailwater effects).
- Stage-discharge through a spillway.

2.0 Types of Detention

Detention basin facilities fall into two categories regarding ownership, design aspects, and maintenance. Facilities planned on an individual-site basis are referred to as on-site or private facilities. Facilities that are planned to serve multiple lots, a subdivision, or larger area are referred to as public or regional facilities.

Requirements for detention basins may vary depending on the development situation, including:

- Single Lot Commercial: Generally, these are developments on lots that are not part of a subdivision. Basins shall be designed for full development of the lot based on zoning unless land use restrictions dictate less land is available for development. Construction of detention may be phased when only part of the lot is proposed to develop. In these cases, the location and size of detention facilities for fully developed conditions shall be located and documented.
- Residential or Commercial Subdivision: These are developments that involve the subdivision of property. One or more basins may be required depending on natural drainage patterns.
- Multiple Properties: Multiple properties or developments may be served by a regional basin that is not within the boundary of the development.

Generally, the type of detention is determined by the required design objectives and the appearance and function desired by the developer. Detention basins may fall into one of the following design types.

- Dry: Designed for several different frequency rainfalls for flood control only and drains over a relatively short period of time (<12 hours). The outlet is typically made up of orifices and/or weirs.
- Extended: Designed for pollutant removal and possibly flood control and drains over an extended period of time (24-48 hours). The outlet is typically made up of a filtered control as well as orifices and/or weirs.
- Wet: Contains a permanent pool of water and is designed for pollutant removal, flood control, and often aesthetics. May be designed to drain down to the permanent pool level over a short or long period of time.

Storage may also be present in features such as sinkholes and the upstream side of railroad and highway embankments. When planning a development along a major waterway, upstream existing storage should be accounted for when calculating existing flow rates but generally should not be accounted for when calculating ultimate future peak flow rates. Exceptions include storage that is dedicated for perpetuity and has adequate assurances for long-term maintenance.

In developments where an off-site area drains across the property, the developer must consider whether to construct the basin in-line and direct off-site runoff through the basin or construct it off-line and convey the off-site runoff so that it bypasses the basin. In-line and off-line storage are defined as:

- In-Line Storage: A facility located in-line with the drainageway that captures and routes the entire flood volume. A disadvantage with in-line storage is that it must be large enough to store and convey the total flood volume of the entire tributary catchment, including off-site runoff, if it exists. A U.S. Army Corps of Engineers (USACE) Section 404 permit for dredge and fill activities within the waters of the United States and a Section 401 Water Quality Certification from the Missouri Department of Natural Resources (MDNR) are typically required for in-line storage. The developer shall contact the USACE to determine permit requirements if an in-line basin is proposed.
- Off-Line Storage: A facility located off-line from the drainageway that receives runoff from a smaller drainage area or from a particular site. These facilities are often smaller but may require permitting similar to in-line storage facilities.

For all types of basins, the designer should consider safety, aesthetics, and multi-purpose uses during both wet and dry conditions. The use of other specialists such as landscape architects, biologists, and planners is encouraged to achieve these objectives.

3.0 Hydrologic and Hydraulic Design

3.1 Design Methods

Three design methods acceptable for use in detention design are summarized in Table 1, depending on the detention volume and impervious area added. When determining which method is acceptable, the calculated volume takes precedence over the impervious area added.

Table 1. Acceptable Detention Design Methods

Detention Design Method	Acceptable Volume (cubic feet [ft3])	Approx. Acceptable Impervious Area Added
Tabular Method (Section 3.1.1)	< 5,000 ft3	½ acre
Simplified (Modified FAA) Method (Section 3.1.2)	<20,000 ft3	2 acres
Hydrograph Method (Section 3.1.3)	Any size	Any amount

3.1.1 Tabular Method for Detention Volumes Less than 5,000 ft^3

Table 2 may be used to determine detention volumes less than 5,000 ft^3. To determine the required volume, cross-reference the area of the site in acres in the left column with the percentage of impervious area on the top row. This method may be used to determine the required volume for a payment in lieu of detention or the required volume for construction of a basin.

Using this method the design shall include a low-flow orifice designed to discharge at the 1-year peak flow rate and an overflow spillway designed to convey the 100-year post-development flow rate above the required volume. Peak flow rates must be calculated using the Rational Method

(Chapter 5, Calculation of Runoff). The low-flow orifice and overflow spillway must be designed based on methods given in Section 3.3.2 of this chapter. The low-flow orifice must be a minimum of 6 inches in diameter. Where design velocities allow, overflow spillways using turf reinforcement mat or sod are preferred over concrete. A freeboard of 6 inches must be provided.

Table 2. Tabular Method for Determining Detention Volumes Less than 5,000 ft³

		Percent Impervious Added								
		20%	30%	40%	50%	60%	70%	80%	90%	100%
		Required Detention Volume (ft3)								
Area of Site (acres)	0.10	250	390	500	640	765	900	1,020	1,150	1,280
	0.20	500	765	1,020	1,275	1,530	1,800	2,040	2,300	2,550
	0.30	765	1,150	1,530	1,920	2,300	2,680	3,060	3,450	3,830
	0.40	1,020	1,530	2,040	2,550	3,060	3,570	4,080	4,600	
	0.50	1,280	1,910	2,550	3,200	3,830	4,460			
	0.60	1,530	2,300	3,060	3,830	4,600				
	0.70	1,800	2,680	3,570	4,460					
	0.80	2,040	3,060	4,080						
	0.90	2,300	3,450	4,590						
	1.00	2,550	3,830							
	1.25	3,190	4,780							
	1.50	3,830								
	1.75	4,470								

3.1.2 Simplified Method for Detention Volumes Less than 20,000 ft³

An acceptable simplified method of detention design for volumes less than 20,000 ft³ is the FAA Method (FAA 1966) as modified by Guo (1999a). It is acceptable to use hydrograph routing procedures for the sizing of facilities smaller than 20,000 ft³, provided the inflow hydrograph runoff rates are consistent with the peak flow rates obtained using the methods described in Chapter 5, Calculation of Runoff, and the maximum allowable release rates given in this chapter. For more detail on detention design using the Modified FAA Method, see references outside this manual.

3.1.3 Hydrograph Method for Large Detention Basins

For detention volumes greater than 20,000 ft³, a hydrograph method must be used (i.e., Kinematic Wave Method or Soil Conservation Service [SCS] Unit Hydrograph Method with the appropriate Huff rainfall distribution, as described in Chapter 5, Calculation of Runoff). If detention facilities or other significant storage basins are located upstream, hydrograph routing methods should be used to account for their effects. If off-site tributary areas contribute runoff to an on-site detention facility, the total tributary area must be included in the sizing of the on-site storage volumes, with the assumption that off-site land uses are fully developed based on anticipated land uses, in order to account for the total runoff volume in the watershed.

3.1.4 Determining Detention Storage for Extended Detention Basins

See Chapter 10, Water Quality, for design procedures for extended detention to meet water quality requirements. When extended detention is incorporated into the basin, the water quality capture volume (WQCV) may also be used for flood control volume (i.e., the basin may be assumed to be empty at the start of the level pool routing calculation in Section 3.3).

3.2 Sizing of On-site Detention Facilities

3.2.1 Peak Flow Attenuation Requirements for On-site Facilities

These criteria for peak flow attenuation apply for on-site facilities unless other rates are recommended in a City-approved master plan. Three conditions must be examined for determination of attenuation requirements for an on-site facility:

- Condition 1—Pre-project conditions
- Condition 2—Post-project conditions
- Condition 3—Fully urbanized conditions for the entire tributary watershed with no upstream detention

On-site detention facilities must be designed so that peak flow rates for post-project conditions (Condition 2) are limited to pre-project levels (Condition 1) for the design events specified in this chapter. Condition 3 is applied for overflow spillway design. Condition 3 requires analysis for the 100-year event (to assure safe conveyance). If downstream safety considerations warrant, it may be necessary to size a spillway for greater than a 100-year event.

3.2.2 Design Storms for Outlet Works Design

To maintain peak flow rates at pre-development levels, a multi-frequency outlet design approach is required. The designer must demonstrate that the 1-, 10-, and 100-year post-development peak flow rates are limited to the corresponding pre-development flow rates. Because the FAA Method calculates required volume only, Section 3.3.2 must be used to design the outlet. The designer must show that the volume design and outlet design are compatible with the calculated volume for each design event to ensure peak discharges do not exceed pre-development rates for each design event (e.g., for the water surface elevation corresponding to the volume calculated for the 10-year event, the outlet should be designed to discharge no greater than the 10-year pre-development peak flow rate). If the facility is also providing water quality treatment, then the detention volume and outlet design must also incorporate the WQCV (See Chapter 10, Water Quality).

3.3 Reservoir Routing of Storm Hydrographs for Sizing of Storage Volumes

Detention facilities larger than 20,000 ft^3 (typically 5 acres of residential development or 2.5 acres of commercial development) must use the hydrograph sizing procedure described in this section.

3.3.1 Detention Volume Estimation

The required detention volume for a proposed development may be estimated using a variety of methods, including the Rational Formula Based Modified FAA Method or the Hydrograph Volumetric Method. The Rational Formula Based Modified FAA Method may be used to find an initial storage volume for any size watershed. This technique for initial sizing yields best results

when the tributary watershed area is less than 300 acres, but can be applied to larger watersheds, although the design volumes may need to be adjusted significantly.

It is possible to use the inflow hydrograph, along with desired maximum release rates, to make an initial estimate of the required storage volume using the Hydrograph Volumetric Method. This technique assumes that the required detention volume is equal to the difference in volume between the inflow hydrograph and the simplified outflow hydrograph. This is represented by the area between those two hydrographs from the beginning of a runoff event until the time that the allowable release occurs on the recession limb of the inflow hydrograph (Guo 1999b) (see Figure 1). Generally, the inflow hydrograph is obtained from a hydrograph method using the Huff distribution presented in Chapter 5, Calculation of Runoff. The outflow hydrograph can be approximated using a straight line between zero at the start of the runoff to a point where the allowable discharge is on the descending limb of the inflow hydrograph, T_p.

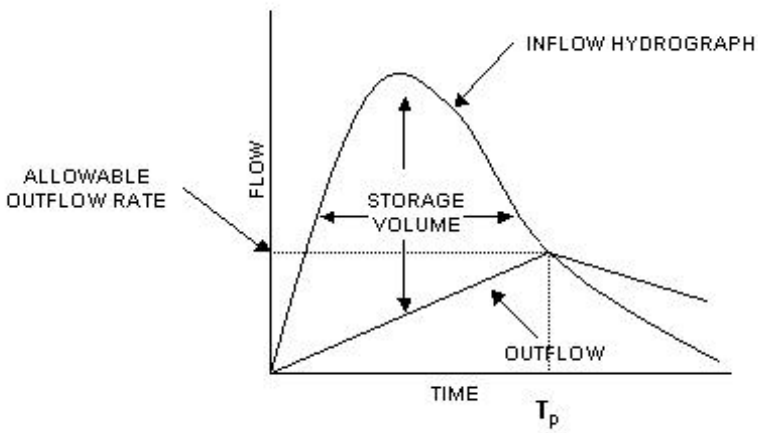


Figure 1. Hydrograph Volumetric Method of Detention Volume Sizing

The volume can be calculated by setting up tabular calculations, as shown by example in Table 4 (Section 5.1). The Hydrograph worksheet in the SF-Detention spreadsheet can also be used to complete these calculations. Descriptions of the variables in the table columns include:

- The time T (in minutes), from 0 to T_p in uniform increments. Time increments (Δt) of 5 minutes are typically used. T_p is the time (in minutes) where the descending limb of the inflow hydrograph is equal to the allowable release rate.
- The inflow rate, Q_i (cfs), to the detention basin corresponding to the time T. The inflow rate can be obtained using the SCS Unit Hydrograph Method with the Huff distribution presented in Chapter 5, Calculation of Runoff.
- The outflow rate, Q_o (cfs), calculated as:

$$Q_o = \frac{T}{T_p} Q_{po} \qquad \text{(Equation 1)}$$

In which:

Q_{po} = the peak outflow rate. The allowable peak outflow rate is determined from City criteria or a City-approved master plan.

- The incremental storage volume, V_s:

$$V_s = (Q_i - Q_o) \cdot \Delta t \cdot 60 \text{ seconds} \quad \text{(Equation 2)}$$

- The total cumulative storage volume calculated as the sum of the incremental storage volumes.

$$V_s total = \sum V_s \text{ incremental} \quad \text{(Equation 3)}$$

3.3.2 Outlet Works Design

The hydraulic capacity of the various components of the outlet works (i.e., orifices, weirs, pipes) can be determined using standard hydraulic equations. The discharge pipe of the outlet works generally function as a culvert. See Chapter 7, Culverts and Bridges, for guidance regarding the calculation of the hydraulic capacity of outlet pipes. To create a rating curve for the entire outlet, a composite total outlet rating curve can be developed based on the rating curves developed for each of the components of the outlet and then selecting the most restrictive element that controls the release at a given stage. Several worksheets for various types of outlets are provided in the SF-Detention spreadsheet to aid in calculations for outlet works designs.

3.3.2.1 Orifices

Single or multiple orifices may be used in a detention facility and are commonly used as a low-flow control. The hydraulics of each can be superimposed to develop the outlet rating curve. The basic orifice equation is:

$$Q = C_o A_o (2gH_o)^{0.5} \quad \text{(Equation 4)}$$

In which:

Q = the orifice flow rate (cfs)

C_o = discharge coefficient (0.60 for concrete openings)

A_o = area of orifice (ft^2)

H_o = effective head on the orifice (ft)

g = gravitational acceleration (32.2 ft/s^2)

If the orifice discharges as a free outfall, the effective head is measured from the centroid of the orifice to the upstream water surface elevation. If the orifice discharge is submerged, then the effective head is the difference in elevation of the upstream and downstream water surfaces.

3.3.2.2 Weirs

Several different types of weirs may be used, as described below.

Rectangular Sharp-crested Weirs: A sharp-crested weir is defined as a weir with a wall thickness of 6 inches or less. The basic equation for a rectangular sharp-crested weir is:

$$Q = CL_{eff}H^{3/2} \quad \text{(Equation 5)}$$

In which:

Q = discharge (cfs)

L_{eff} = effective horizontal weir length (ft) (as calculated in Equation 6 to account for contractions)

$$L_{eff} = L_{total} - 0.1NH \quad \text{(Equation 6)}$$

In which:

N = number of contracted sides

L_{total} = the total weir length (ft)

H = head above weir crest excluding velocity head (ft)

C = weir coefficient (as calculated in Equation 7 or 8)

The weir coefficient is a function of the head above the weir crest, H, and the height of the weir crest above the pond or channel bottom, H_c. For ratios of H/H_c up to approximately 10, the following equation should be applied to determine C (Debo and Reese 2003):

$$C = 3.237 + 0.428\frac{H}{H_c} + 0.0175H \quad \text{(Equation 7)}$$

For ratios of H/H_c greater than 15, the weir coefficient is found using:

$$C = 5.68(1 + \frac{H_c}{H})^{1.5} \quad \text{(Equation 8)}$$

For ratios of H/H_c between 10 and 15, the designer should interpolate between Equations 7 and 8.

Broad-crested Weirs: The equation for a broad-crested weir is:

$$Q = CLH^{3/2} \quad \text{(Equation 9)}$$

In which:

Q = discharge (cfs)

C = broad-crested weir coefficient from Table 3

L = broad-crested weir length (ft). (For weirs with tapered sides, it is acceptable to use a length equal to the average of the upper and lower weir lengths.)

H = head above weir crest (ft)

Table 3. Broad-crested Weir Coefficients

Depth (ft)	C for 6-inch Thick Wall	C for 8-inch Thick Wall	C for 12-inch Thick Wall
0.20	2.80	2.77	2.69
0.25	2.83	2.79	2.70
0.30	2.86	2.80	2.71
0.40	2.92	2.84	2.72
0.50	3.00	2.90	2.74
0.60	3.08	2.95	2.75
0.70	3.19	3.03	2.80
0.75	3.25	3.08	2.83
0.80	3.30	3.12	2.85
0.90	3.31	3.16	2.92
1.00	3.32	3.20	2.98
1.25	3.32	3.25	3.11
1.50	3.32	3.29	3.24
1.75	3.32	3.31	3.27
2.00	3.32	3.32	3.30
2.50	3.32	3.32	3.31
> 2.5	3.32	3.32	3.32

Slot and V-notch Weirs: Capacity of broad-crested slot and V-notch weirs shall be determined by the following equation developed by Joe Wilson at the University of Missouri-Rolla (Missouri School of Science and Technology):

$$Q = 0.86H + (3.65W + 5.82z)H^{3/2} \qquad \text{(Equation 10)}$$

In which:

Q = discharge (cfs)

H = upstream head (ponded depth above the slot invert) (ft) (maximum of 6 ft)

W = slot invert width perpendicular to flow (ft) ($0.333<W<2.0$)

z = slope of slot sides expressed in terms of $H(z)$:1V ($0<z<0.6$)

3.3.3 Reservoir Routing

The City recommends the use of the Modified Puls method for level pool reservoir routing for the design of detention facilities. This reservoir routing method determines an outflow hydrograph for

a detention facility based on a given inflow hydrograph and the storage-outflow characteristics of a facility. This method is typically carried out using computer programs such as HEC-1, HEC-HMS, or proprietary software packages. Model input is typically a storage-outflow relationship for the detention facility. This section provides background on the Modified Puls method and shows an example calculation to assist the engineer in understanding the reservoir routing method. The description is adapted from Fundamentals of Hydraulic Engineering Systems (Hwang and Houghtalen 1996).

3.3.3.1 Modified Puls Method

The mathematical basis of Modified Puls routing is the continuity equation (conservation of mass with constant density). Simply stated, the change in storage is equal to inflow minus outflow. In differential format, the equation can be expressed as:

$$\frac{dS}{dt} = I - O \qquad \text{(Equation 11)}$$

In which:

dS/dt = rate of change of storage with respect to time

I = instantaneous inflow

O = instantaneous outflow

If average rates of inflow and outflow are used, an acceptable solution can be obtained over a discrete time step (Δt) using:

$$\frac{\Delta S}{\Delta t} = \bar{I} - \overline{O} \qquad \text{(Equation 12)}$$

Where ΔS is the storage change over the time step. By assuming linearity of flow across the time step, the storage equation may be expressed as:

$$\Delta S = \left[\frac{(I_i + I_j)}{2} - \frac{(O_i + O_j)}{2} \right] \cdot \Delta t \qquad \text{(Equation 13)}$$

Where the subscripts i and j designate inflow and outflow at the beginning and end of the time step, respectively.

The storage relationship in Equation 13 has two unknowns. Because the inflow hydrograph must be defined prior to performing the routing calculations (using the SCS Unit Hydrograph Method with the Huff rainfall distribution), inflow values (I_i and I_j) are known. Likewise, the time increment (Δt) is chosen, and outflow at the beginning of the time step (O_i) was solved in the previous time step calculations (or specified as an initial value). That leaves the storage increment (ΔS) and the outflow at the end of the time step (O_j) as unknowns. Because both storage and outflow (for

uncontrolled outlet devices) are related to the depth of water in the detention facility, they are related to one another. This relationship is employed to compute the solution.

The data requirements to perform Modified Puls reservoir routing include:

- An inflow hydrograph (determined using the SCS Unit Hydrograph Method or the Kinematic Wave Method using the Huff rainfall distribution).
- An elevation versus storage relationship for the detention facility. The Stage-Storage worksheets in the SF-Detention Spreadsheet can be used to develop this relationship.
- An elevation versus outflow relationship. The Stage-Discharge worksheets in the SF-Detention Spreadsheet can be used to develop this relationship. Figure 2 displays these data requirements graphically. The procedure for obtaining the stage (elevation) versus storage curve is described in the figure. Also, the two basic types of outlet devices (weirs and orifices) are noted with typical stage-discharge relationships.

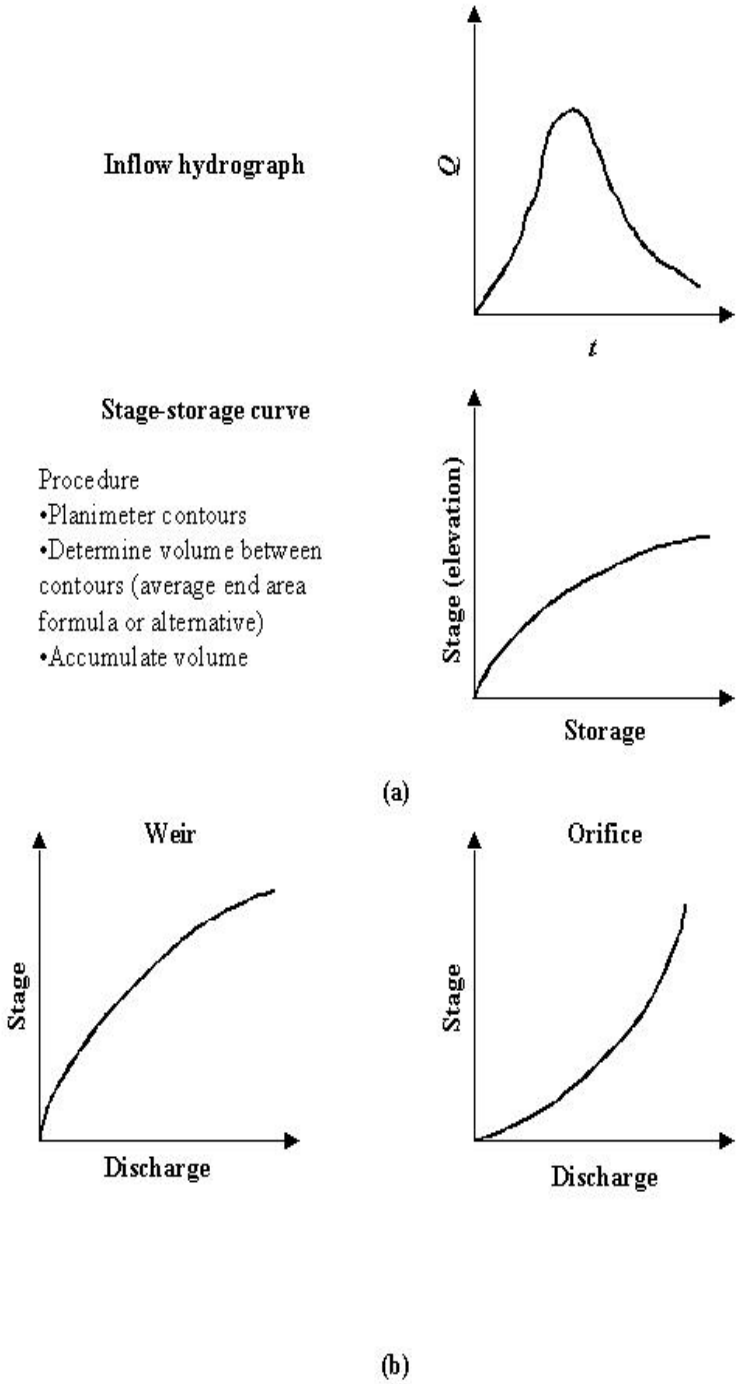


Figure 2. Data Requirements for Storage Routing (after Hwang and Houghtalen 1996)

The Modified Puls routing method reformulates Equation 13, as shown by Equation 14:

$$(I_i + I_j) + \left[\frac{2S_i}{\Delta t} - O_i\right] = \left[\frac{2S_j}{\Delta t} + O_j\right] \qquad \text{(Equation 14)}$$

Where (S_j-S_i) equals the change in storage (ΔS). The advantage of this expression is that all of the known values are on the left side and all of the unknowns are grouped on the right. The solution procedure for Modified Puls routing is as follows:

- Determine the appropriate inflow hydrograph for the detention facility (see Chapter 5, Calculation of Runoff).
- Select a routing interval (Δt). Linearity of inflows and outflows over the time step is assumed.
- Determine stage-storage and stage-outflow relationships for the detention facility and outlet device(s) selected. (See SF-Detention Spreadsheet for assistance in these calculations.)
- Establish the storage-outflow relationship by setting up a table with the following headings (note that headings b through e correspond with variables in Equation 14:
    - Elevation
    - Outflow (O)
    - Storage (S)
    - $2S/\Delta t$
    - $2S/\Delta t+O$
- Plot the ($2S/\Delta t+O$) versus O relationship.
- Perform routing using a table with the following headings:
    - Time
    - Inflow at time step i (I_i)
    - Inflow at time step j (I_j)
    - $2S/\Delta t-O$
    - $2S/\Delta t+O$
    - Outflow

See Section 5.2 for an example calculation.

4.0 Final Design Considerations

4.1 Potential for Multiple Uses

When designing a detention facility, multi-purpose uses, such as active or passive recreation and wildlife habitat, are encouraged in addition to providing the required storage volume. Facilities used for recreation should be designed to inundate no more frequently than every two years. In certain situations, it may be beneficial to utilize a portion of a parking lot, along the fringe of a detention basin for additional flood volume storage. However, the depth of flooding in the paved

areas shall not exceed 12 inches during an event with a one percent annual exceedance probability and the paved surfaces shall be outside of the area ponded by the water quality capture volume.

4.2 Detention Basin Location

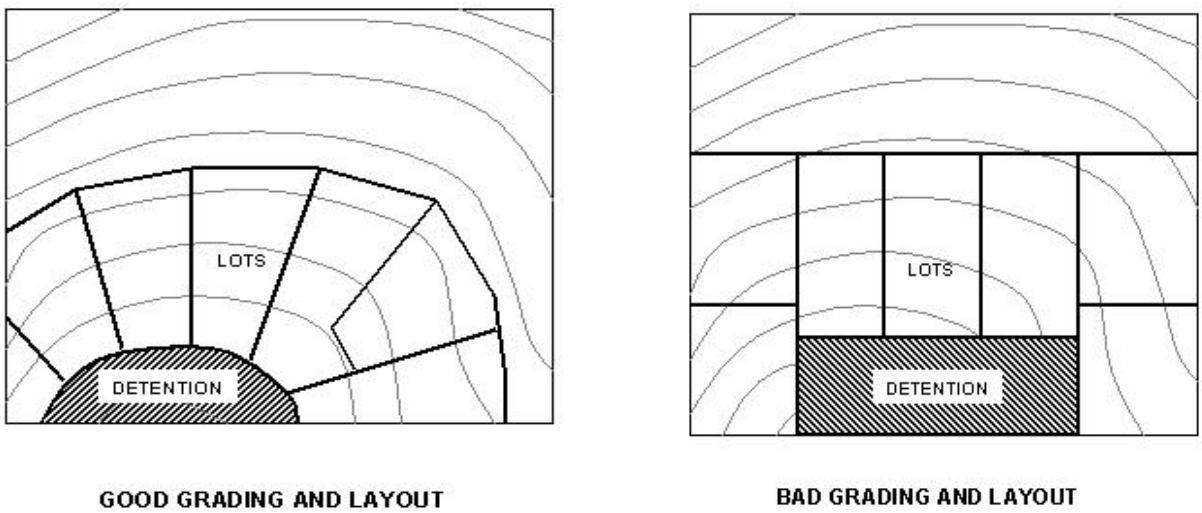
Detention basins should be located at the natural low point of the site and must discharge to the natural drainage location to minimize downstream impacts.

4.3 Detention Basin Grading

Detention basin grading shall conform to the natural topography of the site to the maximum extent practical. Developments should be laid out around the existing waterways and proposed detention basin (see Figure 3). Layouts conforming to existing topography often reduce construction costs, land disturbance and maintenance costs, and increase aesthetic quality. Existing slopes should be used to the maximum extent practical. If slopes are modified, the maximum preferred slope is 3H:1V. Significant modifications to existing topography may require geologic impact studies and geotechnical analysis, particularly where shallow bedrock is believed to be present.

Figure 3. Examples of Good and Bad Location, Grading and Lot Layout for Detention

4.4 Geometry of Storage Facilities



The geometry of a detention facility depends on specific site conditions such as adjoining land uses, topography, geology, existing natural features, volume requirements, etc. The following criteria apply to the geometry of detention facilities:

- Pond side slopes of 4H:1V are the maximum permissible; slopes between 5H:1V and 10H:1V are encouraged. If slopes steeper than 4H:1V are desired, the engineer must show why 4H:1V slopes are not feasible. For proposed slopes steeper than 3H:1V, the designer shall provide a long term maintenance plan.
- Dry pond bottom slopes must be a minimum of one percent to ensure drainage.
- In some cases, to minimize erosion, a low-flow channel may be provided where the 2-year design flow exceeds 5 cfs. These are less desirable in water quality basins or where grass contact or infiltration is desired.

- Lining and surfaces shall be based on design velocities and flow characteristics in accordance with Chapter 8, Open Channels. Section 5.7.4 of Chapter 8 states that riprap lining should be used only when design constraints prevent the channel design velocity from falling within the allowable range for vegetated channels. Dry and extended detention basins shall have a vegetated bottom and side slopes unless design velocity or slope is not within the allowable range for vegetation.
- Where bedrock is encountered when excavating the detention basin, it is not required to excavate and remove the bedrock so long as the design of the basin can be altered to meet the City's standards.
- The water quality portion of a facility should be shaped with a gradual expansion from the inlet and a gradual contraction toward the outlet, thereby minimizing short-circuiting. Storage facility geometry and layout are best developed in concert with a land planner/landscape architect.
  Storage facilities shall not be any closer than 5 feet from a building.

4.5 Embankments and Cut Slopes

If the storage facility is jurisdictional, meaning it is subject to dam safety regulation by the MDNR, the embankment shall be designed, constructed, and maintained to meet most current MDNR criteria for jurisdictional structures. The design for an embankment of a stormwater detention or retention storage facility should be based upon a site-specific engineering evaluation. The embankment should be designed to prevent catastrophic failure during the 100-year and larger storms. The following criteria apply in many situations (ASCE and WEF 1992):

- Side Slopes—For ease of maintenance, side slopes of the embankment should not be steeper than 3H:1V. If slopes steeper than 3H:1V or retaining walls are used then a portion of the perimeter, no less than 10 feet in width and at a slope of 3H:1V or flatter, shall be provided from the top of the basin to the bottom of the basin for maintenance access.The embankment's side slopes should be well vegetated, and riprap protection (or the equivalent) may be necessary to protect it from wave action and bank erosion.
- Freeboard—The elevation of the top of the embankment shall be a minimum of one foot above the 100-year water surface elevation. When relevant, all MDNR dam safety criteria must be carefully considered when determining the freeboard capacity of an impoundment. A freeboard greater than one foot may be required based on design flows, embankment height and downstream risks associated with embankment failure.
- Settlement— All earth fill should be free from unsuitable materials and all organic materials such as grass, turf, brush, roots, and other material subject to decomposition. The fill material in all earth dams and embankments should be compacted to at least 95 percent of the maximum density obtained from compaction tests performed by the Modified Proctor method in ASTM D698. Additional height should be considered to account for settlement, particularly for larger facilities.
- Emergency Spillway—An emergency spillway shall be designed to convey flows that exceed the primary outlet capacity. The spillway shall be sized to safely pass the flow from the 100-year, 24-hour rainfall event using the SCS Type II rainfall distribution with no

overtopping of the embankment. The flow capacity of other components of the outlet works may be considered when designing the emergency spillway. An emergency spillway may be waived for embankments of 2 feet in height or less and no safety risks exist immediately downstream.

4.6 Linings

Detention facilities may benefit from an impermeable clay or synthetic liner for a number of reasons. Stormwater detention and retention facilities have the potential to raise the groundwater level in the vicinity of the basin. If the basin is close to structures or other facilities that could be damaged by raising the groundwater level, consideration should be given to lining the pond. An impermeable liner may also be warranted in a retention basin where the designer seeks to limit seepage from a permanent pond. Alternatively, there are situations where the designer may seek to encourage seepage of stormwater into the ground. In this situation, a layer of permeable material may be warranted.

4.7 Inlets

Inlets shall incorporate energy dissipation and/or linings to limit erosion. They should be designed in accordance with drop structure criteria in Chapter 8, Open Channels, or using other approved energy dissipation techniques. In addition, forebays or sediment traps should be considered at significant inflow points to storage facilities to settle a significant portion of the sediment being delivered by stormwater to the facility. Forebays will need regular maintenance to reduce the sediment being transported and deposited on the storage basin's bottom.

4.8 Outlet Works

Outlet works should be sized and structurally designed to release at the specified flow rates without structural or hydraulic failure. A concentrated discharge to a natural channel shall have a property line setback of a minimum of 5 times the effective diameter of the conveyance structure. Design guidance for outlet works used for water quality purposes is included in Chapter 10, Water Quality.

4.9 Trash Racks

Trash racks should be sufficiently sized to not interfere with the hydraulic capacity of the outlet and must be designed in a manner that is protective of public health, safety, and welfare. See Chapter 10, Water Quality, for minimum trash rack sizes.

4.10 Vegetation

The type of vegetation specified for a newly constructed storage facility is a function of the frequency and duration of inundation of the area, soil types, whether native or non-native vegetation is desired, and other potential uses (park, open space, etc.) of the area. A planting plan should be developed for new facilities to meet their intended use and setting in the urban landscape. Generally, trees and shrubs are not recommended on dams or fill embankments.

4.11 Operations and Maintenance

Maintenance considerations during design include the following (ASCE and WEF 1992):

- If the detention period is long, and especially if children are apt to play in the vicinity of the impoundment, use of relatively flat side slopes along the banks is advisable. In addition, installation of landscaping that will discourage entry, such as thick, thorny shrubs, is suggested for locations along the periphery, near the outlets, and at steeper embankment sections. If the impoundment is situated at a lower grade and adjacent to a highway, installation of a guardrail should be considered consistent with all applicable highway safety standards. Providing features to discourage public access to the inlet and outlet areas of the facility should be considered.
- The facility should be accessible to maintenance equipment for removal of silt and debris and for repair of damages that may occur over time. Easements and/or rights-of-way are required to allow access to the impoundment by the owner or agency responsible for maintenance.
- Bank slopes, bank protection, and vegetation types are important design considerations for site aesthetics and maintainability.
- Permanent ponds should have provisions for complete drainage for sediment removal or other maintenance. The frequency of sediment removal will vary among facilities, depending on the original volume set aside for sediment, the rate of accumulation, rate of growth of vegetation, drainage area erosion control measures, and the desired aesthetic appearance of the pond.
- Adequate dissolved oxygen supply in ponds (to minimize odors and other nuisances) can be maintained by artificial aeration. Use of fertilizer and pesticides adjacent to the permanent pool pond should be carefully controlled.
- Secondary uses that are incompatible with sediment deposits should not be planned unless a high level of maintenance will be provided.
- French drains or the equivalent are almost impossible to maintain and should be used with discretion where sediment loads are apt to be high.
- Underground tanks or conduits designed for detention should be sized and designed to permit pumping. Multiple entrance points should be provided to remove accumulated sediment and trash.
- Detention facilities should be designed with sufficient depth to allow accumulation of sediment for several years prior to its removal.
- Permanent pools should be of sufficient depth to discourage excessive aquatic vegetation on the bottom of the basin, unless specifically provided for water quality purposes.
- Trash racks and/or fences are often used to minimize hazards. These may become eyesores, trap debris, impede flows, hinder maintenance, and, ironically, fail to prevent access to the outlet. On the other hand, desirable conditions can be achieved through careful design and positioning of the structure, as well as through landscaping that will discourage access (e.g., positioning the outlet away from the embankment, etc.). Creative designs, integrated with innovative landscaping, can be safe and can also enhance the appearance of the outlet and pond.
- To reduce maintenance and avoid operational problems, outlet structures should be designed with no moving parts (i.e., use only pipes, orifices, and weirs). Manually and/or electrically operated gates should be avoided. To reduce maintenance, outlets should be

designed with openings as large as possible, be compatible with the depth-outflow relationships desired, and be designed with water quality, safety, and aesthetic objectives in mind. Outlets should be robustly designed to lessen the chances of damage from debris or vandalism. The use of thin steel plates as sharp-crested weirs should be avoided because of potential accidents, especially with children. Trash racks must protect all outlets, especially ones made of a thin plate.

- Clean out all forebays and sediment traps on a regular basis or when routine inspection shows them to be ¾ full.

See Chapter 10, Water Quality, for additional recommendations regarding operation and maintenance of water quality related facilities, some of which also apply to detention facilities designed to meet other objectives.

4.12 Access

Access to the bottom, inflow, forebay, and outlet works areas shall be provided for maintenance vehicles.

4.13 Geotechnical Considerations

The designer must account for the geotechnical conditions of the site. These considerations may include issues related to embankment stability, geologic hazards, seepage, and other site-specific issues. It may be necessary to confer with a qualified geotechnical engineer during both design and construction, especially for larger detention and retention storage facilities.

4.14 Environmental Permitting and Other Considerations

The designer must account for environmental considerations surrounding the facility and the site during its selection, design, and construction. These can include regulatory issues such as:

- Whether the facility will be located in a jurisdictional wetland,
- Whether the facility is to be located on a waterway regulated by the USACE as a "Water of the U.S.,"
- Whether there are threatened and endangered species or habitat in the area. See Chapter 2, Authority and Law, and Chapter 3, Stormwater Planning, for more information on regulatory and permitting requirements.

There are also non-regulatory environmental issues that should be taken into account. Detention facilities can become breeding grounds for mosquitoes unless they are properly designed, constructed and maintained. Area residents may object to facilities that impact riparian habitat or wetlands. Considerations of this kind must be carefully taken into account, and early discussions with relevant federal, state and local regulators are recommended.

5.0 Examples

The examples provided in this section are calculated step-by-step to provide an understanding of the underlying engineering principles. Worksheets in the SF-Detention Spreadsheet can also be used to complete these calculations, but are not used in these examples.

5.1 Simplified Detention Storage Calculation

Given an inflow hydrograph for a 20-acre commercial site (calculated according to guidelines in Chapter 5, Calculation of Runoff) and a maximum allowable release rate of 30 cfs, determine the preliminary detention volume required. The tabular format for use with the inflow hydrograph method is shown in Table 4 below. The time and flow ordinates of the inflow hydrograph are entered in columns 1 and 2 of Table 4. Based on the inflow hydrograph, the allowable release rate of 30 cfs is matched on the falling limb at a time between 102 and 108 minutes, so 108 minutes is used as an estimate for T_p.

Table 4. Simplified Detention Volume Calculation Example

Time (min)	Inflow Hydrograph (cfs)	Outflow Rising Hydrograph (cfs)	Incremental Storage Volume (acre-feet)	Cumulative Storage Volume (acre-feet)
(1)	(2)	(3)	(4)	(5)
0	0	0	0.00	0.00
6	0	2	0.00	0.00
12	5	3	0.02	0.02
18	41	5	0.30	0.31
24	97	7	0.75	1.06
30	128	8	0.99	2.05
36	130	10	0.99	3.05
42	122	12	0.91	3.95
48	107	13	0.78	4.73
54	91	15	0.63	5.36
60	77	17	0.50	5.86
66	66	18	0.40	6.26
72	56	20	0.30	6.56
78	45	22	0.19	6.75
84	37	23	0.12	6.87
90	33	25	0.07	6.94
96	31	27	0.04	6.98
102	30	28	0.02	7.00
108	30	30	0.00	7.00
114	28			

Columns (1) & (2) Input from SCS Unit Hydrograph analysis with Huff distribution

Column (3) = $(T/Tp)*Q_{po}$ = (Col(1)/108)*30 [Equation 1]

Column (4) = ((Col (2) – Col (3))*60*6)/43,560. (includes unit conversion) Note: if Col (2) – Col (3) < 0, then Col (4) = 0.

Column (5) = (Col (5) Row (i-1)) + (Col (4) Row (i))

5.2 Modified Puls Reservoir Routing Example

Given the inflow hydrograph from the example in Section 5.1 for a 20-acre commercial site, a detention basin with the stage-storage relationship in Table 5 is proposed.

Table 5. Stage-storage Relationship for Detention Facility

Stage (elevation [ft] above mean sea level)	Storage (acre feet)
1320	0
1321	0.5
1322	1.5
1323	4.0
1324	7.0
1325	10.0

The stage-outflow relationship for the detention facility outlet structure (determined from hydraulic analysis) is summarized in Table 6.

Table 6. Stage-outflow Relationship for Detention Facility

Stage (elevation [ft] above mean sea level)	Outflow (cfs)
1320	0
1321	5
1322	10
1323	20
1324	30
1325	40

The following steps are used to determine the outflow hydrograph for this proposed facility following the guidance in Section 3.3.3.1:

- Determine the inflow hydrograph: The inflow hydrograph should be developed following guidance in Chapter 5, Calculation of Runoff.
- Select a routing interval (Δt): A rule of thumb for selecting the routing interval is to divide the rising limb of the hydrograph into 10 increments. Since it takes about 40 minutes for the hydrograph to peak, use a routing interval of 4 minutes.
- Establish the storage-outflow relationship as shown in Table 7:
- Plot the $(2S/\Delta t) + O$ versus O relationship: Plot values from Table 7. This relationship is shown in Figure 4.
- Perform the Modified Puls routing using a table:
    - An example of the Modified Puls routing method is shown in Table 8. Table heading descriptions are provided following the table.

Table 7. Storage-outflow Relationship for Detention Facility

Stage (elevation [ft] above mean sea level)	Outflow (*O*) (cfs)	Storage (*S*) (acre-feet)	*2S/Δt* (cfs)	*2S/Δt + O* (cfs)
(1)	(2)	(3)	(4)	(5)
1320	0	0.0	0	0
1321	5	0.5	182	187
1322	10	1.5	545	555
1323	20	4.0	1452	1472
1324	30	7.0	2541	2571
1325	40	10.0	3630	3670

Columns (1) and (3) from Table 5
Columns (1) and (2) from Table 6
Column (4) = *2S/Δt**(unit conversion) = 2*Col (3)/(4 min * 60 sec/min)* (43,560 ft^2/acre)
Column (5) = Col (4) + Col (2)

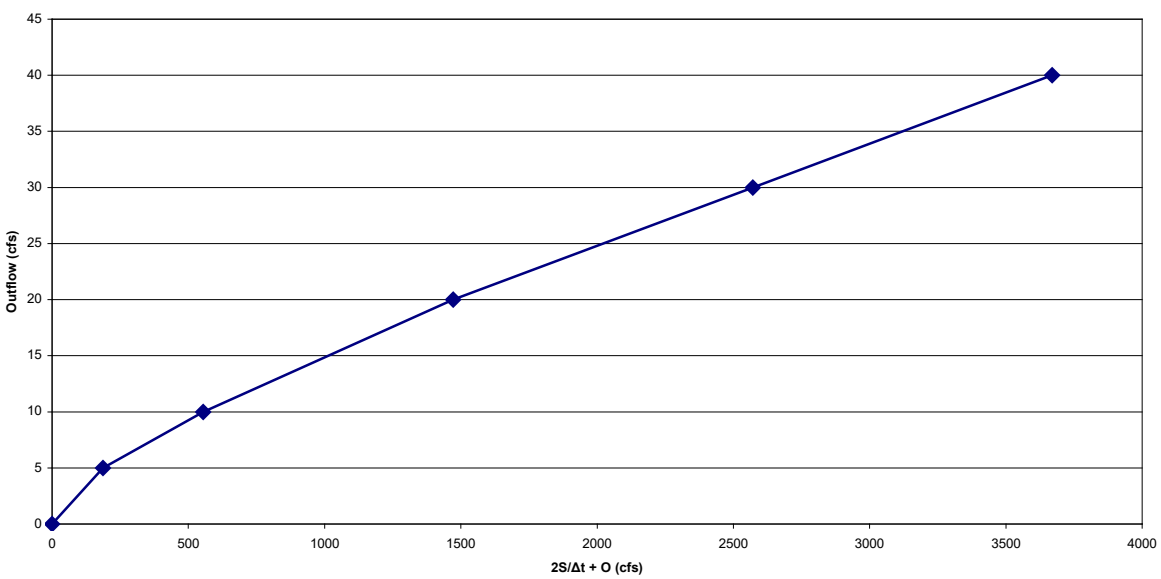


Figure 4. 2S/Δt +O versus O for Reservoir Routing Example

Table 8. Modified Puls Routing Table

Time (min)	Inflow (I_i) (cfs)	Inflow (I_j) (cfs)	$2S/\Delta t - O$ (cfs)	$2S/\Delta t + O$ (cfs)	Outflow (O) (cfs)
(1)	(2)	(3)	(4)	(5)	(6)
0	0.00	0.01	0	--	0
4	0.01	0.59	0.01	0.01	0.0006
8	0.59	5.40	0.59	0.62	0.02
12	5.40	25.61	6.23	6.58	0.18
16	25.61	60.13	35.24	37.23	1.00
20	60.13	97.40	114.48	120.97	3.24
24	97.40	121.10	259.69	272.01	6.16
28	121.10	130.28	460.26	478.19	8.96
32	130.28	130.03	688.22	711.64	11.71
36	130.03	124.85	919.94	948.53	14.29
40	124.85	117.18	1141.29	1174.81	16.76
44	117.18	107.44	1345.25	1383.32	19.03
48	107.44	96.71	1528.09	1569.87	20.89
52	96.71	86.37	1687.50	1732.24	22.37
56	86.37	77.29	1823.33	1870.58	23.63
60	77.29	69.90	1937.62	1986.99	24.69
64	69.90	63.07	2033.65	2084.81	25.58
68	63.07	56.02	2113.98	2166.62	26.32
72	56.02	48.75	2179.22	2233.07	26.93
76	48.75	42.31	2229.21	2283.99	27.39
80	42.31	37.42	2264.82	2320.26	27.72
84	37.42	34.42	2288.67	2344.55	27.94
88	34.42	32.54	2304.35	2360.52	28.08
92	32.54	31.38	2314.95	2371.31	28.18
96	31.38	30.72	2322.37	2378.87	28.25
100	30.72	30.30	2327.86	2384.46	28.30
104	30.30	29.96	2332.19	2388.88	28.34
108	29.96	29.24	2335.70	2392.46	28.38
112	29.24	26.98	2338.11	2394.90	28.40
116	26.98	24.08	2337.55	2394.33	28.39
120	24.08	21.58	2331.93	2388.61	28.34
124	21.58	19.40	2321.11	2377.59	28.24
128	19.40	16.20	2305.90	2362.09	28.10
132	16.20	11.82	2285.67	2341.49	27.91
136	11.82	7.66	2258.37	2313.69	27.66
140	7.66	4.56	2223.20	2277.86	27.33
144	4.56	2.83	…	…	…

Columns 1-3 are known inputs into the table, and the rest of the columns are unknown (blank) when the routing process begins. The objective is to complete the last column, which represents the outflow hydrograph. Inputs and calculations for each column include:

- Column 1 (time) and Column 2 (inflow) provide the design inflow hydrograph (obtained using methods described in Chapter 5, Calculation of Runoff).
- Column 3 is the value from column 2 moved earlier in time (up the table) one time increment.
- Column 4: To initiate the routing process with little or no inflow, assume the initial value is 0. The next value of $2S_j/\Delta t - O_j$ confirms this assumption. Subsequent values of $2S/\Delta t - O$ are calculated by doubling the outflow values in column 6 and subtracting them from $2S/\Delta t + O$.
- Column 5: The values in column 5 are calculated by applying the continuity equation (storage relationship) in Equation 19:

$$(I_i + I_j) + \left[\frac{2S_i}{\Delta t} - O_i\right] = \left[\frac{2S_j}{\Delta t} + O_j\right]$$

For the first time increment (4 minutes), this is: $(0 + 0.01) + [0] = [0.01]$.

- Column 6: The first value of outflow is assumed to be equal to inflow. Subsequent values are obtained from the $2S/\Delta t + O$ versus O relationship in Figure 4 and Table 8. Linear interpolation can be used to determine O values for a given $2S/\Delta t + O$ using Table 8 for values that cannot be easily read from Figure 4 (for the first row of Column 6, see Step 2 above)

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Chapter 10 Water Quality

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1.0 Introduction

Photo 1. Jordan Creek in Springfield, MO.

The potential adverse effects of urban runoff on the physical, chemical, and biological characteristics of receiving waters have been widely documented (NRC, 2008; WEF/ASCE, 1992, 1998; Debo and Reese, 2002; Horner, et al., 1994; Schueler and Holland, 2000). As urbanization occurs, the removal of vegetation, compaction of soils, and addition of impervious surfaces significantly increases the volume of stormwater runoff. Industrial, commercial, and residential sources of pollution also become prevalent with urbanization. Urban runoff picks up pollutants from lawns, streets, parking lots, and industrial and commercial operations. Traditional stormwater management focused on moving water away from people, structures, and transportation systems as quickly and efficiently as feasible. This was accomplished by creating conveyance networks of roof drains, street inlets, pipes, and concrete channels, which concentrated runoff discharges to receiving waters. Some of the consequences of this traditional approach on receiving waters include:

- Increased pollutant concentrations and loads, which impact water quality for recreation, drinking water supply, aquatic life protection, and other beneficial uses;
- Stream channel widening and instability, increasing risk of damage to adjacent property and structures;
- Habitat degradation and ecosystem disruption associated with streambed and bank erosion, changes in stream flow, and reduction of both aquatic and terrestrial physical habitats.

Because of the adverse consequences of this traditional approach, stormwater management has evolved over the past several decades to focus on minimizing runoff and managing it near the source to address hydrologic and water quality effects of smaller, more frequently occurring events while also providing detention storage to attenuate peak runoff rates from larger events. Smaller, more frequently occurring events carry the bulk of the stormwater pollutant load to receiving waters and have the most significant effects on stream stability and geomorphology. Site planning that minimizes disturbance and impervious cover, and preserves soils, vegetation, steep slopes, and natural drainageways is an integral first step in this modern approach of minimizing runoff and managing it near the source. Following site planning, stormwater control measures (SCMs)[1] are designed to manage runoff near the source through infiltration, evapotranspiration, treatment, and harvesting for use (irrigation, toilet-flushing, etc.). Representative practices include rain gardens, pervious

[1] A note on terminology: SCM refers to both non-structural measures (such as preservation of natural areas) and structural controls to manage the quantity and quality of stormwater runoff from development, including SCMs that provide runoff reduction and water quality treatment as well as detention to control peak flows. SCM is used with this meaning in City Code Chapter 96. Nationally, SCM has begun to replace the term Best Management Practice (BMP) when referring to permanent, post-construction practices that provide runoff reduction and water quality treatment. BMP is still commonly used to refer to erosion and sediment controls and other construction site practices to manage runoff of pollutants during construction.

pavement, and vegetated swales, often referred to as Green Infrastructure (GI). This stormwater management approach of preserving natural site hydrology, and managing runoff close to its source using GI, is called Low Impact Development (LID). It can reduce the volume of stormwater runoff that must be managed by the flood control detention and conveyance components of the stormwater drainage system.

This chapter provides requirements and standards to protect the health, safety, and welfare of the public through stormwater management that reduces the harmful effects of urban runoff on area waterways and enhances the livability of the community. This chapter focuses on the following objectives:

- Compliance with federal and state requirements under the National Pollutant Discharge Elimination System (NPDES) Municipal Separate Storm Sewer System (MS4) program. The City of Springfield (City) is regulated under this program through its MS4 permit, which mandates the City to have requirements in place to reduce the discharge of pollutants from the MS4 to the Maximum Extent Practicable (MEP) by addressing the post-construction water quality impacts of stormwater runoff from new development and redevelopment.
- Design criteria to most effectively protect water quality by focusing on the small, frequently occurring storm events and encouraging a treatment train approach to provide multiple treatment processes and runoff reduction.
- Site planning and design principles to minimize disturbance and impervious surfaces and preserve and protect vegetation, soils, natural topography, natural channels, and karst features.
- Design standards for green infrastructure that provides multiple environmental, social, and economic benefits.

In developing this chapter, the following design manuals from other communities were referenced and adapted based on local conditions and experience. Designers may find these resources useful.

- Urban Drainage and Flood Control District (Denver, Colorado) Urban Storm Drainage Criteria Manual Volume 3
- Metropolitan St. Louis Sewer District BMP Toolbox
- American Public Works Association/Mid-America Regional Council (Kansas City, Missouri) Manual of Best Management Practices for Stormwater Quality
- Metro Government of Nashville & Davidson County, Tennessee Stormwater Management Manual
- Minnesota Stormwater Manual

2.0 Water Quality Requirement

The water quality requirement is to reduce the discharge of pollutants by: (1) following the site planning and design principles and criteria described herein, and (2) managing the Water Quality Volume (WQV) using approved SCMs that reduce the discharge of pollutants through treatment or runoff reduction and are properly designed, constructed, and maintained. The water quality

requirement applies to new development and redevelopment projects within the city limits of Springfield that disturb 1 acre or greater, including projects less than 1 acre that are part of a larger common plan of development or sale that will disturb 1 or more acres over the life of the project[2]. City Code Sec. 36-472 addresses zoning flexibilities that may be requested for redevelopment projects meeting water quality requirements.

Redevelopment means alterations of a property that remove and replace existing impervious surface in such a way that results in the disturbance of 1 or more acres of land and the existing impervious area within the project limits of disturbance equals or exceeds 40 percent. Existing impervious area means the impervious area existing within the last 12 months from the date of plan submittal. Redevelopment does not include activities, such as exterior remodeling or overlay of parking lots, that do not result in land disturbance. It does not include impervious area that is not removed and replaced.

Redevelopment projects where the previous development was not required to meet the water quality requirement shall meet a reduced WQV based on the runoff from a 0.5-inch rainfall for the redeveloped impervious area within the project limits of disturbance. Redevelopment projects that result in a net increase in impervious area must meet the WQV for new development (1-inch rainfall) for the net increase compared to existing impervious area.

It is recognized that in some unique situations it may not be reasonably feasible to achieve the full Water Quality Volume (WQV) for redevelopment projects, as defined in this section, due to extraordinarily difficult site conditions. These redevelopment projects either have space constraints or unusual topographical/geological conditions that limit the toolbox of typical water quality stormwater control measures (SCMs) that can be constructed on the site. Extraordinarily difficult site conditions that will be considered include:

- **Lack of available space in certain zoning districts.** Lack of available space, not covered by vertical buildings, for implementation of typical stormwater control measures such as extended detention, pervious pavement, underground detention, and bioretention. This situation is limited to zoning districts that do not have open space and off-street parking requirements.
- **Incompatibility with surrounding public stormwater system**. A project site drains to an existing stormwater collection system whose elevation/location precludes connection to a properly functioning SCM or there is no feasible public stormwater system for connection of the SCM outlet.
- **Unique conditions that would require substantial re-grading for SCMs.** Unique topographic or geologic conditions that would require site re-grading or re-contouring

[2] The U.S. Environmental Protection Agency provides the following explanation of "larger common plan of development or sale" on their website. "A 'larger common plan of development or sale' is a contiguous area where multiple separate and distinct construction activities may be taking place at different times on different schedules under one plan. For example, if a developer buys a 20-acre lot and builds roads, installs pipes, and runs electricity with the intention of constructing homes or other structures sometime in the future, this would be considered a larger common plan of development or sale. If the land is parceled off or sold, and construction occurs on plots that are less than one acre by separate, independent builders, this activity still would be subject to stormwater permitting requirements if the smaller plots were included on the original site plan…"

substantially different from typical and customary practices for the installation of SCMs (e.g., raising the site elevation significantly in order to install a SCM).

- **Subsurface conditions limiting SCMs.** The presence of subsurface conditions, including soil contamination or shallow depth to bedrock, that present significant and atypical technical requirements for mitigation, SCM design or installation, or create a likelihood for subsurface pollutant flume transport.
- **Potential for off-site basement flooding.** Surface or subsurface conditions indicating a likelihood that basement flooding on properties other than the development site are reasonably foreseeable if SCMs are installed.
- **Conditions that require pumping of stormwater.** Unique site or operational conditions that would require pumping or other mechanical routing of stormwater.
- **Other extraordinarily difficult site conditions.** There may be instances, not outlined above, where extraordinarily difficult site conditions preclude construction of on-site SCMs.

Redevelopment projects impacted by these extraordinarily difficult site conditions may apply to pay a full or partial fee-in-lieu of meeting the WQV. A partial fee-in-lieu is considered when it is feasible to utilize SCMs to meet some, but not all, of the required WQV. The redevelopment water quality fee-in-lieu shall be a rate established in a schedule adopted by ordinance from time to time. The fees shall be used by the City to implement water quality improvements within the James River or Sac River watershed where the water quality measures would have been constructed.

To submit a water quality fee-in-lieu request for consideration by the Departments of Public Works and Environmental Services, the Engineer of Record must apply and submit a letter and supporting documentation of the reason(s) that a water quality fee-in-lieu should be considered. The letter and supporting documentation shall include the following:

- Site plan for the proposed development;
- Letter and supporting evidence demonstrating extraordinarily difficult site conditions, including:
    - Narrative describing the nature of the extraordinarily difficult site conditions which preclude construction of on-site SCMs;
    - Detailed explanation of SCMs that were considered and the reason they were infeasible;
    - Geotechnical reports (if applicable);
    - Environmental site assessments (if applicable);
    - Any necessary engineering analyses demonstrating the difficulty of the site conditions.

If the request is denied, the applicant may then appeal to the Directors of Public Works and Environmental Services as provided by City Code Section 96-6. In the event the Directors uphold the denial, further appeals may proceed in accordance with City Code Section 96-6.

New developments and redevelopments that disturb less than 1 acre and are not part of a larger common plan of development or sale that will disturb 1 or more acres over the life of the project are not required to meet the water quality requirement. In accordance with Chapter 11, developments that disturb less than one acre that drain to a sinkhole shall utilize site design approaches that minimize directly connected impervious area and incorporate sheet flow and vegetated conveyance

where feasible to provide some level of water quality treatment and runoff reduction. Sites that disturb less than 1 acre that don't drain to a sinkhole are encouraged to utilize these site design approaches as well. Often this can be done through simple approaches such as directing downspouts to grass areas and utilizing flush curbs or curb cuts to allow parking lot runoff to flow into adjacent vegetated areas. Small sites may also have detention or landscape requirements that could be designed as dual-purpose water quality SCMs, such as parking lot landscape islands designed as rain gardens.

Prior to the adoption of this manual, the WQV was required to be calculated using the SCS method. Existing stormwater control measures designed for water quality based on this method are grandfathered in if the site redevelops.

All new or redeveloped impervious surface must convey runoff into the water quality stormwater control measure. An exception may be made for de minimis areas, or small areas of a site when it is not feasible and water quality is provided for off-site drainage area that is not currently served by a water quality SCM in exchange for not treating in equivalent amount of on-site area. The off-site drainage area shall be the same land use and equal or greater amount of impervious surface as the on-site area that will not be treated.

2.1 Water Quality Volume

Stormwater systems designed for flood control are typically designed for large, infrequent storm events. In contrast, stormwater controls to protect water quality are designed for small, frequent storm events. In Springfield, approximately 90 percent of all rainfall events are 1 inch or less. Studies indicate that most pollutants are washed off in the "first flush," of these small, frequent storms. Therefore, the WQV is based on the runoff from a 1 inch rainfall. The WQV must be captured using properly designed, approved SCMs that reduce the discharge of pollutants through treatment or runoff reduction.

Two methods can be used to calculate the WQV - the Short Cut Method and the Small Storm Hydrology Method. According to Claytor and Schueler (1996), these methods are more accurate than other methods for calculating runoff volumes from small storms on urban sites. Use of these methods is also consistent with other Missouri communities. The designer may choose to calculate the WQV using either method. Both methods compute a volumetric runoff coefficient (R_v) and multiply this by the 1 inch water quality storm and the site area. The volumetric runoff coefficient represents the amount of rainfall volume that becomes runoff volume on a site. The methods differ in how R_v is computed. **See Section 3.0 for credits that can be applied when calculating the WQV with either method.**

<u>Short Cut Method</u> - The Short Cut Method (Claytor and Schueler, 1996) computes R_v based on percent impervious cover. It is recommended where the site consists of predominately one type of land surface. The Short Cut Method uses the following equation to calculate the WQV.

$$WQV\ (ft^3) = (P/12)(R_v)(A*43{,}560)$$

Where

P = rainfall depth = 1 inch for new development or 0.5 inch for redevelopment
R_v = volumetric runoff coefficient = 0.05 + 0.009I
I = percent impervious cover (in percent, e.g. 80% = 80) (for redevelopment, use 100%)
A = total site area in acres for new development or impervious area for redevelopment

Small Storm Hydrology Method - The Small Storm Hydrology Method (Claytor and Schueler, 1996) computes R_v based on the specific characteristics of the pervious and impervious surfaces of the drainage area. The R_v to be used for each cover type is provided in Table 1. The Small Storm Hydrology Method uses the following equation to calculate the WQV.

$$WQV\ (ft^3) = (P/12)(\text{ weighted } R_v)(A*43{,}560)$$

Where

P = rainfall depth = 1 inch
Weighted $R_v = [(R_{v1}*A_1)+(R_{v2}*A_2)+...(R_{vi}*A_i)]/A$
R_{vi} = volumetric runoff coefficient for cover type *i*
A_i = area of cover type *i* in acres
A = total site area in acres

Table 1. Volumetric runoff coefficients for urban runoff from directly connected impervious areas for a 1 inch rainfall (Claytor and Schueler, 1996; Hirschman, et al., 2008)

Flat roofs and large unpaved parking lots	Pitched roofs and large impervious areas (large parking lots)	Small impervious areas and narrow streets	Urban pervious areas		Forest cover		
			Hydrologic Soil Group B	Hydrologic Soil Groups C & D	Hydrologic Soil Group B	Hydrologic Soil Group C	Hydrologic Soil Group D
0.84	0.97	0.7	0.11	0.21	0.03	0.04	0.05

2.2 Designing for Runoff Reduction and Targeted Pollutants

Development significantly increases the volume of runoff compared to pre-development conditions, contributing to increased pollutant loads and hydrologic stream impacts including erosion and aquatic habitat degradation. To address these impacts, consideration should be given to runoff reduction during site design and SCM selection and design. This can be accomplished through site planning and design techniques such as tree preservation and planting, natural area conservation, and minimizing grading and impervious surfaces, all of which contribute to runoff reduction. SCM selection and design can incorporate moderate to high performing runoff reduction SCMs and/or use a treatment train approach of more conventional SCMs such as vegetated filter strips, grass channels, and extended detention in series. The runoff reduction and pollutant removal performance of SCMs in series is greater than their use as stand-alone practices. Table 2 gives typical runoff reduction percentages for SCMs. Volume reduction also has economic benefits, including potential reductions in storage requirements for minor and major events, reduced extent and sizing of conveyance

infrastructure, and cost reductions associated with addressing channel stability issues. See Sections 5.5 and 5.6 for additional information on runoff volume reduction and the treatment train approach.

SCMs vary in their pollutant removal efficiencies for various pollutants. Common urban pollutants include nutrients, sediment, and bacteria. The majority of Springfield drains to the James River, which is categorized as impaired by the Missouri Department of Natural Resources due to excess nutrients that cause algae blooms and reduced water clarity, affecting recreation and other beneficial uses. The north side of Springfield drains to the Little Sac River which is impaired due to bacteria, largely from sources other than urban runoff. There are multiple sources of nutrients and bacteria in these watersheds including agriculture, wastewater, wildlife, and urban runoff. Most of the SCMs in this chapter are known to provide moderate to very good removal of sediment and nutrients. Typical effectiveness of SCMs for bacteria removal is generally not as good. SCM selection and design for commercial and industrial facilities should take into consideration pollutants specific to the facility such as heavy metals. Table 3 gives the typical effectiveness of SCMs for targeted pollutants. See Section 5.3 for additional information about pollutant removal processes.

Table 2. Typical Runoff Reduction Percentages for SCMs (Adapted from Hirschman, et al., 2008)

SCM	Runoff Reduction
Vegetated Filter Strip	
Natural Area	50-75%
Lawn/landscaping	25-50%
Grass Channel (meeting minimum residence time)	10-20%
Pervious Pavement	45-75%
Bioretention	40-80%
Extended Dry Detention Basin	0-15%
Extended Wet Detention Basin	0%
Constructed Wetland Pond	0%
Green Roof	45-60%
Proprietary SCMs	Based on site specific design
Rainwater Harvesting	40%; May be higher based on site specific design
Natural Area Conservation	% based on calculated WQV credit (see Section 3.1.1)
Natural Area Restoration	% based on calculated WQV credit (see Section 3.1.2)
Tree Preservation	% based on calculated WQV credit (see Section 3.1.3)
Tree Planting	% based on calculated WQV credit (See Section 3.1.3)

Table 3. Typical Effectiveness of SCMs for Targeted Pollutants (Source: UDFCD, 2010)

SCM	Sediment/Solids	Nutrients	Total Metals	Bacteria
Vegetated Filter Strip	Good	Moderate	Good	Poor
Grass Channel	Good	Moderate	Good	Poor
Pervious Pavement	Very Good[1]	Good	Good	Unknown
Bioretention	Very Good[1]	Moderate	Good	Moderate
Extended Detention Basin	Good	Moderate	Moderate	Poor
Retention Pond	Very Good	Moderate	Moderate	Moderate
Constructed Wetland Pond	Very Good	Moderate	Good	Poor
Green Roof[2]	Unknown	Unknown	Unknown	Unknown
Proprietary SCMs	Variable	Variable	Variable	Variable

[1]Not recommended for drainage areas with high sediment yield (unless pretreatment is provided.) [2]Water quality data for green roofs are not yet robust enough to provide meaningful conclusions about pollutant removal. By reducing volume, green roofs have the de facto capability to reduce pollutant loads; however, on a concentration basis, more data is needed to better define effectiveness.

2.3 Water Quality SCM Design in Floodplains

When developing in or near a floodplain, the bottom of the water quality SCM shall be above the 1-year flood elevation.

3.0 Site Planning and Design Credits

To encourage LID site planning and design approaches that preserve and restore natural areas and trees, disconnect impervious surfaces, and utilize vegetated channels for conveyance, the following credits can be used to reduce or meet the WQV.

3.1.1 Natural Area Conservation Credit

A WQV credit can be given for conserving natural areas on a development site, thereby retaining pre-development hydrologic and water quality characteristics. Natural areas include woods, wetlands, or other undisturbed open space that does not have managed turf, including floodplains and stream buffers. Previously disturbed areas are subject to staff review to determine if they qualify as a natural area in their current condition or if restoration would be needed to receive credit under Section 3.1.2. Under the credit, the conserved natural area can be subtracted from total site area when computing the WQV. The R_v is still calculated based on the percent impervious cover for the entire site (Short Cut Method) or based on a weighted R_v that includes the natural area (Small Storm Hydrology Method), even when there are multiple separate drainage areas within the site. An added incentive is that the hydrologic soil group for the conserved area will not have to be adjusted up one level (e.g. from C to D) for calculation of detention volume since the area is not being disturbed. To receive the natural area conservation credit, the following criteria shall be met:

- The natural area shall not be disturbed during or after project construction (e.g. cleared or graded) except for temporary impacts associated with incidental utility work with proper tree protection in place, and vegetation management activities consistent with preserving or improving the ecological function of the area, including but not limited to selective cutting to improve forest health, removal of invasive species, and periodic mowing. Low impact recreation facilities such as trails or picnic tables are also allowed if disturbance is minimized and proper tree protection is in place during installation.
- The natural area shall be protected by having the limits of disturbance clearly shown on all construction drawings and staked and protected in the field except as provided for above.
- The natural area shall be delineated and included in the approved long-term operation and maintenance plan and agreement required for all SCMs and filed with the Greene County Recorder of Deeds.

Example: A 5-acre site with 3.25 acres of impervious cover (65% impervious composed of pitched roof and large impervious areas), 0.75 acres of urban pervious area (C soil), and 1 acre of conserved forest cover (C soil). The designer may calculate the WQV using either the Short Cut Method or the Small Storm Hydrology Method. For example purposes, both are shown. The WQV is the lesser of the two volumes. In this example, the Short Cut Method produces the lesser volume.

Short Cut Method **(without credit):** WQV = (1/12)(R_v)(A*43,560) where
R_v = 0.05+0.009(65) = 0.64
A = 5 acres
WQV = (1/12)(0.64)(5*43,560) = 11,616 ft^3

Small Storm Hydrology Method
(without credit): WQV = (1/12)(R_v)(A*43,560) where
R_v = [(0.97*3.25)+(0.21*0.75)+(0.04*1)]/5 = 0.67
A = 5 acres
WQV = (1/12)(0.67)(5*43,560) = 12,161 ft^3

Short Cut Method **(with credit):** WQV = (1/12)(R_v)(A*43,560) where
R_v = 0.05+0.009(65) = 0.64
A = 5 acres - 1 acre conserved area = 4 acres
WQV = (1/12)(0.64)(4*43,560) = 9,292 ft^3

Small Storm Hydrology Method
(with credit): WQV = (1/12)(R_v)(A*43,560) where
R_v = [(0.97*3.25)+(0.21*0.75)+(0.04*1)]/5 = 0.67
A = 5 acres - 1 acre conserved area = 4 acres
WQV = (1/12)(0.67)(4*43,560) = 9,728 ft^3

3.1.2 Natural Area Restoration Credit

A WQV credit can be given for restoring a minimum contiguous area of 5,000 square feet of the development site as native prairie or urban forest. An area acceptable for restoration can be an area that is currently turf grass, has undergone past disturbance, or a previously developed area. Under the credit, the restored area can be subtracted from total site area when computing the WQV. The R_v is still calculated based on the percent impervious cover for the entire site (Short Cut Method) or based on a weighted R_v that includes the restored area as forest cover (Small Storm Hydrology Method). See the example in Section 3.1.1. An added incentive is that the hydrologic soil group for the restored area will not have to be adjusted up one level (e.g. from C to D) for calculation of detention volume since the area will be considered undisturbed once restored. To receive the natural area restoration credit, the following criteria shall be met:

- The area shall be restored based on a plan prepared by a qualified landscape architect, licensed forester, or licensed arborist.
- The natural area shall be delineated and included in the approved long-term operation and maintenance plan and agreement required for all SCMs and filed with the Greene County Recorder of Deeds.

3.1.3 Tree Preservation and Planting Credits

Trees reduce runoff through interception, evapotranspiration, and increased infiltration. In recognition of the stormwater benefits of trees, the following volume reduction credits can be applied to the WQV. These credits are based on District of Columbia (2013). Trees for which volume reduction credits have been taken shall be included in the Operation and Maintenance Plan and Agreement to ensure their long-term maintenance.

- A volume of 20 ft^3 can be deducted from the WQV for each preserved tree. To receive the credit, preserved trees shall be identified by a licensed forester or arborist as healthy trees that are structurally sound with a minimum current size of 6 inches measured at 4.5 feet above ground level and with an average mature spread of at least 35 feet that can be adequately protected during construction to ensure long-term survival. The natural area conservation credit in Section 3.1.1 or the tree preservation credit can be taken for tree preservation in a given area, but not both.
- A volume of 10 ft^3 can be deducted from the WQV for each tree planted on the site, including trees planted in SCMs such as rain gardens and the bottom of detention basins and trees planted in non-SCM areas. No credit will be given for trees required to be planted to meet City Code Sec. 36-482 *Landscaping and Bufferyards* unless the required landscape area where the tree is located is designed as an SCM (e.g. a parking lot landscape island designed as a rain garden or a bufferyard designed as a vegetated filter strip). The intent of the credit is to incentivize tree planting beyond zoning requirements and to incentivize the dual use of required landscape areas as SCMs. To receive the credit, planted trees shall have a minimum caliper size of 1.5 inches and an average mature spread of at least 35 feet, or if planted in an SCM in a required landscape area, the planted trees shall meet the criteria in City Code Sec. 36-482. The natural area restoration credit in Section 3.1.2 or the tree planting credit can be taken for tree planting in a given area, but not both.

3.1.4 Vegetated Filter Strip and Grass Channel Credits

SCMs can generally be categorized as conveyance-based versus storage-based. Conveyance-based SCMs, which aren't designed based on a storage volume, include vegetated filter strips and grass channels. These simple approaches are an important part of an LID approach to site design and can be used to disconnect and convey runoff from roof downspouts, parking lots, and other impervious surfaces. This section specifies how conveyance-based SCMs can contribute toward meeting the WQV requirement. A vegetated filter strip meeting the full design criteria in Section 8.0 is considered to meet the WQV requirement. Vegetated filter strips can be used as stand-alone SCMs or in series with other SCMs when part of a larger site drainage area. When used in series with other SCMs, the WQV for the area draining to the vegetated filter strip can be subtracted from the total WQV for the larger site drainage area. Partial credit can also be applied to the WQV for vegetated filter strips that do not meet the full length requirement and are used in series with other SCMs. The vegetated filter strip must be a minimum of 20 feet in length to receive partial credit. The intent of this partial credit is to encourage treatment train approaches that disconnect impervious surfaces. WQV credit is given based on the percentage of the required length provided. For example, the WQV can be reduced by 50% for the drainage area to a vegetated filter strip that is 50% of the required length (minimum 20-foot length). Grass channels are not considered a stand-alone SCM that meets the WQV requirement

but can be used in series with other SCMs to reduce the WQV by 20% for the contributing drainage area when designed to meet the criteria in Section 9.0, including minimum residence time.

4.0 Water Quality Design Principles

This section contains fundamental design principles that should be followed when designing a site.

Principle 1: Consider stormwater early. Stormwater site planning and design should be considered early in the concept phase of a development. Site planning is a step that has typically received little attention from a stormwater design perspective. *Low Impact Development Design Strategies: An Integrated Design Approach* (Prince George's County, Maryland, 1999) is recommended as a comprehensive guide for site planning. When considered early, strategies to meet stormwater requirements through low-cost practices that minimize runoff (Principle 2) are most easily achieved and SCM design issues are minimized.

Principle 2: Minimize runoff. The impacts of hydromodification and the total quantity of pollutants transported to receiving waters can be reduced most effectively by minimizing the total runoff volume and the volume of directly connected runoff. This can be achieved by minimizing total and directly connected impervious area, preservation or restoration of trees, natural vegetation and soils, and use of SCMs that provide runoff reduction benefits. Impervious surfaces can be minimized through thoughtful layout that minimizes building footprints and unnecessary street/driveway lengths and parking lot area while still meeting codes. No-disturbance zones can be specified in areas where clearing and grading is not necessary for infrastructure or buildings.

Principle 3: Maximize holding and settling time. The most effective SCMs reduce both the runoff peak and volume. By reducing the rate of outflow and increasing the time of detention storage, settling of pollutants and infiltration/evapotranspiration of runoff are maximized.

Principle 4: Maximize contact with vegetation. Contact with vegetation should be maximized to allow for treatment processes, evapotranspiration, and reduced flow velocities for settling of pollutants.

Principle 5: Utilize SCMs in series. Performance monitoring of SCMs throughout the country has shown that the combined effect of several SCMs in series (sometimes called a “treatment train”) can be more effective in reducing the level of pollutants than just providing a single SCM at the point of discharge. To the extent practicable, SCMs should be used in series. For example, a combination of downspout disconnection, vegetated filter strips, grass channels, and extended detention could be used to reduce and treat the WQV.

Principle 6: Incorporate flood control, water quality, and landscape objectives in designs, where practical. Incorporating both flood control and water quality enhancement into a single stormwater management facility (such as an extended detention basin or pervious pavement with subsurface storage) can work well on many sites. Water quality and landscape requirements can also be combined into a single, dual-purpose facility such as parking lot islands designed as rain gardens

that meet landscaping requirements and water quality requirements. Combining several objectives maximizes the cost-effectiveness of stormwater management facilities.

Principle 7: Use open channels for conveyance. Natural channels should be preserved when feasible, and stabilized if needed in accordance with procedures in Chapter 8. Open, vegetated channels for site conveyance are preferred rather than enclosed or concrete lined channels and can be used to reduce or meet water quality requirements when properly designed. Stream buffer requirements must be met as specified in Chapter 8.

Principle 8: Protect karst features. Sinkholes, springs, caves, and other karst features require special protection to minimize groundwater contamination and instability. Sinkhole and karst buffer requirements must be met as specified in Chapter 11. Site design and SCM selection should focus on small-scale, distributed practices and sheet flow to avoid concentrating large volumes of runoff which can result in collapses in karst areas.

Principle 9: Design for industrial/high risk runoff and pollutant types. Site specific SCMs should be incorporated into sites with activities or materials that have the potential to discharge significant pollutant loads. Such sites are generally regulated under NPDES industrial stormwater permits and the location and type of potential pollutant sources should be considered during site design and selection of SCMs to aid in NPDES permit compliance. Site and building design should consider specific needs such as materials storage or operations that may require source controls and/or containment or treatment SCMs. Non-NPDES regulated sites may also have specific pollutant types or hot spots such as fueling stations that should be considered when selecting and designing SCMs. Infiltration SCMs such as pervious pavement or bioretention may not be appropriate for sites with higher concentrations of hydrocarbons, metals, or other toxics unless an impermeable liner is provided to design the SCM for filtration only.

5.0 SCM Selection and Design Considerations

The following are general considerations when selecting and designing SCMs. Additional considerations are included in each SCM section.

5.1 Physical Site Characteristics

Physical characteristics of a site should drive the site design and SCM selection, including topography, vegetation, soils, contributing drainage area, groundwater, baseflows, and karst. A fundamental concept of LID is preservation and protection of site features including wetlands, drainageways, soils that are conducive to infiltration, tree canopy, etc., that provide water quality and other benefits. LID stormwater treatment systems are also designed to take advantage of these natural resources. For example, if a portion of a site is known to have soils with high permeability, this area may be well-suited for rain gardens or pervious pavement. The following are physical site characteristics that should be considered in SCM selection and design.

5.1.1 Soils

Soils with good permeability, most typically associated with Hydrologic Soil Groups (HSGs) A and B, provide opportunities for infiltration of runoff and are well-suited for infiltration-based SCMs such

as rain gardens, pervious pavement, and bioswales, often without the need for an underdrain system. Even when soil permeability is low, these types of SCMs may be feasible if soils are amended to increase permeability or if an underdrain system is used. In some cases, however, soils restrict the use of infiltration-based SCMs. When soils with moderate to high swell potential are present, infiltration should be avoided to minimize damage to adjacent structures due to water-induced swelling. In some cases, infiltration-based designs can still be used if an impermeable liner and underdrain system are included in the design; however, when the risk of damage to adjacent infrastructure is high, infiltration-based SCMs may not be appropriate. In all cases, consult with a geotechnical engineer when designing infiltration SCMs near structures. Consultation with a geotechnical engineer is necessary for evaluating the suitability of soils for different SCM types and establishing minimum distances between infiltration SCMs and structures.

5.1.2 Vegetation

Preservation of trees and natural vegetation are non-structural SCMs that should be considered during the concept phase of site layout and can reduce the WQV as well as be utilized as vegetated filter strips to meet the WQV requirement. Natural area restoration or reforestation is also an approved SCM that should be considered, especially for larger green space areas.

5.1.3 Topography

Steep slopes may prohibit the use of SCMs such as vegetated filter strips that require sheet flow. Bioswales and rain gardens can be designed for slopes by incorporating check dams. Minimizing disturbance of steep slopes should be considered in site design and can reduce grading and infrastructure costs as well as problems associated with managing flow and erosion.

5.1.4 Watershed Size

The contributing drainage area is an important consideration both on the site level and at the regional level. On the site level, there is a practical minimum size for certain SCMs, largely related to the ability to drain the WQV over the required drain time. For example, it is technically possible to size the WQV for an extended detention basin for a half-acre site; however, designing a functional outlet to release the WQV over a 24-hour drain time is practically impossible due to the very small orifices that would be required. For this size watershed, a rain garden would be more appropriate. At the other end of the spectrum, there must be a limit on the maximum drainage area for a regional facility to assure adequate treatment of rainfall events that may produce runoff from only a portion of the area draining to the SCM. If the overall drainage area is too large, events that produce runoff from only a portion of the contributing area will pass through the SCM outlet (sized for the full drainage area) without adequate residence time in the SCM.

5.1.5 Groundwater

Shallow groundwater on a site presents challenges for SCMs that rely on infiltration and for SCMs that are intended to be dry between storm events. Shallow groundwater may limit the ability to infiltrate runoff or result in unwanted groundwater storage in areas intended for storage of the WQV (e.g., porous sub-base of a pervious pavement system or in the bottom of an otherwise dry facility such as an extended detention basin). Conversely, for some types of SCMs such as constructed wetland basins, groundwater can be beneficial by providing saturation of the root zone and/or a source of baseflow. Groundwater quality protection is an issue that should be considered for infiltration-based

SCMs. Infiltration SCMs may not be appropriate for land uses that involve storage or use of materials that have the potential to contaminate groundwater underlying a site (i.e., "hot spot" runoff from fueling stations, materials storage areas, etc.). If groundwater or soil contamination exists on a site and it will not be remediated or removed as a part of construction, it may be necessary to avoid infiltration-based SCMs or use an impermeable liner to prevent infiltration into contaminated areas.

5.1.6 Base Flows

Base flows are necessary for the success of some SCMs such as constructed wetland ponds and retention ponds. Without baseflows, these SCMs will become dry and unable to support wetland vegetation. For these SCMs, a hydrologic budget should be evaluated.

5.1.7 Karst

Disconnection of impervious surfaces with conveyance-based SCMs and small, distributed storage-based SCMs are preferred in karst areas to minimize the risk of collapses due to concentration of large volumes of water. The incidence of collapses is higher in detention basins than in other areas.

5.2 Space Constraints

Space constraints are frequently cited as feasibility issues for SCMs, especially for high-density development and redevelopment sites. In some cases, constraints due to space limitations arise because adequate space for SCMs is not considered early enough in the planning process. This is most common when a site plan for roads, structures, etc., is developed and SCMs are squeezed into the remaining spaces. The most effective and integrated SCM designs begin by determining areas of a site that are best suited for SCMs (e.g., natural low areas, areas with well-drained soils) and then designing the layout of roads, buildings, and other site features around the existing drainage and water quality resources of the site. Allocating a small amount of land to water quality infrastructure during early planning stages will result in better integration of water quality facilities with other site features. Often, green spaces can be dual purpose for meeting zoning open space/landscaping requirements and stormwater management.

5.3 Targeted Pollutants and SCM Processes

SCMs have the ability to remove pollutants from runoff through a variety of physical, chemical and biological processes. The processes associated with a SCM dictate which pollutants the SCM will be effective at controlling. Pollutant load reduction is also affected by hydrologic processes. In addition to pollutant removal capabilities, many SCMs offer channel stability benefits in the form of reduced runoff volume and/or reduced peak flow rates for frequently occurring events. The International Stormwater BMP Database (www.bmpdatabase.org) provides SCM performance information that is updated periodically. Brief descriptions of several key processes are provided below and listed for each SCM in Table 4.

5.3.1 Hydrologic Processes

- **Flow Attenuation**: SCMs that capture and slowly release the WQV help to reduce peak discharges. In addition to slowing runoff, volume reduction may also be provided to varying degree in SCMs designed for flow attenuation.

- **Infiltration:** SCMs that infiltrate runoff reduce both runoff peak and volume. The extent to which runoff volumes are reduced depends on a variety of factors such as whether the SCM is equipped with an underdrain and the characteristics and long-term condition of the infiltrating media. Examples of infiltrating SCMs include rain gardens and pervious pavements. Water quality treatment processes associated with infiltration can include filtration and sorption.
- **Evapotranspiration**: Runoff volumes can be reduced through the combined effects of evaporation and transpiration in vegetated SCMs. Plants extract water from soils in the root zone and transpire it to the atmosphere. Evapotranspiration is the hydrologic process provided by vegetated SCMs, whereas biological uptake may help to reduce pollutants in runoff.

5.3.2 Pollutant Removal/Treatment Processes

- **Sedimentation:** Gravitational separation of particulates from urban runoff, or sedimentation, is a key treatment process of SCMs that capture and slowly release runoff. Smaller particles under 60 microns in size (fine silts and clays) (Stahre and Urbonas, 1990) can account for approximately 80% of the metals attached or adsorbed along with other contaminants in stormwater and can require long periods of time to settle out of suspension. Extended detention allows smaller particles to agglomerate into larger ones (Randall et al, 1982), and for some of the dissolved and liquid state pollutants to adsorb to suspended particles, thus removing a larger proportion of them through sedimentation. Sedimentation is the primary pollutant removal mechanism for many treatment SCMs including extended detention basins, retention ponds, and constructed wetland basins.
- **Straining**: Straining is physical removal or retention of particulates from runoff as it passes through a SCM. For example, grass channels and vegetated filter strips provide straining of sediment and coarse solids in runoff. Straining can be characterized as coarse filtration.
- **Filtration**: Filtration removes particles as water flows through media such as bioretention soil mix. A wide variety of physical, chemical, and biological mechanisms may occur along with filtration, depending on the filter media. Filtration is a primary treatment process provided by infiltration SCMs. Particulates are removed at the ground surface and upper soil horizon by filtration, while soluble constituents can be absorbed into the soil, at least in part, as the runoff infiltrates into the ground. Site-specific soil characteristics, such as permeability, cation exchange potential, and depth to groundwater or bedrock are important characteristics to consider for filtration (and infiltration) SCMs. Examples of filtering SCMs include rain gardens and pervious pavements with a sand filter layer.
- **Adsorption/Absorption**: In the context of SCMs, sorption processes describe the interaction of waterborne constituents with surrounding materials (e.g., soil, water). Absorption is the incorporation of a substance in one state into another of a different state (e.g., liquids being absorbed by a solid). Adsorption is the physical adherence or bonding of ions and molecules onto the surface of another molecule. Many factors such as pH, temperature and ionic state affect the chemical equilibrium in SCMs and the extent to which these processes provide pollutant removal. Sorption processes often play primary roles in SCMs such as constructed wetland basins, retention ponds, and rain gardens. Opportunities may exist to optimize

performance of SCMs through the use of engineered media or chemical addition to enhance sorption processes.

- **Biological Uptake:** Biological uptake and storage processes include the assimilation of organic and inorganic constituents by plants and microbes. Plants and microbes require soluble and dissolved constituents such as nutrients and minerals for growth. These constituents are ingested or taken up from the water column or growing medium (soil) and concentrated through bacterial action, phytoplankton growth, and other biochemical processes. In some instances, plants can be harvested to remove the constituents permanently. In addition, certain biological activities can reduce toxicity of some pollutants and/or possible adverse effects on higher aquatic species. Unfortunately, not much is understood yet about how biological uptake or activity interacts with stormwater during the relatively brief periods it is in contact with the biological media in most SCMs, with the possible exception of retention ponds between storm events (Hartigan, 1989). Rain gardens, constructed wetlands, and retention ponds are all examples of SCMs that provide biological uptake.

Table 4. Primary, Secondary, and Incidental Treatment Processes Provided by Various SCMs (Adapted from UDFCD, 2010)

SCM	Hydrologic Processes			Treatment Processes				
	Peak	Volume		Physical			Chemical	Biological
	Flow Attenuation	Infiltration	Evapo-transpiration	Sedimentation	Filtration	Straining	Adsorption/ Absorption	Biological Uptake
Grass Channel	I	S	I	S	S	P	S	S
Vegetated Filter Strip	I	S	I	S	S	P	S	S
Green Roof	P	S	P	N/A	P	N/A	I	P
Pervious Pavement	P	P	N/A	S	P	N/A	N/A	N/A
Bioretention	P	P[1]	S	P	P	S	S[2]	P
Extended Detention Basin	P	I	I	P	N/A	S	S	I
Retention Pond	P	I	P	P	S	S	P	P

P=Primary; S=Secondary, I=Incidental; N/A=Not Applicable

[1]Depending on presence and design of an underdrain.

[2]Depending on soil media.

5.4 Pretreatment

Forebays or other pretreatment is recommended and/or required for SCMs including extended detention and rain gardens. The purpose of forebays is to settle out coarse sediment prior to reaching the main body of the facility. It is extremely important that sediment loading be controlled for SCMs that rely on infiltration, including pervious pavement systems and rain gardens. Pretreatment can ensure long-term functionality and reduce maintenance of SCMs.

5.5 Volume Reduction

As specified in Section 2.2, site design and SCM selection and design should consider runoff volume reduction. Infiltration-based SCMs can be designed with or without underdrains, depending on soil

permeability and other site conditions. The most substantial volume reductions are generally associated with SCMs that have permeable sub-soils and allow infiltration to deeper soil strata and eventually groundwater. For SCMs that have underdrains, there is still potential for volume reduction although to a lesser degree. As runoff infiltrates through SCM soils to the underdrain, moisture is retained by soils. The moisture eventually evaporates, or is taken up by vegetation, resulting in volume reduction. Runoff that drains from these soils via gravity to the underdrain system behaves like interflow from a hydrologic perspective with a delayed response that reduces peak rates. Although the runoff collected in the underdrain system is ultimately discharged to the surface, on the time scale of a storm event there are volume reduction benefits.

Although effects of evapotranspiration are inconsequential on the time scale of a storm event, on an annual basis, volume reduction due to evapotranspiration in vegetated SCMs such as bioretention can be an important component of the hydrologic budget. Between events, evapotranspiration lowers soil moisture content, providing additional storage capacity for subsequent events. Volume reduction provided by a particular SCM type will be influenced by site-specific conditions and SCM design features. Table 2 provides typical runoff reduction percentages for SCMs. National research is ongoing with regard to estimating volume reduction provided by various SCM types.

5.6 Treatment Train

The term "treatment train" refers to multiple SCMs in series (e.g., a disconnected roof downspout draining to a grass channel draining to an extended detention basin.) Engineering research over the past decade has demonstrated that treatment trains are one of the most effective methods for management of stormwater quality (WERF 2005). Advantages of treatment trains include:

- **Multiple processes for pollutant removal**: There is no "silver bullet" for a SCM that will address all pollutants of concern as a stand-alone practice. Treatment trains that link together complementary processes expand the range of pollutants that can be treated and increase the overall efficiency of the system for pollutant removal.
- **Redundancy**: Given the natural variability of the volume, rate and quality of stormwater runoff and the variability in SCM performance, using multiple practices in a treatment train can provide more consistent treatment of runoff than a single practice and provide redundancy in the event that one component of a treatment train is not functioning as intended.
- **Maintenance**: SCMs that remove trash, debris, coarse sediments and other gross solids are a common first stage of a treatment train. From a maintenance perspective, this is advantageous since this first stage creates a well-defined, relatively small area that can be cleaned out routinely. Down-gradient components of the treatment train can be maintained less frequently and will benefit from reduced potential for clogging and accumulation of trash and debris.

5.7 Onsite and Subdivision SCMs

SCMs can be onsite, meaning they are located on the lot they are serving or they can be in subdivision common areas or easements that serve multiple lots. SCMs that serve multiple lots can be an efficient means of meeting water quality requirements in a common facility that is often maintained by a

property owners' association. However, a single subdivision SCM may not provide significant runoff volume reduction and does not provide the benefits of a treatment train approach. To achieve these benefits, an extended detention basin might be combined with downspout disconnection. Residential subdivisions usually already incorporate disconnection of roof runoff by directing downspouts to lawns. Disconnection of downspouts is an option for commercial buildings as well. Other options include vegetated filter strips for sheet flow from parking lots, grass channels to convey runoff to the extended detention basin, and other SCMs such as pervious pavement and rain gardens on the individual lots. This treatment train approach can reduce the WQV and detention volume needed in the extended detention basin, while providing volume reduction and a range of water quality treatment processes that will minimize hydromodification and provide better water quality than a stand-alone extended detention basin.

5.8 Integration with Flood Control

In addition to water quality, most projects will require detention for flood control, whether onsite or in a facility that serves multiple lots. It can be efficient to combine water quality and flood control facilities. Examples include extended detention basins and pervious pavement designed to provide the WQV and flood control storage. SCMs can also reduce required detention volume through lower curve numbers and decreased time of concentration.

5.9 Online SCMs and Offsite Drainage

Online refers to locating a SCM such that runoff from upstream of the development flows through it. Generally, on-line SCMs to capture the WQV are strongly discouraged, especially in a natural channel. It is preferable for natural channels to be preserved and SCMs to be located off-line. Online SCMs may require federal and state permits under Section 404 of the Clean Water Act if located in a jurisdictional waterway. There may be situations where SCMs may be located in an area that receives some offsite drainage. This may be acceptable if the offsite drainage is minimal and will not affect the integrity and functionality of the SCM. In these cases, the SCM does not need to be sized for the WQV for the offsite drainage but special design considerations may be needed to ensure the SCM can handle the offsite drainage while still providing the intended water quality treatment or volume reduction for the onsite drainage. See Section 2.0 for requirements for treating off-site runoff in exchange for on-site runoff.

5.10 Land Use, Compatibility with Surroundings, and Safety

SCMs can add interest and diversity to a site, serving multiple purposes in addition to providing water quality functions. Gardens, plazas, rooftops, and even parking lots can become amenities and provide visual interest while performing water quality functions and reinforcing urban design goals for the neighborhood and community. The integration of SCMs and associated landforms, walls, landscapes, and materials can reflect the standards and patterns of a neighborhood and help to create lively, safe, and pedestrian-oriented districts. The quality and appearance of SCMs should reflect the surrounding land use type, the immediate context, and the proximity of the site to important civic spaces. Aesthetics will be a more critical factor in highly visible urban commercial and office areas than at a heavy industrial site. The standard of design and construction should maintain and enhance property values without compromising function (WWE et al. 2004).

Public access to SCMs should be considered from a safety perspective. The highest priority of engineers and public officials is to protect public health, safety, and welfare. SCMs must be designed and maintained in a manner that does not pose health or safety hazards to the public. As an example, steeply sloped and/or walled ponds should be avoided. Where this is not possible, emergency egress, lighting and other safety considerations should be incorporated. Facilities should be designed to minimize mosquito breeding, which can be a nuisance and a public health concern (e.g., West Nile virus). The potential for nuisances, odors and prolonged soggy conditions should be evaluated for SCMs, especially in areas with high pedestrian traffic or visibility.

5.11 Maintenance

Maintenance is an important consideration in SCM selection and should be considered early in the planning and design phase. Even when SCMs are thoughtfully designed and properly installed, they can become eyesores, breed mosquitoes, and cease to function if not properly maintained. SCMs can be more effectively maintained when they are designed to allow easy access for inspection and maintenance and take into consideration factors such as property ownership, type of maintenance, visibility, and vehicle and equipment access. An important consideration for a rain garden with plantings is whether the property owner can commit to maintaining it as a landscape feature that requires weeding, watering, and replacement of mulch just like other site landscaping. Selection of pervious pavement should consider the need for periodic vacuum sweeping. See Section 7.0 for more information about maintenance requirements.

6.0 Plant Selection

Landscaped SCMs are a good choice where landscaping is already required by the zoning regulations, such as interior and perimeter parking lot landscaping and bufferyard landscaping. Such areas can be designed as rain gardens, vegetated filter strips, grass channels, or in some cases small extended detention basins. Vegetated filter strips, grass channels, and extended detention basins that are turf grass with trees and shrubs are generally easiest to maintain for most property owners because they will already be mowing other areas. Fully landscaped SCMs such as rain gardens with plantings and mulch require a higher level of commitment to maintain, including weeding and re-mulching. Often, non-SCM landscape beds around buildings get maintained very well but landscaped SCMs such as rain gardens get neglected. Fully landscaped SCMs should be designed with a plant palette and mulch that blends in with other landscape beds so that they get maintained equally well. Trees and shrubs are good options for ease of maintenance. When incorporating grasses and perennials, a simple plant palette of a few easily recognizable species will be easier to maintain.

Springfield's Field Guide 2030 Strategic Plan includes a goal to foster the utilization of native plants within our community (see Natural Environment Chapter, Major Goal 11). Requiring native plants in both public and private SCMs that utilize plants is one of the objectives listed to achieve this goal. Native plants are best adapted to our region's climate and generally require minimal watering once established and no chemical fertilizers or pesticides. Many native plants are particularly well-suited for SCMs because they can withstand wet conditions followed by dry periods. Native plants also provide important habitat and food sources for insects, birds, and animals that play important roles in our ecosystem. In support of the Field Guide 2030 goal and these benefits, Missouri native plants

should be selected when choosing plants for SCMs. The native species is preferable but cultivars of native plants are acceptable and are sometimes preferred due to characteristics such as being more compact or more readily available. To provide additional flexibility, non-native plants may be used that are climate tolerant to the local hardiness zone. Any non-native species selected shall be non-invasive. Native plant information is available from the Missouri Grow Native! program (www.grownative.org). A list of resources can be found on the City's website at www.springfieldmo.gov/stormwater.

Trees are highly recommended for SCMs, including rain gardens and the bottom of extended detention basins (with proper species selection and maintenance procedures to address clogging from leaves). Trees provide stormwater benefits through interception and evapotranspiration of rainfall, improved soil infiltration, and uptake of pollutants. Trees provide many other environmental, social, and economic benefits as well including improved air quality and increased property values.

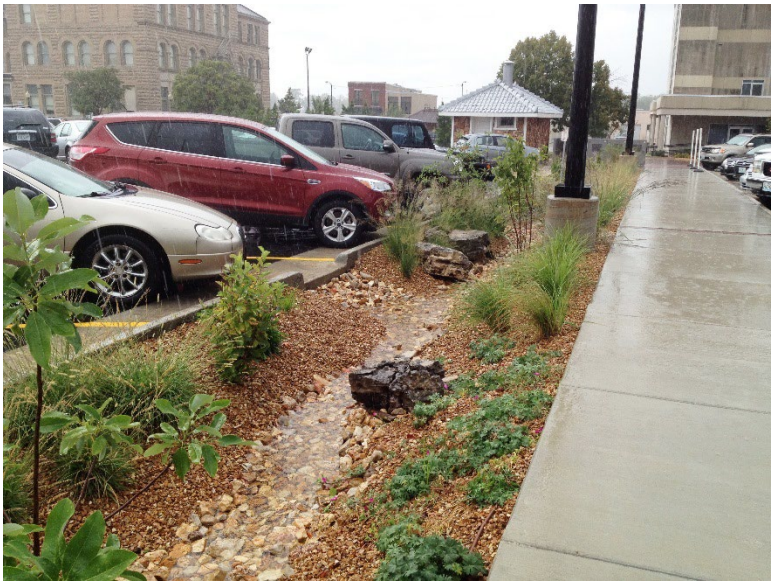


Photo 2. Bioswale with native grasses, perennials, shrubs, and trees at the City's Government Plaza.

Photo 3. Rain garden in a parking lot island with native plants at the City's Government Plaza.

Photo 4. Showy coneflower in a rain garden on Campbell between Mount Vernon and Elm.

Photo 5. Tussock sedge, Foxglove beardtongue, and Indian pink in a rain garden on Campbell between Mount Vernon and Elm

7.0 Operation and Maintenance Plan and Agreement

Water quality SCMs are designed to reduce and/or treat runoff to reduce stormwater pollutant loads and therefore may require higher levels of maintenance to serve their designed functions. An operation and maintenance plan and agreement shall be submitted for approval by the City for all SCMs required to meet the water quality requirements in Chapter 10, flood control detention requirements in Chapter 9, or zoning conditions in City Code 36-482(8)(b). The operation and maintenance plan and agreement shall meet requirements set forth by the Director of Environmental Services (Director) and shall be recorded with the Greene County Recorder of Deeds. In order to ensure the long-term operation and maintenance of SCMs, the property owner shall conduct annual self-inspections of the SCMs and reporting of these inspections in accordance with schedules, inspection forms, and reporting procedures set forth by the Director. Deficiencies identified through self-inspections or inspections by the City shall be addressed in a timely manner.

8.0 Vegetated Filter Strip

8.1 Description

Vegetated filter strips are densely vegetated areas that reduce and treat runoff as sheet flow from adjacent impervious and pervious areas. They can be turf grass lawn, landscaping, or conserved/restored natural areas. They require sheet flow to promote filtration/settling of pollutants, infiltration, and evapotranspiration. Lawn or landscaping near buildings can be designed as a vegetated filter strip for roof downspouts. Vegetated filter strips can also be designed for parking lots or other impervious surfaces. Vegetated filter strips differ from grass channels in that they are designed to accommodate sheet flow rather than concentrated or channelized flow. Grass, trees, and shrubs in vegetated filter strips can provide aesthetically pleasing green space, which can be incorporated into a landscaping and bufferyard plan. In addition, their use typically adds little cost to a development when incorporated into the existing green space requirements, and their maintenance should be no different than routine maintenance of onsite landscaping.

Photo 6. Natural conservation area as vegetated filter strip (SEMCOG, 2015).

Photo 7. Turf grass vegetated filter strip.

8.2 Site Selection

Vegetated filter strips can be utilized for a variety of land uses and are typically located adjacent to impervious areas. Because of the amount of space required for filter strips to meet full WQV requirements, additional SCMs are often required. Sites can be designed with a treatment train approach that utilizes vegetated filter strips that provide WQV reduction, in series with storage-based SCMs to provide the remaining WQV. Because the effectiveness of vegetated filter strips depends on having an evenly distributed sheet flow over their surface, the size of the contributing drainage area and the associated volume of runoff must be limited.

8.3 Design Considerations

Design of a vegetated filter strip is based primarily on maintaining sheet flow conditions across a uniformly graded area with a gentle slope and a dense grass cover. Whenever concentrated runoff occurs, it should be evenly distributed across the width of the filter strip via a flow spreader. This may be a pervious pavement strip or another type of structure used to achieve uniform sheet-flow

conditions. When a filter strip is used over unstable slopes, soils or vegetation, formation of rills and gullies that disrupt sheet flow will occur. The resultant short-circuiting will invalidate the intended water quality benefits and must be corrected through maintenance. A rectangular strip is the preferred shape and should be free of gullies or rills that concentrate flow.

Vegetated filter strips shall not be used in areas where there will be vehicular traffic or heavy, routine pedestrian use. When used in appropriate areas, they should also be protected from excessive pedestrian or vehicular traffic that can damage the grass cover and affect uniform sheet-flow distribution. This can be accomplished using slotted curb or other types of barriers. The top of the filter strip should be designed and installed 1 to 3 inches below the adjacent pavement so that growth of vegetation and accumulation of sediment at the edge of the strip does not prevent runoff from entering the filter strip. Alternatively, a sloped edge can be used adjacent to vehicular traffic areas (where vehicle safety would not be impacted). A mixture of grass and trees may offer benefits for slope stability and improved aesthetics, as well as increased runoff reduction.

8.4 Design Procedure and Criteria

A vegetated filter strip meeting the full design criteria in this section is considered to meet the WQV requirement. Vegetated filter strips can be used as stand-alone SCMs or in series with other SCMs when part of a larger site drainage area. When used in series with other SCMs, the WQV for the area draining to the vegetated filter strip can be subtracted from the total WQV for the larger site drainage area. Partial credit can also be applied to the WQV for vegetated filter strips that do not meet the full length requirement and are used in series with other SCMs. The vegetated filter strip must be a minimum of 20 feet in length to receive partial credit. The intent of this partial credit is to encourage treatment train approaches that disconnect impervious surfaces. WQV credit is given based on the percentage of the required length provided. For example, the WQV can be reduced by 50% for the drainage area to a vegetated filter strip that is 50% of the required length (minimum 20-foot length).

The following steps outline the vegetated filter strip design procedure and criteria. Figure 1 is a schematic of a filter strip and its components.

1. **Design Discharge:** Calculate the 2-year peak flow rate, $Q_{2\text{-year}}$ (cfs), of the area draining to the filter strip as described in Chapter 5, Calculation of Runoff.

2. **Minimum Width:** The Width (W), the distance normal (i.e. perpendicular) to flow of the filter strip, is typically the same as the contributing basin (see Figure 2). An exception to this is where flows become concentrated. Concentrated flows require a level spreader to distribute flows evenly across the width of the filter strip. The minimum design width, W_G (ft), (normal to flow) is calculated as:

$$W_G = \frac{Q_{2-year}}{0.05}$$

3. **Length:** The minimum design Length, L_G (ft), along the sheet flow direction, shall meet the minimum length calculated using the following equations for sheet flow or concentrated flow. Concentrated flow includes roof downspouts, pipe discharges or other situations where flow will concentrate (see #5 below).

$L_G = 0.2L_I$ or 20 feet (for sheet flow control)

$L_G = 0.15(A_t/L_t)$ or 20 feet (for concentrated flow control)

In which:

L_I = Flow path length of sheet flow over the upstream impervious surface (ft)

A_t = Tributary area (ft^2)

L_t = Length of the tributary inflow normal to flow spreader (i.e., width of flow spreader) (ft)

4. **Filter Strip Slope:** The vegetated filter strip slope in the direction of flow, S, shall not exceed 4%. Generally, a minimum slope of 2% in turf is adequate to facilitate positive drainage. For slopes less than 2%, consider including an underdrain system to mitigate nuisance drainage.

5. **Flow Characteristics (sheet or concentrated)**: Concentrated flows can occur when the width of the watershed differs from that of the vegetated filter strip. Additionally, when the product of the watershed flow length and the interface slope (the slope of the watershed normal to flow at the vegetated filter strip, see Figure 1) exceeds approximately one, flows may become concentrated. Use the following equations to determine flow characteristics:

   Sheet Flow: FL(SI) ≤ 1

   Concentrated Flow: FL(SI) > 1

   Where:

   FL = watershed flow length (ft)

   SI = interface slope (normal to flow) (ft/ft)

6. **Flow Distribution:** Flows delivered to a vegetated filter strip must be sheet flows. Slotted or flush curbing, pervious pavements, or other devices can be used to spread flows. The filter strip should have relatively consistent slopes to avoid concentrating flows within the filter strip. A level spreader should be used when flows are concentrated. A level spreader can be a slotted drain designed to discharge flow through a slot. The slot openings should be small to encourage frequent flows to overtop the level spreader, but, not so small that it is frequently clogged. A level spreader could also be an infiltration trench filled with gravel, which allows water to infiltrate prior to discharging over a level concrete or rock curb. There are many ways to design and construct a level spreader. They can also be used in series when the length of the filter strip allows flows to re-concentrate. Figure 3 is a schematic of typical level spreader details. Other guidance can be used when designing level spreaders.

7. **Soil Preparation:** To encourage establishment and long-term health of the vegetation and maximize runoff absorption and infiltration, it is essential that soil conditions be properly prepared prior to installation. Following site grading, poor soil conditions often exist. For a constructed filter strip, stockpile and reuse on-site topsoil when possible. A minimum of 4 inches

of topsoil shall be used. Alternatively, soil can be amended with 2 to 4 inches of compost, tilled to a depth of 6 to 10 inches. Compost shall be derived from the decomposition of yardwaste as defined by MDNR (2014). Compost derived from animal or poultry manure shall not be acceptable. Compost shall have a C/N ratio <25, indicating a finished compost. Compacted soil should be loosened or tilled. Finish grading to achieve desired elevations and slopes should be performed using tracked equipment to prevent compaction. After the topsoil or compost soil amendments are placed, sod or seed the filter strip and cover with suitable erosion control until vegetation is established. Conserved open space used as a filter strip should be protected from grading and compaction with fencing or other suitable barriers.

8. **Vegetation:** This is the most critical component for treatment with a vegetated filter strip. Select durable, dense, and drought tolerant grasses. Also, consider the size of watershed, as larger watersheds will experience more frequent flows. The goal is to provide a dense mat of vegetative cover. Vegetated filter strip performance falls off rapidly as the vegetation coverage declines below 80% (Barrett el al., 2004). Trees and shrubs are strongly encouraged due to the additional runoff reduction benefits provided and can be compatible with a perimeter or bufferyard landscape plan.

9. **Outflow Collection:** Provide a means for outflow collection. The filter strip can drain to a grass channel, bioswale, storm drain, or street gutter in accordance with design criteria for those facilities. In some cases, the use of underdrains can maintain better infiltration rates and help dry out the filter strip after storms.

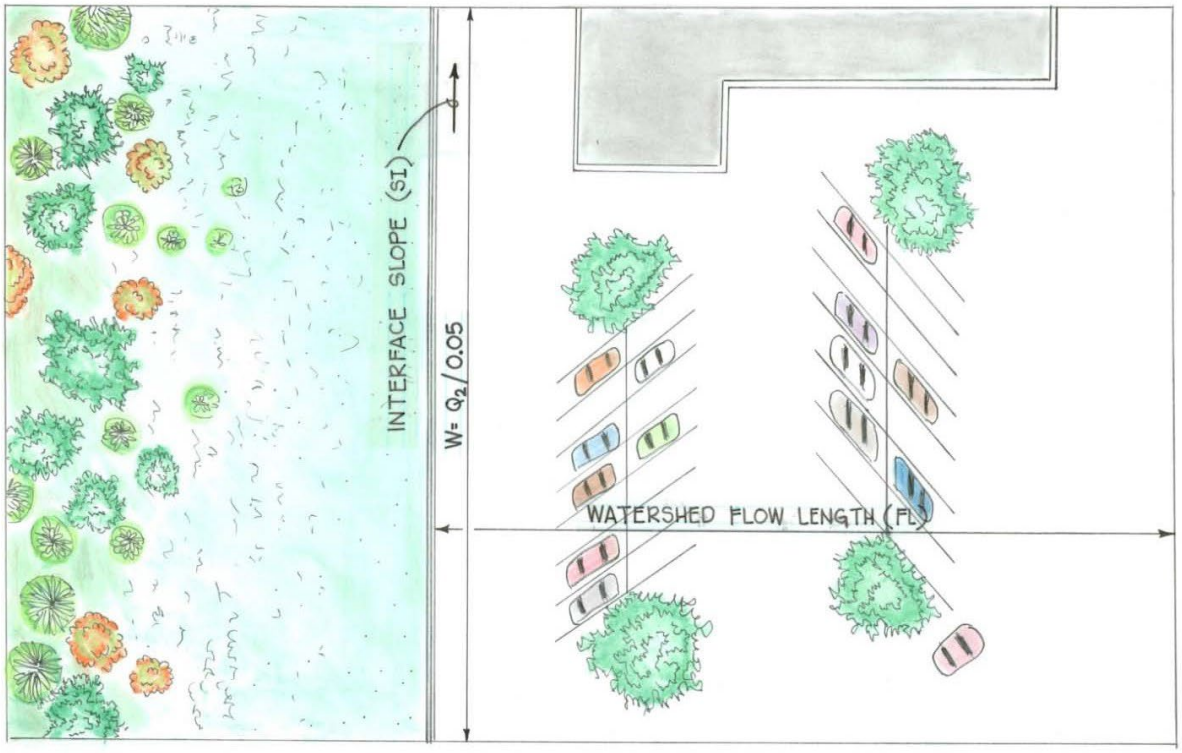


Figure 1. Vegetated filter strip for a parking lot (Source: UDFCD, 2010. Graphic by Adia Davis).

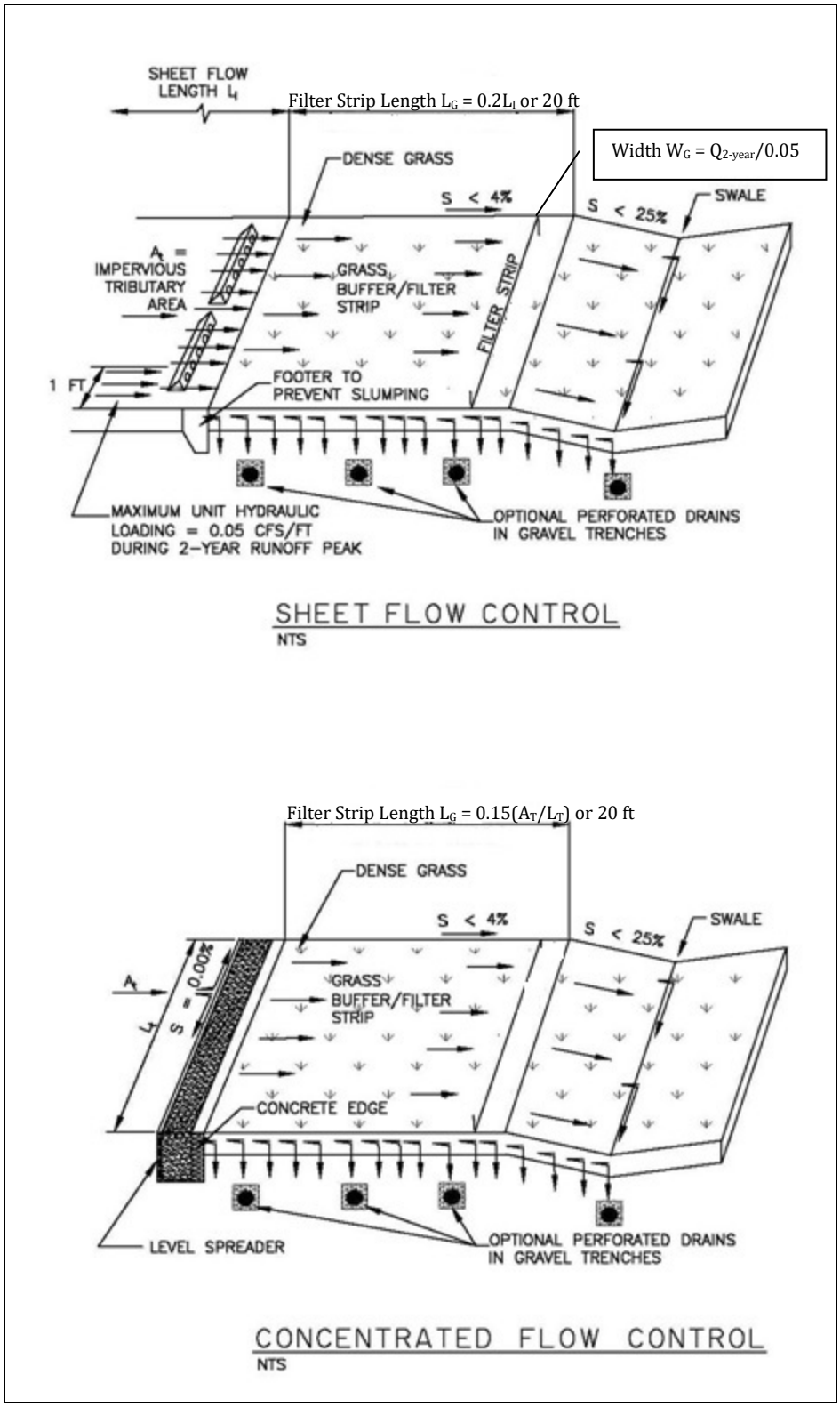


Figure 2. Typical vegetated filter strips for sheet flow and concentrated flow.

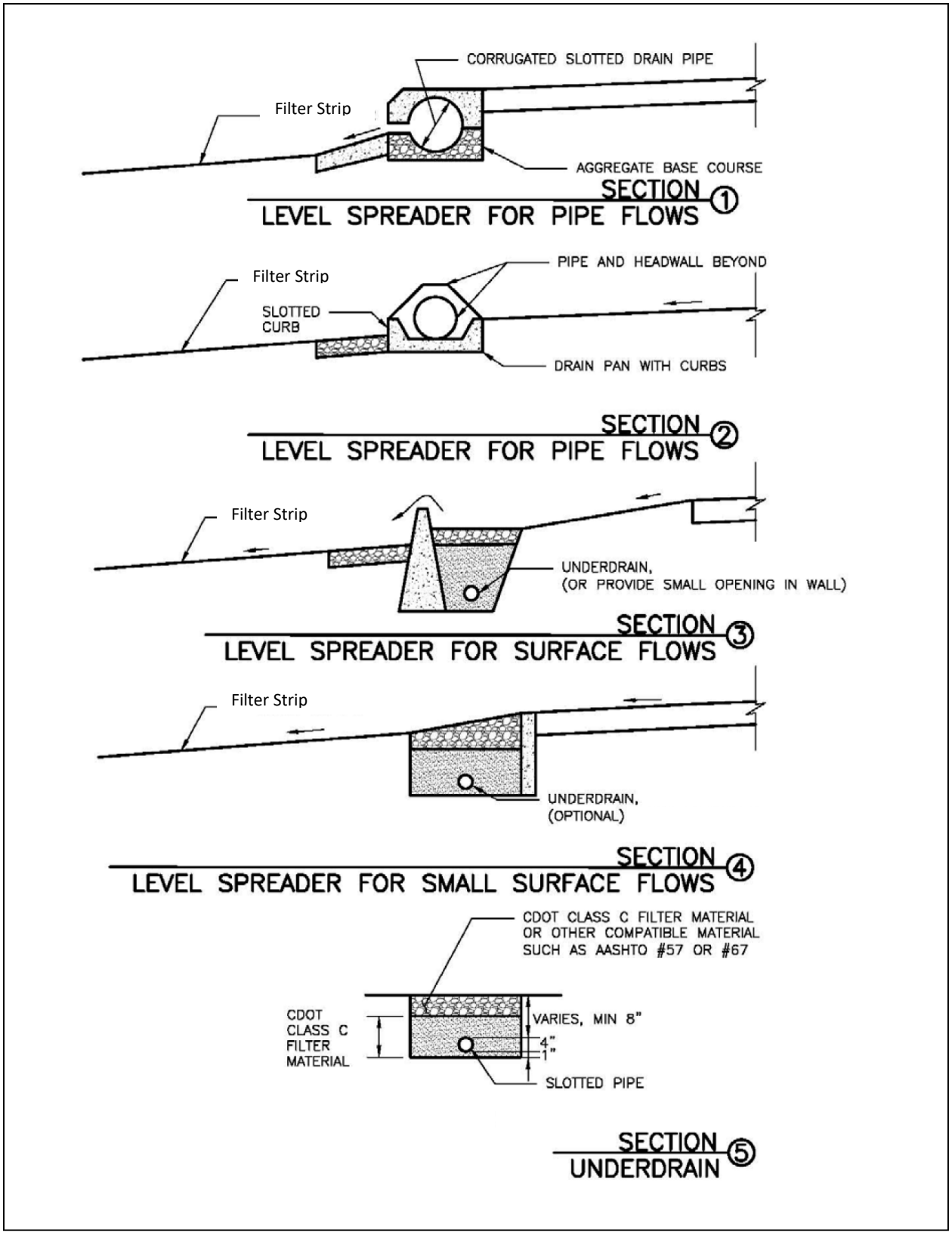


Figure 3. Typical level spreaders (Source: UDFCD, 2010).

8.5 Construction Considerations

Success of a vegetated filter strip depends not only on a good design and long-term maintenance, but also on installing the facility in a manner that enables it to function as designed. Construction considerations include:

- The final grade of the filter strip is critical. Oftentimes, following soil amendment and placement of sod, the final grade is too high to accept sheet flow. The filter strip should be inspected prior to placement of seed or sod to ensure appropriate grading.
- Perform soil amending, fine grading, and seeding after tributary areas have been stabilized and utility work crossing the filter strip has been completed.
- When using sod tiles, stagger the ends of the tiles to prevent the formation of channels along the joints. Use a roller on the sod to ensure there are no air pockets between the sod and soil.
- Avoid over-compaction of soils in the filter strip area during construction to preserve infiltration capacities.
- Erosion and sediment control measures on upstream disturbed areas must be maintained to prevent excessive sediment loading to the filter strip.

8.6 As-Built Certification

Upon completion of the vegetated filter strip, prior to final acceptance, an as-built certification signed and sealed by the Missouri-registered Professional Engineer of Record shall be submitted verifying that the vegetated filter strip was installed as designed and approved. The following components shall be addressed in the as-built certification:

1. Level spreader is properly installed to create sheet flow.
2. Vegetated filter strip does not exceed the maximum slope.
3. Impervious areas drain to the vegetated filter strip.
4. Soil has been properly prepared or protected.
5. Proper vegetation has been established or protected.

9.0 Grass Channel

9.1 Description

Photo 8. Construction of a grass channel along Erie Street.

A grass channel is a densely vegetated drainageway with gentle side slopes that collects and slowly conveys runoff. Grass channels have low longitudinal slopes and broad cross-sections that convey flow in a slow and shallow manner, thereby facilitating sedimentation and filtering (straining) while limiting erosion and providing some reduction in runoff volumes for small storms through infiltration and evapotranspiration. Grass channels are an integral part of the LID concept as an alternative to pipes or concrete channels, and are generally less expensive to construct. The grass channel should be vegetated with dense grasses that can reduce flow velocities and protect against erosion during larger storm events.

Photo 9. Roadside channel with native plants in the Legacy Trails Subdivision.

Grass channels are not considered a stand-alone SCM that meets the WQV requirement; however, they can be used to reduce the required WQV by 20% for the contributing drainage area. To receive the 20% credit towards meeting the WQV requirement, the grass channel must meet all design criteria herein including the minimum residence time. The 20% credit is based on the average runoff reduction benefit of a grass channel (Hirschman, et al., 2008; Nashville & Davidson County, 2012). Grass channels that do not meet the minimum residence time are still beneficial as an alternative to pipes or concrete channels.

9.2 Site Selection

A grass channel can be located to collect overland flows from areas such as parking lots, buildings, roadways and vegetated filter strips. They can also be used to convey runoff from a pipe discharge. A grass channel is well suited for sites with low to moderate slopes.

9.3 Design Considerations

A grass channel is sized to maintain a low velocity during small storms and to collect and convey larger runoff events. A grass channel generally should not be used where site slopes exceed 5 percent. The longitudinal slope of a grass channel should be kept to less than 1 percent in most cases, which often necessitates the use of grade control checks or drop structures. Figure 4 shows

trapezoidal and triangular swale configurations. If one or both sides of the grass channel are also to be used as a vegetated filter strip, the design of the vegetated filter strip must follow the requirements in the vegetated filter strip specification.

9.4 Design Procedure and Criteria

The following steps outline the grass channel design procedure and criteria. Figure 4 is a schematic of a grass channel and its components.

1. **Design Discharge:** Calculate the 2-year peak flow rate, Q2-year (cfs), to be conveyed in the grass channel as described in Chapter 5, Calculation of Runoff. For grass channels connecting directly to the public stormwater system, the grass channel must meet the criteria given in Chapter 8, Open Channels. For all developments with detention, it must be shown that the channel can convey the maximum design flow to the detention basin and that bypass will not occur.

2. **Hydraulic Residence Time:** Increased hydraulic residence time in a grass channel improves runoff reduction and water quality treatment. Maximize the length of the channel when possible. If the length of the channel is limited due to site constraints, the slope can also be decreased or the cross-sectional area increased to increase hydraulic residence time. Grass channels with a minimum hydraulic residence time of 5 minutes can be used to reduce the WQV by 20% for the contributing drainage area. Grass channels that do not meet the minimum residence time are still beneficial as an alternative to pipes or concrete channels. The hydraulic residence time shall be calculated by dividing the channel length by the velocity.

3. **Geometry:** The geometry of the cross-section should be either trapezoidal or triangular with side slopes not exceeding 4:1 (horizontal: vertical), preferably flatter.

4. **Longitudinal Slope:** The longitudinal slope, So, of the grass channel should be kept to less than 1% in most cases. If the longitudinal slope requirements cannot be satisfied with available terrain, grade-control checks or small drop structures must be incorporated to maintain the required longitudinal slope. (See Chapter 8, Open Channels.)

5. **Velocity and Flow Depth:** To promote sedimentation and water quality treatment, the maximum velocity of the 2-year peak flow shall not exceed 2 feet per second (ft/s) and the maximum flow depth of the same flow shall not exceed 1 foot.

6. **Soil Preparation:** To encourage establishment and long-term health of the vegetation and maximize runoff absorption and infiltration, it is essential that soil conditions be properly prepared prior to installation. Following site grading, poor soil conditions often exist. When possible, stockpile and reuse on-site topsoil. A minimum of 4 inches of topsoil shall be used. Alternatively, soil can be amended with 2 to 4 inches of compost, tilled to a depth of 6 to 10 inches. Compost shall be derived from the decomposition of yardwaste as defined by MDNR (2014). Compost derived from animal or poultry manure shall not be acceptable. Compost shall have a C/N ratio <25, indicating a finished compost. Compacted soil should be loosened or tilled. Finish grading to achieve desired elevations and slopes should be performed using tracked equipment to prevent compaction.

7. **Vegetation:** Select durable, dense, and drought tolerant grasses. Also, consider the size of watershed, as larger watersheds will experience more frequent flows. The goal is to provide a dense mat of vegetative cover. After the topsoil or compost amendments are placed, sod or seed

the grass channel and cover with suitable erosion control until established. Erosion control blanket or turf reinforcement mat may be used.

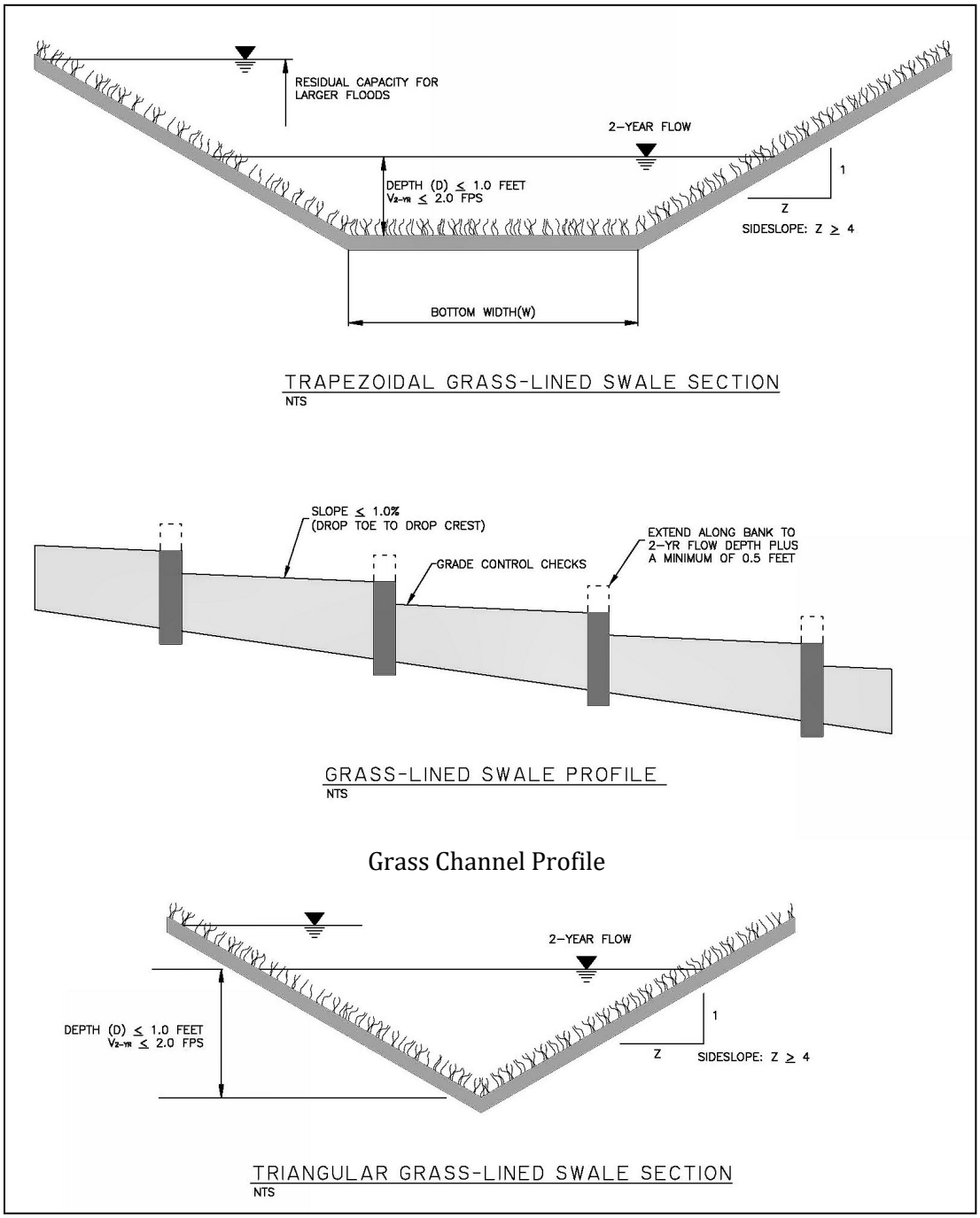


Figure 4. Typical grass channel sections.

9.5 Construction Considerations

Success of grass channels depends not only on good design and maintenance, but also on construction practices that enable the SCM to function as designed. Construction considerations include:

- Perform fine grading, soil amendment, and seeding only after upstream areas have been stabilized and utility work crossing the channel has been completed.
- Avoid compaction of soils to preserve infiltration capacities.
- Provide irrigation appropriate to the grass type for establishment.
- If weed control is necessary during establishment, mowing to prevent seeding of weeds and selective spot spraying are preferred methods over wide-spread application of chemical weed control herbicides.
- Protect the channel from other construction activities.

9.6 As-Built Certification

Upon completion of the grass channel, prior to final acceptance, an as-built certification signed and sealed by the Missouri-registered Professional Engineer of Record shall be submitted verifying that the grass channel was installed as designed and approved. The following components shall be addressed in the as-built certification:

1. Side slopes, longitudinal slope, and depth constructed as designed.
2. The channel meets the maximum flow velocity and minimum hydraulic residence time.
3. Soil has been properly prepared.
4. Proper vegetation has been established.

10.0 Permeable/Pervious Pavement (General)

10.1 Description

The term permeable or pervious pavement, as used in this manual, is a general term to describe any one of several pavements that allow movement of water into the layers below the pavement surface. Permeable pavement and pervious pavement are often used interchangeably. For simplicity, pervious pavement will be used in this section. Depending on the design, pervious pavements can be used to provide volume reduction, and/or treatment and slow release of the WQV. Use of pervious pavements is a common LID practice used alone or in combination with other SCMs to meet the water quality requirements. Pervious pavement can also be designed with an increased depth of aggregate material to provide storage for storm events in excess of the water quality storm event. This requires some additional design considerations which are discussed within this section. The types of pervious pavement that are considered to have acceptable longevity and are therefore allowed include permeable interlocking concrete pavement (PICP) and pervious concrete. Modular block porous pavers and other proprietary pervious pavement systems may be acceptable on a case by case basis and should adhere to manufacturer's specifications and the design considerations and plan notes herein, as applicable.

Photo 10. Permeable interlocking concrete pavers at the City Government Plaza.

Photo 11. Installation of pervious concrete at the City Government Plaza.

10.2 Site Selection

Pervious pavement systems provide an alternative to conventional pavement and are most commonly used in parking lots, pedestrian areas, and lower-traffic vehicle areas. Maintenance should be considered when selecting the location for pervious pavement to ensure parking schedules and access allow cleaning of the pavement to occur at the necessary frequency. They are not appropriate where sediment-laden runoff could clog the system (e.g., near loose material storage areas, or at sites where vehicles and equipment are likely to track sediment), or where erosive conditions such as steep slopes and/or sparse vegetation drain to the pervious pavement. For sites where land uses or activities can cause infiltrating stormwater to contaminate groundwater, special design requirements are required to ensure no-infiltration from the pavement sections. Pervious pavement

shall not be constructed where there are underground utility easements and is not recommended in the floodplain due to maintenance concerns.

When pervious pavement (or other SCMs that allow infiltration) are proposed adjacent to buildings or pavement, protective measures should be implemented to avoid adverse impacts to these structures. Oversaturated subgrade soil underlying a structure can cause the structure to settle or result in moisture-related problems. Wetting of expansive soils or bedrock can cause swelling, resulting in structural movements. A geotechnical engineer should evaluate the potential impact of the pervious pavement on adjacent structures based on an evaluation of the subgrade soil, groundwater, and bedrock conditions at the site. Additional minimum requirements for these site conditions include:

- An underdrain shall be provided whenever possible and shall be designed to divert water away from the structure.
- In locations where potentially expansive soils or bedrock exist, placement of pervious pavement adjacent to structures and conventional pavement should only be considered if the pervious pavement includes an underdrain designed to divert water away from the structure and is lined with an essentially impermeable geomembrane liner designed to restrict seepage.

10.3 General Performance Criteria

To be considered an effective SCM, pervious pavement designs shall meet the following:

- Provide storage equal to the required design volume for water quality, flood control detention, or both. The volume in the voids of the open graded base and subbase shall be considered the total volume. A porosity not greater than 40 percent shall be used to calculate storage volume for No. 57 and No. 2 stone. No storage volume will be allowed in the pervious concrete, PICP, or PICP bedding stone layer.
- Capture and treat the drainage area to meet the required drain time of 12-72 hours.
- Pervious pavement systems must be designed to handle the drainage area to ensure acceptable performance and system longevity. Larger drainage areas may increase clogging and maintenance frequency. Designs shall meet a maximum ratio of impervious area to pervious pavement of 2:1.
- An underdrain shall be provided if required per Section 10.4. The underdrain shall be 4-6" perforated or slotted pipe. Do not put a filter sock on the underdrain. This is not necessary and can clog. Use a minimum perforation size of 3/8 inch to avoid clogging. Provide documentation that the design meets the drain time of 12-72 hours. The horizontal and vertical locations of the underdrain shall be determined by the design engineer, depicted on the drawings, and be in general accordance with the pervious pavement details. Horizontal spacing of underdrains shall be a maximum of 20 feet on center when multiple underdrains are necessary for pervious pavement sections wider than 40 feet. Cleanouts shall be provided to allow inspection by camera of the underdrain system during and after construction to ensure that the pipe was not crushed or disconnected during construction and to allow for maintenance of the underdrain.

- The thickness of the rock storage shall be a minimum of 6 inches when no underdrain is used and 9 inches when an underdrain is used. Storage, drain time, and traffic loads shall be considered in determining thickness of rock storage.
- A properly designed overflow mechanism shall be provided. Provide an overflow system or additional storage to prevent water in the open graded storage bed from rising into the pervious pavement for the 2-yr, 24-hr storm event when designing for water quality only, or the 100-yr critical storm when designing for detention. Any emergency overflow pipes placed within the subbase should discharge only when the storage volume is exceeded. The horizontal and vertical location of all underdrains and overflow systems shall be determined by the design engineer and shown on the plans. Emergency overflow pipes and underdrain systems shall discharge to a stormwater structure or daylight to a stabilized outfall.
- Observation wells shall be provided in low areas within the pervious pavement system and shall extend to the bottom of the storage bed. The wells shall consist of a 6-inch perforated pipe with cast iron frame and cover, as shown on the pervious concrete section (Figure 9). The number of wells required on an installation will vary on a site-specific basis and will be determined by the design engineer.
- In-service pervious pavement shall have a minimum infiltration rate of 10 inches/hour (ASCE, 2015) which shall be tested in accordance with a frequency established as part of operation and maintenance plan requirements set forth by the Director per Section 7.0.

10.4 Soil and Geotechnical Evaluation

Because of local soil conditions, underdrains shall be provided if the existing subgrade infiltration rate is less than 0.5 inches/hour, or where required to divert water away from structures as determined by a professional engineer. The existing subgrade infiltration rate shall be determined either using an infiltration soil testing procedure or based on the site's hydrologic soil group. Infiltration soil testing shall follow or be equal to the following procedure:

- Nashville Low Impact Development Manual – Permeable Pavement

Based on the existing subgrade infiltration soil evaluation, the subgrade soil may be modified if needed to increase the infiltration rate in lieu of an underdrain. Additional infiltration soil testing will be necessary after modification of the subgrade soil.

The depth to bedrock will not only influence excavation costs but will also influence the infiltration capabilities of the facility. If near the underlying infiltration zone (subgrade) of the pervious pavement, the bedrock will act as an impermeable layer. It is recommended that the bottom of the infiltration component of the pervious pavement be located at least two feet above the bedrock.

When the groundwater table is close to the infiltration zone, this can inhibit the effective infiltration capacity of the facility. Pervious pavement storage should be located at least two feet above the seasonal high level of the water table. It is recommended to determine the seasonal high water table elevation from taxonomy (e.g., soil borings that indicate certain types of mottling or coloration).

10.5 General Design Considerations

- See Sections 11.0 and 12.0 for additional, specific design considerations.
- Pervious pavement can be excluded from percent impervious area when calculating the WQV using the Short Cut Method and can be considered urban pervious area with HSG C/D soil (R_v = 0.21) when calculating the WQV using the Small Storm Hydrology Method. For calculating detention, pervious pavement can be considered open space in good condition with the actual soil type present on the site.
- Consideration should be given to the type of traffic loads that the pervious pavement will be required to endure when designing pervious concrete thickness and rock storage thickness. Refer to ACI 330-21 for parking lots and ACI 325.12R for streets and roads. An engineer with expertise in pavement design should provide input on this aspect early in the design phase.
- Placing pervious pavement over areas of recent fill or compacted fill is not optimal for infiltration.
- Consider slopes and velocity of upstream drainage area and length of flow path of pervious pavement to maximize infiltration into pervious pavement and minimize bypass flow over the pervious pavement.
- When designing grades to ensure drainage to pervious pavement, a minimum of 1% slope is needed and the slope to the pervious pavement should be sufficiently greater than slopes in other directions, taking into account construction and paving accuracy. Sufficient spot elevations should be provided on the plans to ensure grades are constructed as intended.
- Design gutters to spill onto pervious pavement to prevent runoff from bypassing.
- Consider where snow is likely to be piled in determining location of pervious pavement. If a mix of pervious and conventional pavement is being used in a parking lot, use conventional pavement where snow is likely to be piled.
- A geotextile or graded filter may be used at the engineer's discretion between the subbase and subgrade. A geotextile may be used on the vertical sides of the pervious pavement base to provide separation from adjacent material. An impermeable membrane or barrier may be needed if lateral flow is a concern for adjacent pavement or structures.
- Consider structural integrity, constructability, and aesthetics when designing the perimeter of pervious pavement. A hard edge such as a curb and gutter or flush concrete band is needed on the perimeter of pervious concrete to prevent crumbling of the edge and on the perimeter of PICP to restrain movement of the pavers. Metal edge may be appropriate for PICP. If pervious pavement is adjacent to asphalt pavement, a concrete band is recommended in between for constructability and aesthetics.
- The use of pervious pavement on sites whose land use or activity generates higher concentrations of hydrocarbons, trace metals or toxicants than are found in typical stormwater runoff requires the use of an impermeable liner and underdrain. Designers should refer to the Permeable Pavement section of the UDFCD *Urban Storm Drainage Criteria Manual* (2013) when designing the impermeable liner system.
- To provide an infiltration bed, the primary underdrain system may be perched or configured as internal water storage (upturned elbow) within the subbase rock. The perched height is dependent on the infiltration characteristics of the underlying subgrade and the desired

storage. The underdrain system shall not be perched if the underlying soils are plastic or plastic soils that have been stabilized with lime.

- A permanent sign shall be posted indicating it is pervious pavement and stating the following: Use care when plowing. No piling of snow, use of sand abrasives, or sealants.
- The design of the finished grade of the pavement surface shall take into consideration the Americans with Disabilities Act (ADA) and local code requirements.
- Subgrade should be flat. Where topography requires, terracing of the subgrade may be needed, and shall be designed as shown in Figure 5. The volume of water stored behind each terrace will be considered part of the infiltration bed.
- Pervious pavement is not recommended in the floodplain. If it is used in a floodplain, consideration shall be given to increased maintenance that may result from sediment/debris clogging from flood inundation.

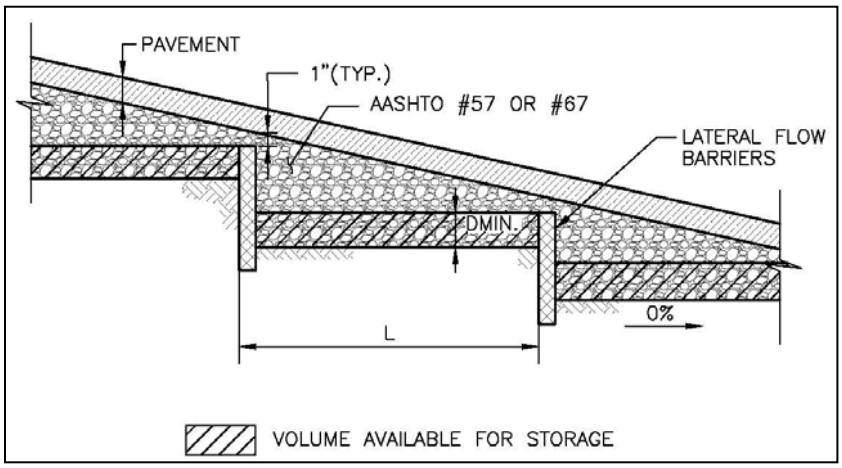


Figure 5. Terraced subgrade under pervious pavement (Source: UDFCD, 2013).

10.6 General Construction Considerations

1. See Sections 11.0 and 12.0 for additional, specific construction considerations.
2. Protect the base aggregate and the pervious pavement from sediment through phasing, runoff diversion, sediment control measures, and keeping the pavement covered as necessary.
3. The subgrade should be stripped of topsoil or other organics and either excavated or filled to the final subgrade level. Unnecessary compaction or over-compaction will reduce the subgrade infiltration rate. However, a soft or loosely compacted subgrade will settle, adversely impacting the performance of the entire pervious pavement system. The following recommendations for subgrade preparation are intended to strike a balance between those competing objectives:
    a. For sites, or portions thereof, requiring excavation to the final subgrade level, compaction of the subgrade may not be needed, provided that loose materials are removed from the excavation, and a firm subgrade is provided for the support of the pavement system. A geotechnical engineer should observe the prepared subgrade.

Local soft areas should be excavated and replaced with properly compacted fill. As an alternative to excavating and replacing material, stabilization consisting of geogrid and compacted granular fill material can be used to bridge over the soft area. Fill material should be free draining and have a hydraulic conductivity significantly higher than the subgrade soil. Fill is typically compacted to a level equivalent to 95% Standard Proctor compaction (ASTM D 698). The designer should specify the level of compaction required to support the pavement system.

b. For sites (or portions thereof), requiring placement of fill above the existing subgrade to reach the final subgrade level, the fill should be properly compacted. Specify the hydraulic conductivity for the material that is to be placed. This should be at least one order of magnitude higher than the native material. If the type or level of compaction of fill material available for construction is different than that considered in design, additional soil evaluation should be performed to substantiate that the design infiltration rate can be met.

c. Low ground pressure track equipment should be used within the pavement area to limit over-compacting the subgrade. Wheel loads should not be allowed.

10.7 General Plan Notes

1. See Sections 11.0 and 12.0 for additional, specific plan notes.
2. The subgrade shall be excavated using low ground pressure track equipment to minimize over-compaction of the subgrade. Grading and compaction equipment used in the area of the pervious pavement shall be approved by the engineer prior to use.
3. It is recommended that pervious pavement be installed near the end of construction to prevent sediment and debris from clogging it.
4. The pervious pavement area shall not be used for construction staging or materials storage.
5. The contractor shall, at all times during and after installation, prevent sediment and debris from any source from entering the pavement base or the pavement. This may require runoff diversion, sediment controls, traffic barriers, or covers such as plastic.
6. Vehicular traffic shall be prohibited on the pervious pavement until the site is stable to prevent mud from being deposited by vehicles.
7. Stone shall be open-graded, clean, washed and meeting applicable ASTM standards.
8. No product or material substitutions are permitted unless previously approved by the City plan review engineer or by the City inspector assigned to the project. All substitutions shall be presented to the City through the engineer responsible for the design of the pervious pavement.

10.8 As-Built Certification

Upon completion of the pervious pavement, prior to final acceptance, an as-built certification signed and sealed by the Missouri-registered Professional Engineer of Record shall be submitted verifying that the pervious pavement was installed as designed and approved. The following components shall be addressed in the as-built certification:

1. The pervious pavement was built in accordance with the details, dimensions, and materials as approved by the City for this project.
2. The pervious pavement was installed by a qualified contractor and has satisfied all applicable quality control and performance tests.
3. The pervious pavement installation was witnessed periodically by the certifying engineer or a representative under their direct supervision.
4. For sections with no underdrain, adequate measures were taken to preserve the subgrade infiltration rate.
5. The base aggregate and pervious pavement were adequately protected from sediment during construction.
6. Infiltration testing has been conducted and submitted per the following applicable ASTM standards and meets a minimum infiltration rate of 100 in/hr for new pavement (ASCE, 2015):
    a. Pervious concrete: ASTM C1701/C1701M Standard Test Method for Infiltration Rate of In Place Pervious Concrete;
    b. PICP, concrete grid paving units or clay paving brick: ASTM C1781/C1781M Standard Test Method for Surface Infiltration Rate of Permeable Unit Pavement Systems.
7. Verify the location of observation wells and cleanouts shown on the plans and provide an as-built plan sheet if the locations have changed.

11.0 Permeable Interlocking Concrete Pavers

PICP is comprised of a layer of concrete pavers separated by joints filled with small stones. Water enters joints between solid concrete pavers and flows through an "open-graded" base, i.e. crushed stone layers with no small or fine particles. The void spaces among the crushed stones store water and infiltrate it back into the soil subgrade or into an underdrain.

11.1 PICP Design Considerations

1. See Section 10.5 for general design considerations.
2. The design engineer shall reference the following resources published by the Interlocking Concrete Pavement Institute: (1) Permeable Interlocking Concrete Pavements Manual, and (2) Tech Spec 18: Construction of PICP Systems. The Permeable Design Pro software is recommended to aid in the design; all are available at www.icpi.org.
3. The paving units supplied to construct the PICP shall meet the requirements in ASTM C936 and be designed for use as PICP.
4. Consideration should be given to the type of traffic loads placed upon the PICP. An engineer experienced with pavement design shall provide input on this aspect early in the design phase. The minimum pavement section subject to vehicular traffic shall be (from top to bottom) 3-1/8 inch thick paving units, 2-inch thick bedding stone (typically ASTM No. 8 or 9 stone), 4-inch thick layer of base stone (ASTM No. 57 or similar size), and a layer of subbase stone (ASTM No. 2 or similar size). The thickness of the subbase will vary depending on storage and anticipated traffic loads as described in ICPI guidance literature. However, a minimum 6-inch thick subbase will be required for all applications without an underdrain and 9-inch thick when using an underdrain. Alternate paving unit and stone thicknesses may be proposed for residential uses or very light traffic loads. The paver joints shall be filled with aggregate meeting manufacturer's specs, typically ASTM No. 8. For example typical drawings, see Figures 8-10.

11.2 PICP Design Procedure and Criteria

See Section 10.6 for general design procedure and criteria.

11.3 PICP Construction Considerations

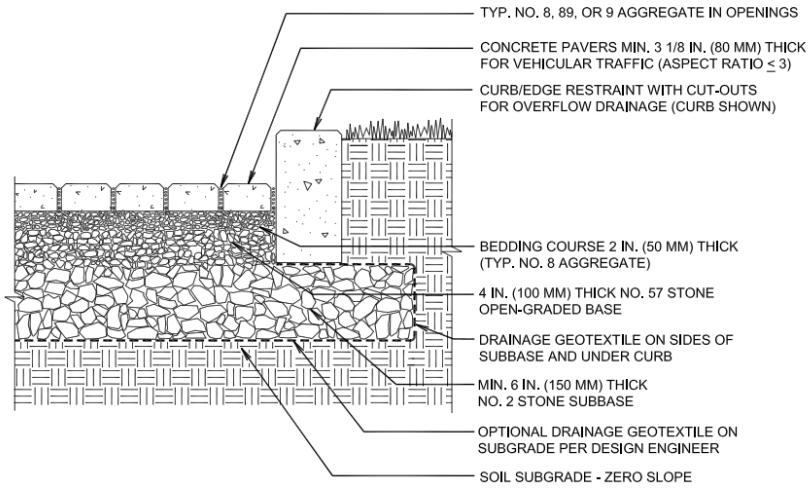
See Section 10.7 for general construction considerations. Bedding, base, and subbase rock shall be compacted per manufacturer's specifications.

11.4 PICP Plan Notes

See Section 10.8 for general plan notes.

11.5 PICP Contractor Qualifications

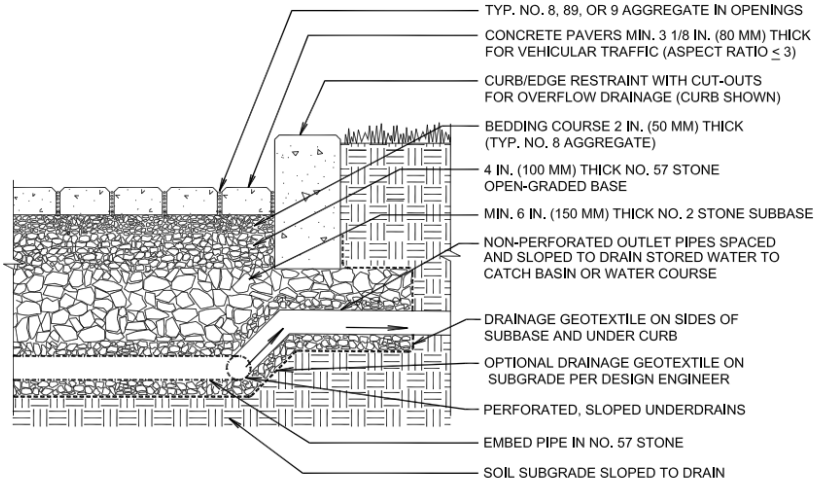
It is recommended that the PICP installation contractor have a current Level 1 certificate from the Interlocking Concrete Pavement Institute's concrete paver installer program.



NOTES:
1. 2 3/8 IN. (60 MM) THICK PAVERS MAY BE USED IN PEDESTRIAN AND RESIDENTIAL APPLICATIONS.
2. NO. 2 STONE SUBBASE THICKNESS VARIES WITH DESIGN. CONSULT ICPI PERMEABLE INTERLOCKING CONCRETE PAVEMENT MANUAL.
3. NO. 2 STONE MAY BE SUBSTITUTED WITH NO. 3 OR NO. 4 STONE.
4. SELECT GEOTEXTILE PER AASHTO M 288.

PERMEABLE PAVEMENT WITH FULL INFILTRATION TO SOIL SUBGRADE

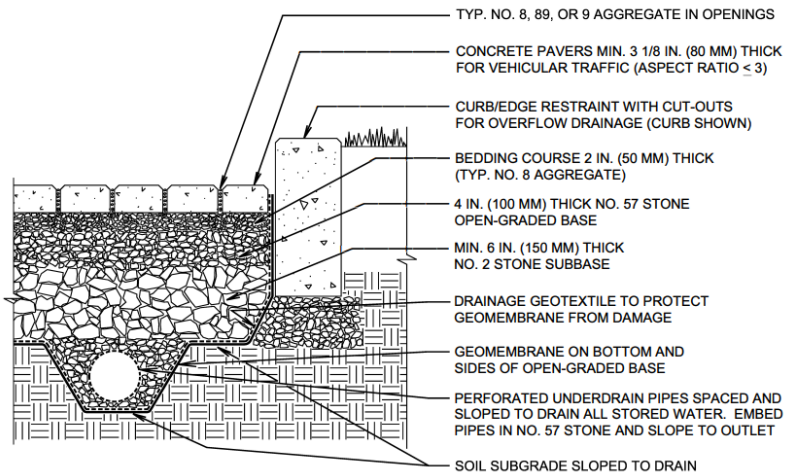
DRAWING NO. ICPI-68
SCALE NO SCALE



NOTES:
1. 2 3/8 IN. (60 MM) THICK PAVERS MAY BE USED IN PEDESTRIAN AND RESIDENTIAL APPLICATIONS.
2. NO. 2 STONE SUBBASE THICKNESS VARIES WITH DESIGN. CONSULT ICPI PERMEABLE INTERLOCKING CONCRETE PAVEMENT MANUAL.
3. NO. 2 STONE MAY BE SUBSTITUTED WITH NO.3 OR NO.4 STONE.
4. SELECT GEOTEXTILE PER AASHTO M 288.

PERMEABLE PAVEMENT WITH PARTIAL INFILTRATION TO SOIL SUBGRADE

DRAWING NO. ICPI-69
SCALE NO SCALE



NOTES:

1. 2 3/8 IN. (60 MM) THICK PAVERS MAY BE USED IN RESIDENTIAL APPLICATIONS.
2. NO. 2 STONE SUBBASE THICKNESS VARIES WITH DESIGN. NO. 3 OR NO. 4 STONE IS ACCEPTABLE. CONSULT ICPI PERMEABLE INTERLOCKING CONCRETE PAVEMENT MANUAL.
3. PERFORATED PIPES MAY BE RAISED FOR WATER STORAGE FROM LARGE RAIN EVENTS WITH OUTLET(S) AT LINER BOTTOM TO DRAIN SMALL RAIN EVENTS.
4. SELECT GEOTEXTILE PER AASHTO M 288.

PERMEABLE PAVEMENT WITH NO INFILTRATION TO SOIL SUBGRADE	DRAWING NO.	ICPI-70
	SCALE	NO SCALE

12.0 Pervious Concrete

Pervious concrete is a specific mix with carefully controlled amounts of water and cementitious materials that creates a system of permeable, interconnected voids. It has reduced strength compared to conventional concrete mixtures, but sufficient strength for many applications.

12.1 Pervious Concrete Design Considerations

1. See Section 10.5 for general design considerations.
2. The design engineer shall reference ACI 522.1-13.
3. A typical pavement section shall be shown on the plans. See Figure 11 for a typical section. Designer should reference ACI 522.1-13.
4. Typical thicknesses for pervious concrete range from 6-12 inches, depending on the traffic load and other requirements.
5. Jointing of pervious concrete is at the Engineer's discretion. Jointing may be used during the finishing process to provide expansion joints, control/contraction joints, and construction joints. If joints are to be installed, the design engineer shall provide a jointing plan. If applicable as specified by the Engineer's jointing plan,

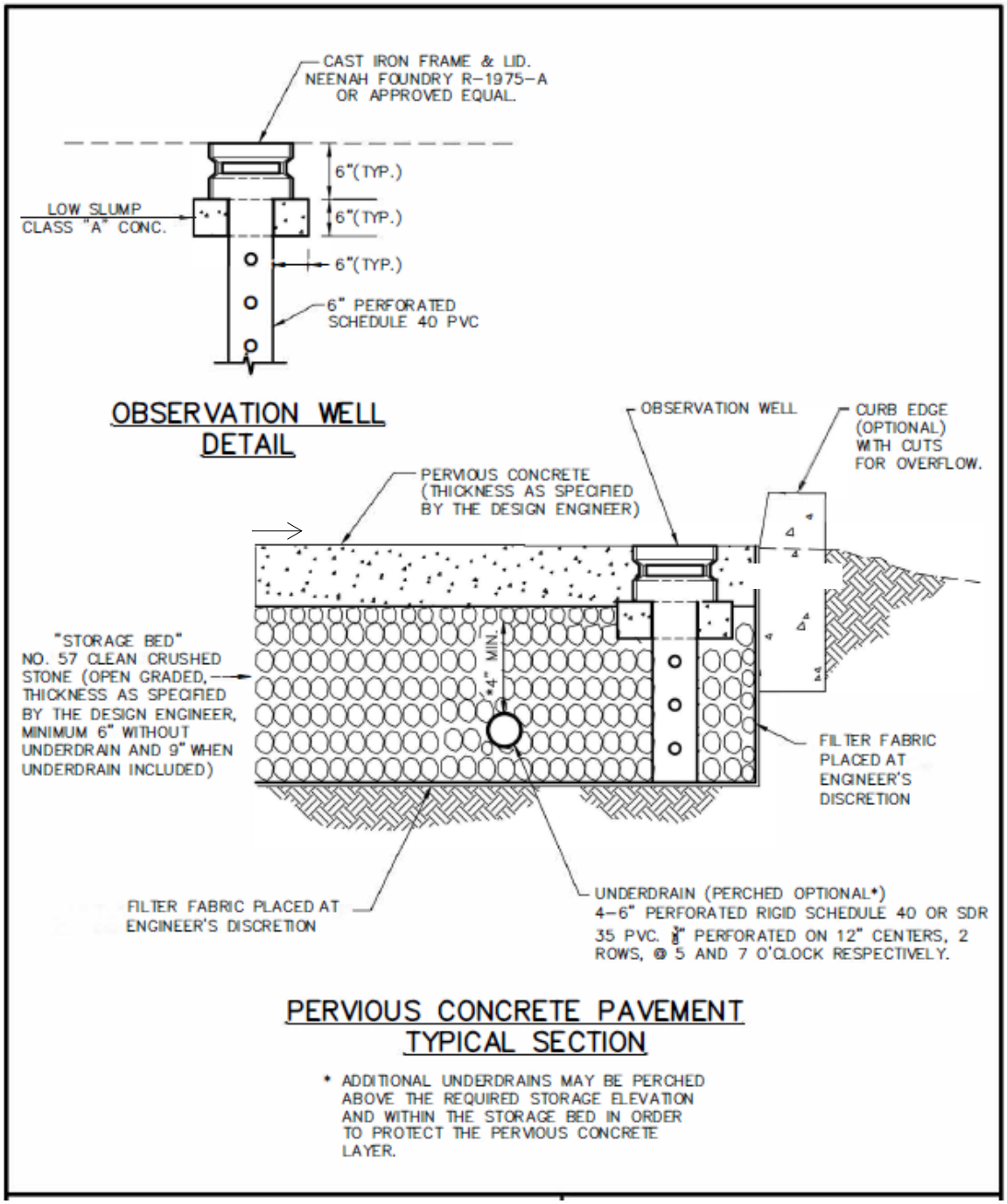


Figure 9. Typical pervious concrete section (Source: Modified from St. Louis MSD, 2014).

12.2 Plan Notes:

The following notes shall be included on plans, details, and specifications for pervious concrete pavement designs proposed for plan approval:

1. See Section 10.8 for general plan notes.
2. All pervious concrete construction shall meet the requirements of ACI 522.1-13 and Chapter 10 of the City's Flood Control & Water Quality Protection Manual.

12.3 Pervious Concrete Contractor Qualifications

Beginning one year from adoption of this manual, the qualifications of this section apply. If qualifications in this section differ from ACI 522.1-13, this section shall govern. Contractors installing pervious concrete shall submit documentation showing they meet the following qualifications:

1. The contractor's history shall demonstrate their experience and training in installing pervious concrete pavement. If the contractor has insufficient experience (less than 10,000 square feet successfully installed), the contractor shall retain an experienced consultant (such as an NRMCA Certified Craftsman) to monitor production, handling, and placement operations.
2. The contractor shall meet at least one of the following:
    a. At least one NRMCA Certified Pervious Concrete Craftsman will be on site overseeing each placement crew during all pervious concrete placement, or
    b. At least three NRMCA Certified Pervious Concrete Installers shall be on site installing the pervious concrete, or
    c. At least 2/3 of the placing crew shall be NRMCA Certified Pervious Concrete Technicians.

13.0 Bioretention (Rain Garden)

13.1 Description

Photo 12. Rain garden on Park Central East and Jefferson.

Bioretention and rain garden are often used interchangeably to refer to an engineered, depressed landscape area designed to filter, uptake, and infiltrate stormwater runoff through the natural processes of plants, microbes, and soil (APWA/MARC, 2012). The term bioretention refers to the ability of the biomass to retain stormwater and remove pollutants (Prince George's County, MD, 2002). In general, the term bioretention will be used in this chapter for consistency. Bioswale is another related term that often refers to a linear bioretention feature. Depending on in-situ soil and other design considerations, bioretention can be designed without an underdrain to allow full infiltration, or with an underdrain. During a storm, runoff ponds in the depressed, vegetated surface of the bioretention where a combination of processes occurs that includes evapotranspiration and pollutant uptake by plants and, depending on design, infiltration into the underlying in-situ soil and/or filtration through a porous bioretention soil mix before discharging through an underdrain. Bioretention is best suited for meeting the water quality volume requirement but may be designed to contribute toward meeting the flood control detention requirement as well if designed properly.

13.2 Site Selection and Designing for Maintenance

Bioretention systems are intended to be small, distributed practices that manage runoff close to the source for drainage areas of typically one impervious acre or less although they can be designed for larger tributary areas. Therefore, they are ideally suited for small installations such as parking lot islands and perimeter landscaping, bufferyards, roof downspout areas, and streetscapes. Managing runoff close to the source reduces the amount of runoff that must be managed further downstream with larger infrastructure. Smaller, distributed bioretention areas are also preferred to minimize the potential for karst collapses due to concentrated infiltration of water. Dual use of required landscape areas as bioretention can be an efficient and cost-effective practice. Following establishment, long-term irrigation requirements can often be reduced by designing landscaping as bioretention. They can be an excellent alternative to extended detention basins for small sites, or used as a companion to extended detention basins to provide runoff reduction and treatment train benefits.

Bioretention is best suited for a stabilized drainage area (impervious surfaces or pervious surfaces with good vegetative cover) and land use with minimal sediment load. The bottom surface of bioretention should be flat. Terracing can be used in designing bioretention on a slope.

When bioretention areas (or other SCMs that allow infiltration) are proposed adjacent to buildings or pavement, protective measures should be implemented to avoid adverse impacts to these structures. Oversaturated subgrade soil underlying a structure can cause the structure to settle or

result in moisture-related problems. Wetting of expansive soils or bedrock can cause swelling, resulting in structural movements. A geotechnical engineer should evaluate the potential impact of the bioretention on adjacent structures based on an evaluation of the subgrade soil, groundwater, and bedrock conditions at the site. Additional minimum requirements for these site conditions include:

- An underdrain shall be provided whenever possible and shall be designed to divert water away from the structure.
- In locations where potentially expansive soils or bedrock exist, placement of bioretention adjacent to structures and pavement should only be considered if the bioretention includes an underdrain designed to divert water away from the structure and is lined with an essentially impermeable geomembrane liner designed to restrict seepage.

Site selection and bioretention design should also consider all potential maintenance requirements and the future need for replacement of the growing medium. Consider the method and equipment for maintenance tasks and ensure adequate space and access to complete these tasks. Other considerations for designing for maintenance are provided in subsequent sections regarding depth, underdrain design, pretreatment, vegetation, and mulch.

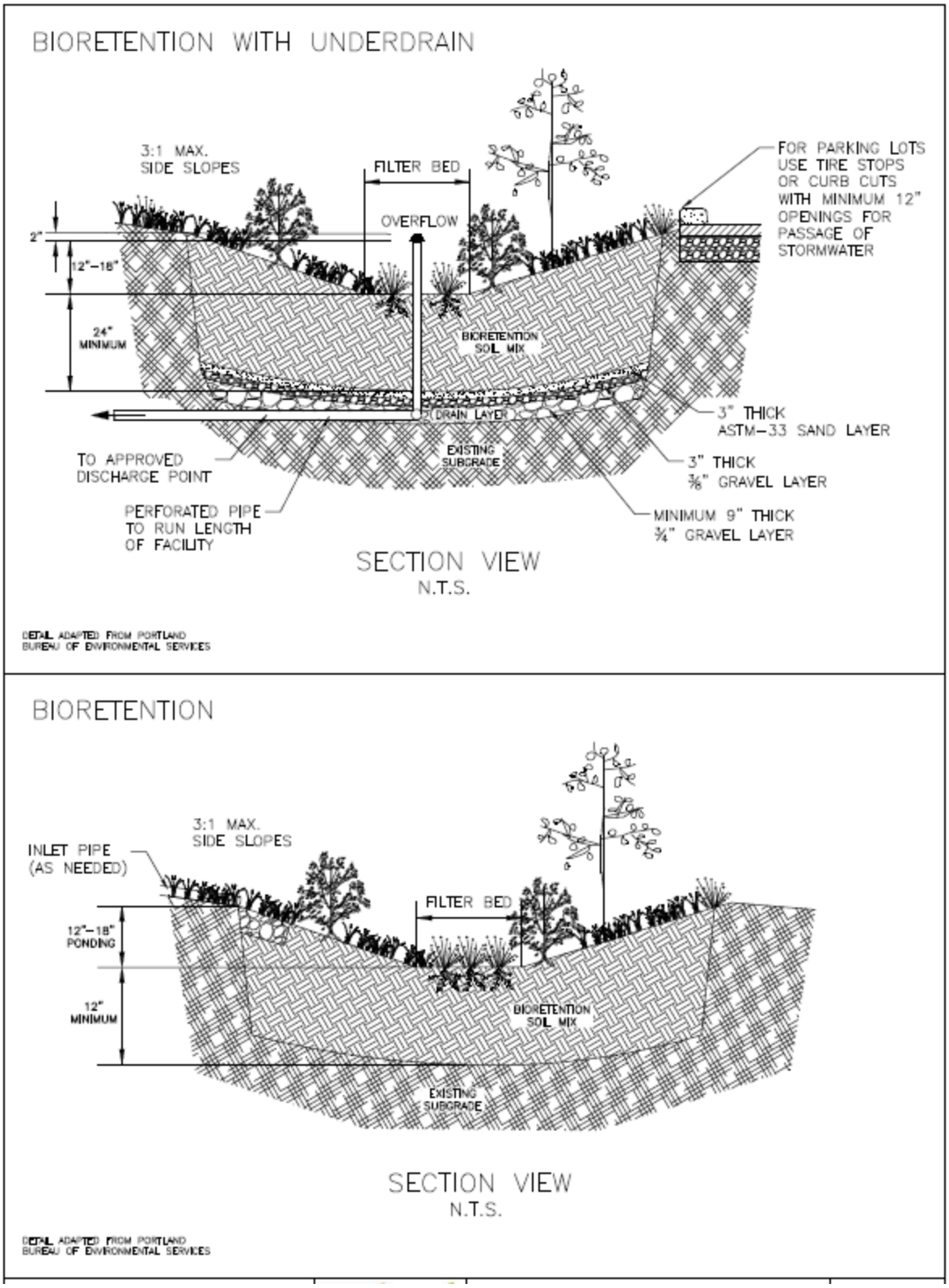


Figure 10. Bioretention Typical Sections (Source: Modified from Portland BES, 2021).

13.3 Design Criteria and Procedure

13.3.1 Soil and Geotechnical Evaluation

Because of local soil conditions, underdrains shall be provided if the existing subgrade infiltration rate is less than 0.5 inches/hour, or where required to divert water away from structures as determined by a professional engineer.

The existing subgrade infiltration rate shall be determined either using an infiltration soil testing procedure or based on the site's hydrologic soil group. Infiltration soil testing shall follow or be equivalent to the following procedure:

- Nashville Low Impact Development Manual - Bioretention

Based on the existing subgrade infiltration soil evaluation, the subgrade soil may be modified if needed to increase the infiltration rate in lieu of an underdrain. Additional infiltration soil testing will be necessary after modification of the subgrade soil.

The depth to bedrock will not only influence excavation costs, but will also influence the infiltration capabilities of the facility. If near the underlying infiltration zone (subgrade) of the bioretention, the bedrock will act as an impermeable layer. The City recommends the bottom of the infiltration component of the bioretention be located at least two feet above the bedrock.

When the groundwater table is close to the infiltration zone, this can inhibit the effective infiltration capacity of the facility. Bioretention storage should be located at least two feet above the seasonal high level of the water table. The City recommends determining this seasonal high water table elevation from taxonomy (e.g., soil borings that indicate certain types of mottling or coloration).

13.3.2 On-line and Off-line Design

Bioretention can be designed on-line or off-line. If designing an on-line bioretention, it shall allow all storms to safely convey stormwater through either the filter bed or an overflow structure to the next stormwater drainage feature. Off-line bioretention systems pass the water quality flow rate into the bioretention but bypass higher flows into other stormwater drainage features. This typically is provided using a weir or high-flow/low-flow piping system. Refer to Metropolitan St. Louis Sewer District's Flow Splitting Design Criteria on their BMP Toolbox website. Overflows are recommended for off-line bioretention. The type of overflow selected should consider potential for re-suspension of trash/pollution, but also the potential for overtopping and availability of a safe overland flow path for large storms.

The design of a bioretention system may provide detention for events exceeding the WQV. There are generally two ways to achieve this. The design can provide the flood control volume above the WQV water surface elevation, with flows bypassing the filter usually by overtopping into an inlet designed to restrict the peak flow for a larger event (or events). Alternatively, the design can provide and slowly release the flood control volume in an area downstream of one or more bioretention areas. Bioretention shall be designed so that runoff from storm events greater than the water quality event safely pass through or around the bioretention. If larger events are to pass through the bioretention, the maximum velocity shall be kept below 2 feet per second to avoid erosion of the soil.

13.3.3 Bioretention Storage Volume and Geometry

Bioretention is best suited for meeting water quality requirements. The water quality volume for the drainage area of the bioretention shall be calculated according to Section 2.1. Bioretention can be used to help meet flood control detention requirements as well if designed properly. Orifices, weirs, and other outlet devices are typically required to release flood control volume from bioretention. The volume of the bioretention is considered to be the ponding volume above the bioretention surface (including above the filter area and side slopes) and the volume within the gravel layer which may be a part of the underdrain system or designed as additional storage. A porosity not greater than 40 percent shall be used to calculate storage volume for No. 57 and No. 2 stone and can be used to reduce the WQV in the equation in this section.

Bioretention should be designed as shallow as possible. Increasing the depth can create erosive side slopes, limit plant species and survivability, and complicate maintenance. Shallow bioretention areas are also more attractive, an important consideration for public acceptance. The preferred ponding depth is 12 inches and the maximum allowed is 18 inches. An inlet or other means of overflow shall be provided at this elevation. When used for flood control detention, the maximum ponding depth may be increased up to 36 inches if approved based on appropriate location and design considerations, including public acceptance, aesthetics, and plant survivability.

Vertical walls or side slopes can be used to achieve the required volume. Side slopes should be no steeper than 3:1 (horizontal: vertical). The bottom surface of the bioretention, also referred to here as the filter area, should be flat. Sediment will accumulate over time on the filter area. If the filter area is too small, it may clog prematurely. Increasing the filter area will reduce clogging and decrease the frequency of maintenance. The following equation calculates the minimum filter area.

$A_f = WQV * d_f / [k * (h_f + d_f) * t_f]$

A_f = Minimum surface area of filter bed (ft^2)

WQV = Water quality volume (WQV can be reduced by gravel storage volume per this section)

d_f = filter bed thickness (ft)

k = saturated hydraulic conductivity (ft/day) (Use 1 ft/day unless documentation provided supporting different k value for bioretention soil mix design

h_f = maximum ponding depth ÷ 2 (ft)

t_f = maximum drain time (days) (use 3 days for the 72-hour max drain time requirement)

13.3.4 Bioretention Soil Mix

The bioretention soil mix filter bed thickness (d_f) shall be a minimum of 24 inches for pollutant removal and plant health in bioretention with an underdrain. The bioretention soil mix filter bed thickness (d_f) shall be a minimum of 12 inches for bioretention without an underdrain. A greater depth may be needed to accommodate trees.

The bioretention soil mix shall be a uniform mix, free of stones, stumps, roots or other similar objects larger than two inches excluding mulch. For best results, it should be free of noxious weed seeds. The composition of the bioretention soil mix is important in balancing the objectives of pollutant removal, plant growth, infiltration rate, local availability, and affordability. The majority of Springfield drains to the James River which is impaired for excess nutrients that cause algae growth and reduced water clarity. Reducing nutrients in runoff is an important consideration in all areas of the City to reduce impacts on local and downstream waters. The bioretention soil mix shall meet the specifications of the Minnesota Pollution Control Agency's bioretention design criteria recommendations for a mix that addresses phosphorus leaching concerns as follows:

- Coarse sand: 50 to 65 percent
- Topsoil: 25 to 35 percent
- Compost: 10 to 15 percent

A saturated hydraulic conductivity of k = 1 foot/day is recognized for a mix meeting this criteria. A higher k value may be approved based on acceptable documentation.

13.3.5 Drain Time and Underdrain System

The required drain time for bioretention is 12-72 hours.

Underdrains shall be spaced a maximum of 20 feet on center when multiple underdrains are necessary for bioretention areas that are wider than 40 feet. Provide cleanouts to enable observation and maintenance of the underdrain. Use a minimum perforation size of 3/8 inch to avoid clogging.

The underdrain shall be 4-6" perforated or slotted pipe. Do not put a filter sock on the underdrain. This is not necessary and can clog. The underdrain shall be placed with a minimum 9-inch thick section of ¾-inch gravel, typically ASTM No. 57. To separate the underdrain gravel layer from the bioretention soil mix, a graded filter shall be used instead of a geotextile to reduce the potential for clogging. The graded filter shall consist of a minimum 3-inch thick layer of ASTM-33 sand underlain by a minimum 3-inch thick layer of 3/8-inch gravel, typically ASTM No. 8 or 9. A geotextile separator fabric may be used on the sides of the rain garden if needed but shall not be used between the underdrain gravel layer and the subgrade.

13.3.6 Impermeable Geomembrane Liner

Designers should refer to the Bioretention section of the UDFCD *Urban Storm Drainage Criteria Manual* (2013) when designing an impermeable liner system for bioretention. An impermeable liner may be appropriate in the following situations:

- Land use or activities could contaminate groundwater if stormwater is allowed to infiltrate;
- The rain garden is located over potentially expansive soils or bedrock and is adjacent (within 10 feet) to structures.

13.3.7 Pretreatment

Pretreatment shall be provided for bioretention to prevent erosion of the filter bed, reduce velocities, and capture trash and coarse sediment that can shorten the life of the filter bed. The most common

methods of pretreatment are large rock, sumps or forebays, and sheet flow over filter strips. For bioretention with larger drainage areas (>0.5 acres), it is recommended to size the forebay to store 25% of the water quality volume. The forebay floor should be designed to fully drain to the surface of the filter bed. For smaller bioretention, pretreatment can be designed as rock (Photo 13.a.), or small sumps with a concrete or rock bottom (Photo 13.b.). A filter strip is typically used when stormwater enters the bioretention as overland flow. A grass filter strip or combination gravel diaphragm and grass filter strip between the diaphragm and filter bed can be used. Hydrodynamic separators or baffle boxes can also be used as pretreatment, particularly if higher loads of solids and floatables are anticipated. Rain barrels can be used as a method for slowing velocities and providing additional storage for roof runoff upstream of bioretention.

13.3.8 Inlet and Outlet Design

How flow enters and exits the bioretention area is a function of the location and overall drainage design for the site. Common inlet designs include curb cuts, curb or grate inlets, trench drains, or small pipe discharges. Flow into the bioretention can also occur as overland flow. The most important aspect of site and inlet design is making sure the runoff from the intended drainage area gets into the bioretention. Runoff bypassing the bioretention is a common problem and can result from inlet design, insufficient slope, tight designs that don't allow for construction and paving tolerances, and inadequate construction staking (Photo 14).

The following are specific considerations for inlet design:

- Slope of drainage area toward the bioretention shall be a minimum of 1% and shall be sufficiently greater than slopes in other directions to ensure runoff goes into the rain garden and bypass doesn't occur. Adequate spot elevations shall be provided on the plans to ensure the grades of the drainage area are constructed as intended for drainage into the bioretention.
- Grades shall ensure drainage from the pavement into the gutter occurs upstream of the curb cut. Even when grades are correct, placement of asphalt can create a high spot where the asphalt meets the concrete gutter, which can cause runoff to bypass (Photo 15). Plan notes and proactive communication with the pavement contractor are necessary to prevent these types of issues.

- The slope of the gutter toward the curb cut shall be greater than the longitudinal slope of the gutter (Photo 16).
- The curb cut opening shall be wide enough to ensure the design storm runoff does not bypass the curb cut, depending on velocity and slopes. Curb cuts with 2-foot or 4-foot width are common.
- The gutter shall be designed with a depression or grooves in front of the curb cut opening as needed to ensure runoff does not bypass the opening.
- Provide pretreatment in the form of rock, or a small concrete sump or forebay (see Section 13.3.7).

Careful design is also needed for bioretention outlets. In addition to serving as inlets, curb cuts can also be designed as outlets to release runoff in excess of the design volume. Other common designs for overflow above the design volume include atrium grates and grated inlets. If using a curb inlet outside of the bioretention for bypassing of flows that exceed the design volume, ensure that the design volume of runoff will not short-circuit the bioretention. Bioretention used in a series, such as on a slope, may be designed to pond and overflow to the next downstream bioretention with a curb cut, weir, level spreader, or outlet structure.

13.3.9 Vegetation

Vegetation is vital for the bioretention processes. Plants uptake pollutants, remove water through evapotranspiration, and improve infiltration through root growth and improved soil structure. Attractive vegetation is also vital for public acceptance of bioretention. Through careful design and plant selection, bioretention can blend seamlessly with surrounding landscaping or be a distinct, attractive feature that complements the surrounding design. A planting plan shall be submitted that includes the list of plant species, plant size, and plant spacing for the bioretention surface area used to meet the required volume (including above the filter area and non-vertical side slopes). The plant spacing and establishment maintenance shall achieve vegetation coverage of at least 70% of the bioretention surface area at the end of the second growing season. The planting plan shall include

primarily Missouri native species. It may include some cultivars/nativars or non-native plants that are climate tolerant to the local hardiness zone and not invasive. See Missouri invasive plants list. Typically, container plants/plugs should be used to achieve more immediate coverage and landscaping effect. Depending on the species, typical plant spacing is 12" – 36". Larger shrubs and trees are encouraged and can reduce the number of plants needed. Bioretention areas may also be seeded using a native seed mix; however, erosion control and re-seeding may be necessary to achieve proper establishment and coverage. Turf grass seed or sod is not acceptable vegetation for the bioretention surface area because it does not provide the infiltration and uptake benefits of native plants and regular mowing would compact the filter area and affect infiltration.

See Section 6.0 for more information on plant selection.

The surface of the rain garden shall be mulched to protect against erosion. Wood mulch or rock mulch is acceptable. Wood mulch provides some benefits over rock mulch for pollutant removal and may be more beneficial in regulating temperature and moisture for plant health. It can also be easier to remove accumulated sediment on wood mulch. However, wood mulch decomposes and need to be replaced periodically. Rock mulch generally only needs to be replaced if removed as part of sediment removal. If using wood mulch, it shall be hardwood mulch to minimize floating of the mulch. The use of wood mulch should also be considered when designing the overflow to minimize clogging. If using rock mulch, a 1-inch diameter decorative rock is common with larger rock at inlet points.

If installing irrigation, design and adjust the irrigation system (temporary or permanent) to provide appropriate water for the establishment and maintenance of the vegetation without over-saturating the soil and reducing the capacity of the rain garden for rain events.

13.4 Construction Considerations

Do not allow machinery on bottom surface of bioretention. If machinery must enter the bioretention area, use small, tracked equipment to minimize compaction. Do not allow machinery in the bioretention when the bottom surface of the bioretention is wet as this may smear the soil, greatly reducing infiltration. Start digging at one end and work out so machinery does not track on bottom of finished excavation. Excavation must be flat but not smooth. Do not scrape the bottom smooth since this will reduce infiltration.

13.5 As-Built Certification

Upon completion of the bioretention, prior to final acceptance, an as-built survey and certification signed and sealed by the Missouri-registered Professional Engineer of Record shall be submitted verifying that the bioretention was installed as designed and approved. The following components shall be addressed in the as-built survey and certification:

1. Pretreatment measures have been correctly installed as designed.
2. The grades of the drainage area and inlet(s) ensure flow into the bioretention as designed.
3. The outlet is properly installed.
4. The bioretention geometry was constructed as designed, including side slopes, bottom surface area and ponding depth.
5. Adequate measures were taken to preserve the subgrade infiltration rate per Section 13.4.

6. The bioretention soil mix meets the design criteria and was installed per the depth on the plan.
7. If applicable, the underdrain system was installed per plan including graded filter, bioretention soil mix, gravel layer depth, pipe diameter and elevation.
8. The bioretention was adequately protected from sediment during construction to prevent clogging of the filter bed.
9. Vegetation and mulch have been installed as designed.

14.0 Extended Dry Detention Basin

14.1 Description

An extended dry detention basin (EDB) is a basin designed to provide sedimentation by detaining and slowly releasing stormwater. An EDB is similar to a detention basin used for flood control but is designed with a much smaller outlet that extends the emptying time of the more frequently occurring runoff events to facilitate pollutant removal, primarily through sedimentation. An EDB is called "dry" because it is designed not to have a significant permanent pool of water remaining between storm runoff events. It can be used for regional or on-site treatment or as follow-up treatment in series with other SCMs.

An EDB should typically be designed and maintained to pool water for no more than the design drawdown time of 24 to 48 hours. In cases where there is a sufficient distance between the EDB and the nearest residential land use, it may be desirable to allow pools to form and wetland vegetation to grow. These plants generally provide water quality benefits through pollutant uptake, but they often cause public complaints when located near a residential area. In addition, the bottom will be the depository of all the sediment that settles out in the basin. As a result, the bottom can be muddy and may have an undesirable appearance. To mitigate this problem, the designer may provide a small wetland marsh or ponding area in the basin's bottom, which may be considered as part of the design to promote biological uptake of pollutants.

In addition to reducing peak runoff rates and improving water quality, an EDB can be designed to provide other benefits such as recreation, wildlife habitat and open space. As with other SCMs, public safety issues need to be addressed through proper design. EDBs may also be used during land development to trap sediment from construction activities within the tributary drainage area. The accumulated sediment, however, must be removed after upstream land disturbance ceases and before the basin is placed into final long-term use.

14.2 Site Selection

EDBs are best suited for watersheds with at least five impervious acres up to approximately one square mile of watershed. They can be designed for smaller watersheds as long as the outlet structure criteria can be met. Small watersheds can result in orifice sizes that are prone to clogging. Larger watersheds and watersheds with baseflows can complicate the design and reduce the level of treatment provided. EDBs are well suited where flood control detention is incorporated into the same basin.

14.3 Design Considerations

- Special consideration must be made when placing an EDB in an area of high groundwater, wet weather springs or areas that otherwise have baseflow. Consideration should be given to constructing an extended wet detention basin or a wetland bottom in those cases. If an EDB is constructed in this case, a low flow channel shall be constructed to maintain positive drainage to allow mowing and maintenance. Sites with persistent flow typically require a special design by a qualified professional for the unique conditions of the site.

- EDBs should be incorporated into the larger flood control basin whenever possible. In all cases, the embankments and spillway shall be designed to safely pass the 100-year flow as described in Chapter 9, Detention for Flood Control.
- When multiple uses such as recreation or habitat creation are incorporated into a detention basin, a multiple-stage design should be used to limit the frequency of inundation of passive recreational areas. Generally, the area within the WQV is not well suited for active recreation facilities such as ballparks, playing fields, and picnic areas. These are best located above the WQV pool level.
- Soil maps should be consulted, and soil borings may be needed to establish design geotechnical parameters, particularly for larger basins or when bedrock or other sensitive karst features are believed present. A regular concern with storage basins in Springfield is "puncturing" limestone during the course of excavation, thereby providing a conduit for stormwater in the shallow groundwater system.
- Access to critical elements of the pond, such as the inlet, outlet, spillway, and sediment collection areas must be provided for maintenance purposes.

14.4 Aesthetic Design

When an EDB is designed with aesthetics in mind, it becomes an amenity of much greater value to a landowner and can contribute to quality of place in the community. Incorporating aesthetic goals into the design of an EDB is strongly encouraged. A recommended resource is *Aesthetically Enhanced Detention and Water Quality Ponds (City and County of Denver, 2010).* Softened and varied slopes, interspersed fields, planting areas and wetlands can all be part of an EDB. The design should be aesthetic whether it is considered to be an architectural or naturalized basin. Architectural basins incorporate design borrowed or reflective of the surrounding architecture or urban forms. An architectural basin is intended to appear as part of the built environment, rather than hiding the cues that identify it as a stormwater structure. A naturalized basin is designed to appear as though it is a natural part of the landscape. The built environment, in contrast to the natural environment, does not typically contain the randomness of form inherent in nature. Constructed slopes typically remain consistent, as do slope transitions. Even dissipation structures are usually a hard form and have edges seldom seen in nature. If the EDB is to appear as though it is a natural part of the landscape, it is important to minimize shapes that provide visual cues indicating the presence of a drainage structure. The following are suggested methods for designing a naturalized basin.

- Create a flowing form that looks like it was shaped by water.
- Extend one side of the basin higher than the other. This may require a berm.
- Shape the bottom of the basin differently than the top.
- Slope of one side of the basin more mildly than the opposing side.
- Vary slope transitions both at the top of the bank and at the toe.
- Use a soft-surface trickle channel such as rock if appropriate and approved.
- When using rock for energy dissipation, the rock should graduate away from the area of hard edge into the surrounding landscape. Other non-functional matching rock should occur in other areas of the basin to prevent the actual energy dissipation from appearing out of context.

- Design vegetation to reflect the type of water regime expected for their location within the basin.
- Incorporate trees in the bottom of the basin. Select species that are less likely to produce significant leaf litter that will clog the outlet structure. See the Appendix of this chapter for a list of recommended trees.

14.5 Design Procedure and Criteria

The following steps outline the design procedure and criteria for an EDB. Figure 13 shows a representative layout of an EDB.

1. Calculate the design volume based on the WQV for the drainage area and any reductions or credits based on upstream SCMs.
2. The basin length to width ratio (L:W) should be between 2:1 and 4:1 and the inlets should be as far as possible from the outlet. Maximizing the distance between the inlet and the outlet and shaping the pond with a gradual expansion from the inlet and a gradual contraction toward the outlet will minimize short-circuiting.
3. Basin side slopes should be a maximum of 4H:1V and the use of flatter slopes is encouraged to facilitate maintenance, access, and safety. If steeper side slopes are necessary, 3H:1V is the maximum allowed and must incorporate a flatter upper zone and/or a "safety bench."
4. Determine the preliminary basin geometry necessary to provide the design volume. Select the preferred depth of the basin, then solve for the basin bottom width that will provide adequate storage of the design volume. Assume a trapezoidal pond with the selected L:W ratio, side slopes and basin depth. The EDB design spreadsheet will assist with this calculation. This information is not necessary if detailed stage-area-volume relationships are available for the EDB.
5. Design the outlet structure to release the design WQV over a 24- to 48-hour period. The outlet structure shall consist of a perforated plate with a stainless steel well-screen trash rack. Figure 14 shows details for a perforated plate. The outlet structure shall meet the requirements in Table 12. Use the fewest number of columns possible to maximize the perforation hole diameter. This helps to reduce clogging problems. If persistent clogging of well screen occurs, making it difficult to establish grass growth, the well screen may be temporarily removed until vegetation is established. Well screen must be reinstalled prior to final termination of the Land Disturbance Permit. The EDB design spreadsheet should be used to complete the design.

Table 5. Requirements for Water Quality Outlet Structures

Parameter	Perforated Plate Requirement
Minimum Perforation Diameter	1/2 inch
Maximum Perforation Diameter	2 inches
Minimum Number of Holes Per Row	1
Maximum Number of Holes Per Row	3
Minimum Row Spacing	4 inches
Maximum Row Spacing	12 inches

6. For perforated plates, provide a trash rack of sufficient size to prevent clogging of the primary water quality outlet. Size the rack so as not to interfere with the hydraulic capacity of the outlet. Using the total outlet area (calculated by multiplying the perforation area per row by the number of rows) and the selected perforation diameter, Figure 15 will help to determine the minimum open area required for the trash rack. Use one-half of the total outlet area to calculate the trash rack's size. This accounts for the variable inundation of the outlet orifices. The EDB design spreadsheet should be used to complete the design.
7. A freeboard of at least 12 inches shall be provided above the 100-year water surface elevation for all EDBs (including facilities that are solely for water quality purposes and allow larger flows to "pass through") and detention areas in accordance with Chapter 9, Detention.
8. A low flow channel should be provided when groundwater or base flow exists in the basin or as required in Chapter 9, Detention.
9. Extended dry detention basins shall have a vegetated bottom and side slopes unless design velocity or slope is not within the allowable range for vegetation. Consideration should be given to the use of native grasses and plants for pond bottoms, berms, and side slopes.
10. Access to the facility shall be provided for maintenance. Grades of the access should not exceed 10 percent, and a stabilized, all-weather driving surface must be provided.
11. Energy dissipation and erosion control should be provided at inlets in accordance with Chapter 9, Detention.
12. A forebay should be considered when the design volume exceeds 20,000 ft^3 or a large sediment, trash or debris load is anticipated due to upstream land use. A forebay provides an opportunity for larger particles to settle out in the inlet area, which has a solid surface bottom to facilitate mechanical sediment removal. The forebay volume for the extended dry detention basin should be between 3 and 5 percent of the design volume. Outflow from the forebay to the basin shall be through a gravel filter designed to be stable under maximum design flow conditions. The top of the gravel filter shall be set equal to the stage of the design volume. The floor of the forebay should be concrete and contain a low flow channel to define sediment removal limits.
13. Combining the water quality facility with a flood control facility is acceptable. Design of the flood control volume may assume the extended dry detention basin is dry at the beginning of the storm. Additional information can be found in Chapter 9, Detention.
14. Plan and design the facility with appearance and neighborhood compatibility as design objectives. Consider naturalized basin design (see Section 14.4).
15. Consider incorporating trees in the bottom of the detention basin. Tree credits can be taken towards meeting the WQV in accordance with Section 3.1.3.

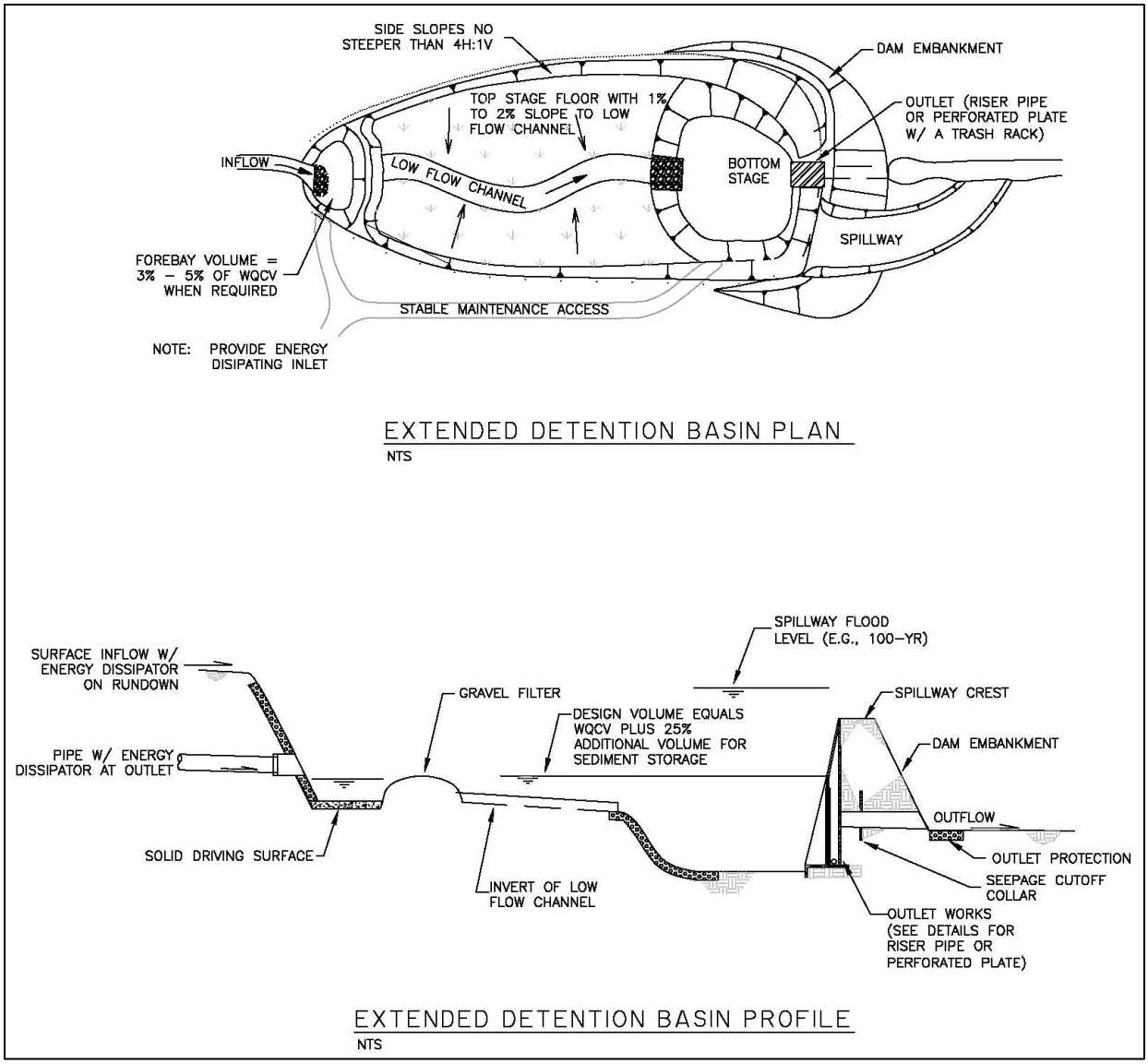


Figure 11. Extended Detention Basin Plan and Profile

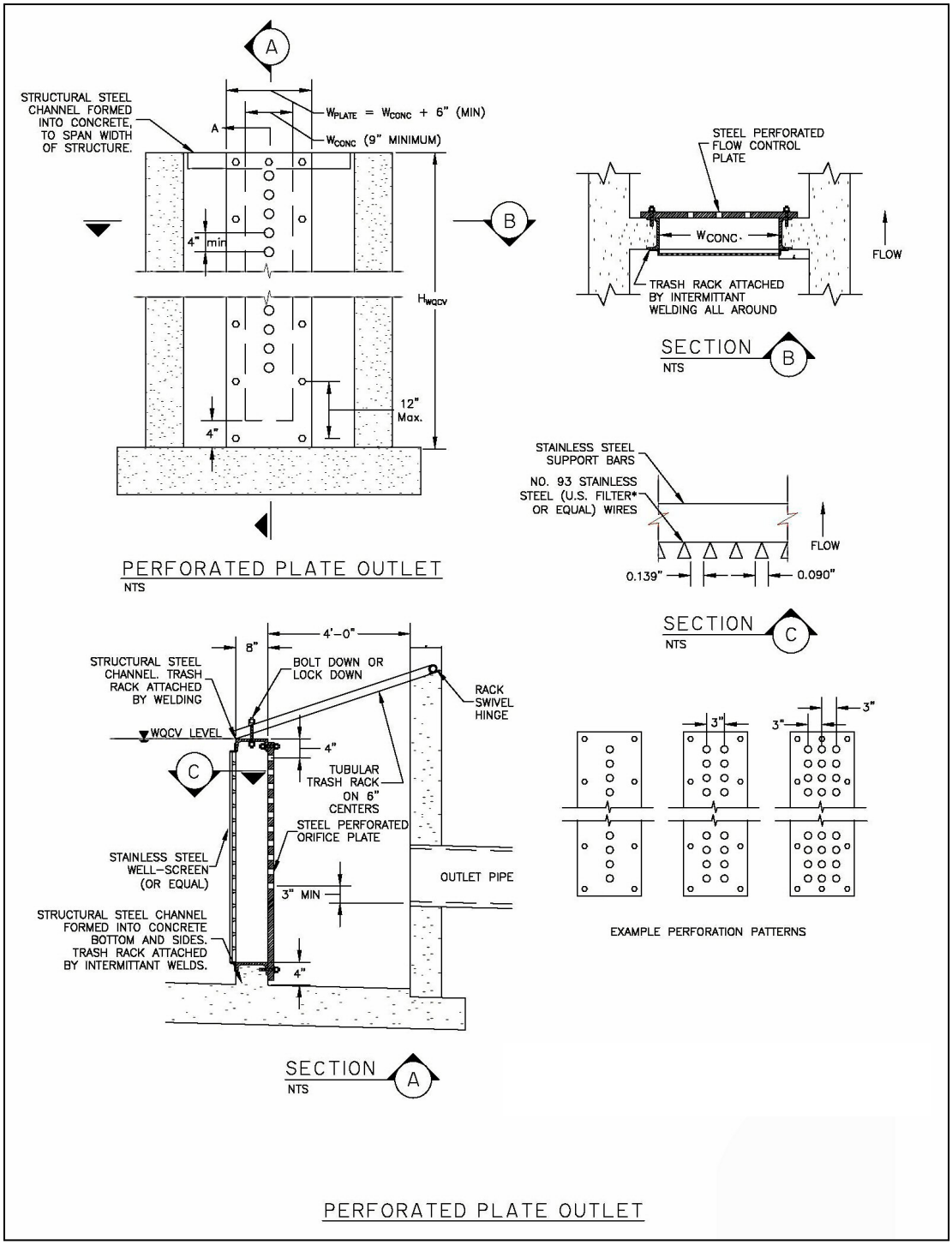


Figure 12. Details for a Perforated Plate and Trash Rack

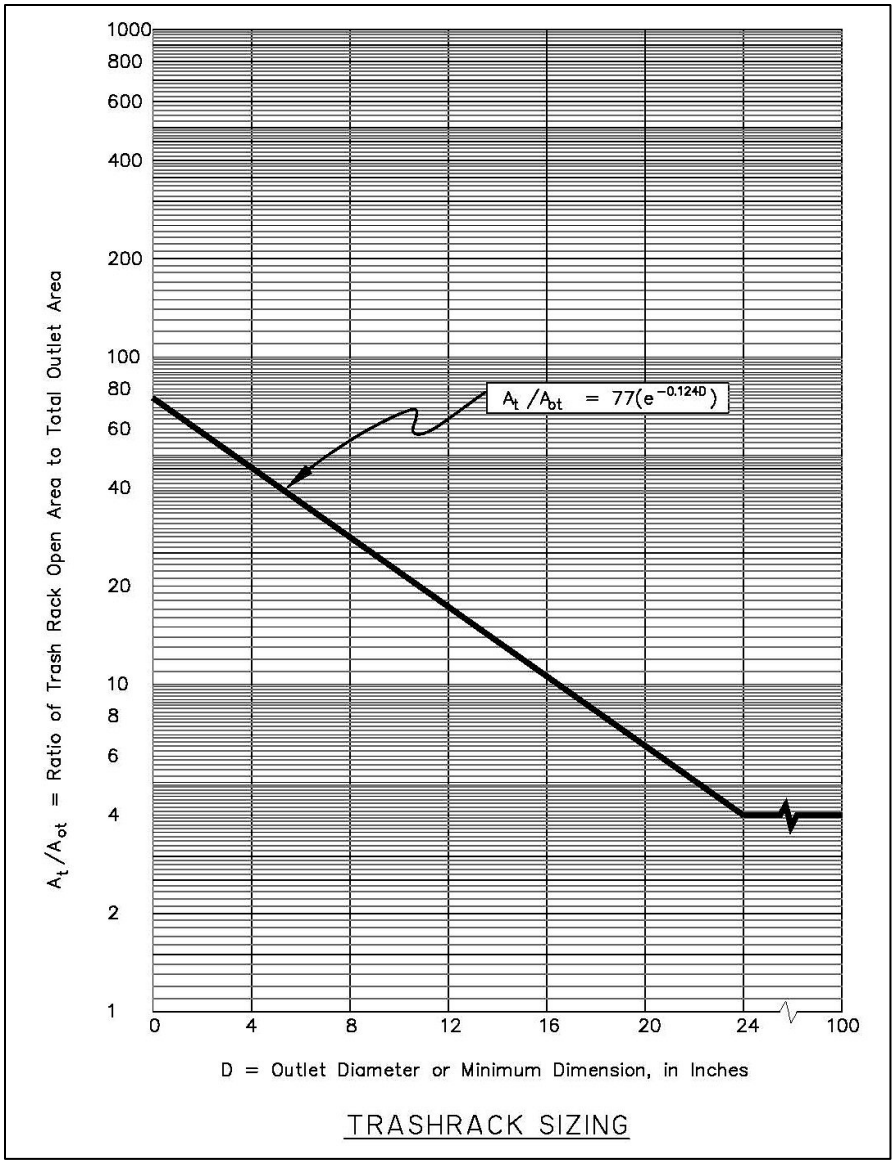


Figure 13. Trash Rack Sizing

14.6 As-Built Certification

Upon completion of the EDB, prior to final acceptance, an as-built survey of the basin and outlet structure in accordance with Chapter 4 Section 9.0 shall be submitted along with a certification signed and sealed by the Missouri-registered Professional Engineer of Record certifying that the EDB was constructed as designed and approved. The following components shall be addressed in the as-built certification:

1. Stormwater infrastructure is installed as designed to ensure stormwater from the site drains to the basin.
2. Basin geometry was constructed as designed and basin volume has been verified.

3. Inlet and forebay (if applicable) were constructed as designed.
4. Outlet works and trash rack are installed as designed.
5. Proper vegetation has been established in the basin.

15.0 Extended Wet Detention Basin (Retention Pond)

15.1 Description

Photo 17. Extended wet detention basin.

Similar to an extended dry detention basin, an extended wet detention basin (also sometimes called a retention pond or wet pond) is designed to collect the runoff from smaller, more frequent rainfall events and release the runoff over a longer period of time. The design collects and treats the "first flush" runoff, which typically has a higher concentration of most pollutants found in urban runoff. Like an extended dry detention basin, an extended wet detention basin can be used for regional or on-site treatment or as follow-up treatment in series with other SCMs. Unlike an extended dry detention basin, an extended wet detention basin is designed with a permanent pool, which provides water quality benefits as the influent water mixes with the permanent pool water and most of the sediment deposits remain in the permanent pool zone. An extended wet detention basin provides a similar level (or better due to the permanent pool) of water quality treatment as compared to an extended dry detention basin, but in less time because the outflow occurs above the bottom of the basin and sedimentation continues after the captured surcharge volume is emptied.

An extended wet detention basin should be designed with the WQV above the permanent pool, and the outlet structure should be sized to drain the WQV in approximately 12 to 15 hours. The reduced drain time (when compared to the extended dry basin) is due to the permanent pool. Flood control volume may also be provided above the permanent pool by including modified outlet controls, a 100-year (minimum) overflow spillway and a minimum of 1 foot of freeboard above the 100-year water surface.

Extended wet detention basins can be very effective in removing pollutants and, when properly designed and maintained, can satisfy multiple objectives such as the creation of wildlife habitats; provision of recreational, aesthetic, and open space opportunities; and inclusion into a larger, regional flood control basin. An extended wet detention basin must be carefully designed and maintained to address safety concerns, bank erosion, sediment removal, and upstream and downstream impacts to waterways. In addition, extended wet detention basins have the potential for floating litter, debris, algae growth, nuisance odors, and mosquito problems. Aquatic plant growth can be a factor in clogging outlet works, and the permanent pool can attract waterfowl, which can add to the nutrient and bacteria loads entering and leaving the pond. Refer to Chapter 9, Detention and Chapter 12, Easements and Maintenance for additional design criteria.

15.2 Site Selection

Retention ponds require groundwater or a dry-weather base flow if the permanent pool elevation is to be maintained year-round. The designer should consider the overall water budget to ensure that the baseflow will exceed evaporation, evapotranspiration, and seepage losses (unless the pond is lined). High exfiltration rates can initially make it difficult to maintain a permanent pool in a new pond, but the bottom can eventually seal with fine sediment and become relatively impermeable over time. However, it is best to seal the bottom and the sides of a permanent pool if the pool is located on permeable soils and to leave the areas above the permanent pool unsealed to promote infiltration of the stormwater detained in the surcharge WQV. Studies show that retention ponds can cause an increase in temperature from influent to effluent. Retention ponds are discouraged upstream of receiving waters that are sensitive to increases in temperature (e.g., fish spawning or hatchery areas).

Use caution when placing this SCM in a basin where development will not be completed for an extended period, or where the potential for a chemical spill is higher than typical. When these conditions exists, it is critical to provide adequate containment and/or pretreatment of flows. In developing watersheds, frequent maintenance of the forebay may be necessary.

15.3 Design Considerations

The total basin volume of an extended wet detention basin facility consists of the permanent pool volume, the WQV above the permanent pool and, if included, the flood control volume above the WQV. Care should be taken to assess the complete water budget of the watershed accounting for runoff, baseflow, evaporation, evapotranspiration, seepage, and other losses to assure the permanent pool can be maintained.

Design considerations for an extended wet detention basin in addition to the considerations typically given to an extended dry detention basin include:

- Water balance calculations should be conducted to assure there is adequate flow to maintain a desirable permanent pool and provide adequate flushing through the basin.
- Edge treatments must be considered that will prevent bank erosion.
- To minimize the potential of algae growth, a minimum permanent pool depth of 6 feet must be provided. Other control methods including aeration or upstream SCMs may also be provided.
- Basin lining must be provided to ensure the basin is watertight and a permanent pool will be maintained. Karst features can make this difficult and expensive.
- The embankments must be carefully designed with keys and cutoff collars to prevent seepage and piping that can lead to loss of the permanent pool or dam failure.
- A shorter detention time of 12 to 15 hours may be used due to the inherent sedimentation that occurs in a wet basin.

15.4 Aesthetic Design

When an extended wet detention basin is designed with aesthetics in mind, it becomes an amenity of much greater value to a landowner. Softened and varied slopes, interspersed fields, planting areas and wetlands can all be part of an EDB. The design should be aesthetic whether it is considered to be

an architectural or naturalized basin. Architectural basins incorporate design borrowed or reflective of the surrounding architecture or urban forms. An architectural basin is intended to appear as part of the built environment, rather than hiding the cues that identify it as a stormwater structure. A naturalized basin is designed to appear as though it is a natural part of the landscape. The built environment, in contrast to the natural environment, does not typically contain the randomness of form inherent in nature. Constructed slopes typically remain consistent, as do slope transitions. Even dissipation structures are usually a hard form and have edges seldom seen in nature. If the EDB is to appear as though it is a natural part of the landscape, it is important to minimize shapes that provide visual cues indicating the presence of a drainage structure. The following are suggested methods for designing a naturalized basin.

15.5 Design Procedure and Criteria

The following steps outline the design procedure and criteria for an extended wet detention basin. Figure 16 shows a representative layout for an extended wet detention basin.

1. For large ponds, if the residence time for the permanent pool volume is 24 hours or greater during a 2-year storm event, the surcharge WQV is not required above the permanent pool. The residence time, t (hr), is calculated by dividing the permanent pool volume, V_p (ft^3), by the average inflow rate during a 2-year storm event, $Q_{2yr,\ avg}$ (cfs), as shown in the equation below. The 2-year average inflow rate must be calculated using the appropriate hydrologic analysis method presented in Chapter 5, Calculation of Runoff.

$$t = \frac{V_p}{Q_{2yr-avg} \cdot 3600}$$

2. If the residence time is less than 24 hours, the WQV shall be added above the permanent pool. The WQV is the surcharge volume above the permanent pool. Generally, an extended wet detention basin should be located away from any offsite drainage crossing the site to ensure proper function. If offsite area is drained through the facility, that area must be included in all volume calculations.
3. The minimum volume required for the permanent pool is a function of the WQV and is calculated using the following equation.

   V_p = 1.2*WQV

   The permanent pool shall have a depth of at least 6 feet (and preferably deeper) to decrease the likelihood of algae growth. An option to improve water quality treatment and minimize bank erosion is to provide a littoral zone 18 inches deep and 10 feet wide for aquatic plant growth along the perimeter of the permanent pool. This also enhances pond safety.

4. The outlet works are to be designed in accordance with requirements set forth in design procedure and criteria for an extended dry detention basin, with the following exceptions:
   a. Design the outlet works to release the WQV over a 12- to 15-hour period.

   b. Where perforated riser pipes are not encased in gravel, only corrugated metal or ductile iron pipe may be used, and an anti-seep collar must be provided around the outlet.

5. The trash rack is to be designed in accordance with requirements set forth in design procedure and criteria for an extended dry detention basin.
6. The basin length to width ratio should be between 2:1 and 4:1. The minimum allowable ratio is 1:1. Maximizing the distance between the inlet and the outlet will minimize short-circuiting.
7. Basin side slopes above the permanent pool should be no steeper than 4:1, preferably 5:1 or flatter to limit rill erosion and facilitate maintenance and safety.
8. A 4- to 6-inch organic topsoil layer, vegetated with aquatic species, shall be provided on the littoral bench if incorporated.
9. Access to the basin bottom, forebay, and outlet area must be provided for maintenance vehicles. Grades of the access should not exceed 10 percent, and a stabilized, all-weather driving surface must be provided.
10. Provide erosion protection at all inlets to the pond.
11. A forebay should be considered when the design volume exceeds 20,000 ft^3 or a large sediment, trash or debris load is anticipated due to upstream land use. Forebays provide an opportunity for larger particles to settle out at a controlled location where sediment and debris can be more easily removed. Install a solid driving surface on the bottom and sides below the permanent water line to facilitate sediment removal. A berm consisting of rock and topsoil mixture should be part of the littoral bench to create the forebay. The forebay volume within the permanent pool volume should be between 5 and 10 percent of the design WQV.

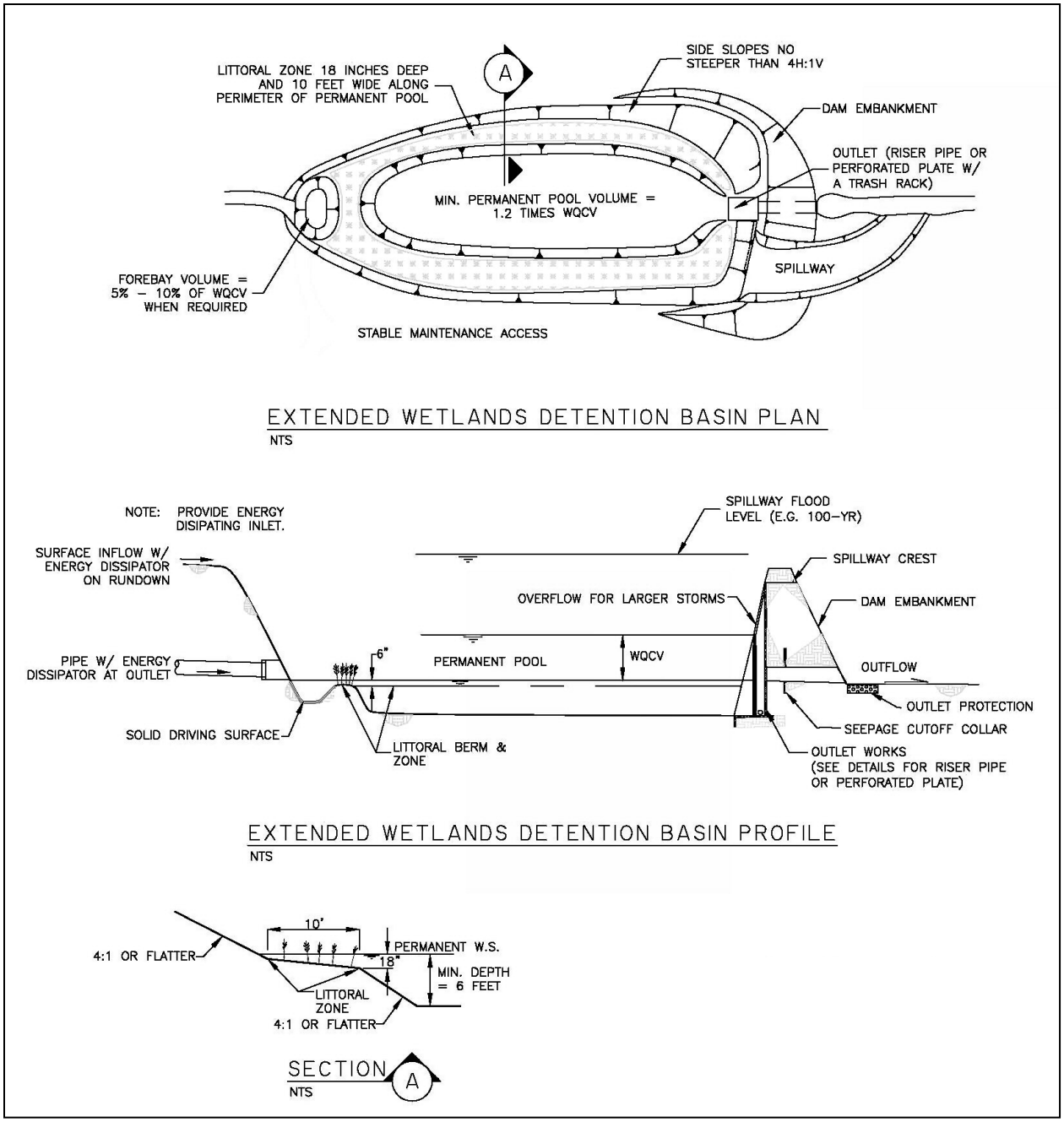


Figure 14. Extended Wet Detention Basin Plan and Profile

15.6 As-Built Certification

Upon completion of the extended wet detention basin, prior to final acceptance, an as-built survey of the basin and outlet structure shall be submitted along with a certification signed and sealed by the Missouri-registered Professional Engineer of Record certifying that the extended wet detention basin was installed as designed and approved. The following components shall be addressed in the as-built certification:

1. Stormwater infrastructure is installed as designed to ensure stormwater from the site drains to the basin.
2. Pond geometry was constructed as designed and pond volume has been verified.
3. Inlet and forebay were constructed as designed.
4. Outlet works and trash rack are installed as designed.
5. Proper vegetation has been established on pond banks, and the littoral zone planting plan installed if applicable.

16.0 Constructed Wetland Pond

16.1 Description

A constructed wetland pond is a shallow extended wet detention basin that requires a perennial base flow to maintain microorganism habitat and to permit the growth of rushes, willows, cattails, and reeds to slow runoff and allow time for sedimentation, filtering, and biological uptake. Constructed wetlands differ from "natural" wetlands, as they are artificial and built to treat stormwater. Do not use existing or natural wetlands for stormwater treatment. Stormwater should be treated prior to entering natural or existing wetlands. Sometimes, small wetlands that exist along ephemeral drainageways can be enlarged and incorporated into a constructed wetland system. Such actions, however, require the approval of federal and state regulators.

Regulations intended to protect natural wetlands recognize a separate classification of wetlands constructed for water quality treatment. Such wetlands generally are not allowed to be used to mitigate the loss of natural wetlands but are allowed to be disturbed by maintenance activities. Therefore, the legal and regulatory status of maintaining a wetland constructed for the primary purpose of water quality enhancement is separate from the disturbance of a natural wetland. Nevertheless, any activity that disturbs a constructed wetland should be cleared through the U.S. Army Corps of Engineers as to whether a 404 permit is needed.

16.2 Site Selection

A constructed wetland pond requires a positive net influx of water to maintain vegetation and microorganisms. This can be supplied by groundwater or a perennial stream. An ephemeral stream will not provide adequate water to support a constructed wetland pond. It is best used as a follow-up SCM in a treatment train, although it can serve as a stand-alone facility. Constructed wetland ponds can also be designed for flood control in addition to capture and treatment of the WQV. Although constructed wetlands can provide an aesthetic onsite amenity, significant algae blooms can occur. The owner should maintain realistic expectations of aesthetics. Algae blooms may be reduced when SCMs that are effective in removing nutrients are placed upstream.

16.3 Design Considerations

When properly designed, a constructed wetland basin can offer several potential advantages, such as natural aesthetic qualities, wildlife habitat, erosion control, and pollutant removal. Additionally, the constructed wetland basin can act as part of a multi-use facility by providing flood control storage above the WQV pool or by providing effective follow-up treatment to onsite and source control SCMs that rely upon settling of larger sediment particles.

The primary drawback of the constructed wetlands basin is the need for a continuous base flow to ensure viable wetland growth. In addition, silt and algae can accumulate and, unless properly designed and built, can be flushed out during larger storms, reducing downstream water quality benefits. Also, in order to maintain healthy wetland vegetation growth, the surcharge depth for WQV above the permanent water surface cannot exceed roughly 2 feet.

Development and analysis of a water budget is needed to show the net inflow of water is sufficient to meet all the projected losses (such as evaporation, evapotranspiration, and seepage for each season of operation) and ensure a perennial baseflow. Insufficient inflow can cause the wetland to become saline or die.

Loamy soils are needed in a wetland bottom to permit plants to take root. Exfiltration through a wetland bottom cannot be relied upon because the bottom is either covered by soils of low permeability or because the groundwater is higher than the wetland's bottom. Also, wetland basins require a near zero longitudinal slope, which can be provided using embankments.

During design, consider maintenance access and a means for draining the pond for sediment removal. Along with vegetation management and other routine maintenance, occasional sediment removal will be required when sediment accumulations become too large and affect performance. This may be required whenever sediment accumulation occupies approximately 20 percent of the WQV. Periodic sediment removal is also needed for proper distribution of growth zones and water movement within the wetland.

16.4 Design Procedure and Criteria

The following steps outline the design procedure for a constructed wetland basin. Figure 17 illustrates an idealized constructed wetland basin.

1. Calculate the WQV in cubic feet. The WQV is the surcharge volume above the permanent wetland pool.
2. The volume of the permanent wetland pool shall be no less than 75 percent of the WQV.
3. Proper distribution of wetland habitat is needed to establish a diverse plant community. Distribute pond area in accordance with Table 13.
4. The surcharge depth of the WQV above the permanent pool's water surface shall not exceed 2.0 feet.
5. The outlet works shall be designed in accordance with requirements set forth for extended dry detention basins, with the following exceptions:
    a. Design the outlet works to release the WQV in 22 to 28 hours.
    b. Where perforated riser pipes are not encased in gravel, only corrugated metal or ductile iron pipe may be used, and an anti-seep collar must be provided around the outlet pipe.
    c. Outlet design should consider the elevated potential for wetland vegetation growth and clogging around the outlet.
6. The trash rack shall be designed in accordance with requirements set forth for extended detention basins.
7. Determine whether flood storage or other uses will be provided and design accordingly for combined uses.
8. The basin length to width ratio should be between 2:1 and 4:1. The minimum allowable ratio is 1:1. Maximizing the distance between the inlet and the outlet will minimize short-circuiting.

9. Basin side slopes should be no steeper than 4:1, preferably 5:1 or flatter to facilitate maintenance, safety and access.
10. A net influx of water must be available through a perennial base flow and must exceed the losses. A hydrologic balance should be used to estimate the net quantity of base flow available at a site.
11. Provide energy dissipation at all inlets to limit sediment re-suspension.
12. Forebay design considerations and criteria for extended wet detention basins shall be followed.
13. Cattails, sedges, reeds, and wetland grasses should be planted in the wetland bottom. Qualified professionals must be utilized to develop the planting plan and to plant the wetland plants. Berms and side-slopes should be planted with native or turf-forming grasses. Initial establishment of the wetland requires control of the water depth. After planting wetland species, the permanent wetland pool should be kept at 3 to 4 inches deep at the plant zones to allow growth and to help establish the plants, after which the pool should be raised to its final operating level.
14. Provide vehicle access to the forebay and outlet area for maintenance and removal of bottom sediments. Maximum grades should not exceed 10 percent, and a stabilized, all-weather driving surface must be provided.

Table 6. Constructed Wetland Pond Design Depths

Components	% of Permanent Pool Surface Area	Water Design Depth
Forebay, outlet and free water surface areas	30% to 50%	2 to 4 feet deep
Wetland zones with emergent vegetation	50% to 70%	6 to 12 inches deep (1/3 to 1/2 of this zone should be 6 inches deep)

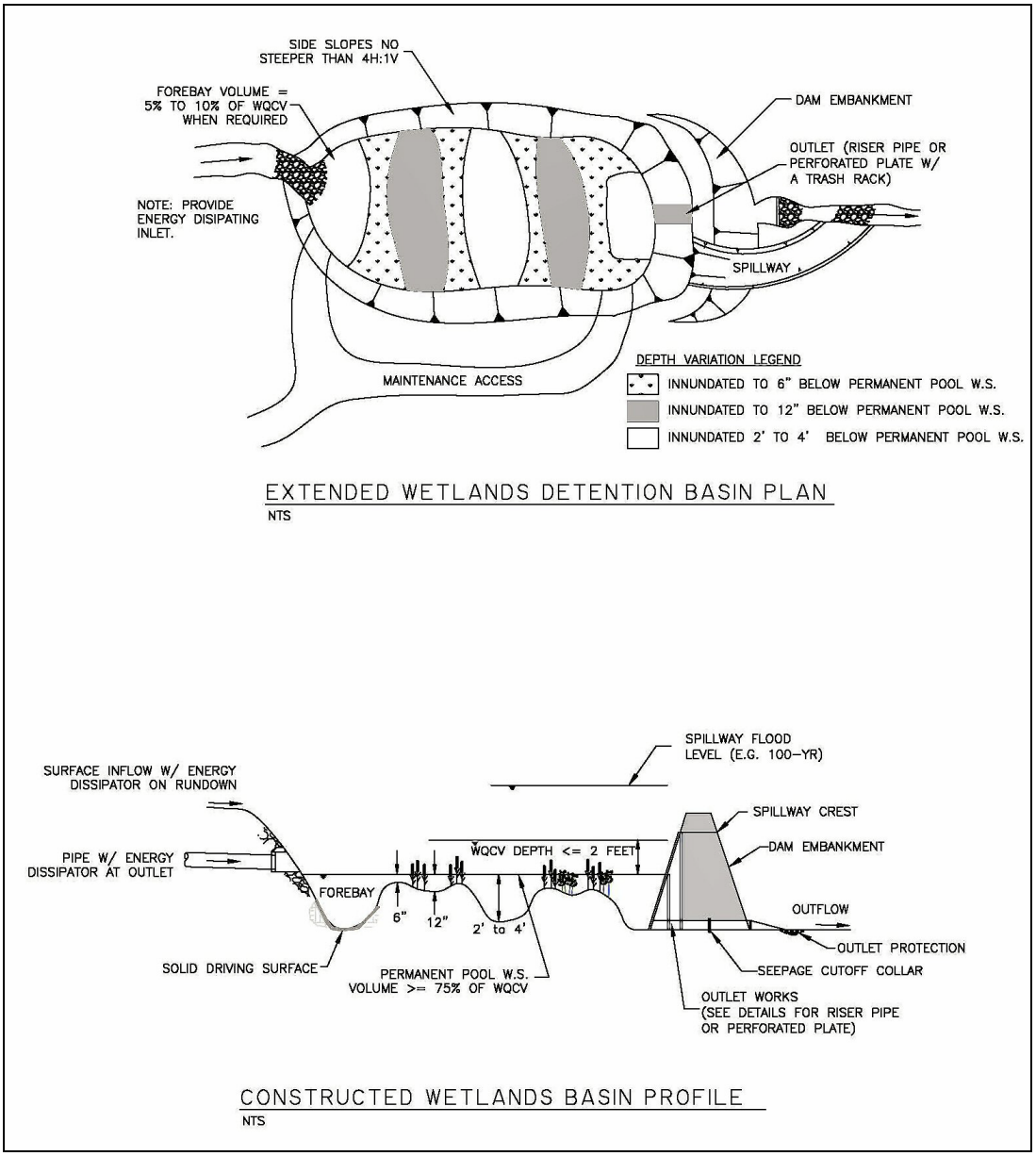


Figure 15. Constructed Wetland Typical Drawings

16.5 As-Built Certification

Upon completion of the constructed wetland pond, prior to final acceptance, an as-built survey of the pond and outlet structure shall be submitted along with a certification signed and sealed by the Missouri-registered Professional Engineer of Record shall be submitted certifying that the constructed wetland pond was installed as designed and approved. The following components shall be addressed in the as-built certification:

1. Stormwater infrastructure is installed as designed to ensure stormwater from the site drains to the basin.

2. Pond geometry was constructed as designed and pond volume has been verified.
3. Inlet and forebay were constructed as designed.
4. Outlet works and trash rack are installed as designed.
5. The planting plan has been installed as designed.

17.0 Green Roof

17.1 Description

The term green roof refers to a roof partially or completely covered with vegetation underlain with an engineered growing medium, drainage and filter layers, and waterproofing. It provides stormwater volume reduction and flow attenuation benefits by capturing and temporarily storing rainfall before it is conveyed to the roof drainage system. A portion of the captured rainfall evaporates and is taken up by plants. Green roofs can also provide other benefits including extended roof life, increased insulation and energy savings, urban heat island reduction, and social benefits of increased green space.

There are two types of green roofs: extensive and intensive. Extensive green roofs have a shallow depth of growing medium, typically 3-6 inches thick, and are planted with sedums or other plants suitable for the limited root zone. Intensive green roofs have deeper growing medium, typically 6 inches to 4 feet thick, and a wider variety of plants that may include shrubs and trees. Green roofs can be modular trays that contain the necessary drainage layers, growing medium and plants, or each component can be installed separately. The additional weight loading of intensive green roofs may limit their application. Both types of green roofs are acceptable; however, because extensive green roofs are generally more common, this section predominantly focuses on extensive green roof design only. The design of a green roof involves many disciplines in addition to stormwater engineers, including structural engineers, architects, landscape architects, horticulturalists, and others. This section is intended to provide general green roof stormwater design criteria only. Designers should reference other resources for more comprehensive green roof design information, including but not limited to *Standard Guide for Vegetative (Green) Roof Systems* (ASTM, 2014). In addition to this standard guide, ASTM has issued several standards for specific green roof components. Green roof design should generally adhere to ASTM standards.

Photo 18. Extensive green roof on employee balcony of Greene County Public Safety Center.

Photo 19. Extensive green roof on Greene County Public Safety Center.

17.2 Site Selection

Green roofs can be installed on commercial or residential buildings or structures. They can be particularly well-suited for ultra urban areas where space is limited and where they be accessed for enjoyment by building tenants, customers, or employees.

Photo 20. Intensive green roof on Green Circle Shopping Center (Source: Green Circle Shopping Center)

17.3 Design Considerations

The growing medium, plant selection, and irrigation needs and methods are critical factors determining the long-term functionality of a green roof. They should be carefully designed to ensure establishment and minimize maintenance needs such as replanting vegetation. The following are additional considerations when designing a green roof (adapted from Metropolitan Nashville - Davidson County, 2012).

- **Roof Structural Capacity.** The roof must be designed to support the green roof system as well as loads associated with rainfall, snow, people, and equipment. Typically, the roof must be designed to support an additional 15 to 30 pounds per square foot for an extensive green roof. A structural engineer, architect or other qualified professional should be involved with all green roof designs to ensure that the building has adequate structural capacity to support the green roof. Structural capacity should conform to ASTM standards.
- **Roof Pitch.** The volume reduction and flow attenuation benefits of a green roof are maximized when the roof is relatively flat (a pitch of 1 to 2%). Some pitch is needed to promote positive drainage and prevent ponding and/or saturation of the growing medium. Green roofs can be installed on roofs with slopes up to 25% if baffles, grids, or strips are used to prevent slippage of the medium.
- **Access.** Adequate access to the roof must be available to deliver construction materials and perform routine inspections and maintenance. If an underdrain system is used, provide cleanouts as needed for inspection and maintenance. Access in the form of non-vegetated walkways should also be provided to allow for weeding and spot repairs of vegetation.
- **Building Codes.** The green roof design should comply with applicable City building codes.
- **Waterproofing.** Ensure that the waterproofing warranty for the roof will not be voided by a green roof application. A leak test is recommended following installation of the impermeable membrane.

17.4 Design Procedure and Criteria

The WQV shall be provided within the void space of the drainage layer and the growing medium. The drainage layer should be designed to convey the 10-year storm without backing water up into the growing medium. The void space shall be specified by the designer based on the materials selected. If using a proprietary green roof system, designers should consult with the manufacturer for design information and the design shall adhere to manufacturer's specifications. Designers may also design a non-proprietary green roof system in which case they should consult and follow design resources including but not limited to *Standard Guide for Vegetative (Green) Roof Systems* (ASTM, 2014).

Metropolitan Nashville - Davidson County's (2012) "GIP-12 Green Roof" document also contains good information and was referenced in developing this section.

Green roofs are composed of the following basic components which shall be addressed in the design:

- **Roof deck:** The roof deck provides the foundation for the green roof. Concrete decks are generally preferred but other decking materials can be used if appropriately designed. The potential for decking materials to leach metals or chemicals should be considered when choosing decking material.
- **Waterproofing layer**: A wide range of waterproofing materials can be used to prevent water from entering the building. The waterproofing layer must have an expected life span that meets or exceeds the expected life span of the green roof system.
- **Insulation layer (optional):** Green roofs may include an insulation layer that increases the energy efficiency of the building and/or protects the roof deck.
- **Root barrier (optional)**: Root barriers are sometimes used to protect the waterproof membrane from root penetration.
- **Drainage layer and system**: A layer of aggregate or a proprietary product is installed to remove excess water from the root zone. This drainage layer should convey flow to a roof drainage system. The roof drainage system should be designed to be kept free of debris and plant material. Roof drains immediately adjacent to the growing medium should be separated by a barrier such as perforated metal edging filled with gravel (Photo 20). A drainage barrier should also be used at the roof border with the parapet wall and for any joints where the roof is penetrated, or joins with vertical structures. The outlet can be controlled by an orifice or orifices located at one central location or at each roof drain and will be dictated by the overall drainage design.
- **Filter fabric**: A filter fabric is placed between the drainage layer and the growing medium to prevent migration of the growing medium from clogging the drainage layer.
- **Growing medium**: Growing medium is a key issue with regard to plant health, irrigation needs, and potential stormwater benefits. The recommended growing medium for extensive green roofs is composed of approximately 80-90% lightweight inorganic materials such as expanded slates, shales or clays, pumice, scoria or other similar materials. The remaining media should contain no more than 15% organic matter, normally well-aged compost. The percentage of organic matter should be limited to minimize leaching of nutrients and clogging of the filter fabric. The medium should have a maximum water retention capacity of around 30%.
- **Vegetation**: Succulents, grasses, perennials, and shrubs with relatively shallow root depths are possibilities for green roof plantings depending on whether the design is extensive or intensive. An experienced professional should be consulted for plant selection and design. Designers should order plants at least 6 months in advance to ensure supply or consider having plants contract-grown.
- **Irrigation**: The design should include a plan for irrigation during establishment, which generally takes 12 to 18 months. The design should also include a plan for long-term supplemental irrigation as needed depending on species selection. Even vegetation with low water requirements may require supplemental irrigation.

Photo 21. Separation of the roof drain from the growing media and plants using perforated metal edging and rock (Source: UDFCD, 2010).

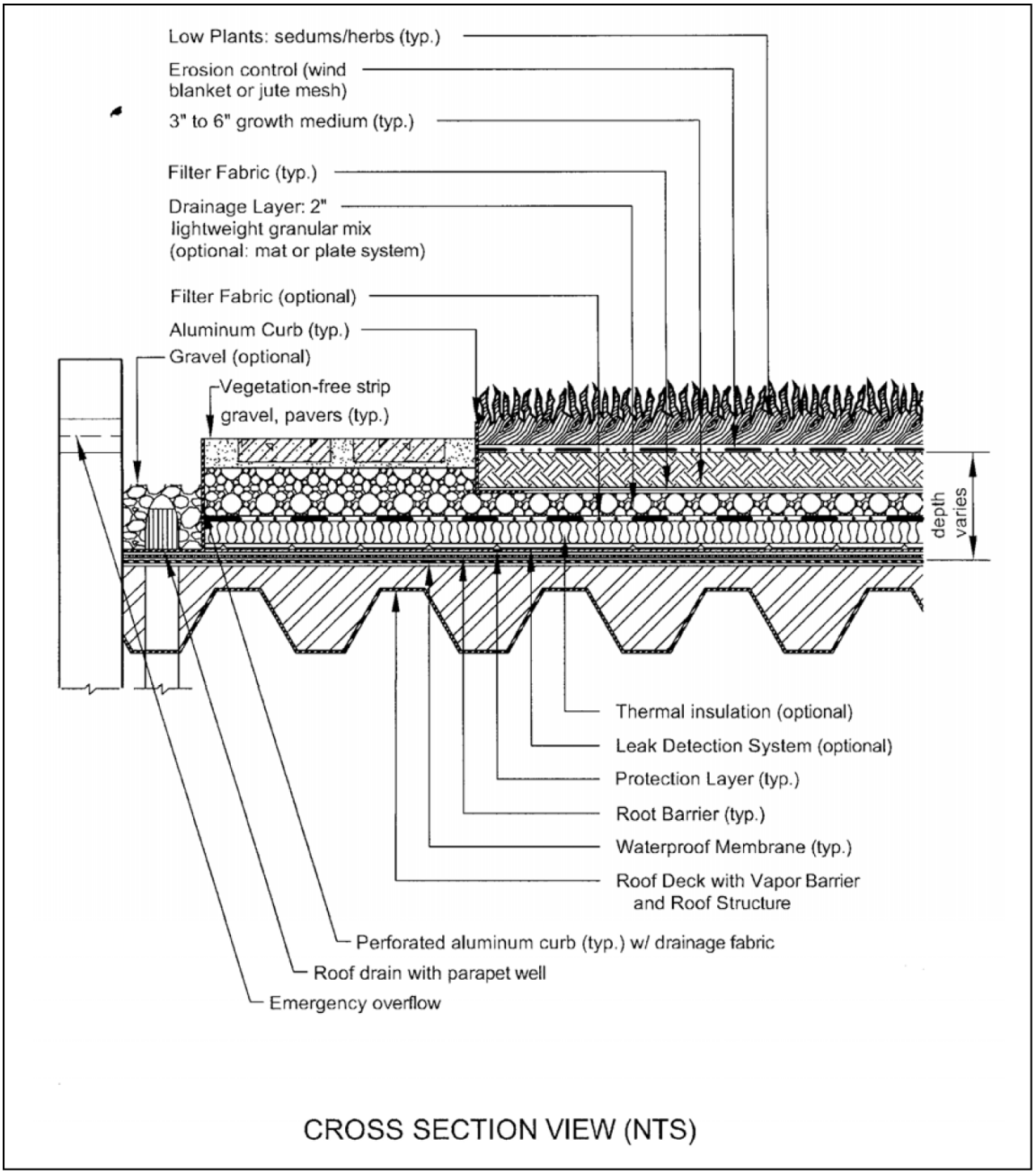


Figure 16. Extensive Vegetated Roof Typical Section (Source: NVRC, 2007).

17.5 Construction Considerations

The following should be considered during construction and plan notes provided as needed.

- Conduct a flood test to ensure the system is water tight by placing at least 2 inches of water over the membrane for 48 hours to confirm the integrity of the waterproofing system.
- Take care not to damage the waterproofing when adding other system components.

- The growing medium should be mixed prior to delivery to the site. It should be spread evenly over the filter fabric surface and covered until planting to prevent weeds from growing. Sheets of exterior grade plywood can be laid over the medium to accommodate foot and wheelbarrow traffic. Foot and equipment traffic should be limited to reduce compaction of the growing medium.
- The growing medium should be moistened prior to planting and the plants watershed immediately after installation and routinely during establishment.
- The construction contract should contain a warranty that specifies a 75% minimum survival after the first growing season and a minimum effective vegetative ground cover of 75% for flat roofs and 90% for pitched roofs.

17.6 As-Built Certification

Upon completion of the green roof, prior to final acceptance, an as-built certification signed and sealed by the Missouri-registered Professional Engineer of Record shall be submitted verifying that the green roof was installed as designed and approved. The following components shall be addressed in the as-built certification:

1. Protection of vulnerable areas (abutting vertical walls, roof vent pipes, outlets, air conditions units and perimeter areas) from leakage;
2. Profile view of facility including typical cross-sections with dimensions;
3. Growing medium specification including dry and saturated weight;
4. Filter fabric specification;
5. Drainage layer specification;
6. Waterproof membrane specification, including root barriers;
7. Stormwater piping associated with the site, including pipe materials, sizes, invert elevations at bends and connections; and
8. Planting and irrigation plan.

18.0 Rainwater Harvesting

18.1 Description

Rainwater harvesting refers to the collection and storage of roof runoff in tanks, cisterns, or barrels for non-potable uses such as irrigation and toilet flushing. Storage tanks or cisterns can be aboveground or below ground. Rainwater harvesting provides stormwater volume reduction and flow attenuation benefits as well as conserving public drinking water supplies.

Photo 22. Installation of underground cistern at the City Environmental Resource Center.

18.2 Site Selection

Rainwater harvesting can be used for residential, commercial, and industrial applications where the system can be designed for automatic use or owners have adequate buy-in to ensure drawdown and use of the harvested water.

18.3 Design and Construction Considerations and Criteria

Rainwater harvesting shall be from roofs only, and for non-potable interior and exterior uses only. Rainwater harvesting systems for non-residential developments shall adhere to Section 707 Rainwater Collection and Distribution Systems of the International Green Construction Code, as adopted into the Plumbing Code in City Code Sec. 36-622(x). Residential rainwater harvesting systems shall adhere to City Code Sec. 36-1302(y). Designers should refer to Metropolitan Nashville - Davidson County's (2012) "GIP-11 Cistern" specification for additional design considerations and criteria. Where conflicts exist, City Code Sec. 36-622(x) and Sec. 36-1302(y) shall govern.

Photo 23. Installation of underground cistern at the Missouri State University Pinegar Arena.

18.4 As-Built Certification

Upon completion of the rainwater harvesting system, prior to final acceptance, an as-built certification signed and sealed by the Missouri-registered Professional Engineer of Record shall be submitted verifying that the rainwater harvesting system was installed as designed and approved. The following components shall be addressed in the as-built certification:

Photo 24. Aboveground cistern at the Watershed Center at Valley Water Mill.

1. Rainwater harvesting system volume has been verified.
2. Pre-screening/first flush diversion mechanisms have been installed as designed.
3. Roof, gutter, and downspout design ensures rainwater collection as designed.
4. Downspout leaders from the rooftops being used to capture rainwater.
5. Distribution system for non-potable use has been installed as designed.
6. Overflow system has been installed as designed.

19.0 Proprietary SCMs

19.1 Description

A proprietary SCM is a pre-fabricated structure utilizing settling, filtration, absorptive/adsorptive materials, vortex separation, vegetative components, and/or other appropriate technology to provide pollutant removal. Some proprietary SCMs may be appropriate for underground detention only and not as stand-alone SCMs to meet water quality requirements.

19.2 Site Selection

Proprietary SCMs are generally used for pretreatment or as part of a treatment train approach. They are particularly suitable as pretreatment for industrial or commercial sites that are likely to generate a high loading of sediment, hydrocarbons, or metals. They can be used as a stand-alone SCM if meeting the criteria in Section 19.4.

19.3 Design Considerations

Primary design considerations include the pollutant type and loading anticipated for the site as well as maintenance needs and access.

19.4 Design Procedure and Criteria

Proprietary systems will be approved as stand-alone SCMs meeting water quality requirements on a case by case basis. To be used as a stand-alone SCM for meeting water quality requirements, proprietary systems shall be capable of treating the WQV, providing pollutant removal effectiveness that meets or exceed other stand-alone SCMs in this chapter, and shall have an acceptable longevity rate in the field. Systems with a volume-based sizing approach shall be sized to capture and treat the full WQV. Flow-through systems must be sized to treat the WQV based on its associated peak rate. Pollutant removal effectiveness should meet or exceed other stand-alone SCMs in this chapter for total suspended sediment at a minimum and should also consider phosphorus and other pollutants specific to the site such as metals or hydrocarbons. Pollutant removal efficiency of the system shall be certified by an independent certification program including but not limited to: U.S. EPA Technology Verification Program, State of Washington Technology Assessment Protocol - Ecology (TAPE), the Technology Acceptance Reciprocity Partnership Protocol (TARP), New Jersey Corporation for Advance Technology (NJCAT) or the State of Maryland Proprietary Practice acceptance program.

Proprietary systems shall be designed by a Professional Engineer registered in the state of Missouri and shall follow manufacturer's specifications. Inspection ports and cleanout access shall be provided per manufacturer’s recommendations. The system design and manufacturer's specifications shall be included on the construction plans. Revised plans shall be submitted for any change in design or manufacturer. For systems that rely on infiltration, the soil and geotechnical evaluation requirements in Section 10.4 of this chapter shall be followed.

19.5 Construction Considerations

Construction shall follow manufacturer's specifications.

19.6 As-Built Certification

Upon completion of the proprietary SCM, prior to final acceptance, an as-built certification signed and sealed by the Missouri-registered Professional Engineer of Record shall be submitted verifying that the proprietary SCM was installed as designed and approved. The as-built certification shall address critical components per manufacturer's specifications for construction, include measurements of the outlet structure dimensions and elevations, verify the location of inspection ports and cleanouts shown on the plans, and provide an as-built plan sheet if the locations have changed.

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Chapter 11 Sinkholes and Karst Features

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1.0 Overview

The Springfield area is located on the Springfield Plateau of the Ozarks physiographic region. The area is underlain by Mississippian Age limestone, which is highly susceptible to solutional weathering. This geology is commonly referred to as "karst" and is characterized by numerous sinkholes, losing streams, springs, caves, fracture trends, and other related features. As a result, a complex and often fragile interaction exists between surface and groundwater, requiring special consideration and protection. Development in areas with karst geology can present certain hazards, such as unstable soil foundation for structures, flood hazards, groundwater contamination, and public safety hazards related to collapses. Requirements, design standards, and methods to address these hazards and protect karst features are contained in this chapter. Springfield City Code Chapter 96, Article I Division 3- Protection of Sinkholes and Other Karst Features, provides regulatory authority to require protection of sinkholes and other karst features in compliance with this chapter.

The general policy in addressing karst hazards and features shall be based on the following stepped approach:

- Avoidance – Construction in or around karst features shall be avoided. Exceptions will be made only in situations where it can be conclusively demonstrated that there are no practical alternatives to such construction.
- Minimization – In cases where there is no practical alternative to avoid karst features, measures which will have minimal impact on the karst feature or receiving water may be proposed. Plans for minimal alteration can be approved provided it is conclusively demonstrated that the proposed plan has the least impact to others or the environment.
- Mitigation – Potential impacts of construction on karst features and receiving waters must be studied and assessed, and recommendations made for mitigation of potential impacts upon flooding, structural stability, and groundwater quality before the development plan can be approved. The degree and sophistication of study required will increase in proportion to the potential impacts.

Because karst features can occur in varying forms and severity, each feature must be addressed on an individual basis. However, for the purpose of establishing standards, sinkholes will be referred to in this chapter as being in one of two broad categories: solution sinkholes or collapse sinkholes.

- Solution sinkholes have a defined drainage area and will generally be shown on the City topographic maps as a depression. Development concerns related to solution sinkholes that must be addressed include flood hazards and soil stability within the geologic rim. When runoff from a development is draining to a solution sinkhole, impacts to groundwater quality must be addressed through water quality protection measures.
- Collapse sinkholes are areas of karst-related subsidence with no defined drainage area when occurring outside of a solution sinkhole. Collapse sinkholes can occur within a solution sinkhole and are commonly referred to as an "eye". Stabilization of collapse sinkholes requires a permit from the Department of Public Works. A report by a qualified

professional may be waived if the feature is a minor feature outside of the geologic rim of a solution sinkhole and no development is proposed in the area. For public health and safety reasons, small collapses outside of a solution sinkhole require a permit to be filled and stabilized in accordance with the City standard or recommendation of a qualified professional that is approved by the City.

2.0 Sinkhole Permit and Report Requirements

A sinkhole permit from the Department of Public Works is required prior to any land disturbance, placement of fill or any object, discharge of any substance, or any construction including the operation of any motorized equipment within 100 feet of a cave, spring, or losing stream, or within 25 feet of a sinkhole rim, as defined by the most restrictive of the following:

- Geologic rim as determined by a qualified professional engineer or geologist
- Topographic rim as determined by a qualified professional engineer or geologist
- Sinkhole rim shown on City sinkhole maps
- Other best available data

Prior to the approval of any development containing a sinkhole or draining to a sinkhole, a sinkhole evaluation must be completed. Other city, state or federal permits may be required, depending on the size and nature of the proposed activity. The SF-Sinkholes spreadsheet may be used to assist in calculations needed to complete the sinkhole evaluation.

Where a sinkhole collapse has occurred and presents a risk to public safety, the owner of the property or their representative shall notify the City at their earliest convenience. If immediate action is required the owner shall consult with a qualified geologist or professional engineer to determine appropriate measures. The owner will be responsible for submitting sufficient documentation and a permit will be issued retroactively.

2.1 Permit Requirements

Application for a sinkhole permit requires the following:

1. A plan must be submitted containing measures to minimize impacts on the sinkhole. The plan shall contain a sinkhole evaluation, geologic evaluation, and flood evaluation, where applicable.
2. An analysis of the drainage from a development to a sinkhole must be provided.
3. In general, development within the rim of a sinkhole is prohibited; however, in special circumstances when no other practical alternative exists and documentation is provided in accordance with this chapter, the Director of Public Works may approve development within the rim of a sinkhole provided the developer can demonstrate there will be no significant impacts upon flooding, stability of structures, water quality, or other natural resources on the site or adjoining properties.
4. For any land with a required sinkhole-related non-buildable area or restricted fill area, the developer shall place the following notes on the final subdivision plat and/or development plan:

a. The sinkhole-related non-buildable areas or restricted fill areas shown on this plan have been determined based on the study and recommendation of a professional engineer or geologist. However, approval of this plan is not to be interpreted as any guarantee that future sinkhole activity will not occur due to either natural or human activities.

b. Any sinkhole-related non-buildable area identified here has been determined to be unsuitable for any construction activity, and no buildings, parking areas, land disturbance or other structures shall be permitted within this area.

c. Any sinkhole or restricted fill area identified here has been determined to be unsuitable for soil bearing foundation, and the entire structure of any building (including the floor system) constructed therein must be founded on solid rock, or as determined by the director of building development services.

d. The lowest enclosed space of any structure within or adjacent to a sinkhole flooding area shall be a minimum of five (5) feet above the flooding elevation where there is no overflow from the sinkhole from the critical flood event, or one foot above the flooding elevation determined by the overflow elevation calculated for the critical flood event, whenever the difference between the topographic rim and flooding elevation is less than five (5) feet.

5. Water quality protection measures must be provided in accordance with Section 2.3.

2.2 Sinkhole Evaluation

A sinkhole evaluation includes general information about the sinkhole, a geological evaluation, and a flooding evaluation. A sinkhole evaluation must be completed by a qualified professional engineer or geologist. A geologic evaluation of an off-site sinkhole will not be required if it is determined by a qualified professional that the sinkhole will not have any geological effect on the site.

2.2.1 Geological Evaluation

A geologic evaluation is required for any sinkhole within a proposed development. The evaluation shall provide the following:

1. Identification of all sinkholes as solution or collapse sinkholes.
2. A map of the topographic rim of all solution sinkholes.
3. A map of the geologic rim based on geologic evaluation of all solution and collapse sinkholes and subsurface evaluation of soil and bedrock.
4. A map showing no-build areas for buildings and other structures based on topographic and geologic rims of solution and collapse sinkholes.
5. Details of proposed stabilization of collapse sinkholes, if applicable.
6. Other significant features on the property.

The topographic rim shall be based on a one-foot contour interval or less. Where the site is located in a sinkhole cluster area, the area studied shall extend to include the watershed area of the cluster. The geologic rim shall be determined by a geologic evaluation conducted by a qualified professional engineer or geologist. The no-build zone shall cover all of the area within the topographic rim and

the geologic rim. The no-build zone may be reduced based on the results of the flooding evaluation and a geotechnical investigation.

2.2.2 Flooding Evaluation

A flooding evaluation is required for proposed developments that potentially reside within the sinkhole flooding area or that increase the volume of runoff to a sinkhole. The evaluation shall provide the following components:

1. Drainage area map.
2. Details of the drainage path of the discharge from the development to the sinkhole (off-site sinkholes).
3. Flooding evaluation as described below.

Sinkhole flooding elevations must be determined under both pre-development and post-development conditions. **All calculations must be completed assuming no subsurface outflow from the sinkhole.** This evaluation may not be necessary for certain collapse sinkholes that do not have a drainage area and therefore do not pose a flood risk.

The flooding elevation for a sinkhole shall be determined using the runoff from a storm with an annual exceedance probability of one percent (1%) and a duration of twenty-four (24) hours. Runoff shall be calculated using the SCS Curve Number Loss Model (Chapter 5, Calculation of Runoff, Section 4.1).

If the flooding elevation is determined to be higher than the overflow point on the topographic rim (saddle), then the flooding elevation shall be determined using reservoir routing methods (Chapter 9, Detention for Flood Control, Section 3.3.3). In this case, additional downstream evaluation is necessary. To determine the downstream boundary conditions, a flooding evaluation shall be made of the receiving sinkhole(s), and/or the impact to the receiving stream.

2.2.3 Flooding Elevation Restrictions

If the post-development flooding area is <u>located entirely on the development property</u>, a drainage easement restricting construction of structures shall be established covering the sinkhole flooding area, which is the area inundated by the flood elevation based on fully developed conditions in the watershed as well as current zoning and potential land use.

If the post-development sinkhole flooding area is <u>located fully or partially on another property</u>, the following conditions apply:

1. The post-development sinkhole flooding area shall be contained within a drainage easement restricting structures, and
2. Any flow leaving the proposed development shall be contained within a drainage easement until it reaches the receiving sinkhole. This easement shall contain the runoff from the critical storm event with an annual exceedance probability of one percent (1%). The critical storm event is defined as the storm event with an annual exceedance probability of one percent (1%) that produces the highest peak flow, regardless of duration.

3. Where it is not possible for a drainage easement to contain the sinkhole flooding area, it must be shown that:
   - **a.** The proposed development will not cause a rise in the flood elevation within a reasonable tolerance (0.1 ft), or
   - **b.** The impacts of both the proposed development and any future developments in the watershed will not impact any existing structures or improvements and will not increase the flooding elevation by more than one foot. The increase in the flooding elevation shall be distributed proportionately based on watershed size e.g. if the development is twenty (20) percent of the watershed then they can increase the flooding elevation by twenty (20) percent of one foot or 0.2 feet. This can be determined by calculating the runoff rates and volumes from the entire watershed, assuming fully developed conditions based on current zoning and potential future land use, and calculating the resulting WSE.
   - **c.** The following alternatives, listed in order by preference, may be used individually or in combination, if needed, to comply with a or b:
     - i. Stormwater Control Measures (SCMs) that reduce runoff volume such as bioretention, pervious pavements, etc. Small-scale, distributed practices are preferred over centralized, large-scale practices in karst areas.
     - ii. Detention Storage – Since traditional detention storage has little to no impact on the volume of runoff from a site, it is seldom the solution for impacting the WSE of an adjacent sinkhole. However, in the case where detention is warranted, the following conditions must be met:
       1. It must be shown that the peak basin outflow is less than the existing peak rate of runoff from the site and less than the discharge rate of the sinkhole. (See below)
       2. Compensatory excavation within the sinkhole flood area – Karst features can have a significant, and often unknown, impact on subsurface hydrology and groundwater quality. **Therefore, compensatory excavation within the sinkhole flooding area will generally not be permitted.** In rare cases, where there are exceptional conditions, alternative measures, such as compensatory excavation, may be permitted with the approval of the Director of Public Works, provided the following conditions are satisfied:
          - a. Such alternative creates no adverse impact on groundwater, sinkhole stability, flood conditions, or other properties. If, at the City's discretion, excavation to the sinkhole has the potential to cause an adverse impact, the City may deny the request to excavate within the sinkhole.
          - b. A comprehensive erosion and sediment control plan is developed to keep sediment confined to the excavation site. This plan would likely include additional control measures and inspections beyond the scope of a traditional plan.

The **lowest enclosed space** for all new structures within or adjacent to a sinkhole flooding area shall be:

1. A minimum of five (5) feet above the flooding elevation where there is no overflow from the sinkhole from the critical flood event, or
2. One foot above the flooding elevation determined by the overflow elevation calculated for the critical flood event, whenever the difference between the topographic rim and flooding elevation is less than five (5) feet.

When existing improvements are below the 100-year flooding elevation, an evaluation of the impacts during higher frequency or shorter duration rainfall events may be required. It shall be shown that runoff rates and volumes from a proposed development will not increase the flooding frequency for any such structure or improvement.

2.2.4 Determination of Discharge Capacity of Sinkhole

In the event that the discharge rate of a sinkhole needs to be estimated in order to size off-site detention, the following guidance is provided:

1. The stage-discharge relationship for the sinkhole shall be estimated by monitoring the sinkhole during at least two storm events exceeding 1 inch of runoff in a 6 hour period.
2. The sinkhole shall be monitored immediately after the storm event to document the stage at various times to better estimate the stage-discharge relationship.
3. In sinkhole complexes, receiving or terminal sinkholes must also be analyzed if they receive overflow from upstream sinkholes.
4. Rainfall depths and intensities shall be determined based on a recording rain gauge or readings from a City of Springfield rain gauge at 15 minute intervals.
5. The discharge rate shall be estimated by adjusting the stage-discharge relationship of the reservoir routing model until the reservoir stages in the model correlates with the observed stages in the sinkhole (within 0.1 feet).
6. The maximum observed stage in the sinkhole shall be surveyed and photographs provided where debris lines are used as evidence of the maximum stage.
7. The volume of runoff storage in the sinkhole(s) can be counted toward stormwater detention requirements, provided that erosion and sediment control and water quality requirements, in accordance with city code and this manual, are satisfied.

2.3 Water Quality Protection

Sinkhole conduits provide direct recharge routes to groundwater. As a result, these conduits provide a route for polluted runoff to enter drinking water supplies that are otherwise protected and often being consumed with no treatment. Protection of water quality entering sinkholes protects the quality of area wells, caves, springs and streams. Because the nature of groundwater movement in the Springfield area is complex and not fully known, it is assumed that any conduit could potentially be a source of any of the features mentioned above. Therefore, it is critical to implement water quality protection measures on all developments that drain to sinkholes. The most effective water quality protection measures for sinkholes are setbacks and buffers around

sinkhole flooding areas, use of small-scale, distributed SCMs such as vegetated filter strips, grass channels and rain gardens, and distribution of runoff into sheet flow as it nears the sinkhole. The following water quality protection measures are required on all new developments and redevelopments that drain to sinkholes.

- Maintain a 25-foot vegetated buffer from the sinkhole flooding area. A vegetated buffer is a necessary addition to on-site SCMs because of the increased need for water quality protection around sinkholes. A reduction in the buffer width may be allowed if it will unreasonably restrict development and water quality protection can be otherwise addressed.
- Developments that disturb one acre or greater, including projects less than one acre that are part of a larger common plan of development or sale that will disturb one or more acres over the life of the project, shall obtain a land disturbance permit. Developments disturbing less than one acre shall submit an erosion and sediment control plan for approval.
- Developments that disturb one acre or greater, including projects less than one acre that are part of a larger common plan of development or sale that will disturb one or more acres over the life of the project, shall meet the Chapter 10 Water Quality Requirement. Developments that disturb less than one acre are not required to meet the Chapter 10 Water Quality Requirement but shall utilize site design approaches that minimize directly connected impervious area and incorporate sheet flow and vegetated conveyance where feasible to provide some level of water quality treatment and runoff reduction.
- Developments for facilities and operations involving the outdoor handling of hazardous materials or significant quantities of non-hazardous materials that could negatively impact water quality must provide a containment plan to show what measures will be taken to assure that discharges of these materials will be contained and prevented from entering the sinkhole.

2.4 Development Restrictions

1. Increasing sinkhole discharge rate by excavating the sinkhole eye or installing disposal wells for diverting surface runoff to the groundwater system is prohibited unless clear and imminent danger to public health and safety can be demonstrated.
2. New <u>non-residential</u> construction shall not be permitted within twenty-five (25') of the sinkhole rim, unless special measures are approved to address structural, flooding, and water quality concerns.
3. New <u>residential</u> construction may be permitted within the sinkhole rim provided that it is set back a minimum of twenty-five (25') from the sinkhole flooding area, floor elevations meet the flood elevation restrictions listed above, and a geotechnical investigation is provided by a qualified professional engineer.
4. No public street shall be placed below an elevation of at least one foot above the sinkhole flood elevation resulting from the 100-year, 24-hour rainfall with no outlet.
5. Golf courses will be subject to approval of a management plan for use of pesticides and fertilizers.
6. Use of pesticides and fertilizers within twenty-five (25') of the sinkhole rim is prohibited.

7. Pruning of trees, removal of dangerous or dead trees, and limited removal of undergrowth is permitted; however, the use of heavy equipment is generally prohibited.
8. Landscaping and minor gardening is permitted outside of the sinkhole eye provided erosion and sediment control measures are practiced through the use of minimum tillage and mulches.
9. Construction of light incidental landscaping and recreational structures such as playground equipment, etc. is permitted except in the sinkhole eye.

3.0 Other Karst Features

In addition to sinkholes, other karst features shall be protected including caves, springs, losing streams, and exceptional geologic features.

3.1 Caves

Any cave feature that may be accepting or discharging water shall be treated as a sinkhole eye with all applicable restrictions and setbacks. No proposed construction shall be located within 100 feet of a known cave alignment unless a report prepared by a qualified professional engineer or geologist is submitted and approved by the Director of Public Works, verifying that:

1. The cave will not be materially altered by the development, and
2. Sound foundations or the support for the development will not be subject to collapse or undue settling.

3.1.1 Cave Security

If cave entrance protection is to be provided to prevent unauthorized entry, it shall allow for the unimpeded flow of water and shall not disrupt habitat for cave-dwelling animal species. Plans for cave entrance protection must be approved by Public Works prior to construction.

3.2 Springs

No new development shall be within 100 feet of a spring unless a report prepared by a qualified engineer or geologist is submitted and approved by the Director of Public Works verifying that the quality and quantity of the spring flow will not be materially altered by the development. In the case of small, wet-weather springs that only flow for a short period of time after rainfall, normal sinkhole setbacks apply, and provision should be made to allow the spring to flow unaltered with no damage to structures or other improvements.

3.3 Other Features

Developments containing any other significant karst features shall be designed to protect the features to the maximum extent practicable, shall take measures to protect all improvements from potential impacts, and shall take measures to protect the health, safety, and welfare of the public.

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Chapter 12 Easements and Maintenance

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1.0 Overview

Drainage easements shall be provided for all conveyances of runoff to the public drainage system outside of public right-of-way. The public drainage system begins at the point where drainage from one property or public right-of-way drains onto another property or public right-of-way. The required easement widths and maintenance responsibilities for the drainage system are covered in this chapter.

Proper maintenance of stormwater control facilities is essential for effective flood control, water quality management, and the health, safety and welfare of the public. Maintenance includes both routinely scheduled activities and non-routine repairs that may be required after heavy storm events or as a result of other unforeseen problems. As noted in previous chapters, designing facilities with maintenance in mind is critical for long-term functionality. Successful long-term maintenance is dependent on many factors, including appropriate design, good access, a maintenance plan that is adequately developed and funded, and maintenance practices that are in accordance with good public works standards.

Easements for the storage and conveyance of stormwater and maintenance of the stormwater system may be established by any of the following methods:

- Identification on a recorded plat drawing.
- Recording the easement in written form (paper easement).
- Prescriptive easement. (Easements that a public entity inherently owns along waterways that are part of the public drainage system or have been historically improved and maintained by the public entity.)

This chapter provides a performance-based maintenance standard to maintain function and safety throughout the stormwater system. The guidelines provided herein to achieve this standard are not all-inclusive and should be applied with common sense and good engineering judgment.

1.1 Authority

The Springfield City Code authorizes requirements for maintenance in various sections including:

- Chapter 96, Stormwater addresses the requirement of responsible parties to maintain the function and safety of watercourses, sinkholes, stormwater control measures and other constructed or natural sections of the drainage system. It also addresses restrictions related to discharging pollutants to the drainage system. Refer to the City Code for more information.
- Chapter 36 Land Development, Article II Subdivision, authorizes the Director of Public Works to require public improvements in accordance with the *City of Springfield, Missouri, Design Standards for Public Improvements*, including this manual, and provides authority to require easements through the subdivision process.
- Chapter 36, Article III Zoning Regulations, gives authority through the building permit process to require drainage improvements in accordance with all other City codes and ordinances.

Maintenance violations may result from the intentional or unintentional alteration of a watercourse or stormwater control measure due to human activities or from naturally occurring events. Violations can also result from lack of maintenance and repair of a watercourse or stormwater control measure. In many cases, the City maintains the right to enter a property and make necessary corrections if they are not corrected by the property owner.

1.2 Inspections

Regular inspections of stormwater control measures and drainage facilities are key to maintaining a properly functioning and safe drainage system. At a minimum, inspections should be made by property owners on an annual basis. In addition, inspections should occur on a regular basis, particularly after rainfalls, to determine if any changes have occurred that require action to maintain the functionality and safety of the drainage system.

2.0 Easement Requirements

Drainage easements shall be provided for all public drainages flowing across any proposed development. Generally, private, onsite drainage does not require a drainage easement. In some cases, additional drainage improvements and easements may be required upstream or downstream of a new development to address potential impacts of the development.

2.1 Minimum Boundaries

Easements must be provided to contain the 100-year flow based on proposed elevation contours of the site and fully developed conditions of the contributing watershed. The minimum width of a required drainage easement is determined based on the type of drainage facility, as summarized in Table 1, assuming the improvement is centered within the easement. Additional width may be required for maintenance access. A discussion of required easements for various types of facilities is provided in Sections 2.1.1 through 2.1.3.

Table 1. Minimum Drainage Easement Boundaries

Conveyance System	Minimum Boundary
24-inch diameter or less	10 feet
> 24-inch diameter to 42-inch diameter	15 feet
> 42-inch diameter	20 feet
Reinforced Concrete Box	10 feet wider than box outer wall
Vegetated Channel	Entire channel width
Structural (Hard Improved) Channel	10 feet wider than channel (5 feet beyond the outside edge of the structure on each side)
Natural/Unimproved Channel	100-year flood boundary

2.1.1 Enclosed System

Easements for an enclosed drainage system and constructed open channels must be adequate to allow for future maintenance of the structure, including its possible removal and replacement. Flowline depths greater than 4 feet may warrant widths exceeding these minimums. When the flowline depth of an enclosed drainage system or constructed open channel exceeds 4 feet, the drainage easement should extend from the edge of the structure for a distance equal to the depth of the flowline plus 1 foot. If the enclosed system is designed for the 25-year flow and the 100-year flow results in an overflow on the ground surface, the required easement width will shall be governed by the width of the ground surface overflow if it is wider than the minimums listed in Table 1.

2.1.2 Constructed Open Channels

Easements must be adequate to allow for future maintenance of the channel, including possible removal and replacement. In the case of vegetated channels, the easement shall cover the entire channel. In the case of structural channels, the easement shall extend 5 feet beyond the outside edge of the top of the structure. When the flowline depth exceeds 4 feet, the drainage easement should extend from the edge of the structure for a distance equal to the depth of the flowline plus 1 foot. In any event the width of the easement shall not be less than that required to contain the 100-year flow.

2.1.3 Natural Channels

Easements must be adequate to encompass the 100-year flood boundary under fully developed watershed conditions and the most restrictive flow conditions.

2.2 Land Use Restrictions

Drainage easements are areas that, based on engineering analysis, have been determined to be necessary for the conveyance of the 100-year flow, are anticipated to be inundated by the 100-year flood, or are necessary for the maintenance of the drainage system. These areas must be kept free and clear of obstructions that could impede the flow of water, development that could be damaged by inundation, or development that could create a safety risk or nuisance for the public. No grading or placement of fill, structures, fences, or parking lots shall be permitted within a drainage or detention easement without approval by the Department of Public Works. Such approval may require an engineering analysis to clearly demonstrate any of the following:

- There will be no flooding impact on adjacent properties.
- The 100-year flood will remain within a drainage easement.
- No safety hazard or nuisance to the public will be caused.
- The drainage system can be properly maintained.
- For structures, the proposed structure must be properly flood-proofed as required by Building Development Services. When encroachment into the easement involves an enclosed structure, the area of encroachment shall be vacated as a drainage easement.
- For parking lots, there shall be no water depths in the area exceeding 12 inches during the 100-year flood.

For fences, an exception will be made when it can be shown that reasonable action has been taken to allow for the conveyance of the 100-year flow, and the conditions listed above have been met. Chain link fences are generally considered to be acceptable in drainage easements with the exception of areas where concentrated flows exist and vegetation or other debris may collect on the fence.

The City, as necessary to maintain the drainage system and the flow of water, retains the right to remove any structures, fences, fill, or parking lot or other facility used for the movement of vehicular or pedestrian traffic placed within a drainage easement without approval of the Public Works Department. The construction of buildings and other permanent structures over the public stormwater system should be avoided to the maximum extent practicable. Where no feasible alternative exists, a structure may be built over the public stormwater system upon the approval of the Director of Public Works and execution and recording of a build over agreement on a form provided by the City which at a minimum shall specify the following:

- City shall have the right to repair, maintain and replace the stormwater infrastructure as may be necessary, including the right to enter property, excavate and remove portions of the building or structure as may be required to gain access to the stormwater infrastructure in connection with such work.
- Any damage to building or structure resulting from repair, maintenance, or replacement of the stormwater infrastructure shall be the sole responsibility of the property owner.

3.0 Maintenance Responsibility

Maintenance of drainage facilities is generally the responsibility of the entity owning the facility. Maintenance responsibilities may be further clarified in other legally binding documents such as recorded final plats, recorded paper easements and subdivision covenants. Additionally, information regarding how the facility is to be maintained may be found in the original construction documents and approved operation and maintenance plan and agreement.

3.1 Subdivisions

Generally, all drainage facilities in new subdivisions that are outside the public right-of-way shall be maintained by a property owners association or the property owner. Larger facilities within a subdivision, such as detention basins, channels, and large boxes and pipes, shall be located within a Common Area that is owned and maintained by the association. The following statement shall be placed on all final plats:

> *All Common Areas shall be considered drainage easements. All Common Areas are to be maintained by the property owners association. All drainage easements are to be maintained by the property owner.*

Subdivision covenants establishing the property owners association and giving it the responsibility and authority to collect the necessary fees to properly maintain common areas and drainage facilities must be accepted and recorded through the Department of Planning and Development. City Code Chapter 36 Land Development Code identifies requirements for common area

maintenance in subdivision covenants or other legal documents. Subdivision covenants are required to include specific language regarding maintenance, including the right of the City to intercede and maintain common areas and recover costs associated with such maintenance.

Smaller facilities within a subdivision, such as small pipes and swales, are typically within a drainage easement maintained by the property owner. Generally, for facilities maintained by individual homeowners, the property owner must maintain the surface (trash pickup, mowing, minor erosion repair), and the City will correct major deficiencies such as structural failure of a box, pipe or wall, or a major erosion problem.

If the party with primary responsibility fails to properly maintain any drainage facility and the City has notified the party of the deficiency, the City shall have the right to enter the property in order to maintain the facility and charge the primary responsible party for any costs associated with the work.

3.2 Existing Facilities with No Easement

Existing drainage facilities that are not within a drainage easement shall be maintained by the property owner. On major waterways where it is determined the City has a prescriptive easement, the City may conduct maintenance in the form of brush or tree removal, removal of large amounts of debris or sediment, stream stabilization, or structural repairs. Maintenance may be conducted to maintain flow capacity, reduce pollution and sediment into the waterway, and maintain the safety, health and welfare of the public.

If a drainage easement does not exist, the responsibility to maintain the facility falls to the property owner. The City may accept an easement from the property owner or assume maintenance responsibility through a prescriptive easement. In any case, minor maintenance of the surface, including mowing and trash pickup, is the responsibility of the property owner.

3.3 Major Drainage Facilities

Major drainage facilities include large channels, detention basins, hydraulic structures, and culverts. Sections 3.3.1 through 3.3.3 provide key maintenance requirements for each of these.

3.3.1 Major Channels and Floodplain

Major drainage channels may be natural or constructed. Natural channels and their floodplains may consist of grass, trees, roots and other vegetation, cobble, boulders, bedrock, soil or other natural materials. Constructed channels may consist of grass, concrete, riprap, blocks or other materials. Maintenance requirements for each channel type are discussed below.

3.3.1.1 Natural Channels

Maintenance of natural channels and their floodplains should be conducted with great care. Natural channels can be dynamic in nature, and it can be difficult to predict how they will respond to changes made to them. In areas where the entire floodplain has been preserved as open space, natural channels can generally be left to move and change. Maintenance intervention may be necessary in cases where debris, sediment or channel movement is threatening the integrity of a structure, causing a potential flood hazard, or causing excessive erosion or stream degradation. In

areas where development has encroached into floodplains or is near a natural channel, the channel and floodplain should be kept clear of debris, structures, fill, fences and other potential blockages. Excessive vegetation growth should be controlled to maintain channel capacity and prevent damage to adjacent properties. See Chapter 8 for information regarding maintenance of stream buffer areas. See Section 3.5 below for additional information regarding vegetation management.

3.3.1.2 Constructed Channels

Maintenance of constructed channels must include maintaining the original design capacity and structural integrity of the channel. The channel capacity should never be decreased by maintenance activities unless a thorough engineering study has concluded the action is acceptable. Maintenance of concrete channels can include sediment removal, structural and sub-grade repairs and vegetation control. See Section 3.5 below for additional information regarding vegetation management.

3.3.2 Enclosed Systems and Culverts

Box culverts and pipes shall be kept clear of debris and sediment. Any removed debris or sediment shall be hauled from the site rather than placed in the drainage system. Flushing shall be completed only when limited access makes it absolutely necessary. Any structural deficiencies such as cracked or damaged concrete shall be reported to the Department of Public Works and corrected with the assistance of a qualified engineer.

3.3.3 Detention Basins

Detention storage includes dry detention, extended detention, and wet detention ponds. The following maintenance measures shall be implemented on all detention basins:

- Storage volume in basins must be preserved through regular maintenance and removal of sediment. Sediment should be removed and the basin returned to design grades when either a sediment depth of 6 inches exists or more than 10 percent of the design volume has been lost. Sediment removal in wet ponds requires draining of the pond.
- The storage area and outlet structure shall be inspected to ensure that they are functional, free from debris and have no structural deficiencies in need of repair.
- Erosion of riprap, vegetation or soil, particularly near discharge pipes into the basin, shall be repaired and restored to the original design.
- Vegetation and aesthetic features including fences, shrubs, trees, native grasses, and water quality vegetation shall be maintained to function and provide safety to the public. See Section 3.5 for mowing and vegetation requirements.
- Basins should be inspected on an annual basis. Additional periodic inspections should be made, particularly after rainfall events, to ensure the basin meets the requirements of this chapter and is functional.
- Seed and mulch, sod, or other necessary erosion and sediment control best management practices (BMPs) shall be placed immediately after any excavation or grading is complete to minimize erosion and discharge of sediment to the drainage system.

- Routine maintenance to return a facility to its intended designed condition may be conducted without specific permission by the City. Modified designs shall be submitted to the Department of Public Works for approval.

3.3.4 Hydraulic Structures

Maintenance of hydraulic structures, including riprap, grade control structures, or any other structures in the drainage system, may include the following:

- Removal of debris, excessive vegetation, and excessive sediment.
- Replacing riprap or boulders and repairing grout and concrete.
- Inspecting adjacent banks and structures for erosion damage and repairing, as needed.
- Repairing guardrails and fences, as needed.

3.4 Water Quality SCMs

Water quality SCMs are designed to reduce and/or treat runoff to reduce stormwater pollutant loads and therefore may require higher levels of maintenance to serve their designed functions. An operation and maintenance plan and agreement shall be submitted for approval by the City for all SCMs required to meet the water quality requirements in Chapter 10. The operation and maintenance plan and agreement shall meet requirements set forth by the Director of Environmental Services (Director) and shall be recorded with the Greene County Recorder of Deeds. In order to ensure the long-term operation and maintenance of SCMs, the property owner shall conduct annual self-inspections of the SCMs and reporting of these inspections in accordance with schedules, inspection forms, and reporting procedures set forth by the Director. Deficiencies identified through self-inspections or inspections by the City shall be addressed in a timely manner.

3.5 Mowing and Vegetation Management

Property within the City is required to be mowed and maintained to meet the City Code, Section 74-401 *et. seq*. that states grass heights cannot exceed 12 inches. Facilities that incorporate vegetation with heights greater than 12 inches for water quality or other beneficial purposes are allowed, provided that the vegetation does not cause a nuisance or threat to the public health, safety, or welfare.

EXHIBIT B

Chapter 96 STORM WATER[1]

ARTICLE I. FLOOD CONTROL AND WATER QUALITY PROTECTION

DIVISION 1. GENERAL PROVISIONS

Sec. 96-4. Enforcement.

The director may exercise any of the following enforcement powers as may be necessary to effectively implement and enforce this article:

(1) *Violations deemed a public nuisance.* In addition to the penalties provided in section 96-5, any condition caused or permitted to exist in violation of any of the provisions of this article is a threat to the public health, safety or welfare and is hereby declared a public nuisance.

(2) *Notice of violation (NOV).* Whenever the director finds that any person has violated or is violating this article, or any permit, or order issued hereunder, the director may serve, by personal service, or by registered or certified mail, upon said person a written NOV. The NOV shall specify the deficiencies, what corrective action is necessary, and a specific time frame in which the responsible party is to achieve compliance. Within ten business days after the deadline established by the director, the responsible party shall submit to the director a letter certifying that the required corrective action has been taken. Submission of this certification shall in no way relieve the person of liabilities for violations occurring before or after receipt of the NOV. Nothing in this section shall limit the authority of the city to take any action, including emergency actions or any other enforcement action without first issuing a notice of violation.

(3) *Stop work order.*

a. *Delivery of order.* All stop work orders that are issued by the director must be posted on the property on which the violation is taking place. All stop work orders posted in this manner shall be considered validly delivered. It shall be the responsibility of the owner to ensure that no violation of this article occurs on their property.

b. *Contents of order.* Stop work orders shall specifically state the provisions of this article, permit, or order being violated.

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[1]Editor's note(s)—G.O. No. 6445, § 1, adopted April 9, 2018, amended chapter 96 in its entirety to read as herein set out. Formerly, chapter 96, articles I—IV, pertained to similar subject matter and derived from G.O. No. 5130, § 1, adopted October 29, 2001; G.O. No. 5383, § 1, adopted June 21, 2004; G.O. No. 6002, § 1, adopted June 4, 2012; G.O. No. 6226, §§ 10—17, adopted September 14, 2015, and G.O. No. 6415, § 1, adopted December 11, 2017.

G.O. No. 6329, § 1, Exhibits B and C, adopted January 9, 2017, contains a schedule of fees and charges for various departments of the city. A complete copy of said schedule is adopted by reference and available at the office of the city clerk for inspection by the public.

c. *Effect of order.* Issuance of a stop work order shall result in the immediate suspension of all construction activity on the property, except for work related to remediation of the violation, until the violation is resolved to the director's satisfaction. The stop work order shall also suspend the right of the permittee, applicant, owner, contractor, developer or any related entity to build or construct any structure or public improvement on any portion of the property. It shall be unlawful for any person or responsible party to fail to comply with a stop work order. The director and the director of building development services, upon issuance of a stop work order, are authorized to suspend the issuance of building permits and occupancy permits for structures on any portion of the property, terminate utility services to the property, and to suspend all inspections and plan review related to any other work that is taking place on the property, until such time as the violation is resolved to the director's satisfaction.

d. *Failure to comply with order.* Any person who shall continue any work on the property after having been served with a stop work order, except such work related to remediation of the violation, shall be subject to penalties as specified in section 96-5.

e. *Lifting of stop work order.* Said stop work order may be lifted when the violation alleged in the stop work order has been addressed to the director's satisfaction.

(4) *Summons.* If the responsible party fails to comply with a NOV, stop work order, or there is no immediate settlement, a summons to court may be issued to the responsible party. The summons to court shall contain all the information required by the City Code and will be enforced and issued through the municipal court. The director shall have the option of causing a summons to municipal court to be issued immediately upon discovery of a violation, in lieu of a NOV.

(~~4)~~5) *Abatement.*

a. Police officers, and other employees of the city authorized by the city manager, or the chief of police are hereby authorized ~~and required~~ to enter ~~go,~~ in the daytime, in and upon any house, building, lot or premises, whether public or private, for the purpose of removing or abating any nuisance, when abatement of a nuisance is ordered under the provisions of this article.

b. If a violation has not been corrected pursuant to the requirements set forth in the notice of violation, or in the event of an appeal, within 15 days of the decision of the hearing officer, then the hearing officer shall make an order authorizing the city to abate such nuisance. The abatement shall be subject to appropriated and unencumbered funds being available to perform the abatement. In addition to the city physically abating the nuisance, the city may seek abatement through injunctive relief or any other available legal remedy.

(~~5~~6) *Costs of abatement.* Whenever the city abates a nuisance under the provisions of this article, the owner of the property at the time the nuisance was abated shall be personally liable to the city for the cost of the abatement, which shall be a lien upon the tract of land where the nuisance was abated until paid in full.

(G.O. No. 6445, § 1, 4-9-2018)

DIVISION 2. STORMWATER INFRASTRUCTURE DESIGN, OPERATION, AND MAINTENANCE

Sec. 96-10. Flood control and water quality protection manual.

~~The flood control and water quality protection manual, a copy of which shall be on file in the office of the city clerk, is hereby adopted.~~ Development of property subject to chapter 36 of the land development code and land disturbance activity subject to chapter 96 article III shall comply with the Flood Control and Water Quality Protection M~~m~~anual, which shall be on file in the office of the city clerk. Where any provision of the manual differs from any provision of this chapter, the manual shall control.

(G.O. No. 6445, § 1, 4-9-2018)

DIVISION 4. STREAM BUFFERS

Sec. 96-22. Scope and authority.

This division applies to streams shown on the stream buffer map for all new applications for land disturbance permits, building permits requiring site plan review, floodplain development permits, public improvements, preliminary plats, subdivisions, and zoning cases with the exception of those streams that have been previously enclosed or converted to an engineered channel as stated in the flood control and water quality protection manual. This division shall also apply to streams located on properties which are annexed after the adoption of the stream buffer map, and have not been added to said stream buffer map, but have a contributing drainage area of 40 acres or greater in accordance with the flood control and water quality protection manual, for all new applications as those listed above. The provisions in this division shall be administered and enforced by the director of public works.

(G.O. No. 6445, § 1, 4-9-2018)

ARTICLE III. LAND DISTURBANCE ACTIVITY

Sec. 96-49. ~~Security requirement.~~ Permit duration and termination.

(a) *Permits issued until termination.* Land disturbance permits for a full plan submittal of architectural and civil site improvements shall be issued and valid until termination standards set forth by the director and located in the BMP manual are met in accordance with subsection 96-49(c).

(b) *Permits issued with limited duration.* Stand-alone permits for land disturbance only or permits for phased submittal of civil site improvements only shall be issued for 180 calendar days and can be renewed for an additional 180 calendar days if active land disturbance is ongoing or additional plans are submitted by the expiration date. If additional plans are not approved within 180 calendar days of submittal, the permit shall terminate.

(c) *Permit termination.* The responsible party shall meet termination standards set forth in the BMP manual within 30 days of demobilization and shall request permit termination from the city. Demobilization can include removal of all contractor and subcontractor personnel, supplies, materials, rubbish, temporary facilities, and construction equipment.

(G.O. No. 6445, § 1, 4-9-2018; G.O. No. 6671, § 1, 7-26-2021)

Sec. 96-50. Failure to comply.

Enforcement of this article shall be the responsibility of the department. The party or parties responsible and liable for actions or non-action in ~~regards~~regard to this article, including responsibility for abating violations of this article, shall be the property owner or person authorized to act on the property owner's behalf; or any person allowing, causing or contributing to a violation of this article.

(1) *Finding of non-compliance.* If an investigation or inspection results in a finding of noncompliance with this article, the director is authorized to issue a notice of violation (NOV) that may, at the discretion of the director, include a stop work order. The NOV shall specify the deficiencies, what corrective action is necessary, and a specific timeframe in which the responsible party is to achieve compliance. The written NOV, including a stop work order as applicable, shall be mailed, postage pre-paid, or hand-delivered to both the permittee and owner. Failure to comply with a notice from the director shall result in the issuance of a stop work order.

(2) *Stop work order.*

a. *Delivery of order.* All stop work orders that are issued by the director must be posted on the site on which the land disturbance activity is taking place, and in reasonable proximity to a location where the land disturbance activity is taking place. All stop work orders posted in this manner shall be considered validly delivered. It shall be the responsibility of the owner to ensure that no violation of this article occurs on his/her property.

b. *Contents of order.* Stop work orders shall specifically state the provisions of this article or the land disturbance permit being violated.

c. *Effect of order.* Issuance of a stop work order shall result in a suspension of all construction activity on the site, except for work related to remediation of the violation, until the violation is resolved to the city's satisfaction. The stop work order shall also suspend the right of the permittee, applicant, owner, contractor, developer or any related entity to build or construct any structure or public improvement on any portion of the site. It shall be unlawful for any person or responsible party to fail to comply with a stop work order. The director and the director of building development services, upon issuance of a stop work order, are authorized to suspend the issuance of building permits and occupancy permits for structures on any portion of the site, terminate utility services to the site, and to suspend all inspections and plan review related to any other work that is taking place on the site, until such time as the violation is resolved to the city's satisfaction.

d. *Failure to comply with order.* Any person, who shall continue any work in or about the site after having been served with a stop work order, except such work related to remediation of the violation, shall be subject to penalties as specified in section 96-52.

e. *Lifting of stop work order.* Said stop work order may be lifted upon the presentation and construction of an accepted plan to avoid sediment runoff and the removal of any such sediment as ordered.

(3) *Summons.* If the responsible party fails to comply with an NOV, stop work order, or there is no immediate settlement, a summons to court may be issued to the responsible party. The summons to court shall contain all the information required by the City Code and will be enforced and issued through the municipal court. The director shall have the option of causing a summons to municipal court to be issued immediately upon discovery of a violation, in lieu of a NOV.

(4) *Violations deemed a public nuisance.* In addition to the penalties provided in section 96-52, any condition caused or permitted to exist in violation of any of the provisions of this article is a threat to the public health, safety, or welfare and is hereby declared a public nuisance.

(5) *Abatement.*

a. Police officers, and other employees of the city authorized by the city manager, or the chief of police are hereby authorized ~~and required~~ to enter ~~go,~~ in the daytime, in and upon any house, building, lot or premises, whether public or private, for the purpose of removing or abating any nuisance, when abatement of a nuisance is ordered under the provisions of this article.

b. If a violation has not been corrected pursuant to the requirements set forth in the notice of violation, or in the event of an appeal, within 15 days of the decision of the hearing officer, then the hearing officer shall make an order authorizing the city to abate such nuisance. The abatement shall be subject to appropriated and unencumbered funds being available to perform the abatement. In addition to the city physically abating the nuisance, the city may seek abatement through injunctive relief or any other available legal remedy.

(6) *Costs of abatement.* Whenever the city abates a nuisance under the provisions of this article, the owner of the property at the time the nuisance was abated shall be personally liable to the city for the cost of the abatement, which shall be a lien upon the tract of land where the nuisance was abated until paid in full.

(G.O. No. 6445, § 1, 4-9-2018; G.O. No. 6671, § 1, 7-26-2021)

One-rdg. _____
P. Hrngs. _____
Pgs. 14
Filed: 03-15-22

Sponsored by: McGull

First Reading: _____ Second Reading: _____

COUNCIL BILL 2022-074 GENERAL ORDINANCE _____

AN ORDINANCE

AMENDING the Springfield Land Development Code, Article III, 'Zoning Regulations,' Division 5, 'Supplemental District Regulations,' Section 36-472, 'Stream Buffers.' (Staff and Planning and Zoning Commission both recommend approval.)

WHEREAS, the Department of Environmental Services is proposing changes to the Flood Control and Water Quality Protection Manual, including a new water quality requirement for redevelopment sites; and

WHEREAS, the existing City Code Section 36-472 allows applicants to seek Administrative Review Committee ("ARC") approval to increase building height or decrease off-street parking requirements in direct proportion to the area being used to preserve a stream buffer; and

WHEREAS, the amendments to Section 36-472 set forth below will also allow applicants to seek ARC approval to decrease off-street parking requirements on redevelopment sites that are required to meet water quality standards; and

WHEREAS, the amendments to Section 36-472 further clarify that a building height increase is limited to a one-story increase and that the building height increase cannot exceed density requirements; and

WHEREAS, on February 10, 2022, the Planning and Zoning Commission initiated amendments to Section 36-472, 'Stream Buffers'; and

WHEREAS, the Planning and Zoning Commission reviewed the proposed amendments to Section 36-472 'Stream Buffers' at the March 10, 2022 meeting, and after a public hearing, recommended approval of the proposed changes; and

WHEREAS, proper notice was given of a public hearing before City Council, and said hearing was held in accordance with law.

NOW, THEREFORE, BE IT ORDAINED BY THE COUNCIL OF THE CITY OF SPRINGFIELD, MISSOURI, as follows, that:

Section 1 – The Springfield Land Development Code, Article III, 'Zoning Regulations,' Division 5, 'Supplemental District Regulations,' Section 36-472, 'Stream Buffers,' is hereby amended as set forth in "Exhibit B - Attachment 2," which is attached hereto and incorporated herein by this reference as if set forth verbatim. The unmarked version of the revised Section 36-472 is set forth in "Exhibit B - Attachment 3," which is attached hereto and incorporated herein by this reference as if set forth verbatim.

Section 2 – Savings Clause. Nothing in this Ordinance shall be construed to affect any suit or proceeding now pending in any court, or any rights acquired or liability incurred, nor any cause or causes of action accrued or existing, under any act or ordinance repealed hereby, or shall any right or remedy of any character be lost, impaired, or affected by this Ordinance.

Section 3 – Severability Clause. If any section, subsection, sentence, clause, or phrase of this Ordinance is for any reason held to be invalid, such decision shall not affect the validity of the remaining portions of this Ordinance. City Council hereby declares that it would have adopted the Ordinance and each section, subsection, sentence, clause, or phrase thereof, irrespective of the fact that any one or more sections, subsections, sentences, clauses, or phrases be declared invalid.

Section 4 – This Ordinance shall be in full force and effect as of the date of passage.

Passed at meeting: _____

_____
Mayor

Attest: _____, City Clerk

Filed as Ordinance: _____

Approved as to form: Jill Burris, Assistant City Attorney

Approved for Council action: Jason A. Gage, City Manager

EXPLANATION TO COUNCIL BILL 2022 -074

FILED: 03-15-22

ORIGINATING DEPARTMENT: Planning and Development and Environmental Services

PURPOSE: An amendment to the Springfield Land Development Code, Article III, 'Zoning Regulations,' Division 5, 'Supplemental District Regulations,' Section 36-472, 'Stream Buffers,' to provide flexibility for a reduced parking requirement, subject to approval of the Administrative Review Committee, when necessary to meet water quality standards for redevelopment sites, as defined in proposed changes to the Flood Control and Water Quality Protection Manual.

BACKGROUND INFORMATION:

ZONING ORDINANCE TEXT AMENDMENT – STREAM BUFFER AND WATER QUALITY AMENDMENTS

Planning and Zoning Commission initiated amendments to Section 36-472, Stream Buffers, on February 10, 2022.

Section 36-472 currently allows applicants to seek ARC approval to decrease parking in direct proportion to the area that is being used to preserve a stream buffer. The proposed amendment will provide the same tool for requesting a parking reduction on redevelopment sites, as defined in the Flood Control and Water Quality Protection Manual, that are required to meet water quality standards. In instances when meeting the water quality requirement on a redevelopment site is otherwise infeasible, this amendment will allow an applicant to seek ARC approval for a reduction in parking in direct proportion to the area needed in order to make the water quality requirement feasible.

The Department of Environmental Services is proposing changes to the Flood Control and Water Quality Protection Manual that will be presented to City Council for consideration separate from this zoning amendment. These changes include a new water quality requirement for redevelopment sites. Redevelopment, as defined in the manual, means alterations of a property that remove and replace existing impervious surface in such a way that results in the disturbance of 1 or more acres of land and the existing impervious area within the project limits of disturbance equals or exceeds 40 percent.

During the stakeholder input process for the proposed water quality requirement for redevelopment, comments were received requesting flexibility for reduced parking on redevelopment sites required to meet water quality. The amendment to Section 36-472 is proposed in response to this stakeholder input. The amendment language for calculating the area that is directly proportional to the reduction in parking is based on the size of one parking stall, which has an area of 167 square feet.

The amendment also makes changes to the existing language regarding when a

building height increase could be approved for sites with a stream buffer by clarifying that the building height increase can not exceed density requirements and limiting it to a one-story increase.

Before an amendment shall be approved by ordinance, the Planning and Zoning Commission shall have first had a public hearing regarding the proposed amendment and made an official report to the City Council regarding the Planning and Zoning Commission's recommendation regarding said amendment. Once the Planning and Zoning Commission has made its official report, any further review by the Planning and Zoning Commission shall not be required unless City Council elects to refer a matter back to the Planning and Zoning Commission for further review.

The Growth and Development Advisory Council ("GDAC"), Downtown Springfield Association ("DSA"), Commercial Club, Environmental Advisory Board, Stormwater Technical Committee, and all Registered Neighborhood Associations were notified of these amendments.

FINDINGS FOR STAFF RECOMMENDATION:

1. The proposed amendment to Section 36-472 will provide flexibility, if needed, in meeting zoning requirements for parking on redevelopment sites, as defined in the Flood Control and Water Quality Protection Manual, that are required to meet water quality standards.

REMARKS:

The Planning and Zoning Commission held a public hearing on March 10, 2022, and recommended approval, by a vote of 7 to 0, of the proposed changes to the Zoning Ordinance.

The Planning and Development staff recommends approval of the proposed amendments.

Submitted by:

Daniel Neal, Senior Planner

Recommended by:

Susan Istenes, Director

Errin Kemper, Director
Environmental Services

Approved by:

Jason Gage, City Manager

EXHIBITS:
Exhibit A, Record of Proceedings
Exhibit B, Development Review Staff Report
ATTACHMENTS:
Attachment 1, Department Comments
Attachment 2, Proposed Amendments
Attachment 3, Citizen Correspondence
Attachment 4, Neighborhood Correspondence

EXHIBIT A

RECORD OF PROCEEDINGS
Planning and Zoning Commission – March 10, 2022

Stream Buffer and Water Quality Amendments
Citywide
Applicant: City of Springfield

Ms. Carrie Lamb states that this is a request to Amend Section 36-472, Stream Buffers. The proposed amendment will modify the Zoning Ordinance Section 36-472 to allow an applicant to seek approval of the Administrative Review Committee (ARC) for a reduction in the parking requirement when necessary to make it feasible to meet the water quality standards for redevelopment. The Department of Environmental Services is proposing a new water quality requirement for redevelopment sites that will be presented to City Council separate from this zoning amendment. During the stakeholder input process for the proposed water quality requirement for redevelopment, comments were received requesting flexibility for reduced parking on redevelopment sites. The proposed amendment is in response to this stakeholder input. Section 36-472 currently allows an applicant to seek ARC approval for a reduction in the parking requirement for sites required to meet stream buffer standards. This amendment will provide the same tool for requesting a parking reduction on redevelopment sites required to meet water quality standards. Parking area may be reduced in direct proportion to the area that is being used for the stream buffer and/or water quality stormwater control measure for redevelopment, not to exceed a twenty (20) percent reduction in required parking. For every 167 square foot area of stream buffer or water quality stormwater control measure, a reduction of one parking space will be allowed. This measurement is based on the size of one parking stall, which has an area of 167 square feet. The proposed amendment also makes changes to the existing language regarding when a building height increase could be approved for sites with a stream buffer by clarifying that the building height increase cannot exceed density requirements and limiting it to a one-story increase. The Growth & Development Advisory Council, Downtown Springfield Association, Commercial Club, all Registered Neighborhood Associations, the Stormwater Technical Committee, and the Environmental Advisory Board were notified of this amendment and public hearing dates. Water quality protection is consistent with the Comprehensive Plan. The proposed amendment supports water quality protection by providing a tool to assist applicants in meeting water quality requirements on redevelopment sites.

PROPOSED AMENDMENTS UNDERLINED

Note: Language to be added is underlined, language to be deleted is ~~stricken~~.

Sec. 36-472. Stream buffers and water quality.

Stream buffers and water quality stormwater control measures may be used for open space and/or bufferyards when they exist in the same location and are in conformity with chapter 36 open space and bufferyard standards and chapter 96 stream buffer and water quality standards. In the event the minimum requirements of chapter 96 [of the Springfield Code of Ordinances] stream buffer standards, or water quality standards for redevelopment sites, as defined in the Flood Control and Water Quality Protection Manual, are otherwise infeasible on a proposed site plan ~~without reducing parking below the minimum requirement or increasing maximum building height~~, the lot will be considered conforming if approved by the administrative review committee ("ARC") using the following design requirements. ~~Stream buffers may be used or substituted for open space and/or bufferyards when they exist in the same location as approved by ARC and in conformity with chapter 96 stream buffer standards.~~

(a) Design requirements.

1. For stream buffer standards only, t ~~T~~he height of buildings may be increased above maximum height restrictions for the district provided it does not exceed any required bulk plane restriction or density requirement. ~~The height may be increased~~ Additional building square footage/floor area is allowed in building height in direct proportion to the area (square footage) that is being used for the stream buffer, provided the height is not increased more than one storyabove the required height limit, or

2. ~~An o~~ Off-street parking area may be reduced ~~requirement reduction may be allowed up to 20 percent. The off-street parking can be decreased~~ in direct proportion to the area that is being used for the stream buffer and/or water quality stormwater control measure for redevelopment, not to exceed a twenty (20) percent reduction in required parking. For every 167 square foot area of stream buffer or water quality stormwater control measure, a reduction of one parking space will be allowed.

Staff recommends approval.

Mr. Colony asked if the buildings will be allowed to exceed (existing) bulk plane or setback requirements and if the water quality standard improves.

Mr. Hosmer noted that it would not be allowed, and Ms. Lamb noted several situations where this would provide the parking to

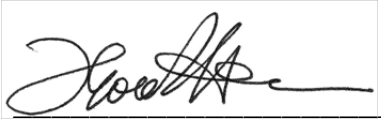
be reduced the space and it will not impact water quality.

Mr. Doennig opened the public hearing.

No speakers.

Mr. Doennig closed the public hearing.

COMMISSION ACTION:
Mr. Colony motioned to recommend **approval** for Stream Buffer and Water Quality Amendments (Citywide) as presented by staff. Ms. Bruce seconded the motion. Ayes: Doennig, Coltrin, Knuckles, Colony, Bruce, Jobe, and Lebeck. Nays: None. Abstain: None. Absent: Broekhoven.

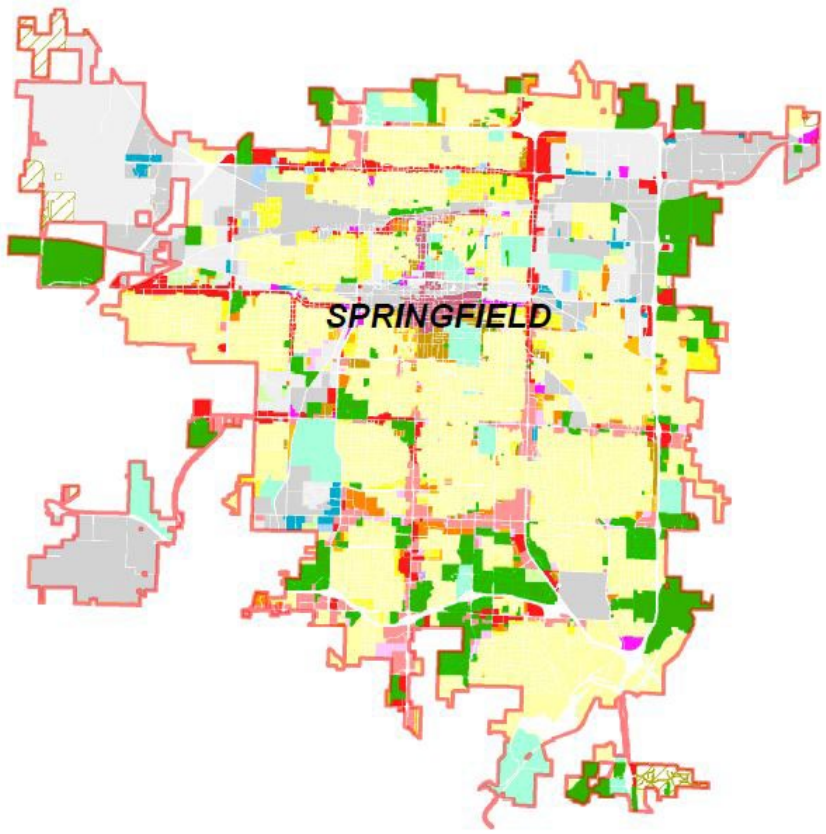


Bob Hosmer, AICP
Planning Manager

Exhibit B

Development Review Staff Report

PLANNING AND ZONING COMMISSION PUBLIC HEARING:	MARCH 10, 2022
CITY COUNCIL PUBLIC HEARING:	MARCH 21, 2022



CASE:
Stream Buffer and Water Quality Amendments

STAFF:
Carrie Lamb, 864-1996

STAFF RECOMMENDATIONS:
Approve

PROPOSED MOTION:
Move to approve the proposed amendments to the Zoning Ordinance as submitted in the staff report

SUMMARY OF REQUEST:

Staff is proposing amendments to Section 36-472., Stream buffers, to provide flexibility to request a reduction in the parking requirement from the Administrative Review Committee when necessary to make it feasible to meet the water quality standards for redevelopment, as defined in proposed changes to the Flood Control and Water Quality Protection Manual.

FINDINGS FOR STAFF RECOMMENDATION:

1. Section 36-472 currently allows applicants to seek ARC approval to decrease parking in direct proportion to the area that is being used to preserve a stream buffer.
2. The proposed amendment to Section 36-472 will provide the same tool for requesting a parking reduction on redevelopment sites, as defined in the Flood Control and Water Quality Protection Manual, that are required to meet water quality standards. In instances when meeting the water quality requirement on a redevelopment site is otherwise infeasible, this amendment will allow an applicant to seek ARC approval for a reduction in parking in direct proportion to the area needed to make meeting the water quality requirement feasible.
3. The Department of Environmental Services is proposing changes to the Flood Control and Water Quality Protection Manual that will be presented to City Council for consideration separate from this zoning amendment. These changes include a new water quality requirement for redevelopment sites. Redevelopment, as defined in the manual, means alterations of a property that remove and replace existing impervious surface in such a way that

results in the disturbance of 1 or more acres of land and the existing impervious area within the project limits of disturbance equals or exceeds 40 percent.

4. During the stakeholder input process for the proposed water quality requirement for redevelopment, comments were received requesting flexibility for reduced parking on redevelopment sites required to meet water quality. The amendment to Section 36-472 is proposed in response to this stakeholder input.
5. The amendment language for calculating the area that is directly proportional to the reduction in parking is based on the size of one parking stall, which has an area of 167 square feet.
6. The amendment also makes changes to the existing language regarding when a building height increase could be approved for sites with a stream buffer by clarifying that the building height increase can not exceed density requirements and limiting it to a one-story increase.

COMPATIBILITY WITH COMPREHENSIVE PLAN:

The need to protect water quality is consistent with the *Parks, Open Space, and Greenways Plan* and *Growth Management and Land Use Plan* elements of the City's *Comprehensive Plan.* This proposed zoning amendment supports water quality protection by providing a tool to assist property owners in meeting water quality requirements on redevelopment sites.

SUMMARY OF PROPOSED TEXT AMENDMENT:

1. Staff is requesting amendments to the Zoning Ordinance to amend subsection 36-472 to provide flexibility, if needed, in meeting zoning requirements for parking when there are water quality requirements for redevelopment sites. Requests for flexibility in meeting these zoning requirements would be subject to the approval of the Administrative Review Committee (ARC).

STAFF COMMENTS:

1. Over the past year, City staff worked with a Stormwater Technical Committee and solicited input from a broad range of stakeholder groups on a water quality requirement for redevelopment and other changes to the Flood Control and Water Quality Protection Manual. This proposed amendment to Section 36-472 is in response to stakeholder input.

2. Staff requests that Commission approve amendments to the Zoning Ordinance of the city code as specified.

PUBLIC COMMENTS:

The Springfield Chamber of Commerce Growth & Development Advisory Council, Downtown Springfield Association, Commercial Club, all Registered Neighborhood Associations, the Stormwater Technical Committee, and the Springfield-Greene County Environmental Advisory Board were notified of this amendment and public hearing dates.

DEPARTMENT COMMENTS:

ATTACHMENT 1
DEPARTMENT COMMENTS

BUILDING DEVELOPMENT SERVICES COMMENTS:

No issues.

PUBLIC WORKS TRAFFIC DIVISION COMMENTS:

No issues.

REQUIREMENTS FOR APPROVAL:

ATTACHMENT 2
PROPOSED AMENDMENTS REDLINED

Note: Language to be added is underlined, language to be deleted is ~~stricken~~.

Sec. 36-472. Stream buffers and water quality.

Stream buffers and water quality stormwater control measures may be used for open space and/or bufferyards when they exist in the same location and are in conformity with chapter 36 open space and bufferyard standards and chapter 96 stream buffer and water quality standards. In the event the minimum requirements of chapter 96 [of the Springfield Code of Ordinances] stream buffer standards, or water quality standards for redevelopment sites, as defined in the Flood Control and Water Quality Protection Manual, are otherwise infeasible on a proposed site plan ~~without reducing parking below the minimum requirement or increasing maximum building height~~, the lot will be considered conforming if approved by the administrative review committee ("ARC") using the following design requirements. ~~Stream buffers may be used or substituted for open space and/or bufferyards when they exist in the same location as approved by ARC and in conformity with chapter 96 stream buffer standards.~~

(a) *Design requirements.*

1. For stream buffer standards only, t~~T~~he height of buildings may be increased above maximum height restrictions for the district provided it does not exceed any required bulk plane restriction or density requirement. ~~The height may be increased~~ Additional building square footage/floor area is allowed in building height in direct proportion to the area (square footage) that is being used for the stream buffer, provided the height is not increased more than one story above the required height limit, or

2. ~~An o~~ Off-street parking area may be reduced ~~requirement reduction may be allowed up to 20 percent. The off-street parking can be decreased~~ in direct proportion to the area that is being used for the stream buffer and/or water quality stormwater control measure for redevelopment, not to exceed a twenty (20) percent reduction in required parking. For every 167 square foot area of stream buffer or water quality stormwater control measure, a reduction of one parking space will be allowed.

REQUIREMENTS FOR APPROVAL:

ATTACHMENT 3
PROPOSED AMENDMENTS FINAL CLEAN VERSION

Sec. 36-472. Stream buffers and water quality.

Stream buffers and water quality stormwater control measures may be used for open space and/or bufferyards when they exist in the same location and are in conformity with chapter 36 open space and bufferyard standards and chapter 96 stream buffer and water quality standards. In the event the minimum requirements of chapter 96 [of the Springfield Code of Ordinances] stream buffer standards, or water quality standards for redevelopment sites, as defined in the Flood Control and Water Quality Protection Manual, are otherwise infeasible on a proposed site plan, the lot will be considered conforming if approved by the administrative review committee ("ARC") using the following design requirements.

(a) *Design requirements.*

1. For stream buffer standards only, the height of buildings may be increased above maximum height restrictions for the district provided it does not exceed any required bulk plane restriction or density requirement. Additional building square footage/floor area is allowed in building height in direct proportion to the area (square footage) that is being used for the stream buffer, provided the height is not increased more than one story above the required height limit, or

2. Off-street parking area may be reduced in direct proportion to the area that is being used for the stream buffer and/or water quality stormwater control measure for redevelopment, not to exceed a twenty (20) percent reduction in required parking. For every 167 square foot area of stream buffer or water quality stormwater control measure, a reduction of one parking space will be allowed.

Attachment 4

From: Galloway Village
To: Neal, Daniel
Subject: Re: Comments Requested - Proposed Text Amendments to P&Z and CC
Date: Tuesday, March 8, 2022 9:48:47 PM

CAUTION This email originated from outside the organization. Do not open attachments or click links from sources you do not know and trust.

Galloway Village Neighborhood Association is opposed to these changes. They add exceptions to rules that already have too many exceptions and leave final review up to the ARC, which has little or no oversight. Springfield needs concrete protections on our unique natural resources, especially our streams and the areas that buffer them. Please do not make it even easier for developers to negatively affect the areas from which they are seeking to profit.

On Tue, Mar 1, 2022, 10:33 Neal, Daniel <dneal@springfieldmo.gov> wrote:

> Staff is proposing text amendments (attached) to the Zoning Ordinance at the Planning and Zoning Commission meeting on March 10, 2022, and City Council Meeting on March 21, 2022.
>
> Over the past year, City staff worked with a Stormwater Technical Committee and solicited input from a broad range of stakeholder groups on a water quality requirement for redevelopment and other changes to the Flood Control and Water Quality Protection Manual. This proposed amendment to Section 36-472 is in response to stakeholder input.
>
> Staff is requesting amendments to the Zoning Ordinance to amend subsection 36-472 to provide flexibility, if needed, in meeting zoning requirements for parking, building heights, and bufferyards when there are water quality requirements for redevelopment sites. Requests for flexibility in meeting these zoning requirements would be subject to the approval of the Administrative Review Committee (ARC).
>
> If you have any additional questions or concerns, please, feel free to contact me or our department. I would also appreciate it if you don't reply to all since I have a wide range of boards and citizens that have been notified and they may not want to participate in an e-mail chain discussion.
>
> **R. Daniel Neal**
> Senior Planner
> City of Springfield, Missouri
> Planning and Development Department
> Office: 417-864-1611
> Direct: 417-864-1036
> dneal@springfieldmo.gov

One-rdg. X
P. Hrngs. _____
Pgs. 21
Filed 03-29-22

Sponsored by: McGull

COUNCIL BILL 2022-076 RESOLUTION _____

A RESOLUTION

DESIGNATING the Calhoun Orchard Estate, located at 836 South Delaware Avenue, as a Historic Site on the Springfield Historic Register.

WHEREAS, Ryan and Elaine Jones, property owners, requested that the Landmarks Board nominate the Calhoun Orchard Estate, located at 836 South Delaware Avenue as a Historic Site, said nomination form attached hereto and incorporated herein as "Exhibit B," and provided a statement of historic significance with supporting photographs and citations, which are attached hereto and incorporated herein as "Exhibit C;" and

WHEREAS, the Landmarks Board, at their meeting on March 9, 2022, reviewed and recommended approval by a vote of 5 to 0 that the Calhoun Orchard Estate, located at 836 South Delaware Avenue, be nominated as a Historic Site, with the record of those proceedings attached hereto and incorporated herein as "Exhibit A."

NOW, THEREFORE, BE IT RESOLVED BY THE COUNCIL OF THE CITY OF SPRINGFIELD, MISSOURI as follows, that:

Section 1 – City Council hereby designates Calhoun Orchard Estate, located at 836 South Delaware Avenue, as a Historic Site on the Springfield Historic Register.

Section 2 – This Resolution shall be in effect from and after passage.

Passed at meeting: _____

_____
Mayor

Attest: _____, City Clerk

Filed as Resolution: _____

Approved as to form: _____, Assistant City Attorney

Approved for Council action: _____, City Manager

EXPLANATION TO COUNCIL BILL 2022-076

FILED: 03-29-22

ORIGINATING DEPARTMENT: Planning and Development

PURPOSE: To adopt a Resolution to designate the Calhoun Orchard Estate, located at 836 South Delaware Avenue, as a Historic Site on the Springfield Historic Register.

BACKGROUND INFORMATION:

Ryan and Elaine Jones, property owners, requested that the Landmarks Board initiate a Historic Site nomination of the property. The Landmarks Board initiated the nomination. Mr. Jones submitted the nomination form and provided a statement of historic significance with supporting historic narrative and photographs (see attached Historic Significance narrative).

The Landmarks Board, at their meeting on March 9, 2022, reviewed and recommended approval by a vote of 5 to 0, that the Calhoun Orchard Estate, located at 836 South Delaware Avenue be nominated as a Historic Site.

REMARKS: Passage of this resolution will designate the Calhoun Orchard Estate, located at 836 South Delaware Avenue, as a Historic Site on the Springfield Historic Register. Property designation as a Historic Site requires review by the Landmarks Board for any exterior alterations requiring a building permit or exterior material change. The permit shall not be issued unless the Landmarks Board approves a Certificate of Appropriateness. If the Landmarks Board denies an application for a Certificate of Appropriateness, the Department of Building Development Services shall not grant a building permit until the expiration of sixty (60) days from the date of the application for the Certificate of Appropriateness.

FINDINGS FOR LANDMARKS BOARD RECOMMENDATION:

1. The Landmarks Board determined that 836 South Delaware Avenue meets the criteria for being designated as a Historic Site, as detailed in the attached Historic Significance narrative.

2. The designation of 836 South Delaware Avenue as a Historic Site is consistent with the Landmarks Board's effort of nominating sites that exemplify a period of historical development in Springfield.

Submitted by:

Michael Sparlin

Michael Sparlin, Senior Planner

Recommended by:

Brendan Griesemer, AICP
Assistant Director

Approved by:

Jason Gage, City Manager

EXHIBITS:
Exhibit A, Record of Proceedings
Exhibit B, Nomination Form
Exhibit C, Historic Significance Narrative

EXHIBIT A

RECORD OF PROCEEDINGS
Landmarks Board – March 9, 2022

Local Historic Site Nomination Review
836 South Delaware Avenue

Mr. Michael Sparlin speaking on behalf of the owners, who couldn't attend the meeting due to work schedules, stated that the house at 836 and 836½ South Delaware were originally owned by the Calhoun family and stayed in the family for approximately 110 years. Alexander and Susie Calhoun married in 1877 and move to Springfield and owned Calhoun Buggy and Implement Company, located downtown Springfield. The Calhoun's started with 25 acres of farmland and used their house as a social center for the community and also served as a meeting area for the Pickwick Sewing Club and Springfield Little Theatre.

836 S. Delaware features both a large two-story farmhouse and smaller split level carriage house (836½) and the main feature of the Craftmans style farmhouse is the Carthage limestone that lines the large overhanging front porch, which is a characteristic of the Craftsman style.

What makes this notable is that the structure's is the masonry and very few houses in Rountree between Grand and Cherry have masonry. The floor plan in the farmhouse is classically Victorian and there is a large foyer, large front rooms, spartan kitchen with large pocket doors that close of the dining room and kitchen. The house features are perfect for entertaining.

The owners plan to apply for a short-term rental application for the carriage house. Listing in the Historic Register is a requirement for carriage houses to be used as short-term rentals.

Mr. Hunton opened the public hearing.

No speakers.

Mr. Hunton closed the public hearing.

Board Action: Mr. Hawkins motioned to **approve** Historic Site Nomination (836 South Delaware Avenue). Ms. Preston seconded the motion. The motioned carried as follows: Ayes: Hunton (Vice-Chair), Preston, Hawkins, Letterman, and Lenox. Nays: None. Abstain: None. Absent: Kaitlyn McConnell (Chair), Paul Lewis, and Kent Brown.

Michael Sparlin

Michael Sparlin, Senior Planner

EXHIBIT B

Springfield, Missouri Nomination Form for Designation of Historic Site, Historic Landmark, Interior Landmark, or Historic District

1. Current Property Owner

Name : Ryan & Elaine Jones

Address : 836 S. Delaware

Springfield, MO 65802

2. Title/Name of Property

Calhoun Orchard Estate

3. Location/Address of Property

836 S. Delaware

Springfield, MO 65802

4. Classification (circle all that apply)

Class	Ownership	Status	Accessibility
Historic site	Public	Occupied	yes : restricted
Historic Landmark	Private	Unoccupied	yes : unrestricted
Interior Landmark	Both	Work in progress	no
Historic District			

Present Use

Agriculture	Museum
Commercial	Park
Educational	Private residence
Entertainment	Religious
Government	Scientific
Industrial	Transportation
Military	Other:

5. Description

Condition	Check One	Check One
___ excellent	___ unaltered	✓ original site
✓ good	✓ altered	___ moved date: ____
___ fair		
___ deteriorated		
___ ruins		

If known, describe the original physical appearance. Describe the present physical appearance. Use a continuation page if necessary.

6. Significance

Date built : c. 1889

Builder/Architect : Unknown

Circle the number before each criterion below that applies to the nominated site, structure, object, or district. For criteria under number 13, circle the letter before each criterion that applies.

1. Has significant character, interest, or value as part of the city, region, state or nation's history;

2. Is associated with the life of a personality significant to the past.

3. Is the site of a historic event with a significant effect upon the development, heritage or cultural characteristics of the city, region, state, or nation.

4. Exemplifies the cultural, political, economic, social, or historic heritage of the community.

5. Portrays the environment in the era of history characterized by a distinctive architectural style.

6. Embodies distinguishing characteristics of an architectural type or engineering specimen.

7. Is the work of a designer, architect, or contractor whose individual work has influenced the development of the city, region, state, or nation.

8. Contains elements of design, detail, materials, or craftsmanship which represent a style unique to the past.

9. Is a part of, or related to, a square, park, or other distinctive area.

10. Represents an established and familiar visual feature of the neighborhood, community, or skyline, owing to its unique location or singular physical characteristics.

11. Is part of or related to a distinctive, geographical area which should be developed or preserved according to a plan based on cultural, historic or architectural motif.

12. Based upon physical evidence, has yielded, or is likely to yield, the integrity of information important to history or prehistory.

13. In addition, the Landmarks Board shall consider the site, structure, object, or district in light of its integrity of:

a. location,

b. design,

c. setting,

d. materials,

e. workmanship,

f. feeling,

g. association, and

h. its suitability for preservation and reuse.

Below, write every number and letter circled. Then, provide a narrative explaining why each circle is appropriate. For example, if there is a circle around criterion number 1, there should be a "1." followed by a narrative explaining the structure's character and how that character is significant to local, regional, state, or national history.

Attach all relevant photographs of the nomination (past and present).

7. Nomination by

Name : Ryan & Elaine Jones

Address : 836 S. Delaware

Springfield, MO 65802

8. Landmarks Board Approval

Date : _____

2. See attached.

8. See attached.

Friends of the Landmarks Board,

I, Ryan Jones, own and reside at 836 S. Delaware. I am seeking historic designation on this address for the purposes of its continued preservation and the development of its financial potential. If historic designation is indeed established, I plan to pursue Short Term Rental status next. I have read and understood the regulations of historic designation. I consent to those terms and whatever consequences may follow from them.

All the best,

Ryan R. Jones
3/6/2022
RYAN R. JONES

2. The houses at 836 and 836 ½ S. Delaware were originally owned by the Calhoun family and stayed in that family for roughly 110 years. Alexander and Susie Calhoun married in 1877 and moved to Springfield from Delaware and Missouri, respectively. Alexander owned Calhoun Buggy and Implement Company, located in downtown Springfield. He is described in one article as "a pioneer implement dealer of Springfield." The earliest record linking Alexander to the house on Delaware comes from an 1889 phone directory (see attached). The area being farmland at the time, the house was listed as being "2d s of Madison." The city would later develop Delaware street and assign the house its current address.

It should also be noted that the Calhouns started with 25 acres of farmland, for which Alexander paid taxes as early as 1894. In the 1900 census, Alexander listed himself as head of household with six children on site and, interestingly enough, a "farmer." As time progresses, one can see through tax records and maps that the Calhouns sold off more and more of the property until it shrunk to its present size. The cause of this was the growth of the Rountree neighborhood. This happened largely in the second and third decades of the 20th century.

The Calhouns used their house as a social center for the community. There are blurbs from the local newspaper announcing family visits, anniversary parties, etc. Perhaps more relevant, the house also served as a meeting area for the Pickwick Sewing Club and Springfield Little Theatre (see attached). Later, after Alexander's and Susie's deaths, the house was willed to their niece, Ms. Margaret "Maggie" Crighton. Maggie was an interesting and notable figure in her own right. She served as head librarian at Southwest Missouri State college (now MSU) for thirty years. She also hosted various gatherings at 836 S. Delaware, including informal groups of students, meetings for the sorority Sigma Sigma Sigma. and groups of professors.

As an aside, while I don't have the documentation to prove this, I wonder if Calhoun Street in Springfield is in any way linked to this particular Calhoun family. Being a pioneer and prominent family of the time, it seems probable.

8. 836 S. Delaware features both a large two-story farmhouse and a smaller split-level carriage house (836 ½). Perhaps the main feature of the Craftsman style farmhouse is the Carthage limestone. It lines the large overhanging front porch, which is also a characteristic of the Craftsman style popularized in the late 19th and early 20th centuries. Furthermore, there is a breezeway built onto the second floor on the backside of the house.

There is documentation stating that 828 and 842 S. Delaware were also owned by the Calhoun family until late 1960s. What makes this notable is that these four structures are some of the very few masonry houses in Rountree between Grand and Cherry.

The floor plan in the farmhouse is classically Victorian. There is a large foyer, large front rooms for entertaining, a Spartan kitchen, impressively large pocket doors that close off the dining room and kitchen, one bathroom on the second floor, and a large landing on the second floor. In other words, the house features large common spaces and small private spaces – a house perfectly suited for entertaining.

10-4-27

• • •

Alexander Calhoun of 836 Delaware is seriously ill and has been in bad health for the last year. In January he celebrated his fiftieth wedding anniversary. He is a pioneer implement dealer of Springfield and at one time had a large establishment in a big frame building where the Milligan Grocer company is now located. It furnished a spectacular fire one night.

Mr. Calhoun is also a pioneer of southeast Springfield and had a 25-acre farm along Pickwick street where some of the city's finest residences now stand.

• • •

10-4-27

• • •

Alexander Calhoun of 836 Delaware is seriously ill and has been in bad health for the last year. In January he celebrated his fiftieth wedding anniversary. He is a pioneer implement dealer of Springfield and at one time had a large establishment in a big frame building where the Milligan Grocer company is now located. It furnished a spectacular fire one night.

Mr. Calhoun is also a pioneer of southeast Springfield and had a 25-acre farm along Pickwick street where some of the city's finest residences now stand.

• • •

Announcements

Members of the Pickwick Sewing club will meet at 2:30 o'clock Friday afternoon at the home of Mrs. A. Calhoun, 836 South Delaware Avenue. Mrs. Walter Lines will be the assistant hostess.

Members of Junior Sorosis will hold their annual picnic at 10:30 o'clock Saturday morning at Doling park.

Daughters of Isabella will hold a social meeting tonight at their hall on Olive Street. Mrs. J. A. Koch is chairman of the social committee.

SO MUCH NICER

"Why does Mrs. Grumbine always go to the movies just as the picture is ending."

"She likes to know how it turns out, before she sees the main part of it?"

1-1-27

TODAY IS FIFTIETH WEDDING ANNIVERSARY OF THE CALHOUNS

Many Here From Out-of-Town for Celebration Dinner and Reception.

Today marks the fiftieth anniversary of the marriage of Mr. and Mrs. Alex Calhoun, 836 South Delaware avenue. The celebration took the form of a family dinner at noon, at which there were 31 guests, all of whom are members of the family or intimate friends of the elderly couple, and a reception from 4 to 8 this evening. Mr. Calhoun is 76 years of age and his wife is 72. They were married January 11, 1877, in Independence, Mo., and moved to this city in 1884, locating first on Benton avenue. Mr. Calhoun was for several years owner and president of the Calhoun Buggy and Implement company here. He was born in Concord, Del., and Mrs. Calhoun's birthplace is Independence. Seven children, three boys and four girls, all of whom are here to attend the celebration; 13 grandchildren and three great-grandchildren comprise the offspring of Mr. and Mrs. Calhoun. The children are: Mrs. George Crighton, David Calhoun, who is connected with the Ford Brass company, and Mary S. Calhoun, all of this city; Guy H. Calhoun, Walters, Okla.; L. M. Calhoun, Borger, Tex.; Mrs. Harry Nelson, Walker, Mo., and Mrs. P. H. Magnus, Pittsburgh, Pa.

Mr. and Mrs. Calhoun were remembered by their many friends with flowers and other gifts, the children and grandchildren presenting them with a purse of goldpieces. The house contained many baskets of flowers of various hues, and a long table for the 31 guests at noon. In the center was a massive cake iced in white and gold and bearing the names "Alex" and "Susie," and the dates, "1877" and "1927." Gold candles stood in glass holders.

Other honor guests at the golden wedding, besides the bride and bridegroom, were Mrs. E. C. Montgomery and Blue Springs, Mo, a cousin of Mrs. Calhoun, and Mr. T. W. Records of Independence are the only living guests who attended the wedding 50 years ago.

Mr. Calhoun is well known here on account of his activity in helping build up the southeast part of this city. The guests at the dinner were as follows: Mr. and Mrs. Guy Calhoun and children, Virginia and Harry, of Walters, Okla.; Mrs. Harry Nelson and Betty Jane of Walker, Mo.; Mr. and Mrs. P. H. Magnus and sons, Paul, Jr., and John, of Pittsburgh, Pa; Mr. L. M. Cauhoun, Borger, Tex.; Mr. and Mrs. C. B. Kelly and Lillian Louise, Mr. and Mrs. Joseph Crighton and children, George, Maurice, Mary, David, Betty Jane and Margaret; Mrs. C. H. Well and children, Susanna and Mary Margaret, all of Springfield; Rev. C. H. Briggs, formerly pastor of the St. Paul Methodist Episcopal church in which Mr. and Mrs. Calhoun have been active since their residence here, and Mrs. Montgomery and Mr. Records.

TOBER 11, 192

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1927

PIONEER RESIDENT OF CITY IS DEAD

Alexander Calhoun Expires at 77; Was Extensive Owner Of Property Here

Alexander Calhoun, 77 years old, retired business man and for many years a resident of Springfield, died at 5:45 o'clock yesterday evening at his home, 836 Delaware avenue, following a lingering illness.

He came to Springfield and engaged in business in 1885, opening an establishment on Water street near Robberson avenue, known as the Calhoun Buggy and Implement company. He was one of the first to realize the future possibilities of property in the southeast section of the city and acquired large holdings there.

He is survived by the widow, Mrs. Susie Calhoun; by four daughters, Mrs. George Crighton, Miss Mary Calhoun of Springfield, Mrs. H. R. Nelson of Walker, Mo., and Mrs. P. H. Magnus of Pittsburgh, Pa., and by three sons, Guy of Walters, Okla., D. E. of Springfield and L. M. Calhoun of Borger, Texas. He was a member of St. Paul Methodist church.

Funeral arrangements are incomplete but probably will be held Wednesday afternoon at the home. Burial will be under direction of the Herman H. Lohmeyer Funeral home.

VERNIE HILL

BENTON AND PHELPS AVE.
Telephone 254.
RING US UP FOR... ✳ FLOUR, FEED AND FUEL.

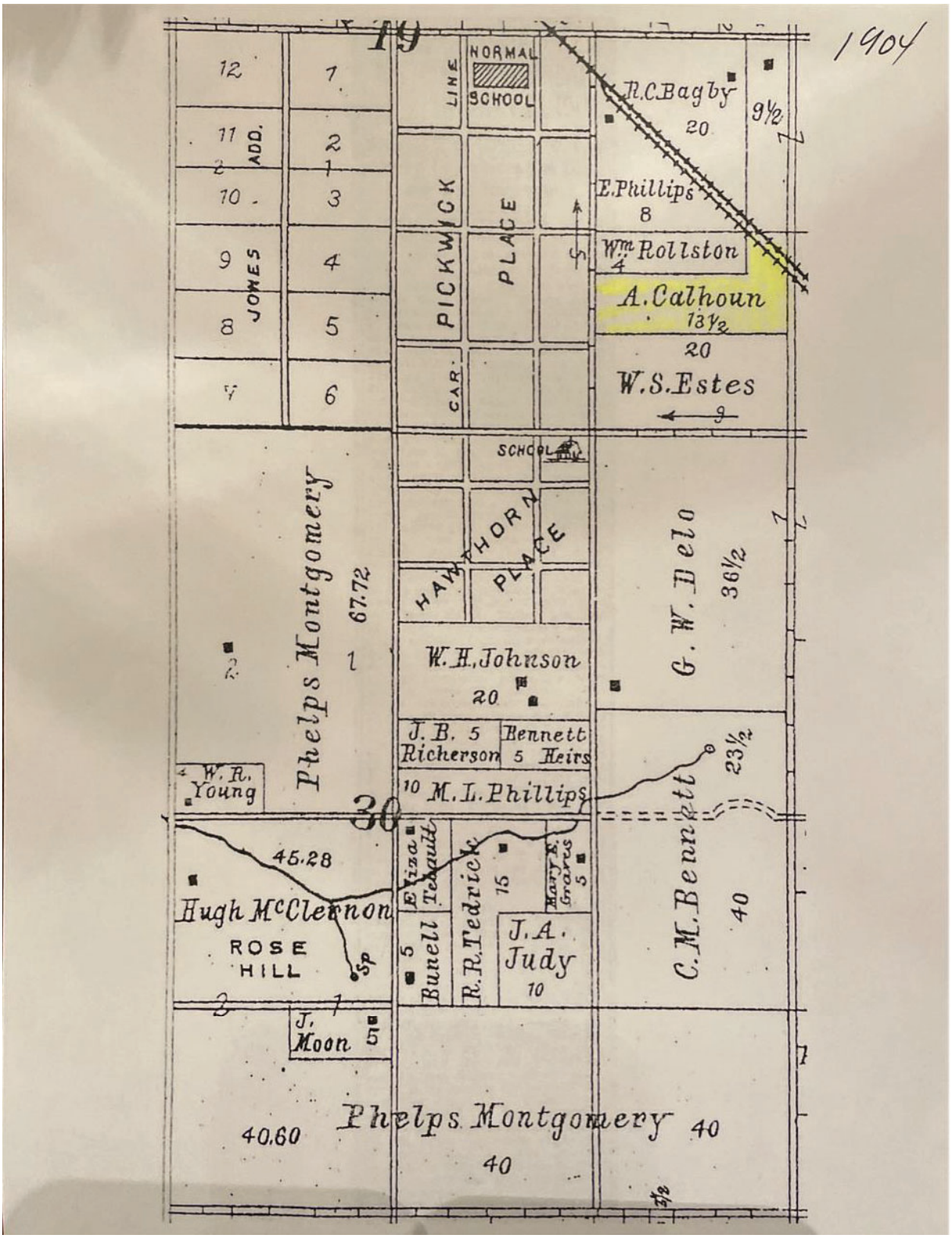
L. E. LINES, High Grade Pianos and Organs,
298-308 St. Louis. Tel. 225.

Cain Rob't, col'd blksmith Eddy F & M Co r 833 Wash'n
Cain's Thomas Cat (weekly), 328 Boonville, J M Cain pub
Caldwell Annie, cook Woman's Exch r 221 St Louis
Caldwell Geo. carp r 722 Prospect
Caldwell H. C. Judge U S Circuit Court, Federal bldg r Topeka, Kas
Caldwell Julian C. Rev. col'd pastor A M E Church r 510 e Center
Caldwell Lou, col'd cook 419 South
Caldwell Sam'l H. r 722 Prospect
Caldwell Tishia, col'd dom 419 South
Caldwell Wm. A. car rep St L & S F r 2141 Howard
Cale Geo. W. Jr. Dr. chief surgeon Employes' Hospital Ass'n of the Frisco Line, Broad se cor Atlantic r ws Douglas 2d s of High
Calhoun Alex. car rep J W Coombe r es Delaware 2d s of Madison
Calhoun Guy H. r es Delaware 2d s of Madison
Calhoun Kate Mrs. steno Spr Grocer Co r 603 w Walnut

R. M. STANCILL, ..Pure Drugs..
TEL. 64
223 SOUTH.

Calhoun Wm. T. wks Crescent Iron Wks r ws Fremont 5th s of

1889


1904
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NORMAL
SCHOOL
LINE
R.C.Bagby
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9½
E.Phillips
8
Wm Rollston
4
A.Calhoun
13½
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W.S.Estes
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6
JONES
ADD.
PICKWICK
PLACE
CAR.
SCHOOL
HAWTHORN
PLACE
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W.H.Johnson
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J.B. Richerson
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Bennett Heirs
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10 M.L.Phillips
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C.M.Bennett
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W.R. Young
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Hugh McClennon
ROSE HILL
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Eliza Tedault
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Bunell
R.R.Tedrick
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Mary E. Graves
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J.A. Judy
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J. Moon
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Phelps Montgomery
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1947

As Main Heir

Calhoun Will Lists Niece

The will of Miss Mary Sidney Calhoun, 82, of 836 South Delaware, longtime teacher who died recently, lists numerous bequests to relatives and names Margaret Crighton, of the home, a niece, her residuary heir.

Jewlery of various kinds is left to six nieces: Mary Madeline Reed St. Louis; Virginia Calhoun Johnson, Broken Bow, Okla.; Lillian Crighton Kelly, 1345 East Belmont; Betty Nelson Basseri, San Luis Obispo, Calif., Catherine Crighton Wells, Webb City, and Betty Crighton Amelon, Houston, Mo.

Miss Calhoun left her car and a half-interest in the home to Margaret Crighton. Property at 842 South Delaware is to be sold with half the proceeds going to Margaret Crighton and the other half to be divided among the following brothers and sisters: Guy Calhoun, Walters, Okla.; David Calhoun and Lindley Calhoun, both of 828 South Delaware; Myrtle Magnus, Pittsburgh, Pa., and Elizabeth Calhoun Nelson, Independence.

All the rest of the estate goes to Margaret Crighton.

One-rdg. _____
P. Hrngs. X
Pgs. 27
Filed: 03-29-22

Sponsored by: Simpson

First Reading: _____ Second Reading: _____

COUNCIL BILL 2022-077 GENERAL ORDINANCE _____

AN ORDINANCE

AMENDING the Springfield Land Development Code, Section 36-306, 'Official zoning map and rules for interpretation,' by rezoning approximately 10.23 acres of property generally located at 1616 East Bradford Parkway and 3811 and 3813 South Weller Avenue from Planned Development No. 117, 5th Amendment, and Planned Development No. 363 to Planned Development No. 379; and adopting an updated Official Zoning Map. (Planning and Zoning Commission and Staff recommend approval.)

WHEREAS, an application has been filed for a zoning change of the property generally located at 1616 East Bradford Parkway and 3811 and 3813 South Weller Avenue, and more fully described in "Exhibit A," from Planned Development No. 117, 5th Amendment, and Planned Development No. 363 to Planned Development No. 379; and

WHEREAS, following proper notice, a public hearing was held before the Planning and Zoning Commission on March 10, 2022, a copy of the Record of Proceedings from said public hearing being attached hereto and incorporated herein by this reference as "Exhibit B," and said Commission made its recommendation; and

WHEREAS, the City has reviewed the applicant's request and prepared a staff report concerning the application; and

WHEREAS, proper notice was given of a public hearing before City Council and said hearing was held in accordance with law.

NOW, THEREFORE, BE IT ORDAINED BY THE COUNCIL OF THE CITY OF SPRINGFIELD, MISSOURI, as follows, that:

Section 1 – The property described in "Exhibit A," which is attached hereto and incorporated herein by this reference, is hereby rezoned from Planned Development No. 117, 5th Amendment, and Planned Development No. 363 to Planned Development No. 379. Springfield Land Development Code, Section 36-306, 'Official zoning map and

rules for interpretation,' is hereby amended, changed, and modified consistent with this Ordinance.

Section 2 – The property described in "Exhibit A" of this Ordinance shall be subject to the requirements and standards included in "Exhibit C – Exhibit 1," with said "Exhibit C" being attached hereto and incorporated herein in its entirety by this reference; and these requirements and standards shall govern and control the use and development of the land in Planned Development No. 379.

Section 3 – City Council hereby directs the City Manager, or designee, to update the City's digital zoning map to reflect this rezoning, and City Council adopts the map thereby amended as the Official Zoning Map of Springfield, Missouri, as provided for in Springfield Land Development Code, Section 36-306, 'Official zoning maps and rules of interpretation.'

Section 4 – The Official Zoning Map herein adopted shall be maintained and archived in the same digital form in which this Council has approved its adoption.

Section 5 – This Ordinance shall be in full force and effect from and after passage.

Passed at meeting: _____

_____
Mayor

Attest: _____, City Clerk

Filed as Ordinance: _____

Approved as to form: _____, Assistant City Attorney

Approved for Council action: _____, City Manager

EXPLANATION TO COUNCIL BILL 2022 –077

FILED: 03-29-22

ORIGINATING DEPARTMENT: Planning and Development

PURPOSE: Amending the Springfield Land Development Code Section 36-306, 'Official zoning map and rules for interpretation,' by rezoning approximately 10.23 acres of property generally located at 1616 East Bradford Parkway and 3811 & 3813 South Weller Avenue from Planned Development No. 117, 5th Amendment and Planned Development No. 363 to Planned Development No. 379. (Planning and Zoning Commission and Staff recommend approval).

BACKGROUND INFORMATION:

PLANNED DEVELOPMENT DISTRICT NO. 379

The applicant is proposing to rezone the properties from Planned Development No. 117 5th Amendment and Planned Development No. 363 to Planned Development No. 379. The applicant has proposed the new Planned Development with the intent of developing an additional mixed-use development with multi-family residential and office/personal service uses. The subject properties are currently two lots, and both have a different zoning. The subject properties will be combined into one lot. The North property is zoned PD 117, 5th amendment and allows, among other uses, multi-family residential with densities up to twenty (20) dwelling units per acre. The southern property also allows multi-family residential uses at a lesser density of 17 dwelling unit per acre. Both districts allow for mixed uses. This request is to have a maximum of twenty (20) dwelling units per acre and a maximum of 20,000 square feet for first-floor commercial uses. The permitted commercial uses will be limited to general office, medical office, retail sales and personal service uses. The applicant is proposing a new 5 story mixed-use building with commercial on part of the first floor and residential above and behind at the corner of Weller Avenue and Bradford Parkway. There will be 4 full stories and a fifth partial story.

The existing Planned Development 363 & PD 117, 5th amendment allows many of the same uses as the proposed PD. PD 363, which is the southern and western portion of the subject property, allows the same uses, but a lesser density of 15 dwelling units per acre. PD 117, 5th amendment, which is the northern portion of the property, allows both office, retail/commercial uses and multi-family residential at the same density as proposed. The proposed PD in effect takes provisions of the existing zoning and applies it to both properties involved in the rezoning area and allows for the mixed-use development. The proposed PD allows multi-family residential at a higher density with a maximum of 20 dwelling units per acre. Commercial uses will be located on the first floor of the development and will allow the use groups of general office, medical office, personal services and retail sales.

REMARKS:

The Planning and Zoning Commission held a public hearing on March 10, 2022, and recommended to approve the proposed Planned Development No. 379, by a vote of 7 to 0.

The Planning and Development staff recommends the application be approved (see the attached Development Review Staff Report).

FINDINGS FOR STAFF RECOMMENDATION:

1. The request is consistent which the *Growth Management and Land Use Plan* of the *Comprehensive Plan* which identifies this property as an appropriate area for High Intensity Retail, Office or Housing. The requested Planned Development No. 379 is consistent with the *Plan's* recommendation to generally increase the compactness of urban development and housing may be combined in the same building or closely integrated on the same site with retail or office space. Further, the *Plan* promotes the development of well-designed moderate-density housing adjacent to amenities such as shopping, recreational or cultural facilities and employment centers.

2. The request is consistent with the recommendations of the Revised Multi-Family Development Location and Design Guidelines which will limit the development to 20 dwelling units per acre and requires specific design guidelines.

3. Approval of this application will facilitate redevelopment of this property and promote infill development where investments have already been made in public services and infrastructure.

Submitted by:

Daniel Neal
Senior Planner

Recommended by:

Brendan Griesemer, AICP
Assistant Director

Approved by:

Jason Gage,
City Manager

EXHIBITS:
Exhibit A, Legal Description
Exhibit B, Record of Proceedings
Exhibit C, Development Review Staff Report

ATTACHMENTS:
Attachment 1, Department Comments
Attachment 2, Neighborhood Meeting Summary and Comments

PLANNED DEVELOPMENT 379 EXHIBITS:
Exhibit 1, Planned Development Ordinance Text
Exhibit 2, Preliminary Development Site Plan

EXHIBIT A

LEGAL DESCRIPTION
PLANNED DEVELOPMENT 379

A TRACT OF LAND AS DESCRIBED IN THE GREENE COUNTY, MISSOURI RECORDER'S OFFICE LYING IN LOT 1 OF PRIMROSE THIRD ADDITION, PLAT BOOK ZZ, PAGE 89 AND ALSO IN DESCRIBED IN BOOK 2019, PAGE 001211-19 AND LOT 1 OF PRIMROSE CENTER SECOND ADDITION, PLAT BOOK VV, PAGE 27 AND SAID TRACT BEING MORE PARTICULARLY DESCRIBED AS FOLLOWS:

BEGINNING AT THE SOUTHEAST CORNER OF LOT 1 OF PRIMROSE THIRD ADDITION, PLAT BOOK ZZ, PAGE 89; THENCE ALONG THE SOUTH LINE OF LOT 1, NORTH 88°06'18" WEST, 364.96 FEET TO THE SOUTHWEST CORNER OF LOT 1; THENCE ALONG THE NORTH LINE OF THOMPSON PLAZA II, PLAT BOOK AAA, PAGE 213, AND CONTINUING NORTH 88°06'18" WEST, 1157.62 FEET TO A POINT LYING ON THE EASTERLY RIGHT-OF-WAY OF FREMONT AVENUE; THENCE LEAVING SAID NORTH LINE AND ALONG SAID EASTERLY RIGHT-OF-WAY THE FOLLOWING COURSES, NORTH 00°18'51" EAST, 41.52 FEET; THENCE NORTH 10°48'30" WEST, 73.65 FEET; THENCE LEAVING SAID EASTERLY RIGHT-OF-WAY, NORTH 83°56'57" EAST, 255.05 FEET; THENCE NORTH 74°50'25" EAST, 16.76 FEET; THENCE NORTH 77°36'28" EAST, 174.46 FEET; THENCE NORTH 77°25'15" EAST, 121.41 FEET; THENCE NORTH 89°30'19" EAST, 88.07 FEET; THENCE NORTH 70°23'35" EAST, 49.45 FEET; THENCE NORTH 71°00'17" EAST, 69.93 FEET; THENCE NORTH 80°53'45" EAST, 62.48 FEET; THENCE NORTH 81°38'10" EAST, 134.52 FEET; THENCE NORTH 88°57'08" EAST, 219.77 FEET TO THE SOUTHWEST CORNER OF LOT 1 OF PRIMROSE CENTER SECOND ADDITION; THENCE ALONG THE WEST LINE OF SAID LOT 1, NORTH 00°37'56" EAST, 174.25 FEET TO A POINT LYING ON THE SOUTHERLY RIGHT-OF-WAY OF BRADFORD PARKWAY; THENCE ALONG SAID RIGHT-OF-WAY SOUTH 89°22'04" EAST, 335.00 FEET; THENCE 47.12 FEET ALONG A 30.00 FOOT CURVE TO THE RIGHT WHOSE CHORD BEARS SOUTH 44°22'03" EAST FOR 42.43 FEET TO A POINT LYING ON THE WESTERLY RIGHT-OF-WAY OF WELLER AVENUE; THENCE ALONG SAID RIGHT-OF-WAY SOUTH 00°37'58" WEST, 473.17 FEET TO THE POINT OF BEGINNING. ALL LYING IN THE EAST HALF OF SECTION 7, TOWNSHIP 28 NORTH, RANGE 21 WEST, IN THE CITY OF SPRINGFIELD, GREENE COUNTY, MISSOURI. CONTAINING 10.23 ACRES, MORE OR LESS. BEARINGS BASED ON GRID NORTH OF THE MISSOURI COORDINATE SYSTEM OF 1983, CENTRAL ZONE.

EXHIBIT B

RECORD OF PROCEEDINGS
Planning and Zoning Commission – March 10, 2022

Planned Development 379
1616 East Bradford Parkway and 3811 & 3813 South Weller Avenue
Applicant: EWR Springfield Cambium, LLC and EWR Springfield Cambium II, LLC

Mr. Hosmer states that this is a request to rezone approximately 10.23 acres generally located at 1616 E. Bradford Parkway and 3811 & 3813 South Weller Avenue from Planned Development No. 117 5th Amendment and Planned Development No. 363 to Planned Development No. 379. The Comprehensive Plan designates this property as appropriate for high Intensity Retail, Office or Housing. The request is consistent with the recommendations of the Revised Multi-Family Development Location and Design Guidelines which will limits the development to 20 du/ac. The Transportation Plan classifies Weller and Bradford as Local Commercial roadways, and a Traffic Impact Study was not required. The property is located in a FEMA designated floodplain, and a stream buffer area with no sinkholes and stormwater detention will be required. The proposed changes from the current PD 117 5th Am and PD 363 are:

- The existing PDs allow for many of the same uses but a lesser density of 15 dwelling units per acre. PD 117, 5th Am, allows both office, retail/commercial uses and multi-family residential at the same density as being proposed 20 du/ac.
- The proposed PD will allow multi-family residential at a higher density with a maximum of 20 dwelling units per acre.
- Commercial uses will be located on the first floor of the development and will allow general office, medical office, personal services and retail sales use groups.

Staff recommends approval.

Mr. Doennig opened the public hearing.

Mr. Hill, 3811 S. Weller Avenue representing the owner and noted that the staff report is concise and to bring this under the same zoning.

Mr. Doennig closed the public hearing.

COMMISSION ACTION:
Mr. Knuckles motioned to recommend **approval** for Planned Development 379 (1616 East Bradford Parkway and 3811 & 3813 South Weller Avenue). Ms. Bruce seconded the motion. Ayes: Doennig, Coltrin, Knuckles, Colony, Bruce, Jobe, and Lebeck. Nays: None. Abstain: None. Absent: Broekhoven.

Bob Hosmer, AICP
Planning Manager

EXHIBIT C

Development Review Staff Report

PLANNING AND ZONING COMMISSION PUBLIC HEARING:	MARCH 10, 2022
CITY COUNCIL PUBLIC HEARING:	APRIL 4, 2022

CASE NUMBER:
Planned Development No. 379

LOCATION:
1616 E. Bradford Pkwy and 3811 & 3813 South Weller Avenue

ACRES:
10.23 acres

EXISTING LAND USE:
Undeveloped land, regional detention and multi-family residential development

APPLICANT:
EWR Springfield Cambium, LLC & EWR Springfield Cambium II, LLC

STAFF: Daniel Neal, 864-1036

STAFF RECOMMENDATIONS:
Approve

PROPOSED MOTION:
Move to approve rezoning the subject property to Planned Development No. 379

SUMMARY OF REQUEST:

Request to rezone approximately 10.23 acres generally located at 1616 E. Bradford Parkway and 3811 & 3813 South Weller Avenue from Planned Development No. 117 5th Amendment and Planned Development No. 363 to Planned Development No. 379.

FINDINGS FOR STAFF RECOMMENDATION:

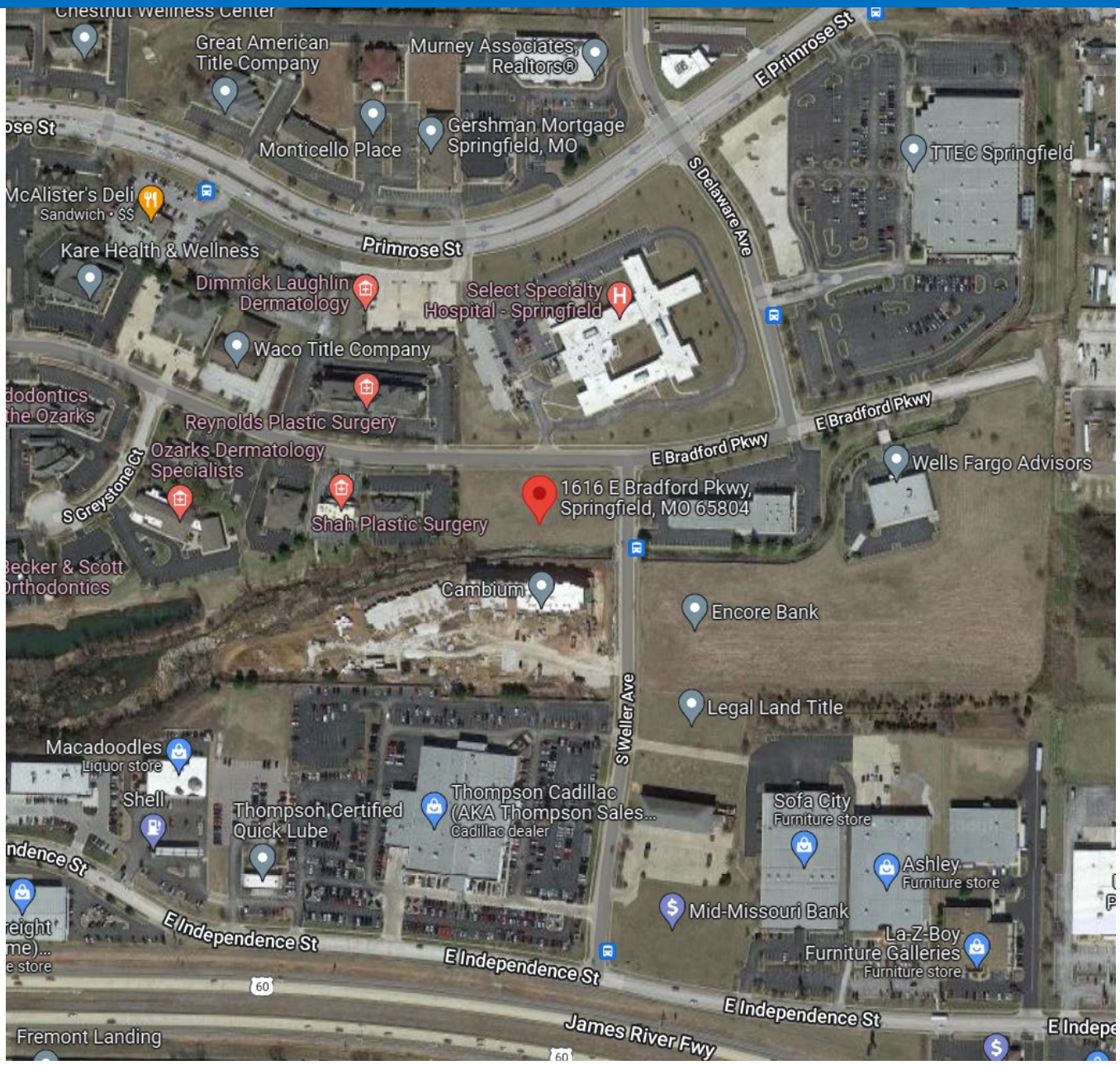
1. The request is consistent which the *Growth Management and Land Use Plan* of the *Comprehensive Plan* which identifies this property as an appropriate area for High Intensity Retail, Office or Housing. The requested Planned Development No. 379 is consistent with the *Plan's* recommendation to generally increase the compactness of urban development and housing may be combined in the same building or closely integrated on the same site with retail or office space. Further, the *Plan* promotes the development of well-designed moderate-density housing adjacent to amenities such as shopping, recreational or cultural facilities and employment centers.

2. The request is consistent with the recommendations of the Revised Multi-Family Development Location and Design Guidelines which will limit the development to 20 dwelling units per acre and requires specific design guidelines.

3. Approval of this application will facilitate redevelopment of this property and promote infill development where investments have already been made in public services and infrastructure.

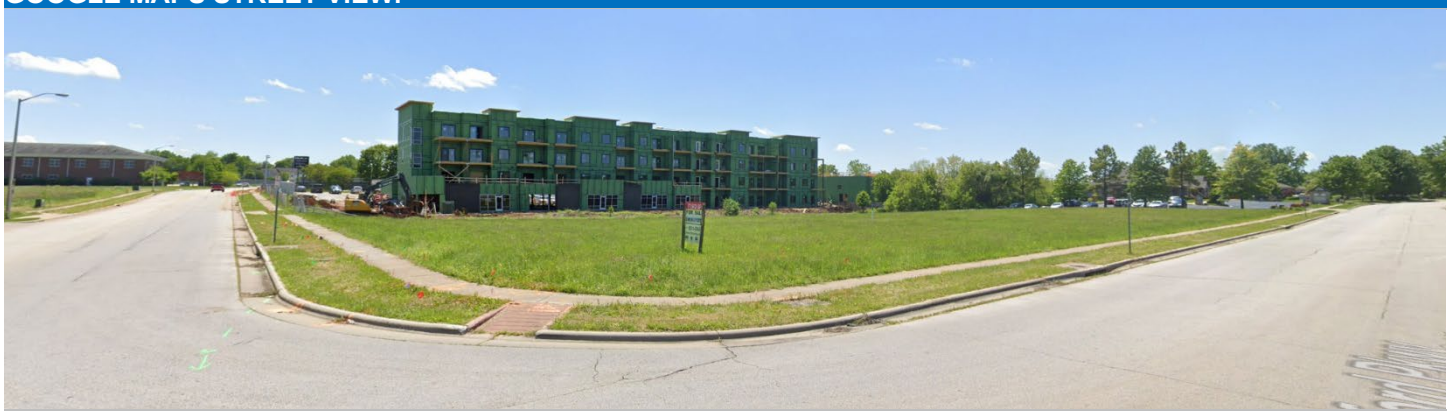
SURROUNDING ZONING AND LAND USES:				
	NORTH	**SOUTH**	**EAST**	**WEST**
ZONING	PD 117 amd. 4 & 5	PD 117 amd. 4 & 5	PD 117 amd. 5	PD 117 amd. 5
LAND USE	Office and medical uses	Automotive sales, commercial uses	Multi-family residential uses	Medical office uses

SURROUNDING LAND USES (GOOGLE MAP AERIAL VIEW):



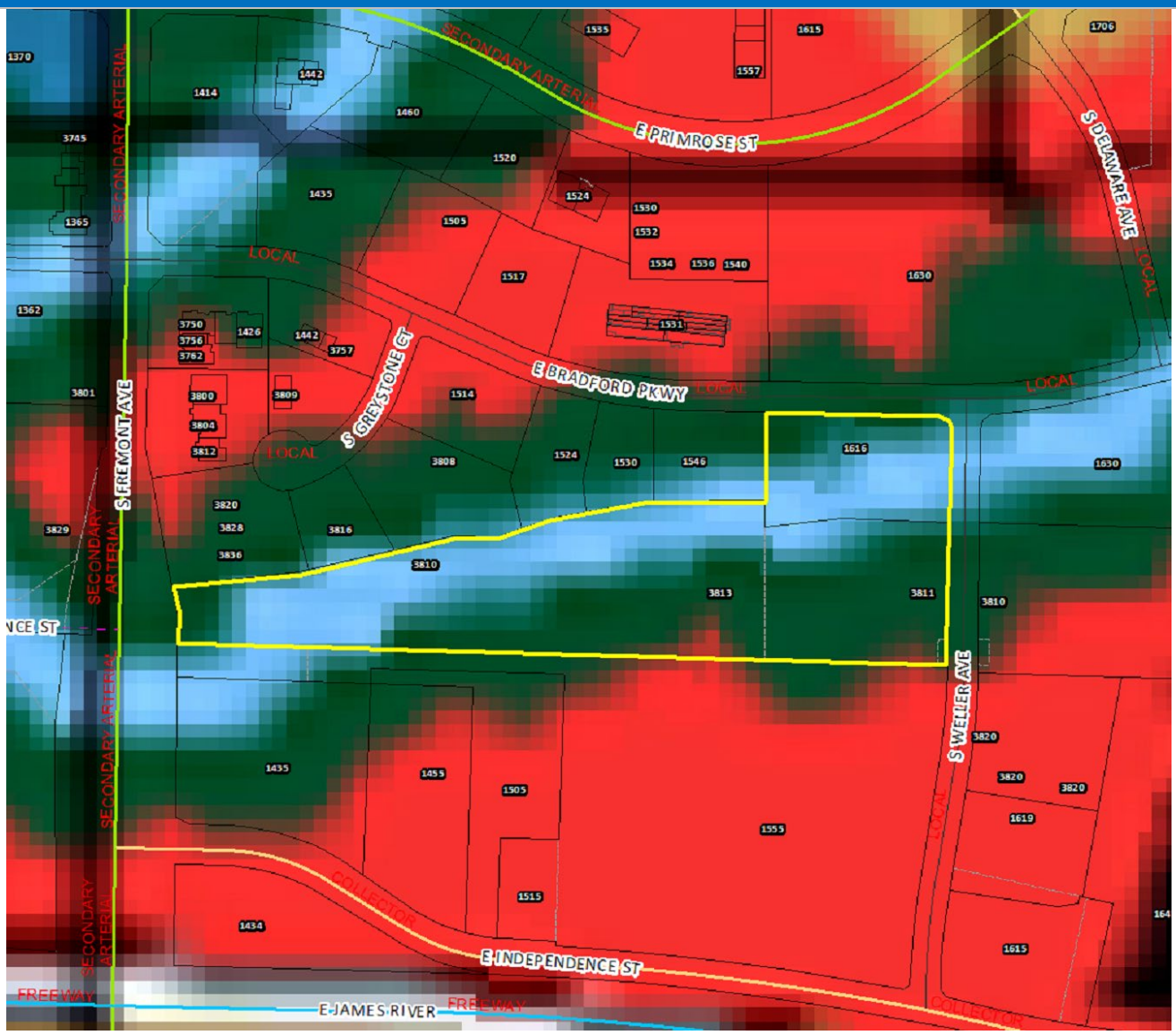
Development Review Staff Report

GOOGLE MAPS STREET VIEW:



Development Review Staff Report

GROWTH MANAGEMENT AND LAND USE PLAN:



- Low-Density Housing
- Medium or High Density Housing
- Medium Intensity Retail, Office or Housing
- High Intensity Retail, Office or Housing
- Greater Downtown
- Business Park
- Light Industrial, Office and Office-Warehouse
- General Industry, Transportation and Utilities
- Park
- School
- Golf
- Community-Public
- Urban Reserve Area
- Rural Area
- Greenway
- Parkway
- City Boundary
- Urban Service Area Boundary, Year 2020
- Urban Reserve Boundary, Year 2040

Development Review Staff Report

CITY OF Springfield

PROPERTY HISTORY:

This property was originally zoned from R-1 to Planned Development 117 in 1992. Since the citywide rezoning in 1995, the property at 3811 & 3813 S. Weller Avenue has been amended three times. It was amended to Planned Development No. 117, 2nd Amendment in 1997, Planned Development No. 117, 6th Amendment in 2001 and the latest amendment occurred in 2018 when it was amended to Planned Development 363. The property at 1616 E. Bradford Parkway was amended to Planned Development 117, 5th Amendment in 1996.

COMPATIBILITY WITH THE ZONING ORDINANCE:

CODE ITEM	REQUIREMENTS FOR PD 379
Use Limitations	Same as existing.
Maximum Structure Height	Five stories
Front Yard Setback	None
Side and Rear Setbacks	None, use limitations, design requirements and bufferyards will dictate
Open Space Requirement	20% (same as existing)
Design Requirements	See Exhibit 1 for details
BULK PLANE	**LANDSCAPING**
None, the surrounding properties allow office and commercial uses	As indicated on Site plan.

COMPATIBILITY WITH COMPREHENSIVE PLAN:

The *Growth Management and Land Use Plan* element of the *Comprehensive Plan* identifies this as an appropriate area for High Intensity Retail, Office or Housing. This mixed category indicates that a variety of office, commercial and/or mid- or high-density housing may be appropriate at major intersections or along certain roadway corridors.

The *Plan* also promotes a policy of generally increasing the compactness of urban development and housing may be combined in the same building or closely integrated on the same site with retail or office space. Further, the *Plan* promotes the development of well-designed moderate-density housing adjacent to amenities such as shopping, recreational or cultural facilities and employment centers.

STAFF COMMENTS:

1. The applicant is proposing to rezone the properties from Planned Development No. 117 5th Amendment and Planned Development No. 363 to Planned Development No. 379. The applicant has proposed the new Planned Development with the intent of developing an additional mixed-use development with multi-family residential and office/personal service uses. The subject properties are currently two lots, and both have a different zoning. The subject properties will be combined into one lot. The North property is zoned PD 117, 5th amendment and allows, among other uses, multi-family residential with densities up to twenty (20) dwelling units per acre. The southern property also allows multi-family residential uses at a lesser density of 17 dwelling unit per acre. Both districts allow for mixed uses. This request is to have a maximum of twenty (20) dwelling units per acre and a maximum of 20,000 square feet for first-floor commercial uses. The permitted commercial uses will be limited to general office, medical office, retail sales and personal service uses. The applicant is proposing a new 5 story mixed-use building with commercial on part of the first floor and residential above and behind at the corner of Weller Avenue and Bradford Parkway. There will be 4 full stories and a fifth partial story.

2. The *Growth Management and Land Use Plan* element of the *Comprehensive Plan* identifies this as an appropriate area for High Intensity Retail, Office or Housing. This mixed category indicates that a variety of office, commercial and/or mid-or high-density housing may be appropriate at major intersections or along certain roadway corridors. The *Plan* also promotes policy of generally increasing the compactness of urban development and housing may be combined in the same building or closely integrated on the same site with retail or office space. Further, the *Plan* promotes the development of well-designed moderate-density housing adjacent to amenities such as shopping, recreational or cultural facilities and employment centers. The proximity of the proposed development to the Battlefield-Glenstone-James River Freeway will place residents in an area that has many amenities such as shopping, and employment centers. Staff believes that the proposed PD 379 is appropriate for this area.

3. The applicant is requesting a maximum residential density of 20 dwelling units per acre. This density has been determined to be appropriate for this area based on an assessment completed under the Revised Multi-Family Development Location and Design Guidelines. That assessment resulted in a density of 17 dwelling units per acre. The developer is proposing a multi-family development with a density of 20 dwelling units per acre and allow the additional density under the Opportunity and Constraints section. Staff can support an increase in density based on the *Comprehensive* Plan identifying this area appropriate from High-Intensity Retail, Office, or Housing. Further analysis of the proposed development under the Revised Multi-Family Development Location and Design Guidelines is attached (Attachment 2). The development must be in substantial conformance to the attached site plan (Exhibit 2).

4. The existing Planned Development 363 & PD 117, 5th amendment allows many of the same uses as the proposed PD. PD 363, which is the southern and western portion of the subject property, allows the same uses, but a lesser density of 15 dwelling units per acre. PD 117, 5th amendment, which is the northern portion of the property, allows both office, retail/commercial uses and multi-family residential at the same density as proposed. The proposed PD in effect takes provisions of the existing zoning and applies it to both properties involved in the rezoning area and allows for the mixed-use development. The proposed PD allows multi-family residential at a higher density with a maximum of 20 dwelling units per acre. Commercial uses will be located on the first floor of the development and will allow the use groups of general office, medical office, personal services and retail sales.

5. Approval of this application will facilitate redevelopment of this property and promote infill development where investments have already been made in public services and infrastructure.

6. The proposed rezoning was reviewed by City departments and comments are contained in Attachment 1.

NEIGHBORHOOD MEETING:

The applicant held a neighborhood meeting on February 17, 2022. A summary of the meeting and sign-in sheet is attached (Attachment 3).

PUBLIC NOTIFICATION:

The public notice was advertised in the Daily Events at least 15 days prior to the public hearing. The property was posted by the applicant at least 10 days prior to the public hearing. Public notice letters were sent out at least 10 days prior to the public hearing to all property owners within 185 feet.

Notices sent to property owners within 185 feet: Mailed: 19 Returned: 0

DEPARTMENT COMMENTS:

ATTACHMENT 1
DEPARTMENT COMMENTS
PLANNED DEVELOPMENT 379

DEPARTMENT OF BUILDING DEVELOPMENT SERVICES:

No comments.

CITY UTILITIES:

No issues.

DEPARTMENT OF ENVIRONMENTAL SERVICES WASTEWATER MANAGEMENT DIVISION:

No issues.

FIRE DEPARTMENT:

No issues. Fire lane on the north side shall be within 15 to 30 feet of the building.

DEPARTMENT OF PUBLIC WORKS TRAFFIC OPERATIONS DIVISION:

STREET CLASSIFICATION, RIGHT-OF-WAY, & JURISDICTION
The City's Transportation Plan classifies both S. Weller Avenue and E. Bradford Parkway as Local - Commercial roadways. The standard right-of-way width for both S. Weller Avenue and E. Bradford Parkway is 60-feet from the centerline. It appears no additional right-of-way is needed along either of these roadways. A survey is recommended to determine the exact amount of existing right-of-way as nothing can be constructed within the required right of way. Both S. Weller Avenue and E. Bradford Parkway are both city- maintained streets.

TRAFFIC COUNTS & ON-STREET PARKING
The are no recent traffic counts on either S. Weller Avenue or E. Bradford Parkway. On-street parking is not allowed along S. Weller Avenue or E. Bradford Parkway.

DRIVEWAY ACCESS
There is currently no driveway access points onto the property from S. Weller Avenue or E. Bradford Parkway. Access will be allowed based on existing City of Springfield access standards for Local roadways.

SIDEWALK
Sidewalk already exists along the property frontage of S. Weller Avenue and E. Bradford Parkway. The existing infrastructure meets current City Standards.

TRAILS, BUS STOPS, & ADDITIONAL INFORMATION
There are no Greenway Trails in the area surrounding the property pertaining to this zoning. There is one bus stop along northbound lane of S. Weller Avenue. The proposed development is in an area that provides for multiple direct connections and provides for good connectivity in the area.

IMPROVEMENTS
None required. A Traffic Impact Study was not required.

SITE PLAN
Detailed site-specific comments.

TRAFFIC - TABLE 1: PLANNED DEVELOPMENT/CONDITIONAL USE PERMIT DETAILS

	Street Name	Street Classification	On-Street Parking	Existing Street ROW from Centerline (ft.) (Approx.)	Required Street ROW from Centerline (ft.)
Street 1	S. Weller Avenue	Local-Commercial	No	30	30
Street 2	E. Bradford Parkway	Local-Commercial	No	30	30

	AM Peak	PM Peak	Weekday	Weekend
Existing Trips Generated	0	0	0	
***Proposed Trips Generated**	32	40	432	
Additional Trips Generated	32	40	432	

*Proposed Trips Generated is based on the highest, most intense use permitted in the proposed rezoning, Planned Development, or Conditional Use Permit

DEPARTMENT OF PUBLIC WORKS STORMWATER ENGINEERING DIVISION:

The property is in the **Ward Branch** drainage basin. The property **is** located in a FEMA designated floodplain. Staff **is not** aware of flooding problems in the area. The city is not aware of a sinkhole at this location. A fee in lieu of on-site stormwater detention **will not be allowed and detention is required.** The property **does have a stream buffer on site.**

Please note that development of the property will be subject to the following conditions at the time of development:

1. For any increase in impervious surface, current detention requirements must be met per Chapter 3 Sec. 2.3.3 of the City's Flood Control and Water Quality Protection Manual. This site primarily drains to the West. A fee in lieu of constructing onsite stormwater detention will not be permitted.
2. Water quality will be required per Chapter 10 Sec. 2.0 if greater than one acre of land is disturbed. Water quality is also required for less than one acre of disturbance if part of a larger common plan.
3. As-builts of the detention and water quality improvements are required.
4. Operation and maintenance agreements are required for any permanent stormwater control measures. O&M will need to be approved during the ProjectDox process and will be reviewed by ES-Water Quality per Chapter 12 Sec. 3.0. More details at the following link: https://www.springfieldmo.gov/2120/Resources.
5. The stream through the center portion of the property has been previously converted to an engineered channel and therefore stream buffer requirements do not apply.
6. The FEMA Floodplain 2010 1% Chance Hazard area is located on the western edge of the property inside of the drainage easement.
7. A land disturbance permit will be required if disturbing 1 acre or greater per Chapter 4 Section 5 of the City's *Flood Control and Water Quality Protection Manual*.

REQUIREMENTS FOR APPROVAL:

ATTACHMENT 2
MULTI-FAMILY DEVELOPMENT LOCATION AND DESIGN GUIDELINE ASSESSMENT
PLANNED DEVELOPMENT 379

The applicant is requesting approval of multi-family apartments on 10.23 acres of property. According to the Multi-Family Location and Design Assessment Matrix, the proposed development has attained 10 points, which would allow up to 17 dwelling units per acre. The applicant has requested a density of 20 dwelling units per acre. The additional 3 dwelling unit per acre was determined to be allowed under the Opportunity and Constraints sections. Below is an analysis of the five categories used to calculate the Matrix score.

A. Land Use Accessibility (2/3 points)
One point was given for land use accessibility. There is a high employment concentration and medical/dental uses within a ¼ mile and a neighbor retail mixture within a ½ mile.

B. Connectivity Analysis (1/5 points)
One out of a maximum of five points were given for connectivity. The proposed development received scores for its proximity to transit routes.

C. Road Network Evaluation (1/2 points)
One point was given for the road network evaluation.

D. Design Guidelines (6/6 points)
A maximum of six points were given for design guideline criteria. Below are the design considerations that have been incorporated into the proposed development.

1. Pedestrian Amenities - Pedestrian amenities shall include benches placed near walkways at appropriate locations throughout the development. Pedestrian-scale lighting shall be provided within the development lighting sources or luminaries that do have a cutoff shall not exceed a maximum of 30 feet in height. All lighting shall be glare-free and shielded from the sky and adjacent residential properties and structures, either through external shields or through optics within the fixture. A site lighting and photometric plan shall be submitted conforming to these requirements for building permits.

2. Building Scale and Articulation - Street facing walls that are greater than 50 feet in length shall be articulated at least each 25 feet with bays, projections or recesses. Articulation means a difference in the vertical plane of the building at least 18 inches or more. This project shall be in compliance with the attached site plan and elevations.

3. Building Orientation and Interior Landscaping – All building orientations will address Weller Avenue to receive design points for this element. Landscaping and open spaces shown shall be provided with approved ground cover and/or plantings per required city ordinances and zoning requirements. Landscaping islands with plantings shall be located throughout the parking lot. A landscaping plan shall be submitted conforming to these requirements for building permits.

4. Avoidance of Blank Walls along pedestrian circulation areas – Facades that face public streets or connecting pedestrian frontage that are greater than 25 feet in length shall be

subdivided and proportioned using at least one or more of the following features: windows, entrances, arcades, arbors, awning (over windows or doors), distributed along the façade at least once every 25 feet. This project shall be in conformance with the attached site plan and elevations

5. Internal Connectivity – Internal sidewalks shall connect internally and to the public sidewalk system.

6. Useable Recreational Area/Facility – A minimum of 20% usable open space is required.

7. Amenities – The development will have a resident clubhouse and swimming pool.

8. Preservation of Trees –All existing trees of 6" caliper or greater shall be preserved or replaced with 2-inch caliper trees in accordance with the attached site plan and the city ordinance.

D. Opportunities and Constraints

The opportunities and constraints listed in this document must be considered in evaluating a site for higher residential density.

1. How much higher density exists or is planned or approved for the area?

   If the Vision 20/20 Comprehensive Plan or other adopted plans or studies recommend a lower or higher density than that determined by the matrix calculation, staff may consider recommendation of a density more consistent with approved plans.

   The *Growth Management and Land Use Plan* recommended higher intensity at this location. The *Plan* recommended High Intensity Retail, Office or Housing. Staff supports the requested additional one dwelling unit/acre in this Planned Development for apartments and commercial uses which would complement the area that has higher intensity retail sales and offices uses.

DENSITY: The assessment criteria resulted in a total of a maximum density of 17 dwelling units per acre. The applicant has requested a total density of 20 dwelling units per acre which the additional density awarded under the Opportunity and Constraints section.

AFFIDAVIT OF NEIGHBORHOOD NOTIFICATION AND MEETING SUMMARY

1. Request change to zoning from: PD 117 and PD 363 to PD 379
   (existing zoning) *(proposed zoning)*
2. Meeting Date & Time: February 17, 2022 4:00 pm to 6:30 pm
3. Meeting Location: 3811 S Weller Ave., STE A-101, Springfield, MO 65804
4. Number of invitations that were sent: 78
5. How the mailing list was generated: City Planning Staff
6. Number of neighbors in attendance (attach a sign-in sheet): 0
7. List the verbal comments and how you plan to address any issues:
   (City Council does not expect all the issues to be resolved to the neighborhood's satisfaction; however, the developer must explain why the issues cannot be resolved).

   No one in attendance thus no verbal comments received.

8. List or attach the written comments and how you plan to address any issues:

   No one in attendance thus no written comments received.

I, HARLAN HILL *(print name)*, attest that the neighborhood meeting was held on 2/17/2022 *(month/date/year)*, and is at least twenty-one (21) days prior to the Planning and Zoning Commission public hearing and in accordance with the attached "Neighborhood Notification and Meeting Process."

Signature of person completing affidavit

HARLAN HILL

Printed name of person completing affidavit

CAMBIUM II

NEIGHBORHOOD MEETING
2/17/2022

SIGN-IN SHEET

NO ATTENDEES

2/17/2022

6:35 PM

EXHIBIT 1
Requirements and Standards Applicable
To Planned Development District No. 379

A. APPLICATION:

Building or other permits may not be issued for development permitted by this planned development, nor can any changes be made to this property until the final development plan has been approved in the manner described at the end of this exhibit.

All requirements of the Springfield Zoning Ordinance shall apply unless modified by the requirements and standards that follow.

B. INTENT:

Mixed use development with multi-family residential, office, personal service and retail uses.

C. DEFINITIONS:

The definitions contained in the Zoning Ordinance shall apply to this ordinance.

D. USES PERMITTED:

1. Residential uses:
   a. Multifamily dwellings;
   b. Clubhouses associated with any permitted use;
   c. Noncommercial, not-for-profit residential neighborhood facilities, including indoor and outdoor recreational facilities, community centers, offices of property owners associations and maintenance facilities operated by a neighborhood or community organization or a property owners association in accordance with the provisions of section 36-467, noncommercial not-for-profit neighborhood facilities.
2. Non-Residential uses:
   a. General office use group, excluding banks and financial institutions with automatic teller machines and drive-thru facilities;
   b. Medical office use group;
   c. Personal service use group;
   d. Retail sales use group.
3. Other uses:
   a. Accessory uses, as permitted by section 36-450, accessory structures and uses;
   b. Temporary uses, as permitted by section 36-452, temporary uses.
   c. Tier I and II wireless facilities in accordance with section 36-466, telecommunication towers.

E. USE LIMITATIONS:

1. Location of Non-Residential Uses. All non-residential uses shall be located on the first floor of a building. The non-residential uses shall not exceed 20,000 square feet of floor area in aggregate of all structures.
2. Noise Standards. All uses shall operate in accordance with the noise standards contained in Section 36-485 of the Springfield Zoning Ordinance.
3. Nuisance. No use shall emit an odor that creates a nuisance as determined by Springfield City Code.

F. **INTENSITY OF DEVELOPMENT**:

Development shall adhere to the following standards.

1. Residential Density: The maximum residential gross density shall not exceed twenty (20) units per acre.
2. All of the subject properties shall be combined into one lot per Exhibit 2.

G. BULK, AREA AND HEIGHT REQUIREMENTS:

Development shall adhere to the following standards.

1. Maximum structure height: Five (5) stories.

H. DESIGN STANDARDS:

The design requirements shall adhere to the following standards:

Design to Encourage Pedestrian Activity

1. Provide pedestrian amenities such as pedestrian scale lighting and non right-of- way street furniture to enhance the pedestrian environment. Lighting sources or luminaries that do not have a cutoff and are used in parking lots and pedestrian ways shall not exceed a maximum of 15 feet in height. Lighting sources or luminaries that do have a cutoff shall not exceed a maximum 30 feet in height. Parking lot lighting and pedestrian lighting should be appropriate to create adequate visibility at night and evenly distributed to increase security. Street furniture may include but is not limited to benches; shelters; and decorative trash bins. There shall be one (1) street/park bench provided within each multi-family development, thereafter, one (1) park/street bench for every 50 dwelling units.

2. The project will blend the building scale and set back with existing developments that are consistent with these guidelines. Street facing walls that are greater than 50 feet in length must be articulated at least each 25 feet with bays, projections, or recesses. Articulation means a difference in the vertical plane of the building of at least 18 inches or more.

3. Buildings adjacent to the street will be situated on the site to provide pedestrian access to the street. Additional interior lot buildings may be oriented toward parking lots or public/common open space. Buildings adjacent to the street shall not have parking lots located between the building and the street. Corner lots may have parking on one street face. Interior areas of parking and vehicular use areas shall contain planting islands every 20 contiguous parking spaces whether double staked or linear. The size of the planting island shall be the equivalent area of one parking space. This shall be used toward satisfying the 5% interior landscaping requirements.

4. Avoid blank walls along pedestrian circulation areas. Facades that face streets or connecting pedestrian frontage that are greater than 25 feet in length shall be subdivided and proportioned using at least one or more of the following features; windows, entrances, arcades, arbors, awnings (over windows or doors), distributed along the façade at least once every 25 feet.

Provide a Good Circulation System

1. Provide connectivity by including direct vehicular or access easements, pedestrian and bicycle connections between abutting or adjacent developments, including retail centers and bus stops, wherever possible.

2. Buildings shall connect building entrances to one another and to sidewalks on adjacent public and/or private streets via a minimum four (4) foot wide sidewalk separated from vehicular traffic by a four-foot-wide planting strip (the 4 foot planting strip does not apply to parking lots where the sidewalk is intended to provide access to the parking lot). Public sidewalks may be considered part of the walkway system if they provide convenient movement between structures. Fences, landscaping and other site improvements shall be

located so as not to impede safe and convenient pedestrian circulation. On-site sidewalks shall be designed to connect to off-site sidewalks on adjoining properties and public and/or private streets. Sidewalks shall connect parking areas or parking structures that serve the principal multi-family building; community amenities, such as swimming pools, community centers, other recreational facilities, or common open space.

3. Provide shared driveways, cross access driveways and/or other forms of connectivity and secondary access to existing or future adjacent developments.

Respect the Natural Environment

1. The development shall include at least 15% of the total site or premise as a usable recreational area and/or facility. Usable recreational area/facility is defined as an open recreational area or recreational facility which are designed and intended to be used for outdoor living and/or recreation, and/or amenity. Usable open recreational areas shall not include land occupied by buildings, structures, streets, sidewalks, driveways, or parking areas but may include outdoor recreational facilities such as walkways used solely for recreational purposes/connections, swimming pools, sports courts, clubhouse, community center, exercise room or other amenities as defined in these guidelines. The 15% usable recreational area or facility does not reduce the required 20% open space. All common open recreational areas on the site, including recreational facilities, shall be readily accessible to all occupants and should, wherever possible, be physically connected to other common open space areas on and off the site. Generally, usable open recreational areas should have a minimum dimension of thirty (30) feet in any direction and minimum area of nine hundred (900) square feet; however, it is recognized that open recreational areas can be of a smaller minimum dimension or area provided it meets the definition.

2. Incorporate three (3) functional amenities. There must be at least two (2) different amenities used for Multi-family development sites with more than 100 units. Allowable recreational amenities:
    a. Swimming pool;
    b. Golf course;
    c. Resident clubhouse.
    d. One tot lot with a minimum size of nine hundred square feet (900') per tot lot area;
    e. Basketball, volleyball, tennis court, handball court or other sports court.
    f. One (1) picnic area, with a minimum size of nine-hundred square feet (900') per area, and including a minimum of one (1) picnic table and one (1) barbeque grill/pits per picnic area;
    g. Community center (meeting room, assembly hall, etc.);
    h. Exercise room and/or recreation building

3. A tree six inches or greater in diameter measured 4 1/2 feet above ground must be preserved or replaced with a tree of at least two inches (2) in diameter—for a maximum total of 7 trees per acre. Trees meeting the landscape requirements in the zoning ordinance may be counted toward this requirement. If this is not possible then the total diameter of trees at the time they are lost shall be replaced with an equal diameter amount of trees with no less than 2 in diameter throughout the project area.

1. Service and Loading Areas. Off-street loading shall be regulated in accordance with *Sections 36-456 and 36-483* of the *Springfield Zoning Ordinance*. The following requirements are supplementary.
    (1) All service and loading areas shall be located in the side or rear yard of buildings.

(2) Service and loading areas shall be designed so that the entire service and loading operations are conducted on the building site. The visibility of service and loading from public streets shall be minimized.

I. OPEN SPACE, LANDSCAPING & SCREENING:

The landscaping and screening provisions are intended to improve the physical appearance of the District; to improve the environmental performance by contributing to the abatement of heat, glare and noise, and by promoting natural percolation of storm water and improvement of air quality; to buffer potentially incompatible land uses from one another; and to conserve the value of adjoining property and neighborhoods.

1. Open Space Requirements.
   a. Minimum open space: Not less than twenty (20) percent of the total lot area shall be devoted to open space including required yards, and bufferyards.
   b. Maximum impervious area: The combined area occupied by all main and accessory buildings or structures, parking areas, driveways and any other surfaces which reduce and prevent absorption of stormwater shall not exceed eighty (80) percent of the total lot area.
2. Bufferyards.
   a. There shall be no required bufferyards.
3. Vehicular use area open space.
   a. Perimeter. The requirements and standards of Section 36-482(9) of the Springfield Zoning Ordinance, in effect at the time of development shall apply.
   b. Interior. The requirements and standards of Section 36-482(9) of the Springfield Zoning Ordinance, in effect at the time of development shall apply.
4. Open Space Landscaping. Except as otherwise set forth herein, provided the Development complies with the design requirements set forth in Section VII.B hereof, no additional open space landscaping shall be required.
5. Screening.
   a. Screening types. An opaque barrier at least six (6) feet in height shall be provided which visually screens the potentially offensive feature from less-intensive uses or districts as follows:
      (1) A solid wood and/or masonry fence or wall at least six (6) feet in height.
      (2) A hedge-like screen or a random or informal screen of evergreen or approved deciduous plant material, capable of providing a substantially opaque barrier and attaining a minimum height of six (6) feet within three (3) years of planting.
      (3) A landscaped earth berm with a maximum slope of three (3) to one (1), rising no less than six (6) feet above the existing grade of the lot line of the less-intensive use or district.
      (4) Any combination of these methods that achieves a cumulative six-foot-high screen.
6. Screening Locations. Waste cans, dumpster units, or other forms of litter control and refuse disposal devices shall be placed within the District where they are least visible from a public street or adjoining properties. Screening of these devices, in the form of a sight-proof fence or wall, shall be provided.
7. Screening Standards. Screening shall not adversely affect surface water drainage.

J. EXTERIOR LIGHTING:

The requirements and standards of Section 36-484 of the Springfield Zoning Ordinance, in effect at the time of development shall apply.

K. ACCESS TO PUBLIC THOROUGHFARES:

Access to the public street system shown on Exhibit 2 shall be governed by the existing standards of the City of Springfield for the applicable street classification.

L. OFF-STREET PARKING:

Sections 36-455, 36-456 and 36-483 of the Springfield Zoning Ordinance in effect at the time of development shall apply; provided that parking requirements shall be determined using the net usable floor area of the total area.

M. SIGNS:

The requirements and standards of Section 36-454 of the Springfield Zoning Ordinance, in effect at the time of development shall apply.

N. REQUIRED IMPROVEMENTS.

1. Public improvements to be completed. Public and private improvements necessary to adequately accommodate the intensity of development proposed in this District shall be constructed prior to or concurrently with the development of the property. If the development of the property is phased, the construction of the improvements may also be phased provided there is a logical relationship between each phase of the development and the construction of the required improvements.
2. Building Permits. Prior to building permits being issued to the applicant, the applicant shall consolidate the two lots comprising the District into one lot by filing an approved subdivision plat in accordance with the Subdivision Regulations.
3. Improvement Standards. All utilities and utility connections shall be located underground, including, but not limited to, electrical and telephone cables, security and other telecommunication systems and wires. Transformers, meters of any type (including electric, gas or other meters), or other apparatus shall be adequately screened and landscaped. All improvements shall be subject to utility provider approval.

O. MAINTENANCE OF COMMON AREAS AND FACILITIES.

The maintenance of common areas and facilities within the District shall remain the responsibility of the developer(s) or shall be assumed by any subsequent owners.

P. FINAL DEVELOPMENT PLAN

A final development plan, showing conformance with the requirements of this Exhibit, shall be submitted to the Planning and Development Department and approved in the manner described below prior to the issuance of any building permits or prior to the commencement of any of the permitted uses or improvements permitted or required by this exhibit.

1. The intent of Exhibit 2 is to show development of this tract in conformance with the requirements of Exhibit 1. The site layout of buildings and parking may shift while still maintaining conformance with Exhibit 1. A final development plan shall only be approved if it is in substantial conformance with Exhibit 2 as defined by Subsection 36-405 of the Springfield Zoning Ordinance.

2. The Administrative Review Committee is herby authorized to, acting jointly, approve the final development plan provided such plan substantially conforms to the provisions of this ordinance. The Administrative Review Committee is hereby authorized, at its discretion, to approve minor adjustments and modifications to the site plan. Such authority shall not, however, be construed to permit:

    a. Any uses within the District other than those specifically prescribed by the ordinance.

b. Any increase in the intensity of use permitted within the District.

EXHIBIT 2

PRELIMINARY DEVELOPEMENT PLAN

LEGAL DESCRIPTION

A TRACT OF LAND AS DESCRIBED IN THE GREENE COUNTY, MISSOURI RECORDER'S OFFICE LYING IN LOT 1 OF PRIMROSE THIRD ADDITION, PLAT BOOK ZZ, PAGE 89 AND ALSO IN DESCRIBED IN BOOK 2019, PAGE 001211-19 AND LOT 1 OF PRIMROSE CENTER SECOND ADDITION, PLAT BOOK VV, PAGE 27 AND SAID TRACT BEING MORE PARTICULARLY DESCRIBED AS FOLLOWS:

BEGINNING AT THE SOUTHEAST CORNER OF LOT 1 OF PRIMROSE THIRD ADDITION, PLAT BOOK ZZ, PAGE 89; THENCE ALONG THE SOUTH LINE OF LOT 1, NORTH 88°06'18" WEST, 364.96 FEET TO THE SOUTHWEST CORNER OF LOT 1; THENCE ALONG THE NORTH LINE OF THOMPSON PLAZA II, PLAT BOOK AAA, PAGE 213, AND CONTINUING NORTH 88°06'18" WEST, 1157.62 FEET TO A POINT LYING ON THE EASTERLY RIGHT-OF-WAY OF FREMONT AVENUE; THENCE LEAVING SAID NORTH LINE AND ALONG SAID EASTERLY RIGHT-OF-WAY THE FOLLOWING COURSES, NORTH 00°18'51" EAST, 41.52 FEET; THENCE NORTH 10°48'30" WEST, 73.65 FEET; THENCE LEAVING SAID EASTERLY RIGHT-OF-WAY, NORTH 83°56'57" EAST, 255.05 FEET; THENCE NORTH 74°50'25" EAST, 16.76 FEET; THENCE NORTH 77°36'28" EAST, 174.46 FEET; THENCE NORTH 77°25'15" EAST, 121.41 FEET; THENCE NORTH 89°30'19" EAST, 88.07 FEET; THENCE NORTH 70°23'35" EAST, 49.45 FEET; THENCE NORTH 71°00'17" EAST, 69.93 FEET; THENCE NORTH 80°53'45" EAST, 62.48 FEET; THENCE NORTH 81°38'10" EAST, 134.52 FEET; THENCE NORTH 88°57'08" EAST, 219.77 FEET TO THE SOUTHWEST CORNER OF LOT 1 OF PRIMROSE CENTER SECOND ADDITION; THENCE ALONG THE WEST LINE OF SAID LOT 1, NORTH 00°37'56" EAST, 174.25 FEET TO A POINT LYING ON THE SOUTHERLY RIGHT-OF-WAY OF BRADFORD PARKWAY; THENCE ALONG SAID RIGHT-OF-WAY SOUTH 89°22'04" EAST, 335.00 FEET; THENCE 47.12 FEET ALONG A 30.00 FOOT CURVE TO THE RIGHT WHOSE CHORD BEARS SOUTH 44°22'03" EAST FOR 42.43 FEET TO A POINT LYING ON THE WESTERLY RIGHT-OF-WAY OF WELLER AVENUE; THENCE ALONG SAID RIGHT-OF-WAY SOUTH 00°37'58" WEST, 473.17 FEET TO THE POINT OF BEGINNING. ALL LYING IN THE EAST HALF OF SECTION 7, TOWNSHIP 28 NORTH, RANGE 21 WEST, IN THE CITY OF SPRINGFIELD, GREENE COUNTY, MISSOURI. CONTAINING 10.23 ACRES, MORE OR LESS. BEARINGS BASED ON GRID NORTH OF THE MISSOURI COORDINATE SYSTEM OF 1983, CENTRAL ZONE.

EXISTING DEVELOPMENT

BUILDING A

UNIT MIX		REQUIRED PARKING	
MICRO STUDIO	11	11 X 1	11
STUDIO	12	12 X 1.5	18
ONE BEDROOM	34	34 X 1.5	51
TWO BEDROOM	14	14 X 2	28
TOTAL	71	SUB-TOTAL	108

BUILDING B

UNIT MIX		REQUIRED PARKING	
MICRO STUDIO	8	8 X 1	8
STUDIO	24	24 X 1.5	36
ONE BEDROOM	8	8 X 1.5	12
TWO BEDROOM	16	16 X 2	32
TOTAL	56	SUB-TOTAL	88

OFFICE INFILL

TENANT SUITE A-101 9,340 SQUARE FEET	REQUIRED PARKING 9,340/350 sf	27

REQUIRED PARKING TOTALS	
SUB-TOTAL	223
10% BICYCLE REDUCTION	-22
TOTAL REQUIRED	201
TOTAL PROVIDED	204

PROPOSED DEVELOPMENT

PROPOSED BUILDING

UNIT MIX		REQUIRED PARKING	
STUDIO	9	9 X 1	9
ONE BEDROOM	31	31 X 1.5	47
TWO BEDROOM	10	10 X 2	20
THREE BEDROOM	3	3 X 2	6
TOTAL	53	SUB-TOTAL	82

OFFICE INFILL

TENANT SUITE 5,510 SQUARE FEET	REQUIRED PARKING 5,510/350 sf	16

REQUIRED PARKING TOTALS	
SUB-TOTAL	98
10% BICYCLE REDUCTION	-9
TOTAL REQUIRED	89
TOTAL PROVIDED	93

SITE DATA

SITE AREA COMBINED: 10.23 ACRES 445,618.8 SF

DENSITY: 20 UNITS PER ACRE MAXIMUM
204 UNITS ALLOWED
180 UNITS PROVIDED

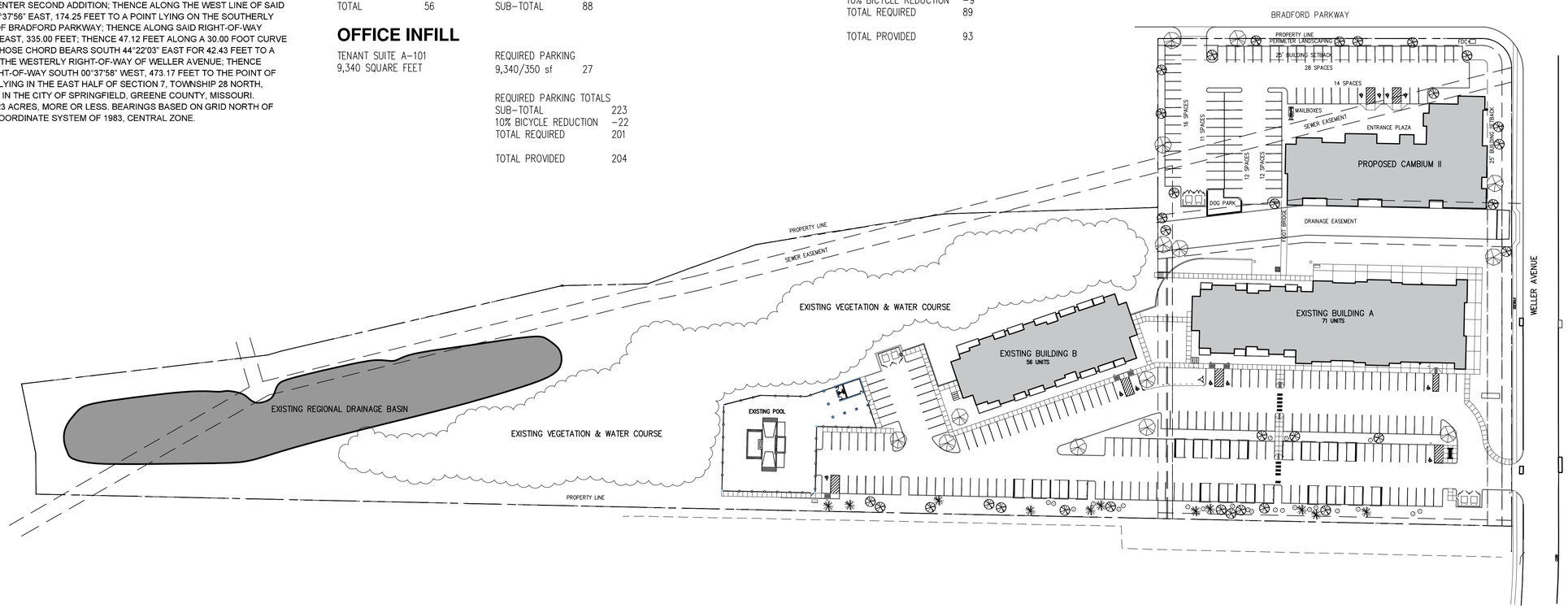
OPEN SPACE REQUIRED: 20%
PROVIDED: 153,464.4 / 445,618.8 = 0.34

IMPERVIOUS AREA 80% MAX
PROVIDED: 292,127 / 445,618.8 = 0.66

PROPOSED AND EXISTING USES
MULTIFAMILY DWELLINGS
GENERAL OFFICES
CLUBHOUSE – EXISTING
ACCESSORY USES

BUILDING HEIGHT
MAX STRUCTURE HEIGHT
5 STORIES 70'-0"

BROWNFIELDS: N/A



1A
C1.1

PRELIMINARY SITE PLAN

SCALE: 1" = 60'-0"

PRELIMINARY NOT FOR CONSTRUCTION

Harlan H. Hill, Architect
MO# A-006582

DOCUMENTS BEARING THIS SEAL ARE AUTHENTICATED RESPONSIBILITY FOR ANY OTHER DOCUMENTS NOT PREPARED AND ISSUED BY THIS ARCHITECT ARE DISCLAIMED

TEAM C CONSTRUCTION, LLC
MO CERT. #2021034823

3811 S WELLER AVENUE
SUITE A101
SPRINGFIELD, MO 65804
417-869-1118

TEAM C CONSTRUCTION

STRUCTURAL ENGINEER:
COMPANY NAME
CERTIFICATE OF AUTHORITY
STREET ADDRESS
CITY, COUNTY, STATE
Phone:
Fax:

MECHANICAL ENGINEER:
COMPANY NAME
CERTIFICATE OF AUTHORITY
STREET ADDRESS
CITY, COUNTY, STATE
Phone:
Fax:

ELECTRICAL ENGINEER:
COMPANY NAME
CERTIFICATE OF AUTHORITY
STREET ADDRESS
CITY, COUNTY, STATE
Phone:
Fax:

Cambium II
EDGEWOOD REIT
3811 SOUTH WELLER AVE AND
1616 E BRADFORD PARKWAY
SPRINGFIELD, MISSOURI

SITE PLAN

REVISIONS: DATE:
1
2
3

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Project No. XXXX-XXX
Date 1/31/22
Sheet Number
C1.1
OF: # SHEETS

One-rdg. _____
P. Hrngs. X
Pgs. 16
Filed: 03-29-22

Sponsored by: McGull

First Reading: _____ Second Reading: _____

COUNCIL BILL 2022- 078 GENERAL ORDINANCE _____

AN ORDINANCE

AMENDING the Springfield Land Development Code, Section 36-306, 'Official zoning map and rules for interpretation,' by rezoning approximately 1.04 acres of property generally located at 1310 East St. Louis Street from R-HD, High-Density Multifamily Residential District, with Conditional Overlay No. 123, to GR, General Retail District; and adopting an updated Official Zoning Map. (Staff and Planning and Zoning Commission both recommend approval.)

WHEREAS, an application has been filed for a zoning change of the property generally located at 1310 East St. Louis Street from R-HD, High-Density Multifamily Residential District, with Conditional Overlay No. 123, to GR, General Retail District; and

WHEREAS, following proper notice, a public hearing was held before the Planning and Zoning Commission, a copy of the Record of Proceedings from said public hearing being attached hereto and incorporated herein by this reference as "Exhibit B," and said Commission made its recommendation; and

WHEREAS, the City has reviewed the applicant's request and prepared a staff report concerning the application which is attached hereto and incorporated herein by this reference as "Exhibit C;" and

WHEREAS, proper notice was given of a public hearing before City Council, and said hearing was held in accordance with the law.

NOW, THEREFORE, BE IT ORDAINED BY THE COUNCIL OF THE CITY OF SPRINGFIELD, MISSOURI, as follows, that:

Section 1 – The property described in "Exhibit A," which is attached hereto and incorporated herein by this reference, is hereby rezoned from R-HD, High-Density Multifamily Residential District, with Conditional Overlay No. 123, to GR, General Retail District. Springfield Land Development Code, Section 36-306, 'Official zoning map and

rules for interpretation,' is hereby amended, changed, and modified consistent with this Ordinance.

Section 2 – City Council hereby directs the City Manager, or designee, to update the City's digital zoning map to reflect this rezoning, and City Council adopts the map thereby amended as the Official Zoning Map of Springfield, Missouri, as provided for in the Springfield Land Development Code, Section 36-306, 'Official zoning maps and rules of interpretation.'

Section 3 – The Official Zoning Map herein adopted shall be maintained and archived in the same digital form in which this Council has approved its adoption.

Section 4 – This Ordinance shall be in full force and effect from and after passage.

Passed at meeting: _____

_____
Mayor

Attest: _____, City Clerk

Filed as Ordinance: _____

Approved as to form: _____, Assistant City Attorney

Approved for Council action: _____, City Manager

EXPLANATION TO COUNCIL BILL 2022 -078

FILED: 03-29-22

ORIGINATING DEPARTMENT: Planning and Development

PURPOSE: Amending the Springfield Land Development Code, Section 36-306, 'Official zoning map and rules for interpretation,' by rezoning approximately 1.04 acres of property generally located at 1310 East St. Louis Street from R-HD, High-Density Multi- Family Residential District with Conditional Overlay No. 123 to GR, General Retail. (Staff and Planning and Zoning Commission both recommend approval).

BACKGROUND INFORMATION:

ZONING CASE NUMBER Z-5-2022

The applicant is requesting to rezone approximately 1.04 acres of property generally located at 1310 East St. Louis Street from R-HD, High-Density Multi- Family Residential District with Conditional Overlay No. 123 to GR, General Retail The applicant intends to develop a mixed-use development consisting of retail uses and multi-family apartments. The current zoning does not allow for retail uses.

REMARKS:

The Planning and Zoning Commission held a public hearing on March 10, 2022, and recommended to approve, by a vote of 7 to 0.

The Planning and Development staff recommends the application be approved (see the attached Development Review Staff Report).

FINDINGS FOR STAFF RECOMMENDATION:

1. The application is consistent with the *Growth Management and Land Use Plan element* of the *Comprehensive Plan* which identifies this as an appropriate area for Medium-Intensity Retail, Office, or Housing. This mixed category indicates that a variety of office, commercial and/or mid-or high-density housing may be appropriate at major intersections or along certain roadway corridors. The GR district is identified as an appropriate zoning district for this land use category. The *Plan* also identifies Center City and Missouri State University and surrounding area as major Activity Centers, which are to be locations of employment, housing, business, and entertainment.

2. This application is consistent with past City Council decisions. The subject property has been zoned GR in the past. In February 2010, City Council approved General Ordinance No. 5860 rezoning the subject property from CS, Commercial Services to GR, General Retail.

3. Approval of this application will allow for development of this underutilized property and promote infill development where investments have already been made in public services and infrastructure.

Submitted by:

Michael Sparlin, Senior Planner

Recommended by:

Brendan Griesemer, AICP
Assistant Director

Approved by:

Jason Gage, City Manager

EXHIBITS:
Exhibit A, Legal Description
Exhibit B, Record of Proceedings
Exhibit C, Development Review Staff Report
ATTACHMENTS:
Attachment 1: Department Comments
Attachment 2: Neighborhood Meeting Summary

EXHIBIT A

LEGAL DESCRIPTION
ZONING CASE Z-5-2022

ALL OF LOT ONE (1), REGAL SUBDIVISION, CITY OF SPRINGFIELD, GREENE COUNTY, MISSOURI, FORMERLY DESCRIBED AS: BEGINNING AT THE SOUTHEAST CORNER OF ST. LOUIS STREET AND KICKAPOO AVENUE IN SPRINGFIELD, GREENE COUNTY, MISSOURI, THENCE SOUTH ALONG THE EAST LINE OF KICKAPOO AVENUE, 239.85 FEET; THENCE IN AN EASTERLY DIRECTION 190 FEET, MORE OR LESS TO A POINT 190 FEET EAST OF THE EAST LINE OF KICKAPOO AVENUE AND 238 FEET SOUTH OF THE SOUTH LINE OF ST. LOUIS STREET; THENCE NORTH 238 FEET TO A POINT ON THE SOUTH LINE OF ST. LOUIS STREET 190 FEET EAST OF THE POINT OF BEGINNING, THENCE WEST 190 FEET TO THE POINT OF BEGINNING.

EXHIBIT B

RECORD OF PROCEEDINGS
Planning and Zoning Commission – March 10, 2022

Z-5-2022
1310 East St. Louis Street
Applicant: Urban Village Living, LLC

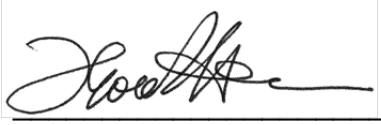
Mr. Hosmer states that this is a request to rezone approximately 1.04 acres of property generally located at 1310 East St. Louis Street from R-HD, High-Density Multi- Family Residential District with Conditional Overlay No. 123 to GR, General Retail. The Comprehensive Plan identifies this as an appropriate area for Medium-Intensity Retail, Office or Housing. The property was previously zoned GR in 2010. The Transportation Plan classifies St. Louis as a Secondary Arterial and Kickapoo as a Local roadway, and a Traffic Impact Study is not required. The property is not located in a FEMA designated floodplain, sinkhole or stream buffer area. Stormwater detention is required. Staff recommends approval.

Mr. Doennig opened the public hearing.

Mr. Jared Davis, 3213 S. West Bypass and here to answer any questions.

Mr. Doennig closed the public hearing.

COMMISSION ACTION:
Mr. Colony motioned to recommend **approval** for Z-5-2022 (1310 East St. Louis Street). Ms. Bruce seconded the motion. Ayes: Doennig, Coltrin, Knuckles, Colony, Bruce, Jobe, and Lebeck. Nays: None. Abstain: None. Absent: Broekhoven.



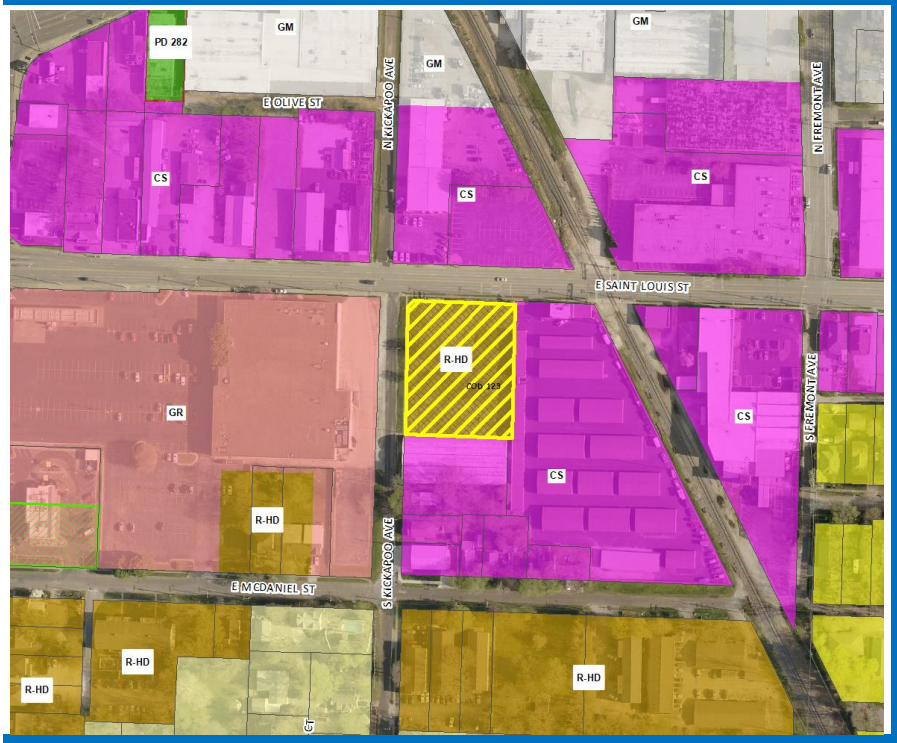
Bob Hosmer, AICP
Planning Manager

EXHIBIT C

Development Review Staff Report

PLANNING AND ZONING COMMISSION PUBLIC HEARING: MARCH 10, 2022

CITY COUNCIL PUBLIC HEARING: April 4, 2022



CASE: Z-5-2022

ACRES: Approximately 1.04 acres

LOCATION: 1310 East St. Louis Street

EXISTING LAND USE: Undeveloped Land

APPLICANT: Urban Village Living LLC

STAFF: Michael Sparlin, Senior Planner
417-864-1091

STAFF RECOMMENDATIONS:
Approve

PROPOSED MOTION: Move to approve as submitted in the staff report. Required vote is a majority of those present (5 members are a quorum).

SUMMARY OF REQUEST:

Request to rezone approximately 1.04 acres of property generally located at 1310 East St. Louis Street from R-HD, High-Density Multi- Family Residential District with Conditional Overlay No. 123 to GR, General Retail.

FINDINGS FOR STAFF RECOMMENDATIONS:

1. The application is consistent with the *Growth Management and Land Use Plan element* of the *Comprehensive Plan* which identifies this as an appropriate area for Medium-Intensity Retail, Office or Housing. This mixed category indicates that a variety of office, commercial and/or mid-or high-density housing may be appropriate at major intersections or along certain roadway corridors. The GR district is identified as an appropriate zoning district for this land use category. The *Plan* also identifies Center City and Missouri State University and surrounding area as major Activity Centers, which are to be locations of employment, housing, business and entertainment.

2. This application is consistent with past City Council decisions. The subject property has been zoned GR in the past. In February 2010, City Council approved General Ordinance No. 5860 rezoning the subject property from CS, Commercial Services to GR, General Retail.

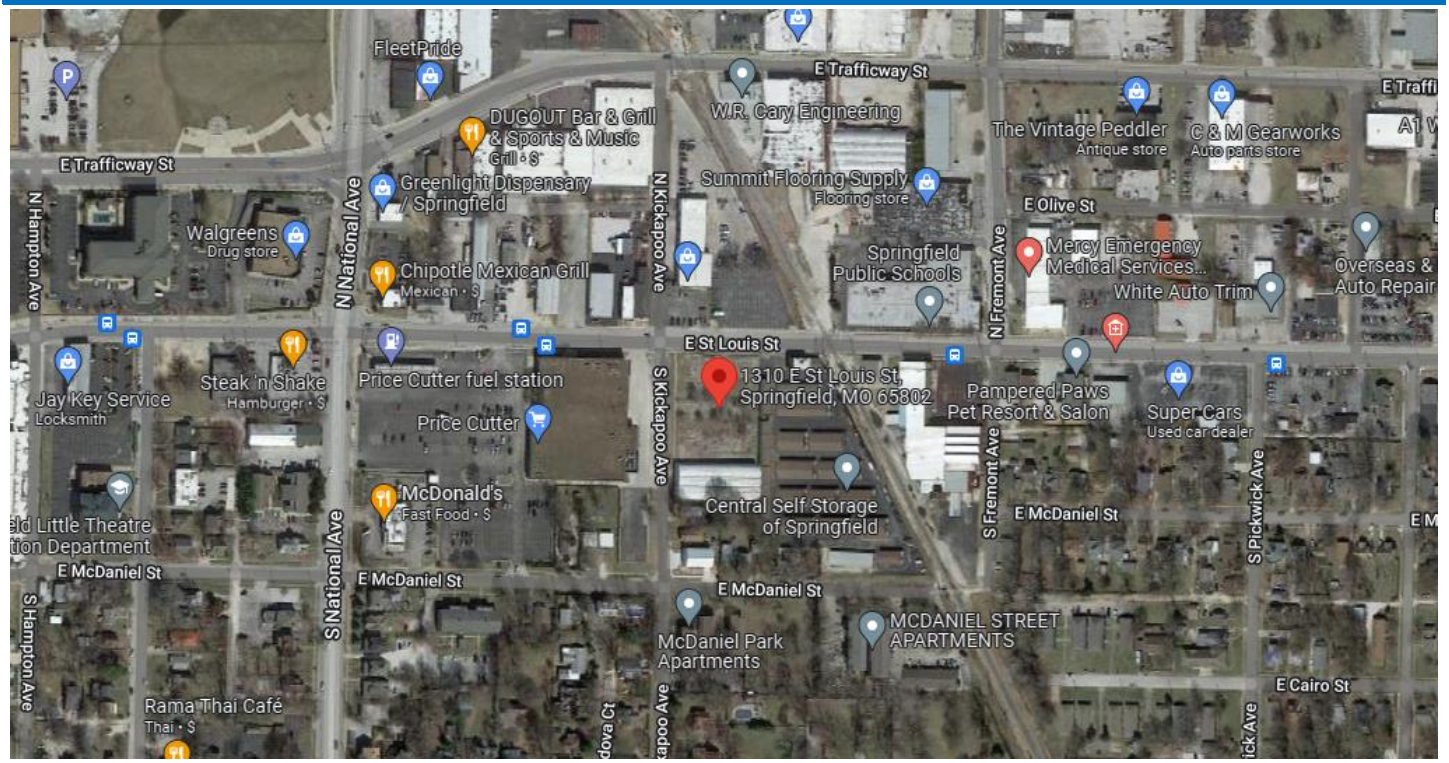
3. Approval of this application will allow for development of this underutilized property and promote infill development where investments have already been made in public services and infrastructure.

SURROUNDING ZONING AND LAND USES:

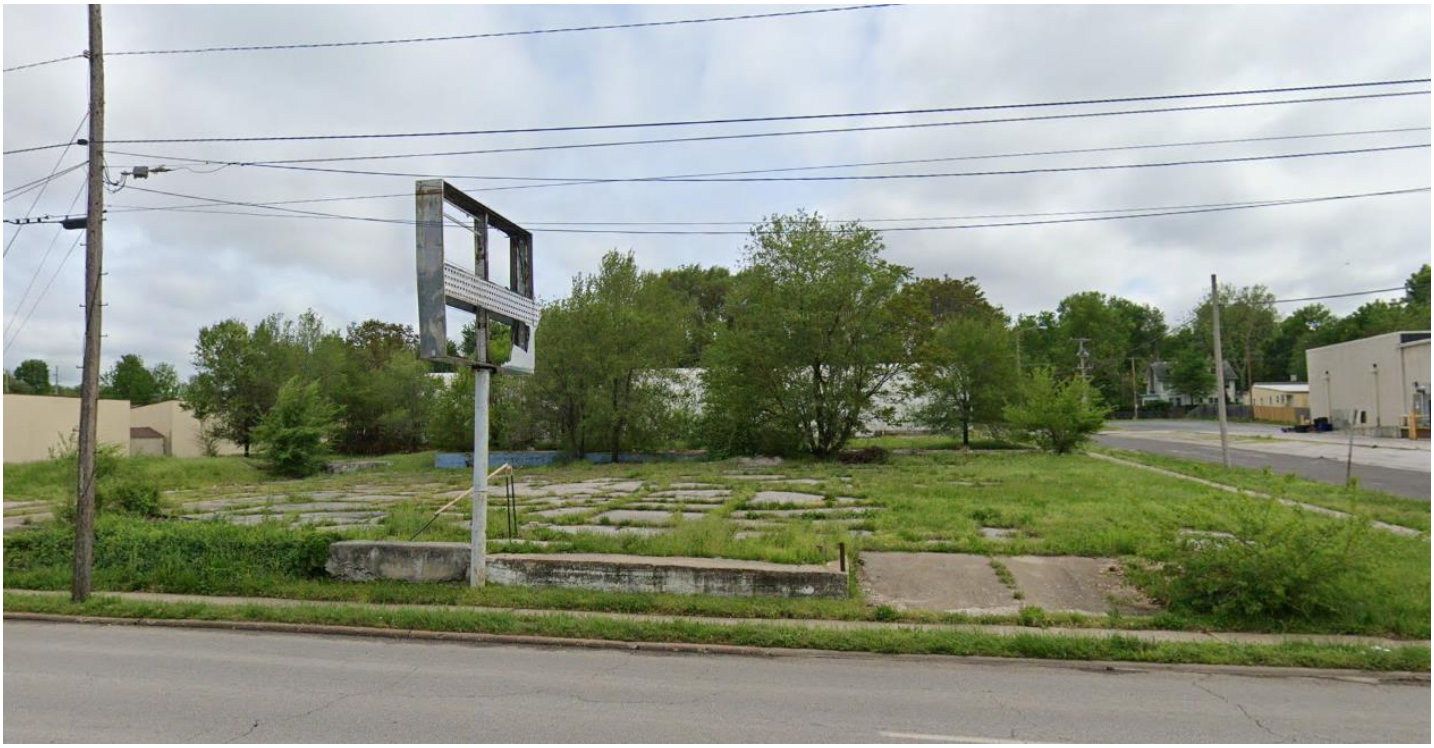
	NORTH	SOUTH	EAST	WEST
ZONING	GR	CS	CS	GR
LAND USE	Automobile Service Garage	Warehouse Use	Self-service storage facility	Grocery Supermarket

Development Review Staff Report

GOOGLE AERIAL OF LANDMARKS, BUSINESSES, AND ATTRACTIONS:

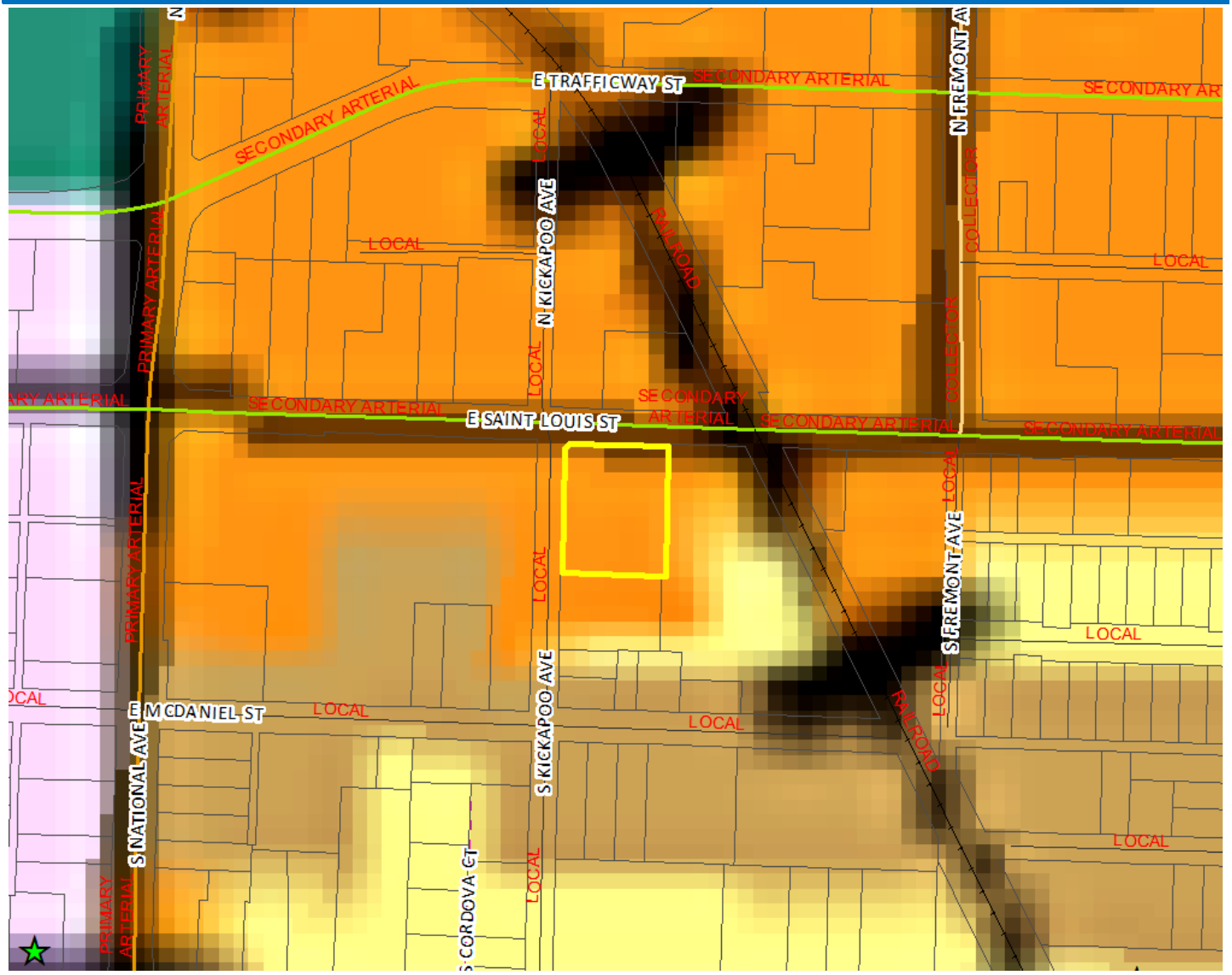


GOOGLE MAPS STREET VIEW:



Development Review Staff Report

GROWTH MANAGEMENT AND LAND USE PLAN:



- Low-Density Housing
- Medium or High Density Housing
- Medium Intensity Retail, Office or Housing
- High Intensity Retail, Office or Housing
- Greater Downtown
- Business Park
- Light Industrial, Office and Office-Warehouse
- General Industry, Transportation and Utilities
- Park
- School
- Golf
- Community-Public
- Urban Reserve Area
- Rural Area
- Greenway
- Parkway
- City Boundary
- Urban Service Area Boundary, Year 2020
- Urban Reserve Boundary, Year 2040

PROPERTY HISTORY:

In February 2010, City Council approved General Ordinance No. 5860 rezoning the subject property from CS, Commercial Services to GR, General Retail.

In April 2017, City Council approved General Ordinance No. 6358 rezoning the subject property from GR, General Retail District, to a R-HD, High-Density Multifamily Residential District, and establishing Conditional Overlay District No. 123.

PLANNING AND ZONING COMMISSION AUTHORITY:

Sec. 36-367. – Amendments

(7) Findings by the commission.

(a) Rezonings. If the application is for a reclassification of property to a different zoning district classification on the zoning map, the report of the planning and zoning commission may consider:

1. Whether the proposed zoning district classification is consistent with the Springfield Comprehensive Plan;
2. Whether there are any changed or changing conditions in the area affected that make the proposed rezoning necessary;
3. Whether the range of uses in the proposed zoning district classification are compatible with the uses permitted on other property in the immediate vicinity;
4. Whether adequate utility and sewer and water facilities exist or can be provided to serve the uses that would be permitted on the property if it were rezoned;
5. The impact the uses, which would be permitted if the property were rezoned, will have upon the volume of vehicular and pedestrian traffic and traffic safety in the vicinity;
6. Whether the proposed rezoning would correct an error in the application of this article as applied to the subject property;
7. Whether a reasonably viable economic use of the subject property will be precluded if the proposed rezoning is denied; and
8. Information submitted at the public hearing.

ZONING ORDINANCE OR CODE REQUIREMENTS:

CODE ITEM	REQUIREMENTS FOR GR
Use Limitations	a. All outdoor automobile parking areas used for the purpose of retail or wholesale storage or sale of motorized or commercial vehicles shall be prohibited. Other outdoor activities that are not specifically permitted may only be allowed as an accessory use to the permitted uses as provided in subsection 36-421(2), permitted uses, as follows: i) If any portion of the premises abuts any residential zoning district, the outdoor activities may be permitted, provided they meet the provisions of, and a conditional use permit is issued pursuant to section 36-363, conditional use permits, of this article. A building permit(s) showing compliance with all applicable codes and ordinances may be required as determined by the director of building development services. ii) If the premises abuts only nonresidential zoning districts, the outdoor activities may be permitted. A conditional use permit will not be required. A building permit(s) showing compliance with all applicable codes and ordinances may be required as determined by the director of building development services. b. No outdoor storage except as provided in subsection 36-421(2), permitted uses, and subsection 36-421(3), conditional uses. c. All uses shall operate in accordance with the noise standards contained in section 36-485, noise standards. d. No use shall emit an odor that creates a nuisance as determined by chapter 2A, article X, Springfield City Code. e. Uses on parcels not served by public water and public sewer shall meet the requirements of subsection 36-303(22). f. Streets through an adjacent residential area shall not be used to provide principal access for truck traffic to any nonresidential use in this district except on streets classified as expressways, arterials, or collectors
Maximum Structure Height	None, except that all structures shall remain below a 30-degree bulk plane as measured from the boundary of any R-SF or R-TH district.
Minimum open space requirements	20 percent
Bulk plane	30-degree bulk plane as measured from the boundary of any R-SF or R-TH district.
Bufferyard and landscaping	None required because property is surrounded by other commercial districts.

COMPATIBILITY WITH COMPREHENSIVE PLAN:

The *Growth Management and Land Use Plan element* of the *Comprehensive Plan* identifies this as an appropriate area for Medium-Intensity Retail, Office or Housing. This mixed category indicates that a variety of office, commercial and/or mid-or high-density housing may be appropriate at major intersections or along certain roadway corridors. The R-HD district is identified as an appropriate zoning district for this land use category.

The *Plan* also identifies Center City and Missouri State University and surrounding area as major Activity Centers, which are to be locations of employment, housing, business and entertainment.

Development Review Staff Report

STAFF COMMENTS:

1. The applicant is requesting to rezone approximately 1.04 acres of property generally located at 1310 East St. Louis Street from R-HD, High-Density Multi- Family Residential District with Conditional Overlay No. 123 to GR, General Retail The applicant intends to develop a mixed-use development consisting of retail uses and multi-family apartments. The current zoning does not allow for retail uses.

2. The GR district is intended for uses that provide community-wide personal and business services, shopping centers and specialty shops. This district is also intended for on-site production of handcrafted items in conjunction with retail sales. Commercial uses permitted in this district are generally required to conduct business activities indoors. The need for community-wide accessibility dictates that this district be located along or at the intersection of two or more arterial or higher classification streets.

3. The application is consistent with the *Growth Management and Land Use Plan element* of the *Comprehensive Plan* which identifies this as an appropriate area for Medium-Intensity Retail, Office or Housing. This mixed category indicates that a variety of office, commercial and/or mid-or high-density housing may be appropriate at major intersections or along certain roadway corridors. The GR district is identified as an appropriate zoning district for this land use category. The *Plan* also identifies Center City and Missouri State University and surrounding area as major Activity Centers, which are to be locations of employment, housing, business and entertainment.

4. This application is consistent with past City Council decisions. The subject property has been zoned GR in the past. In February 2010, City Council approved General Ordinance No. 5860 rezoning the subject property from CS, Commercial Services to GR, General Retail.

5. The GR district is consistent with surrounding properties which all have commercial zoning districts.

6. St. Louis Street is classified as a Secondary Arterial roadway and Kickapoo Avenue is classified as a local roadway. The applicant is proposing to have access on both St. Louis Street and Kickapoo Avenue. The Kickapoo Avenue access is currently allowed. St. Louis Street access will require an administrative replat of the property because the current plat restricts access to St. Louis Street. The applicant intends to apply for the administrative replat to remove this restriction, so that the primary access into the development will be on a Secondary Arterial, St. Louis Street, which will improve the internal circulation of the proposed development.

7. Approval of this application will allow for development of this underutilized property and promote infill development where investments have already been made in public services and infrastructure.

8. The proposed rezoning was reviewed by City departments and comments are contained in Attachment 1.

NEIGHORHOOD MEETING:

The applicant held a neighborhood meeting on February 17, 2022. The meeting summary is attached (Attachment 3).

PUBLIC NOTIFICATIONS:

The public notice was advertised in the Daily Events at least 15 days prior to the public hearing. The property was posted by the applicant at least 10 days prior to the public hearing. Public notice letters were sent out at least 10 days prior to the public hearing to all property owners within 185 feet.

Notices sent to property owners within 185 feet: Mailed: 11 Returned: 0

Development Review Staff Report

CITY OF Springfield

DEPARTMENT COMMENTS:

ATTACHMENT 1

DEPARTMENT OF BUILDING DEVELOPMENT SERVICES:

No issues with proposed rezoning.

CITY UTILITIES:

No issues with proposed rezoning.

DEPARTMENT OF ENVIRONMENTAL SERVICES WASTEWATER MANAGEMENT DIVISION:

No objection to rezoning. Public sewer is available for the address.

FIRE DEPARTMENT:

No issues.

DEPARTMENT OF PUBLIC WORKS TRAFFIC OPERATIONS DIVISION:

STREET CLASSIFICATION, RIGHT-OF-WAY, & JURISDICTION

City's Transportation Plan classifies E. Saint Louis Street as a Secondary Arterial roadway and S. Kickapoo Avenue as a Local-Commercial roadway. The standard right-of-way width for E. Saint Louis Street is 35-feet from the centerline and 30-feet from the centerline for S. Kickapoo Avenue. It appears no additional right-of-way is needed along E. Saint Louis Street or S. Kickapoo Avenue. A survey is recommended to determine the exact amount of existing right-of-way as nothing can be constructed within the required right of way. E. Saint Louis Street and S. Kickapoo Avenue are both city-maintained streets.

TRAFFIC COUNTS & ON-STREET PARKING

There most recent traffic count for E. Saint Louis Street 7.080 vehicles per day. There are no recent traffic counts for S. Kickapoo Avenue. On-street parking is not allowed along E. Saint Louis Street and is allowed along S. Kickapoo Avenue.

DRIVEWAY ACCESS

There is currently one access point onto the property from E. Saint Louis Street. This access point will need to be shifted as far east as possible to meet existing spacing standards. One access point will be allowed to S. Kickapoo Avenue a minimum of 100-feet from the intersection of S. Saint Louis Street.

SIDEWALK

There is existing sidewalk along the property frontage of E. Saint Louis Street and S. Kickapoo Avenue.

TRAILS, BUS STOPS, & ADDITIONAL INFORMATION

There are no Greenway Trails in the area surrounding the property pertaining to this zoning. There are three bus stops along E. Saint Louis Street within the vicinity of this property. The proposed development is in an area that provides for multiple direct connections and provides for good connectivity in the area.

IMPROVEMENTS

A Traffic Impact Study was not required.

TRAFFIC - TABLE 1: REZONING DETAILS

	Street Name	Street Classification	On-Street Parking	Existing Street ROW from Centerline (ft.) (Approx.)	Required Street ROW from Centerline (ft.)
Street 1	E. Saint Louis Street	Secondary Arterial	No	35	35
Street 2	S. Kickapoo Avenue	Local - Commercial	Yes	30	30

	AM Peak	PM Peak	Weekday	Weekend
Existing Trips Generated	18	22	240	
***Proposed Trips Generated**	16	67	720	
Additional Trips Generated	-2	45	480	

*Proposed Trips Generated is based on the highest, most intense use permitted in the proposed rezoning, Planned Development, or Conditional Use Permit

DEPARTMENT OF PUBLIC WORKS STORMWATER ENGINEERING DIVISION:

The property is in the **Jordan Creek South Branch** drainage basin. The property **is not** located in a FEMA designated floodplain. Staff **is** aware of flooding problems in the area. The city is not aware of a sinkhole at this location. A fee in lieu of on-site stormwater detention **will not be allowed and detention is required.** The property **is not in a stream buffer area.**

Please note that development of the property will be subject to the following conditions at the time of development:

1. For any increase in impervious surface, current detention requirements must be met per Chapter 3 Sec. 2.3.3 of the City's Flood Control and Water Quality Protection Manual. This site primarily drains to the North. A fee in lieu of constructing onsite stormwater detention will not be permitted.
2. Water quality will be required per Chapter 10 Sec. 2.0 if greater than one acre of land is disturbed. Water quality is also required for less than one acre of disturbance if part of a larger common plan.
3. As-builts of the detention and water quality improvements are required.
4. Operation and maintenance agreements are required for any permanent stormwater control measures. O&M will need to be approved during the ProjectDox process and will be reviewed by ES-Water Quality per Chapter 12 Sec. 3.0. More details at the following link: https://www.springfieldmo.gov/2120/Resources.
5. A land disturbance permit will be required if disturbing 1 acre or greater per Chapter 4 Section 5 of the City's *Flood Control and Water Quality Protection Manual*.

AFFIDAVIT OF NEIGHBORHOOD NOTIFICATION AND MEETING SUMMARY

1. Request change to zoning from: (R-HD) High-Density Multifamily R to (GR) General Retail.
   (existing zoning) *(proposed zoning)*
2. Meeting Date & Time: February 17, 2022 -- 4:00pm-6:30pm
3. Meeting Location: Panera Bread - 500 S National Ave, Springfield, MO 65802
4. Number of invitations that were sent: approximately 74
5. How the mailing list was generated: City Staff
6. Number of neighbors in attendance (attach a sign-in sheet): 2
7. List the verbal comments and how you plan to address any issues:
   (City Council does not expect all the issues to be resolved to the neighborhood's satisfaction; however, the developer must explain why the issues cannot be resolved).

   No comments, only questions.

8. List or attach the written comments and how you plan to address any issues:

   No comments, only questions. Please see attached sign in sheet.

I, Jared Davis (*print name)*, attest that the neighborhood meeting was held on 02/17/2022 (*month/date/year),* and is at least twenty-one (21) days prior to the Planning and Zoning Commission public hearing and in accordance with the attached "Neighborhood Notification and Meeting Process."

Signature of person completing affidavit

Jared M. Davis

Printed name of person completing affidavit

ANDERSON ENGINEERING
EMPLOYEE OWNED

www.AndersonEngineeringInc.com
Toll Free (866) 866-2741

CLIENT
CLIENT No. SHEET No. Of
CALCULATED By DATE
CHECKED By DATE
PROJECT

CALCULATIONS FOR: Rezone Neighborhood Meeting

Printed Name	Address	Phone #
BRIAN KUBIK	1554 E. RIVEROAKS LN	407-299-5000
JOANNA WILLIAMS	TRICECLITTER	(407) 210-0011

One-rdg. _____
P. Hrngs. X
Pgs. 34
Filed: 03-29-22

Sponsored by: Simpson

First Reading: _____ Second Reading: _____

COUNCIL BILL 2022- 079 GENERAL ORDINANCE _____

AN ORDINANCE

AMENDING the Springfield Land Development Code, Section 36-306, 'Official zoning map and rules for interpretation,' by rezoning approximately 1 acre of property generally located at 404, 420, and 424 East Sunshine Street from R-SF, Single-Family Residential District, to LB, Limited Business District, with Conditional Overlay District No. 207; establishing Conditional Overlay District No. 207; and adopting an updated Official Zoning Map. (Planning and Zoning Commission recommends denial and staff recommends approval.)

WHEREAS, an application has been filed for a zoning change of the property generally located at 404, 420, and 424 East Sunshine Street from R-SF, Single-Family Residential District, to LB, Limited Business District, with Conditional Overlay District No. 207; and

WHEREAS, Conditional Overlay District No. 207 shall modify the requirements of the Springfield Land Development Code Section 36-420, LB, Limited Business District, by requiring that the property described in "Exhibit B" comply with the requirements described in "Exhibit A;" and

WHEREAS, following proper notice, a public hearing was held before the Planning and Zoning Commission, a copy of the Record of Proceedings from said public hearing being attached hereto and incorporated herein by this reference as "Exhibit C," and said Commission made its recommendation; and

WHEREAS, the City has reviewed the applicant's request and prepared a staff report concerning the application which is attached hereto and incorporated herein by this reference as "Exhibit D;" and

WHEREAS, proper notice was given of a public hearing before City Council, and said hearing was held in accordance with the law.

NOW, THEREFORE, BE IT ORDAINED BY THE COUNCIL OF THE CITY OF

SPRINGFIELD, MISSOURI, as follows, that:

Section 1 – The property described in "Exhibit B," which is attached hereto and incorporated herein by this reference, is hereby rezoned from R-SF, Single-Family Residential District, to LB, Limited Business District, with Conditional Overlay District No. 207. Springfield Land Development Code, Section 36-306, 'Official zoning map and rules for interpretation,' is hereby amended, changed, and modified consistent with this Ordinance.

Section 2 – City Council hereby establishes Conditional Overlay District No. 207 which shall contain the requirements and standards provided in "Exhibit A," which is attached hereto and incorporated herein by this reference as though set forth herein. The requirements of Conditional Overlay District No. 207 shall modify the requirements of the Springfield Land Development Code Section 36-420, LB, Limited Business District, by requiring the property described on "Exhibit B" comply with the requirements contained in "Exhibit A."

Section 3 – City Council hereby directs the City Manager, or designee, to update the City's digital zoning map to reflect this rezoning, and City Council adopts the map thereby amended as the Official Zoning Map of Springfield, Missouri, as provided for in the Springfield Land Development Code, Section 36-306, 'Official zoning maps and rules of interpretation.'

Section 4 – The Official Zoning Map herein adopted shall be maintained and archived in the same digital form in which this Council has approved its adoption.

Section 5 – This Ordinance shall be in full force and effect from and after passage.

Passed at meeting: _____

_____
Mayor

Attest: _____, City Clerk

Filed as Ordinance: _____

Approved as to form: Jill Burris, Assistant City Attorney

Approved for Council action: Jason A. Gage, City Manager

EXPLANATION TO COUNCIL BILL 2022 -079

FILED: 03-29-22

ORIGINATING DEPARTMENT: Planning and Development

PURPOSE: Amending the Springfield Land Development Code, Section 36-306, 'Official zoning map and rules for interpretation,' by rezoning approximately 1 acre of property generally located at 404, 420 and 424 East Sunshine Street from R-SF, Single-Family Residential District to LB, Limited Business District and establishing new Conditional Overlay District No. 207. (Planning and Zoning Commission recommends denial and staff recommends approval.)

BACKGROUND INFORMATION:

ZONING CASE NUMBER Z-1-2022/ CONDITIONAL OVERLAY DISTRICT NO. 207

The applicant is proposing to rezone approximately 1 acre of properties generally located at 404, 420 and 424 East Sunshine Street from R-SF, Single-Family Residential District to LB, Limited Business District and establishing a new Conditional Overlay District No. 207. The applicant is proposing to construct a drive-thru coffee shop. This application is being processed concurrently with Conditional Use Permit No. 461 to allow an eating and drinking establishment with drive-thru windows.

The Limited Business District is intended for uses that provide convenience goods or personal services primarily to people residing in adjacent residential areas. It also includes selected retail and service uses that are similar in land use intensity and physical impact to the neighborhood sales and service uses permitted in this district. This district is designed to accommodate compact, freestanding commercial centers or to function as a transition between more intense commercial uses and residential neighborhoods. Because the permitted retail and personal service uses may be an integral part of the neighborhood, more restrictive requirements for light, air, open space, building design and landscaping are made than are provided in other commercial districts. This district should be located along or at the intersections of collector or higher classification streets.

REMARKS:

The Planning and Zoning Commission held a public hearing on March 10, 2022, and recommended to deny, by a vote of 7 to 0.

The Planning and Development staff recommends the application be approved (see the attached Development Review Staff Report).

FINDINGS FOR STAFF RECOMMENDATION:

1. The *Growth Management and Land Use Plan* designate this area as appropriate for Low Density Housing uses; however, the properties are located at a major intersection of arterial roadways. Non-residential uses exist at all other corners of this major intersection.

2. The Limited Business District is intended for uses that provide convenience goods or personal services primarily to people residing in adjacent residential areas.

3. The Conditional Overlay District (Attachment 2) will prohibit access to Sunshine, require cross-access between Jefferson and Roanoke, a lot combination of 420 & 424 East Sunshine and require full bufferyards for adjacent R-SF properties.

Submitted by:

Daniel Neal,
Senior Planner

Recommended by:

Brendan Griesemer, AICP
Assistant Director

Approved by:

Jason Gage,
City Manager

EXHIBITS:
Exhibit A, Conditional Overlay District Provisions
Exhibit B, Legal Description
Exhibit C, Record of Proceedings
Exhibit D, Development Review Staff Report

ATTACHMENTS:
Attachment 1: Department Comments
Attachment 2: Conditional Overlay District Provisions
Attachment 3: Neighborhood Meeting Summary
Attachment 4: Neighborhood Correspondence

EXHIBIT A

CONDITIONAL OVERLAY DISTRICT PROVISIONS
ZONING CASE Z-1-2022 & CONDITIONAL OVERLAY DISTRICT NO. 207

The requirements of *Section 36-420.* of the *Springfield Zoning Ordinance* shall be modified herein for development within this district to include the following.

1. No access is allowed to Sunshine Street from any lots except for the existing residential driveway on Lot 7 of Noble Heights Subdivision Unit #1 (420 E. Sunshine St.) which shall be closed, at the owner's expense, once the existing residence has been demolished or is no longer used residentially.

2. The exemption for narrow or shallow properties per Section 36-482 shall not be applied to any development of these properties.

3. Access to Jefferson Avenue and Roanoke Avenue is limited to the most southern portion of the property that are not located in the required bufferyard.

4. Provisions for a cross access easements shall be provided through all Lots 6-11 of Noble Heights Subdivision Unit #1 between Jefferson and Roanoke Avenues.

5. The required bufferyard/landscaping on Lots 6 & 7 shall be established once the existing residential structures at 420 & 424 E. Sunshine St. have been demolished.

6. An administrative lot combination of Lots 6 & 7 of Noble Heights Subdivision Unit #1 is required at the time of development.

EXHIBIT B

LEGAL DESCRIPTION
ZONING CASE Z-1-2022 & CONDITIONAL OVERLAY DISTRICT NO. 207

Lots 6 through 11 of Unit #1, Noble Heights Subdivision, Springfield, Greene County, Missouri except new street right-of-way.

EXHIBIT C

RECORD OF PROCEEDINGS
Planning and Zoning Commission – March 10, 2022

Z-1-2022 w/COD #207
404, 420 & 424 East Sunshine Street
Applicant: Kelly & Tamra Rhoades

Mr. Hosmer states that this is a request to rezone approximately 1 acre of property located at 404, 420 and 424 East Sunshine Street from R-SF, Single-Family Residential District to LB, Limited Business District and establishing a new Conditional Overlay District No. 207. The Comprehensive Plan identifies this area for Low Density Housing uses; however, the properties are located at a major intersection of arterial roadways. Non-residential uses exist at all other corners of this major intersection and the Transportation Plan classifies Sunshine as a Secondary Arterial, Jefferson as a Collector and Roanoke as a Local roadway and a Traffic Impact Study is not required. The property is not located in a FEMA designated floodplain, sinkhole or stream buffer area and stormwater detention is required. The Limited Business District is intended for uses that provide convenience goods or personal services primarily to people residing in adjacent residential areas.

The Conditional Overlay District will:

- Not allow access to Sunshine (except for existing home),
- Not allow the narrow lot exemption for reduced landscaping, require landscaping lots 6-7 if homes are demolished,
- Limit access to the southern portions of Jefferson and Roanoke. Require cross access,
- Require a lot combination for lots 6-7 at time of development.

Staff recommends approval.

Mr. Colony asked if all would be under the same zoning (Phase II) and any access to Phase II.

Mr. Hosmer noted that it will be under the same zoning classification and no access to Phase II until the homes are demolished.

Mr. Knuckles asked about the access on Phase II to Sunshine.

Mr. Hosmer said currently house has access to Sunshine, but when demolished then no access to Sunshine would be allowed.

Mr. Lebeck asked again about access to Sunshine and how many car lines are for queuing.

Mr. Hosmer noted that there will no access from the coffee shop to Sunshine and he noted that there are approximately 3 lines for cars.

Mr. Doennig opened the public hearing.

Mr. Dane Seiler, 5051 S. National and representative for the applicant and trying to rezone the 3 lots (one vacant and two with rental homes) and asking for Limited Business. Already have an interested party for a coffee shop and only access is off Jefferson Avenue and when the two houses are demolished then connection will be made at Roanoke Avenue with capability for 15 vehicles. Stormwater will be under the parking lot due to lack of size and will clean out the trash and into the storm system. At the neighborhood meeting the issues were traffic (access to Sunshine) and adding sidewalk to Roanoke.

Mr. Colony asked about the retention.

Mr. Seiler noted that he believes it would be underground due to lack of size.

Ms. Peterson, 1024 E. Stanford and is the President of the University Heights and have submitted commits. She stated that the board has several issues with rezoning in this residential neighborhood. She noted that they take pride in their homes, and this would allow for more drive-throughs and strip malls and asked that the City reconsider this type of redevelopment and suggested that it be redeveloped like it is at Cherry and Pickwick. She does not believe this type of development belongs in the location.

Ms. Hemann, 1039 E. University and is a member of University Heights and noted current traffic issues with a mention of major traffic issues just up the street (Caines Chicken). Believes this would generate more traffic and noise and the destruction of the residential neighborhood that exists would like to see it as a green space.
Mr. Coltrin asked how far University extends.

Ms. Hemann noted the area from National, Campbell, and Sunshine.

Mr. Colony asked if the proposed development is in University Heights.

Ms. Hemann stated that it is not in University Heights.

Mr. Jeremy Roberts, 500 E. Sunshine noted that his father owns the residence directly across from the proposed development that are to be demolished (Phase II) and asked about the access from Roanoke to Sunshine. Believes that there is a better use for the area.

Mr. Cody Hicks, 1817 S. Roanoke Avenue lives behind the proposed development and believes it could have a better use and talked about traffic issues and the kids walking in the area. He also noted noise issues, traffic, and lights, is not opposed to a business, but a different type of business.

Mr. Coltrin asked what type of business he would like to see.

Mr. Hicks said that he would like to see a bistro, etc., and noted that he cannot see how a second business would be able to be put in the area (Phase II).

Mr. Doennig asked about kids and what school they go to.

Mr. Hicks does not have kids so was not aware where they go to school.

Ms. Hollon 1133 E. Linwood Drive and had two children attend Sunshine Elementary School and has safety issues with the children and buses crossing over Sunshine Street and gave examples of the children walking to the school with the designated crosswalk (Sunshine Street/Jefferson Avenue) and has no crossing guard at this time.

Mr. Colony asked about the crossing guard at Sunshine Street and Jefferson Avenue.

Ms. Hollon noted that there is no crossing guard and use the light at Sunshine Street and Jefferson Avenue and the school zone is on Jefferson Avenue.

Ms. Regan, 901 E. University noted school safety issues with children possibly walking in front of a high traffic business. She also noted previous zoning issues in area the regarding safety issues.

Mr. Biskup, 800 E. Portland Street lives in University Heights and noted traffic issues and disagreed on staff approval and noted the non-residential use being a church and school and said the Growth Management Plan must be taken into account with the existing residential uses and new development need to be compatible and believes it is breaking the fabric of the corridor. The Conditional Use Permit (CUP) needs to be appropriate to minimize any adverse effects and believes the drive through would be an would not be the best use.

Ms. Schulze, 505 E. Ottowa Court and agrees that there are safety issues and noted the lack of sidewalks and would like to see this as a green space noting that west of the area is nothing but concrete and fast-food restaurants and now extending in the other direction.

Mr. Lebeck asked how long she has lived in the area and what type of block does she consider Jefferson and National.

Ms. Schulze said she has lived in the area for 30 years and Jefferson and National is residential/neighborhood except for the school.

Mr. Doennig closed the public hearing.

Mr. Knuckles asked about traffic and if Jefferson and Sunshine and if traffic is regulated for the school.

Ms. Gardner stated that it is regulated on the north side of Sunshine Street.

Mr. Doennig asked if we could approve for a same type of drive through on Phase II.

Mr. Hosmer stated they are only approving for current drive-through and the CUP does not extend to Phase II.

Mr. Doennig asked what type of traffic (trip generation rates) this type of coffee shop has.

Ms. Gardner said they have done a trip generation rates on a coffee shop, not necessarily for Starbucks, etc., however based on a coffee shop with no inside seating, this would under the threshold for a traffic study.

Ms. Bruce asked if adverse concerns or effects for the coffee shop from the neighborhood.

Ms. Gardner noted that she is not aware of any.

Mr. Codichini noted the only concern was from the coffee shop (7 Brew) on Glenstone Avenue and it was regarding trash and detention and not comparable.

Mr. Jobe stated that this particular stretch of Sunshine was considered an US Hwy and what does the Comprehensive Plan consider this stretch of Sunshine to be currently and what is to be done with this stretch of road to be.

Mr. Hosmer noted it is considered low density residential for this section, however noted the activity center at National Avenue and Sunshine Street and stated that staff has been discussed a lot and not sure what the answer is and will need to have a study done.

Mr. Doennig said that the Comprehensive Plan consider this low density residential.

Mr. Hosmer noted different types due to a split with institutional/public.

Mr. Doennig commented about a prior project at Kansas Express and Sunshine Street that would change the zoning and would force traffic into the residential neighborhood and believes that this is the same situation and cannot see where a drive through business with kids crossing and an exit on Roanoke Avenue where it is not able to handle commercial traffic. This neighborhood is unique in the city and believes the area is still viable as a neighborhood and believes it is not a good idea and will be voting against it.

Mr. Colony also agrees with comments on traffic issues and if an approach would be allowed to the east.

Ms. Gardner stated that they would not be able to have access to Sunshine Street if project goes forward and only 420 E. Sunshine would have driveway access if it remained residential (not demolished).

Mr. Jobe is conflicted about this project and believes this is a major arterial but does not know what the future is and supporting this would be consistent with the Comprehensive Plan and will reserve making any changes until we do.

Mr. Lebeck believes this is the wrong place for a coffee shop and this is residential (low density housing) and went over example in the Comprehensive Plan and will not be supporting it.

COMMISSION ACTION: (motion failed)
Mr. Jobe motioned to recommend **approval** for Z-1-2022 w/COD #207 (404, 420 & 424 East Sunshine Street). Mr. Colony seconded the motion. Ayes: None. Nays: Doennig, Coltrin, Knuckles, Colony, Bruce, Jobe, and Lebeck. Abstain: None. Absent: Broekhoven.

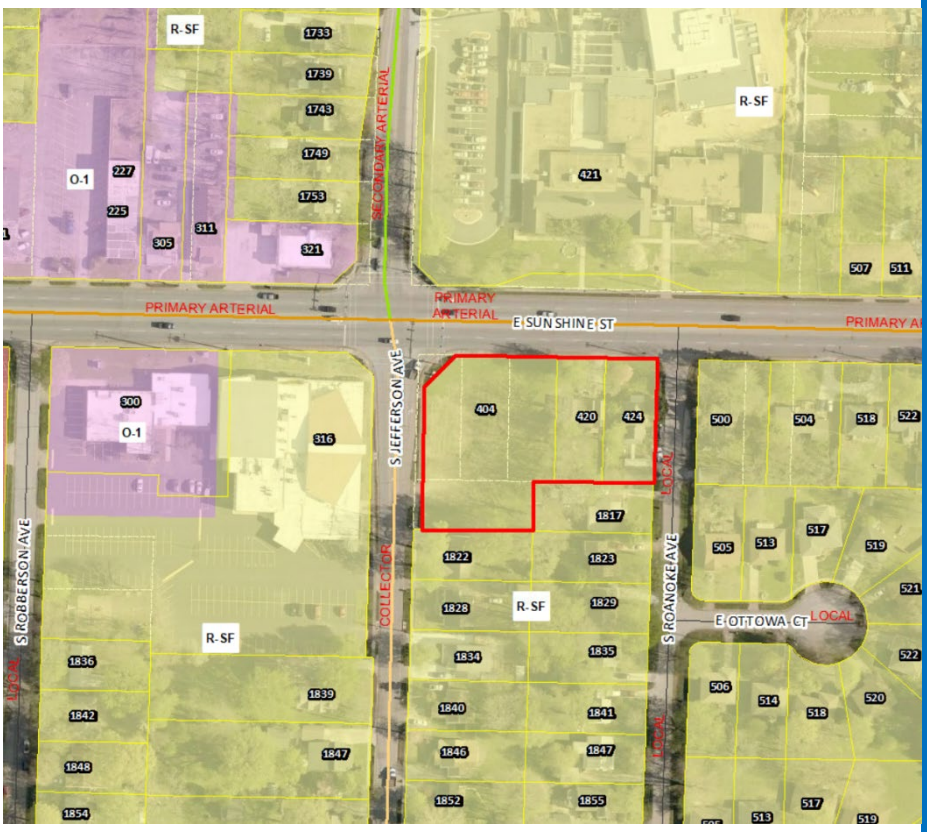
Bob Hosmer, AICP
Planning Manager

EXHIBIT D

Development Review Staff Report

CITY OF Springfield

PLANNING AND ZONING COMMISSION PUBLIC HEARING:	MARCH 10, 2022
CITY COUNCIL PUBLIC HEARING:	APRIL 4, 2022



CASE NUMBER:
Z-1-2022 w/Conditional Overlay District No. 207

LOCATION:
404, 420 & 424 E. Sunshine Street

ACRES:
Approximately 1 acre

EXISTING LAND USE:
Undeveloped lot and single-family homes

APPLICANT:
Reding Management and Redec, LLCs

STAFF:
Daniel Neal, 864-1036

STAFF RECOMMENDATIONS:
Approve

PROPOSED MOTION: Move to approve as submitted in the staff report. Required vote is a majority of those present (5 members are a quorum).

SUMMARY OF REQUEST:

Request to rezone approximately 1 acre of properties from R-SF, Single-Family Residential District to LB, Limited Business District and establishing a new Conditional Overlay District No. 207.

FINDINGS FOR STAFF RECOMMENDATION:

1. The *Growth Management and Land Use Plan* designate this area as appropriate for Low Density Housing uses; however, the properties are located at a major intersection of arterial roadways. Non-residential uses exist at all other corners of this major intersection.

2. The Limited Business District is intended for uses that provide convenience goods or personal services primarily to people residing in adjacent residential areas.

3. The Conditional Overlay District (Attachment 2) will prohibit access to Sunshine, require cross-access between Jefferson and Roanoke, a lot combination of 420 & 424 E. Sunshine and require full bufferyards for adjacent R-SF properties.

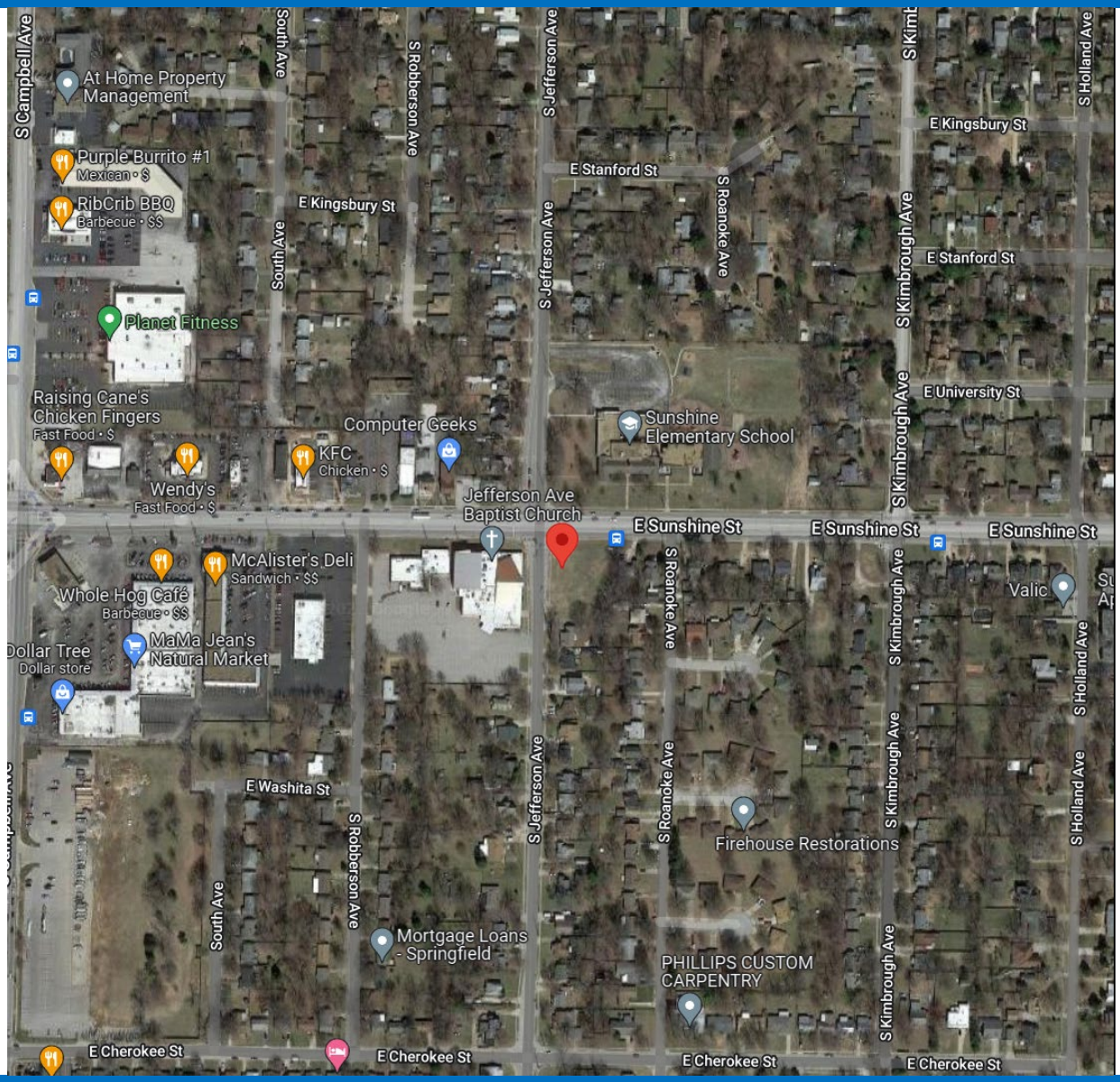
SURROUNDING ZONING AND LAND USES:

	NORTH	SOUTH	EAST	WEST
ZONING	R-SF	R-SF	R-SF	R-SF
LAND USE	Elementary school	Single-family residential uses	Single-family residential uses	Church uses

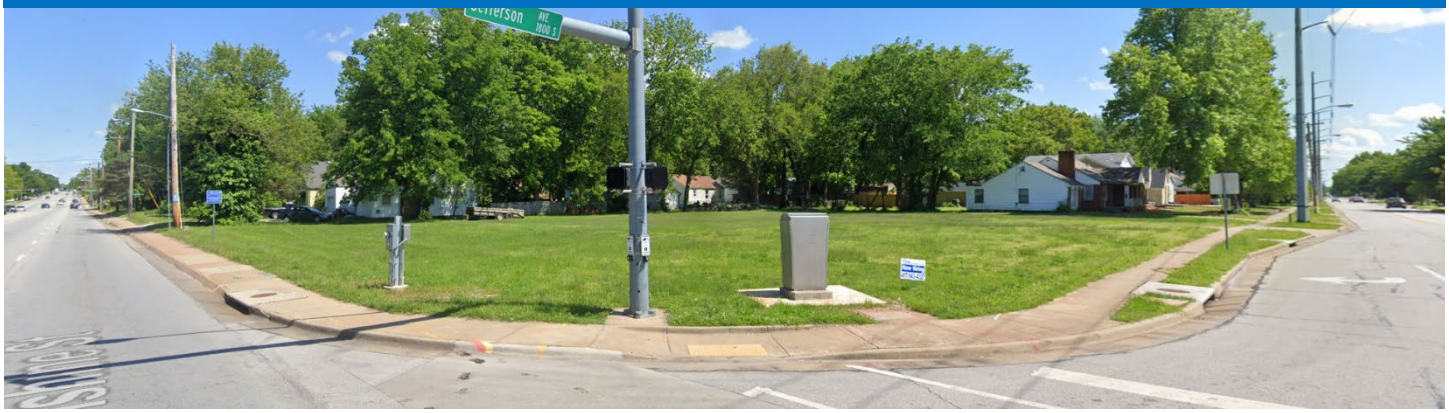
Development Review Staff Report

CITY OF Springfield

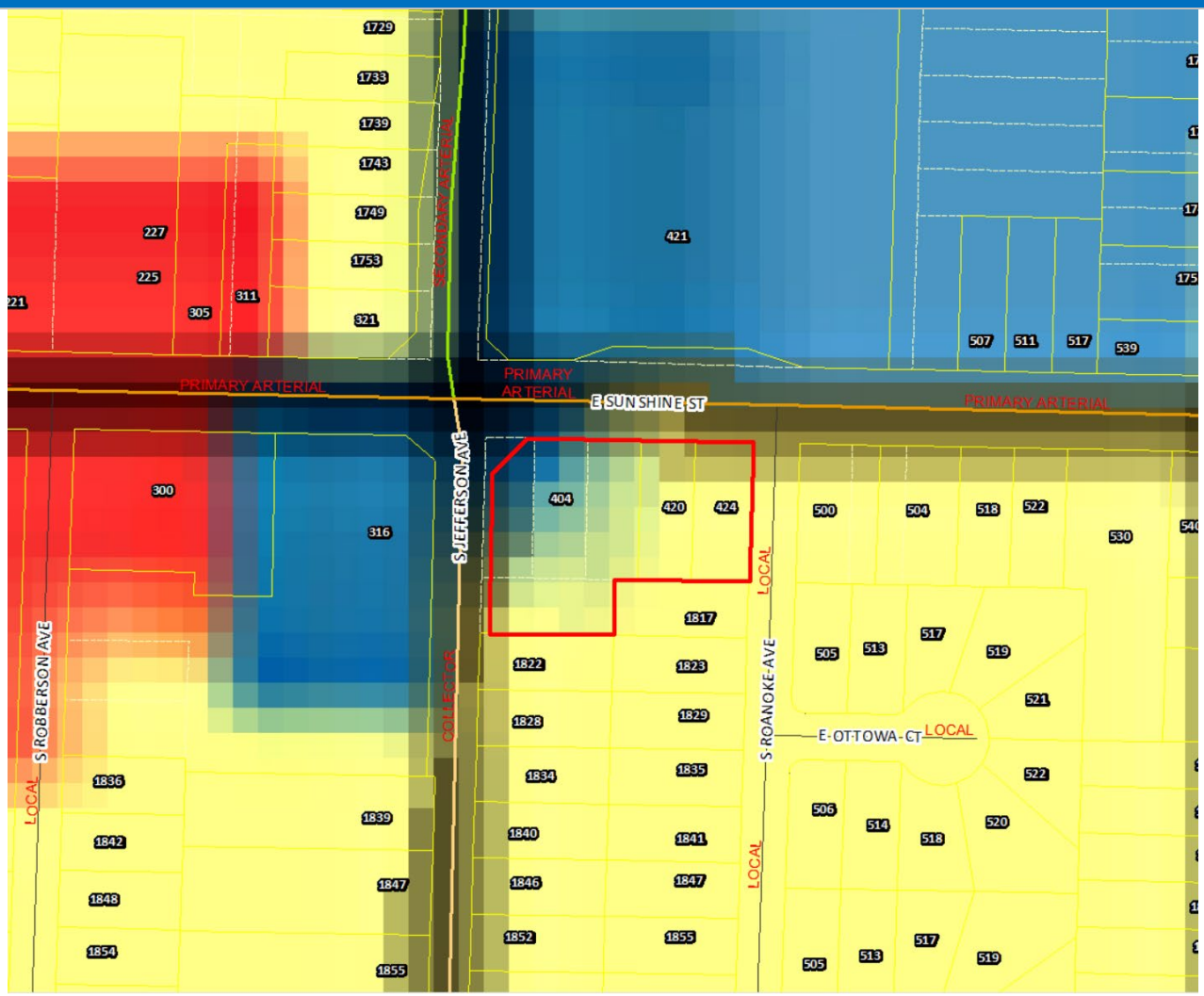
SURROUNDING LAND USES (GOOGLE MAP AERIAL VIEW):



GOOGLE MAPS STREET VIEW:



GROWTH MANAGEMENT AND LAND USE PLAN:



- Low-Density Housing
- Medium or High Density Housing
- Medium Intensity Retail, Office or Housing
- High Intensity Retail, Office or Housing
- Greater Downtown
- Business Park
- Light Industrial, Office and Office-Warehouse
- General Industry, Transportation and Utilities
- Park
- School
- Golf
- Community-Public
- Urban Reserve Area
- Rural Area
- Greenway
- Parkway
- City Boundary
- Urban Service Area Boundary, Year 2020
- Urban Reserve Boundary, Year 2040

Development Review Staff Report

PROPERTY HISTORY:

The property was annexed in 1926 and has been zoned R-SF, Single-Family Residential District since the Citywide remapping in 1995.

ZONING ORDINANCE REQUIREMENTS:

Sec. 36-367. – Amendments

(7) Findings by the commission.

(A) Rezonings. if the application is for a reclassification of property to a different zoning district classification on the zoning map, the report of the planning and zoning commission may consider:

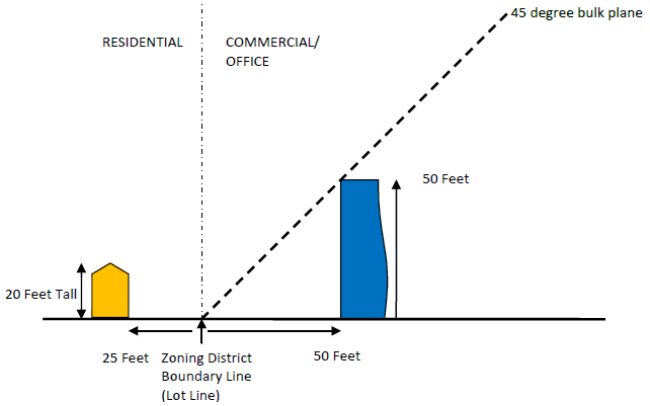
1. Whether the proposed zoning district classification is consistent with the Springfield comprehensive plan;
2. Whether there are any changed or changing conditions in the area affected that make the proposed rezoning necessary;
3. Whether the range of uses in the proposed zoning district classification are compatible with the uses permitted on other property in the immediate vicinity;
4. Whether adequate utility and sewer and water facilities exist or can be provided to serve the uses that would be permitted on the property if it were rezoned;
5. The impact the uses, which would be permitted if the property were rezoned, will have upon the volume of vehicular and pedestrian traffic and traffic safety in the vicinity;
6. Whether the proposed rezoning would correct an error in the application of this article as applied to the subject property;
7. Whether a reasonably viable economic use of the subject property will be precluded if the proposed rezoning is denied; and
8. Information submitted at the public hearing.

COMPATIBILITY WITH THE ZONING ORDINANCE:

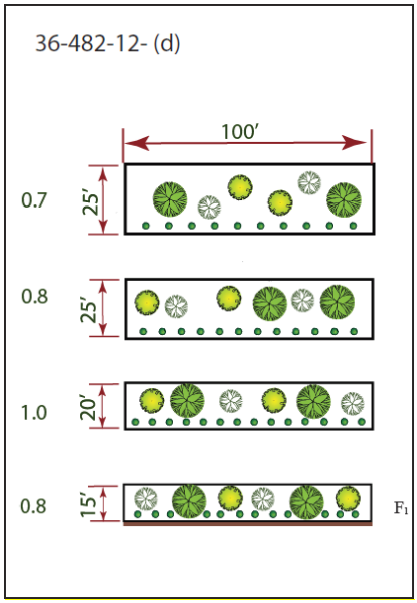
CODE ITEM	REQUIREMENTS FOR LB
Use Limitations	(a) All activities and permitted uses except off-street parking and loading facilities, drive-thru facilities, and day care activities shall be conducted entirely within a completely enclosed building. (b) No individual retail store, personal service establishment or other permitted use shall have a gross floor area greater than 5,000 square feet.
Maximum Structure Height	1. Principal building: 25 feet. 2. Except that all structures shall remain below 30-degree bulk plane as measured from the boundary of any R-SF or R-TH district.
Front Yard Setback	25 feet along a street classified as a collector or higher or 15 feet along a street classified as a local street
Side and Rear Setbacks	*Side yard:* None, except as required by Section 36-453, supplemental open space and yard regulations. *Rear yards:* Twenty percent of the lot depth or ten feet whichever is greater. No more than 25 feet shall be required.
Open Space Requirement	20%
Design Requirements	Standard per code

BULK PLANE	LANDSCAPING

30-degree bulk plane is required from the boundaries of a R-SF zoning district



Bufferyard Type D when adjacent to R-SF



COMPATIBILITY WITH COMPREHENSIVE PLAN:

The *Growth Management and Land Use Plan* designate this area as appropriate for Low Density Housing uses; however, the properties are located at a major intersection of arterial roadways.

The Major Thoroughfare Plan classifies Sunshine Street as a primary arterial, Jefferson Avenue north of Sunshine Street as a secondary arterial and south of Sunshine as a collector roadway. Roanoke Avenue is classified as a local roadway.

The *Growth Management and Land Use Plan* of the *Comprehensive Plan* states that protection of our existing residential neighborhoods is a prime concern. It is important to ensure that new land uses are not detrimental to residential areas and to recognize the vulnerability of residential areas to certain adverse impacts. This objective does not mean that non-residential land uses are automatically inappropriate in residential areas; it means that design and location criteria must take into account the existing residential areas. Mixed land uses, as well as mixed residential densities, will need to be accommodated in the future. These must be accommodated with sensitivity to existing residential neighborhoods. The plan encourages mixed use. However, where commercial areas are concentrated, they should be sited and designed to have a minimal effect on adjacent lower-intensity development, and the environment.

The *Community Physical Image and Character Plan* element of the *Comprehensive Plan* developed goals to improve the visual appearance of the urban area and the *Growth Management and Land Use* Plan element encourages the protection of residential neighborhoods from adverse impacts of proposed development and inappropriate land use changes. New development should be compatible with existing development in terms of scale, materials, rooflines, setbacks and open space.

The *Growth Management and Land Use Plan* of the *Comprehensive Plan* also states that new development should be compatible with existing development in terms of scale, materials, rooflines setbacks and open space. Landscaped transitions should be used between sharply differing types of land use. Encourage the effective use of location, design and landscaping of commercial uses to screen and buffer neighborhoods from lights, signs, traffic noise and pollution, and other factors incompatible or conflicting with adjacent land uses. These practices will help ensure the integrity and function of the road system, reduce the length and frequency of auto trips, minimize impact on residential areas and contribute to the overall attractiveness of the community.

STAFF COMMENTS:

1. The applicant is proposing to rezone approximately 1 acre of properties generally located at 404, 420 and 424 E. Sunshine Street from R-SF, Single-Family Residential District to LB, Limited Business District and establishing a new Conditional Overlay District No. 207. The applicant is proposing to construct a drive-thru coffee shop. This

application is being processed concurrently with Conditional Use Permit No. 461 to allow an eating and drinking establishment with drive-thru windows.

2. The Limited Business District is intended for uses that provide convenience goods or personal services primarily to people residing in adjacent residential areas. It also includes selected retail and service uses that are similar in land use intensity and physical impact to the neighborhood sales and service uses permitted in this district. This district is designed to accommodate compact, freestanding commercial centers or to function as a transition between more intense commercial uses and residential neighborhoods. Because the permitted retail and personal service uses may be an integral part of the neighborhood, more restrictive requirements for light, air, open space, building design and landscaping are made than are provided in other commercial districts. This district should be located along or at the intersections of collector or higher classification streets

3. Non-residential uses exist at all other corners of this major intersection. There is an existing elementary school at the northeast corner, church building at the southwest corner and office building at the northwest corner of the intersection of Sunshine Street and Jefferson Avenue.

4. The proposed Conditional Overlay District (Attachment 2) will prohibit access to Sunshine Street from any lots except for the existing driveway at 420 E. Sunshine Street, which can remain as long as the residential structure is existing and being utilized residentially. It will also restrict access to Jefferson and Roanoke Avenues to the most southern portion of the property that are not located in the required bufferyard. It will require cross-access easements between Jefferson and Roanoke to provide safer access to Sunshine Street, rather than providing direct access to Sunshine Street. It will require a lot combination of 420 & 424 E. Sunshine Street once the residences have been demolished. It will require full bufferyards for adjacent R-SF properties as opposed to allowing the shallow lot exemptions that would allow a reduction in bufferyard width and landscaping. Lastly, it will require bufferyard/landscaping to be established once the existing residential structures on Lots 6 & 7 at 420 & 424 E. Sunshine St. have been demolished.

5. The development of the property will require a bufferyard along the south property line adjacent to the R-SF, Single-Family Residential zoning district. The normal bufferyard required between LB and R-SF would be a Bufferyard "Type D" at least fifteen (15) feet wide. For each one-hundred (100) linear feet of bufferyard, there must be two (2) canopy trees, two (2) understory trees, two (2) evergreen tree and fourteen (14) shrubs. A six-foot-tall solid wood fence is also required as part of this bufferyard.

6. The maximum structure height for the principal building is 25 feet and all structures shall remain below a 30 degree bulk plane as measured from the boundary of any R-SF or R-TH district.

7. A Traffic Impact Study was not required as the change in zoning does not generate an additional 100 trips in the a.m. or p.m. peak or 500 trips in a 24-hour period.

8. There is currently no sidewalk along the property frontage of S. Roanoke Avenue. The developer will be required to install sidewalk in accordance with the City of Springfield Public Works Design Guide at the time of development.

9. The proposed rezoning was reviewed by City departments and comments are contained in Attachment 1.

NEIGHBORHOOD MEETING:

The applicant held a neighborhood meeting on February 14, 2022, regarding the rezoning request. A summary of the meeting is attached (Attachment 3).

PUBLIC NOTIFICATION:

The public notice was advertised in the Daily Events at least 15 days prior to the public hearing. The property was posted by the applicant at least 10 days prior to the public hearing. Public notice letters were sent out at least 10 days prior to the public hearing to all property owners within 185 feet.

Notices sent to property owners within 185 feet: Mailed: 18 Returned: 0

DEPARTMENT COMMENTS:

ATTACHMENT 1
DEPARTMENT COMMENTS

DEPARTMENT OF BUILDING DEVELOPMENT SERVICES:

No comments.

CITY UTILITIES:

No comments.

DEPARTMENT OF ENVIRONMENTAL SERVICES WASTEWATER MANAGEMENT DIVISION:

No objection to the rezoning. Lot has access to public sewer.

FIRE DEPARTMENT:

No comments.

DEPARTMENT OF PUBLIC WORKS TRAFFIC OPERATIONS DIVISION:

STREET CLASSIFICATION, RIGHT-OF-WAY, & JURISDICTION
City's Transportation Plan classifies E. Sunshine Street as a Primary Arterial, S. Jefferson Avenue as a Collector roadway and S. Roanoke Avenue as a Local-Residential roadway. The standard right-of-way width for E. Sunshine Street is 50-feet from the centerline, 30-feet from the centerline for S. Jefferson Avenue and 25-feet from the centerline for S. Roanoke Avenue. It appears an additional 10-feet of right-of-way is needed along E. Sunshine Avenue. It appears no additional right of way is needed along S. Jefferson Avenue or S. Roanoke Avenue. A 30-foot X 30-foot right of way site triangle is also needed at the intersection of E. Sunshine Avenue and S. Roanoke Avenue. A survey is recommended to determine the exact amount of existing right-of-way as nothing can be constructed within the required right of way. E. Sunshine Avenue, S. Jefferson Avenue and S. Roanoke Avenue are city-maintained streets.

TRAFFIC COUNTS & ON-STREET PARKING
The most recent traffic counts for E. Sunshine Avenue is 35,500 vehicles per day and for S. Jefferson Avenue is 4,995 vehicles per day. There are no traffic counts for S. Roanoke Avenue since it is classified as a Local roadway. On-street parking is not allowed along E. Sunshine Avenue or S. Jefferson Avenue. On-street parking is allowed on S. Roanoke Avenue.

DRIVEWAY ACCESS
There is one driveway access point onto the property from E. Sunshine Street, one from S. Jefferson Avenue and one from S. Roanoke Avenue. No access will be allowed to the property from E. Sunshine Street and one access point will be allowed from S. Jefferson Avenue as far south from the intersection of E. Sunshine Street as possible. One access point will be allowed from S. Roanoke Street and must be a minimum of 100 feet from E. Sunshine Street to meet current City of Springfield spacing standards set forth in the City of Springfield Public Works Design Guide.

SIDEWALK

There is existing sidewalk along the property frontage of E. Sunshine Street and S. Jefferson Avenue. There is currently no sidewalk along the property frontage of S. Roanoke Avenue. The developer will be required to install sidewalk in accordance with the City of Springfield Public Works Design Guide at the time of development.

TRAILS, BUS STOPS, & ADDITIONAL INFORMATION

There are no Greenway Trails in the area surrounding the property pertaining to this zoning. There is one bus stops along E. Sunshine Street along the property frontage of this development. The proposed development is in an area that provides for multiple direct connections and provides for good connectivity in the area.

IMPROVEMENTS

A Traffic Impact Study was not required as the change in zoning does not generate an additional 100 trips in the am or pm peak or 500 trips in a 24-hour period.

TRAFFIC - TABLE 1: REZONING DETAILS

	Street Name	Street Classification	On-Street Parking	Existing Street ROW from Centerline (ft.) (Approx.)	Required Street ROW from Centerline (ft.)
Street 1	E. Sunshine St	Primary Arterial	No	40	50
Street 2	S. Jefferson Ave	Collector	No	30	30
Street 3	S. Roanoke Ave	Local – Commercial	Yes	25	30

	AM Peak	PM Peak	Weekday	Weekend
Existing Trips Generated	3	4	35	
*Proposed Trips Generated	8	29	343	
Additional Trips Generated	5	25	308	

*Proposed Trips Generated is based on the highest, most intense use permitted in the proposed rezoning, Planned Development, or Conditional Use Permit

DEPARTMENT OF PUBLIC WORKS STORMWATER ENGINEERING DIVISION:

The property is in the **Fassnight Creek** drainage basin. The property **is not** located in a FEMA designated floodplain. Staff **is not** aware of flooding problems in the area. The city is not aware of a sinkhole at this location. A fee in lieu of on-site stormwater detention **will not be allowed and detention is required.** The property **is not in a stream buffer area.**

Please note that development of the property will be subject to the following conditions at the time of development:

1. For any increase in impervious surface, current detention requirements must be met per Chapter 3 Sec. 2.3.3 of the City's Flood Control and Water Quality Protection Manual. This site primarily drains to the East. A fee in lieu of constructing onsite stormwater detention will not be permitted.

2. Water quality will be required per Chapter 10 Sec. 2.0 if greater than one acre of land is disturbed. Water quality is also required for less than one acre of disturbance if part of a larger common plan.

3. As-builts of the detention and water quality improvements are required.

4. A land disturbance permit will be required if disturbing 1 acre or greater per Chapter 4 Section 5 of the City's *Flood Control and Water Quality Protection Manual*.

5. Operation and maintenance agreements are required for any permanent stormwater control measures. O&M will need to be approved during the ProjectDox process and will be reviewed by ES-Water Quality per Chapter 12 Sec. 3.0. More details at the following link: https://www.springfieldmo.gov/2120/Resources.

REQUIREMENTS FOR APPROVAL:

ATTACHMENT 2
CONDITIONAL OVERLAY DISTRICT PROVISIONS

The requirements of Section 36-420., Limited business district of the Land Development Codes shall be modified as set forth herein for development within this district to include the following:

1. No access is allowed to Sunshine Street from any lots except for the existing residential driveway on Lot 7 of Noble Heights Subdivision Unit #1 (420 E. Sunshine St.) which shall be closed, at the owner's expense, once the existing residence has been demolished or is no longer used residentially.

2. The exemption for narrow or shallow properties per Section 36-482 shall not be applied to any development of these properties.

3. Access to Jefferson Avenue and Roanoke Avenue is limited to the most southern portion of the property that are not located in the required bufferyard.

4. Provisions for a cross access easements shall be provided through all Lots 6-11 of Noble Heights Subdivision Unit #1 between Jefferson and Roanoke Avenues.

5. The required bufferyard/landscaping on Lots 6 & 7 shall be established once the existing residential structures at 420 & 424 E. Sunshine St. have been demolished.

6. An administrative lot combination of Lots 6 & 7 of Noble Heights Subdivision Unit #1 is required at the time of development.

AFFIDAVIT OF NEIGHBORHOOD NOTIFICATION AND MEETING SUMMARY

1. Request change to zoning from: R-SF (*existing zoning*) to LB, With a CUP (*proposed zoning*)
2. Meeting Date & Time: Febuary 14th, 2022 from 4:00pm to 6:30pm
3. Meeting Location: 316 E Sunshine Street
4. Number of invitations that were sent: _____
5. How the mailing list was generated: Via City of Springfield Planning Services
6. Number of neighbors in attendance (attach a sign-in sheet): 14
7. List the verbal comments and how you plan to address any issues:
(City Council does not expect all the issues to be resolved to the neighborhood's satisfaction; however, the developer must explain why the issues cannot be resolved.)

See Attached

8. List or attach the written comments and how you plan to address any issues:

None received.

I, Dane Seiler (*print name*), attest that the neighborhood meeting was held on Febuary 21st, 2021 (*month/date/year*), and is at least twenty-one (21) days prior to the Planning and Zoning Commission public hearing and in accordance with the attached "Neighborhood Notification and Meeting Process."

Signature of person completing affidavit

Dane Seiler

Printed name of person completing affidavit

Jefferson & Sunshine

Neighborhood Meeting Summary

2/14/2022 – 4:00 PM to 6:30 PM

1. Concerns about the current property conditions, general consensus was the neighborhood would be glad to see the houses razed.
    a. Upon full development the houses will be razed.

2. General comments about liking the exit onto Sunshine (this has been subsequently removed from the plan).
    a. Due to the restrictions that would remove the drive at full development, the right out exit only drive onto Sunshine has been removed from the development.

3. Concerned about existing property maintenance on the corner of Roanoke and Sunshine.
    a. Overgrowth on the corner will be eliminated.

4. Questions about number of employees
    a. Approximately 10

5. Questions about who will maintain the property once construction is complete
    a. The properties will be maintained by the tenants who will have a daily operation at the site.

6. Concerns about sewer capacity
    a. We believe that there is enough capacity in existing sanitary sewer to handle the additional flows. Conversations with Environmental Services confirm this.

7. Concerns about additional traffic on Roanoke.
    a. With no access to Sunshine the development will need to access Roanoke to provide the necessary circulation. Traffic from the coffee shop would be encouraged to exit back through Jefferson, and that would be the natural flow of the site, but one could expect some additional traffic on Roanoke.

8. Questions about hours of operation.
    a. Generally 5:30 AM to 9:00 PM, no 24 hour operation

9. Questions about trees, and what it would look like between the development and houses
    a. A bufferyard with a fence is planned; the bufferyard will be 15' in depth and contain dense plantings. There was a request from one neighbor asking to coordinate the removal of specific trees in that bufferyard.

10. Questions about dumpster location
    a. Currently planned for the south east corner of the site, one request was made to move it to the west side of the property.

Jefferson and Sunshine Neighborhood Meeting

SIGN-IN SHEET

CJW

	Name	Address or Company	Phone	E-mail
1	Dane Seiler	CJW	417-889-3400	dseiler@gocjw.com
2	Rick + Sally Keene	517 E. Ottowa Court	417-886-5828	ricksallyk@sbcglobal.net *
3	Cody + Sarah Hicks	1817 S Roanoke ave	417-839-8997	ybluejazz@yahoo.com
4	J. Dean Price	1847 S. Jefferson		dean@deanpricelaw.com
5	Joan + Chris Heil	2415 S. State Hwy 125 Rogersville MO	417-840-2246	joanichris77@gmail.com
6	Julie Schulze	505 E. Ottowa Ct	417 425 4335	schulzeju@AOL.com
7	Laurie Mertens Price	1847 S. Jefferson		
8	MICHAEL MORISSET	522 E SUNSHINE ST	417.693.2808	michael@millerstructures.com
9	Cawm & Edward Pender	1739 S JEFFERSON AVE	417 766 9795	wcpendere@yahoo.co.uk
10	Ross + Laura Martin	519 E. Ottowa Ct.	417-595-4462	SISEMITE@gmail.com
11				
12				
13				
14				
15				
16				
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19				

DEVELOPMENT REVIEW NOTICE/COMMENT CARD

Enclosed you have received a notice of a "Neighborhood Meeting" submitted by the applicant to discuss a change in land use or zoning in your neighborhood. For all development applications involving an advertised public hearing, City Council requires developers to hold a neighborhood meeting and invite the property owners within 500 feet of the property and to the officers of neighborhood association on file with the Department.

A "Neighborhood Meeting" is held early enough to provide adequate time for the developer to negotiate with the neighborhood in order to resolve any issues and provide any proposed changes to City staff to evaluate and include in City staff reports.

If the developer submits an application for a change in land use or zoning, the property will be posted and there will be public notifications in the newspaper and notification by mail to the property owners within 185 feet of the project.

The Land Use or Zoning Change Process:

1. Application
2. Neighborhood Meeting (500 feet notification from subject property)
3. Planning and Zoning Commission Public Hearing (185 feet notification from subject property)
4. 1st City Council Public Hearing (185 feet notification from subject property)
5. 2nd City Council Meeting to decide either to approve or to deny the change in land use or zoning

City staff is available to meet with you or your neighborhood association representative(s) to discuss the proposed change in land use or zoning and answer questions at 417-864-1611.

Staff submits a report with a recommendation one week prior to the date of the public hearing at the Planning and Zoning Commission. You can provide comments on the attached "Comment Card" by mail or by email at zoning@springfieldmo.gov. Please include your name, address and telephone number as well as the address of the project in your correspondence.

Bob Hosmer, AICP Planning Manager
City of Springfield Development Review Office
840 Boonville Avenue
Springfield, Missouri 65801

Comment Card: Mail comments to the address above or email comments to zoning@springfieldmo.gov

DATE:	2/23/2022	**Telephone No.**	417-839-8997, 417-839-6551
YOUR NAME:	Cody Hicks, Sarah Hicks		
YOUR ADDRESS:	1817 S. Roanoke Ave., Springfield, MO 65807		
PROJECT ADDRESS:	404, 420, 424 E. Sunshine St.		

COMMENTS: All stated addresses of proposed zoning border our property. We have a new fence that is less than a year old. The businesses proposed would border all of our north and west facing property. We would want an easement to maintenance our fence when necessary. We are concerned with the future upkeep and cleanliness of the properties due to the current owners, Reding Mgt. Despite numerous complaints, the company has allowed tenants to behave in an unneighborly fassion. The current tenants have a multitude and variety of animals, have dumped their litter boxes in my bushes, thrown garbage in my yard, intentionally ran over my landscaping, and the whole property is piled up with garbage.

Please turn paper over for rest →

[illegible]

[illegible]

[illegible]

[illegible]

With intent to lease the properties, we are concerned Reding Mgt. will allow the properties to degrade like the current houses and properties have since their purchase. We do not want a commercial dumster anywhere close to our property line, 15 ft. off our property is unacceptable. We would like the trees bordering our property with the exception of the trees in our fence, to be removed. If they are not removed we would ask that they are properly trimmed and maintained. We donot want a road or driveway connecting the businesses to Roanoke Ave. close to our property line; 15 ft. away is unacceptable. We are concerned that a sewer upgrade would effect our new fence and our pre-existing garage. We would like to see more green space than the proposed excess of asphalt. Zoning changing from residential to business concerns us with the possibility of unwanted and additional foot and vehicle traffic. If we are going to welcome a new neighbor, we would like it to benefit the Neighborhood.

Please feel free to contact us.

From: schulzeju@aol.com
To: Zoning@springfieldmo.gov
Subject: Meeting request at Jefferson Avenue Baptist Church on February 14, 2022.
Date: Friday, February 11, 2022 10:28:31 AM

CAUTION This email originated from outside the organization. Do not open attachments or click links from sources you do not know and trust.

Dear Sir or Ma'am,

I have been invited to the meeting with developers about the zoning application for properties, 404, 420, and 424 E Sunshine.

First of all I will not oppose the change of land use. For about five years the neighborhood has tried to get the city to help with the nuisance property at 424 E Sunshine. Calls to the city and contact with the land owner, Reding Management, brought no change. Ironically now the city is contacting us about a change for the better but only because the owner stands to profit from the sale and taxes will increase.

All of this is perfectly legal but is this process good for the city? I plan to address this at the meeting. We in the neighborhood finally welcome an improvement.

Julie Schulze
505 E Ottowa Ct.

Sent from the all new AOL app for iOS

Neal, Daniel

Subject: FW: Behind 7Brew on North Glenstone. This can't happen at Sunshine /Jefferson 7Brew location. Please

---

From: JULIE SCHULZE <schulzeju@aol.com>
Sent: Wednesday, March 2, 2022 12:30 PM
To: Zoning@springfieldmo.gov
Subject: Behind 7Brew on North Glenstone. This can't happen at Sunshine /Jefferson 7Brew location. Please

Julie Schulze

Sent from my iPhone

University Heights Neighborhood Association
Member, City of Springfield Neighborhood Advisory Council

Feb. 24, 2022

To: Bob Hosmer, AICP planning manager, City of Springfield's Development Review Office
From: University Heights Neighborhood Association Board

Dear Mr. Hosmer,

University Heights Neighborhood Association board members recently received notice of a request to rezone 404, 420 and 424 E. Sunshine St. to allow for a drive-through coffee shop.

After careful consideration of the request, our Board of Directors voted to oppose rezoning for a variety of reasons. Primarily, we think the rezoning would be inconsistent with the City of Springfield's Growth Management and Land Use comprehensive plan, specifically its intent to preserve quality of life and the character of its historic neighborhoods, in this instance Seminole/Holland and University Heights.

This stretch of East Sunshine Street is one of only a handful of arterial streets in Springfield that retains its original character and quality of place. It's lined with single-family residences, old-growth trees, sidewalks and, literally, picket fences. A vehicle-forward business would be out of place along this stretch, which enjoys a high degree of walkability.

Other reasons for opposing this development include but are not limited to:

- The limited-business rezoning request requires a conditional use for a drive-through, which is more appropriately zoned as general retail, highway commercial or commercial service district. In our opinion, none of these uses would be appropriate for Sunshine Street between Jefferson and National avenues.
- The site is surrounded by single-family residential zoning and does not border any commercial zoning.
- Traffic through the intersection of Jefferson Avenue and Sunshine Street is already heavy, at an estimated total volume of more than 40,000 vehicles per day. Direct access to East Sunshine would further tangle traffic near Sunshine and Campbell, which is snarled in large part because of drive-through restaurants.

- A drive-through presents a safety concern, as Sunshine Elementary is directly across the street. Traffic is heavy at student drop-off and pickup times, and the school district's border extends well south of Sunshine. Some families may opt to use the crosswalk to access the school. An adjacent drive-through would only increase risk to pedestrians.
- If primary access to the coffee shop is pushed to Jefferson or Roanoke, that would place it in a single-family residential neighborhood.

The city has worked hard on its Forward SGF initiative, emphasizing quality of place to make Springfield a more desirable and vibrant place to live. The Grant Avenue project and the Restore SGF initiative are great examples of how this city is working to celebrate the unique qualities of our historic neighborhoods.

If a drive-through coffee shop is permitted to be developed along this stretch of Sunshine, it will be to the detriment of the character of our historic neighborhoods as well as the city at large. In time, such development could transform our tree-lined neighborhood streets into another North Glenstone Avenue or West Sunshine Street.

We respectfully ask the city to deny this rezoning request and hold off on any other rezoning requests along our borders until the completion of the city's comprehensive plan. We believe there is a path toward development that celebrates and enhances our neighborhoods' uniqueness, and we would like to be partners in finding it.

Sincerely,

Jan Peterson
President, University Heights Neighborhood Association
uhnasgf@gmail.com
417-838-6216

One-rdg. _____
P. Hrngs. X
Pgs. 34
Filed: 03-29-22

Sponsored by: Simpson

First Reading: _____ Second Reading: _____

COUNCIL BILL 2022-080 SPECIAL ORDINANCE _____

AN ORDINANCE

GRANTING Conditional Use Permit No. 461 for the purpose of permitting eating and drinking establishment use group, including drive-in, pick-up window, or drive-thru facilities, as a conditional use within the LB – Limited Business District, generally located at 404, 420, and 424 East Sunshine Street. (Planning and Zoning Commission recommends denial and staff recommends approval.)

WHEREAS, pursuant to Section 36-363 of the Land Development Code, City Council may grant permits authorizing certain enumerated conditional uses as provided in the various zoning districts; and

WHEREAS, the Planning and Zoning Commission held a public hearing on March 10, 2022, and recommended denial of Conditional Use Permit No. 461 for the property generally located at 404, 420, and 424 East Sunshine Street and zoned LB – Limited Business District; and

WHEREAS, City Council finds that sufficient evidence has been presented to satisfy all applicable standards of the Land Development Code for issuance of Conditional Use Permit No. 461; and

WHEREAS, the granting of such permit is deemed proper, and it is not found to harm the community or injure the value, lawful use, and reasonable enjoyment of properties in the vicinity of 404, 420, and 424 East Sunshine Street.

NOW, THEREFORE, BE IT ORDAINED BY THE COUNCIL OF THE CITY OF SPRINGFIELD, MISSOURI, as follows, that:

Section 1 – City Council adopts the City staff's specific findings of fact on the proposed conditional use as set forth in "Exhibit D – Attachment 3." "Exhibit D" is attached hereto and incorporated herein by this reference in its entirety. Conditional Use Permit No. 461 is hereby granted in accordance with and subject to the provisions of Section 36-363 of the Land Development Code. Conditional Use Permit No. 461 is granted for the purpose of permitting eating and drinking establishment use group,

including drive-in, pick-up window, or drive-thru facilities, to operate as a conditional use within the LB – Limited Business District, located at the property described in “Exhibit B,” which is attached hereto and incorporated herein by this reference, and which is generally located at 404, 420, and 424 East Sunshine Street.

Section 2 – Building permits, certificates of occupancy, and any other required permits or approvals may be issued by the duly authorized officials of the City provided that such issuance is consistent with Section 36-363 of the Land Development Code, any other applicable City regulation or ordinance, and the “Requirements for Conditional Use Permit 461” described in “Exhibit A,” which is attached hereto and incorporated herein by this reference. Additionally, the provisions contained in “Exhibit A” and “Exhibit D – Attachment 2” shall govern and control the use and development of the land described in “Exhibit B,” in a manner consistent with the attached site plan depicted on “Exhibit D – Attachment 5.”

Section 3 – Any violation of the provisions of this Ordinance shall be grounds for the revocation of the Conditional Use Permit granted by the adoption of this Ordinance.

Section 4 – This Ordinance shall be in full force and effect from and after passage only so long as the Property and any improvements thereon conform to the conditions and requirements described in Section 36-363 of the Land Development Code, other applicable City regulations or Ordinances, and this Ordinance.

Passed at meeting: _____

_____
Mayor

Attest: _____, City Clerk

Filed as Ordinance: _____

Approved as to form: Jill Burris, Assistant City Attorney

Approved for Council action: Jason A. Gage, City Manager

EXPLANATION TO COUNCIL BILL 2022-080

FILED: 03-29-22

ORIGINATING DEPARTMENT: Planning and Development

PURPOSE: To permit an eating and drinking establishment use group, including drive-in, pick-up window or drive-thru facilities as a Conditional Use Permit within a LB, Limited Business District generally located at 404, 420 & 424 East Sunshine Street. (Planning and Zoning Commission recommends denial and staff recommends approval.)

BACKGROUND INFORMATION:

CONDITIONAL USE PERMIT NUMBER 461

The applicant is requesting to permit an eating and drinking establishment use group, including drive-in, pick-up window or drive-thru facilities as a Conditional Use Permit within a LB, Limited Business District generally located at 404, 420 & 424 East Sunshine Street. The applicant is proposing to construct a new drive-thru restaurant/coffee shop. A rezoning to LB is concurrently being processed with this application.

CONDITIONS:

1. The regulations and standards listed on “Exhibit D - Attachment 3 and 4” shall govern and control the use and development of the land in Use Permit Number 460 in a manner consistent with the attached site plan (“Exhibit D - Attachment 6”).

FINDINGS FOR STAFF RECOMMENDATION:

1. This application meets the approval standards for a Conditional Use Permit (“Attachment 3”).

2. Approval of this application is subject to the Requirements for Approval (“Attachment 2”) and Site Plan (“Attachment 5”).

3. Approval of this request will provide for continued development of the subject property which is already served with public infrastructure and services and is not expected to adversely impact the surrounding properties.

REMARKS:

The Planning and Zoning Commission held a public hearing on March 10, 2022, and recommended denial, by a vote of 7 to 0 of the proposed Conditional Use Permit (see the attached "Exhibit C," Record of Proceedings).

The Planning and Development staff recommends the application be approved with the conditions (see attached “Exhibit A”).

Submitted by:

Daniel Neal,
Senior Planner

Recommended by:

Brendan Griesemer, AICP
Assistant Director

Approved by:

Jason Gage,
City Manager

EXHIBITS:
Exhibit A, Requirements for Conditional Use Permit Number 461
Exhibit B, Legal Description
Exhibit C, Record of Proceedings
Exhibit D, Development Review Staff Report
ATTACHMENTS:
- Attachment 1, Department Comments
- Attachment 2, Requirements for Conditional Use Permit
- Attachment 3, Standards and Responses for Conditional Use Permits
- Attachment 4, Affidavit of Neighborhood Notification and Meeting Summary
- Attachment 5, Proposed CUP Site Plan
- Attachment 6, Neighborhood Correspondence

EXHIBIT A

REQUIREMENTS FOR CONDITIONAL USE PERMIT 461

1. An eating and drinking establishment with drive-in, pick-up window or drive-thru facilities is permitted in substantial conformance with Attachment 5.

2. The eating and drinking establishment with drive-in, pick-up window or drive-thru facilities shall comply with all the standards listed in Attachment 3.

3. No access is allowed to Sunshine Street from any lots except for the existing residential driveway on Lot 7 of Noble Heights Subdivision Unit #1 (420 E. Sunshine St.) which shall be closed, at the owner's expense, once the existing residence has been demolished or is no longer used residentially.

4. Provisions for cross access easements shall be provided through all Lots 6-11 of Noble Heights Subdivision Unit #1 between Jefferson and Roanoke Avenues.

5. The required bufferyard/landscaping on Lots 6 & 7 shall be established once the existing residential structures at 420 & 424 E. Sunshine St. have been demolished.

6. An administrative lot combination of Lots 6 & 7 of Noble Heights Subdivision Unit #1 is required at the time of development.

7. All other standards of the Zoning Ordinance and other applicable ordinances shall be adhered to.

EXHIBIT B

LEGAL DESCRIPTION
CONDITIONAL USE PERMIT 461

Lots 6 through 11 of Unit #1, Noble Heights Subdivision, Springfield, Greene County, Missouri except new street right-of-way.

EXHIBIT C

RECORD OF PROCEEDINGS
Planning and Zoning Commission – March 10, 2022

Conditional Use Permit 461
404, 420 & 424 East Sunshine Street
Applicant: Kelly & Tamra Rhoades

Mr. Hosmer states that this is a request to permit an eating and drinking establishment use group, including drive-in, pick-up window or drive-thru facilities as a Conditional Use Permit within a LB, Limited Business District generally located at 404, 420 & 424 E. Sunshine Street. The applicant is proposing to construct a new drive-thru coffee shop. Limited Business LB District allows eating and drinking establishments, for drive-thru facilities only with a Conditional Use Permit. A site plan is required for a CUP. All activities and uses except off-street parking and loading facilities, drive-thru facilities, activities shall be conducted entirely within a completely enclosed building. No individual retail store establishment or other permitted use shall have a gross floor area greater than 5,000 square feet. The maximum structure height is 25 feet, and all structures shall remain below a 30-degree bulk plane. The CUP will require the following.

- Sidewalks along Roanoke.
- A Type D" bufferyard (15) feet wide. There must be two (2) canopy trees, two (2) understory trees, two (2) evergreen tree and fourteen (14) shrubs.
- A six-foot-tall solid wood fence is also required as part of the bufferyard.
- Not allow access to Sunshine (except for existing home).
- Not allow the narrow lot exemption for reduced landscaping, require landscaping lots 6-7 if homes are demolished.
- Limit access to the southern portions of Jefferson and Roanoke. Require cross access.
- Require a lot combination for lots 6-7 at time of development.

The application meets the approval standards for the conditional use permit. Staff recommends approval.

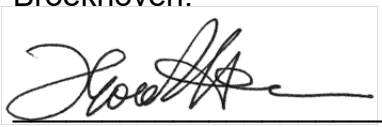
Mr. Doennig opened the public hearing.

Z-1-2022 w/COD #207 and Conditional Use Permit 461 were combined during the hearing.

Mr. Doennig closed the public hearing.

COMMISSION ACTION: (motion failed)
Mr. Colony motioned to recommend **approval** for Conditional Use Permit 461 (404, 420 & 424 East Sunshine Street). Mr. Jobe seconded the motion. Ayes: None. Nays:

Doennig, Coltrin, Knuckles, Colony, Bruce, Jobe, and Lebeck. Abstain: None. Absent: Broekhoven.

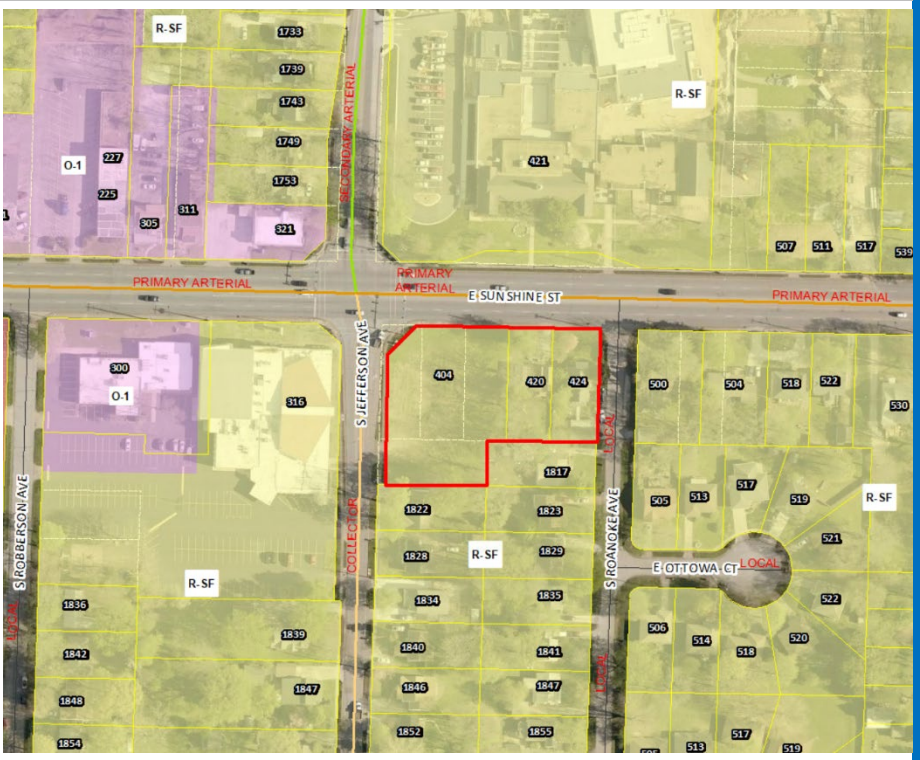


Bob Hosmer, AICP
Planning Manager

EXHIBIT D

Development Review Staff Report

PLANNING AND ZONING COMMISSION PUBLIC HEARING:	MARCH 10, 2022
CITY COUNCIL PUBLIC HEARING:	APRIL 4, 2022



CASE NUMBER:
Conditional Use Permit 461

LOCATION: 404, 420 & 424 E. Sunshine Street

ACRES: Approximately 1 acre

EXISTING LAND USE: Undeveloped lot and single-family homes

APPLICANT: Reding Management and Redec, LLCs

STAFF: Daniel Neal, Senior Planner

STAFF RECOMMENDATIONS:
Approve w/Conditions

PROPOSED MOTION:
I move to recommend approval of the CUP and staff report as the findings of fact. Required vote is a majority of those present (5 members are a quorum).

SUMMARY OF REQUEST:

This is a request to permit an eating and drinking establishment use group, including drive-in, pick-up window or drive-thru facilities as a Conditional Use Permit within a LB, Limited Business District generally located at 404, 420 & 424 E. Sunshine Street.

FINDINGS FOR STAFF RECOMMENDATION:

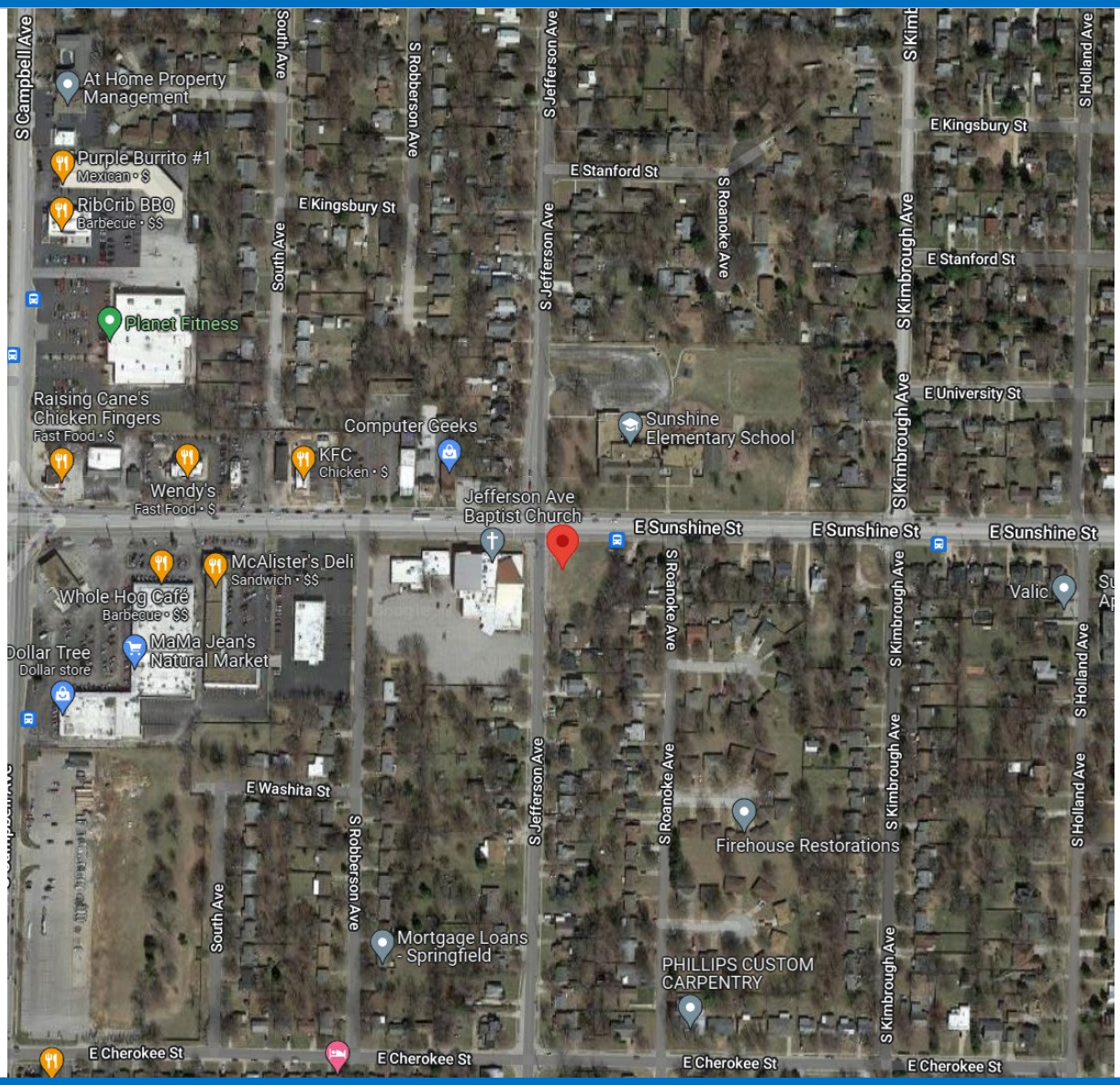
1. This application meets the approval standards for a Conditional Use Permit (Attachment 3).
2. Approval of this application is subject to the Requirements for Approval (Attachment 2) and site plan (Attachment 5).
3. Approval of this request will provide for continued development of the subject property which is already served with public infrastructure and services and is not expected to adversely impact the surrounding properties.

SURROUNDING ZONING AND LAND USES:

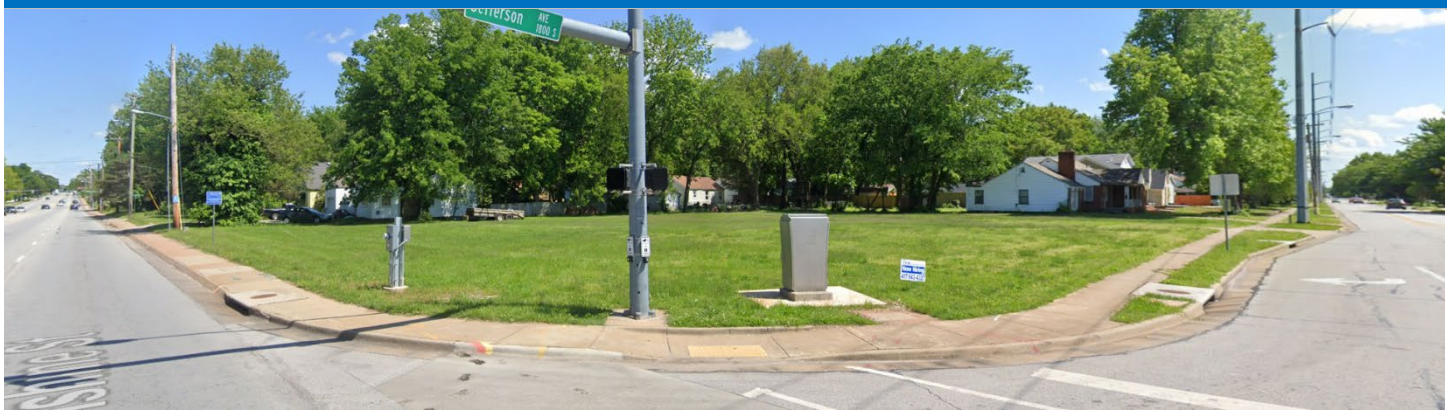
	NORTH	SOUTH	EAST	WEST
ZONING	R-SF	R-SF	R-SF	R-SF
LAND USE	Elementary school	Single-family residential uses	Single-family residential uses	Church uses

Development Review Staff Report

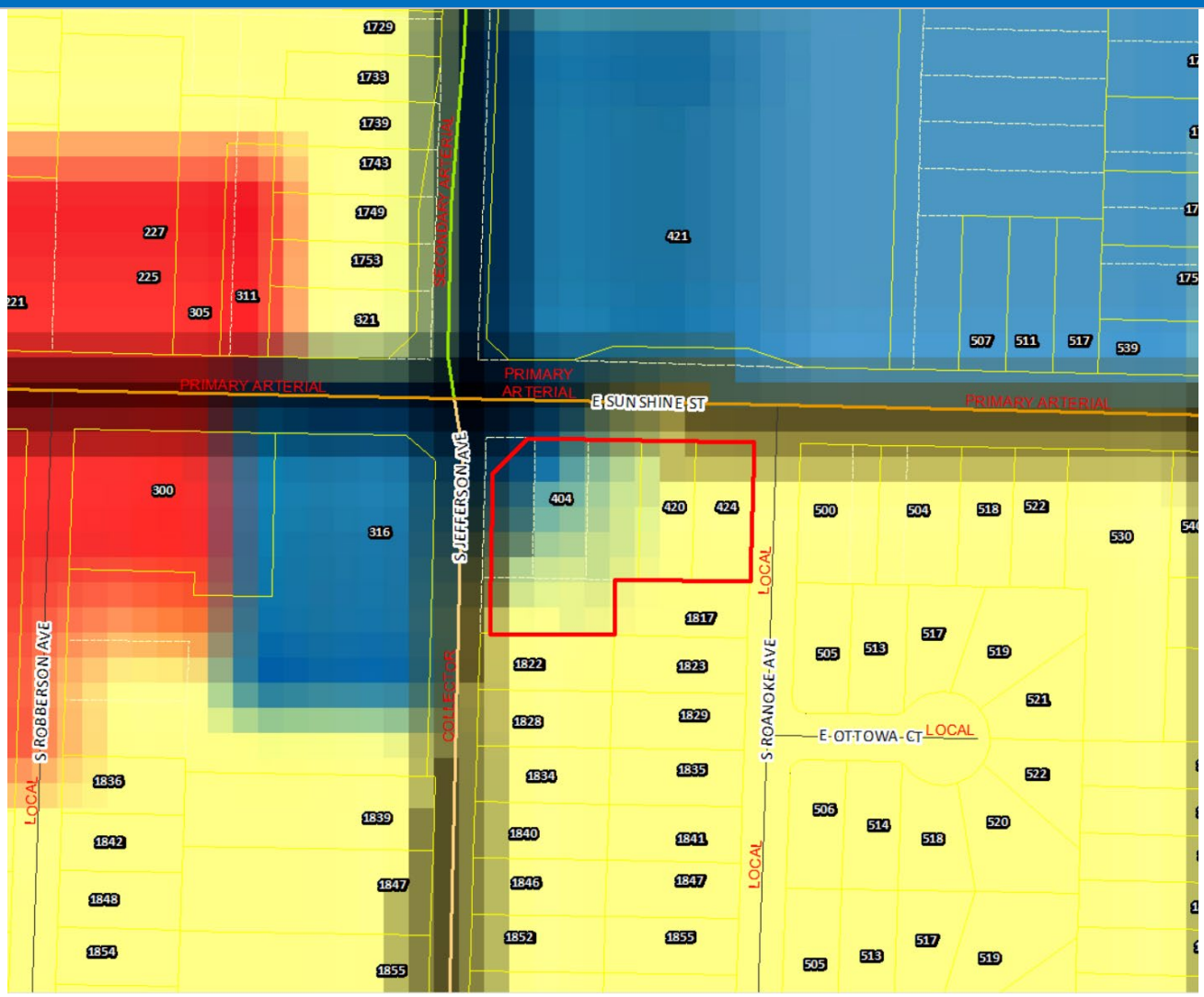
GOOGLE AERIAL OF LANDMARKS, BUSINESSES, AND ATTRACTIONS:



GOOGLE MAPS STREET VIEW:



GROWTH MANAGEMENT AND LAND USE PLAN:



- Low-Density Housing
- Medium or High Density Housing
- Medium Intensity Retail, Office or Housing
- High Intensity Retail, Office or Housing
- Greater Downtown
- Business Park
- Light Industrial, Office and Office-Warehouse
- General Industry, Transportation and Utilities
- Park
- School
- Golf
- Community-Public
- Urban Reserve Area
- Rural Area
- Greenway
- Parkway
- City Boundary
- Urban Service Area Boundary, Year 2020
- Urban Reserve Boundary, Year 2040

PROPERTY HISTORY:

The property was annexed in 1926 and has been zoned R-SF, Single-Family Residential District since the Citywide remapping in 1995.

ZONING ORDINANCE REQUIREMENTS:

Sec. 36-363. - Conditional Use Permit

(1) *Purpose.* The conditional use permit procedure is designed to provide the planning and zoning commission and the city council with an opportunity for discretionary review of requests to establish or construct uses or structures which may be necessary or desirable in a zoning district, but which may also have the potential for a deleterious impact upon the health, safety and welfare of the public. The purpose of the review is to determine whether the proposed location of the use or structure is appropriate and whether it will be designed and located so as to avoid, minimize, or mitigate any potentially adverse effects upon the community or other properties in its vicinity. The discretionary conditional use permit procedure is designed to enable the planning and zoning commission and the city council to impose conditions upon such uses and structures that are designed to avoid, minimize or mitigate potentially adverse effects upon the community or other properties in the vicinity of the proposed use or structure, and to deny requests for a conditional use permit when it is apparent that a proposed use or structure will or may cause harm to the community or injury to the value, lawful use and reasonable enjoyment of other properties in the vicinity of the proposed use or structure.

(8) *Period of validity.*

(a) No conditional use permit shall be valid for a period longer than 18 months from the date on which the city council grants the conditional use permit, unless within such 18-month period:

1. A building permit is obtained and the erection or alteration of a structure is started; or
2. An occupancy permit is obtained and the conditional use commenced.

The city council may grant one additional extension not exceeding 18 months, upon written application, without notice or hearing provided such grant is approved by city council prior to the expiration of the original 18-month period. No additional extension shall be granted without complying with the notice and hearing requirements for an initial application for a conditional use permit. This additional extension shall be considered to have begun on the date of expiration of the original conditional use permit regardless of when this additional extension is granted by city council.

(b) When a conditional use is discontinued or abandoned for a period of 12 consecutive months (regardless of any reservation of an intent not to abandon or to resume such use), such use shall not thereafter be reestablished or resumed unless a new conditional use permit is granted by city council consistent with this section. The burden of proof shall be on the property owner to show that the conditional use has not been discontinued or abandoned for a period of 12 consecutive months or longer.

d. *Damage or destruction.* In the event that the principal building or structure on the property is damaged or destroyed, by any means, to the extent of more than 75 percent of the replacement cost of the building or structure at the time such damage occurred, such building or structure shall not be restored unless it shall thereafter conform to the regulations for the zoning district in which it is located and the property shall not continue to be used for the uses permitted by the provisions of this section.

COMPATIBILITY WITH COMPREHENSIVE PLAN:

The *Growth Management and Land Use Plan* designates this area as appropriate for Low Density Housing uses; however, the properties are located at a major intersection of arterial roadways.

The *Growth Management and Land Use Plan* of the *Comprehensive Plan* states that protection of our existing residential neighborhoods is a prime concern. It is important to ensure that new land uses are not detrimental to residential areas and to recognize the vulnerability of residential areas to certain adverse impacts. This objective does not mean that non-

residential land uses are automatically inappropriate in residential areas; it means that design and location criteria must take into account the existing residential areas. Mixed land uses, as well as mixed residential densities, will need to be accommodated in the future. These must be accommodated with sensitivity to existing residential neighborhoods. The plan encourages mixed use. However, where commercial areas are concentrated, they should be sited and designed to have a minimal effect on adjacent lower-intensity development, and the environment.

The *Community Physical Image and Character Plan* element of the *Comprehensive Plan* developed goals to improve the visual appearance of the urban area and the *Growth Management and Land Use* Plan element encourages the protection of residential neighborhoods from adverse impacts of proposed development and inappropriate land use changes. New development should be compatible with existing development in terms of scale, materials, rooflines, setbacks and open space.

The *Growth Management and Land Use Plan* of the *Comprehensive Plan* also states that new development should be compatible with existing development in terms of scale, materials, rooflines setbacks and open space. Landscaped transitions should be used between sharply differing types of land use. Encourage the effective use of location, design and landscaping of commercial uses to screen and buffer neighborhoods from lights, signs, traffic noise and pollution, and other factors incompatible or conflicting with adjacent land uses. These practices will help ensure the integrity and function of the road system, reduce the length and frequency of auto trips, minimize impact on residential areas and contribute to the overall attractiveness of the community.

The Major Thoroughfare Plan classifies Sunshine Street as a primary arterial, Jefferson Avenue north of Sunshine Street as a secondary arterial and south of Sunshine as a collector roadway. Roanoke Avenue is classified as a local roadway.

STAFF COMMENTS:

1. The applicant is requesting to permit an eating and drinking establishment use group, including drive-in, pick-up window or drive-thru facilities as a Conditional Use Permit within a LB, Limited Business District generally located at 404, 420 & 424 E. Sunshine Street. The applicant is proposing to construct a new drive-thru restaurant/coffee shop.

2. The Limited Business District is intended for uses that provide convenience goods or personal services primarily to people residing in adjacent residential areas. It also includes selected retail and service uses that are similar in land use intensity and physical impact to the neighborhood sales and service uses permitted in this district. This district is designed to accommodate compact, freestanding commercial centers or to function as a transition between more intense commercial uses and residential neighborhoods. Because the permitted retail and personal service uses may be an integral part of the neighborhood, more restrictive requirements for light, air, open space, building design and landscaping are made than are provided in other commercial districts. This district should be located along or at the intersections of collector or higher classification streets.

3. The purpose of the CUP review is to determine whether the proposed location of the use or structure is appropriate and whether it will be designed and located so as to avoid, minimize, or mitigate any potentially adverse effects upon the community or other properties in its vicinity. Conditions have been submitted to mitigate any potential impacts of the LB conditional use. These conditions include:

    a. An eating and drinking establishment with drive-in, pick-up window or drive-thru facilities is permitted in substantial conformance with the site plan.

    b. No access is allowed to Sunshine Street.

    c. Access to Jefferson Avenue is limited to the most southern portion of Lot 6 that is not located in the bufferyard.

    d. Provisions for cross access easements shall be provided through Lots 6-11 between Jefferson and Roanoke Avenues.

e. The required bufferyard/landscaping on Lots 6 & 7 shall be established once the existing residential structures at 420 & 424 E. Sunshine St. have been demolished.

f. An administrative lot combination of Lots 6 & 7 of Noble Heights Subdivision Unit #1 is required at the time of development.

4. A Traffic Impact Study was not required as the change in zoning does not generate an additional 100 trips in the a.m. or p.m. peak or 500 trips in a 24-hour period.

5. The development of the property will require a bufferyard along the south property line adjacent to the R-SF, Single-Family Residential zoning district. The normal bufferyard required between LB and R-SF would be a Bufferyard "Type D" at least fifteen (15) feet wide. For each one-hundred (100) linear feet of bufferyard, there must be two (2) canopy trees, two (2) understory trees, two (2) evergreen tree and fourteen (14) shrubs. A six-foot-tall solid wood fence is also required as part of this bufferyard.

6. Approval of this request will provide for the development of the subject property which is already served with public infrastructure and services and is not expected to adversely impact the surrounding properties.

7. The proposed Conditional Use Permit was reviewed by City departments and comments are contained in Attachment 1.

NEIGHBORHOOD MEETING:

The applicant held a neighborhood meeting on February 14, 2022, regarding the rezoning request. A summary of the meeting is attached (Attachment 4)

PUBLIC NOTIFICATION:

The public notice was advertised in the Daily Events at least 15 days prior to the public hearing. The property was posted by the applicant at least 10 days prior to the public hearing. Public notice letters were sent out at least 10 days prior to the public hearing to all property owners within 185 feet.

Notices sent to property owners within 185 feet: Mailed: 18 Returned: 0

DEPARTMENT COMMENTS:

ATTACHMENT 1
CONDITIONAL USE PERMIT 461

DEPARTMENT OF BUILDING DEVELOPMENT SERVICES:

No comments.

CITY UTILITIES:

No comments.

DEPARTMENT OF ENVIRONMENTAL SERVICES WASTEWATER MANAGEMENT DIVISION:

No objection to the rezoning. Lot has access to public sewer.

FIRE DEPARTMENT:

No comments.

DEPARTMENT OF PUBLIC WORKS TRAFFIC OPERATIONS DIVISION:

STREET CLASSIFICATION, RIGHT-OF-WAY, & JURISDICTION
City's Transportation Plan classifies E. Sunshine Street as a Primary Arterial, S. Jefferson Avenue as a Collector roadway and S. Roanoke Avenue as a Local-Residential roadway. The standard right-of-way width for E. Sunshine Street is 50-feet from the centerline, 30-feet from the centerline for S. Jefferson Avenue and 25-feet from the centerline for S. Roanoke Avenue. It appears an additional 10-feet of right-of-way is needed along E. Sunshine Avenue. It appears no additional right of way is needed along S. Jefferson Avenue or S. Roanoke Avenue. A 30-foot X 30-foot right of way site triangle is also needed at the intersection of E. Sunshine Avenue and S. Roanoke Avenue. A survey is recommended to determine the exact amount of existing right-of-way as nothing can be constructed within the required right of way. E. Sunshine Avenue, S. Jefferson Avenue and S. Roanoke Avenue are city-maintained streets.

TRAFFIC COUNTS & ON-STREET PARKING
The most recent traffic counts for E. Sunshine Avenue is 35,500 vehicles per day and for S. Jefferson Avenue is 4,995 vehicles per day. There are no traffic counts for S. Roanoke Avenue since it is classified as a Local roadway. On-street parking is not allowed along E. Sunshine Avenue or S. Jefferson Avenue. On-street parking is allowed on S. Roanoke Avenue.

DRIVEWAY ACCESS
There is one driveway access point onto the property from E. Sunshine Street, one from S. Jefferson Avenue and one from S. Roanoke Avenue. No access will be allowed to the property from E. Sunshine Street and one access point will be allowed from S. Jefferson Avenue as far south from the intersection of E. Sunshine Street as possible. One access point will be allowed from S. Roanoke Street and must be a minimum of 100 feet from E. Sunshine Street to meet current City of Springfield spacing standards set forth in the City of Springfield Public Works Design Guide.

SIDEWALK
There is existing sidewalk along the property frontage of E. Sunshine Street and S. Jefferson Avenue. There is currently no sidewalk along the property frontage of S. Roanoke Avenue. The developer will be required to install sidewalk in accordance with the City of Springfield Public Works Design Guide at the time of development.

TRAILS, BUS STOPS, & ADDITIONAL INFORMATION

There are no Greenway Trails in the area surrounding the property pertaining to this zoning. There is one bus stops along E. Sunshine Street along the property frontage of this development. The proposed development is in an area that provides for multiple direct connections and provides for good connectivity in the area.

IMPROVEMENTS

A Traffic Impact Study was not required as the change in zoning does not generate an additional 100 trips in the am or pm peak or 500 trips in a 24-hour period.

TRAFFIC - TABLE 1: REZONING DETAILS

	Street Name	Street Classification	On-Street Parking	Existing Street ROW from Centerline (ft.) (Approx.)	Required Street ROW from Centerline (ft.)
Street 1	E. Sunshine St	Primary Arterial	No	40	50
Street 2	S. Jefferson Ave	Collector	No	30	30
Street 3	S. Roanoke Ave	Local – Commercial	Yes	25	30

	AM Peak	PM Peak	Weekday	Weekend
Existing Trips Generated	3	4	35	
***Proposed Trips Generated**	8	29	343	
Additional Trips Generated	5	25	308	

*Proposed Trips Generated is based on the highest, most intense use permitted in the proposed rezoning, Planned Development, or Conditional Use Permit

DEPARTMENT OF PUBLIC WORKS STORMWATER ENGINEERING DIVISION:

The property is in the **Fassnight Creek** drainage basin. The property **is not** located in a FEMA designated floodplain. Staff **is not** aware of flooding problems in the area. The city is not aware of a sinkhole at this location. A fee in lieu of on-site stormwater detention **will not be allowed and detention is required.** The property **is not in a stream buffer area.**

Please note that development of the property will be subject to the following conditions at the time of development:

1. For any increase in impervious surface, current detention requirements must be met per Chapter 3 Sec. 2.3.3 of the City's Flood Control and Water Quality Protection Manual. This site primarily drains to the East. A fee in lieu of constructing onsite stormwater detention will not be permitted.

2. Water quality will be required per Chapter 10 Sec. 2.0 if greater than one acre of land is disturbed. Water quality is also required for less than one acre of disturbance if part of a larger common plan.

3. As-builts of the detention and water quality improvements are required.

4. A land disturbance permit will be required if disturbing 1 acre or greater per Chapter 4 Section 5 of the City's *Flood Control and Water Quality Protection Manual.*

5. Operation and maintenance agreements are required for any permanent stormwater control measures. O&M will need to be approved during the ProjectDox process and will be reviewed by ES-Water Quality per Chapter 12 Sec. 3.0. More details at the following link: https://www.springfieldmo.gov/2120/Resources.

REQUIREMENTS FOR APPROVAL:

ATTACHMENT 2
CONDITIONAL USE PERMIT 461

1. An eating and drinking establishment with drive-in, pick-up window or drive-thru facilities is permitted in substantial conformance with Attachment 5.

2. The eating and drinking establishment with drive-in, pick-up window or drive-thru facilities shall comply with all the standards listed in Attachment 3.

3. No access is allowed to Sunshine Street from any lots except for the existing residential driveway on Lot 7 of Noble Heights Subdivision Unit #1 (420 E. Sunshine St.) which shall be closed, at the owner's expense, once the existing residence has been demolished or is no longer used residentially.

4. Provisions for cross access easements shall be provided through all Lots 6-11 of Noble Heights Subdivision Unit #1 between Jefferson and Roanoke Avenues.

5. The required bufferyard/landscaping on Lots 6 & 7 shall be established once the existing residential structures at 420 & 424 E. Sunshine St. have been demolished.

6. An administrative lot combination of Lots 6 & 7 of Noble Heights Subdivision Unit #1 is required at the time of development.

7. All other standards of the Zoning Ordinance and other applicable ordinances shall be adhered to.

STANDARDS FOR CONDITIONAL USE PERMIT 461

ATTACHMENT 3

36-363 (10) Standards. An application for a conditional use permit shall be granted only if evidence is presented at the public hearing which establishes the following:	Applicant's response:	Staff response:
1. The proposed conditional use will be consistent with the adopted policies in the Springfield Comprehensive Plan.	The property is along a major arterial and thus takes advantage of the infrastructure that an arterial provides.	This application is consistent with the *Growth Management and Land Use Plan* of the *Comprehensive Plan* which encourages higher intensity uses at major intersections. The Major Thoroughfare Plan classifies Sunshine Street as a primary arterial, Jefferson Avenue north of Sunshine Street as a secondary arterial and south of Sunshine as a collector roadway. Roanoke Avenue is classified as a local roadway.
2. The proposed conditional use will not adversely affect the safety of the motoring public and of pedestrians using the facility and the area immediately surrounding the site.	Primary Access will be taken from Jefferson Avenue and a potential secondary access to Roanoke Avenue.	Public Works Traffic Division has reviewed the application and has determined that the conditional use will not adversely affect safety of the motoring public and of pedestrians with traffic access controls that are required. Traffic comments are provided in Attachment 1.
3. The proposed conditional use will adequately provide for safety from fire hazards and have effective measures of fire control.	A new building will be constructed on site that will meet all applicable fire codes.	The Fire Department has reviewed this request and has no concerns with regard to safety from fire hazards and fire controls. Fire comments are provided in Attachment 1.
4. The proposed conditional use will not increase the hazard to adjacent property from flood or water damage.	Drainage flows north on the property towards Sunshine Street, and the development will meet the Stormwater requirements of the City.	Public Works Stormwater Division has reviewed this request and provided comments in Attachment 1. The development is required to meet development standards for stormwater management.
5. The proposed conditional use will not have noise characteristics that exceed the sound levels that are typical of uses permitted as a matter of right in the district.	The proposed use is for a drive through facility, so no noise will exceed the levels that are typically permitted in the district.	The applicant's response adequately addresses this condition. It is not expected that the proposed use will have noise characteristics that exceed Zoning Ordinance standards.
6. The glare of vehicular and stationary lights will not affect the established	A fence will be installed per the screen regulations in the zoning	It is not expected that the proposed use will negatively

36-363 (10) Standards. An application for a conditional use permit shall be granted only if evidence is presented at the public hearing which establishes the following:	Applicant's response:	Staff response:
character of the neighborhood, and to the extent such lights will be visible from any residential district, measures to shield or direct such lights to eliminate or mitigate such glare are proposed.	code to eliminate any head light glare and stationary light glare.	affect the neighborhood. The applicant's response adequately addresses this condition.
7. The location, lighting, and type of signs and the relationship of signs to traffic control is appropriate for the site.	Signage will be along Sunshine Street and adhere to the Sign code.	The development will be subject to the signage standards of the Zoning Ordinance.
8. Such signs will not have an adverse effect on any adjacent properties.	Signage will be along Sunshine Street to minimize any impact to adjacent properties.	The development will be subject to the signage standards on the Zoning Ordinance.
9. The street right-of-way and pavement width in the vicinity is or will be adequate for traffic reasonably expected to be generated by the proposed use.	The right of way and adjacent street pavement widths are wide enough in the area to support the development.	Jefferson Avenue and Sunshine Street pavement width is adequate to handle increased traffic volume.
10. The proposed conditional use will not have any substantial or undue adverse effect upon, or will lack amenity or will be incompatible with, the use or enjoyment of adjacent and surrounding property, the character of the neighborhood, traffic conditions, parking utility facilities, and other matters affecting the public health, safety and general welfare.	The site is planned in such a manner that it would not.	It is not anticipated that the proposed drive-thru restaurant will have an adverse effect or be incompatible with the adjacent and surrounding properties along Sunshine Street.
11. The proposed conditional use will be constructed, arranged and operated so as not to dominate the immediate vicinity or to interfere with the development and use of neighboring property in accordance with the applicable district regulations. In determining whether the proposed conditional use will so dominate the immediate neighborhood, consideration shall be given to: a. The location, nature and height of buildings, structures, walls and fences on the site; and b. The nature and extent of landscaping and screening on the site.	a. The current plan is to construct and arrange the buildings in such a manner that customers will utilize Jefferson and Roanoke, this will allow for the conditional use to not dominate the adjacent properties. Buildings will be shifted north, with fencing along the south property line for screening. Vehicle circulation will face vehicles to the north to help lessen any glare impact on the adjacent properties. b. The site will be developed to meet all of the landscaping and screen requirements of the City of Springfield.	The standards of the Zoning Ordinance adequately address these issues. The subject property is located in an area of non-residential uses and is not anticipated to dominate the immediate vicinity or to interfere with the development and use of neighboring properties.
12. The proposed conditional use, as shown by the application, will not destroy, damage, detrimentally modify	Currently the site is a vacant lot so it should not.	It is not expected that the proposed development will negatively affect any significant

36-363 (10) Standards. An application for a conditional use permit shall be granted only if evidence is presented at the public hearing which establishes the following:	Applicant's response:	Staff response:
or interfere with the enjoyment and function of any significant natural topographic or physical features of the site.		natural topography or physical features.
13. The proposed conditional use will not result in the destruction, loss or damage of any natural, scenic or historic feature of significant importance.	Currently the site is a vacant lot so it should not.	The applicant's response adequately addresses this condition. The two houses at 420 & 424 E. Sunshine Street are not designated as historical.
14. The proposed conditional use otherwise complies with all applicable regulations of the Article, including lot size requirements, bulk regulations, use limitations and performance standards.	It currently does and will be developed in a manner that will meet those regulations.	The proposed use is required to comply with applicable regulations with regard to lot size, bulk regulations, use limitations and performance standards.
15. The proposed conditional use at the specified location will contribute to or promote the welfare or convenience of the public.	The drives are placed in such a manner to contribute to the convenience and promote the welfare.	The applicant's response adequately addresses this condition.
16. Off-street parking and loading areas will be provided in accordance with the standards set out in 36-455, 36-456 and 36-483 of this Article, and such areas will be screened from any adjoining residential uses and located so as to protect such residential uses from any injurious effect	Such screenings are planned, and the development of the site will meet these regulations.	The development will be subject to these standards of the Zoning Ordinance.
17. Adequate access roads or entrance or exit drives will be provided and will be designed so as to prevent traffic hazards and to minimize traffic congestion in public streets and alleys.	The new drives will be designed in such a manner to meet this criterion.	Public Works Traffic Division has reviewed the proposed site plan and has determined that it will not create these hazards.
18. The vehicular circulation elements of the proposed application will not create hazards to the safety of vehicular or pedestrian traffic on or off the site, disjointed vehicular or pedestrian circulation paths on or off the site, or undue interference and inconvenience to vehicular and pedestrian travel.	The vehicular circulation will not. It is expected that traffic will only enter off Jefferson Avenue, and then exit either onto Jefferson or Roanoke. It was done in this manner to have the least impact on adjacent properties.	Public Works Traffic Division has reviewed the proposed site plan and has determined that it will not create these hazards with the traffic access controls that are required with this Conditional Use.
19. The proposed use, as shown by the application, will not interfere with any easements, roadways, rail lines, utilities and public or private rights-of-way.	The new structure and parking lot will not.	There is not any known interference with any public rights-of-way or easements.
20. In the case of existing structures proposed to be converted to uses requiring a conditional use permit, the structures meet all fire, health, building,	A new structure is planned that will conform to all current codes.	The development is required to adhere to all standards of the Zoning Ordinance and other applicable ordinances.

36-363 (10) Standards. An application for a conditional use permit shall be granted only if evidence is presented at the public hearing which establishes the following:	Applicant's response:	Staff response:
plumbing and electrical requirements of the City of Springfield.		
21. The proposed conditional use will be served adequately by essential public facilities and services such as highways, streets, parking spaces, police and fire protection, drainage structures, refuse disposal, water and sewers, and schools; or that the persons or agencies responsible for the establishment of the proposed use will provide adequately for such services.	The proposed conditional use is located along a major roadway with the necessary utilities and services.	This property is already served with public infrastructure and services.

Attachment 4

AFFIDAVIT OF NEIGHBORHOOD NOTIFICATION AND MEETING SUMMARY

1. Request change to zoning from: R-SF (*existing zoning*) to LB, With a CUP (*proposed zoning*)
2. Meeting Date & Time: Febuary 14th, 2022 from 4:00pm to 6:30pm
3. Meeting Location: 316 E Sunshine Street
4. Number of invitations that were sent: _____
5. How the mailing list was generated: Via City of Springfield Planning Services
6. Number of neighbors in attendance (attach a sign-in sheet): 14
7. List the verbal comments and how you plan to address any issues:
   (City Council does not expect all the issues to be resolved to the neighborhood's satisfaction; however, the developer must explain why the issues cannot be resolved.)

   See Attached

8. List or attach the written comments and how you plan to address any issues:

   None received.

I, Dane Seiler (*print name*), attest that the neighborhood meeting was held on Febuary 21st, 2021 (*month/date/year*), and is at least twenty-one (21) days prior to the Planning and Zoning Commission public hearing and in accordance with the attached "Neighborhood Notification and Meeting Process."

Signature of person completing affidavit

Dane Seiler

Printed name of person completing affidavit

Jefferson & Sunshine

Neighborhood Meeting Summary

2/14/2022 – 4:00 PM to 6:30 PM

1. Concerns about the current property conditions, general consensus was the neighborhood would be glad to see the houses razed.
    a. Upon full development the houses will be razed.

2. General comments about liking the exit onto Sunshine (this has been subsequently removed from the plan).
    a. Due to the restrictions that would remove the drive at full development, the right out exit only drive onto Sunshine has been removed from the development.

3. Concerned about existing property maintenance on the corner of Roanoke and Sunshine.
    a. Overgrowth on the corner will be eliminated.

4. Questions about number of employees
    a. Approximately 10

5. Questions about who will maintain the property once construction is complete
    a. The properties will be maintained by the tenants who will have a daily operation at the site.

6. Concerns about sewer capacity
    a. We believe that there is enough capacity in existing sanitary sewer to handle the additional flows. Conversations with Environmental Services confirm this.

7. Concerns about additional traffic on Roanoke.
    a. With no access to Sunshine the development will need to access Roanoke to provide the necessary circulation. Traffic from the coffee shop would be encouraged to exit back through Jefferson, and that would be the natural flow of the site, but one could expect some additional traffic on Roanoke.

8. Questions about hours of operation.
    a. Generally 5:30 AM to 9:00 PM, no 24 hour operation

9. Questions about trees, and what it would look like between the development and houses
    a. A bufferyard with a fence is planned; the bufferyard will be 15' in depth and contain dense plantings. There was a request from one neighbor asking to coordinate the removal of specific trees in that bufferyard.

10. Questions about dumpster location
    a. Currently planned for the south east corner of the site, one request was made to move it to the west side of the property.

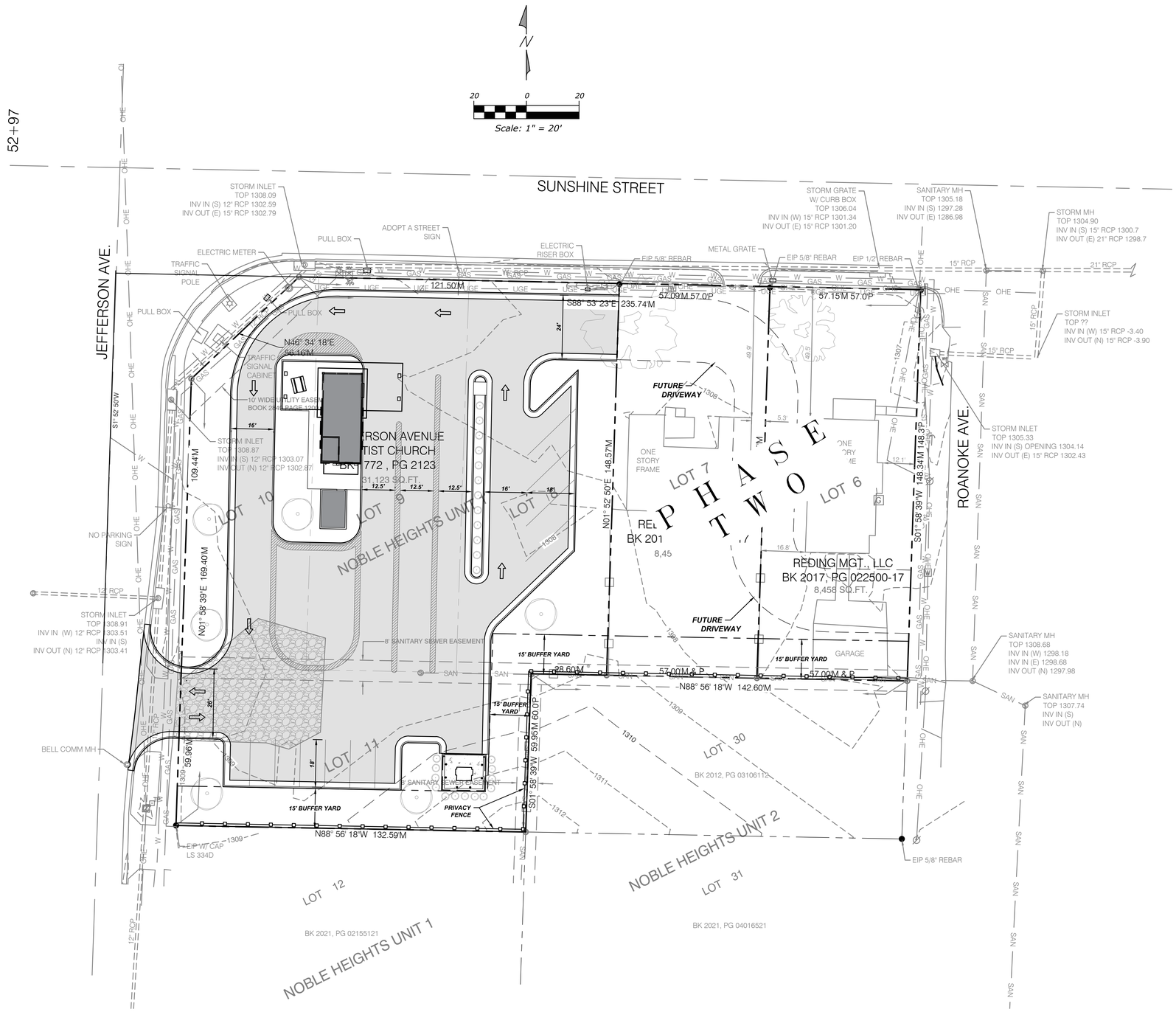
Jefferson and Sunshine Neighborhood Meeting

SIGN-IN SHEET

CJW

	Name	Address or Company	Phone	E-mail
1	Dane Seiler	CJW	417-889-3400	dseiler@gocjw.com
2	Rick + Sally Keene	517 E. Ottowa Court	417-886-5828	ricksallyk@sbcglobal.net *
3	Cody + Sarah Hicks	1817 S Roanoke ave	417-839-8997	ybluejazz@yahoo.com
4	J. Dean Price	1847 S. Jefferson		dean@deanpricelaw.com
5	Joan + Chris Heil	2415 S. State Hwy 125 Rogersville MO	417-840-2246	joanichris77@gmail.com
6	Julie Schulze	505 E. Ottowa Ct	417 425 4335	schulzeju@AOL.com
7	Laurie Mertens Price	1847 S. Jefferson		
8	MICHAEL MORISSET	522 E SUNSHINE ST	417.693.2808	michael@millerstructures.com
9	Cawm & Edward Pender	1739 S JEFFERSON AVE	417 766 9795	wcpendere yahoo.co.uk
10	Ross & Laura Martin	519 E. Ottowa Ct.	417-595-4462	SISEMITE@gmail.com
11				
12				
13				
14				
15				
16				
17				
18				
19				

SITE IMPROVEMENT PLAN
PROPOSED COFFEE SHOP
SUNSHINE ST & JEFFERSON AVE
SPRINGFIELD, MISSOURI



G:\21181 - Sunshine & Jefferson Alta Survey\Design dwg\xrefs\21181 CIVIL PLAN TITLE BLOCK.dwg - LAST SAVED: 2/18/2022 8:30:27 AM - PLOTTED: 2/18/2022 8:31:16 AM

Prepared by:
CJW
CJW Transportation Consultants, L.L.C.
CJW Transportation Consultants, L.L.C. Engineering MO C.A. #2006012385
5051 S. National Suite 4-110 Springfield, MO 65810
Tel: 417.889.3400 Fax: 417.889.3402 www.GoCJW.com

SITE IMPROVEMENT PLAN
COFFEE SHOP
SUNSHINE ST & JEFFERSON AVE

No.	Description:	Date:

SURVEY BY	CJW
DATE	02/18/2022
DWG	21181
DESIGN	CJW
DRAWN	CJW
CHECKED	CJW
SCALE HOR.	1"=20'
SCALE VERT.	N/A

EXHIBIT

SHEET NO. 1
CJW NO. 21181 OF 1

DEVELOPMENT REVIEW NOTICE/COMMENT CARD

Enclosed you have received a notice of a "Neighborhood Meeting" submitted by the applicant to discuss a change in land use or zoning in your neighborhood. For all development applications involving an advertised public hearing, City Council requires developers to hold a neighborhood meeting and invite the property owners within 500 feet of the property and to the officers of neighborhood association on file with the Department.

A "Neighborhood Meeting" is held early enough to provide adequate time for the developer to negotiate with the neighborhood in order to resolve any issues and provide any proposed changes to City staff to evaluate and include in City staff reports.

If the developer submits an application for a change in land use or zoning, the property will be posted and there will be public notifications in the newspaper and notification by mail to the property owners within 185 feet of the project.

The Land Use or Zoning Change Process:

1. Application
2. Neighborhood Meeting (500 feet notification from subject property)
3. Planning and Zoning Commission Public Hearing (185 feet notification from subject property)
4. 1st City Council Public Hearing (185 feet notification from subject property)
5. 2nd City Council Meeting to decide either to approve or to deny the change in land use or zoning

City staff is available to meet with you or your neighborhood association representative(s) to discuss the proposed change in land use or zoning and answer questions at 417-864-1611.

Staff submits a report with a recommendation one week prior to the date of the public hearing at the Planning and Zoning Commission. You can provide comments on the attached "Comment Card" by mail or by email at zoning@springfieldmo.gov. Please include your name, address and telephone number as well as the address of the project in your correspondence.

Bob Hosmer, AICP Planning Manager
City of Springfield Development Review Office
840 Boonville Avenue
Springfield, Missouri 65801

Comment Card: Mail comments to the address above or email comments to zoning@springfieldmo.gov

DATE:	2/23/2022	**Telephone No.**	417-839-8997, 417-839-6551
YOUR NAME:	Cody Hicks, Sarah Hicks		
YOUR ADDRESS:	1817 S. Roanoke Ave., Springfield, MO 65807		
PROJECT ADDRESS:	404, 420, 424 E. Sunshine St.		

COMMENTS: All stated addresses of proposed zoning border our property. We have a new fence that is less than a year old. The businesses proposed would border all of our north and west facing property. We would want an easement to maintenance our fence when necessary. We are concerned with the future upkeep and cleanliness of the properties due to the current owners, Reding Mgt. Despite numerous complaints, the company has allowed tenants to behave in an unneighborly fassion. The current tenants have a multitude and variety of animals, have dumped their litter boxes in my bushes, thrown garbage in my yard, intentionally ran over my landscaping, and the whole property is piled up with garbage.

Please turn paper over for rest →

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[illegible]

[illegible]

With intent to lease the properties, we are concerned Reding Mgt. will allow the properties to degrade like the current houses and properties have since their purchase. We do not want a commercial dumster anywhere close to our property line, 15 ft. off our property is unacceptable. We would like the trees bordering our property with the exception of the trees in our fence, to be removed. If they are not removed we would ask that they are properly trimmed and maintained. We donot want a road or driveway connecting the businesses to Roanoke Ave. close to our property line; 15 ft. away is unacceptable. We are concerned that a sewer upgrade would effect our new fence and our pre-existing garage. We would like to see more green space than the proposed excess of asphalt. Zoning changing from residential to business concerns us with the possibility of unwanted and additional foot and vehicle traffic. If we are going to welcome a new neighbor, we would like it to benefit the Neighborhood.

Please feel free to contact us.

From: schulzeju@aol.com
To: Zoning@springfieldmo.gov
Subject: Meeting request at Jefferson Avenue Baptist Church on February 14, 2022.
Date: Friday, February 11, 2022 10:28:31 AM

CAUTION This email originated from outside the organization. Do not open attachments or click links from sources you do not know and trust.

Dear Sir or Ma'am,

I have been invited to the meeting with developers about the zoning application for properties, 404, 420, and 424 E Sunshine.

First of all I will not oppose the change of land use. For about five years the neighborhood has tried to get the city to help with the nuisance property at 424 E Sunshine. Calls to the city and contact with the land owner, Reding Management, brought no change. Ironically now the city is contacting us about a change for the better but only because the owner stands to profit from the sale and taxes will increase.

All of this is perfectly legal but is this process good for the city? I plan to address this at the meeting. We in the neighborhood finally welcome an improvement.

Julie Schulze
505 E Ottowa Ct.

Sent from the all new AOL app for iOS

Neal, Daniel

Subject: FW: Behind 7Brew on North Glenstone. This can't happen at Sunshine /Jefferson 7Brew location. Please

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From: JULIE SCHULZE <schulzeju@aol.com>
Sent: Wednesday, March 2, 2022 12:30 PM
To: Zoning@springfieldmo.gov
Subject: Behind 7Brew on North Glenstone. This can't happen at Sunshine /Jefferson 7Brew location. Please

Julie Schulze

Sent from my iPhone

University Heights Neighborhood Association
Member, City of Springfield Neighborhood Advisory Council

Feb. 24, 2022

To: Bob Hosmer, AICP planning manager, City of Springfield's Development Review Office
From: University Heights Neighborhood Association Board

Dear Mr. Hosmer,

University Heights Neighborhood Association board members recently received notice of a request to rezone 404, 420 and 424 E. Sunshine St. to allow for a drive-through coffee shop.

After careful consideration of the request, our Board of Directors voted to oppose rezoning for a variety of reasons. Primarily, we think the rezoning would be inconsistent with the City of Springfield's Growth Management and Land Use comprehensive plan, specifically its intent to preserve quality of life and the character of its historic neighborhoods, in this instance Seminole/Holland and University Heights.

This stretch of East Sunshine Street is one of only a handful of arterial streets in Springfield that retains its original character and quality of place. It's lined with single-family residences, old-growth trees, sidewalks and, literally, picket fences. A vehicle-forward business would be out of place along this stretch, which enjoys a high degree of walkability.

Other reasons for opposing this development include but are not limited to:

- The limited-business rezoning request requires a conditional use for a drive-through, which is more appropriately zoned as general retail, highway commercial or commercial service district. In our opinion, none of these uses would be appropriate for Sunshine Street between Jefferson and National avenues.
- The site is surrounded by single-family residential zoning and does not border any commercial zoning.
- Traffic through the intersection of Jefferson Avenue and Sunshine Street is already heavy, at an estimated total volume of more than 40,000 vehicles per day. Direct access to East Sunshine would further tangle traffic near Sunshine and Campbell, which is snarled in large part because of drive-through restaurants.

- A drive-through presents a safety concern, as Sunshine Elementary is directly across the street. Traffic is heavy at student drop-off and pickup times, and the school district's border extends well south of Sunshine. Some families may opt to use the crosswalk to access the school. An adjacent drive-through would only increase risk to pedestrians.
- If primary access to the coffee shop is pushed to Jefferson or Roanoke, that would place it in a single-family residential neighborhood.

The city has worked hard on its Forward SGF initiative, emphasizing quality of place to make Springfield a more desirable and vibrant place to live. The Grant Avenue project and the Restore SGF initiative are great examples of how this city is working to celebrate the unique qualities of our historic neighborhoods.

If a drive-through coffee shop is permitted to be developed along this stretch of Sunshine, it will be to the detriment of the character of our historic neighborhoods as well as the city at large. In time, such development could transform our tree-lined neighborhood streets into another North Glenstone Avenue or West Sunshine Street.

We respectfully ask the city to deny this rezoning request and hold off on any other rezoning requests along our borders until the completion of the city's comprehensive plan. We believe there is a path toward development that celebrates and enhances our neighborhoods' uniqueness, and we would like to be partners in finding it.

Sincerely,

Jan Peterson
President, University Heights Neighborhood Association
uhnasgf@gmail.com
417-838-6216

One-rdg. _____
P. Hrngs. _____
Pgs. 14
Filed: 03-29-22

Sponsored by: Hardinger

First Reading: _____ Second Reading: _____

COUNCIL BILL 2022-082 SPECIAL ORDINANCE _____

AN ORDINANCE

APPROVING the plans and specifications for the Division Street Roadway Improvements – National Avenue to Glenstone Avenue project; accepting the bid of Hartman and Company, Inc., in the amount of $4,689,870.65 for said project; authorizing the City Manager, or his designee, to enter into a contract with such bidder; and amending the Fiscal Year 2021-2022 budget for the Department of Public Works in the amount of $1,100,000.00 to appropriate reserves of the 1/8-cent Transportation Sales Tax for said project.

_____

WHEREAS, Hartman and Company, Inc., is the lowest responsive and responsible bidder for the Division Street Roadway Improvements – National Avenue to Glenstone Avenue project, Plan No. 2017PW0036 (the "Project"); and

WHEREAS, the Project includes roadway improvements along Division Street from a point east of National Avenue to a point west of Glenstone Avenue as depicted on "Exhibit A," which is attached hereto and incorporated herein by this reference, and will widen the three drive lanes and add an upgraded storm water system, new sidewalks on the north side of Division Street, and a multi-purpose trail on the south side of Division Street; and

WHEREAS, bids for this Project were solicited by advertisement in *The Daily Events* from February 3, 2022, to February 7, 2022. Bids were opened on March 8, 2022.

NOW, THEREFORE, BE IT ORDAINED BY THE COUNCIL OF THE CITY OF SPRINGFIELD, MISSOURI, as follows, that:

Section 1 – City Council hereby approves the plans and specifications for the Division Street Roadway Improvements – National Avenue to Glenstone Avenue project, Plan No. 2017PW0036, and accepts the bid of Hartman and Company, Inc., for said Project, at the price and sum of $4,689,870.65, except as said sum may be lawfully increased or decreased by the actual quantities of work units involved.

Section 2 – The City Manager, or his designee, is hereby authorized to enter into a contract with said bidder for such work, said contract to be in substantially similar form to the document attached hereto, and incorporated herein by this reference, as “Exhibit B,” and in accordance with the terms of the bid, the plans, and the specifications.

Section 3 – All workers performing work under the contract attached hereto as “Exhibit B,” shall be paid a wage of no less than the prevailing hourly rate of wages for work of a similar character in this locality or the public works contracting minimum wage, whichever is applicable. Contractor shall fully comply with the provisions and requirements of the Missouri State Prevailing Wage Law. Contractors and any subcontractor performing work under this contract must provide a 10-hour OSHA construction safety training program, or similar program approved by the Department of Labor, for on-site employees, unless employees demonstrate they previously completed the program.

Section 4 – The budget of the Department of Public Works for Fiscal Year 2021-2022 is hereby amended in the accounts and amounts as shown on Budget Adjustment No. 059, a copy of which is attached hereto and incorporated herein by reference as “Exhibit C.”

Section 5 – City Council hereby finds the budget adjustment described herein has been recommended by the City Manager.

Section 6 – The City Manager is directed to cause the appropriate accounting entries to be made in the books and records of the City.

Section 7 – This Ordinance shall be in full force and effect from and after passage.

Passed at meeting: _____

_____
Mayor

Attest: _____, City Clerk

Filed as Ordinance: _____

Approved as to form: _____, Assistant City Attorney

Approved for Council action: _____, City Manager

EXPLANATION TO COUNCIL BILL 2022-082

FILED: 03-29-22

ORIGINATING DEPARTMENT: Public Works

PURPOSE: Approving the plans and specifications for Division Street Roadway Improvements – National Avenue to Glenstone Avenue, Plan No. 2017PW0036, accepting the bid of Hartman and Company, Inc., for construction of the Division Street Roadway Improvements – National Avenue to Glenstone Avenue project, as shown on the project location map ("Exhibit A"), authorizing the City Manager, or his designee, to enter into a contract ("Exhibit B") with such bidder, and amending the FY 2021-2022 budget for the Department of Public Works in the amount of $1,100,000.00 to appropriate reserves of the 1/8-cent Transportation Sales Tax for this project.

BACKGROUND INFORMATION: This project consists of roadway improvements along Division Street from a point east of National Avenue to a point west of Glenstone Avenue. The reconstruction of Division street will widen the three drive lanes and add an upgraded storm water system, new 5-foot sidewalks on the north side and a multi-purpose trail on the south side.

Bids were solicited for this project by advertising in the *Daily Events* from February 3, 2022 through February 7, 2022. Bids were opened for the project at 9:30 a.m. on March 8, 2022, with the following bids received:

Contractor	Bid Amount
Hartman and Company, Inc.	$4,689,870.65
Radmacher Brothers Excavating Co., Inc.	$5,374,665.70
D & E Plumbing and Heating, Inc.	$5,492,212.00
Engineer's Estimate	$5,248,853.50

The low bid, if accepted, will be partially funded from the 1/4-cent Capital Improvements Sales Tax and is already budgeted. The attached budget adjustment for $1,100,000.00 will appropriate 1/8-cent Transportation Sales Tax reserves to provide additional funding due to the increasing cost of construction in the current market as a result of inflation and supply shortages. The project will include $720,156.25 of gas and water utility improvements that will be reimbursed by City Utilities, reducing the City cost to $3,969,714.40.

Supports the following City Council Priorities:

- Public safety
- Economic vitality
- Quality of Place
- Fiscal sustainability

REMARKS: Public Works recommends acceptance of the bid of Hartman and Company, Inc. as the lowest responsible bid and passage of this Council bill and budget adjustment.

Submitted by:

Martin Gugel, Assistant Director
of Public Works

Recommended by:

Dan Smith, Director of
Public Works

Approved by:

Jason Gage,
City Manager

CITY OF Springfield

Exhibit A

DISCLAIMER: All information included on this map or digital file is provided "as-is" for general information purposes only. The City of Springfield, and all other contributing data suppliers, make no warranties, expressed or implied, concerning the accuracy, completeness, reliability, or suitability of the data for any particular use. Furthermore, the City of Springfield, and all other contributing data suppliers, assume no liability whatsoever associated with the use or misuse of the data.

Exhibit B

ROUTING ORDER	(1) ORIGINATING DEPARTMENT	(2) CONTRACTOR	(3) FINANCE DEPARTMENT
	(4) LAW DEPARTMENT	(5) CITY MANAGER'S OFFICE	(6) CITY CLERK'S OFFICE
EFFECTIVE DATE	**TERMINATION DATE**	**CONTRACT NUMBER:**	

CITY	**CONTRACTOR**
CITY OF SPRINGFIELD	**NAME: HARTMAN & COMPANY, INC.**
840 BOONVILLE, P.O. BOX 8368	**ADDRESS: 1200 E. WOODHURST DRIVE J-200,**
SPRINGFIELD, MO 65802	**SPRINGFIELD, MO. 65804**
PHONE: (417) 864- 1945	**PHONE: (417)882-2062**
ATTN: ANDY HAASE	**FAX:**
DEPT.: PUBLIC WORKS	**ATTN: DEAN HARTMAN**

AGREEMENT

THIS AGREEMENT, made and entered into this ____ day of _____, 20____, by the parties identified above.

WITNESSETH: That whereas, the Contractor has become the lowest responsible bidder for furnishing the supervision, labor, tools, equipment, materials and supplies and for constructing the following City improvements:

Division Street Reconstruction - National Ave. to Glenstone Ave. 2017PW0036TE

The City and Contractor agree to the following:

1. Manner and Time for Completion. The Contractor will furnish all supervision, labor, tools, equipment, materials and supplies necessary to perform, and to perform said work at Contractor's own expense in accordance with the contract documents and any applicable City ordinances and state and federal laws within 350 calendar days from the date Contractor is ordered to proceed, which order shall be issued by the Director of Public Works within 30 days after the date of this contract.

2. Prevailing Wages. All workers performing work under this Contract shall be paid a wage of no less than the "prevailing hourly rate of wages" for work of a similar character in this locality or the public works contracting minimum wage, whichever is applicable, as set out in the Wage Order attached to and made part of the specification for work under this Contract. If at any time the Contractor is found to not have paid prevailing wages, the Contractor shall forfeit as a penalty to the City one hundred dollars for each calendar day or portion of a calendar day for each worker paid less than the stipulated required rates for any work done under this Contract by the Contractor or by any subcontractor under the Contractor. Notwithstanding the foregoing, if the engineer's estimate of the total project cost or the bid accepted by the City is $75,000.00 or less, then all labor utilized in the construction of the improvements shall not be required to pay the "prevailing rate of wages" or the public works minimum wage. However, if the project becomes subject to a change order that increases the total project cost to more than $75,000.00, a "prevailing hourly rate of wages" or the public works contracting minimum wage, whichever is applicable, shall be paid for all labor utilized in the construction of the improvements but only for that portion of the project which exceeds $75,000.00.

3. Insurance Requirements. Without limiting any of the other obligations or liabilities of the Contractor, the Contractor shall secure and maintain at its own cost and expense, throughout the duration of this Contract and until the work is completed and accepted by the City of Springfield, City Utilities of Springfield, and the Board of Utilities, insurance of such types and in such amounts as may be necessary to protect it and the interests of the City of Springfield, City Utilities of Springfield, and the Board of Utilities, against all hazards or risks of loss as hereunder specified or which may arise out of the performance of the Contract Documents. The form and limits of such insurance, together with the underwriter thereof in each case, are subject to approval by the City of Springfield, City Utilities of Springfield, and the Board of Utilities. Regardless of such approval, it shall be the responsibility of the contractor to maintain adequate insurance coverage at all times during the term of the Contract. Failure of the Contractor to maintain coverage shall not relieve it of any contractual responsibility or obligation or liability in general or under the Contract Documents.

The certificates of insurance, including evidence of the required endorsements hereunder or the policies, shall be filed with the City within ten (10) days after the date of the receipt of Notice of Award of the Contract to the Contractor and prior to the start of work. All insurance policies shall require that the insurance company in question provide thirty (30) days written notice prior to modification or cancellation of such insurance. Such notices shall be mailed, certified mail, return receipt requested, to:

City of Springfield - Public Works, P.O. Box 8368, Springfield, MO 65801-8368; and

City Utilities of Springfield, P.O. Box 551, Springfield, MO 65801

As of January 1, 2022, the minimum coverage for the insurance referred to herein shall be as set out below:

a. Workers' Compensation…. Statutory coverage per RSMo 287.010 et seq
Employer's Liability……. $1,000,000.00

b. Commercial General Liability Insurance, including coverage for Premises, Operations, Products and Completed Operations, Contractual Liability, Broad Form Property Damage, Independent Contractors, Explosion, Collapse, and Underground Property Damage and endorsed for blasting if blasting required. Such coverage shall apply to bodily injury and property damage on an "Occurrence Form Basis" with limits of at least Three Million and 00/100 Dollars ($3,000,000) for all claims arising out of a single accident or occurrence. Contractor agrees that the proceeds of such insurance policy shall first be used to pay any award, damages, costs, and/or attorneys' fees incurred by or assessed against City, its employees, officers and agents, before payment of any award, damages, costs or attorneys fees of Contractor, its employees, officers or agents. Contractor agrees to cause its insurer to name City as an additional insured on such insurance policy, including the City as an additional insured for coverage under its products-completed operations hazard, and said policy shall be primary and noncontributory. Aggregate Limit must apply on a Per Project basis, and the endorsement must accompany the certificate of insurance. A Waiver of Subrogation endorsement must be provided by contractor in favor of the City**.**

c. Automobile Liability Insurance covering bodily injury and property damage for owned, non-owned and hired vehicles, with limits of at least Three Million and 00/100 Dollars ($3,000,000) for all claims arising out of a single accident or occurrence. Contractor agrees to cause its insurer to name City as an additional insured on such insurance policy.

d. Owner's and Contractor's Protective Liability Insurance to protect the City, its agents, servants and employees from claims which may arise from the performance of this Contract, with limits of at least Three Million and 00/100 Dollars ($3,000,000) for all claims arising out of a single accident or occurrence.

The Owner's and Contractor's Protective Liability Insurance must:

(1) Be a separate policy with the named insured being: The City of Springfield; and

(2) Be with the same insurance company with which the Contractor carrier its Commercial General Liability Insurance; and

(3) Contain an endorsement that disclaims coverage for any claim barred by the doctrines of sovereign immunity or official immunity, except attorney's fees and other litigation costs incurred in defending a claim. Nothing contained in this policy (or this endorsement thereto) shall constitute any waiver of whatever kind of these defenses or sovereign immunity or official immunity for any monetary amount whatsoever.

e. Builders Risk Insurance for contracts involving unoccupied structures. The Contractor shall secure All Risk Builder's Risk Insurance. Unless specifically authorized by the City, the amount of such insurance shall not be less than the total contract price. The policy shall name as insured the Contractor and the City of Springfield.

f. Subcontracts. In case any or all of this work is sublet, the Contractor shall require the subcontractor to procure and maintain all insurance required in subparagraphs (a), (b) and (c) hereof and in like amounts. Contractor shall require any and all subcontractors with whom it enters into a contract to perform work on this project to protect the City of Springfield, City Utilities of

Springfield, Missouri, and the Board of Utilities through insurance against applicable hazards or risks and shall, upon request of the City, provide evidence of such insurance.

g. Notice. The Contractor and/or subcontractor shall furnish the City prior to beginning the work, the policy as specified in subparagraph (d), and satisfactory proof of carriage of all the insurance required by this contract, with the provision that policies shall not be canceled, modified or non-renewed without thirty (30) days written notice to the City of Springfield.

h. Legislative or Judicial Changes. In the event the scope or extent of the City's tort liability as a governmental entity as described in Section 537.600 through 537.650 RSMo is broadened or increased during the term of this agreement by legislative or judicial action, the City may require Contractor, upon 10 days written notice, to execute a contract addendum whereby the Contractor agrees to provide, at a price not exceeding Contractor's actual increased premium cost, additional liability insurance coverage as the City may require to protect the City from increased tort liability exposure as the result of such legislative or judicial action. Any such additional insurance coverage shall be evidenced by an appropriate certificate of insurance and shall take effect within the time set forth in the addendum.

4. Performance, Labor, and Materials Payment Bond: The Contractor shall furnish a Performance Bond and a Labor and Materials Payment Bond with surety approved by the City and on the forms approved by the City, each bond shall be in the amount of **$4,689,870.65 (Four Million Six Hundred and Nine Thousand Eight Hundred and Seventy Dollars and Sixty Five Cents)** conditioned upon the full and faithful performance of all major terms and conditions of this contract and payment of all labor and material suppliers. It is further mutually agreed between the parties hereto that if at any time after the execution of this agreement and the surety bond(s) hereto attached for its faithful performance and payment of labor and material suppliers, the City shall deem the surety or sureties upon such bond(s) to be unsatisfactory, or if, for any reason, such bond(s) ceases to be adequate to cover the performance of the work, the Contractor shall, at its expense, within five (5) days after the receipt of notice from the City to do so, furnish an additional bond or bonds, in such form and amount, and with such surety or sureties as shall be satisfactory to the City. In such event no further payment to the Contractor shall be deemed to be due under this contract until such new or additional security for the faithful performance of the work and the payment of labor and material suppliers shall be furnished in a manner and form satisfactory to the City. The corporate surety on any performance or payment bond must be licensed by the State of Missouri and if the required bond exceeds $25,000.00 must be listed in United States Treasury Circular 570.

5. Contractor's responsibility for subcontractors. The Contractor shall be as fully responsible to the City for the acts and omissions of its subcontractors, and of persons either directly or indirectly employed by them, as Contractor is for the acts and omissions of persons it directly employs. Contractor shall cause appropriate provisions to be inserted in all subcontracts relating to this work, to bind all subcontractors to Contractor by all the terms herein set forth, and insofar as applicable to the work of subcontractors and to give Contractor the same power regarding termination of any subcontract as the City may exercise over Contractor under any provisions of this contract. Nothing contained in this contract shall create any contractual relation between the subcontractor and the City or between any subcontractors.

6. General Independent Contractor Clause. This agreement does not create an employee/employer relationship between the parties. It is the parties' intention that the Contractor will be an independent contractor and not the City's employee for all purposes, including, but not limited to, the application of the Fair Labor Standards Act minimum wage and overtime payments, Federal Insurance Contribution Act, the Social Security Act, the Federal Unemployment Tax Act, the provisions of the Internal Revenue Code, Missouri Revenue and Taxation laws, Missouri Workers' Compensation and Unemployment Insurance laws. The Contractor will retain sole and absolute discretion in the judgment of the manner and means of carrying out the Contractor's activities and responsibilities hereunder. The Contractor agrees that it is a separate and independent enterprise from the public employer, that it has a full opportunity to find other business, that it has made its own investment in its business, and that it will utilize a high level of skill necessary to perform the work. This agreement shall not be construed as creating any joint employment relationship between the Contractor and the City, and the City will not be liable for any obligation incurred by the Contractor, including but not limited to unpaid minimum wages and/or overtime premiums.

7. Liquidated Damages. Time of completion of work by the Contractor is of the essence. Should Contractor, or in the case of default, the surety, fail to substantially complete the work within the time specified in the contract, or within such extra time as may be allowed, Contractor (or surety) shall be liable to the City in the amount of $4,700.00 per day for each and every calendar day that the contract remains uncompleted after the time allowed for substantial completion, as liquidated damages, and not as a penalty, it being stipulated that actual damages to the City and the public arising from Contractor's failure to timely complete the work would

be difficult, if not impossible, to ascertain. The amount assessed as liquidated damages may be withheld from any moneys otherwise due to Contractor from the City. The project is not considered complete until final acceptance by the City. After substantial completion, liquidated damages for failure to complete the remaining work shall be in the amount specified in the General Conditions, unless an amount is provided in the Job Special Provision, in which case, the Job Special Provision amount will apply.

8. Termination for Cause. The City reserves the right to terminate this contract by giving at least five (5) days prior written notice to the Contractor, without prejudice to any other rights or remedies of the City should the Contractor be adjudged a bankrupt, or if Contractor should make a general assignment for the benefit of its creditors, or if a receiver should be appointed for Contractor or for any of its property, or if Contractor should persistently or repeatedly refuse or fail to supply enough properly skilled workmen or proper material, or if Contractor should refuse or fail to make prompt payment to any person supplying labor or materials for the work under the contract, or persistently disregard instructions of the City or fail to observe or perform any provisions of the contract.

9. City's Right to Proceed. In the event this contract is terminated pursuant to Paragraph 8, then the City may take over the work and prosecute the same to completion, by contract or otherwise, and Contractor and its sureties shall be liable to the City for any costs over the amount of this contract thereby occasioned by the City. In any such case, the City may take possession of, and utilize in completing the work, such materials, appliances and structures as may be on the work site and are necessary for completion of the work. The foregoing provisions are in addition to, and not in limitation of, the rights of the City under any other provisions of the contract, city ordinances, and state and federal laws.

10. Termination for Convenience of City. The City shall have the right at any time by written notice to Contractor to terminate and cancel this contract, without cause, for the convenience of the City, and Contractor shall immediately stop work. In such event City shall not be liable to Contractor except for payment for actual work performed prior to such notice in an amount proportionate to the completed contract price and for the actual costs of preparations made by Contractor for the performance of the cancelled portions of the contract, including a reasonable allowance of profit applicable to the actual work performed and such preparations. Anticipatory profits and consequential damages shall not be recoverable by Contractor.

11. Guards and Lights. The Contractor agrees that during the performance of said work, adequate barricades, guards and warning signs, lights or devices consistent with the requirements contained in the Manual on Uniform Traffic Control Devices shall be provided by Contractor during construction.

12. Liability and Indemnity.

a. In no event shall the City be liable to the Contractor for special, indirect, or consequential damages, except those caused by the City's gross negligence or willful or wanton misconduct arising out of or in any way connected with a breach of this contract. The maximum liability of the City shall be limited to the amount of money to be paid or received by the City under this contract.

b. The Contractor shall defend, indemnify and save harmless the City, its elected or appointed officials, agents and employees from and against any and all liability, suits, damages, costs (including attorney fees), losses, outlays and expenses from claims in any manner caused by, or allegedly caused by, or arising out of, or connected with, this contract, or the work or any subcontract thereunder (the Contractor hereby assuming full responsibility for relations with subcontractors), including, but not limited to, claims for personal injuries, death, property damage, or for damages from the award of this contract to Contractor, notwithstanding any possible negligence, whether sole or concurrent, on the part of the City, its officials, agents and employees.

c. The Contractor shall indemnify and hold the City harmless from all wages or overtime compensation due any employees in rendering services pursuant to this agreement or any subcontract, including payment of reasonable attorneys' fees and costs in the defense of any claim made under the Fair Labor Standards Act, the Missouri Prevailing Wage Law or any other federal or state law.

d. The indemnification obligations of Contractor hereunder shall not be limited by any limitations as to the amount or type of damages, compensation or benefits payable by or for the Contractor, under any federal or state law, to any person asserting the claim against City, its elected or appointed officials, agents and employees, for which indemnification is sought.

e. The indemnification obligations herein shall not negate, abridge or reduce in any way any additional indemnification rights of the City, its elected or appointed officials, agents and employees, which are otherwise available under statute, or in law or equity.

f. Contractor affirms that it has had the opportunity to recover the costs of the liability insurance required in this agreement in its contract price. Contractor's obligation under this agreement to defend, indemnify, and hold harmless any person from that person's own negligence or wrongdoing is limited to the coverage and limits of the applicable insurance required of the Contractor under this agreement.

g. The Contractor shall indemnify and hold the City harmless for any penalties, fines, fees or costs, including costs of defense, which are charged or assessed by any Federal, state or local agency including, but not limited to, Environmental Protection Agency or Department of Natural Resources.

13. Attorney Fees. In the event of any litigation arising from breach of this Agreement the City shall be entitled to recover from the Contractor all reasonable costs incurred for such litigation, including staff time, court costs, attorney fees, and all other related expenses incurred in such litigation.

14. Payment for Labor and Materials. The Contractor agrees and binds itself to pay for all labor done and for all the materials used in the construction of the work to be completed pursuant to this contract.

15. Payment. The City will pay the Contractor in accordance with the rate set forth in the contract documents on file in the Public Works Department and by this reference made a part hereof, which shall constitute full and complete compensation for the Contractor's work provided hereunder. It is expressly understood that in no event will the total compensation and reimbursement to be paid to the Contractor under the terms of this contract exceed the sum of **$4,689,870.65 (Four Million Six Hundred and Nine Thousand Eight Hundred and Seventy Dollars and Sixty Five Cents)** unless specifically and mutually agreed to in writing by both the City and the Contractor. No partial payment to the Contractor shall operate as approval of acceptance of work done or materials furnished hereunder. Such compensation will be paid in progress payments (less five (5) percent retainage), as established by the City, subject to receipt of a requisition for payment and a statement of work provided by the Contractor and agreement by both the City and the Contractor that the Contractor has fully performed the work to be paid for in such progress payments in conformance with the contract.

16. Contract Documents. The contract documents shall consist of the following:

- **a.** This Contract
- **b.** All Change Orders
- **c.** Bid Plans and Specifications
- **d.** City of Springfield Standard General Conditions and Technical Specifications for Public Works Construction (most recent edition as of this project's first date of advertisement)
- **e.** Special Conditions & Provisions
- **f.** Proposal
- **g.** Statement of Bidder's Qualifications
- **h.** Acknowledgment
- **i.** Performance Bond
- **h.** Payment and Material Bond
- **k.** Instructions to Bidders
- **l.** Non-collusion Affidavit
- **m.** Notice to Proceed

This contract, together with the other documents enumerated in this paragraph, forms the contract between the parties. These documents are as fully a part of the contract as if attached hereto or repeated herein.

17. Subsurface Conditions. Contractor agrees that information contained in the published reports and public actions of the Missouri Division of Geology and Land Survey shall be conclusive and binding upon the Contractor as to what subsurface conditions at the job site are reasonably anticipated or reasonably foreseeable.

18. Conflict of Interest. In accepting this contract, Contractor certifies that no member or officer of its firm or corporation is an officer or employee of the City of Springfield, Missouri, or any of its boards or agencies, and further that no officer or employee of the

City has any financial interest, direct or indirect, in this contract. All applicable federal regulations and provisions of RSMo. Section 105.450 et seq. shall not be violated.

19. Assignment. The Contractor shall not assign any interest in this contract, and shall not transfer any interest in the same (whether by assignment or novation), without prior written consent of the City thereto, provided, however, that claims for money due or to become due to the Contractor from the City under this Contract may be assigned to a bank, trust company, or other financial institution without such approval. Notice of such assignment or transfer shall be furnished in writing promptly to the City and the bond surety. Any such assignment is expressly subject to all rights and remedies of the City under this agreement, including the right to change or delete activities from the Contract or to terminate the same as provided herein, and no such assignment shall require the City to give any notice to any such assignee of any actions which the City may take under this agreement.

20. Nondiscrimination. The Contractor agrees in the performance of this Contract not to discriminate on the ground or because of race, color, religion, sex, sexual orientation, gender identity, national origin, age, status as a protected veteran or status as a qualified individual with a disability, or political opinion or affiliation, against any employee of Contractor or applicant for employment and shall include a similar provision in all subcontracts let or awarded hereunder. The parties hereby incorporate the requirements of 41 C.F.R. §§ 60-1.4(a)(7), 29 C.F.R. Part 471, Appendix A to Subpart A, 41 C.F.R. § 60-300.5(a) and 41 C.F.R. § 60-741.5(a), if applicable.

a. This contractor and subcontractor shall abide by the requirements of 41 C.F.R. § 60-300.5(a). This regulation prohibits discriminations against qualified protected veterans, and requires affirmative action by covered prime contractors and subcontractors to employ and advance in employment qualified protected veterans.

b. This contractor and subcontractor shall abide by the requirements of 41 C.F.R. § 60-741.5(a). This regulation prohibits discrimination against qualified individuals on the basis of disability, and requires affirmative action by covered prime contractors and subcontractors to employ and advance in employment qualified individuals with disabilities.

21. Nonresident/Foreign Contractors. The Contractor shall procure and maintain during the life of this contract:

a. If the Contractor is a foreign corporation, a certificate of authority to transact business in the State of Missouri from the Secretary of State, unless exempt pursuant to the provisions of Section 351.570 RSMo.

b. A certificate from the Missouri Director of Revenue evidencing compliance with the transient employer financial assurance law, unless exempt pursuant to the provisions of Section 285.230 RSMo.

22. Notices. All notices required or permitted hereinunder and required to be in writing may be given by FAX or by first class mail addressed to City and Contractor at the addresses shown above. The date of delivery of any notice given by mail shall be the date falling on the second full day after the day of its mailing. The date of delivery of notice by FAX transmission shall be deemed to be the date transmission occurs, except where the transmission is not completed by 5:00 p.m. on a regular business day at the terminal of the receiving party, in which case the date of delivery shall be deemed to fall on the next regular business day for the receiving party.

23. Occupational License: The Contractor shall obtain and maintain an occupational license with the City of Springfield, Missouri, if required by city code and any required state or federal license. The cost for this occupational license shall be borne by the Contractor. No contract will be executed by the City until this occupational license has been obtained and that the Contractor is current on any City taxes is verified.

24. Safety Training. Pursuant to Missouri Revised Statute Section 292.675, Contractors and subcontractors who sign a contract to work on public works projects must provide a 10-hour OSHA construction safety program, or similar program approved by the Department of Labor and Industrial Relations, to be completed by their on-site employees, unless such employees hold documentation of prior completion of the program, within sixty (60) days of beginning work on the construction project. The Contractor shall provide an acceptable notarized affidavit stating that Contractor has verified the completion of a 10-hour construction safety program with respect to the employees working in connection with the contracted services. Contractors and subcontractors in violation of this provision will forfeit to the public body $2,500 plus $100 a day for each employee who is employed without training. Public bodies and contractors may withhold assess penalties from the payment due to those contractors and subcontractors. The penalties shall

not begin to accrue until the time periods in the statute have elapsed (60 days after notice to proceed and 20 days to produce documentation for employee found in violation).

25. Affidavit for Contracts over $5,000.00. That pursuant to Missouri Revised Statute Sections 285.525 through 285.550, if this contract exceeds the amount of $5,000.00 and Contractor is associated with a business entity, Contractor shall provide an acceptable notarized affidavit stating that the associated business entity is enrolled in and participates in a federal work authorization program with respect to the employees working in connection with the contracted services, and that said business entity does not knowingly employ any person who is an unauthorized alien in connection with the contracted services. Additionally, Contractor must provide documentation for said business entity evidencing current enrollment in a federal work authorization program.

26. Certificate of Compliance with 34.600 RSMo. (Anti-Discrimination Against Israel Act). That pursuant to Missouri Revised Statute Sections 34.600 et., seq., A Contractor must provide a written certification of compliance with the Anti-Discrimination Against Israel Act, RSMo. 34.600 et.,seq. that the contractor is not currently engaged in, and shall not, for the duration of the contract, engage in a boycott of goods or services from the State of Israel; companies doing business in or with Israel or authorized by, licensed by, or organized under the laws of the State of Israel; or persons or entities doing business in the State of Israel. This section shall not apply to contracts with a total potential value of less than one hundred thousand dollars or to contractors with fewer than ten employees.

27. Compliance with Laws. Contractor agrees to comply with all applicable federal, state and local laws or rules and regulations applicable to the provision of services and products hereunder. Contractor affirmatively states that payment of all local, state, and federal taxes and assessments owed by Contractor is current.

28. Entire Agreement. This agreement contains the entire agreement of the parties. No modification, amendment, or waiver of any of the provisions of this agreement shall be effective unless in writing specifically referring hereto, and signed by both parties.

29. Jurisdiction. This agreement and every question arising hereunder shall be construed or determined according to the laws of the State of Missouri. Should any part of this agreement be adjudicated, venue shall be proper only in the Circuit Court of Greene County, Missouri.

(Remaining Page Intentionally Left Blank)

IN WITNESS WHEREOF, the parties hereto evidence their agreement to the terms of this Contract by their signatures below.

APPROVED AS TO FORM

_____
City Attorney or Assistant City Attorney

RECOMMENDED BY:

_____
Director of Public Works or Acting Director

CONTRACTOR:

By: _____

Printed Name: _____

Title: _____

If Contractor is a Disadvantaged Business Enterprise (DBE), please indicate classification.
Minority Owned ☐ Women Owned ☐ Veteran Owned ☐

CERTIFICATE OF DIRECTOR OF FINANCE

I certify that the expenditure contemplated by this document is within the purpose of the appropriation to which it is to be charged and that there is an unencumbered balance of appropriated and available funds to pay therefor.

_____
Director of Finance or Acting Director

CITY OF SPRINGFIELD, MISSOURI

By: _____
City Manager or his/her designee

CITY OF SPRINGFIELD, MO
BUDGET ADJUSTMENT

Exhibit C

Budget Adjustment
059

Revenues:

Fund	Dept	Org	Account	P&G	Location	Amount	Description
Net Revenue Adjustment						$ -	

Expenditures:

Fund	Dept	Org	Account	P&G	Location	Amount	Description
40056	20	73020	509110	102743	00000	$ 1,100,000	Division Street Improvements - National to Glenstone
Net Expenditure Adjustment						$ 1,100,000	

Fund Balance Appropriation:

Fund		Title	Amount
40056		1/8-cent Transportation Sales Tax	(1,100,000)

Explanation: To amend the FY2021-22 budget by appropriating fund balance reserves from the 1/8-cent Transportation Sales Tax in the amount of $1,100,000 for Division Street Improvements from National to Glenstone.

Requested By:

Dan Smith 3-29-2022

Department Head Date

Approved By:

3-29-2022

Director of Finance Date

City Manager Date

Authorization:

Council Bill No. 2022-082

Ordinance No.

1st Reading

2nd Reading

Journal Imp No.

One-rdg. _____
P. Hrngs. _____
Pgs. 4
Filed 03-29-22

Sponsored by: Hosmer

First Reading: _____ Second Reading: _____

COUNCIL BILL 2022- 083 SPECIAL ORDINANCE _____

AN ORDINANCE

AMENDING Special Ordinance 27630, which declared the necessity of acquiring by condemnation the final easements for the purpose of constructing and maintaining sanitary sewers in the Chestnut South Lift Station Relief Sewer Project, to correct the legal description of a perpetual sanitary sewer easement.

WHEREAS, on January 24, 2022, City Council adopted Special Ordinance 27630 declaring the necessity of utilizing condemnation to acquire final easements, affecting one property, for the purpose of constructing and maintaining sanitary sewers in the Chestnut South Lift Station Relief Sewer Project, #2017PW0007; and

WHEREAS, after adoption of Special Ordinance 27630, it was determined that a legal description included in said ordinance included superfluous text, which did not enlarge or reduce the size of the needed easement, but which needs to be removed; and

WHEREAS, the legal description should be corrected so that the condemnation can proceed.

NOW, THEREFORE, BE IT ORDAINED BY THE COUNCIL OF THE CITY OF SPRINGFIELD, MISSOURI, as follows, that:

Section 1 – Special Ordinance 27630 is hereby repealed in its entirety.

Section 2 – City Council hereby declares it necessary to condemn the following described property, for the purpose of constructing, maintaining, and extending the public sanitary sewer system of the City of Springfield, Missouri, a municipal corporation, to-wit:

Owner(s) of Tract 5 are Kenny H. Tran and Angie O. Bui, husband and wife to the extent they claim any right in the property described as Tract 5. Also, Allen Icet, Greene County Collector of Revenue, to the extent of any unpaid taxes.

Tract #5: (Kenny H. Tran and Angie O. Bui):

PERPETUAL SANITARTY SEWER EASEMENT BEING DESCRIBED AS FOLLOWS:

A Fifteen (15) foot wide strip of land for a Sanitary Sewer Easement over, under and across a portion of the North Half of Government Lot 1 of the Fractional Southwest Quarter of Section 19, Township 29 North, Range 22 West of the 5th Principal Meridian, also being a portion of Tract "A" of the Subdivision of the West Half of the North Half of Lot 1 of the Southwest Quarter of Section 19, Township 29 North, Range 22 West, as per plat recorded in Book 2014 at Page 019184-14, Official Records of Greene County, Missouri, described as follows: Commencing at an iron bar marking the southeast corner of said Tract "A"; thence North 2°20'24" East along the east line thereof a distance of 197.67 feet; thence North 87°56'46" West along the northerly line thereof a distance of 181.37 feet to the Point of Beginning; thence South 9°31'51" East a distance of 4.38 feet; thence South 18°23'18" West a distance of 175.86 feet; thence South 5°54'25" West a distance of 24.81 feet to the south line of said Tract "A"; thence North 87°56'24" West along said south line a distance of 15.03 feet; thence North 5°54'25" East a distance of 27.46 feet; thence North 18°23'18" East a distance of 173.78 feet; thence North 9°31'51" West a distance of 3.72 feet to the northerly line of said Tract "A"; thence South 87°56'46" East along said northerly line a distance of 15.31 feet to the Point of Beginning, containing 3,075 square feet.

ALSO,

TEMPORARY CONSTRUCTION EASEMENT BEING DESCRIBED AS FOLLOWS:

A Forty (40) foot wide strip of land for a Temporary Construction Easement over and across a portion of the North Half of Government Lot 1 of the Fractional Southwest Quarter of Section 19, Township 29 North, Range 22 West of the 5th Principal Meridian, also being a portion of Tract "A" of the Subdivision of the West Half of the North Half of Lot 1 of the Southwest Quarter of Section 19, Township 29 North, Range 22 West, as per plat recorded in Book 2014 at Page 019184-14, Official Records of Greene County, Missouri, described as follows: Commencing at an iron bar marking the southeast corner of said Tract "A"; thence North 2°20'24" East along the east line thereof a distance of 197.67 feet; thence North 87°56'46" West along the northerly line thereof a distance of 168.62 feet to the Point of Beginning; thence South 9°31'51" East a distance of 4.92 feet; thence South 18°23'18" West a distance of 177.60 feet; thence South 5°54'25" West a distance of 22.60 feet to the south line of said Tract "A"; thence North 87°56'24" West along said south line a distance of 40.09 feet; thence North 5°54'25" East a distance of 29.66 feet; thence North 18°23'18" East a distance of 172.04 feet; thence North 9°31'51" West a distance of 3.18 feet to the northerly line of said Tract "A"; thence South 87°56'46" East along said northerly line a distance of 40.83 feet to the Point of Beginning, EXCEPT that part taken and described in the accompanying sanitary sewer easement document, containing 5,125 square feet.

Said Temporary Construction Easements to terminate upon completion and acceptance of improvements.

Section 3 – City Council hereby finds and declares that the Chestnut South Lift Station Relief Sewer Project, identified as project #2017PW0007, serves a legitimate public purpose as it is necessary to reduce sewer operating costs of a lift station and provide sewer infrastructure to future sewer districts.

Section 4 – The City Attorney, or her designee, is hereby authorized to proceed immediately with condemnation proceedings against the above-described properties as authorized by Article II, Sections 2.16(3), (7) and (10), and Article XIX, Section 19.18 of the City Charter; and the officers of the City are further authorized to exercise any and all powers necessary to carry out the terms of this Ordinance.

Section 5 – This Ordinance shall be in full force and effect from and after passage.

Passed at meeting: _____

_____
Mayor

Attest: _____, City Clerk

Filed as Ordinance: _____

Approved as to form: _____, Assistant City Attorney

Approved for Council action: _____, City Manager

EXPLANATION TO COUNCIL BILL 2022-083

FILED: 03-29-22

ORIGINATING DEPARTMENT: Environmental Services

PURPOSE: To amend Special Ordinance 27630, which declared the necessity of acquiring by condemnation the final easements for the purpose of constructing and maintain sanitary sewers in the Chestnut South Lift Station Relief Sewer Project, to correct the legal description of a perpetual sanitary sewer easement.

BACKGROUND INFORMATION: On January 24, 2022, City Council adopted Special Ordinance 27630 declaring the necessity of utilizing condemnation to acquire final easements, affecting one property, for the purpose of constructing and maintaining sanitary sewers in the Chestnut South Lift Station Relief Sewer Project, #2017PW0007.

When preparing to initiate condemnation proceedings, staff determined there was an oversight in the construction of the legal description for the perpetual sanitary sewer easement included in Special Ordinance 27630. The oversight did not enlarge or reduce the size of the needed easement, rather it involves the inclusion of superfluous text that needs to be removed. Specifically, the description of the perpetual sanitary sewer concluded with the expression “EXCEPT that part taken and described in the accompanying sanitary sewer easement.” This expression is appropriate for inclusion at the end of the temporary construction easement description but should not have been included at the end of the perpetual sanitary sewer easement description. The purpose of this bill is to correct the legal description of the perpetual sanitary sewer easement by removing this superfluous text.

Since the time of approval of Special Ordinance 27630, representatives of the City have once again attempted to engage with the property owners to discuss acquiring the necessary easements through negotiation, but those efforts remain unproductive.

REMARKS: The Environmental Services Department recommends passage of this Council bill.

Submitted by:

Ron Petering, P.E., Assistant
Director of Environmental Services

Recommended by:

Errin Kemper, P.E.,
Director of Environmental Services

Approved by:

Jason Gage,
City Manager

One-rdg. X
P. Hrngs. _____
Pgs. 7
Filed 03-29-22

Sponsored by: Schilling

COUNCIL BILL 2022-084 RESOLUTION _____

A RESOLUTION

ACKNOWLEDGING the appointments made by Greene County and the Republic School District to the Tax Increment Finance Advisory Commission.

WHEREAS, the City of Springfield has created a Tax Increment Financing Advisory Commission ("Commission") pursuant to section 2-241 of the Springfield City Code; and

WHEREAS, City Council desires to acknowledge the appointments made by Greene County and the Republic School District to the Commission.

NOW, THEREFORE, BE IT RESOLVED BY THE COUNCIL OF THE CITY OF SPRINGFIELD, MISSOURI, as follows, that:

Section 1 – City Council hereby acknowledges the appointment of John Russell as Greene County's representative to the Tax Increment Finance Advisory Commission as set forth in "Exhibit A," which is attached hereto and incorporated herein by reference, with a term to expire on May 31, 2026.

Section 2 – City Council hereby acknowledges the appointment of Matt Pearce as the Republic School District's representative to the Tax Increment Finance Advisory Commission as set forth in "Exhibit B," which is attached hereto and incorporated herein by reference, with a term to expire on May 31, 2026.

Section 3 – This Resolution shall be effective immediately upon adoption.

Passed at meeting: _____

_____
Mayor

Attest: _____, City Clerk

Filed as Resolution _____

Approved as to form: Jill Burris, Assistant City Attorney

Approved for Council action: Jason A. Gage, City Manager

EXPLANATION TO COUNCIL BILL 2022-084

FILED: 03-29-22

ORIGINATING DEPARTMENT: Economic Vitality Department

PURPOSE: Acknowledging appointments to the Tax Increment Finance Advisory Commission made by Greene County and the Republic School District.

BACKGROUND INFORMATION: Section 2-241 of the Springfield City Code establishes the creation of the Tax Increment Finance Advisory Commission. The Code also establishes the membership of the TIF Commission in accordance with State law. The Mayor appoints six of the eleven members with the consent of City Council. Of the six, one of the members appointed by the Mayor is to be a member of City Council, one is to be from the Springfield-Greene County Library Board, and the remaining four members from the public at large. The other five members of the Commission are appointed by Greene County (2), the affected school board (2), and all other taxing jurisdictions (1).

The Mayoral appointments are made for four-year terms, which are staggered based on the expiration date of the former Commission members' terms. The other appointments may be made for a specific term or for a period of time to coincide with the Commission's consideration of a specific redevelopment plan or project. By past practice, these members are also appointed for 4-year terms.

The other taxing jurisdiction's appointments are as follows:

Greene County representative:

- John Russell, term to expire May 31, 2026

Republic School District representatives (for redevelopment projects and areas located within the Republic School District)

- Dr. Matt Pearce, term to expire May 31, 2026

REMARKS: Passage of this Resolution will signify City Council's acknowledgement of appointments made by Greene County and the Republic School District. Staff recommends approval.

Submitted and Recommended by:

Sarah Kerner

Sarah Kerner,
Assistant Director of Economic Vitality

Approved by:

Jason A. Gage

Jason Gage,
City Manager

Bob Dixon
Presiding Commissioner

Rusty MacLachlan
1st District Commissioner

John C. Russell
2nd District Commissioner

EXHIBIT A

Shane Schoeller
Clerk of the Commission

Christopher J. Coulter, AICP
County Administrator

Megan Applegate
Executive Assistant

COUNTY COMMISSION

Greene County, Missouri

(417) 868-4112

Greene County Commission
Commission Briefing Minutes

Tuesday, March 8, 2022
8:45 AM
Commission Conference Room
1443 N. Robberson, 10th Floor

The Greene County Commission is now offering an alternative to attending the meeting. Please join our meeting from your computer, tablet or smartphone. https://www.gotomeet.me/GCCommissionOffice. You can also dial in using your phone. United States: +1 (872) 240-3412. You will be prompted for a PIN number where you will hit the "#" key and be prompted for an access code: 675-853-269

PLEASE BE AWARE: Cox Health has adopted a universal masking policy for all their properties. Masks are to be worn entering and exiting their facilities and medical office buildings as well as when in any interior common areas such as a lobby, hallway, shared bathroom, elevator, and stairwell.

WARNING Under Missouri law, any individual entering the premises or engaging the services of Greene County waives all civil liability against the individual or Greene County for any damages based on inherent risks associated with an exposure or potential exposure to COVID-19, except for recklessness or willful misconduct.

Attendees: Bob Dixon, Rusty MacLachlan, John Russell, Chris Coulter, Megan Applegate, Jenny Hayward and Robert Jehle.

Teleconference Attendees: Jeff Scott, Phil Corcoran, Rod Rahn, Jeff Avers, Rance Burger, Jeff Avers, Mike Cagle, Fred Lizama, Royce Denny, Crystal Richards, Jeff Bassham, Mailyn Jeffries, Kami Johnson, Cindy Stein and Andrea Stewart.

Informational Items
Budget-Jeff Scott
- ERA1 and ERA2 update.
- Bond update.

(EX1)Human Resources-Mailyn Jeffries and Kami Johnson
- Workers Compensation Update.

Chris Coulter
ARPA update

Public Information Office-Robert Jehle
- Project update
- Rotunda update.

Items for Consideration and Action by the Commission

(EX2)Discussion and Possible Vote: Warranty Deed, Highway

Commissioner Rusty MacLachlan moved to approve the warranty deed between Mark and Mark Eck and Greene County. Commissioner John Russell seconded the motion and it passed. Yes: Dixon, MacLachlan and Russell.

(EX3)Discussion and Possible Vote: Temporary Construction Easement, Highway

Commissioner John Russell moved to approve the temporary construction easement between Mark and Mark Eck and Greene County. Commissioner Rusty MacLachlan seconded the motion and it passed. Yes: Dixon, MacLachlan and Russell.

(EX4)Discussion and Possible Vote: No Known Loss letter, Budget

Commissioner Rusty MacLachlan moved to approve the no known loss letter as presented. Commissioner John Russell seconded the motion and it passed. Yes: Dixon, MacLachlan and Russell

Discussion and Possible Vote: Reappointment to the Springfield TIF Commission

Commissioner Rusty MacLachlan moved to reappoint Commissioner John Russell to the Springfield TIF commission. Commissioner John Russell seconded the motion and it passed. Yes: Dixon, MacLachlan and Russell

Other:

With no other business the meeting was adjourned.

Republic R-III School District
Regular Board Meeting (Monday, March 21, 2022)
Executive Session 6:00 pm
Regular Session 7:00 pm

EXHIBIT B

Members present
Denny Lawson, Tammy Messier, John Parker, Rusty Swift, and Todd Wojciechowski, Anne Buchanan

Members absent
Travis L Edwards

1. Action Items
Information: 1.01 Call to Order
The board president called the meeting to order.

Action: 1.02 Adjourn to Executive Session
The board president recommends meeting in closed session according to Section 610.021, Subsections 1, 3, 11, and 13, for the discussion of matters related to individually identifiable records and legal actions at 6:00 PM. Motion by Denny Lawson, second by Anne Buchanan.
Final Resolution: Motion Carries
Yea: Anne Buchanan, Denny Lawson, Tammy Messier, John Parker, Rusty Swift, Todd Wojciechowski

- The superintendent recommends approving the amended closed agenda as presented. Motion by John Parker, second by Tammy Messier. Motion Carries
  Yea: Anne Buchanan, Denny Lawson, Tammy Messier, John Parker, Rusty Swift, Todd Wojciechowski

- The superintendent recommends approving the retirements, resignations, employments and transfers as presented. Motion by John Parker, second by Tammy Messier.
  Motion Carries
  Yea: Anne Buchanan, Denny Lawson, Tammy Messier, John Parker, Rusty Swift, Todd Wojciechowski

- The superintendent recommends approving the rehires of probationary teachers, extended duties and classified directors for the 22-23 school year as presented. Motion by John Parker, second by Denny Lawson.
  Motion Carries
  Yea: Anne Buchanan, Denny Lawson, Tammy Messier, John Parker, Rusty Swift, Todd Wojciechowski

Action: 1.03 Adjourn Executive Session and Reconvene in Open Session
The board president recommends adjourning the closed session at 7:10 PM and reconvene in open session at 7:15 PM. Motion by Anne Buchanan, second by Denny Lawson.
Final Resolution: Motion Carries
Yea: Anne Buchanan, Denny Lawson, Tammy Messier, John Parker, Rusty Swift, Todd Wojciechowski

Travis L Edwards arrived at 7:11 pm

2. Procedural Items
Action: 2.02 Adoption of Agenda
The superintendent recommends adopting the agenda as presented. Motion by Denny Lawson, second by Rusty Swift. Final Resolution: Motion Carries. Vote: 7 for, 0 against.

Action, Minutes: 2.03 Consent Agenda
Consent items include: #1 check register, various agreements, technology and HVAC bids, 22-23 school calendar, overnight trips, substitute lists, financial documents and board minutes.
The superintendent recommends approving the consent agenda with the exception of item #1 as presented. Motion by John Parker, second by Travis L Edwards.
Final Resolution: Motion Carries. Vote: 7 for, 0 against.

The superintendent recommends approving item #1 as presented. Motion by Tammy Messier, second by Rusty Swift. Final Resolution: Motion Carries. Vote: 6 for, 0 against, 1 abstention by Anne Buchanan

Report: 2.04 Board of Education Update

Information: 2.05 Public Comments
None

3. Report Items
Report: 3.01 RepMo Hero
Report: 3.02 Student Spotlight
Report: 3.03 Building Highlight
Report: 3.05 Administrative Team

4. Discussion Items
Discussion: 4.01 PDP Plan
Discussion: 4.02 23-24 School Calendar
Discussion: 4.03 Public Comments

5. Action Items
Action: 5.01 TIF Commission
The board president recommends appointing Superintendent Dr. Matt Pearce as a representative on the TIF Commission as presented. Motion by Denny Lawson, second by Tammy Messier.
Final Resolution: Motion Carries. Vote: 7 for, 0 against.

Action: 5.02 Revised FY22 Budget
The superintendent recommends approving the revised FY22 budget as presented. Motion by Travis L Edwards, second by Rusty Swift. Final Resolution: Motion Carries. Vote: 7 for, 0 against.

6. Procedural Items
Discussion: 6.01 Future Agenda Items

Action: 6.02 Next Meeting
The superintendent recommends a reorganization meeting to be April 14, 2022 at 6:00 pm and the next regular board meeting to be April 21, 2022 at 6:00 p.m. (Executive Session) and 7:00 p.m. (Regular Session). Motion by Tammy Messier, second by John Parker.
Final Resolution: Motion Carries. Vote: 7 for, 0 against.

Action: 6.03 Adjournment
The board president will adjourn this meeting at 8:48 pm. Motion by Anne Buchanan, second by Rusty Swift. Final Resolution: Motion Carries. Vote: 7 for, 0 against.

_____ _____
Todd Wojciechowski, Board President Sheryl Blankenship, Board Secretary