# STORMWATER CAPACITY

## 4.00 DESIGN STANDARDS

### 4.01 PURPOSE

The purpose of the Stormwater Capacity Design Standards is to provide a consistent policy under which certain physical aspects of stormwater conveyance design will be implemented. These standards have the objective of developing a stormwater conveyance system that shall:

A. Be consistent with the most current stormwater studies, master plans, and discharge permits for Springfield, the Springfield Development Code (SDC), the Springfield Standard Construction Specifications, and other Chapters of this Manual;

B. Be of adequate design to safely manage all volumes of water generated upstream and on the site to an approved point of discharge;

C. Provide points of disposal for stormwater generated by future development upstream;

D. Prevent the uncontrolled or irresponsible discharge of stormwater onto adjoining public or private property;

E. Prevent the capacity of downstream channels and stormwater management facilities from being exceeded;

F. Have sufficient structural strength to resist erosion and all external loads that may be imposed;

G. Avoid impacts to stream water quality and quantity, and seek to maintain the historic hydrograph, including peak and base flows;

H. Maximize efficient use of Springfield's natural drainage systems and wetlands;

I. Promote groundwater recharge by utilizing stormwater management techniques that decrease impervious surfaces to manage stormwater runoff;

J. Promote the protection of the Springfield's existing high level of overall water quality and facilitate implementation of further water quality improvements;

K. Be designed in a manner and use materials that allow economical maintenance;

L. Be designed using methods and materials to insure a minimum practical design life of 75 years for all systems and 100+ years in traveled right-of-way; and

M. Be designed based on future land use.

### 4.02 GENERAL DESIGN CONSIDERATIONS

Stormwater system design within a development site shall include provisions to address water quality concerns (see Chapter 3), the collection and conveyance of runoff from all public and private streets and easements, and from the roof, footing, and area drains of single-family, duplex, multi-family, commercial, or industrial buildings. Furthermore, the design shall provide for the future extension of the stormwater system to the entire drainage basin in conformance with current adopted stormwater master plans or approved modifications to those plans.

All stormwater system designs shall be based on an engineering analysis that takes into consideration water quality issues, runoff rates, pipe flow capacity, hydraulic grade line, soil characteristics, pipe strength, and potential construction problems.

In locations where stormwater infrastructure is not available, or where suitable subsurface conditions exist, a Low Impact Development Approach, discussed in more detail in Section 4.17, shall be utilized.

## 4.03 ACCOUNTABILITY FOR STORMWATER SYSTEM DESIGN

This Chapter presents Springfield's standards for engineering and design of stormwater system facilities. While Springfield believes these standards are appropriate for a wide range of development proposals, compliance solely with these requirements does not relieve the professional engineer of their responsibility to ensure stormwater facilities are engineered to provide adequate protection for public and private property and natural resources.

To assist applicants in preparing a Stormwater Study, Springfield has developed a Stormwater Scoping Sheet to ensure that site stormwater system design is prepared in compliance with this Manual. The Stormwater Scoping Sheet shall be completed for each development and can be found at http://www.springfield-or.gov/dept_dpw.htm.

Other agencies may require some form of stormwater system review and impose requirements that are separate from, and in addition to, Springfield's requirements. The applicant shall coordinate with these agencies and resolve any conflicts or concerns in stormwater conveyance and water quality requirements.

### 4.03.1 Stormwater Study

All developments that will increase or modify impervious surface shall submit, if further study is not required by the criteria outlined below, a Stormwater Study and a plan for the development site that provides for a system capacity design for a 2-year storm event. The time of concentration for the study shall be determined by using a ten minute start time and calculated travel times in gutters, pipes and swales for each drainage basin on the development site. The stormwater system design shall be checked for overflow impacts that may occur in the 25-year storm event and include contingency measures to protect both on-site buildings and abutting properties.

A complete Stormwater Study, as outlined below, shall be submitted for all developments that generate public and/or private stormwater runoff from more than one (1) acre of land or generate peak flows in excess of 0.5 cfs. Developments or redevelopments that create 5,000 square feet of new impervious surface or modify an existing stormwater system with capacity of 0.5 cfs or greater shall also submit a complete Stormwater Study. Note: an Oregon licensed Civil Engineer shall prepare the complete Stormwater Study. All developments containing or adjacent to a floodplain, stream, wetland, natural resource area, or wellhead protection zone shall review and report their impact to those systems as part of the required Stormwater Study.

If required by the criteria stated above, a complete Stormwater Study shall be provided for a development that is proposed within Springfield's planning jurisdiction. This study shall include the following:

A. A written narrative describing the proposed stormwater system in detail, including connections to the public system, a description addressing water quality measures (Best Management Practices) proposed, as well as any necessary capacity measures that may be required for development (i.e. – a detention pond).

B. A hydrological study map, that shall contain:

1. The development site and adjacent areas that contribute significant offsite flows, well defined, and an appropriate amount of area beyond the development site of not less than 100 feet;

2. Streets important to the study, and street names;

3. Flow arrows in streets and ditches;

4. Contours or spot elevations for verification of direction of overland flow and pipe cover; Contour intervals on the study map shall be as follows:

| Slope (%) | Contour Interval (Feet) |
|---|---|
| 0 - 10 | 2 |
| 11 - 25 | 5 |
| > 25 | 10 |

5. Drainage areas of all sub-basins (in acres);

6. Collection points (nodes) at downstream limits of all sub-basins;

7. A profile of the stormwater system showing invert elevations, manhole top and bottom elevations, existing utilities, and existing and finished ground line elevations;

8. Existing and proposed stormwater pipes and channels with sizes and/or cross-sections included;

9. Future pipes in the system, complete with proposed sizes, slopes, pipe cover, flow line elevations at manholes, etc.;

10. North arrow, scale, company name and logo, designer, date, etc.;

11. Environmentally sensitive areas (e.g. gullies, ravines, swales, wetlands, steep slopes, springs, creeks, etc.) For natural drainage features show direction of flow; and

12. 100-year flood plain with flood elevations and 100-year flood way, as applicable.

C. Hydrologic calculations to establish runoff volumes (see analysis method requirements and design event in the Sections 4.03.2).

D. Hydraulic calculations to establish pipe size, flow velocity, hydraulic grade line, etc.

Unless specifically required by Springfield for a particular development, land use applications will not be required to provide engineering level details for on-site pipe profiles (showing invert elevations, manhole top and bottom elevations, pipe cover, etc) as part of application. However, these details shall be required prior to final development approval.

### 4.03.2 Stormwater Study Types

A. A Small Site Stormwater Study shall be required when ALL of the following criteria are met:

1. The study area is less than five (5) acres in size.

2. The study area drains into an established public system with available capacity for the peak flow based on the storm event frequency required under Section 4.03.4 Hydrologic Calculations.

3. For sites using a Low Impact Design Approach, a soils study may be required to ensure the site soils are suitable for the proposed stormwater management facilities.

4. The development proposed is a residential development. Commercial and industrial developments may also qualify for a Small Site Stormwater Study, provided the proposed development site is less than 1 acre.

5. The study area does not contain and is not adjacent to a floodplain, stream, wetland, natural resource area, or well head protection zone.

B. A Mid-Level Site Stormwater Study shall be required when the criteria for a Small Site Stormwater Study cannot be met and when ALL of the following criteria are met:

1. The study area is less than 25 acres in size.

2. The study area drains to an established public system within the city limits.

3. The study area does not contain and is not adjacent to a floodplain, stream, wetland, natural resource area, or well head protection zone.

C. A Full Site Stormwater Study shall be required when the criteria for a Small Site and Mid-Level Site Stormwater Study cannot be met and where ANY of the following conditions are met:

1. The study area is greater than 25 acres in size.

2. Developments that require creation of a new outfall and/or exceed existing system capacity.

3. The study area that contains or is adjacent to a floodplain, stream, wetland, or natural resource area.

4. Any development that does not qualify for a Small Site or Mid-Level Site Stormwater Study and that either generates a peak flow in excess of 0.5 cfs, or modifies a stormwater system with a capacity of 0.5 cfs or greater, or is a redevelopment or development that creates 5,000 square feet or more of new impervious area.

### 4.03.3 Hydrologic Calculations

Hydrologic calculations for the various study types shall conform to the following:

A. Small Site Stormwater Study:

1. Rational peak flow method[1].

[1] When the 'C' factor in rational method peak flow analysis is 0.5 or greater, the time of concentration / flow time and the peak flow from the impervious areas shall be computed separately and compared to the combined area. The higher of the two peak flow rates shall then be used to size the conveyance.

2. 2-year storm event frequency for volumes up to 5 cfs.

3. 5-year storm event frequency for volumes from 5 cfs to 20 cfs.

B. Mid-Level Site Stormwater Study:

1. Unit Hydrograph Method. Use SCS Type 1A distribution for rainfall (values given below)

2. Storm events and volumes same as Small Site and using the 10-year event for volumes of 20 cfs to 40 cfs.

3. 25-year storm event for detention facilities where necessary to meet downstream capacity issues.

4. 50-year storm event for volumes above 40 cfs.

C. Full Site Stormwater Study:

1. Unit Hydrograph Method. Use SCS Type 1A distribution for rainfall (values given below).

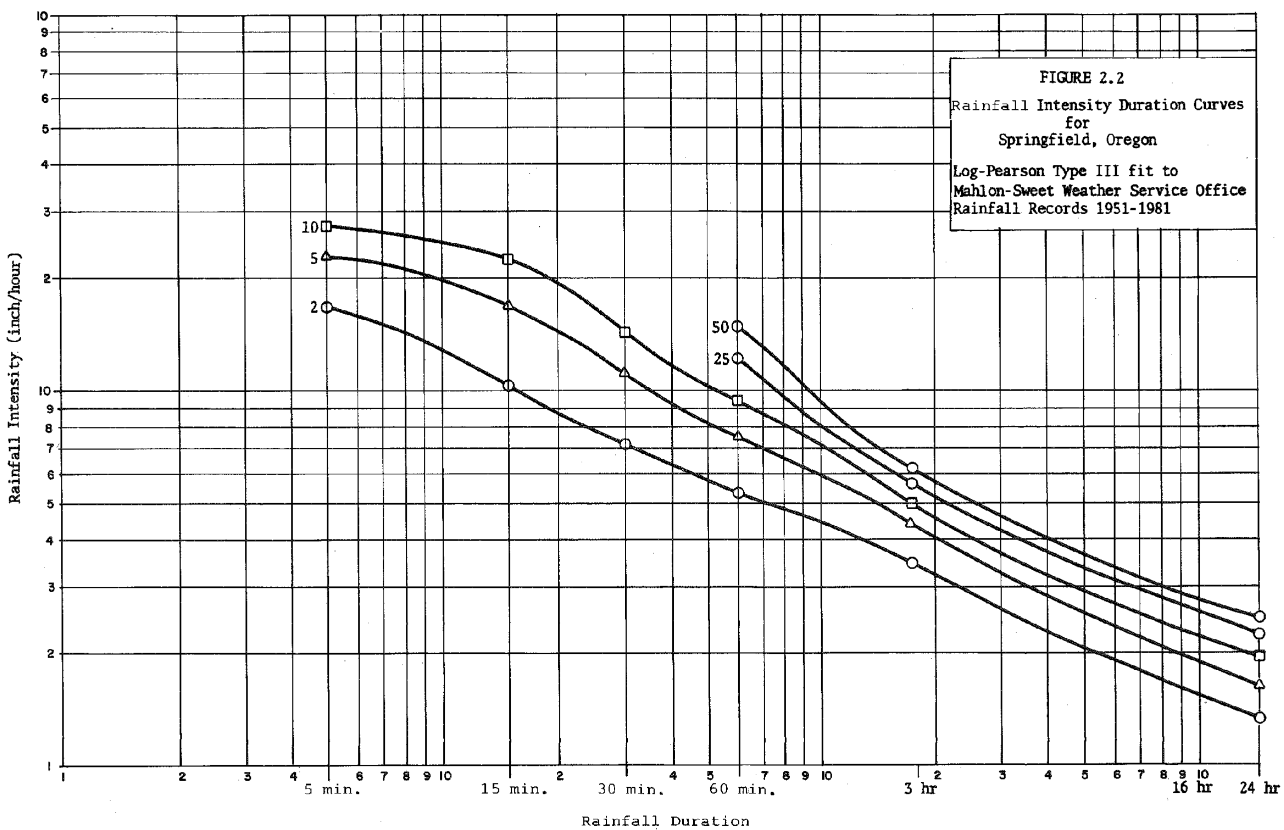
2. Floodplain analysis if development affects a floodplain.

3. Storm events and volumes same as outlined in Small and Mid-Level above and 100-year flood for areas in the floodplain.

Based on the Springfield *Stormwater Facilities Master Plan* (2008) and the Portland *Stormwater Management Manual* (2008), the following represents the SCS Type 1A design rainfall depths that shall be used for Unit Hydrograph calculations for the following 24-hour duration storm events:

| Storm Event | Rainfall |
|---|---|
| Water Quality Event | 0.83 Inches |
| 2 – Year | 3.3 Inches |
| 5 – Year | 3.8 Inches |
| 10 – Year | 4.3 Inches |
| 25 – Year | 4.8 Inches |
| 100 – Year | 5.2 Inches |

When utilizing the rational method, the Intensity Duration Frequency curves from the *West Springfield Drainage Master Plan* (1983) located below shall be used for design. An intensity of 1/4 inch per hour shall be used for the water quality storm event as specified in Chapter 3.




## 4.03.4 Hydraulic Calculations

A. The method of hydraulic calculations shall be subject to City Engineer approval.

B. Site development improvement projects shall address on-site and off-site stormwater management concerns, both upstream and downstream of a project, including but not limited to:

1. Modifications to the existing on-site stormwater management facilities shall not restrict flows creating backwater onto off-site property to levels greater than the

existing situation unless approved by the affected off-site property owners and Springfield. The affected property owner(s) shall agree to and sign an easement identifying the location of the backwater storage. The easement shall be in a form approved by the City Engineer.

2. Stormwater management facilities shall be designed and constructed to accommodate all flows generated from upstream property from the most recent approved land use plan at full development.

3. The design of stormwater management facilities shall analyze the impact of restrictions downstream of the project site. The developer shall remove downstream restrictions that create on-site backwater or the on-site backwater shall be addressed in the design of the development's storm system. The removal of downstream obstructions shall not be allowed if this removal creates downstream capacity problems.

C. Review of Downstream System:

1. The design engineer for each development constructing new impervious surface of more than 5,000 square feet shall submit documentation, for review by the City Engineer, of the downstream capacity of any existing storm facilities impacted by the proposed development. The design engineer shall perform an analysis of the stormwater system downstream of the development to a point in the stormwater system where the proposed development site constitutes 10 percent or less of the total tributary drainage volume, but in no event less that 1/4 mile.

2. If the capacity of any downstream public storm conveyance system or culvert is surpassed during the Event/CFS level requirements, due directly to the development, the developer shall correct (mitigate) the capacity problem or construct an on-site detention facility unless approved otherwise by the City Engineer.

3. If the projected increase in surface water runoff that will leave a proposed development will cause or contribute to damage from flooding to existing buildings or dwellings, the downstream stormwater system shall be enlarged to relieve the identified flooding condition prior to development, or the developer shall construct an on-site detention facility.

4. Any increase in downstream flow shall be reviewed for erosion potential, defined as downstream channels, ravines, or slopes with evidence of erosion/incision sufficient to pose a sedimentation hazard to downstream conveyance systems or pose a landslide hazard by undercutting adjacent steep slopes.

### 4.03.5 Design of Conveyance

The conveyance system shall be designed to convey and contain at least the peak runoff for the Event/CFS design requirements. Structures for proposed pipe systems shall provide a minimum of 1 foot of freeboard between the hydraulic grade line and the top of the structure or finish grade above pipe for a 25-year peak rate of runoff. Surcharge in pipe systems shall not be allowed if it will cause flooding in portions of a habitable structure, including below-floor crawl spaces. All public pipes shall be laid at a positive slope, and no system shall be designed to be permanently surcharged.

The following conditions may cause the City Engineer to require hydraulic designs to include an overland conveyance component demonstrating how a 100-year event will be accommodated. This overland component shall not be allowed to flow through or inundate an existing building.

1. Discharges to an already overloaded portion of the stormwater network, as determined by the Springfield *Stormwater Facilities Master Plan*;

2. Additional discharges to overloaded or surcharged conveyances where overflows may cause significant property damage; or

3. Where failure of on-site treatment and infiltration stormwater systems could lead to flooding of adjacent or on site structures.

## 4.04 DESIGN OF STORMWATER SYSTEMS

A. Manhole Design:

1. Manholes shall be provided at least every 500 feet, at every grade change, and at every change in alignment and junction of 2 or more lines. Manhole lids shall have a minimum of 6 inches of clearance from the edge of a curb or gutter and shall not be in a wheel path of the traveled way.

2. All manholes shall be a minimum of 42 inches in diameter.

3. Pipe crowns of branch or trunk lines entering and exiting junctions shall be at the same elevation. If a lateral is placed so its flow is directed against the main flow through the manhole or catch basin, the lateral invert shall be raised to match the crown of the mainline pipe.

4. Manholes on a sealed joint system (tight line) and all stormwater systems on slopes greater than 10 percent shall be constructed with a 20-foot, parallel perforated line to collect ground and trench water into the system.

5. Inside drop structures shall provide a minimum of 42 inches of clear space.

6. All manholes shall have a minimum 12-inch ledge on 1 side of the channel in the base at an elevation of 0.8 of pipe height, except for water quality manholes.

7. Details of pipe configuration and flow channelization shall be submitted with the plans where pipes into or out of a manhole are larger than 24 inches, or where more than 4 mainline connections are made.

8. Connections to an existing manhole, elevation of the existing ledge, and elevations of existing inlets and outlets shall be submitted with the plans.

9. Connections are allowed directly into a manhole if the manhole is properly channelized. No more than 3 side laterals shall be connected to a manhole unless otherwise approved by the City Engineer. There shall be a minimum of 8 inches

separating connections as measured from the outside diameter of the pipe.

10. A manhole may have a free inside drop of up to 2 feet.

11. Line manholes may be 'T' top design for pipe diameters 42 inches and larger where no side line connections are present or planned.

B. Water Quality Manholes/Structures:

1. Water quality manholes or structures shall be an approved, manufactured unit. All capacity, efficiency, operation and maintenance data shall be submitted at the time of plan review.

2. Each water quality manholes or structures shall be designed for the runoff from the upstream watershed at build out, based on the applicable comprehensive land use plan. No flow shall be introduced into the manhole or structure in addition to the design amount.

3. Water quality manholes shall be a minimum of 60 inches in diameter, unless otherwise approved by the City Engineer.

4. Water quality manholes shall not be used in a submerged or surcharged system. The manufacturer's required head losses shall be accommodated for in the system design.

5. Water quality structures and water quality catch basins shall meet the requirements of current Stormwater Quality Standards as specified in Chapter 3.

C. Pipe Type:

1. Concrete pipe – standard pipe material for stormwater system design within Springfield. Refer to the Springfield Standard Construction Specifications for pipe bedding details.

2. PVC – may be used in areas that meet criteria for Hillside Development as specified in Chapter 7, where tight-line or sealed systems are required, or areas located outside of the right-of-way. Pipe loading analysis calculations may be required on a case-by-case basis.

3. HDPE –may be used in all areas that meet manufacturer's installation requirements when approved by the City Engineer. Pipe loading analysis may be required on a case-by-case basis.

D. Pipe Size:

1. Pipe from an inlet to the main line in the public system shall be a minimum of 10 inches in diameter.

2. Main line pipe shall be a minimum of 12 inches in diameter.

3. Service laterals for single-family residences shall be 6 inches in diameter. All other service laterals shall be a minimum of 10 inches in diameter.

E. Minimum and Maximum Velocities:

1. All storm pipes shall achieve a minimum velocity of 3 feet per second at 0.5 part full based upon Table 4-1 and the associated 'n' value.

2. All pipe exceeding critical flow velocities shall have analysis data submitted showing the effects of hydraulic jump at manholes and downstream water levels for peak flow situations.

**Table 4-1: Manning's 'n' Values for Pipes**

| **Type of Pipe Material** | **Uniform Flow (Preliminary Design)** | **Backwater Flow (Capacity Verification)** |
|---|---|---|
| Concrete Pipe and Lined Corrugated PE Pipe | 0.014 | 0.012 |
| Annular Corrugated Metal Pipe | | |
| · 2-2/3 inch X ½ inch Plain or Fully Coated | 0.028 | 0.024 |
| · Paved Invert | 0.021 | 0.018 |
| · 3 inch X 1 inch Corrugation | 0.031 | 0.027 |
| · 6 inch X 2 inch Corrugation (Field Bolted) | 0.035 | 0.030 |
| Helical 2-2/3 inch X 1/2 inch Corrugation and Corrugated PE Pipe | 0.028 | 0.024 |
| Spiral Rib Metal Pipe and PVC Pipe | 0.013 | 0.011 |
| Ductile Iron Pipe Cement Lined | 0.014 | 0.012 |
| Solid Wall PE Pipe (Butt Fused Only) | 0.009 | 0.009 |

F. Pipe Location:

1. All public stormwater pipes shall be located within the public right-of-way. The City Engineer may grant exceptions for systems with physical constraints precluding the location within the public right-of-way.

2. Stormwater pipes shall not be located closer than 10 feet from the edge of a public street right-of-way.

3. Stormwater pipes in easements shall be located in the center of the easement unless otherwise approved by the City Engineer. The centerline of a stormwater pipe shall not be located closer than 7 feet to an easement side line.

4. Stormwater pipes shall be located so that manholes are not in the wheel path.

5. Stormwater laterals shall be provided on the down slope side of all lots in developments where drainage to the street cannot be provided.

6. The crowns (inside tops) of pipes shall match wherever practical when changing pipe sizes at manholes.

G. Distance between Structures:

1. The maximum length of pipe between stormwater structures shall be 500 feet for all systems with pipe 24 inches and smaller. Large diameter trunk systems shall not exceed 600 feet between structures.

H. Alignment:

1. Pipe shall be laid on a straight alignment and at a uniform grade rate from structure to structure except as provided for in the Hillside Overlay District as specified in Chapter 7 and SDC 3.3-500.

I. Pipe Cover:

1. Pipe cover shall be measured from the finished ground elevation to the top of the outside surface of the pipe in areas outside paved areas. In paved areas, the pipe cover shall be measured from the lowest point of the gutter section to the top outside surface of the pipe.

2. The minimum pipe cover shall be 18 inches for reinforced pipe and 36 inches for plain concrete and plastic pipe materials. An engineered solution may be accepted for pipe not able to meet these conditions.

3. In flat drainage basins, the design engineer shall demonstrate that the stormwater pipe has been laid at a depth sufficient to properly drain the remainder of the upstream tributary area.

J. Tight-line (a sealed pipe system) shall be used for conveyance systems traversing a slope that is steeper than 10 percent and greater than 20 feet in height. It shall also be required within sensitive areas or where contamination of either the ground water or the stormwater from contaminated ground areas is a particular concern.

K. Perforated pipe drain systems or ‘French drains’ shall be engineered and be approved by the City Engineer. Where perforated pipe systems are used to dispose of stormwater, they shall meet all requirements for an Underground Injection Control (UIC) system.

## 4.05 CATCH BASIN/INLET DESIGN

A. All inlet and catch basin openings shall be designed to accept flow from a 10year storm event. Combination inlets with grates, where used, shall be of multi-chambered design, and shall be designed, as far as practical, to avoid failure due to accumulation of debris.

B. The standard catch basin for use within Springfield shall be the curb inlet basin in the forms listed in the current issue of the Springfield Standard Specifications. Gutter catch basins may be used where conflicts dictate their use only if no on-street bike facilities are present or planned. Combination gutter/curb inlet basins shall be used where slopes and velocities allow by-pass of more the 15 percent of the design flow (HEC 12 method of determination), or for use in Hillside development (see Chapter 7).

C. All catch basins shall be constructed with an 18 inch sump.

D. A main stormwater line shall not pass through a sumped catch basin, unless approved as a manhole inlet combination.

E. Flows in streets during the 2-year event shall not run deeper than 4 inches against a curb or extend more than 2 feet into the travel lane. Streets classed as collector and above and streets in commercial areas shall meet the above requirements for the 10 year event. Inlets in sag locations shall be designed with no more than 1 foot of water above the gutter flow line during the 25-year event.

F. A catch basin shall be provided just upslope to curb returns on streets with a centerline gradient of 3 percent or more and a street gutter flow run of 100 feet or more.

G. Catch basins may connect to main stormwater lines with a tee connection when the main stormwater line is at least 1 size larger that the catch basin line. When the catch basin line is the same size as the main stormwater line, the connections shall be made at a manhole or other approved structure. The maximum length of pipeline between the catch basin and the mainline shall be 40 feet for 10 inch pipe and 60 feet for 12 inch pipe. Oversize catch basins (30 inch inside dimension) shall be installed when a tee connection is used.

## 4.06 AREA DRAINS AND DITCH INLETS

A. The standard area drain shall be as shown in Springfield Standard Drawing No. 4-11 and 4-12. Ditch inlets shall be as shown in Standard Drawings No. 4-13 and 4-14 with 12-inch sumps and 10 inch minimum outlet size.

B. A main stormwater line shall not pass through a field inlet or ditch inlet.

C. Ditch inlets shall be located at the upper terminus of a main stormwater line or shall connect to a main stormwater line only at a manhole.

## 4.07 CONSTRUCTED CHANNELS

A. When constructed channels are used or modified, they shall be lined with vegetation whenever possible.

B. Rock-lined channels shall be used where a vegetative lining will not provide adequate protection from erosive velocities.

C. Channel Design:

1. Constructed open channels shall be sized to pass the required flows and have side slopes no steeper than 2:1. Any proposed constructed channel improvement that does not meet these requirements may be required to be piped by the City Engineer.

2. Channels designed to handle the runoff from a development shall be constructed from the development to an existing public stormwater system with an established outfall to a receiving waterway.

3. Channels shall not contain protruding pipes, culverts or other structures that reduce or hinder the flow characteristics of the channel, except for structures that are required

and designed to dissipate velocities. Channels shall be designed to prevent scouring and erosion.

4. Channel protection shall be as shown in Table 4-2.

D. Access – Maintenance:

1. Access roads or other suitable access ways for maintenance purposes shall be provided when channels do not abut public right-of-way. Access shall be provided along 1 side of the channel as necessary for vehicular maintenance access.

2. Access roads shall have a maximum grade of 15 percent, and a maximum cross slope of 3 percent.

3. A 40-foot minimum outside turning radius shall be provided on the access road.

4. Access roads shall be a minimum of 15 feet wide on curved sections and 12 feet on straight sections.

5. Access roads in excess of 50 feet in length shall have a turnaround unless approved by the City Engineer.

6. Access roads shall have the capability of supporting a 20-ton vehicle under all weather conditions.

**Table 4-2: Channel Protection for Channel Construction**

| Greater Than (FPS) | Less Than or Equal to (FPS) | Required Protection | Thickness | Min. Height Above Design Water Surface |
|---|---|---|---|---|
| 0 | 5 | Vegetation Lining | N/A | 0.5 ft. |
| 5 | 8 | Riprap Class 50 | 1 ft. | 1 ft. |
| 8 | 12 | Riprap Class 100 | 2 ft. | 2 ft. |
| 12 | 20 | Gabion or Velocity Dissipaters | Varies | 2 ft. |

### <u>4.07.1 Roadside Ditches</u>

A. Existing or new roadside ditches shall be constructed with a maximum depth of 2 feet as measured from the shoulder of the road.

B. Side slopes shall be 2:1 or less.

C. Velocity when flowing full shall not exceed the erosive velocity limits of the soil or lining in the ditch.

## <u>4.08 OUTFALLS</u>

Outfalls shall conform to the requirements of all federal, state, and local regulations. Outfall design shall be based on considerations to protect the outfall area and channel from scour, sloughing and channel degradation rather than hydraulic efficiency. The design velocity from the outfall for its largest recurrence interval design storm shall be consistent with the velocity in the receiving channel for the same recurrence interval design storm as the outfall design storm. If the velocity from the outfall is greater than the velocity in the receiving channel, erosion protection and energy dissipation may be required. Installation of backflow prevention gates may be necessary when the outfall is in a tail-water condition.

A. Outfalls shall be placed above the mean low water level except as permitted by the City Engineer.

B. All outfalls shall be provided with a rock splash pad or other approved erosion control protection measures. Rock protection at outfalls shall be designed in accordance with the Springfield Standard Specifications and Table 4-2 above. Mechanisms that reduce velocity prior to discharge from an outfall are encouraged and may be required. Examples are drop manholes and rapid expansion into pipes of much larger size.

C. An engineered energy dissipater, that may include stilling basins, drop pools, hydraulic jump basins, baffled aprons, or bucket aprons, shall be provided for outfalls with velocity at design flow greater than 10 FPS. These shall be designed using published references such as *Hydraulic Design of Energy Dissipaters for Culverts and Channels* published by the Federal Highway Administration of the United States Department of Transportation, and others. Design reference shall be included on the construction plan submittal.

## 4.09 DOWNSTREAM PROTECTION REQUIREMENT

Each new development or redevelopment shall mitigate the impacts, on both the quantity and quality of stormwater, upon the public stormwater system. The development may be able to mitigate capacity impacts on the public stormwater system using the following techniques, subject to the limitations and requirements of this Manual and, approval by the City Engineer.

A. Constructing permanent on-site stormwater capacity detention facilities designed in accordance with current stormwater management practices.

B. Using Low Impact Design Approaches (LIDA) to minimize impervious surfaces and stormwater runoff increases.

C. Enlarging or improving the downstream conveyance system.

## 4.10 CRITERIA FOR REQUIRING ON-SITE DETENTION

On-site detention facilities shall be constructed when any of the following conditions exist:

A. There is an identified downstream deficiency, and detention, rather than conveyance system enlargement, is determined to be the more effective solution.

B. There is an identified regional detention site within the boundary of the development.

C. The need for pre-treatment of stormwater discharge dictates that flows be detained for water quality processes.

D. There is a need to mitigate flow impacts on receiving streams.

E. The development site is located in an area where on-site treatment and disposal using LIDA is required or considered desirable and feasible.

### 4.10.1 On-Site Detention Design Criteria

A. When required, on-site stormwater detention facilities shall be designed to capture runoff so the runoff rates from the site after development do not exceed the pre-development conditions, based upon a 2- through 25-year, 24-hour return storm. Volume and duration of pre-development conditions will be considered.

B. When required because of an identified downstream deficiency, on-site stormwater detention facilities shall be designed so that the peak runoff rates will not exceed pre-development rates for the specific range of storms that cause the downstream deficiency.

C. Construction of on-site detention shall not be allowed as an option if such a detention facility would have an adverse effect upon receiving waters in the basin or sub-basin in the event of flooding, or would increase the likelihood or severity of flooding problems downstream of the site.

## 4.11 IMPERVIOUS AREA USED IN DESIGN

For single family and duplex residential subdivisions, stormwater capacity detention facilities shall be sized for all impervious areas created by the subdivision, including all streets, residences on individual lots at a rate of 2,640 square feet of impervious surface area per dwelling unit, and other impervious area. These facilities shall be constructed in conjunction with the subdivision's public improvements.

For all developments other than single family and duplex, the sizing of stormwater capacity detention facilities shall be based on the impervious area to be created by the development, including structures and all streets and impervious areas. Impervious surfaces shall be determined based upon building permits, construction plans, or other appropriate methods deemed reliable by the City Engineer.

## 4.12 DETENTION POND DESIGN

Detention ponds and other open impoundment facilities such as landscape areas, open playing fields and parklands, shall comply with the requirements of ORS 537, in general and more specifically. ORS 537.400 Ponds and Reservoirs. All detention ponds shall be designed by an Oregon licensed Civil Engineer and comply with the following criteria:

A. Facility Geometrics:

1. Interior side slopes up to the maximum water surface shall be no steeper than 3H:1V. If the interior slope needs to be mowed, the slope shall be 4H:1V

2. Exterior side slopes shall not be steeper than 2H:1V unless analyzed for stability by an Oregon licensed Geotechnical Engineer.

3. Pond walls and/or dikes may be retaining walls, provided that the design is prepared

and stamped by an Oregon licensed Civil Engineer; and a fence is provided along the top of the wall; and that at least 25 percent of the pond perimeter will be a vegetated soil slope of not greater than 3H:1V.

B. Water Quality Considerations:

1. Pond bottoms shall be level, and located a minimum of 0.5 feet below the inlet and outlet to provide sediment storage.

2. The inlet and outlet structures should be on opposite ends of the pond to promote maximum residence time and to prevent short-circuiting. Baffles may be installed to increase the residence time and flow path if locating outlet structures on opposite sides of the pond is not practical.

3. Detention facilities shall be designed so that the “drawdown” time does not exceed 48 hours. In the event drawdown time exceeds 48 hours, additional calculations shall be submitted showing the proposed facility can contain an additional 25-year, 24-hour return period storm.

4. The use of a sedimentation fore bay shall be required during the construction process if the pond is to be used for sedimentation control. After construction is complete, the pond shall be completely cleaned and all sediment removed prior to hook up to Springfield infrastructure.

C. Overflow - Emergency Spillway:

1. A pond overflow system shall provide controlled discharge of the design storm event for developed contributing area without overtopping any part of the pond embankment or exceeding the capacity of the emergency spillway. The design shall provide controlled discharge directly into the downstream conveyance system. An emergency overflow spillway (secondary overflow) shall be provided to safely pass the 100-year, 24-hour design storm event over the pond embankment in the event of control structure failure and for storm/runoff events exceeding design. The spillway shall be located to direct overflows safely towards the downstream conveyance system. The emergency spillway shall be stabilized with riprap or other approved means and shall extend to the toe of each face of the berm embankment.

D. Access – Maintenance:

1. Pond access easements and roads shall be provided when ponds do not abut public right-of-way. Access roads shall provide access to the control structure and along 1 or both sides of the pond as necessary for vehicular maintenance access.

E. Access roads shall meet the criteria specified in Section 4.07D.

F. Berm Embankment - Slope Stabilization:

1. Pond berm embankments higher than 6feet shall be designed by an Oregon licensed Civil Engineer or Geotechnical Engineer. The berm embankment shall have a minimum 15 foot top width where necessary for maintenance access; otherwise, top width may vary as recommended by the design engineer, but in no case shall top

width be less than 4 feet.

2. The toe of the exterior slope of pond berm embankment shall be no closer than 5 feet from the tract or easement property line.

3. The pond berm embankment shall be constructed on native consolidated soil (or adequately compacted and stable fill soils analyzed by an Oregon licensed Geotechnical Engineer) free of loose surface soil materials, roots and other organic debris.

4. The pond berm embankments shall be constructed by excavating a ‘key’ equal to 50 percent of the berm embankment cross-sectional height and width or as designed by an Oregon licensed Geotechnical Engineer.

5. The berm embankment shall be constructed on compacted soil (95 percent minimum dry density, per AASHTO T99, placed in 6 inch lifts, with the following soil characteristics: a minimum of 30 percent clay, a maximum of 60 percent sand, a maximum of 60 percent silt, with nominal gravel content) or as designed by an Oregon licensed Geotechnical Engineer.

6. Anti-seepage collars shall be placed on pipes in berm embankments that impound water greater than 4 feet in depth at the design water surface.

7. Exposed earth on the pond bottom and side slopes shall be seeded with seed mixture approved by the City Engineer.

## 4.13 USE OF PARKING LOTS FOR DETENTION

Parking lots may be used to provide additional detention volume for runoff events greater than the 2-year runoff event provided that:

A. The depth of water detained shall not exceed 1 foot at any location in the parking lot for runoff events up to and including the 100-year event; AND

B. The gradient of the parking lot area subject to ponding shall be 1 percent or greater; AND

C. The emergency overflow path shall be identified and noted on the engineering plan, and comply with all other development and stormwater management requirements; AND

D. Fire lanes used for emergency equipment shall be free of ponding water for all runoff events up to and including the 100-year event.

## 4.14 USE OF ROOFS FOR DETENTION

Detention ponding on roofs of structures may be used to meet flow control requirements provided that:

A. All applicable provisions of the International Building Code are met or exceeded by the design; AND

B. The roof support structure shall be analyzed by an Oregon licensed Structural Engineer to address the weight of ponded water; AND

C. The roof area subject to ponding shall be sufficiently water-proofed to achieve a minimum service life of 30 years; AND

D. The minimum pitch of the roof area subject to ponding shall be 1/4 inch per foot, AND

E. An overflow system shall be included in the design to safely convey the 100-year peak flow from the roof; AND

F. A mechanism shall be included in the design to allow the ponding area to be drained for maintenance purposes or in the event the restrictor device is plugged.

## 4.15 UNDERGROUND DETENTION FACILITIES

Springfield's preference is to have stormwater runoff detention occur above ground. In select locations, the City Engineer may approve the use of underground detention facilities. Underground detention facilities may only be proposed once all other means of surface detention have been explored and exhausted, and are subject to the approval of the City Engineer. All underground detention facilities shall be designed by an Oregon licensed Civil Engineer, and shall be used for controlling stormwater capacity only. Stormwater quality control shall occur in accordance with Chapter 3, while hydrologic and hydraulic calculations shall be in accordance with this Chapter.

Note: To minimize the occurrence of routine maintenance, all underground detention facilities shall be designed with a water quality manhole (or equivalent) upstream, to facilitate sediment fallout prior to stormwater entering the detention facility.

### 4.15.1 Detention Tanks

Detention tanks serve as runoff capacity control through the means of underground storage. Detention tanks shall be limited to large diameter pipes. In addition to runoff capacity control, detention tanks should be designed for factors such as environmental conditions (soil corrosiveness, inundation, etc.), maintenance access, and ground and/or surface loadings. Detention tanks shall comply with the following criteria:

A. General Design:

1. The minimum pipe size allowed for a detention tank in the public stormwater system shall be 36 inches in diameter.

2. All tanks shall be designed as flow-through systems, incorporating the use of in line manholes for maintenance and sediment removal.

3. Detention tank bottoms shall be level, and shall be located a minimum of 0.5 feet below the inlet and outlet to provide sediment storage.

4. City owned tanks shall be located in the public right-of-way; tanks proposed to be located outside the public right-of-way shall be located in a public stormwater easement, dedicated to Springfield.

B. Materials - Acceptable materials for detention are:

1. Reinforced concrete pipe.

2. The following materials may be used if they are located outside of the public right-of-way:
   a. Corrugated or spiral rib aluminum pipe;
   b. Lined corrugated polyethylene pipe; or
   c. PVC pipe.

C. Buoyancy:

1. The effects of buoyancy shall be considered in areas with a known high groundwater table or areas where seasonal high groundwater may cause flotation of the detention tank. Measures such as concrete anchors, concrete backfill, subsurface drains, etc. shall be required in these areas, as well as supporting engineered calculations.

D. Structural Stability:

1. Special consideration shall be given to ensure tanks meet requirements for potential traffic loading and overburden support. Tanks shall be placed on stable, well-consolidated native material with appropriate bedding. A structural analysis, geotechnical analysis, and engineered calculations may be required with the design, demonstrating stability and constructability. For tanks proposed under the travel way, H20 live loadings shall be accommodated.

E. Access Maintenance:

1. Access easements and roads shall be provided when tanks are not located within the public right-of-way.

2. Access openings shall be provided at a distance of no less than 50 feet from any location within the tank; be a minimum of 36 inches in diameter; and have watertight round lids.

3. All access openings shall have surface access for maintenance vehicles.

4. The distance from tank invert to finished grade shall be not more than 20 feet.

5. OSHA confined space requirements shall be met for tanks, and entrances to confined spaces shall be clearly marked.

F. Access Roads:

1. Access roads shall meet the requirements set forth in Section 4.07D.

**4.15.2 Detention Vaults**

Detention vaults serve as runoff capacity control through the means of underground storage. Detention vaults typically are of box-shaped design, and constructed with reinforced concrete. Besides runoff capacity control, vaults shall be designed for considerations such as environmental conditions (soil corrosiveness, inundation, etc.), maintenance access, and ground and/or surface loadings.  Detention vaults shall comply with the following criteria:

A. General Design:

1. Vaults shall be designed as flow-through systems with level bottoms.

2. Construction material shall consist of a minimum 3,000-psi structural reinforced concrete, and all joints shall be equipped with water stops.

3. The locations of the inlet and outlet shall be elevated 0.5 feet above the vault bottom to provide for sediment storage.

B. Structural Stability:

1. Special consideration shall be given to ensure vaults meet requirements for potential traffic loading and overburden support.  Vaults shall be located on well-consolidated native material, with appropriate bedding.  A structural analysis, geotechnical analysis, and engineered calculations may be required with the design, demonstrating stability and constructability.  Buoyancy calculations may also be required.

C. Access Maintenance:

1. Access easements and roads shall be provided in the event vaults are not located within the  public right-of-way.

2. The distance from vault invert to finished grade shall be not more than 20 feet.

3. Access openings shall be provided at a distance of no less than 50 feet from any location within the vault, shall be a minimum of 36 inches in diameter, and shall have watertight round lids.  Additionally, access openings shall be located at both the inlet and outlet locations of the vault.

4. All access openings shall have surface access for maintenance vehicles.

5. OSHA confined space requirements shall be met for vaults, and entrances to confined spaces shall be clearly marked.

D. Access Roads:

1. Access roads shall meet the requirements specified in Section 4.07D.

## 4.16 INFILTRATION FACILITIES

### 4.16.1 Overview

In general, infiltration facilities are used in areas of highly permeable soils, to reduce the quantity of stormwater runoff in receiving systems and to recharge the groundwater aquifer.  Examples of infiltration facilities include but are not limited to retention ponds; infiltration trenches; infiltration tanks; and drywells.  A geotechnical evaluation of the site, prepared by an Oregon licensed Engineer or Geotechnical Engineer, or an Oregon Registered Engineering Geologist shall be required for infiltration facilities other than single lot residential drywells and rain gardens, proposed within Springfield and its Urban Growth Boundary.  Sites utilizing infiltration for stormwater management may be eligible for Systems Development Charges and Stormwater User Rate fee reductions. The Oregon Department of Environmental Quality (DEQ) regulates drywells under its Underground Injection Control (UIC) program.

### 4.16.2 Underground Injection Control

The DEQ regulates and registers certain infiltration facilities as underground injection wells. Registration covers all injection wells, including stormwater disposal wells, industrial/commercial injection facilities, aquifer recharge wells, subsidence control wells, aquifer remediation wells, and other miscellaneous injection wells. In Oregon, all fresh water aquifers are protected as underground sources of drinking water (USDW). In addition to the minimum federal UIC requirements, all injection facilities shall further comply with Oregon Administrative Rule 340-44.

Drywell usage for clean roof runoff shall be considered and may be required in the overall stormwater management system design. Impervious surface area used for runoff calculations may be reduced by 25 percent of the area draining to on-site drywells.

Drywells shall be designed in accordance with Springfield Standard Drawings 4-19 and 4-20.

### 4.16.3 Surface Infiltration Facility Requirements

Infiltration facilities shall conform to the following standards:

A. Water Quality:

1. All infiltration facilities receiving runoff from areas other than building rooftops shall have stormwater quality treatment devices installed upstream of the facility as specified in Chapter 3. Infiltration facilities shall not be put "on-line" in the stormwater system until all upstream erosion control measures are in place, and all proposed project improvements finalized, thereby minimizing the amount of sediment laden runoff input into the facility.

2. All infiltration and water quality facilities are required to go through an Operations and Maintenance submittal process as specified in Chapter 3.

B. Soils:

1. For all proposed infiltration facilities, an Oregon licensed Civil Engineer or Geotechnical Engineer, or Oregon Registered Engineering Geologist, shall demonstrate through percolation rate testing, soil logs, and a written statement that the soil type existing on site will function properly to allow an infiltration facility. A Geotechnical Report as referenced in SDC 5.12-120F.7 or 5.17-120I.10 shall be submitted concurrently with the proposed design. Infiltration facilities will not be allowed on soils with a high groundwater table.

C. Infiltration Rate Testing Procedures:

1. All infiltration rate testing shall comply with either: the *EPA falling head percolation test procedure* (Design Manual – Onsite Wastewater Treatment and Disposal Systems, EPA, 1980; or the *double ring infiltrometer test* (ASTM D3385).

2. Sufficient soil testing shall be performed to establish the representative permeability

of the soil; however, a minimum of 3 soil tests shall be performed for each infiltration facility located on a site.

3. Each test hole shall be filled with water and maintained at depth above the test elevation for a saturation period specified for the respective test.

4. After the saturation period, the infiltration rate shall be determined based on the respective test procedures, with a head of 6 inches of water.

D. Design Infiltration Rate:

1. Research has shown that actual infiltration rates in many facilities are much lower than design infiltration rates predicted by the tests referenced above, particularly after a period of use, in that sedimentation and ground compaction can occur. Eventually, this leads to flooding and expenditures to mitigate the problem. Therefore, the design engineer shall incorporate a safety factor of at least 2 into the design infiltration rate. The maximum design infiltration rate used for sizing facilities shall be 10 inches per hour.

E. Overflow – Emergency Spillway:

1. Infiltration facility overflow systems shall provide controlled discharge of the design storm event for developed contributing area without overtopping any part of the infiltration facility or exceeding the capacity of the emergency spillway. The design shall provide controlled discharge directly into the downstream conveyance system. An emergency overflow spillway shall be provided to safely pass the 100-year, 24-hour design storm event in the event of failure. The spillway shall be located to direct overflows safely towards the downstream conveyance system.

## 4.17 LOW IMPACT DEVELOPMENT APPROACHES

Low Impact Development Approaches (LIDA) is recognized as a preferred and efficient method to manage stormwater runoff in urban areas. LIDA work with the natural and urban surroundings to manage stormwater as close to its source as possible. The LIDA method strives to treat runoff as a resource that is utilized to enhance a development rather than a waste product. This approach includes several technologies such as:

- Rain Gardens
- Infiltration Swales
- Retention Ponds
- Infiltration Planters
- Green Roofs
- Rainwater Harvesting
- Permeable Pavements

If effectively implemented, LIDA may have lower construction costs than conventional stormwater treatment infrastructure and can reduce the needed space for these facilities. In some cases, LIDA can supplement and even replace irrigation systems for landscaped areas and reduce the need for a traditional, extensive underground piping network to drain a dense, urban area.

Many of the undeveloped areas within the Springfield Urban Growth Boundary do not have access to a public stormwater management system. Installing public infrastructure may be costly to developers and utilization of LIDA can substantially reduce these costs. Upgrading existing stormwater systems within the developed area of Springfield will also be costly and reducing runoff from increasing densities from redevelopment will allow Springfield to manage and treat runoff with fewer costly upgrades to existing stormwater systems. LIDA systems are also easily integrated with required landscape areas and as such can be incorporated during development or redevelopment at little additional cost to the property owner and developer.

### 4.17.1 Requirements For Low Impact Development Approach Areas

Springfield currently requires development and redevelopment within the Glenwood Refinement Plan boundary to use LIDA for stormwater management. LIDA is encouraged elsewhere in Springfield and the developer may utilize this approach in any area if site conditions are suitable. In addition, LIDA systems may be applicable in other areas without access to a stormwater system that has sufficient capacity for the increased runoff due to development.

The following criteria shall be used when designing stormwater systems utilizing LIDA:

1. Within the Glenwood Refinement Plan Boundary, all development sites must capture and retain on-site the first 1 inch of rainfall in a 24-hour period using on-site LIDA systems.

2. The site soils shall be evaluated for infiltration capability as stated in 4.16.3 when designing LIDA systems.

3. The amount of runoff infiltrated shall be maximized to the greatest extent practicable taking into account site limitations such as soil type and lot size and configuration.

4. Offsite runoff shall be minimized to the greatest extent practicable. The City Engineer may waive or reduce this requirement in cases where a suitable offsite disposable area is available.

5. The riparian setback and other landscaped areas of any development site shall be utilized for stormwater treatment and infiltration where practicable.

6. For development sites adjacent to public open space areas with sufficient capacity to infiltrate additional runoff, an overflow connection from the site to the public open space will be allowed. For maximum effectiveness of the overall stormwater facilities, design of onsite and adjacent open space treatment areas shall be coordinated where practicable.

7. LIDA systems shall be designed in conformance with Eugene's *Stormwater Management Manual*. For a system that a developer may want to use that is not included in Eugene's manual, the developer must provide the City Engineer with the applicable design standards and criteria from a public agency that has approved its use. The City Engineer will review the developer's proposal and determine if that system is acceptable for use in Springfield at the desired location.