CITY OF PHILOMATH
Storm Drainage System Master Plan

Section 6
DESIGN STANDARDS & MANAGEMENT PRACTICES

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6.1 Introduction

The purpose of this section is to present background and guidance for nonstructural issues related to management of storm drainage systems. Specifically, this section addresses design standards, maintenance issues, legal/liability issues and funding issues related to storm drainage in the City of Philomath.

6.2 Design Standards

The City does not presently have any detailed design criteria for storm drainage system improvements under City jurisdiction. Based on a review of existing drainage design criteria for Philomath and other communities of similar size, the following sections present suggested design criteria and approaches for use by the City. A draft copy of recommended Public Works Design Standards (PWDS), including a section for stormwater management and standard details, is included in Appendix C. The format of these PWDS is designed to allow sections for streets, sanitary sewers, and water distribution can be added as these are adopted by the City.

These draft PWDS are intended to provide a uniform set of standards for public storm drainage improvements. They also are intended to apply to private systems which cannot conform to Uniform Plumbing Codes, particularly minimum slopes. The intent of these standards is to provide guidelines for the construction of public facilities which will provide an adequate service level for the present development as well as for future development.

The PWDS cannot provide for all situations. They are intended to assist but not to substitute for competent work by design professionals. The Standards are also not intended to limit unreasonably any innovative or creative effort which could result in better quality, better cost savings, or both. Any proposed departure from the Standards will be judged on the likelihood that such variance will produce a compensating or comparable result, in every way adequate for the user and City resident.

The objective is to develop Standards which will:

- be consistent with current City Ordinances.
- provide design guidance criteria to the private sector for the design of public improvements within the City of Philomath.
- be of adequate design to safely manage all volumes of water generated upstream and on the site to an approved point of disposal;
- provide points of disposal for stormwater generated by future upstream developments;

- prevent the uncontrolled or irresponsible discharge of stormwater onto adjoining public or private property;

- prevent the capacity of downstream channels and storm drainage facilities from being exceeded;

- have sufficient structural strength to resist erosion and all external loads which may be imposed;

- maximize the use of the City's natural drainage system;

- be designed in a manner to allow economical future maintenance;

- require the use of design and materials to provide a system with a minimum practical design life of not less than 50 years.

It is recommended that the City adopt the PWDS by ordinance or resolution so as to provide guidelines for drainage improvements within the City's UGB. The following is a short discussion of some of the major components of the recommended PWDS.

a. Design Storm Recurrence Interval

The magnitude of the recommended design storm is a function of the level of protection desired and the relative costs of facilities that could be damaged. The level of required hydrologic and hydraulic analysis is also directly related to the size of the drainage area (and related stormwater flowrates) and the selected design storm. As previously noted, **Table 4-2** and PWDS 3.10 outlines the recommended design storms for different components of the storm drainage system.

Section 4.1(d) contains a detailed discussion of recommended design storm frequencies. For sizing of local storm drains serving residential or commercial areas, it is suggested that a 10-year design storm be used. For trunk lines 18-inches or larger and for highway crossings, a 25-year design storm should be used. For perennial streams and major drainage channels not shown as a flood plain on FEMA maps, a 50-year design storm should be used. Major drainage channels shown as flood plains on FEMA maps should be sized to pass a 100-year storm.

As outlined in PWDS 3.18, it is recommended that peak storm water runoff shall be controlled by detention facilities for the following:

- All commercial, industrial and multi-family developments
- Parking lots with 10,000 square feet or more of impervious area
- All other developments where such control is needed to prevent the capacity of the downstream system from being exceeded.

It is recommended that detention facilities have storage capacities to detain the greater of the difference between a 5-year frequency storm with pre-development conditions and a 25-year frequency storm under developed conditions, or the difference between the *remaining available downstream capacity for the site being developed* under design storm conditions and a 25 year frequency storm under developed conditions.

b. Hydrologic Design Calculations

As mentioned in previous sections (Design Storm Recurrence Interval), size of drainage facility (ie. contributing area) should dictate both the design storm recurrence interval and the required level of hydrologic and hydraulic analysis. For drainage areas less than or equal to 200 acres in size, the Rational Method can be applied with sufficient accuracy. For drainage areas greater than 200 acres but less than 640 acres, U.S. Geological Survey (USGS) regional regression relationships should be used. For drainage areas greater than 640 acres (1 square mile), unit hydrograph analysis or other methods approved by the City Engineer should be used.

c. Sheet Flow Escape Routes

In addition to the above described criteria, sheet flow escape routes should be investigated to demonstrate that flows from storms of greater than design magnitude will not cause excessive damage to downstream properties, or when the downstream drainage system becomes clogged. For example, during design of improvements or development review, site grading should be checked and modified as feasible to ensure that flows in excess of design capacity have a route for escape without endangering property or jeopardizing public safety.

d. Minimum Flow Velocity

The recommended minimum flow velocity for improvements to the drainage system is 3 feet per second. This velocity should be adequate for removing the majority of sand, sediment and debris normally entering the drainage system. This, in conjunction with the sumps in catch basins, will help ensure that pipes will remain relatively self-cleaning and thereby not require frequent maintenance on a long-term basis.

e. Catch Basins

It is suggested that the City continue using sumps in all catch basins to trap and remove heavy sediments and debris. This will facilitate maintenance of the system, ensure that pipe capacity is not reduced by inflowing gravel, rocks and other settleable debris. Most of the surface water pollutants are held within the solids that enter the drainage system, and catch basins will allow for easy removal.

f. Dry Wells

Dry wells, or stormwater sumps, are an alternative means of stormwater disposal which discharge to the ground. However, due to the high groundwater table experienced in most parts of Philomath during the winter months, dry wells are not an effective means of stormwater disposal. Also, long-term discharge to the ground could pose geotechnical and slope stability hazards.

g. Open/Natural Drainage

As part of the development review and approval process, it is suggested that the City require minimum utility and access easement widths for open channels located outside of public right-of-ways as follows (PWDS 3.12(d):

- <u>Channel width less than 14 feet at top of banks</u>: Channel width plus 12 feet on one side and 2 feet on the other.

- <u>Channel width greater than 14 feet at top of banks</u>: Channel width plus 12 feet on both sides.

To the greatest extent practicable, open drainage channels should be kept clean and open to ensure that design flow capacity is maintained.

h. Minimum Storm Drain Pipe Size

To minimize long-term maintenance and allow for reliable system capacity, it is suggested that the City require a minimum pipe diameter of 10 inches for all new piped storm drain improvements. All pipes should shall begin at a structure and terminate at an approved point of disposal (discharge).

i. Pipe Material

The type of storm drain pipe material acceptable depends upon a number of criteria, including potential traffic loading, depth of cover and pipe size. An additional consideration relates to anticipated environmental exposure conditions. For instance, since exposure of PVC pipe sunlight (UV radiation) will result in the pipe becoming brittle, PVC pipe should not be used for storm lines which discharge to surface water channels.

PWDS 3.8(b) contains a table outlining recommended pipe material by pipe size and cover depth. Note that uniform pipe material should be used on each pipe run between structures.

j. Runoff Coefficients

Rational Method runoff coefficients are based on land use types and were outlined previously in Section 4, as well as PWDS 3.10(c).

k. Minimum Time of Concentration

As outlined in Section 4, the recommended minimum time of concentration for use with the Rational Method is 10 minutes (PWDS 3.10).

l. Rainfall Intensity-Duration-Frequency (IDF) Relationship

As outlined in Section 4, the recommended IDF relationship for the City of Philomath is taken from Oregon Department of Transportation (ODOT) Highway Division, Hydraulics Manual (Zone 8). The curves and tabular data is presented in PWDS 3.10.

m. Manning's Roughness Coefficient

As discussed in Section 4, it is recommended that design roughness coefficients reflect the condition of the pipe at the end of the design period rather than the pipe condition when new (PWDS 3.15). Since flows typically increase over time as additional development occurs, and the roughness of the pipe also increases over time, it is prudent to design pipes for future conditions based on roughness coefficients under future conditions.

Roughness coefficients for open channels should be determined based on the size of the channel and its ability to be maintained. While large channels (such as Newton Creek and tributaries) tend to have self cleaning beds due to the stormwater volumes, smaller channels tend to silt in and become overgrown with weeds and trees, thereby reducing capacity. East Newton Creek through the City Park is a good example of this type of situation. For new open channels capable of being maintained, a minimum "n" value of 0.04 is recommended. Channels without maintenance access should be designed with a higher coefficient.

6.3 Storm System Management Practices

In order to ensure that the City's storm drainage system continues to function effectively, and to maintain the full capacity of the existing storm drainage system, a regular program of maintenance is recommended.

A successful maintenance program should include the following objectives:

- Provide for public safety
- Reduce potential of property damage by obstructed facilities
- Evaluate and upgrade maintenance priorities
- Reduce impact on City's resources
- Maintain capacity and integrity of storm drainage system
- Identify future maintenance needs
- Add projects to the stormwater CIP as appropriate
- Reduce nuisance water on public streets

The most important objectives of the maintenance program should be to provide for public safety and reduce unplanned storm water flow or flooding on private and public property. It also allows access to public roads to be maintained during storm events for emergency and private vehicles.

Priorities should be established and re-evaluated yearly to ensure that resources are allocated reasonably and fairly. In this manner, limited City resources are not used for resolving minor storm drainage systems when major facilities are in need of repair or improvement. As repairs are made and yearly evaluations are performed, new problem areas and other maintenance requirements can be identified and prioritized. Another benefit is that City residents visibly see that their concerns are being addressed by the City.

For purposes of evaluating the storm drainage maintenance requirements for the City, typical maintenance requirements were developed for each type of structure in the system along with typical maintenance requirements for different conditions. **Table 6-1** outlines typical maintenance requirements for pipes and culverts, while **Table 6-2** outlines those for catch basins.

Table 6-1
RECOMMENDED MAINTENANCE STANDARDS FOR PIPES & CULVERTS

Maintenance Category	Condition Requiring Maintenance	Recommended Maintenance
Sediment and debris	Accumulated sediment exceeds 20% of the pipe diameter	Clean pipe of all sediment and debris
Vegetation	Vegetation that reduces free movement of water through pipes	Remove all vegetation so water flows freely through pipes
Damaged pipe	Protective coating is damaged and rust causing more than 50% of deterioration to any part of pipe	Repair or replace pipe
	Any dent that decreases the end area of pipe by more than 20%	Repair or replace pipe
Debris barrier plugged	Trash or debris plugging more than 20% of the barrier openings	Clear barrier of all debris
Damaged/missing bars	Bars are missing or entire barrier missing	Replace bars per design
	Bars are missing or entire barrier missing	Replace bars per design
	Bars are loose and rust is causing 50% deterioration to any part of barrier	Repair or replace barrier to design

Table 6-2
RECOMMENDED MAINTENANCE STANDARDS FOR CATCH BASINS

Maintenance Category	Condition Requiring Maintenance	Recommended Maintenance
Trash and debris (including sediment)	Trash or debris of more than 1/2 ft3 located in front of the catch basin opening or blocking capacity of basin by >10 percent	Clean trash or debris from in front of catch basin opening
	Sediment, trash or debris in the basin greater than 1/3 to 1/2 the depth of the sump	Remove sediment, trash and debris from catch basin
	Sediment, trash or debris in any inlet or outlet pipe blocking more than 1/3 the diameter	Remove sediment, trash and debris from catch basin
Structural damage or deterioration of curb or frame	Deterioration of curb at inlet location	Replace curb across inlet location
	Damage to diamond plate covers in sidewalk	Repair or replace cover
Cracks in basin walls or bottom	Cracks wider than ½ inch or longer than 3 ft, any evidence of soil particles entering catch basin through cracks, or structure is unsound	Basin repaired or replaced
	Cracks wider than ½ in and longer than 1 ft at the joint of any pipe or any evidence of soil particles entering catch basin through crack	Repair/grout cracks
Settlement/misalignment	Basin has settled more than 1 in or has rotated more than 2 in out of alignment	Basin reset or replaced
Fire or chemical hazard	Chemicals such as natural gas, oil, and gasoline in storm drain system	Remove flammable or hazardous chemicals
Vegetation	Vegetation growing across and blocking more than 10 percent of basin	Remove vegetation blocking basin
	Vegetation growing in inlet/outlet or roots at pipe joints	Remove vegetation and roots

Based on these typical maintenance requirements, a sample maintenance budget worksheet was developed using assumed production rates and unit costs for the various maintenance functions. The level of service and assumed unit costs for the various maintenance functions are presented in **Table 6-3**. This should not be regarded as a final budget number, but is intended only to provide a sample for use in developing a realistic budget as the City implements funding programs for storm system maintenance. In summary, the maintenance budget should allow for cleaning of all catch basins bi-annually, all pipes on a 5-year cycle, and other maintenance, repair, replacement, and system inventory requirements as shown.

To develop a storm system maintenance program for the City, the following recommendations should be implemented:

- Once funding mechanisms are in place, allocate an amount determined by Public Works as the Storm System Maintenance Budget for repairs of "minor" storm drainage facilities. **Table 6-3** can be used a starting point for developing this budget.

- Implement routine inspections of system elements (i.e., catch basins, culverts, etc.) to observe debris accumulation and structural conditions, and to evaluate the required procedures, materials, equipment, personnel, urgency, time, and cost for maintenance activities.

- Develop a storm drainage database to inventory system elements, record maintenance actions and inspection logs, and monitor public concerns (complaints of local problem areas).

- Regularly evaluate database to determine maintenance patterns and refine manpower and budgetary requirements.

- Obtain access easements to existing public facilities from private owners.

- Inspect and evaluate detention ponds (schedule maintenance when capacity is reduced by one-third due to sedimentation).

- Develop a program to require maintenance for private water quality facilities.

- Provide an emergency fund to deal with catastrophic events effecting storm drainage facilities.

Table 6-3
Sample Maintenance Budget Worksheet

Item No.	Category	Number to be Maintained	Frequency (times/yr)	Standard #/Length per day	Crew Size	Total days per year	Labor Cost/ Crew day	Equipment Cost (% Labor)	Preliminary Maintenance Costs: Labor Cost	Material Cost	Equipment Cost	Total Cost	Percent of Total Budget
1	Clean Catch Basins	376	0.5	15	1	12.5	$160	50%	$2,005	$0	$1,003	$3,008	10%
2	Clean Major Culverts/Pipe Inlets	30	1	15	1	2.0	$160	50%	$320	$0	$160	$480	2%
3	Clean Trash Racks	4	6	15	1	1.6	$160	50%	$256	$0	$128	$384	1%
4	Clean Storm Lines	69,590	0.2	1000	2	27.8	$160	100%	$4,454	$0	$4,454	$8,908	29%
5	Clean Pollution Control MH	0	0.5	5	1	0.0	$160	50%	$0	$0	$0	$0	0%
6	Clean/Regrade Ditches	20,000	0.5	1000	2	20.0	$160	100%	$3,200	$0	$3,200	$6,400	21%
7	Repair Major Culverts	10	0.2	1	2	4.0	$160	40%	$640	$0	$256	$896	3%
8	Repair Storm Lines	200	1	50	2	8.0	$160	100%	$1,280	$0	$1,280	$2,560	8%
9	Repair/replace Catch Basins	75	0.1	2	2	7.5	$160	50%	$1,200	$0	$600	$1,800	6%
10	Complaint Response	12	1	1	1	12.0	$160	0%	$1,920	$0	$0	$1,920	6%
11	Detention Basin Maintenance	3	2	1	1	6.0	$160	50%	$960	$0	$480	$1,440	5%
12	System Inventory Reconnaissance	1	6	1	1	6.0	$160	0%	$960	$0	$0	$960	3%
				Total crew days/yr		107.5							
						Sub-total: All Maintenance Categories			$17,195	$0	$11,561	$28,756	
									Administration & Overhead @ 8%			$2,300	
									Grand Total			$31,056	

6.4 Legal/Liability Issues

This section presents a general background on drainage-related legal/liability issues and should not be used in lieu of advice from the City's legal counsel. Therefore, the following items present a basis for further investigation by the City into potential liabilities with storm drainage master planning and implementation of improvements. Historically, the basis for stormwater litigation has been a tort action, as follows:

- In the State of Oregon, the civil law doctrine of drainage applies. Under this doctrine, adjoining landowners are entitled to have the normal course of natural drainage maintained. The lower owner must accept water which naturally comes to his land from above, but he is entitled not to have the normal drainage changed or substantially increased. The lower landowner may not obstruct the runoff from the upper land, if the upper landowner is properly discharging the water (Reference 4).

- A municipality undertaking a public drainage improvement is treated like a private party (Harbison v. City of Hillsboro) and is liable for damage resulting from negligence or an omission of duty (Reference 8).

- Municipalities are generally under no legal duty to construct drainage improvements unless public improvements require drainage facilities (Denver v. Mason) (Reference 9).

- Municipalities are not liable for damages due to overflow of its drainage system in cases of extraordinary/unforeseeable rains or floods. (McQuillan) (Reference 10).

- Municipalities will likely be liable in cases where they take responsibility for collection of surface waters which are then released onto private property which has not historically received runoff, where dams/diversions cause an overflow onto another's land, or where there is failure to exercise reasonable care in the maintenance and repair of drainage improvements (Reference 10).

While instances of public water traversing private property are prevalent throughout the City, a policy of purchasing right-of-way or easements, constructing structural drainage improvements and providing long-term maintenance for the existing major drainage channels (such as Newton Creek and upstream tributaries) is likely not cost-effective for the City unless it can be accomplished in conjunction with development of the surrounding land. This situation is true for many Oregon communities. It is suggested that a more cost-effective approach is to apply Oregon's civil law doctrine of drainage on a case-by-case basis to situations as they arise.

6.5 Funding Issues

This section describes the range of alternative funding sources that municipalities have used in implementing drainage improvements.

a. State/Federal Grants and Loans

Various grant/loan programs are available at both the federal and state level. However, no single grant/loan program is available on a consistent, on-going basis for funding of local stormwater management. With communities competing on both a state-wide and even nation-wide basis, and with constraints on how grant/loan money is to be used, these sources can only serve to supplement an existing local funding program for stormwater management.

b. Debt Financing

General obligation bonds and revenue bonds are two commonly used forms of debt financing for public infrastructure improvements. General obligation bonds, primarily used for major capital improvements, are subject to voter approval and are backed by the full credit of the government issuing them. Revenue bonds, on the other hand, may be sold and secured only by those specific revenue sources which are earmarked for their payment.

c. System Development Charges

These charges are imposed on new development as a way of recovering costs for that portion of existing system capacity solely attributable to new development or for that portion of required system up-sizing. System development charges can begin to answer questions of who should pay for required up-sizing of the stormwater system due to new development, or how historical payers into the system can recover their costs in oversizing facilities that enable future growth.

d. Fee-In-Lieu of On-Site Detention

These fees afford a land developer the option of either constructing an on-site stormwater detention facility in accordance with established design criteria, or paying a fee into a fund dedicated to the construction of an off-site or regional stormwater detention facility serving multiple properties. These fees tend to promote siting and construction of regional versus on-site detention facilities. However, cash flow necessary for a regional stormwater detention facility may not necessarily coincide with the required construction timing.

e. Local Improvement Districts and Special Assessments

The concept of deriving funding from local improvement or special assessment districts is founded on quantifying benefits. For water, sewer or street improvements, these benefits can often be easily identified and thus quantified. However, drainage differs in the respect that upstream or hillside properties that are major contributors of runoff may not be specific recipients of benefits.

f. Plan Review and Inspection Fees

These fees are intended to recover the expense of examining development plans to ensure consistency with comprehensive land use and stormwater master plans, and to ensure that construction standards and regulations are met at the construction site. These fees are not intended to be a primary revenue generating source.

g. Stormwater Service Charges

Another method gaining popularity for financing stormwater management is the utility-based service charge. Historically, the concept of considering stormwater as a public utility attracted very few communities. However, as other more conventional funding sources became difficult to obtain, and as federal requirements increase, the service charge concept has generated greater appeal. Service charges for stormwater management reflect a rationale that those who contribute to stormwater problems should logically contribute to the costs of providing mitigative services.

h. Ad Valorem Taxes

Ad valorem taxes are taxes levied on a property as a direct result of "value added" to the subject property. However, with stormwater there is no clear correlation between property value and contribution of runoff. Ad valorem taxes could provide a significant source of revenue, however with the apparent lack of equity, should not be considered a primary source for funding stormwater programs.

In addition to a System Development Charge (SDC), it is recommended that the City consider implementation of a stormwater service charge. A sample ordinance similar to that adopted by other small communities in the Willamette Valley is included in Appendix F.