City of Cascade Locks, Oregon

Stormwater and Grading Design Standards

June 2005

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Prepared By:

Wallis Engineering
317 Columbia Street
Vancouver, WA 98660
(360) 695-7041

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Development of the Stormwater Drainage System Plan was funded in whole by a grant by the Oregon Department of Land Conservation and Development. The Plan was developed for the City of Cascade Locks by Wallis Engineering in the spring of 2005. The findings and recommendations are based primarily upon field observation and consultations with the City's public works director.

Study Area

The study area covered by this plan is defined by the Urban Growth Boundary for the City of Cascade Locks. The boundary is generally bordered by the Columbia River to the north, National Forest to the south, and the growth boundary limits to the east and west. Rudolph Creek, Dry Creek, and Herman Creek are the three major defined streams within the study area, all of which flow into the Columbia River. There are multiple small drainage-ways that are present adjacent to these major ones.

Interstate 84, Historic Highway 30, and the Union Pacific Railroad all run through the City crossing many of the drainage-ways listed above. As these transportation facilities are under the control of others, any of the drainage structures under these three main transportation facilities are the responsibility of either the State or the Railroad.

Existing and proposed land uses primarily consist of residential with some commercial, industrial, and resort commercial. The present population of Cascade Locks is approximately 1,200.

Background

The City of Cascade Locks is located in the heart of the Columbia River Gorge where rainfall can be heavy at times. The City's current storm drainage system consists of pipe runs connecting catch basins to catch basins/manholes that discharge into open channels (namely the three major defined streams in this area).

Scope

The general scope of the study/planning effort consisted of the following:

- Mapping and evaluation of the existing drainage system
- Identification and analysis of existing drainage problems
- Development of recommended maintenance and operation practices
- Development of a capital improvement plan
- Development of stormwater regulations

Conclusions and Recommendations

This plan consists of an evaluation of the existing Cascade Locks drainage basins and system components with a focus on reducing flood hazards, maintaining water quality, and accommodating future growth.

The existing system is made up of a series of catch basins, manholes, pipes/culverts, creeks and ponds. Based on the City's observation and data collection during the 1996 storm event (the largest in recent history), the existing stormwater collection facilities within the City adequately conveyed the runoff generated from this storm. Therefore, no upgrades/improvements of the existing system were identified in the plan with the exception of maintenance problem areas.

The following items were identified as key elements of the plan:

- No capital improvements were identified after reviewing the City's existing stormwater drainage system.
- Stormwater best management practices should be adopted and required for all new and redevelopment projects. This measure will help preserve Cascade Locks and the surrounding area's natural resources and overall water quality.
- New development and redevelopment projects should not be permitted to increase flow rates above the existing condition. This is a key factor in infrastructure sizing and must be adhered to for effective facilities planning and development. Onsite detention may be required for most new development.
- There is a very large amount of steep forested area upstream of Cascade Locks. Stormwater runoff from this area passes through the City's drainage-ways. It is important that these forested areas within the City's urban growth boundary be managed properly to ensure that the quantity and rate of stormwater runoff not increase and subsequently result in erosion of the downstream system.
- All new land disturbing construction projects should be required to provide temporary erosion and sediment control during construction. This will help prevent erosion from escaping construction sites, protect the existing drainage system from clogging, and help reduce maintenance costs.
- The City must practice good maintenance procedures of the existing drainage system, including street sweeping, catch basin cleaning, and ditch and culvert maintenance among other efforts. These maintenance practices should be continued in the future.
- Public education and continued public involvement is recommended to help raise the awareness of stormwater and its impacts on the community and the environment. The City should develop programs and utilize available resources developed by other agencies to help in this effort.

- A stormwater utility should be established in order to create a reliable continuing source of revenue to support operation, maintenance, and replacement of the stormwater system.

Implementing these recommendations will help reduce flooding and protect property, as well as enhance the community's natural resources.

SECTION 1

INTRODUCTION

1.1 PURPOSE

Presently, the City does not have any drainage regulations or standards in place to manage future development. With development expected to increase in the future due heavily to the likelihood of a new casino being constructed on the east end of town, the need for a formal approach to drainage has become apparent. The purpose of this plan is to:

1. Provide mapping of the existing stormwater system, as well as topography, and identify drainage basins.

2. Identify existing drainage problems, both descriptively and mapped, and recommend solutions.

3. Provide maintenance objectives and recommended practices to ensure long life of system components, reduction of flooding and ponding problems, and promotion of water quality.

4. Provide recommendations for facilities planning and a prioritized capital improvement program.

1.2 AUTHORITY AND COOPERATION

Authorization was provided by the City of Cascade Lock to Wallis Engineering to prepare this Stormwater Drainage System Plan in April of 2005.

1.3 SCOPE OF WORK

The goal of the project is to develop a Stormwater Drainage System Plan that protects the health, safety, and welfare of the residents of Cascade Locks by improving and controlling stormwater drainage; limiting property damage by reducing flooding and controlling landslides; and improving water quality and fish habitat in the Columbia River.

1.4 Goals and Objectives

1. Capital Improvement Plan
2. Maps of the system
3. Control flooding and avoid property damage
4. Require new development to address runoff water quality and quantity
5. Require erosion and sediment controls for construction areas

SECTION 2

STUDY AREA CHARACTERISTICS

2.1 STUDY AREA AND POPULATION

2.1.1 *STUDY AREA*

The City of Cascade Locks, Oregon is located in Hood River County along Interstate 84 at the crest of the Cascade Mountain Range, about 45 miles east of Portland, Oregon. The planning area encompasses approximately 2,000 acres and is delineated by an urban boundary within the Columbia Gorge National Scenic Area. The UGB is bordered by the Columbia River on the north, and dense forest on the south. The terrain of the City slopes north towards the river, with steep slopes in the densely forested area south of town descending onto flatter slopes through town. The area is mostly rural with a relatively small urban downtown area. The existing drainage system consists of a number of drainage-ways (three of which are defined streams) with culverts at roadway crossings that ultimately discharge into the Columbia River. Pipes connect catch basins and manholes to these drainage-ways. A vicinity map is shown in Figure 2.1 on the following page.

2.1.2 *POPULATION*

Per the U.S. Census Bureau, the population of the Cascade Locks in the year 2000 was approximately 1,115 people. Population in the year 2002 was approximately 1,124, which was an increase of about 0.8%.

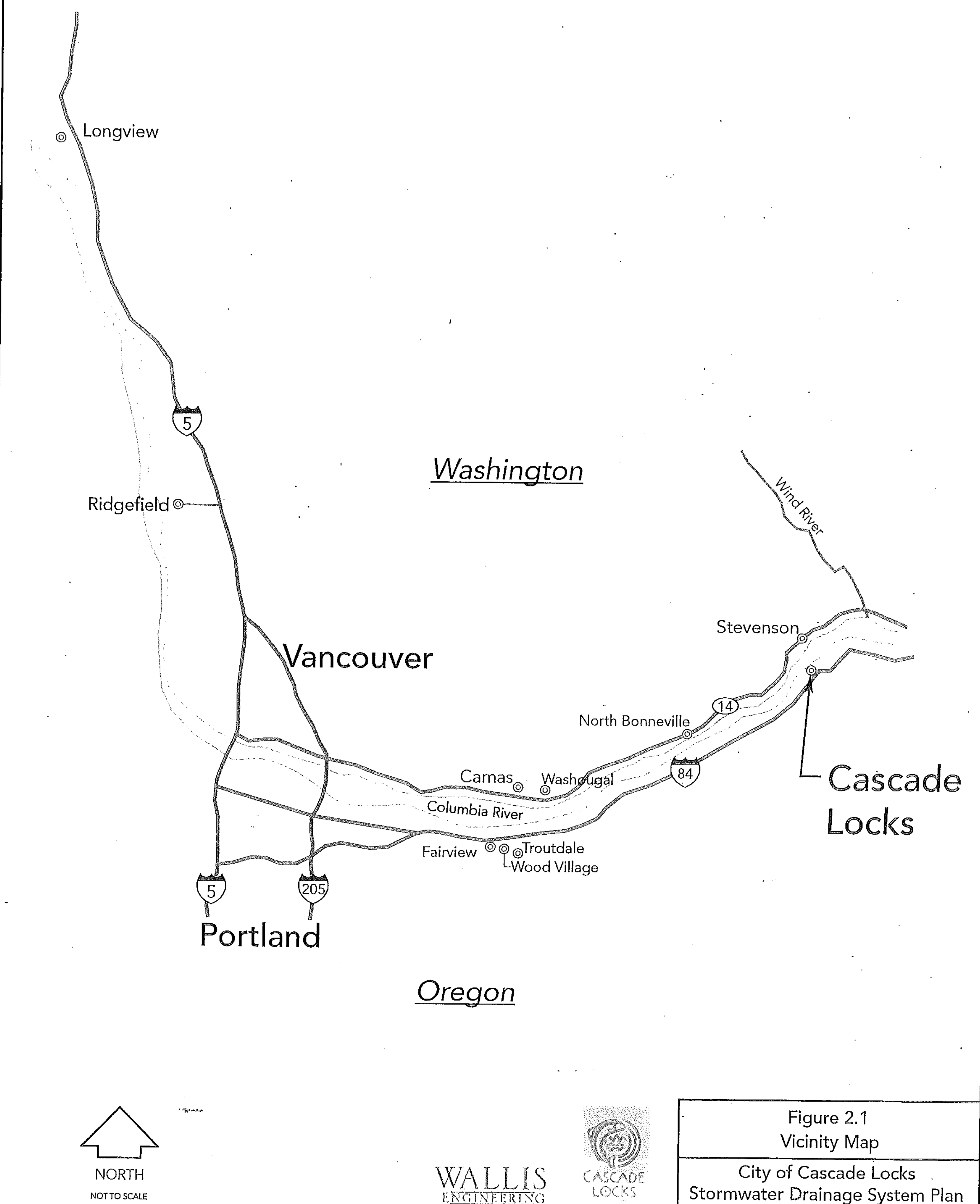
2.2 DRINKING WATER AND SEWER SYSTEMS

2.2.1 *DRINKING WATER SYSTEM*

The City of Cascade Locks operates a municipal water system serving the entire Cascade Locks area. This system is served by existing wells near the mouth of Herman Creek which is pumped to two reservoirs (Dry Creek Reservoir and Oxbow Reservoir), and then dispersed to the community through a series of distribution mains.

2.2.2 *SEWER SYSTEM*

The City of Cascade Locks is served by a sanitary sewer collection system that was installed in the late 1960s. Upgrades to this system were made in the late 1990s including the construction of a new wastewater treatment plant and additional collection system on the east end of town. The new wastewater treatment plant is an SBR type facility with the outfall discharging directly into the Columbia River. Per the City of Cascade Locks, the wastewater treatment plant is currently operating at about 20% of its total capacity.



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CASCADE LOCKS

Figure 2.1
Vicinity Map

City of Cascade Locks
Stormwater Drainage System Plan
June 2005

2.3 CLIMATE AND RAINFALL

Cascade Locks typically has wet, mild winters and cool, dry summers. Occasional, the City will experience snow and freezing rain during the winter. Average temperatures range from 36 degrees Fahrenheit in the winter to 68 degrees Fahrenheit in the summer. Average annual rainfall is approximately 80 inches.

2.4 TOPOGRAPHY, SOILS, AND GEOLOGY

2.4.1 *TOPOGRAPHY*

The City of Cascade Locks slopes toward the Columbia River on the north. The slope is very steep south of town (the area beginning just south of Interstate 84) and is primarily forested. These hills to the south of town rise to an elevation of approximately 4,000 feet. From approximately Interstate 84 to the Columbia River, the slope of the terrain is much less, with the elevation changing from approximately 250 feet to approximately 80 feet at the Columbia River.

2.4.2 *HYDROLOGIC SOIL GROUPS*

Soils are classified by the USDA Soil Conservation Service into hydrologic soil groups (HSGs) to indicate the minimum rate of infiltration obtained for bare soil after prolonged wetting. The HSG classifications A, B, C and D, are one method used in estimating runoff potential for an area. The four hydrologic soil groups are defined as follows:

> Group A soils have low runoff potential and high infiltration rates even when thoroughly wetted. They consist primarily of deep, well to excessively drained sands or gravels and have a high rate of water transmission (greater than 0.30 in/hr).
>
> Group B soils have moderate infiltration rates when thoroughly wetted and generally consist of moderately deep to deep, moderately well to well drained soils with moderately fine to moderately coarse textures. These soils have a moderate rate of water transmission (0.15-0.30 in/hr).
>
> Group C soils have low infiltration rates when thoroughly wetted, and consist of soils with a layer that impedes downward movement of water and soils with moderately fine to fine texture. These soils have a low rate of water transmission (0.05-0.15 in/hr).
>
> Group D soils have high runoff potential. They have very low infiltration rates when thoroughly wetted and consist chiefly of soils with a high swelling potential, soils with a permanent high water table, soils with a claypan or clay layer at or near the surface, and shallow soils over nearly impervious material. These soils have a very low rate of water transmission (0-0.05 in/hr).

There is no USDA soil information available for the City of Cascade Locks. Because of this, the HSG of this area was assumed based upon typical soil groups encountered across the Columbia River in Skamania County, Washington and conversations with the City's Public Works Director in regards to infiltration of the existing soil. Per the USDA Soil Conservation Service October 1990 Soil Survey of Skamania County Area, Washington, the existing soils across the river from Cascade Locks primarily fall into Hydrologic Soil Groups B and C. Per Richard McCulley, the City's Public Works Director, all the soils in Cascade Locks infiltrate stormwater runoff very well, with the exception of an area adjacent to the freeway. Per Mr. McCulley, a narrow clay layer stretches the length of town adjacent to Interstate 84, and also encompasses the neighborhood around Moody Street on the north side of the freeway. Onsite observation supports this; Rudolph Creek drainage-way is an example, due mainly to the fact that a number of underground springs are present immediately prior to crossing Interstate 84. Based on the soil map information across the Columbia River and the City's observation of infiltration of the existing soil, it could be argued that soils within the City fall into HSG B. However, with the presence of an existing clay layer, the assumption was made that soils located in Cascade Locks fall into HSG C.

2.4.3 Surface Water Hydrology

As mentioned above, Rudolph Creek, Dry Creek, and Herman Creek are the three major defined streams that flow through the City of Cascade Locks before emptying into the Columbia River. All three of these flow under Interstate 84, Historic Highway 30 or Forest Lane, and the Union Pacific Railroad tracks prior to reaching the Columbia. Other drainage-ways also exist within the City, some of which drain large areas within the city. One of these drainage-ways, probably the most defined of these smaller drainage-ways, is located between Rudolph Creek and Dry Creek.

It is important to note that most of the contributing flow to these three major defined streams comes from the forested area south of the City, which is about 95% of the drainage-way contributing area. Therefore, the contributing area, and ultimately flow, from the City to these major defined streams is relatively small in comparison to the entire basin area. See Figure 2-2.

The following is a description of the major drainage-ways that flow through the City:

<u>Rudolph Creek</u> (Figure 2.4, Basin B)

Rudolph Creek is located in the western portion of the study area and drains approximately 730 acres. This drainage basin is narrow and fairly steep, especially south of town with the widest point being about three quarters of a mile across. The basin is approximately 2 miles long and is made up mostly of dense undisturbed forest. The elevation of the basin varies from a high of about 3,000 feet to a low of about 80 feet. Most of this creek infiltrates into the ground upstream of Interstate 84. Prior to crossing the freeway, it resurfaces and is contained within a defined rock-lined channel. Rudolph Creek crosses the freeway and Historic Highway 30 via a single 24-inch diameter corrugated metal pipes. A pond backs up south of railroad tracks and is then conveyed into the Columbia River via an unknown drainage facility.

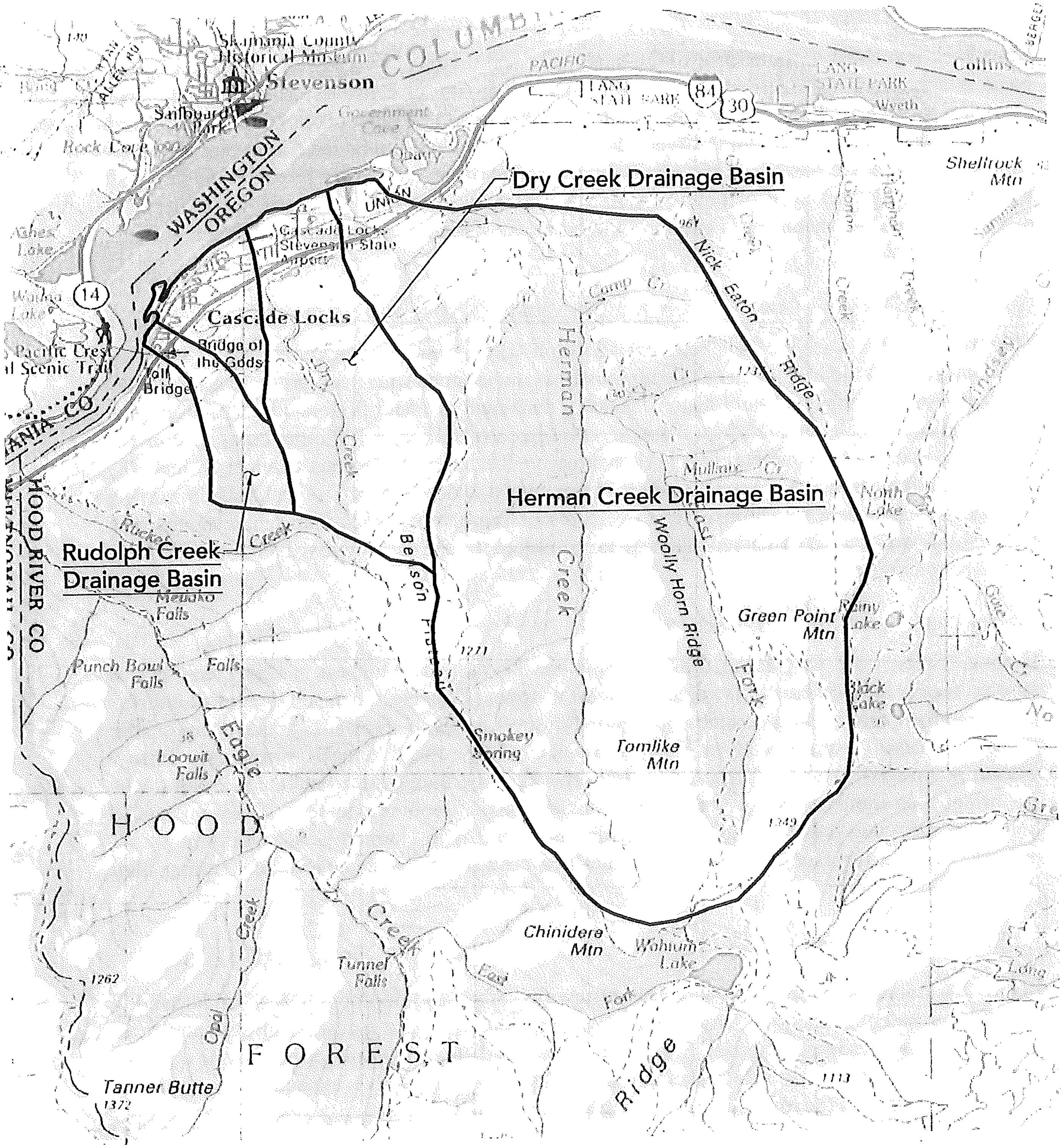

Figure 2.2
Defined Drainage Basins

City of Cascade Locks
Stormwater Drainage System Plan
June 2005

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CASCADE LOCKS

DRY CREEK (FIGURE 2.4, BASIN F)

Dry Creek is located in the middle of the study area and drains approximately 2,500 acres. The basin is approximately 3.5 miles long and is made up mostly of dense undisturbed forest. The elevation of the basin varies from a high of about 4,000 feet to a low of about 80 feet. This basin is large in comparison to Rudolph Creek. In fact, Dry Creek used to be the City's primary water supply. Dry Creek crosses the freeway through a series of large diameter box culverts (7.5-foot box culvert followed by a 5-foot box culvert). It then crosses Forest Lane via two 5-foot diameter corrugated metal pipes and the railroad tracks via a 6-foot box culvert before entering the Columbia River.

DRAINAGE-WAY BETWEEN RUDOLPH CREEK AND DRY CREEK (FIGURE 2.4, BASIN C)

This drainage-way is located between Rudolph Creek and Dry Creek. The basin is approximately 1 mile long and is made up mostly of undisturbed forest and brush. There are two freeway crossings for this basin. One consists of an 8-inch diameter perforated metal drain pipe that feeds an 18-inch and a 24-inch diameter corrugated metal pipe. The other crossing consists of a 24-inch diameter concrete pipe. After crossing the freeway, an open channel collects the stormwater flow from these two crossings and conveys it downstream. A naturally occurring pond is present where the stormwater flow pools before entering a 24-inch diameter concrete pipe that flows into a manhole and is then conveyed to the Columbia River via a 30-inch diameter concrete pipe.

HERMAN CREEK (FIGURE 2.4, BASIN I)

Herman Creek is a very large drainage-way on the eastside of town. This creek drains approximately 13,000 acres to the south and east of town. This basin is made up almost entirely of undisturbed forest and it extends upstream for several miles. Herman Creek receives little stormwater runoff from the City of Cascade Locks, because this drainage basin is very narrow within the limits of the city. The creek crosses the freeway, Forest Lane, and the railroad tracks via bridges, so there are not any flow constraints or road flooding concerns. The impacts to houses, people, and the surroundings from high flow events in Herman Creek would be small, due primarily to the fact the creek is in a defined channel that is capable of containing high flows.

2.5 LAND USE

Figure 2.3 graphically depicts the land use designations for Cascade Locks. Most of the land is devoted to residential and public use. Other land uses include: light industrial; heavy industrial; commercial; and resort commercial. Most of the non-residential areas are located on the east end of the City and on the north side of the railroad tracks. Future growth is expected to occur south of the freeway within the lower limits of the undisturbed forested area.

2.6 DRAINAGE SYSTEM

2.6.1 GENERAL

Figure 2.4 graphically depict the existing drainage system for the City of Cascade Locks. Stormwater runoff initially occurs as overland sheet flow prior to collecting into concentrated channels or storm drainage systems. The existing storm drain system consists of roadside ditches and shoulders, curbs, catch basins, manholes, storm drain pipes (both solid and perforated), culverts, naturally occurring ponds, and natural drainage-ways, including the major ones mentioned previously. Most of the drainage-way areas contain a combination of some or all of these systems.

The existing drainage system has been divided into drainage basins, based on topography and discharge locations. The overall intent of doing this is to show how development in one area affects the downstream drainage system components.

It's important to note that an existing drainage system at the east end of town is in place in the area where a future casino will be constructed. It is understood that this entire area will be reconstructed, along with a new interchange accessing Interstate 84, meaning that a large portion (if not all) of the existing drainage facilities will be removed and replaced with a new system. As a result, these existing facilities were not included on the existing drainage system map. For the same reason, the existing facilities within and adjacent to the freeway were not shown.

2.6.2 HISTORICAL RAINFALL EVENTS

The February 1996 storm event was the largest rainfall event in Cascade Locks in recent years. The City's collected rainfall data show the City received about 16 inches of rain over a four day period. The rainfall amount on one of these days totaled 6 inches, which constituted the SCS Type 1A 50-year, 24 hour storm event for this particular area. Per the City's Director of Public Works, the entire existing collection system had the capacity to pass this storm event without any significant problems or property damage. In comparison, the SCS Type 1A 100-year, 24 hour storm event is six and a half inches, only half an inch more than the 50-year storm that was observed. The impacts of another half an inch of rain would not be great during an already six inch rainfall event.

SCS stands for the Soil Conservation Service (now Natural Resource Conservation Service) of the US Department of Agriculture. A Type 1A storm refers to a pattern of rainfall common in the northwest where a typical 24 hour duration storm begins at a lower rate for a few hours followed by a short period of very heavy rainfall followed by several hours of lower rate rainfall. This type of rainfall pattern produces characteristic discharge flow pattern from a drainage basin that can be modeled with computer software to help determine the size of stormwater facilities.

Because of the complex nature and very large size of the different overall drainage basins crossing the City relative to the study area and the inaccuracies in parameters used for analyses, no hydraulic modeling was performed. Rather than estimate adequacy, based on a computer model, the fact that the existing system passed the 1996 storm event, led to the conclusion that the existing drainage system is adequate to accommodate existing flows.

SECTION 3

DRAINAGE SYSTEM EVALUATION AND RECOMMENDATIONS

3.1 PROBLEM IDENTIFICATION

Existing drainage problems were identified through two different approaches: 1) interviews with City's public works director; and 2) field investigation. From this effort, maps listing the specific problems areas were developed (see Figure 3.1).

3.1.1 CAPITAL IMPROVEMENTS DETERMINATION

Capital improvements projects are those that benefit more than a small section of the community. A capital improvement needs to provide for future growth and not just remedy existing deficiencies for System Development Charges (SDCs) to be established. SDCs are collected from new users to fund or recover costs associated with providing systems to accommodate growth. An example of this, using sanitary sewer as an example, is a wastewater treatment plant. The entire community relies on this facility so it's fair to pass the costs for making expansion upgrades with SDCs since expansion upgrades are to accommodate future growth.

In order for SDCs for drainage related capital improvements to apply to streets, the addition of the drainage should be of benefit to more than a small part of the community. An example of this would be the expansion of the storm collection system to Historic Highway 30 to prevent a flooding problem that would result from new development and impact the community. It would be fair to assume that the entire community uses this route, so therefore it would be fair to pass improvement costs with SDCs to new development. Improvements made to a local residential street that is not generally traveled by the community would not be classified as a capital improvement. While the improvements would make the street better for the local residents, the improvements would benefit just a small part of the community and therefore, it would not be capital improvements funded with SDCs.

Stormwater systems are general built to pass a 10-25 year storm without significant problems and inconvenience. Systems are designed to pass 100 year events without causing serious property damage. A 100 year storm event is one with a 1% chance of occurring in any given year. During a 100 year event, stream banks may overflow and streets may be flooded but remain passable.

At the outset, the intent of this plan was to compile a list of capital improvements/projects that could then be grouped within a prioritized capital improvements plan. With such a plan, the City could establish SDCs to apply to future development that could be collected to fund these capital improvement projects over time. However, no such capital improvements are needed.

The conclusion that no CIP projects are needed is based on the fact that existing drainage facilities passed the February 1996 storm event without causing significant problems or property damage. The 1996 storm was a 50 year event with 6 inches of rain in a 24 hour period. A 100 year event is predicted to have an additional ½ inch of rain, an 8% increase.

As development occurs more impervious area is created, resulting in increased rates of stormwater runoff and increased total volumes. If this increased runoff is not managed, larger facilities become necessary to contain and accommodate it to avoid inconvenience or property damage.

Rather than increase the size of existing facilities to handle increased runoff from new development, it is recommended that the City continue to require that new development manage and control runoff rates and volumes to pre-existing conditions. In addition to controlling the quantity of runoff, measures should be required to treat to reduce pollution impacts.

The problems with the existing stormwater collection system that are identified below do not adversely affect the general public. These problems are maintenance related consisting mainly of plugged pipes.

3.2 PROBLEMS AND SOLUTIONS

Nearly all urbanized areas have some form of drainage problem associated with them. Most of these problems are the direct result of developmental impacts. As a basin develops, regardless of the measures taken to mitigate, there will inherently be unforeseen problems that arise. They may not be immediately evident or obvious, but they are nearly impossible to avoid. These problems can range from erosion or pollution impacts to flooding or capacity problems. In general they can be categorized as either a general drainage problem, capacity problem, water quality problem or some combination of all three. The following analysis includes an identification of each of these, a discussion of each problem, alternative solutions, and a recommended preferred alternative. In all cases, the 'Do Nothing' alternative is always an option. For any proposed project, it is strongly recommended that a detailed topographic survey be conducted prior to design to ensure accuracy and function. It is also important to note that the alternative solutions presented here are conceptual in nature and require a detailed design for construction.

No analysis/evaluation was performed on the existing detention ponds adjacent to Dry Creek and Frontage Road on the south side of Interstate 84. It is very important that ODOT continue to maintain these existing ponds to ensure that they continue to function as designed and prevent downstream flooding.

3.2.1 EXISTING PROBLEMS

The following are identified problems within the Cascade Locks study area. They were documented from conducting interviews with the Director of Public Works and from onsite field observation. They are all General Problems and will be classified accordingly. The locations of these problem areas are shown graphically in Figure 3.1 on the following page.

GENERAL PROBLEM #1 (GP1)

Problem: GP1 refers to an outlet pipe, which is currently plugged, that provides drainage for two catch basins located along Historic Highway 30.

Discussion: This plugged pipe is located in the downtown area of Cascade Locks where Regulator Street intersects with Historic Highway 30. This outlet pipe extends to the west underneath an existing paved parking lot that is located adjacent to an existing building. Stormwater runoff currently bypasses these two catch basins and gets collected by the next two downstream catch basins. The building has been settling, which may be aggravated by the subgrade being saturated with the stormwater runoff that these two basins collect.

Solution(s): In general there are two alternatives available to solve this problem: 1) remove the two existing catch basins and plug this outlet pipe with a water-tight grout to prevent water from entering the pipe and saturating the subgrade, 2) unplug the 30-inch diameter pipe and extend it to the west to connect into the City's existing 30-inch diameter storm drainage pipe that discharges into Rudolph Creek. The system is currently functioning, so eliminating these catch basins would have no immediate impact on the ultimate conveyance of the system. Alternative 1 would also be the cheaper of the two options. Alternative 2 would, however enable the City to have two additional functioning catch basins. Furthermore, connecting these catch basins directly to the existing storm system would allow for a future storm system to be extended up Regulator Street to tie in the storm drainage system serving Moody Street. Both options could also potentially help the settlement problem for the building.

Preferred Alternative: The preferred alternative for GP1 is Alternative 2, due primarily to the fact that the two catch basins could be utilized to drain Historic Highway 30 and a large portion of the upstream drainage currently served by the existing drainage system on Moody Street.

GENERAL PROBLEM #2 (GP2)

Problem: GP2 is another plugged outlet pipe that serves as drainage for two existing catch basins located along Historic Highway 30 adjacent to City Hall.

Discussion: This outlet pipe extends to the north underneath an existing gravel parking lot that is located adjacent to a 76 Gas Station across from City Hall. Stormwater runoff currently bypasses these two catch basins and gets collected by the next two downstream catch basins.

Solution(s): In general there are two alternatives available to solve this problem: 1) unplug the existing outlet pipe to allow drainage 2) connect the eastern-most of these two catch basins to the next downstream catch basin to the east along Historic Highway 30. Alternative 1 would require minimal effort. The pipe would need to be extended past the parking lot and some level of rip rap protection placed at the end of the pipe so that the stormwater flow would not erode away the existing ground downstream. This option would make the system operate as it was initially doing prior to the pipe plugging. Alternative 2 would cost more, but it would ensure that the stormwater runoff gets conveyed through the system without ill effects (like erosion) to the existing ground.

Preferred Alternative: Given the above assessment, either option would work. However, the preferred alternative for GP2 is Alternative 2, due primarily to the fact that this option would ensure that all the stormwater runoff is captured and conveyed downstream in a manner that would have the least amount of impact.

GENERAL PROBLEM #3 (GP3)

Problem: GP3 is a plugged box culvert that crosses under Forest Lane.

Discussion: This culvert has been plugged for quite some time. It is located just to the east of where gravel pit road intersects Forest Lane. The area on the south side of Forest Lane (upstream) currently infiltrates stormwater runoff.

Solution: In general there are two alternatives available to solve this problem: 1) unplug the existing culvert to allow drainage 2) do nothing. Alternative 1 would ensure that any stormwater runoff would pass by Forest Lane without any overtopping. Aside from that, the existing condition seems to be working fine. Per the City's Public Works Director, even during the storm event of 1996, this area drained without ill effects to the roadway or adjacent property.

Preferred Alternative: Based on the 1996 storm occurrence, the preferred alternative for GP3 is Alternative 2.

GENERAL PROBLEM #4 (GP4A - GP4D)

Problem: Drainage-way outlet structures at the railroad tracks through-out the length of the City could not be located to verify size and type.

Discussion: There were a number of drainage crossings underneath the railroad tracks that could not be verified in the field. It was verified in the field that runoff from Rudolph Creek was flowing underneath the railroad tracks but no drainage structure could be found (GP4a). The remaining drainage crossings (GP4b – GP4d) were never observed because the existing brush prevented access. This information is important know, especially in determining if the existing drainage structures have adequate capacity to pass the upstream stormwater flows at peak rainfall events.

Solution: If the railroad is unwilling, the City should do what they can to remove the brush from around these outlet facilities to gage what's existing, and ensure that these facilities (if present) are draining correctly. This could be done with a weed-wacker and a backhoe.

3.2.2 ANTICIPATED FUTURE NEEDS

As stated above, new development creates additional impervious areas and results in increased stormwater runoff. With the determination that the existing major drainage facilities are capable of passing 50-100 year storm events runoff from existing levels of development, it is recommended that new development be required to manage stormwater in such a way that existing facilities do not need to be enlarged. Adopting updated regulations to implement such requirements is necessary to achieve this goal and avoid future problems. Draft regulations are provided in the appendix.

These draft regulations are drawn from those of the City of Oregon City. The regulations of other jurisdictions – Cities of Hood River, Gresham, and Portland Oregon; Clean Water Services; Clark County, Washington; Cities of Vancouver and Washougal, Washington; and The Storm Water Management Manual for the Puget Sound Basin – were considered as well. Those of the larger jurisdictions are very complex, as needed to regulate a wide range of conditions. Those of Oregon City were deemed more appropriate for the City of Cascade Locks.

These draft regulations are more detailed than the City's current Public Works Design Standards. The runoff rates for 2, 10, and 25 year storm events are limited to pre-existing rates, and safe conveyance of the 100 year event is required. The City's current rules are based on the 10 year event.

Another change with the proposed regulations is the implementation of water quality treatment requirements. The current rules are silent about quality, however, two recent development proposals in the City – Windsong Terrace and Shahala subdivisions – have followed these practices and are providing water quality treatment.

In addition to regulating new development, it is critical to maintain existing and future facilities. Proper maintenance requires sufficient labor and equipment, and can only be achieved with reliable and adequate revenue. Thus, a stormwater drainage utility should be established by the City.

SECTION 4
MAINTENANCE AND OPERATIONS

4.1 OBJECTIVES

Ongoing and effective maintenance of a stormwater system is necessary in order to ensure the dependability and reliability of the system. A good maintenance program will protect the City's home and business owners from property damage, minimize life-cycle costs of infrastructure, and enhance water quality and the environment. Maintenance is necessary for all parts of the system, including ditches and culverts, piping, catch basins and drywells. As City staff is stretched, it is often difficult to schedule regular maintenance of stormwater infrastructure, often resulting in a "catch-up" scenario, whereby only those items that are broken receive attention. This scenario is harmful in the long run, as when regular maintenance does not occur, the life of system components often decreases, adding costs.

4.2 REQUIREMENTS

The existing drainage facilities identified in this plan require maintenance in order to maximize the life of the components. The following paragraphs outline the maintenance drainage practices recommended. These recommendations were developed utilizing the following sources: Puget Sound Stormwater Management Manual, discussions with engineers and public works personnel involved in the design and maintenance of drainage facilities, and studies prepared for the City of Vancouver and City of Portland. A general discussion of drainage maintenance issues is presented along with the recommended maintenance practices. Section 4.3.7 below, contains information regarding recommended frequency of maintenance for various items, staffing configurations, etc.

4.2.1 DRAINAGE MAINTENANCE ISSUES

As water quality becomes an increasingly important issue, traditional drainage maintenance practices are changing. The primary changes to maintenance practices are the increased frequency of cleaning and the increased maintenance of vegetation in the drainage system. Other important issues include the use and disposal of hazardous substances and worker safety.

Recommended standards for maintenance frequency are presented herein. Over time, these standards should be adjusted based on local experience. Some of the measures may require more or less frequent implementation depending upon actual local experience.

Drainage system components must be periodically cleaned of accumulated materials in order to remain effective in removal of large particulates. Even more importantly, oil/water separators must be cleaned several times a year to maintain their effectiveness. For these facilities, large volumes of stormwater can flush previously removed silt and oil back into the system if it is not removed between storms.

Detention ponds and swales rely, in part, on vegetation to remove pollutants. The vegetation (grass) must be dense to be effective. Regular mowing helps assure this. Since the soil is the major factor in pollutant removal, it may require periodic tilling, application of mulch, or eventually replacement, to continue its effectiveness.

Infiltration facilities, such as dry wells, also rely on the soil to remove pollutants. The soil in these facilities may eventually become clogged with fine materials or the reactive sites may become saturated. Drywells may require periodic replacement to continue their effectiveness, and should be evaluated on a case by case basis.

4.3 RECOMMENDATIONS

4.3.1 *INSPECTION AND WET WEATHER PREPARATION*

Many of the drainage facilities will require regular inspection to determine their maintenance needs. Inspection results should be tracked to determine costs and scheduling needs. This inspection will also identify drainage problems requiring additional facilities. The majority of the annual maintenance activities should be performed during the dry season. Scheduling of drainage maintenance in the dry season will permit vegetative cover to become re-established prior to heavy seasonal rainfall.

4.3.2 *SEVERE STORM PREPARATION*

Maintenance crews become familiar with chronic problem areas during storms. An informal emergency response program should be developed and formally documented. Weather forecasts should be monitored. When a large storm is in the forecast, crews should inspect problem areas and clean or prepare them as needed. This preparation should help reduce demands arising from emergencies generated by severe storms.

4.3.3 *CONFINED SPACES*

Dangerous gases often collect in the confined spaces typically found in drainage systems. There are strict state and federal requirements for worker safety regarding confined spaces. Generally no worker should enter a confined space without safety training, a harness, breathing apparatus, ventilation, and a gas detection meter. Ideally, one worker will also remain above ground to provide support and assist in the case of an emergency. Check state and federal requirements for specific requirements.

4.3.4 *TOXIC/HAZARDOUS MATERIALS*

Many of the materials used or collected during general maintenance activities are pollutants and may be toxic or hazardous. Caution should be exercised in the use and disposal of such materials in general. Their use should be avoided in the drainage system because of the potential for their introduction into natural waters. For example, vegetation is generally beneficial in the drainage system and should be maintained mechanically rather than chemically.

Materials removed from the drainage system should be periodically tested for pollutant concentrations and disposed of properly.

In particular, the City should explore options to establish a decant facility to dispose of liquid waste materials. Solid waste materials should be periodically tested. Experience in other jurisdictions indicate that these materials generally fall within the criteria for solid waste, but occasionally fall within the criteria for hazardous waste. Where possible, liquids should be decanted to a sanitary sewer system for treatment.

4.3.5 Maintenance Scheduling

Maintenance costs will increase as additional facilities are constructed, however, the costs associated with failure of or inadequate drainage system facilities should decrease over time.

Information regarding maintenance should be expanded and used for scheduling and tracking costs. If used regularly, it will provide improved data for future cost estimating, scheduling and budgeting, that can be accomplished manually. It can also be easily generated on a computer spreadsheet. As an alternative, the maintenance staff may wish to purchase a commercially available software package for maintenance management. The cost of this would be within the proposed administrative costs for the program.

Problem locations should be noted in a maintenance log for future storm drainage improvement projects.

4.3.6 Equipment Needs

To adequately ensure that existing facilities are well maintained, the City will need certain pieces of equipment. These include but are not limited to a street sweeper, and vactor truck. It's important to note that the maintenance needs for the existing facilities are anticipated to increase in direct proportion to the growth in the City. This is why it is so important to have the necessary equipment to be able to keep up with demand.

4.3.7 Maintenance Information and Suggested Guidelines

The following tables summarize some recommended maintenance information on scheduling frequencies, performance standards, and suggested crew configurations to optimize performance. The information provided in the following tables is to aid the City in determining the annual maintenance costs for maintaining the various drainage facilities so that they can better plan for the future.

Table 4.1
MAINTENANCE FREQUENCIES

Activity	Optimal Frequency
Clean Catch Basins	1.5 times/year
Clean Manholes	1.5 times/year
Clean Dry Wells	1.5 times/year
Roadside Ditches – Clean, Reshape, Remove Sediment	0.5 times/year
Roadside Ditches – Vegetation Control	2 times/year
Clean Pipes (non-perforated)	1 time/year
Clean Pipes (perforated)	1 time/year
Clean Stream Culverts	1 time/year
Detention Basins – Vegetation Control	3 times/year
Detention Basins – Remove Sediments	1 time/year
Clean Streams/lake – Remove Trash	6 times/year
Repair/Replace Catch Basins	0.033 times/year
Repair/Replace Manholes	0.033 times/year
Repair/Replace Dry Wells	0.05 times/year
Repair/Replace Pipes (non-perforated)	0.033 times/year
Repair/Replace Pipes (perforated)	0.05 times/year
Drainage Complaints and Flood Response	As Needed
Street Sweeping	4 times/year

Table 4.2
PERFORMANCE STANDARDS

Maintenance Item	Production Unit	Performance Standard
Clean Catch Basins	Each	28 per Day
Clean Manholes	Each	12 Per Day
Clean Dry Wells	Each	12 Per Day
Clean Roadside Ditches (Remove Sediments)	LF	500 LF/Day
Clean Roadside Ditches (Vegetation Control))	LF	2000 LF/Day
Clean Pipes non-perforated)	LF	1000 LF/Day
Clean Pipes (perforated)	LF	1000 LF/Day
Clean Stream Culverts	EA	4 per Day
City Maintained Detention Basins (Vegetation Control)	Each	5 per Day
City Maintained Detention Basins (Remove Sediments)	Each	1 per Day
Clean Streams/lake (Remove Trash)	LF	4000 LF/Day
Repair/Replace Catch Basins	Each	1 per Day
Repair/Replace Manholes	Each	0.5 per Day
Repair/Replace Dry Wells	Each	0.5 per Day
Repair/Replace Pipes (non-perforated)	LF	40 LF/Day
Repair/Replace Pipes (perforated)	LF	40 LF/Day
Drainage Complaints and Flood Response	Each	Varies

Table 4.3
OPTIMAL CREW CONFIGURATIONS

Item No.	Maintenance Activity	Crew Size and Equipment
1.	Clean Catch Basins	2 Maintenance Workers 1 Vactor Truck 1 Pickup
2.	Clean Manholes	2 Maintenance Workers 1 Vactor Truck 1 Pickup
3.	Clean Dry Wells	2 Maintenance Workers 1 Vactor Truck 1 Pickup
4.	Clean Roadside Ditches (Remove Sediments)	3 Maintenance Workers 1 Backhoe/Trailer 1 Dump truck
5.	Clean Roadside Ditches (Vegetation Control)	1 Maintenance Worker 1 Mower
6.	Clean Pipes (non perforated)	3 Maintenance Workers 1 Vactor Truck 1 Pickup
7.	Clean Pipes (perforated)	3 Maintenance Workers 1 Vactor Truck 1 Pickup
8.	Clean Stream Culverts	3 Maintenance Workers 1 Vactor Truck 1 Pickup
9.	City Maintained Detention Basins (Vegetation Control)	2 Maintenance Workers 1 Mower
10.	City Maintained Detention Basins (Remove Sediments)	3 Maintenance Workers 1 Backhoe/Trailer 1 Dump truck
11.	Clean Streams/lake (Remove Trash)	2 Maintenance Workers 1 Pickup
12.	Repair/Replace Catch Basins	3 Maintenance Workers 1 Backhoe/Trailer 1 Dump truck 1 Pickup

Item No.	Maintenance Activity	Crew Size and Equipment
13.	Repair/Replace Manholes	3 Maintenance Workers 1 Backhoe/Trailer 1 Dump truck 1 Pickup
14.	Repair/Replace Dry Wells	3 Maintenance Workers 1 Backhoe/Trailer 1 Dump truck 1 Pickup
15.	Repair/Replace Pipes (non-perforated)	3 Maintenance Workers 1 Backhoe/Trailer 1 Dump truck 1 Pickup
16.	Repair/Replace Pipes (perforated)	3 Maintenance Workers 1 Backhoe/Trailer 1 Dump truck 1 Pickup
17.	Drainage Complaints and Flood Response	3 Maintenance Workers 1 Backhoe/Trailer 1 Dump truck 1 Pickup
18.	Street Sweeping	1 Street Sweeper

SECTION 5

MAINTENANCE PROGRAM

5.1 PRIORITIZATION EVALUATION CRITERIA

Prioritization of the proposed maintenance tasks is based on a couple of factors. These factors include:

- Flood Prevention
- System Prioritization identifying which project within the proposed stormwater drainage system plan requires the highest priority.

It should be noted that project phasing is intended to provide guidance rather than a set of deadlines and may be adjusted according to the City's direction. Funding and resource availability may also require project phasing to be adjusted over time. For problem identification analysis, see Section 3. It should also be noted that ODOT owns and maintains several of the stormwater collection system component around town, and their cooperation will be essential to the success of the future stormwater system conveyance.

5.2 IDENTIFIED MAINTENANCE TASKS

The following Table 5.1 summarizes the priority for the top four recommended maintenance tasks, giving each task a priority rating. 1 indicates the highest priority and 4 indicates the lowest.

Table 5.1
MAINTENANCE TASK LISTING

Problem Identifier	Location/Description	Priority Rating
General Problems (See Figure 3.1 in Section 3 for map showing locations)		
GP1	Plugged outlet pipe that drains two catch basins along Historic Highway 30 at the intersection with Regulator Street.	2
GP2	Plugged outlet pipe that drains two catch basins along Historic Highway 30 adjacent to City Hall	3
GP3	Plugged box culvert along Forest Lane between Roberts Road and Gravel Pit Road	4
GP4	Locating and identifying existing outlet culverts that could not be found but are assumed to exist.	1

5.3 MAINTENANCE TASK LIST

The tasks listed for maintenance focus on developing a conveyance network that is fully functional and observable.

Table 5.2
PRIORITIZED MAINTENANCE TASKS

Project #	Problem Identifier	Description	Estimated Cost (in 2005 construction dollars)
1	GP4	Locating and identifying existing outlet culverts that could not be found but are assumed to exist.	$3,000
2	GP1	Plugged outlet pipe that drains two catch basins along Historic Highway 30 at the intersection with Regulator Street.	$25,000
3	GP2	Plugged outlet pipe that drains two catch basins along Historic Highway 30 adjacent to City Hall	$30,000
4	GP3	Plugged box culvert along Forest Lane between Roberts Road and Gravel Pit Road	- 0 -

City of Cascade Locks, Oregon

Stormwater and Grading Design Standards

June 2005

ADOPTED: November 28, 2005
EFFECTIVE: November 28, 2005

Prepared By:

Wallis Engineering
317 Columbia Street
Vancouver, WA 98660
(360) 695-7041

APPENDIX

CITY OF CASCADE LOCKS STORMWATER AND GRADING DESIGN STANDARDS

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ACRONYMS / GLOSSARY

AASHTO – American Association of State Highway and Transportation Officials

Applicant – A person, party, firm, corporation, or other legal entity that has applied for a development permit or approval.

APWA – American Public Works Association

Architect – An architect licensed by the State of Oregon.

Armor – Artificial surfacing of channel beds, banks, or embankment slopes to resist scour and lateral erosion.

ASTM – American Society for Testing and Materials

Bench – A relatively level step excavated into earth material on which fill is to be placed.

Beneficial Uses – As defined by the Oregon Department of Water Resources: use of an instream public use of water for the benefit of an appropriator for a purpose consistent with the laws and the economic and general welfare of the people of the state and includes, but is not limited to, domestic, fish life, industrial, irrigation, mining, municipal, pollution abatement, power development, recreation, stockwater and wildlife uses.

Berm – A constructed barrier of compacted earth, rock or gravel. Berms are frequently used to direct the flow of surface water runoff.

Best Management Practices (BMP) – Physical, structural, managerial practices and/or activities, when used singly or in combination, prevent, or limit, pollutants/sediments from entering stormwater flows.

Bollard – A post (may or may not be removable) used to prevent vehicular access or to protect above grade structures.

Catch basin – A structure normally with a sump for receiving drainage from a gutter or median and discharging the water through a conduit.

Channel – A feature that conveys surface water and is open to the air.

Channel, Constructed – A water way (or reconstructed natural channel) to convey surface water.

Channel, Natural – Streams, creeks, or swales that convey surface/ground water and have existed long enough (at one point in time) to establish a stable route and/or biological community.

Check Dam – Structure constructed across drainageways to reduce concentrated flows in the channel and protect vegetation in the early stages of growth. They can consist of stones, sandbags, or gravel, and are most commonly used in the bottom of channels that will be stabilized at a later date. Although check dams also collect sediment and hence act as filters, their primary purpose is to reduce erosive velocities.

City – Shall mean the City of Cascade Locks.

City Engineer – The City Manager, their duly authorized representative(s), or the City's duly authorized representative(s) as designated by the City Manager.

Clearing – Surface removal of vegetation.

Compost – A textural organic matter made from decomposed vegetation, with plant fertilizer value. For the purposes of this manual, compost is to be used as a soil amendment. The compost shall be a medium to fine texture, free of foreign matter, shall be fully decomposed, fully composted, and be free of live weed seeds.

Connector Storm Drain – Sewer connecting structures (catch basins, etc.) that collect surface runoff to a lateral, trunk, or out fall storm drain.

Construction – Any site-altering activity, including but not limited to grading, utility construction, and building construction.

Contributing Drainage Area – The subject property together with the watershed contributing runoff to it.

Conveyance – A channel or conduit used to convey water from one point to another point.

Created Wetlands – Wetlands developed in an area previously identified as a non-wetland to replace, or mitigate wetland destruction or displacement. A created wetland shall be regulated and managed the same as an existing wetland.

Constructed Wetlands – Wetlands developed as a water quality or quantity facility, subject to change and maintenance as such. These areas must be clearly defined and/or separated from naturally occurring or created wetlands.

Critical Depth – The depth at which water flows over a weir; this depth being attained automatically where no backwater forces are involved. It is the depth at which the energy content of flow is a minimum.

Culvert – A hydraulically short conduit which conveys surface drainage in artificial or natural water courses through a roadway embankment or past some other type of flow obstruction.

<u>Dam</u> – A water storage structure that may or may not meet Oregon Revised Statute (ORS) requirements for height and storage capacity. All such structures require professional engineer design. In addition, exceeding the ORS criteria drives the need for Oregon State Water Resources Commission approval.

<u>Debris</u> – Discarded man-made objects that would not occur in an undeveloped stream corridor or wetland. Debris includes, but is not limited to, tires, vehicles, litter, scrap metal, construction waste, lumber, plastic or Styrofoam. Debris does not include objects necessary to an allowed use, or ornamental and recreational structures. Debris does not include existing natural plant materials or natural plant materials that are left after flooding, and downed or standing dead trees or trees that have fallen into protected water features as defined in OCMC 17.49.

<u>Department of Environmental Quality (DEQ) Water Quality Standards</u> – The numerical criteria or narrative condition needed in order to protect an identified beneficial use.

<u>DEQ</u> – Department of Environmental Quality

<u>Design Storm</u> – A theoretical rainfall event that, statistically, has a specified probability of being exceeded in any given year. Design storms may be numerically expressed either in years (recurrence interval) or as a percentage. Design storms have a prescribed rainfall amount, with a prescribed rainfall distribution and duration. They are used for estimating surface water runoff for the purposes of analyzing existing drainage, designing new drainage facilities, or assessing other impacts of a proposed project on the flow of surface water. For the design of stormwater quantity control and quality control facilities, the design storm shall have a 24-hour rainfall period with a SCS (Soil Conservation Service, now known as the NRCS, Natural Resources Conservation Service) Type 1A rainfall distribution.

<u>Detention Facility</u> – An above or below ground facility, such as a pond or tank, that temporarily stores stormwater runoff and subsequently releases it at a slower rate than it was collected by the tributary stormwater facilities. There is little or no infiltration of stored stormwater.

<u>Development</u> – Any land use decision or manmade change defined as buildings or other structures, mining, dredging, paving, filling, or excavation. Development does not include the following: a) Stream enhancement or restoration projects approved by the City; b) Farming practices as defined in ORS 30.930 and farm use as defined in ORS 215.203, except that buildings associated with farm practices and farm uses are subject to the requirements of this Chapter; and c) Construction on lots in subdivisions meeting the criteria of ORS 92.040(2) (1995).

<u>Disturb</u> – Any man-made changes to the existing physical status of the land that are made in connection with development.

<u>Drainage Basin</u> – An area which encompasses all of the surface contributing to storm water runoff concentrating at a particular point of discharge.

Drainage Easement – A legal encumbrance that is placed against a property's title to reserve specified privileges for the users and beneficiaries of the drainage facilities contained within the boundaries of the easement.

Drainage Facilities/Systems – See Stormwater Facilities.

Drainage Feature – Any natural or manmade structure, facility, conveyance, or topographic feature which has the potential to concentrate, convey, detain, retain, infiltrate, or affect the flow rate of stormwater runoff.

DSL – Division of State Lands

Easement – The legal right to use a parcel of land for a particular purpose. It does not include fee ownership, but may restrict the owner's use of the land.

Embankment – A raised structure of earth, gravel, or similar material above the surrounding grade.

Emergency – Any man-made or natural event or circumstance causing or threatening loss of life, injury to person or property, and includes, but is not limited to, fire, explosion, flood, severe weather, drought, earthquake, volcanic activity, spills or releases of oil or hazardous material, contamination, utility or transportation disruptions, and disease.

Engineer – A registered professional engineer licensed by the State of Oregon.

Engineering Geologist – A registered professional engineering geologist licensed by the State of Oregon.

Energy Dissipator – Any means by which the total energy of flowing water is reduced. In stormwater design, they are usually mechanisms that reduce velocity prior to, or at, discharge from an outfall in order to prevent erosion. They include rock splash pads, drop manholes, concrete stilling basins, or baffles and check dams.

Energy Grade Line – A line that represents the total energy gradient along the channel. It is established by adding together the potential energy expressed as the water surface elevation (usually expressed as the hydraulic grade line) referenced to a datum and the kinetic energy (usually expressed as velocity head) at points along the stream bed or channel floor.

Enhancement – The process of improving upon the natural functions and/or values of an area or feature which has been degraded by human activity. Enhancement activities may or may not return the site to a pre-disturbance condition, but create/recreate processes and features that occur naturally.

Erosion – The movement of soil particles resulting from actions of water, wind or mechanical means.

Excavation – The mechanical removal of earth material.

FEMA – Federal Emergency Management Agency

Fill – Any material such as, but not limited to, sand, gravel, soil, rock or gravel that is placed for the purposes of development or redevelopment.

Floodway – The portion of a watercourse required for the passage or conveyance of a given storm event. The floodway shall include the channel of the watercourse and the adjacent floodplain that must be reserved in an unobstructed condition in order to discharge the base flood without flood levels by more than one foot.

Forebay – An easily maintained, extra storage area provided near an inlet of a BMP to trap incoming sediments before they accumulate in a pond or wetland BMP.

Freeboard – The vertical distance between the design water surface elevation and the elevation of the barrier which contains the water.

Governing Body – The City Commission of the City of Cascade Locks, Oregon.

Grading – Any excavating, filling, embanking, or altering contours of earth material.

Grubbing – The removal of vegetative matter from below the surface of the ground, such as sod, stumps, roots, buried logs, or other debris, and shall include the incidental removal of topsoil to a depth not exceeding 12 inches.

Headwall – A functional piece of construction to protect the end of a culvert from the erosion of the soil around it.

Headwater (Hw) – That depth of water impounded upstream of a culvert or stormwater inlet, due to the influence of the culvert constriction, friction, and configuration. The depth of the upstream water surface measured from the invert at the entrance is generally referred to as headwater depth.

Hydraulics – A science that deals with practical applications of liquids in motion. The sizing of pipes and channels is determined through the application of hydraulics.

Hydraulic Head – The height of the free surface of a body of water above a given point.

Hydrologic Soil Group – A soil characteristic classification system defined by the U. S. Soil Conservation Service (now known as the NRCS, Natural Resources Conservation Service) in which a soil may be categorized into one of four soil groups (A, B, C, or D). These are based upon infiltration rates and other properties.

Hydrology – A science dealing with the properties, distribution, and circulation of storm water. The amount of runoff is determined through the application of hydrology.

Hydrograph – A graph of runoff rate, inflow rate, or discharge rate, past a specific point over time.

Hydrograph Method – A method of estimating a hydrograph using a mathematical simulation model. Commonly accepted hydrograph methods include the Soil Conservation Service (now known as the NRCS, Natural Resources Conservation Service) TR-55 Method and the Santa Barbara Urban Hydrograph Method.

Impervious Surfaces – A hard surface area which either prevents or retards the entry of water into the soil mantle as under natural conditions prior to development. It can also be a hard surface area which causes water to run off the surface in greater quantities or at an increased rate of flow from the flow present under natural conditions prior to development. Common impervious surfaces include, but are not limited to, roof tops, walkways, patios, driveways, parking lots or storage areas, concrete or asphalt paving, gravel roads with compacted subgrade, packed earthen materials, and oiled, macadam or other surfaces which similarly impede the natural infiltration of stormwater. Open, uncovered retention/detention facilities shall not be considered as impervious surfaces.

Inlet – A connection between the surface of the ground and a drain or sewer for the admission of surface and stormwater runoff.

Inlet Control – Inlet control occurs when the culvert barrel is capable of conveying more flow than the inlet will accept. The control section of the culvert operation under inlet control is located just inside the entrance. Critical depth occurs at or near this location, and the flow regime immediately downstream is supercritical. Hydraulic characteristics downstream of the inlet control sections do not affect the culvert capacity. The upstream water surface elevation and the inlet geometry represent the major flow controls.

Invasive Non-native or Noxious Vegetation – Plant species that have been introduced and due to aggressive growth patterns and lack of natural enemies in the area where introduced, spread rapidly into native plant communities.

Junction – A location where two (2) or more drainage conveyances intersect.

Landscape Architect – A person registered as a landscape architect by the State of Oregon under ORS 671.310 to 671.459.

Landscape Architecture – or the Practice of Landscape Architecture – The performance of professional services such as consultation, investigation, reconnaissance, research, design, preparation of drawings and specifications and responsible supervision where the dominant purpose of the services is:

a. The preservation and enhancement of land uses and natural land features;

b. The location and construction of aesthetically pleasing and functional approaches for structures, roadways and walkways or other improvements for natural drainage and erosion control; or

c. Design for equestrian trails, plantings, landscape irrigation, landscape lighting and landscape grading.

Land Disturbing Activity – Any activity that results in a change in the existing soil cover (both vegetative and nonvegetative and both temporary and permanent) and/or the existing soil topography. Land disturbing activities include, but are not limited to, demolition, construction, paving, clearing, grading and grubbing.

Lot – A single unit of land that is created by a subdivision of land. (ORS 92.010(3)).

Maintenance – Any activity that is necessary to keep a stormwater facility in good working order so as to function as designed. Maintenance shall include complete reconstruction of a stormwater facility if needed to return the facility to good working order. Maintenance shall also include the correction of any problem on the site property, which may directly impact the function of the stormwater facilities.

Maintenance Covenant – A binding agreement between the City and the person or persons holding title to a property served by a stormwater facility whereby the property owner promises to maintain certain stormwater facilities; grants the City the right to enter the subject property to inspect and make certain repairs or perform certain maintenance procedures on the stormwater control facilities when such repairs or maintenance have not been performed by the property owner; and promises to reimburse the City for the cost should the City perform such repairs or maintenance.

Native Vegetation – Any vegetation native to the Cascade Locks area.

Natural Location – The location of those channels, swales, and other non-manmade conveyance systems as defined by the first documented topographic contours existing for the subject property either from maps or photographs, or such other means as appropriate.

NPDES – National Pollutant Discharge Elimination System. A national permit that covers discharges to waters of the United States (reference: Clean Water Act).

Nonpoint Source Pollution – Pollution from any source other than from discernible, confined, and discrete conveyances, and shall include, but not be limited to, pollutants from agricultural, silviculture, mining, construction, subsurface disposal and urban runoff sources.

NRCS – Natural Resource Conservation Service; a Federal Government Agency. The NRCS was formally known as the SCS

ODOT – Oregon Department of Transportation

Oil/Water Separator – A structure or device used to remove suspended, floating or dispersed oil and greasy solids from water.

Off-site – Any area lying upstream of the site that drains onto the site and any area lying downstream of the site to which the site drains.

On-site – The entire property that includes the proposed development.

Operation and Maintenance Manual – A written manual, prepared by a qualified professional engineer, that provides a description of operation and maintenance procedures for specific stormwater control facilities, for use by operation and maintenance personnel.

Open Space – Land that is undeveloped and that is planned to remain so indefinitely. The term encompasses parks, forests, and farmland. It may also refer only to land zoned as being available to the public, including playgrounds, watershed preserves, and schools.

Orifice – An opening with closed perimeter, usually sharp-edged, and of regular form in a plate, wall, or partition through which water may flow, generally used for the purposes of measurement and control of water.

Outlet – A point of discharge of a culvert or other closed conduit.

Outlet Control – Outlet control flow occurs when the culvert barrel is capable of conveying as much flow as the inlet opening will accept. The control section for outlet control flow in a culvert is located at the barrel exit or further downstream. Either subcritical or pressure flow exists in the culvert barrel under these conditions. All of the geometric and hydraulic characteristics of the culvert play a role in determining its capacity. These characteristics include all the factors governing inlet control, the water surface elevation at the outlet, and the slope, length, and hydraulic roughness of the culvert barrel.

Owner or Property Owner – The person who is the legal record owner of the land, or where there is a recorded land sale contract, the purchaser thereunder.

Parcel – A single unit of land that is created by a partitioning of land. (ORS 92.010(7)).

Partition – The division of an existing land ownership into two or three parcels, within a calendar year, and is subject to approval of the Governing Body's Land Use and Development Ordinances.

Peak Discharge – The maximum instantaneous rate of flow during a storm, usually in reference to a specified design storm event.

Perennial Streams – All primary and secondary perennial water ways mapped by the U.S. Geological Survey.

Plans – The construction documents and specifications, including system site plans, storm drain plans and profiles, cross sections, detailed drawings, etc., or reproductions thereof, approved or to be approved by the City, County, or State. They will show the location, character, dimensions, and details for the work to be done.

Point Source or Discharge – The release of collected and/or concentrated surface and stormwater runoff from a pipe, culvert, or channel.

Post-development Conditions – The conditions which exist following the completion of the land disturbing activities in terms of topography, vegetation, land use, and rate, volume, or direction of stormwater runoff.

Practicable – Means available and capable of being done after taking into consideration cost, existing technology, and logistics in light of overall project purpose.

Precipitation – The process by which water in liquid or solid state falls from the atmosphere.

Pre-development Conditions – The site conditions as they existed before manmade alterations in terms of topography, vegetation, land use, and rate, volume, or direction of stormwater runoff.

Professional Engineer – A person who, by reason of his or her special knowledge of the mathematical and physical sciences and the principles and methods of engineering analysis and design, acquired by professional education and practical experience, is qualified to practice engineering as attested by his or her legal registration as a professional engineer in the State of Oregon.

Project Engineer – The professional engineer responsible for the design of the project, who will affix his/her seal on the project drainage plans and drainage analysis. The project engineer shall be licensed in the State of Oregon and qualified by experience or examination.

Public Storm Drain or Public Storm Drainage System – Any storm drain or drainage system in the public right-of-way or easement operated and maintained by the City, County or State.

Release Rate – The controlled rate of release of drainage, storm and runoff water from property, storage pond, runoff detention pond, or other facility during and following a storm event.

Restoration – The process of returning a disturbed or altered area or feature to a previously existing natural condition. Restoration activities reestablish the structure, function, and/or diversity to that which occurred prior to impacts caused by human activity.

Retention Facility – A stormwater facility designed to hold storm water for a considerable length of time and then consume it by evaporation, transpiration, or infiltration into the soil. The intent of this facility is to not return the water to the natural or man-made watercourse from which it entered the facility.

Right-of-Way – All land, or interest therein, which by deed, conveyance, agreement, easement, dedication, usage, or process of law is reserved for, or dedicated to, the use of the general public. The City shall have the right to install and maintain storm drains within this area.

Riparian – Those areas associated with streams, lakes and wetlands where vegetation communities are predominately influenced by their association with water.

Scour – The result of erosive action of running water, primarily in streams and excavations, and carrying away the material from the bed and banks. Wearing away by abrasive action.

SCS – Soil Conservation Service, (now known as the NRCS, Natural Resource Conservation Service) U.S. Department of Agriculture.

SCS Method – A hydrologic analysis based on the Curve Number method (National Engineering handbook – Section 4: Hydrology, August 1971).

Sedimentation – The process of gravity deposition of water suspended matter. The process of depositing soil particles, clays, sands and other sediment, that were picked up by surface water runoff.

Silt – Fine textured soil particles, including clay and sand (largely passing a No. 200 sieve) as differentiated from coarse particles of sand and gravel.

Slope Intercept Drain – A drain or system of drains that intercepts and diverts both surface runoff and groundwater away from areas subject to erosion or instability.

Standard Drawings – Details of structures, devices, or instruction adopted by the Governing Body, as a standard.

Stormwater – The surface water runoff that results from all natural forms of precipitation.

Stormwater Facility – A component of a manmade drainage feature, or features designed or constructed to perform a particular function or multiple functions. Includes, but is not limited to, pipes, swales, ditches, culverts, street gutters, detentions basins, retention basins, wet ponds, constructed wetlands, infiltration devices, catch basins, oil/water separators, and sediment basins. Stormwater facilities shall not include building gutters, downspouts, and drains serving one single-family residence.

Stormwater Management – Encompasses "control," "developmental" and "maintenance" activities in which there is physical interaction with storm water.

Stormwater Quality Control – The control of the introduction of pollutants into stormwater and the process of separating pollutants from stormwater. Stormwater quality control facilities include, but are not limited to, source controls, biofiltration/biofilter facilities, wetponds, wetland forebays, oil/water separators, constructed wetlands and erosion and sedimentation control facilities.

Stormwater Quantity Control – The control of the rate and/or volume of stormwater released from a development site. Stormwater quantity control facilities include but are not limited to, detention and retention facilities.

Stream – A body of running water moving over the earth's surface in a channel or bed, such as a creek, rivulet or river. It flows at least part of the year, including perennial and intermittent streams. Streams are dynamic in nature and their structure is maintained through build-up and loss of sediment.

Street – Includes both public and private streets as defined below:

- Street, Private – Any street, road, or right-of-way which is not a public street, as defined in this Standard.

- Street, Public – A street or road dedicated or deeded for public use. For the purposes of these Standards, public street may include "alley," "lane," "court," "avenue," "boulevard," "cul-de-sac," and similar designations, and any County Roads and State Highways.

Structure(s) – A building or other major improvement that is built, constructed or installed, or manmade improvements to land that are used, or expected to be used, in the operation of a utility, including buildings, utility lines, manholes, catch basins, driveways, sidewalks. It does not including minor improvements, such as fences, utility poles, flagpoles or irrigation system components, that are not customarily regulated through zoning codes.

Subdivide Land – Dividing an area or tract of land into four (4) or more lots. This applies for an area or tract of land which existed as a unit or contiguous units of land under a single ownership at the beginning of the year.

Subdivision – Either an act of subdividing land or an area or tract of land subdivided as defined in the section.

Surface Waters – Stormwater accumulating on the surface (including natural and manmade) and draining in the direction of least resistance due to gravity.

Tailwater – With respect to culverts, tailwater is defined as the depth of water downstream of the culvert measured from the outlet invert. It is an important factor in determining culvert capacity under outlet control conditions.

Time of Concentration – The time period necessary for surface runoff to reach the outlet of a subbasin from the hydraulically most remote point on the tributary drainage area.

Travel Time – The estimated time for surface water to flow between two points of interest.

Unstable Slopes or Unstable Soils -

- Any area identified on the City's unstable soils and hillside constraint overlay district map.
- Any other area that is identified on official city, county, regional or federal or state agency maps as being subject to soil instability, slumping or earth flow high field investigation, performed by a suitably qualified geotechnical engineer or engineering geologist who is licensed in Oregon and derives his or her livelihood from that profession, confirms the existence of, or potential for, a severe hazard.

USGS – United States Department of Interior Geological Survey

Variance – A discretionary decision to permit modification of the terms of an implementing ordinance based on a demonstration of unusual hardship or exceptional circumstances unique to a specific property.

Water Quality Facility – Any structure or drainage way that is designed, constructed and maintained to collect and filter, retain, or detain surface water runoff during and after a storm event for the purposes of water quality improvement. It may also include but not be limited to, existing features such as constructed wetlands, water quality swales, and ponds that are maintained as stormwater quality control facilities.

Water Quality Resource Areas – Vegetated corridors and the adjacent water feature as established in OCMC 17.49.

Watercourse – A channel in which a flow of water occurs, either continuously or intermittently, and if the latter, with some degree of regularity. Such flow must be in a definite direction.

Watershed – A geographic unit defined by the flows of rainwater or snowmelt. All land in a watershed drains to a common outlet, such as a stream, lake or wetland.

Wetlands – Those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support and under normal circumstances do support a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs and similar areas. Wetlands are those areas identified and delineated by a qualified wetland specialist as set forth in the 1987 Corps of Engineers Wetland Delineation Manual.

Wet (Rainy) Season – That period between November 1 and April 30 of each year deemed to receive sufficient precipitation that warrants special erosion control and construction techniques during grading and construction.

Word Interpretation – For the purposes of this document, certain words shall be interpreted as follows: Words in the present tense include the future tense.

- Words used in the singular number include the plural, and words used in the plural number include the singular, unless the natural construction of the wording indicates otherwise.
- The word "person" includes a firm, association, corporation, municipal corporation, trust, and company as well as an individual.
- The word "structure" shall include the word "building."
- The word "lot" shall include the words, "plot," "parcel," or "tract."
- The word "shall" is always mandatory and not merely directory.
- The word "will" is always mandatory and not merely directory.
- The word "may" and "should" are permissive and are not mandatory, unless the City Engineer determines that for a project specific reason it should be mandatory.

CHAPTER 1
INTRODUCTION

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CHAPTER 1 – INTRODUCTION

1.1 ADOPTION OF STANDARDS

Adoption of the City of Cascade Locks Stormwater and Grading Design Standards document is pending.

1.2 PURPOSE

The purpose of these Stormwater and Grading Design Standards is to provide a consistent policy under which certain physical aspects of stormwater and grading design will be implemented. Most of the elements contained in this document are Public Works oriented and most are related to public improvements and City contract projects; however, it is intended that they apply to both public and private work designated herein.

1.3 APPLICABILITY

These Standards cannot provide for all situations. They are intended to assist but not to substitute for competent work by design professionals. Land surveyors, engineers, and architects are expected to bring to each project the best of skills from their respective disciplines.

These Standards are also not intended to unreasonably limit any innovative or creative effort that could result in better quality, better cost savings, or both. Any proposed departures from the Standards will be judged; however, on the likelihood that such variance will produce a compensating or comparable result, in every way adequate for the user and City resident.

1.4 ENGINEER'S RESPONSIBILITIES

Much of the information covered in this document is addressed to professional engineers. In order to assist the professional engineer in fulfilling his/her responsibilities related to a development project, the following comments address the City's expectations regarding the responsibilities of the engineer.

1.4.1 Project Engineer's Responsibilities

A. The Project Engineer shall prepare construction plans for site development meeting the standards and requirements of this document. The Project Engineer shall remain responsible for the accuracy, completeness, and scope of all work submitted to the City Engineer. The Project Engineer shall be responsible for correcting all deficiencies, when necessary, should errors, omissions or inaccurate data due to the Project Engineer's work come to the City Engineer's attention in the future. The Project Engineer shall be responsible for any damages resulting from the incorrect work.

B. The Project Engineer shall incorporate recommendations from geotechnical engineering reports and any other engineering recommendations into the construction plans for site development.

C. The Project Engineer shall, when required by the City Engineer, be responsible for the inspection and approval of the construction within the Project Engineer's area of technical expertise. This responsibility shall include, but need not be limited to, construction observation and approval as to the establishment of line, grade, maintenance, and implementations of Best Management Practices (BMP) and drainage of the development area. In conjunction with the execution of this responsibility, copies of any on-site inspection reports shall be submitted by the Project Engineer to the City Engineer, when so requested. Inspection under this paragraph means the visual observation and documentation of the construction of the stormwater system and BMPs as compared to the approved plans, specifications, and City standards.

D. The Project Engineer shall act as the coordinating agent in the event the need arises for liaison between the owner, other professionals, contractors, the City, and other agencies.

E. The Project Engineer shall be responsible for the preparation of revised plans and the submittal of as-built plans or record drawings, as applicable upon completion of work.

F. The Project Engineer shall be responsible for verification of excavation and embankment quantities, detention/retention pond volumes, slope steepness, and compliance with approved construction plans.

1.4.2 Geotechnical Engineer's Responsibilities

When a geotechnical investigation report is required, the minimum responsibilities of the Geotechnical Engineer shall be as follows:

A. The preparation of any required geotechnical investigation report.

B. All reports, field data, test data, and recommendations shall be submitted to the Project Engineer and to the City Engineer.

C. The Geotechnical Engineer shall provide, when required by the Project Engineer or the City Engineer, professional inspection and approval concerning the preparation of ground to receive fills and testing for required compaction. The Geotechnical Engineer shall also provide oversight on stability of all finished slopes and the design of embankment fills.

D. The Geotechnical Engineer shall prepare, when required by the Project Engineer or the City Engineer, a final soils report which includes locations and elevations of field density tests. The final soils report shall also include summaries of field and laboratory tests and other substantiating data and comments on any changes made during site development.

1.4.3 Landscape Architect's Responsibilities

When plans for a proposed water quality facility is prepared by a licensed landscape architect, the Landscape Architect shall prepare construction plans for site development meeting the standards and requirements of this document. The Landscape Architect shall be responsible for correcting all deficiencies, when necessary, should errors, omissions, or inaccurate data due to the Landscape Architect's work come to the City Engineer's attention in the future. The Landscape Architect shall be responsible for any damages resulting from the incorrect work.

CHAPTER 2

SUBMITTAL REQUIREMENTS AND ADMINISTRATIVE PROVISIONS

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CHAPTER 2 – SUBMITTAL REQUIREMENTS AND ADMINISTRATIVE PROVISIONS

This chapter describes the submittal requirements for stormwater and grading plans and other documents for review by the City. This chapter also describes other administrative provisions associated with the project development process. One or more of the following reports and plans may be required. The Public Works Director or City Engineer have the authority to waive any of the below listed grading or drainage plan preparation requirements.

2.1 GRADING PLANS

2.1.1 Engineered Grading Plans

All Engineered Grading Plans shall be prepared by, and be stamped with the seal of, and signed by, a professional engineer registered in the State of Oregon. Engineered Grading Plans shall include at least the following information:

2.1.1.1 PLAN VIEW REQUIREMENTS

The plan view shall be no smaller than 1 inch = 100 feet scale. Recommended scale is 1 inch = 50 feet.

2.1.1.2 COVER SHEET REQUIREMENTS

The first sheet, or cover sheet if one is provided, shall include the following:

A. North arrow; vicinity map showing project boundaries; streets with street names; streams and rivers, if any; city limit boundaries, if any; and section-township-range. Reproductions of copyrighted materials, without the permission of the owner(s), are not acceptable.

B. Legal description of project site.

C. Name, address and telephone of owner of project.

D. Name, address and telephone of Project Engineer.

E. Datum for project.

F. Legend, in the event that symbols are used in plans.

G. Existing topography.

H. City Planning File Number.

2.1.1.3 SOIL TEST PIT LOCATIONS.

2.1.1.4 CLEARING AND GRUBBING LIMITS.

2.1.1.5 FINISHED GRADE CONTOURS.

2.1.1.6 LOCATIONS OF STORMWATER FEATURES.

Show existing channels, swales, or drainage pipes that either convey offsite stormwater through the project site, or collect and discharge site runoff from the project site.

2.1.1.7 LOCATIONS OF SLOPES.

Show existing slopes steeper than two horizontal to 1 vertical (2h:1v), with the slopes indicated.

2.1.1.8 INFORMATION ON SITE WATER RESOURCES.

Show information concerning wetlands, environmentally sensitive areas, watercourses, natural buffer areas, and similar applicable information.

2.1.1.9 LOCATIONS OF DISTURBED AREAS.

Show areas to be graded, filled, excavated, or otherwise disturbed. The location of tops and toes of graded slopes shall be indicated, together with the proposed steepness and height of these slopes. The location of stockpiles, haul roads, and disposal sites shall also be indicated.

2.1.1.10 QUANTITIES OF CUT/FILL.

Show quantities, in cubic yards, of excavation and/or fill throughout the project site.

2.1.1.11 LOCATIONS OF DRAINAGE STRUCTURES.

Show locations of pipes (size, materials, and slopes), channels, catch basins, ponds, etc., which are to be constructed as a part of the grading plan.

2.1.1.12 CONSTRUCTION INFORMATION.

Show information concerning construction methods, fill material specifications, source of fill material, compaction specifications, haul routes, and other construction information when known and applicable.

2.1.1.13 STANDARD GRADING NOTES.

Engineered Grading Plans shall include, as a minimum, the standard grading notes shown in Appendix 2-1.

2.1.1.14 NUMBER OF SETS.

Two sets of plans shall be submitted for plan reviews. Six sets of plans shall be submitted for final approvals. "Blacklines" (a photocopy process on bond) is preferred for submittals over "bluelines" (a diazo process) to enable the City to recycle the bond. For final approvals, one plan set shall bear a wet ink signature of the Professional Engineer, who prepared the plan.

2.1.2 Abbreviated Grading Plans

Abbreviated Grading Plans shall be prepared by, and be stamped with the seal of, and signed by, a professional engineer registered in the State of Oregon. Abbreviated Grading Plans shall include at least the following information:

2.1.2.1 NARRATIVE.

The Applicant shall submit a narrative describing the project's parameters for grading the site to include the total square footage of new impervious surface. Describe what the project will accomplish and how the project will be executed. Describe how the grading will affect surface water drainage and what is being proposed to ensure the new drainage pattern will direct the surface water to an approved outfall.

2.1.2.2 DRAWING(S).

Provide a simple sketch depicting the topographical lines of the site. Show the project's boundaries and the final desired grading lines versus the existing pre-grading lines. Show drainage patterns with the final outfall. Show a North arrow and at least one street for reference. Drawings shall be on paper at least 8.5 inches by 11 inches, provided sufficient scale can be shown on this size, otherwise the project shall be displayed on 11 inch by 17 inch paper. The plan view shall be no smaller than 1 inch = 100 feet scale. Recommended scale is 1 inch = 50 feet.

2.1.3 Residential Lot Grading Plans

2.1.3.1 PURPOSE.

The purpose of a Residential Lot Grading Plan is twofold. First, this plan illustrates that the storm drainage system is designed to accommodate the drainage patterns of the final graded project. Secondly, the plan provides protective slopes away from all sides of a building.

2.1.3.2 APPROVED DISCHARGE POINT.

Stormwater from residential impervious surfaces (roofs, driveways, etc.) must be conveyed to a City approved stormwater discharge point, which is commonly a stormwater quantity control facility. To accomplish this, roof drains may be directly connected to a public storm drainage system by means of a lateral pipe. Stormwater from roofs may also drain directly to a public street through a curb if the building's top of foundation is at least 2 feet above the curb elevation. (The 2 feet is the minimum elevation difference considered necessary to allow for positive drainage for the footing drain.) If roof drains cannot be collected and conveyed to a detention facility, other means, such as seepage trenches or direct discharge, that is sized to detain to an adjacent stormwater quantity control facility, will be required. These other methods will be reviewed and approved by the City on a case by case basis and shall be discussed in the project's drainage report.

2.1.3.3 PROTECTIVE SLOPES.

Protective slopes away from all sides of all buildings are essential elements of all lot grading plans. The purpose of the protective slopes is to drain surface water away from all building walls and backfill areas. Where such a protective slope meets a slope that drains towards a building, a drainage swale of adequate width, depth, and longitudinal gradient is necessary to carry away surface water without flooding against buildings or ponding any lot areas.

2.1.3.4 BASIC LOT GRADING TYPES.

There are three basic lot-grading types as established by the Federal Housing Authority (FHA), however others may exist depending on the uniqueness of the topography. These three basic lot types are:

A. Lot Grading Type A — All drainage to street.

B. Lot Grading Type B — Drainage to both street and rear of lot.

C. Lot Grading Type C — All drainage to rear lot line.

(See exhibit shown in Appendix 2-1)

If Type B or C lot grading is selected, flows may not be channeled or concentrated onto adjacent properties without the creation of a private drainage easement to convey the water to a natural location or public stormwater system. See Section 6.2.1.D and Section 6.10.1 of these standards for additional discussions regarding drainage easements.

2.1.3.5 RELATIONSHIP TO STREET ELEVATION.

The single most important grade relationship for proper lot grading and drainage is top of foundation elevation in relation to street elevation. If the floor elevation is too low in relation to adjoining street grades, adequate protective slopes and drainage swales cannot be provided to satisfactorily drain the site. If the floor elevation is too high, unnecessary terracing, expensive outside stairs and awkward appearance may result.

Proper top of foundation elevation and lot grades for any lot can be obtained by establishing a lot grading control line on the plans and on the ground appropriate for the specific property. The line is located differently for each lot grading type as shown by the circles lettered "A," "B," "C," etc., in the exhibit shown in Appendix 2-1. Each control line starts at the top of the street curb near the indicated high or low lot corner and ends up at the top of the building foundation. Specific design criteria for the grading control line can be found in note six of the Residential Lot Grading Notes shown in Appendix 2-1. The grading control line must be checked for each lot or parcel.

2.1.3.6 BUILDING CODE.

The City has adopted the most current edition of the Building Code required by the state of Oregon.

2.1.3.7 ROUGH GRADING.

Residential Lot Grading Plans shall be based on final rough grading as-built conditions which are certified by the Project Engineer to +/- one-tenth of a foot.

2.1.3.8 SCALE.

The plan view of detailed drainage plans shall be drawn at an engineering scale no smaller than 1 inch = 50 feet; when more detail is required, 1 inch = 20 feet is preferred.

2.1.3.9 SHEET SIZE.

The plan sheet size shall be 24 inches x 36 inches.

2.1.3.10 COVER SHEET REQUIREMENTS.

The first sheet, or cover sheet if one is provided, shall include the following:

A. North arrow, vicinity map, project boundaries; streets with street names; shorelines, if any; city limit boundaries, if any; and section-township-range. Reproductions of copyrighted materials, without the permission of the owner(s), are not acceptable.

B. Legal description of project site.

C. Name, address and telephone of owner of project.

D. Name, address and telephone of Project Engineer.

E. Datum for project.

F. Legend, in the event that symbols are used in plans.

G. City Planning File Number.

H. Basis of bearing.

I. On site temporary benchmark (TBM).

2.1.3.11 OTHER PLAN SHEET REQUIREMENTS.

A. Standard Residential Lot Grading Notes (see Appendix 2-1).

B. Standard Detail for typical grading patterns (see Appendix 2-1).*

C. Existing and proposed lot/parcel lines including intersecting adjoining properties.

D. Lot/parcel dimensions.

E. Lot parcel identification.

F. Street centerlines.

G. Estimated building envelope (show a building envelope size, based on underlying zone setbacks, that may be considered typical for the type of development and its location).

H. Existing or proposed curb. If no curb, centerline and edge of street pavement.

I. Top of curb elevations at intersection of curb and property line extensions (at ends of curb returns on corner lots). If no curb, centerline and edge of pavement elevations at intersection with property line extensions. Elevations to hundredths.

J. Existing contour lines (minimum 2-foot interval) including adjacent property within 50 feet.

K. Finished grade elevations to the nearest tenth of a foot.*

L. Lot grading type for each lot or parcel.*

M. Top of foundation elevations to the nearest tenth of a foot.*

N. Flow arrows shown in street gutter.

O. Flow arrows shown in swales per typical lot grading type detail.

P. Existing and/or proposed storm system.

* When the average slope on a proposed lot in the likely location of the structure is greater than 5%, it is not necessary to show these items on the developer-produced residential grading plan. For these cases, identify a discharge location for the line that will collect the roof drainage. The average slope shall be calculated by using the average of the three slopes at the two edges of the structure and the middle of the structure.

2.1.3.12 Number of Plan Sets.

Two sets of plans shall be submitted for plan reviews. Six sets of plans shall be submitted for final approvals. "Blacklines" (a photocopy process on bond) is preferred for submittals over "bluelines" (a diazo process) to allow the City to recycle the bond. For final approvals, at least one plan set shall bear a wet ink signature of the Professional Engineer whom prepared the plan.

2.2 ENGINEERED DRAINAGE PLANS

It is the responsibility of the Project Engineer to ensure that engineering plans are sufficiently clear and concise to construct the project in proper sequence. The Project Engineer shall use specified methods and materials, with sufficient dimensions, to fulfill the intent of the design guidelines contained in this document.

Plans submitted for review which contain deficiencies in legibility or presentation of information which hinder the ability of personnel to properly evaluate proposed facilities will be returned to the Project Engineer and review will be suspended.

2.2.1 Required Information

2.2.1.1 PREPARATION.

All Engineered Drainage Plans shall be prepared by, stamped with the seal of, and signed by a professional engineer, registered in the State of Oregon. Landscape plans for stormwater facilities being turned over to the City for maintenance shall be prepared by, stamped with the seal of, and signed by a Landscape Architect, registered in the State of Oregon. The Engineered Drainage Plan shall contain the following information:

2.2.1.2 PLAN VIEW – INDEX.

At least one sheet shall contain a plan view of the entire project site. For large sites, the sheet containing the plan view of the entire site shall serve as an index to subsequent detailed plan sheets.

2.2.1.3 SCALE.

The plan view of detailed drainage plans shall be drawn at an engineering scale no smaller than 1 inch = 50 feet; when more detail is required, 1 inch = 20 feet is preferred.

2.2.1.4 SHEET SIZE.

Should a plan contain any information for proposed City-owned and/or-maintained stormwater facility, the plan sheet size shall be 24 inches x 36 inches. Although a 24 inch x 36 inch sheet size is preferred, the maximum plan sheet size for a proposed privately owned stormwater facility shall be 30 inches x 42 inches.

2.2.1.5 COVER SHEET.

The first sheet, or cover sheet if one is provided, shall include the following:

A. North arrow, vicinity map, project boundaries; streets with street names; shorelines, if any; city limit boundaries, if any; and section-township-range. Reproductions of copyrighted materials, without the permission of the owner(s), are not acceptable.

B. Legal description of project site.

C. Name, address and telephone of owner of project.

D. Name, address and telephone of Project Engineer.

E. Datum for project.

F. Legend, in the event that symbols are used in plans.

G. City Planning File Number.

H. Basis of bearing.

2.2.1.6 TOPOGRAPHIC PLAN.

Plans shall include a topographic map showing existing conditions for the site, including:

A. Current topography for the site and extending 250 feet beyond project boundaries, where practicable. Existing topography for adjacent rights-of-way must be included for the full width of right-of-way. Slopes steeper than 25% shall be identified.

B. Contours extending at least 250 feet beyond project boundaries, where practicable, and including the full width of adjacent rights-of-way. Contours shall be at maximum 5-foot vertical elevation intervals for steep locations (greater than 20%) and maximum 2-foot vertical elevation intervals for other locations. Locations and elevations of at least two bench marks in the project vicinity.

C. Existing structures, including all structures within 250 feet of project boundaries, where practicable.

D. Existing access location(s) for the project site.

E. Existing project boundaries, rights-of-way, easements, jurisdictional boundaries, and sectional boundaries. All shall be clearly identified by note or symbol and key. Project boundaries shall include bearings and dimensions as referenced on existing documentation.

F. Adjacent streets, including street names, centerline, and right-of-way boundaries. Widths of adjacent rights-of-way shall be noted.

G. Existing utilities, including franchised utilities located above or below ground and drainage facilities that transport surface water onto, across, or from the project site. The existing drainage pipes, culverts, and channels shall include the invert or flowline elevations.

H. Existing environmentally sensitive areas (e.g., gullies, ravines, swales, wetlands, steep slopes, estuaries, springs, wetlands, creeks, lakes, etc.). For natural drainage features, show direction of flow and 100-year flood plain boundary (if applicable).

I. Existing wells, sanitary sewer systems, septic tanks, and drainfields within the project boundaries. All known existing wells, sanitary sewer systems, septic tanks and drainfields within 250 feet of project boundaries, to the extent possible with the adjacent property owner's cooperation. Describe abandonment procedure.

J. Existing fuel storage tanks.

2.2.1.7 DRAINAGE IMPROVEMENT PLANS

Plans for proposed drainage improvements shall include the following:

A. Finished grades. Show the extent of cuts and fills by existing and proposed contours, profiles, and/or other explicit designations.

B. Existing structures to be removed.

C. Proposed structures including roads and road improvements, parking surfaces, building footprints, walkways, landscape areas, etc. Lines, grades, and gradients to the nearest tenth of a foot of proposed public roadways shall be shown.

D. Proposed lot boundaries, tracts, and easements. Also, proposed changes to project boundaries, jurisdictional boundaries, and rights-of-way boundaries.

E. Proposed utilities, showing line and grade to the nearest tenth of a foot of all proposed utilities at crossings with the proposed drainage system.

F. Proposed sanitary sewers, septic tanks, drainfields, and water systems.

G. Proposed fuel storage tanks.

H. Setbacks from existing environmentally sensitive areas.

I. Proposed drainage structures, including pipes, open channels, culverts, ponds, vaults, biofiltration swales, infiltration facilities, outfalls, rip rap treatment, energy dissipaters, etc.

J. Plan views of drainage conveyance facilities for which there is no accompanying profile view shall include the following information: pipe sizes, pipe types and materials, lengths of runs, gradients and locations to the nearest tenth of a foot of pipes or channels, structure identifier (e.g., catch basin/manhole number), type of structure (e.g., Type 2 CB), exact location of structures (e.g., station and offset mainline stationing and/or street centerline stationing, or dimensioning to the nearest tenth of a foot, invert elevations in/out of structures to the nearest tenth of a foot, and top elevations of structures to the nearest tenth of a foot. Notes shall be included referencing details, cross-sections, profiles, etc.

K. Locations of all gutter or ditch flowlines, including flow arrows indicating direction of flow.

L. If a roadway system with curbs is proposed in a proposed or existing public right of way, profiles to the nearest tenth of a foot for the following items will be a part of the plan set:

1) Curb returns with elevations shown for the BCR (PC), ECR (PT), quarter points and any low point. Should the roadway section be warped in the vicinity of the BCR or ERC to manipulate the low point location (sometimes done to move a catch basin location away from a handicap ramp), this area of warping will also be shown in this profile. Straight-line segment between data point profiles will be allowed, as they should communicate the design intent. Station equations relative to street centerline stationing shall be shown for the BCR (PC) and ECR (PT).

2) Cul-de-sacs and knuckles with elevations shown for the BCR (PC), ECR (PT), any low point and at a 25-foot intervals along the curve. Station equations relative to street centerline stationing shall be shown for the BCR (PC) and ECR (PT).

3) Pavement spot elevations within some major intersections may be necessary.

4) Alignment data for proposed roadways (Centerline bearings and distances, curve data, and other pertinent data).

M. Indicate any proposed phasing of construction.

2.2.1.8 PLAN AND PROFILE.

In existing and proposed rights-of-way, drainage conveyance facilities shall be shown in profile view. Combining this information with the roadway plan and profile information is acceptable in many cases. Profile views shall be located below the plan view on the same sheet and include:

A. Existing and finish grades.

B. Proposed drainage pipes, channels and structures.

C. Existing underground utilities where such utilities cross proposed drainage facilities.

D. Profile views shall include the following information:

   1) Pipe sizes,

   2) Pipe types and materials,

   3) Lengths of runs, gradients, and exact locations of pipes or channels to the nearest tenth of a foot,

   4) Structure identifier (e.g., catch basin/manhole number),

   5) Type of structure (e.g., Type 4A Inlet),

   6) Exact location of structures (e.g., station and offset mainline stationing and/or street centerline stationing, or dimensioning to the nearest tenth of a foot,

   7) Invert elevations in/out of structures, and top elevations of structures.

   8) In order to minimize duplication of information where plan and profile views appear on the same sheet, drainage facility information provided in the plan view can be limited to the following: structure identifier, type of structure, pipe types and materials, and lengths of runs.

E. Where practicable, the stationing of the plan view should line up vertically with the stationing of the profile view.

2.2.1.9 CONSTRUCTION NOTES.

Construction notes shall appear on drainage plans. These notes shall include, as a minimum, the Drainage Notes included in Appendix 2-1.

2.2.1.10 DRAINAGE STRUCTURE DETAILS.

Details shall be provided for all proposed drainage structures for which there is insufficient information in the plan view.

2.2.1.11 GRADING PLAN.

A detailed grading at 1 inch = 20 feet shall be provided for all open stormwater quantity control and/or quality control facilities. This plan shall include the following:

A. Current ground contours (screened) and proposed ground contours at a minimum of a 2-foot contour interval. Slopes steeper that six horizontal to one vertical (6h:1v) shall be identified.

B. Location of top and toe of slope.

C. Limits of embankment designed to impound water.

D. Location of all drainage structures as well as any other piped utilities in vicinity.

E. Flow route of the secondary/emergency overflow system.

F. Show maintenance access, as applicable.

2.2.1.12 LANDSCAPE PLAN.

A detailed landscape plan, at 1 inch = 20 feet shall be provided for open stormwater quantity control and/or quality control facilities. This plan may be combined with the detailed grading plan. See Chapter 4 for further guidance on landscaping. This plan shall include the following:

A. Landscape plans for publicly maintained stormwater facilities shall be prepared by, stamped with the seal of, and signed by, a Landscape Architect, registered in the State of Oregon. Plans for privately maintained stormwater facilities do not require the involvement of a Landscape Architect.

B. Final ground contours at a minimum of a 2-foot contour interval.

C. Location of top and toe of slope.

D. Limits of embankment designed to impound water.

E. Location of all drainage structures as well as any other piped utilities in vicinity (screened).

F. Limits of areas to receive amended topsoil.

G. Show location of maintenance access, as applicable.

2.2.1.13 CROSS SECTIONS

Cross sections shall be provided for at least the following:

A. Roadways, including access roads.

B. Detention/retention ponds (including parking lot ponds and other multi-use facilities), wet ponds, and sediment ponds. This cross section(s) shall graphically illustrate to the nearest tenth of a foot for elevations:

   1) The maximum water surface elevation for the 2-year and 25-year design storms.

   2) The proposed dead storage water surface elevation (as applicable).

   3) Pavement section or amended soil section as applicable.

C. Proposed ditches and swales, including biofiltration swales.

2.2.2 Plan Sets

Two sets of plans shall be submitted for plan review. Six sets of plans shall be submitted for final approvals. "Blacklines" (a photocopy process on bond) is preferred for submittals over "bluelines" (a diazo process) to allow the City to recycle plans. For final approvals, one plan set shall bear a wet ink signature of the Professional Engineer whom prepared the plan.

2.3 DRAINAGE REPORT

2.3.1 Format Requirements.

The Drainage Report shall be submitted to the Engineering Division on 8-1/2 inch x 11 inch paper and maps shall be folded to an 8-1/2 inch x 11 inch size unless another format is approved prior to submittal.

2.3.2 Preparation Requirements.

A. The Professional Engineer preparing the Drainage Report shall ensure the Report matches and accounts for the design displayed on the grading and drainage construction plans.

B. The Drainage Report shall be prepared by and bear the seal and original signature of a Professional Engineer registered in the State of Oregon and shall contain the following information:

1) Cover Sheet, including the project name, City's planning file number, proponent's name, address and telephone number, Project Engineer, and date of submittal.

2) Table of Contents, showing the page numbers for each section of the report, including exhibits, appendices and attachments.

3) Vicinity Map.

4) Project Description: Describe the type of permit(s) for which the proponent is applying, the size and location of the project site, address or parcel number and legal description of the property, property zoning, etc. Also describe other permits required (e.g., Joint Oregon Division of State Lands/Corps of Engineers 404 Fill Permit, NPDES 1200 c permit, DEQ permits, etc) and submit application summaries. Describe the project, including proposed land use, proposed site improvements, proposed construction of impervious surfaces, proposed landscaping, etc.

5) Existing Conditions:

a. Describe existing site conditions and relevant hydrological conditions including but not limited to:

i. Project site topography;

ii. Land cover and land use;

iii. Abutting property land cover and land use;

iv. Offsite drainage to the property;

v. Natural and constructed channels;

vi. Creeks, lakes, ponds, wetlands, ravines, gullies, steep slopes, springs and other environmentally sensitive areas on or adjacent to the project site

vii. Boundaries of mapped Water Quality Resource Areas and Flood Management Areas.

b. The location of any known wells both "of record" and others on the project site and on adjacent property within 250 feet of the project boundaries; the location of any existing fuel tanks, in-use or abandoned, within the project boundaries.

c. General soils conditions present within the project site.

d. Whether or not the project site is located in a groundwater sensitive area (reference reports); existing natural and manmade drainage facilities within and immediately adjacent to the project site.

e. Points of discharge for existing drainage from the project site.

f. Include references to relevant reports such as basin plans, flood studies, groundwater studies, wetland designation, water quality resource areas designation, sensitive area designation, environmental impact statements, lake restoration plans, water quality reports, etc. Where such reports impose additional conditions on the Proponent, those conditions shall be included in the report.

6) Developed Site Drainage Conditions: Describe the land cover resulting from the proposed project; describe the potential stormwater quantity and quality impacts resulting from the proposed project; describe the proposal for the collection and conveyance of site runoff from the project site, for the control of any increase in stormwater quantity resulting from the project, and for the control of stormwater quality.

7) Drainage Basin Description: Describe the drainage basin(s) to which the project site contributes runoff, and identify the receiving waters for each of these drainage basins.

8) Description of upstream basins, identifying any sources of runoff to the project site. This should be based on a field investigation. Any existing drainage or erosion problems upstream, that may have an impact on the proposed development, should be noted.

9) Downstream Analysis

a. Define and physically verify the study area. The upstream portion of the study area shall encompass the entire tributary drainage area (the area that drains to the proposed project site). The remaining portion of the study area shall extend downstream of the proposed project discharge location to a point on the drainage system where the proposed project site constitutes 15% or less of the total tributary area. This downstream distance shall not be less than ¼ mile.

b. On a map (minimum USGS 1:24000 Quadrangle Topographic Map, recommended: City Topographic Base Maps) delineate the study area, together with the drainage system onto and from the proposed site.

c. Describe in narrative form observations regarding the makeup and general condition of the drainage system.

d. Include such information as pipe sizes, channel characteristics, and stormwater facilities.

10) Soils Report(s), where applicable.

11) Hydrological Analysis

12) Basin Maps(s), showing:

a. Boundaries of project,

b. Any offsite contributing drainage basins,

c. On-site drainage basins,

d. Approximate locations of all major drainage structures within the basins, and

e. Depict the course of stormwater originating from the subject property and extending all the way to the closest receiving body of water.

f. Reference the source of the topographic base map (e.g., USGS),

g. The scale of the map, and

h. Include a north arrow.

13) Hydraulic Design Computations, supporting the design of ALL proposed stormwater conveyance, quantity and quality control facilities, and verifying the capacity of existing and proposed drainage facilities. These computations shall include capacity and backwater analysis when required either as part of the proposed drainage design or as a part of the downstream drainage investigation. These computations shall also include flood routing computations when required for the design of detention/retention storage facilities, for wetland impact analysis, or for flood plain analysis. A description on how the stormwater system will function during the water quality storm, 2-year storm, 25-year storm, and the 100-year storm shall be included. Calculations for the 100-year storm will not be required.

14) Erosion and sediment control.

15) Maintenance Strategy - a narrative discussion addressing the operation and maintenance needs of the proposed stormwater quantity control and quality control facilities.

16) Landscape Plan - a narrative discussion about plant material selection and goals these materials will accomplish (for instance shading, aesthetics, and temperature control).

17) Operation and Maintenance Manual: Required for stormwater quantity and quality control facilities. Two copies of this manual shall be sent to the City for public facilities. This manual will be an attachment to the maintenance covenant for privately owned and maintained facilities; see Appendix 2-3 for an example maintenance covenant. The manual may be included in the drainage report as an option.

18) Appendices: Shall include technical information such as, but not limited to:

a. Rational Method Calculations for Proposed Stormwater Conduit Sizing
b. Inlet Sizing/Spacing (street flooded width calculations as required)
c. Calculations for Proposed Stormwater Detention Facility Design
d. Data on the pre-developed hydrograph, post-developed hydrograph and outflow hydrograph to/from the detention facility.
e. Time of concentration calculation(s),
f. Data on the stage/storage/discharge presented in a tabular format
g. Level pool routing analysis
h. Energy Dissipater Calculations
i. Down Stream Analysis (as required)

Two copies of the drainage report shall be submitted for each review.

Appendix 2-2 contains a sample copy of a drainage report format for a development project.

APPENDIX 2-1

Standard Plan Notes

- General Notes
- Storm Drain Notes
- Engineered Grading Notes
- Lot Grading Notes

City of Cascade Locks Stormwater and Grading Design Standards

General Notes

1. All work and materials shall conform to latest edition of the Oregon Standard Specifications for Construction.

2. Contractor shall obtain all required permits and licenses before starting construction. A City business license is required, if the City has enacted one.

3. It shall be the responsibility of the contractor to verify all utility locations prior to construction and arrange for the relocation of any in conflict with the proposed construction. The locations, depth and description of existing utilities shown were compiled from available records and/or field surveys. The engineer or utility companies do not guarantee the accuracy or the completeness of such records. Additional utilities may exist within the work area.

4. Oregon law requires that the rules adopted by Oregon Utility Notification Center be followed. Those rules are set forth in OAR 952-001-0090. You may obtain copies of the rules by calling the center or accessing via internet at http://www.oregon.gov/. Call before you dig – 503-246-6699.

5. The contractor shall make provisions to keep all existing utilities in service and protect them during construction. Contractor shall immediately repair or replace any damaged utilities using materials and methods approved by the utility owner. No service interruptions shall be permitted without prior written agreement with the utility provider.

6. All water line crossings shall be in conformance with OAR Chapter 333. The City may require more stringent standards.

7. Contractor shall notify Project Engineer and the City of Cascade Locks' City Engineer 48 hours in advance of starting construction and 24 hours before resuming work after shutdowns, except for normal resumption of work following Saturdays, Sundays, or holidays.

8. Contractor shall remove and depose of trees, stumps, brush, roots, topsoil, and other material in the roadway and where indicated on the plans. Material shall be disposed of in such a manner as to meet all applicable regulations.

9. Construction vehicles shall park on the construction site or at a location(s) indicated on the approved plan. Hours of construction shall be 7 AM to 6 PM, Monday through Friday; 9 AM to 6 PM Saturday. Construction is prohibited on Sunday. Construction activities include all field maintenance of equipment, refueling, and pick up and delivery of equipment, as well as the actual construction activity.

10. The contractor shall submit a 15% Maintenance Guarantee as required by the City of Cascade Locks.

11. The contractor shall keep an approved set of plans on the project site at all times.

12. Upon completion of construction, the contractor shall submit "redline drawings" to Project Engineer for preparation of record drawings. "Redline drawings" document all deviations and revisions to the approved plans; they also record a description of construction materials actually used (pipe material, etc.). From the information contained on these redline drawings, as well as any notes recorded by the Project Engineer, the Project Engineer shall prepare and submit record drawings (on 4 mil mylar). Record drawings are required for any public improvements, as well as for any (public or private) stormwater quantity or quality control facility. City acceptance of any public improvements shall also have electronic record drawings submitted to the City in compliance with the digital mapping requirements.

13. Contractor shall erect and maintain traffic control per the "Manual on Uniform Traffic Control Devices," Part VI, Construction and Maintenance, as adopted and modified by ODOT. Should work be in an existing public right of way that are open to traffic, the contractor shall submit a traffic control plan to the appropriate City, County, and State personnel for approval. Approvals shall be obtained prior to start of work.

14. The contractor shall perform all work necessary to complete this project in accordance with the plans and specifications, including such incidentals as may be necessary to meet the intent of the project contract documents, applicable agency requirements and other work as necessary to provide a complete project.

15. There shall be no alteration or variance from the approved plans. The minimum submittal requirements for plan revisions are as follows: plan revisions shall be submitted on an 8 ½ inch by 11 inch sheet (minimum); plan revision shall be wet stamped and signed by Project Engineer; any required engineering calculations, or other agency approvals, shall be included with the submitted revision. Upon approval of the submitted revisions, the City Engineer shall affix an approval stamp to the revised plan sketch and the plan shall be returned to the Project Engineer. It is the responsibility of the Project Engineer to distribute the approved plan revision to all parties to whom the original approved plans were issued. All approved revisions shall be affixed to the construction field prints (also known as the contractor's redline drawings").

16. Contractor shall provide effective erosion protection to include, but not limited to, grading, ditching, hay bales, silt fencing, and sediment barriers to minimize erosion and impact to adjacent property. See erosion and sediment control notes and plan.

17. Open trenches shall be strictly limited to a maximum of 100 linear feet within street right-of-ways unless limited to a lesser amount by permit. No trenches will be allowed to remain open overnight.

18. Contractor shall maintain and coordinate access to all affected properties.

19. Any pavement distortion caused by the construction operations shall be temporarily repaired the same day of occurrence (or in a time period agreed to with the City), using cold

or hot A/C mix. Owner/contractor shall be required to maintain repaired areas until City final acceptance is granted.

20. If ground water springs are encountered during construction, the contractor shall immediately contact the Project Engineer. The Project Engineer shall direct the contractor to take measures to ensure that water is not conveyed through utility trenches and the natural flow path of the spring is altered as little as practicable. The Project Engineer shall submit a report summarizing the findings to the City. Impacts and mitigation shall be addressed for City approval.

21. It is the contractor's responsibility to visit the site and verify all existing conditions before the start of work. The contractor shall take all necessary field measurements and otherwise verify all dimensions and existing construction conditions indicated and/or shown on the plans. Should nay error or inconsistency exist, the contractor shall not proceed with the work affected until reported to the Project Engineer for clarification or correction.

22. Any inspection by the City County, State, Federal Agency or Project Engineer shall not, in any way, relieve the contractor from any obligation to perform the work in compliance with the applicable codes, regulations, city standards and project contract documents.

23. Project plans shall always have an engineer of record performing the function of Project Engineer. If the Project Engineer is changed during the course of work, the City shall be notified in writing and the work shall be stopped until the replacement engineer has agreed to accept the responsibilities of the Project Engineer. The new Project Engineer shall provide written notice of accepting project responsibility to the City within 72 hours of accepting the position of Project Engineer.

Storm Drain Notes

1. Pipe Rules:
   a. Ten-inch diameter pipe or smaller shall be PVC storm drain pipe conforming to either ASTM D-3034, or seamless PVC pipe conforming to ASTM F794, unless otherwise noted on the approved plans. Concrete pipe conforming to ASTM C-14, Class 3 is also acceptable. Watertight gaskets are required on all pipe sizes.

   b. Twelve-inch through 48-inch diameter pipe (for storm drain pipe – but not for culverts) may be one of the following, unless otherwise noted on the approved plans:

      - Class V reinforced concrete pipe, conforming to ASTM C-76. Water tight joints required. When used in public right-of-way, there must be one-foot minimum cover from roadway subgrade.

      - Ductile Iron: Class 50 wall thickness for pipe sizes up to 12 inches; Class 51 wall thickness for 14 inch and larger. Water tight gaskets required. When used in public right-of-way, there must be one-foot minimum cover from roadway subgrade.

      - Corrugated high-density polyethylene pipe (HDPE), smooth interior, ADS N-12 or equivalent, maximum 30-inch diameter, conforming to AASHTO M294. Water tight gaskets required. When used in public right-of-way, there must be two-foot minimum cover from roadway subgrade. Concrete headwalls/treatments are required for any exposed ends.

      - Polyvinyl chloride (PVC), seamless, sewer pipe (SDR 35, meeting requirements of ASTM D3034, ASTM F-794, AWWA C-900, AWWA C-904). Water tight gaskets required. When used in public right-of-way, there must be two-foot minimum cover from roadway subgrade. Concrete headwalls/treatments are required for any exposed ends.

   c. Perforated pipe shall be HDPE pipe, conforming to AASHTO M294 or PVC pipe conforming to either ASTM D3034 or ASTM 2729, unless otherwise noted on the approved plans.

   d. Culvert pipe shall be Class V reinforced concrete pipe, conforming to ASTM C-76, unless otherwise noted on the approved plans. When used in public right-of-way, there must be one-foot minimum cover from roadway surface.

2. All trench excavation shall conform to the requirements of the latest edition of the Oregon Standard Specifications for Construction. All excess material from the trench excavation shall be disposed of on an approved site.

3. Pipe bedding and pipe zone material shall conform with granular bedding and backfill requirements of the latest edition of the Oregon Standard Specifications for Construction and the ODOT Standard Drawings, and shall be ¾"-0" crushed rock, Class B.

4. Trench backfill shall meet the requirements of the latest edition of the Oregon Standard Specifications for Construction and the ODOT Standard Drawings.

5. Trench compaction shall be per the latest edition of the Oregon Standard Specifications for Construction and the ODOT Standard Drawings.

6. Manholes walls shall be precast reinforced concrete manholes of the size required per manufacturer's recommendations for the pipe sizes and number of openings.

7. Box culvert shall be precast reinforced box culvert sections meeting the requirements of ASTM C-850, unless otherwise noted on the approved plans.

8. If drainage field tile is encountered during construction, the contractor shall notify the Project Engineer and the City's Inspector. The intent will be to connect any functioning drain tile system to the storm drain system in an appropriate manner. Such connection must be noted on the as-built drawings and must be approved by the Project Engineer, as well as the City's Inspector.

9. All house service stubouts shall be a minimum of three (3) feet beyond easement or right-of way line and to be marked with a pressure treated 2 x 4, painted white with the label of "Future STM" for future location. Service stubouts to be a minimum of 4-inch diameter pipe at minimum slope of 1%. Tracer wire shall be installed with service bulbouts.

10. All manhole rims not in pavement areas, and not in the roadway right-of-way of a paved road, shall be set six (6) inches above finished grade. They shall have a cast iron manhole frame and cover grouted to just under the top of the frame. Cover shall be bolted down with a minimum of two stainless steel bolts.

11. All materials inspections and tests are to be in accordance with the latest edition of the Oregon Standard Specifications for Construction. All sections failing to pass the required tests and inspections shall locate and repair. After repair these sections shall be retested and inspected until found acceptable by the City.

12. All public storm drain piping shall be video inspected by the contractor per latest edition of the Oregon Standard Specifications for Construction and submitted to the City Engineer with a written report. Before acceptance by the City, pipe shall be shown clear of any debris, rocks, gravel, sand, silt and other foreign material, as well as having the final course of A/C pavement in place within the pipe's tributary drainage area.

Engineered Grading Notes

1. Project grading limits shall be within the project's property boundary and/or street righ-of-way, unless otherwise shown on the plans. No grading shall be conducted in wetlands or other environmentally sensitive areas unless specifically shown on the approved plans.

2. The identification or removal of unsuitable material shall be done with consultation with the Project Engineer or the project's Geotechnical Engineer.

3. Remove and dispose of all organic and/or unsuitable materials, including trees, stumps, roots, brush, and grass in such a manner to meet all applicable regulations. On-site disposal shall be of as determined by the Project Engineer or the project's Geotechnical Engineer.

4. Stockpile excess soil material on-site as directed by the Project Engineer, the project's Geotechnical Engineer, or approved plans; unless approved plans identify excess excavation is to be removed from the site.

5. The contractor shall protect all trees not specifically shown to be removed on the approved plans.

6. Grade the site to the elevations shown on the drawing with the necessary adjustments to accommodate the finishes as specified. Shape future paved areas per the plans to a subgrade elevation that will accommodate future base rock and paving.

7. Straight grades shall be run between finish grade and/or finish contour lines shown, unless otherwise noted. Finish grades are to drain as indicated on the plans. Rough grading shall be finished by blading and raking to reasonable smooth contours with gentle transitions.

8. All cut or fill slopes shall be constructed at no steeper than four (4) horizontal to one (1) vertical unless otherwise shown on the approved plans.

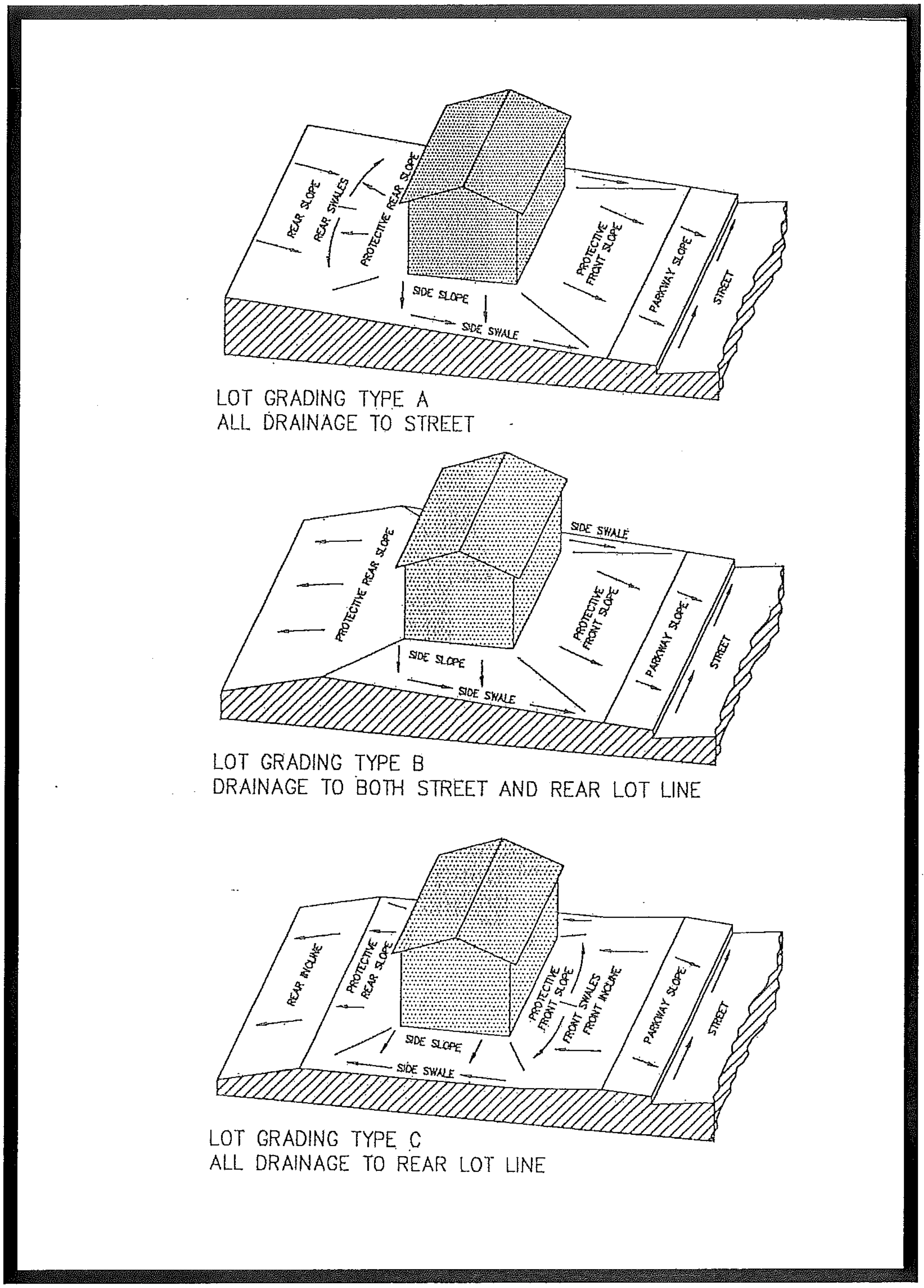
9. Areas to receive fill materials shall be prepared by removing all organic and unsuitable materials and "proof rolled." Benching may be required. Material in soft spots within a proposed building envelope, paved area, or sidewalk area shall be removed to the depth required (as directed by the Project Engineer or the project's Geotechnical Engineer) and shall be replaced with suitable backfill.

10. The construction of structural fills and/or excavations with any public improvements shall be in accordance with the written recommendations made by the project's Geotechnical Engineer in an approved report.

11. Compaction tests and reports for each lot shall be conducted by an approved testing laboratory; test frequency shall be per the Project Engineer or the project's Geotechnical Engineer. Testing to commence with fill activities and as a minimum, one test will be taken for every 500 cubic yards placed.

12. If dusty conditions exist, the Contractor shall apply a fine spray of water on the surface to control the dust.

13. Engineered fill in the building envelope shall be certified by the Project Engineer. This certification shall be sent to the City's building official upon submission of the building permit if it has not already been received by the City's building official.



Lot Grading Examples

LOT GRADING

LEGEND

——————>	DRAINAGE ARROW
▭	BUILDING ENVELOPE
Ⓒ	LOT GRADING TYPE
3	LOT/PARCEL NUMBER
T.F. 451.3	TOP OF FOUNDATION ELEVATION
T.C. 448.84	TOP OF CURB ELEVATION
F.G. 449.1	FINISHED GRADE (GROUND)
F.G. 449.16	FINISHED GRADE (CONCRETE/ASPHALT)
449.1	EXISTING GRADE (GROUND)
451.36	EXISTING GRADE (CONCRETE/ASPHALT)
- - - - - -	EXISTING CONTOUR LINE

DRAWN			City of Cascade Locks Department of Public Works 140 SW WaNaPa. Cascade Locks. OR 97014	SCALE
ENGR				DATE
REV.	DATE	APPR		APPR
			LOT GRADING LEGEND	DWG.NO. LEGEND

Lot Grading Notes

1. Grading of residential lots shall be per the City's development standards.

2. Final lot grading is the responsibility of the individual permit holder/owner unless otherwise noted.

3. The building envelopes shown are generic.

4. The "lot grading control line" is the critical path to determine the top of foundation elevation based on:

a.	Parkway Slope	2%
b.	Swale	1% minimum, 4% maximum
c.	Protective Slope	Minimum of 6 inches within first 10 feet of building
d.	Top of Foundation	Minimum of 12 inches above finished ground elevation
e.	Driveway Slope	14% maximum recommended
f.	Change in Driveway Grade without a Vertical Curve	14% maximum for any ten-foot distance

5. Applicable recommended erosion control measures from the latest edition of the Oregon Standard Specifications for Construction are required and shall be constructed and maintained to ensure minimum erosion and siltation during the course of work.

6. Any change to this lot grading plan must be approved by the engineer of record and resubmitted to the City Engineer for review and approval.

7. No foundation inspection will be scheduled without a city-approved lot grading plan.

8. The top of foundation elevation (TFE) is the elevation of the point on the top of foundation which is 18 inches above the highest point on the adjoining drainage path as depicted by drainage arrows on the approved Residential Lot Grading Plan. Stepdown of the foundation is allowable but there must be a minimum of 18 inches vertically between all points of the top of foundation and the adjoining path.

9. Designers shall use the Lot Grading Legend as a guide for items required on the Lot Grading Plan.

APPENDIX 2-2

Sample Drainage Report Format For a Development Project

City of Cascade Locks Stormwater and Grading Design Standards

Sample Drainage Report Format
For a Development Project

The Text of the Report

1.0 Purpose of This Report

A typical purpose statement might read: "The purpose of this report is documentation of the criteria that the facility was designed to meet, the sources of information upon which it is based, the design methodology, and the results of this analysis."

2.0 Project Location/Description

3.0 Regulatory Design Criteria

3.1 The stormwater quantity management criteria

3.2 The stormwater quality management criteria

3.3 Flood plain

(Note: If project is located within a regulatory flood plain, flood plain analysis may be required.)

4.0 Summary of Stormwater Detention Results

Describe interest point location where values calculated below were modeled.

Design Storm	Target Release Rate Pre-developed conditions	Release Rate Without the Proposed Stormwater Detention Facilities Post-developed conditions	Release Rate With the Proposed Stormwater Detention Facilities Post-developed conditions
2-year			
5-year			
25-year			

5.0 Sources of Information or References to Relevant Reports

6.0 Design Parameters

6.1 Design Storm

6.1.1 For stormwater detention facility design

6.1.2 For proposed stormwater conduit and inlet spacing/sizing

6.2 Pre-developed site topography and land use

(Note: All the area within the legal property line of the development as well as the drainage area tributary to the development must be addressed in this report.)

6.3 Soil type (pre-developed)

6.4 Post-developed site topography and land use

6.5 Description of off-site contributory basins

7.0 Calculation Methodology

7.1 Proposed stormwater conduit sizing and inlet spacing.

(A common method is to use the Rational Method analysis to obtain peak flow rate followed by application of the Manning's equation to the proposed geometry and slope. For culverts, a culvert analysis is required. Where a tailwater condition exists, a backwater analysis is required.)

7.2 Proposed stormwater quantity control (detention) facility design

7.2.1 Design steps for stormwater detention design

- Determine the target release rate(s).

  (A description of input parameters, how calculation was done and the results.)

- Calculate a post-developed stormwater runoff hydrograph tributary to stormwater detention facility.

  (A description of input parameters, how calculation was done and the results.)

- Develop a detention facility design that will attenuate the peak of the post-developed stormwater runoff hyrograph to below the target release rate.

- Verify and document the facility design.

  (A description of how this was done. A typical description might read something like: "Using the HYD v4.xx computer program developed and released by the King County Washington Department of Public Works, a data set containing stage / storage / discharge information was generated and the post-developed stormwater runoff hydrograph was routed via a level pool routing analysis." Documentation on how the stage / storage / discharge information was calculated and the computer run of the analysis is contained in Chapter 4.)

7.3 Proposed Stormwater Quality Control Facility Design

7.3.1 Design steps for stormwater quality control design

- Determine the water quality storm discharge rate to the facility.

  (A Description of input parameters, how calculations were done, and the results.)

- Determine the volume of the water quality storm discharge to the facility.

7.4 Energy Dissipater Calculations

7.5 Down Stream Analysis

7.6 Culvert Analysis

8.0 Proposed Stormwater Quantity Control (detention) Facility Operation

Describe the proposed stormwater quality control (detention) facility operation during the applied design storm and how this proposed facility complies with the criteria shown in the stormwater manual.

9.0 Proposed Stormwater Quality Control Facility Operation

Describe the proposed stormwater quality control facility operation during the applied water quality storm and how this proposed facility complies with the criteria shown in the stormwater manual.

10.0 Stormwater Detention Pond Safeguards

Describe the stormwater detention pond safeguards. For instance, discuss the function of the secondary spillway and/or safe overflow routes in the event the flow control device for the detention facility becomes plugged. Include a discussion on what happens during a 100-year design storm event.

Exhibits

Vicinity Map .... Exhibit EX1

Drainage Area Exhibit(s) .... Exhibit EX2

Showing:

- Proposed stormwater system layout
- Subcatchment areas, (include any offsite area that is tributary to the site drainage)
- Flow path used for the Time of Concentration (Tc) calculation(s)
- Flood Plains (if any)
- Pre-development and post-development impervious areas
- Boundaries of mapped water quality and flood management areas as well as the mapped fish and wildlife habitat conservation areas .... Exhibit EX2
- Existing water resource features on or adjacent to site including streams, wetlands springs, and stormwater facilities

Copy of Soil Survey of Cascade Locks Area showing proposed site......................... Exhibit EX3

Copy of other relevant maps showing the proposed site .... Exhibit EX4

Appendices

Rational Method Calculations for Proposed Stormwater Conduit Sizing and Inlet Sizing/Spacing (street flooded width calculations as required)............................Appendix 1

Calculations for Proposed Stormwater Detention Facility Design (a plot showing the pre-developed hydrograph, post-developed hydrograph and outflow hydrograph from the detention facility is helpful. Also include time of concentration calculations, and stage/storage/discharge calculations to the stormwater detention facility)..Appendix 2

Copy of Stormwater Quality Control Calculations (as required) ....Appendix 3

Energy Dissipater Calculations (as required) ....Appendix 4

Down Stream Analysis (as required)..Appendix 5

Culvert Analysis (as required) ....Appendix 6

Attachments

Construction Drawings

APPENDIX 2-3

Sample Maintenance Covenant

City of Cascade Locks Stormwater and Grading Design Standards

After Recording, Return To

____

____

____

____

MAINTENANCE COVENANT AND ACCESS EASEMENT

THIS MAINTENANCE COVENANT AND ACCESS EASEMENT ("Agreement") is made this ____________day of _____________ 20__, between ____________________________, a _______________________ ("developer"), and the CITY OF CASCADE LOCKS, a municipal corporation of the State of Oregon formed pursuant to ORS chapter 457 (the "City").

RECITALS

A. Developer is the owner and developer of certain property located in the City of Cascade Locks, Hood River County, Oregon, legally described on Exhibit A attached hereto and commonly known as _______________________________ (the "Development").

B. The City has approved construction plans submitted by Developer for the Development. The Development contains on-site stormwater facilities as described in the approved construction plans (together with any other stormwater facilities that may hereafter be constructed on the Development, the "Stormwater Facilities").

C. To protect future lot owners in the Development, owners of neighboring property, and their property, the City has required that Developer enter into this Agreement as a condition to the City's approval of construction plans and the final plat for the Development.

AGREEMENT

NOW THEREFORE, for good and valuable considerations, the receipt and sufficiency of which are hereby acknowledged, the City and Developer agree as follows:

1. **Covenant to Maintain and Repair.** Developer shall, at its sole expense, itself or through qualified independent contractors, at all times maintain the Stormwater Facilities in good

working order, condition and repair, clear of all debris, and in compliance with all applicable state and local rules, regulations, and guidelines (including those adopted from time to time by the City and including the City's Stormwater and Grading Design Standards). Developer shall notify the City in writing of the person responsible for compliance with Developer's obligations under this covenant ("Developer Designee"), and of any change in the Developer Designee. Developer expressly agrees that the Developer Designee shall have the authority to bind Developer, its successors and assigns with respects to the matters described in this Agreement.

2. **Failure to Perform Covenant; Easement.** If the City determines that Developer is not in compliance with the covenant described in Section 1, except in the case of emergency, the City or its designee shall give the Developer Designee written notice to perform the maintenance and/or repair work specific in notice. If such is not performed to the City's satisfaction within seven (7) days after the date of such notice, Developer hereby grants to the City, their employees, independent contractors and designees the right to enter the Development to perform and all work required to bring the Stormwater Facilities into compliance with Section 1.

If the City determines that Developer is not in compliance with the covenant in Section 1 and determines that there exists or will likely exist an emergency on or about the Development with respect to the Stormwater Facilities, Developer hereby grants to the City, their employees, independent contractors and designees the right to enter the Development to perform any and all work required to bring the Stormwater Facilities into compliance with Section 1, and in such case the City shall use reasonable efforts to notify the Developer Designee prior to entering the Development. Notwithstanding the above, the work performed may consist only of cleaning and repairing Stormwater Facilities to their original condition and standards.

Developer hereby grants the City, their employees, independent contractors and designees a nonexclusive easement for ingress and egress over, across and under the Development for the purposes described above in this Section 2 and from time to time at the City's sole discretion to inspect, sample, and monitor components of the Stormwater Facilities and discharges therefrom.

DEVEOPER, FOR ITSELF AND ITS SUCCESSORS AND ASSIGNS (INLUDING ALL OWNERS OF LOTS IN THE DEVELOPMENT), AGREES THAT NONE OF THE CITY, THEIR EMPLOYEES, INDEPENDENT CONTRACTORS AND/OR DESIGNEES SHALL HAVE ANY OBLIGATION TO EXERCISE THEIR RIGHTS UNDER THIS SECTION 2 OR TO PERFORM ANY MAINTENANCE OR REPAIR OF THE STORMWATER FACILITIES, AND THAT NONE OF THEM SHALL HAVE ANY LIABILITY TO DEVELOPER OR ANY OF DEVELOPER'S SUCCESSORS OR ASSIGNS (INCLUDING OWNERS OF LOTS IN THE DEVELOPMENT) IN CONNECTION WITH

THE EXERCISE OR NONEXERCISE OF SUCH RIGHTS, THE MAINTENANCE OR REPAIR OF THE STORMWATER FACILITIES, OR THE FAILURE TO PERFORM THE SAME.

3. **Reimbursement.** If the City exercises its right to enter the Development pursuant to Section 2 (to include inspection, sampling, and monitoring), Developer shall reimburse the City for all of its costs and expenses incurred in connection therewith within thirty (30) days after receipt of an invoice. If Developer fails to pay the invoiced amount within such period, such amount shall thereafter accrue interest as a per annum rate equal to the prime rate of the U.S. Bank (or its successor) plus five percent (5%). Such amount, together with interest, shall be a lien on the Development (and each of the lots contained therein) which may be foreclosed in accordance with ORS Chapter 88. If the Development is owned by more than one person (i.e. multiple lot owners), each such owner shall be jointly and severally liable for payment in the amounts provided for in this Section 3.

4. **Indemnification.** Developer agrees to indemnify, defend (with legal counsel reasonably acceptable to the City), and hold harmless the City, their employees, independent contractors and designees harmless from and against any liability, losses, costs, expenses (including reasonable attorney fees), claims or suits arising from Developer's failure to perform its obligations under this Agreement or the exercise of the City, or their employees, independent contractors or designees of their rights under Section 2.

5. **Run with the Land.** The parties' rights and obligations contained herein shall run with the land and inure to the benefit of, and shall be binding upon, the City and Developer and their respective successors and assigns (including, without limitation, subsequent owners of lots in the Development and any homeowner's association owning common areas in the Development).

6. **Attorney Fees.** If legal action is commenced in connection with this Agreement, the prevailing party in such action shall be entitled to recover its reasonable attorney fees and costs incurred in the trial curt and in the appeal therefrom. The term "action" shall be deemed to include action commenced n the bankruptcy courts of the United States and any other court of general or limited jurisdiction.

7. **Assignment.** The obligations of Developer (and subsequent owners of lots in the Development) under this Agreement may not be assigned except (a) in connection with the sale of the property owned by such person (in which case the transferee will be deemed to assume

such obligations), and (b) with the prior written consent of the City to a homeowner's association that owns and maintains the common areas of the Development.

8. **Authority.** If Developer is an entity, the individual executing this Agreement on behalf of Developer represents and warrants to the City that he or she has the full power and authority to do so and that Developer has full right and authority to enter into this Agreement and perform its obligations under this Agreement.

IN WITNESS WHEREOF, Developer and the City have executed this instrument on the date first written above.

DEVELOPER:	THE CITY:
______________________________	CITY OF CASCADE LOCKS
By: ___________________________	By: ___________________________
Its: ___________________________	Title: _________________________

STATE OF OREGON)
)ss.
County of Hood River)

This instrument was acknowledged before me on ______________________, by ___________________________________, as ___________________________ of the City of Cascade Locks.

____
Notary Public for Oregon
My commission Expires ________

CHAPTER 3
GRADING, FILL, AND EXCAVATION

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CHAPTER 3 – GRADING, FILL AND EXCAVATION

3.1 GRADING STANDARDS

The following grading standards are intended as MINIMUM requirements for grading in The City of Cascade Locks. If circumstances create a hazard to life, endanger or adversely affect the use or stability of a public way, adjacent property, critical area (as defined in the permit), or drainage course, the City may impose additional or more stringent requirements.

3.1.1 Geotechnical Engineering Report

3.1.1.1 MINIMUM REPORT REQUIREMENTS

A Geotechnical Engineering Report, when required, shall include, as a minimum, the following:

A. Data regarding the nature, distribution and strength of existing soils, and

B. Conclusions and recommendations for grading procedures and/or erosion control measures, and

C. Design criteria for corrective measures when necessary, and

D. Opinions and recommendations covering a site's adequacy for further development, such as cut and fill slopes, existing slope, soil types, settlement, expansive soils, applicable and seismic conditions, and

E. Allowable bearing pressure, if applicable. Recommendations in the report shall be incorporated in the proposed plans or specifications, and

F. When the proposed work involves soils which may be excessively erodible or which may have limited compaction capability, due to the moisture content or the potential unsuitable nature of the material itself.

3.1.2 Excavations

Unless otherwise recommended in an approved geotechnical engineering investigation report, all excavations must comply with the following minimum requirements listed below.

A. Excavated slope faces shall be no steeper than is safe for the intended use and shall not be steeper than two-horizontal to one-vertical (2h:1v). Steeper slopes shall be allowed if supported by geotechnical analysis by a Professional Engineer and approved by the City.

B. During excavation, construction shall follow OSHA rules.

3.1.3 Fills And Embankments

Unless otherwise recommended in an approved Geotechnical Engineer investigation report, all fills and embankments must comply with the following minimum requirements shown in the section.

3.1.3.1 PREPARATION OF GROUND

A. Fill slopes shall not be constructed on natural slopes steeper than two-horizontal to one-vertical (2h:1v). The ground surface shall be prepared to receive fill by removing vegetation, non-complying fill, topsoil, and other unsuitable materials. The ground surface shall be scarified to provide a bond with the new fill.

B. The ground surface shall also be benched where natural slopes are steeper than four-horizontal to one-vertical (4h:1v) and the height is greater than 5 feet. This benching shall be into sound bedrock, glacial till or other competent material as determined by a Geotechnical Engineer. The bench under the toe of fill on a slope steeper than four-horizontal to one-vertical (4h:1v) shall be at least 10 feet wide. The area beyond the toe of fill shall be sloped for sheet overflow or a paved drain shall be provided. Refer to Section 00330.42 (a) (7) in ODOT Standard Specifications for guidance.

C. When fill steeper than four-horizontal to one-vertical (4h:1v) and higher than 5 feet is to be placed over an excavation, the Geotechnical Engineer shall certify that the foundation is suitable for the fill.

3.1.3.2 FILL MATERIAL

Organic material shall not be permitted in fills. No rock or similar irreducible material with a maximum dimension greater than 6 inches shall be buried or placed in fills.

> EXCEPTION: The City Engineer may permit placement of larger rock or similar irreducible material (e.g., concrete, etc.) when a Geotechnical Engineer properly devises a method of placement and continuously inspects its placement and approves the fill stability. The following conditions shall also apply:

A. Before issuance of a Fill Permit, potential areas for rock disposal shall be delineated on the grading plan.

B. Rock sizes greater than 6 inches in maximum dimension shall be 5 feet or more below grade, measured vertically.

C. Rocks shall be placed to assure filling of all voids with well-graded soil.

3.1.3.3 COMPACTION

All fills and embankments shall be compacted according to Table 3-1. Fills on sites of proposed structures shall be compacted as directed by the City in accordance with the most current edition of the Building Code required by the state of Oregon. Where the City Engineer requires testing of the compaction of soils outside public right-of-way, compaction shall be tested by an independent soil testing lab at the owner's expense.

3.1.3.4 SLOPE

The slope of fill surfaces shall be no steeper than is safe for the intended use and shall be no steeper than two horizontal to one vertical (2h:1v).

3.1.3.5 STRUCTURES

Fills which are intended to support structures shall be constructed in conformance with the most current edition of the Building Code required by the state of Oregon. An assignment of allowable soil-bearing pressures will be under the jurisdiction of the City in accordance with the most current edition of the Building Code required by the state of Oregon. If a fill is proposed over an area that the City deems to be a potential building site and the Applicant does not state an intent to construct buildings on the fill area at that time, then the City may, at its own discretion, require that a notice be recorded as a public record containing provisions which will include the nature and extent of the grading which has occurred on the parcel.

3.1.3.6 STORMWATER POND BERM EMBANKMENTS

The following guidelines below shall be considered (or addressed as applicable) in the Geotechnical Engineering Report.

A. Pond berm embankments shall be constructed on suitable native consolidated soil (or adequately compacted and stable fill soils), which is free of loose surface soil materials, roots and other organic debris. The embankment soils shall have the following minimum / maximum soil characteristics per the United States Department of Agriculture's Textural Triangle: a minimum of 30% clay, a maximum of 60% sand, a maximum of 60% silt, with nominal gravel and cobble content.

B. The pond berm embankment shall be constructed of compacted soil, (95% maximum dry density, per ASTM D1557) placed in 6-inch to 8-inch lifts with hand held equipment and 10-inch to 12-inch lifts with heavy equipment.

C. Pond berm embankments shall be constructed by excavating a "key" equal to 50% of the berm embankment cross-sectional height and width measured through the center of the berm except in bedrock where the "key" minimum depth can be reduced to 1 foot of excavation into the till.

D. Anti-seepage collars (similar to a pipe anchor wall, see Chapter 8) shall be placed on outflow pipes in pond berm embankments impounding water greater than 6 feet in depth.

E. Pond berm embankments 5 feet or less in height, including freeboard and as measured through the center of the berm, shall have a minimum top width of 5 feet. Pond berm embankments greater than 6 feet in height, as measured through the center of the berm shall be designed by the Geotechnical Engineer.

F. Where maintenance access is provided along the top of berm, the minimum width of the top of berm shall be 12 feet.

3.1.3.7 COMPACTION TESTING FREQUENCY

A. Testing of compaction shall be conducted by an independent, and approved testing laboratory. Test frequency shall be per the Project Engineer direction or at a frequency recommended in the Geotechnical Engineer Report. At a minimum, testing shall start at the commencement of fill activities and one test shall be taken for every 500 cubic yards (500 CY) placed.

B. Testing of compaction will be at the owner's/applicant's expense.

3.1.3.8 TOPSOIL FOR STORMWATER POND AND GRASSY SWALE

All public and private stormwater quantity and quality control facilities that are ponds or grassy swales shall incorporate topsoil, as discussed below, in the facility area.

A. General

1) The topsoil shall be a natural friable soil, possessing characteristics of representative productive soils from the construction site.

2) The topsoil shall be reasonably free from subsoil, clay lumps, stone, or similar objects larger than 1 inch in greatest diameter.

3) The topsoil shall also not contain brush, stumps, roots, nuisance plants, litter, excess acid or alkali, or any other material or substance which may be harmful to plant growth or a hindrance to subsequent smooth grading, and maintenance operations. If on-site topsoil meeting this description is not available, imported material meeting the above requirements shall be placed where required.

4) The purpose of the topsoil is to provide a proper planting medium, which is essential to the successful growth of the vegetation in the stormwater facility area.

B. Topsoil Excavation

1) Treat topsoil to be reused for landscape work with the minimum contact herbicide needed to kill existing grasses, weeds, and other perennial vegetation. Apply per manufacturers' printed instructions. Repeat application if necessary, to achieve full control and eradication of weeds. Do not apply during known periods of wet weather.

2) Do not excavate wet topsoil.

3) It is preferred that on-site topsoil and/or organic soils come from areas to be excavated, or which will receive engineered fill. Allowance shall be made for side slope fills. The depth of the on-site topsoil material is estimated to be 6 to 12 inches, however, this depth may vary. The soils engineer shall approve the depth of excavation. Stockpile quantity needed for backfill in landscape work.

C. Topsoil Placement

1) Topsoil fill shall be placed at grades and elevations shown on the drawings and to a lightly compacted thickness of a minimum depth of 12 inches. Fully incorporate topsoil

into subsoil by discing, tilling, hand spading, or other methods to minimum depth of 6 inches.

2) Use topsoil in a relatively dry state. Place during dry weather. Earthwork shall not be performed when satisfactory results cannot be obtained due to rain, freezing weather, or other unsatisfactory conditions.

3) Topsoil to be placed in all areas, including the bottom of the basin, and the dead storage area.

D. Soil Amendments

1) Amend topsoil by incorporating a minimum of 2 inches of compost into the top 6 inches of all topsoil by tilling.

3.1.4 Setbacks

Excavation and fill slopes shall be set back from site boundaries in accordance with this section. Setback dimensions shall be horizontal distances measured perpendicular to the site boundary.

3.1.4.1 Top of Cut Slopes

The top of cut slopes shall not be made nearer to a site boundary line than one-fifth of the vertical height of cut with a minimum of 2 feet and a maximum of 10 feet. The setback may need to be increased for any required interceptor drains.

3.1.4.2 Toe of Fill Slopes

The toe of fill slopes shall not be nearer to the site boundary line than one half the height of the slope with a minimum distance of 3 feet and a maximum of 20 feet. Where a fill slope is to be located near the site boundary and the adjacent off-site property is developed, special precautions shall be incorporated in the work as the City Engineer deems necessary to protect the adjoining property from damage as a result of such grading. These precautions may include but are not limited to:

A. Additional setbacks.

B. Provision for retaining walls.

C. Mechanical or chemical treatment of the fill slope surface to minimize erosion.

D. Provisions for the control of surface waters.

3.2 SOIL COMPACTION GUIDELINES

The following suggested compaction values are provided as a guide. Actual site conditions may warrant the use of different values. The recommendations that are found in a site specific Geotechnical Engineering Report will supersede the information provided below in Table 3-1.

TABLE 3-1: SOIL COMPACTION GUIDELINES		
Application	**ASTM D 1557** **Native Soils**	**ASTM D 698** **Min. Compaction Import Granular Fill**
Beneath Foundations	92%	95%
Beneath Floor Slabs	92%	95%
Base Rock Layer	---	95%
Beneath Pavement		
Base Rock Layer	---	95%
Within 3 feet of Grade	92%	95%
Below 3 feet of Grade	90%	90%
Utility Trench Backfill		
Upper 3 ft. Beneath Pavements, Slabs, or Structures	92%	95%
Below 3 Feet Beneath Pavements, Slabs, or Structures	90%	90%
In Landscaped Areas Above Pipe Zones	88%	88%
Random Site or Landscaping Fill	85%	---

Notes:
1) Where conflicts occur between values, the higher percentage shall govern.
2) Imported granular backfill shall be approved by the engineer prior to delivery.
3) Use lightweight, manually guided compactors within 3 feet of embedded walls.

CHAPTER 4
STORMWATER QUANTITY CONTROL FACILITIES

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CHAPTER 4 – STORMWATER QUANTITY CONTROL FACILITIES

4.1 HYDROLOGY AND DESIGN STRATEGIES

4.1.1 QUANTITY CONTROL

The minimum peak rate stormwater runoff control requirements are as follows:

- The post-development peak stormwater discharge rate from the development site for the 2-year, 24-hour duration design storm events shall at no time exceed fifty percent (50%) of the pre-development peak stormwater runoff rate for the same design storm event.
- The post-development peak stormwater discharge rate from the development site for the 10-year, 24-hour duration design storm events shall at no time exceed the pre-development peak stormwater runoff rate for the same design storm event.
- The post-development peak stormwater discharge rate from the development site for the 25-year, 24-hour duration design storm events shall at no time exceed the pre-development peak stormwater runoff rate for the same design storm events.
- Provide safe conveyance of the post-development peak stormwater discharge rate from the development site for the 100-year, 24-hour duration design storm event.

4.1.2 Computation Methods

A. Project Classifications

The following four project classes are defined so the applicant can determine which computation method is acceptable for hydrologic analysis and design. The six acceptable computation methods are described below in Section 4.1.1.B.

1) Small Projects typically range in size from 500 square feet to 0.25 acres (10,890 square feet) of new impervious area. These projects include new infill development and small lot subdivisions.
2) Medium Projects typically range in size from 0.25 acres (10,890 square feet) to 7 acres (304,920 square feet) of new impervious area. These projects include subdivisions and commercial ventures.
3) Large Projects are typically 7 acres (304,920 square feet) and larger of new impervious area. They can involve multi-phased developments. These projects include large subdivisions and commercial/industrial developments.
4) Linear Projects typically involve public improvements occurring within transportation corridors.

B. Hydrologic Analysis Methods

The City accepts the six hydrologic analysis methods listed below for estimating both the peak flow rate and quantity (e.g., volume) of surface water runoff. These methods can be used for the analysis of existing as well as proposed drainage systems and facilities.

Because developments vary in size and complexity, the City may allow the use of other methods in some cases. The City must approve the use of any alternate methods in advance.

The City will use a software program to verify the design calculations for all projects, except those classified as "small projects" (see 4.2.1.A. above). This software program will use the Santa Barbara Urban Hydrograph (SBUH) method

The six accepted methodologies include two non-hydrograph analysis methods and four hydrograph analysis methods;

<u>Non-hydrograph Analysis</u>

- Boyd Method
- IDF/Rational Detention Method

<u>Hydrograph Analysis</u>

- Santa Barbara Urban Hydrograph (SBUH) Method
- SCS TR-55
- HEC-1
- SWMM

The non-hydrograph methods use simplified assumptions to describe the rainfall-runoff process and spreadsheet calculation techniques to estimate runoff storage volumes and facility sizing needs. Application of these methods is strictly limited to "small projects" and "linear projects." Hydrograph methods must be used for all "medium projects" and "large projects." The following chart summarizes the application of the six methods to the four project classifications.

APPLICATION OF ANALYSIS METHODS TO PROJECT CLASSIFICATIONS

Project Classification	Analysis Method					
	Boyd	IDF/ Rational	SBUH	SCS TR-55	HEC-1	SWMM
Small	X	X	X			
Medium			X	X	X	X
Large			X	X	X	X
Linear		X	X	X	X	X

Before selecting and using any of these six analysis methods, the applicant must evaluate both the project classification and the size and time of concentration of the development. The following paragraphs describe additional factors that must be considered before selecting and using any of the six methods.

The **Boyd Method** is limited to sizing detention facilities that serve small projects that exhibit rapid response to rainfall (e.g., 5 minutes $\leq T_c \leq$ 15 minutes). This method can also be used in drainage areas comprising less than 0.25 acre of new impervious area.

The **IDF/Rational Method** may be used to size detention facilities serving both small and linear projects. This method is used for drainage areas that experience rapid rainfall response (e.g., 5 minutes $\leq T_c \leq$ 15 minutes).

The **Santa Barbara Urban Hydrograph (SBUH) Method** may be applied to small, medium, large, and linear projects that include a wide variety of land use and development. It is the recommended method for completing the analysis necessary for designing both water quality and flow control facilities.

The **SCS TR-55 Method** may be applied to medium, large, and linear projects that include a wide variety of land use and development. This is also one of the recommended methods for completing hydrologic analysis necessary for designing both water quality and flow control facilities. (Refer to SCS Publication 210-VI-TR-55, Second Edition, June 1986.)

The **HEC-1 Method** may be used on medium, large, and linear projects, including complicated projects, throughout the City. (Refer to the HEC User's Manual)

The **SWMM Method** may be used on medium, large, and linear projects, including complicated projects, throughout the City. (Refer to the SWMM User's Manual)

4.1.2.1 Hydrograph Analysis

The SCS TR-55 Hydrograph Method has been in common use in this region for a number of years and is familiar to most engineers. However, in the City of Cascade Locks, the application of this method is limited to basins that are larger than 100 acres.

Project Engineers designing for developments with contributory drainage areas, or those with unusual hydraulic structures, should consider using more complex modeling software such as HEC-1 or SWMM (EPA-SWMM , CaiCE_{TM} Visual SWMM, or other variants of SWMM). Guidance on modeling stormwater detention using these models is not discussed in this manual, however the project engineer is encouraged to seek outside sources for guidance. Should the use of one of these hydrologic models be proposed, a pre-design conference should be set up with the City Engineer to discuss design parameters and to gain a conditional approval of the analysis method. The City may hire outside consultants to review complex hydrologic and hydraulic models at the Applicant's expense.

Commercial software is presently available for use by engineers for using the aforementioned methods. However, the City expects that when a computer program is used in a design, the City is limited to only reviewing the appropriateness of the computation procedure and the input parameters used. When submitting computations, the engineer must thoroughly document all data input. The City expects that the project engineer have a complete understanding of the processes performed by any software routine.

4.1.2.2 Level-Pool Routing

The storage design capacity of all detention, retention and infiltration systems must be designed using a level pool routing technique.

The Washington State Department of Ecology's Stormwater Management Manual for the Puget Sound Basin ("Technical Manual") includes a description of a level pool routing technique which is accepted by the City.

The "HYD" computer program (Version 4.21B), developed by King County, Washington has a level pool routing routine, which can route a hydrograph through a given data set containing stage/storage/discharge data for a stormwater detention facility. The "HYD" program's RDFAC module is also a useful tool for doing preliminary stormwater detention facility sizing, however final proposed design shall be documented using the ROUTE or ROUTE2 module.

4.1.3 Basic Runoff Parameters

This manual does not attempt to provide a detailed description of the SCS TR-20 Hydrograph Method, the SBUH Method or the level pool routing methods. Detailed descriptions of these methods are available to the project engineer from the Washington State Department of Ecology's Stormwater Management Manual for the Puget Sound Basin or the Soil Conservation Service. Instead, the following comments are offered to assist the project engineer in implementing these methods.

4.1.3.1 Rainfall Distribution

The rainfall distribution to be used within the City is the design storm of 24-hour duration based on the standard SCS Type 1A rainfall distribution (See Figure 4-2).

Table 4-1 below links the total depth per year of reoccurrence.

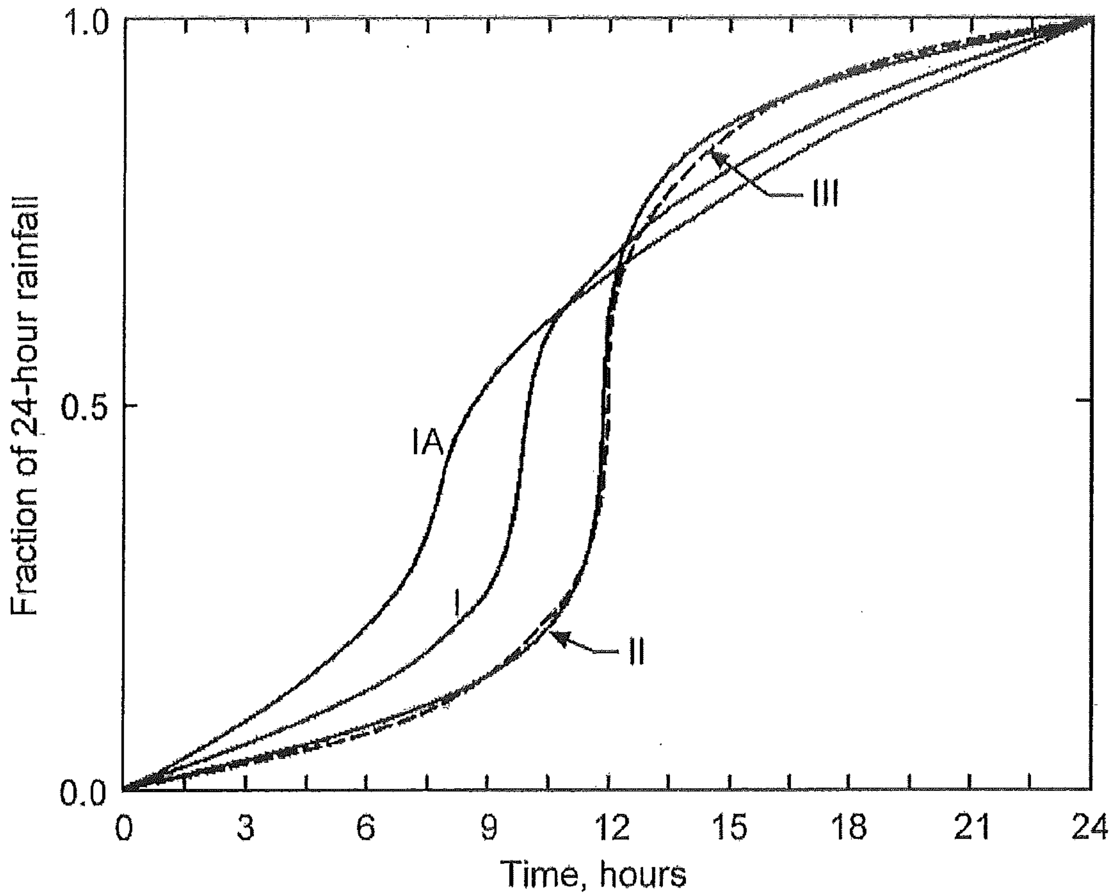
Table 4-1: TOTAL DEPTH

Reoccurrence Year	Total Depth
2	3.5
5	4.3
10	4.7
25	5.5
50	6.0
100	6.5

FIGURE 4-2: SCS RAINFALL DISTRIBUTION

SCS Rainfall Distribution

Use Type 1 A for Cascade Locks



4.1.3.2 CURVE NUMBERS

SCS has post-development "curve number" (CN) values based on soil type and land use. These curve numbers have been assigned to one of four hydrologic soil groups according to their runoff characteristics. All existing soil within the Cascade Locks area is assumed to fall into HSG C.

The curve numbers shown in Table 4-2 have been taken from the Kitsap County, Washington - Stormwater Management Design Manual and will be acceptable (as a minimum standard) for use in any hydrologic analysis within the City. These values were modified by SCS as well as Kitsap County, Washington (the source of the table) to reflect conditions common to the Puget Sound Area and tend to be higher than those found in SCS TR-55 literature. The more conservative curve number values found in the SCS TR-55 literature will also be acceptable for any hydrologic analysis within the City.

Individual curve numbers for a basin must be merged into a "composite" curve number for use as input in either the SCS method or the SBUH method. The SBUH method further requires that a separate composite curve number be computed for the pervious portion and the impervious portion of the site.

To compute composite curve numbers, the following steps should be followed:

1) Break a basin down into areas of differing ground cover or land use.
2) Break down each of these areas based on the homogeneous characteristics on an area (soil groups, pervious versus impervious, etc.).
3) Determine the land area, in acres, for each of these sub-areas and note the curve number for that sub-area.
4) Compute the total acreage and the composite pervious curve number. The composite curve number should be derived by taking the area times the curve number of each of the pervious sub-areas and then dividing this sum by the total area:

$$\text{Composite CN} = \frac{(\text{CNxA})_1 \quad (\text{CnxA})_2 \ldots (\text{CnxA})_N}{A_{\text{Total}}}$$

An accepted alternate method for determination of impervious area of a proposed single-family subdivision, R-6 – R-10 zoning with 3.5-foot minimum width planter areas between sidewalk and curb as follows:

> Measure all the impervious area within the proposed right-of-way (street, curbs, sidewalks, and drive approaches), then add 2,640 square feet impervious per lot.

An accepted alternate calculation method that may simplify the above calculation is as follows:

> Measure all the area within the right-of-way as impervious and add 2,500 square feet impervious per lot.

Table 4-2 MODIFIED CURVE NUMBERS

SCS Western Washington Runoff Curve Numbers

Runoff curve numbers for selected agricultural, suburban, and urban land use for Type 1A rainfall distribution, 24-hour storm duration. (Published by SCS in 1982)

LAND USE DESCRIPTION		CURVE NUMBERS BY HYDROLOGIC SOIL GROUP A	B	C	D
Cultivated land[1]:	Winter Condition	86	91	94	95
Mountain Open Areas:	Low growing brush and grassland.	74	82	89	92
Meadow or pasture:		65	78	85	89
Wood or forest land:	Undisturbed	42	64	76	81
	Established second growth[2]	48	68	78	83
	Young second growth or brush	55	72	81	86
Orchard:	With over crop	81	88	92	94
Open spaces, lawns, parks, golf courses, cemeteries, landscaping					
Good Condition:	Grass cover on > =75% of area	68	80	86	90
Fair Condition:	Grass cover on 50-75% of area	77	85	90	92
Gravel Roads and Parking Lots:		76	85	89	91
Dirt Roads and Parking Lots:		72	82	87	89
Impervious surfaces, pavement, roofs, etc.:		98	98	98	98
Open water bodies:	Lakes, wetlands, ponds, etc.	100	100	100	100
Single Family Residential[3]		Select a separate curve number for pervious and impervious portions of the site or basin.			
Dwelling unit/gross acre	% Impervious[4]				
1.0 DU/GA	15				
1.5 DU/GA	20				
2.0 DU/GA	25				
2.5 DU/GA	30				
3.0 DU/GA	34				
3.5 DU/GA	38				
4.0 DU/GA	42				
4.5 DU/GA	46				
5.0 DU/GA	48				
5.5 DU/GA	50				
6.0 DU/GA	52				
6.5 DU/GA	54				
7.0 DU/GA	56				
Planned Unit Developments, condominiums, apartments, commercial businesses & industrial areas[3]	% impervious[4] Must be computed	Select a separate curve number for pervious and impervious portions of the site or basin.			

1 For a more detailed description of agricultural land use curve numbers, refer to National Engineering Handbook, Sec. 4, Hydrology, Chapter 9, August 1972.
2 Modified by KCFW, 1995.
3 Assumes roof and driveway runoff is directed into street/storm system.
4 The remaining pervious areas (lawn) are considered to be in good condition for these curve numbers.

4.1.3.3 TIME OF CONCENTRATION

The time of concentration (T_c) is the length of time for runoff to travel from the hydraulically most distant point of a watershed to the point of discharge from the watershed. For computation purposes, it is assumed that water moves through the watershed as sheetflow, having a maximum depth of less than one tenth of a foot, as shallow concentrated flow, having a maximum depth exceeding one tenth of a foot, and as open channel flow. Minimum T_c shall be 5 minutes.

It is assumed that runoff in a watershed begins as sheetflow. It is also assumed that regardless of site conditions, the maximum distance that runoff will travel in the form of sheetflow will not exceed 300 feet. Where there are no topographic features suggesting channel flow within the first 300 feet of flow, it may be assumed that the first 300 feet of flow is sheetflow and the remaining flow distance until water reaches a channel is shallow concentrated flow.

For further discussion of methods of computing time of concentration, the designer is referred to the Washington State Department of Ecology's Stormwater Management Manual for the Puget Sound Basin.

For computing the travel time of sheetflow, the following formula should be used:

$$T = \frac{0.42\,(n_s L)^{0.8}}{(P_2)^{0.5}(S_o)^{0.4}}$$

where T = travel time, in minutes
n_s = Manning's roughness coefficient.-sheetflow (Table 4-4)
L = flow length, in feet
P_2 = 2-year, 24-hour rainfall, in inches
s_o = slope of land, in feet per foot

Travel time for shallow concentrated flow and open channel flow is computed using the following formula:

$$T = \frac{L}{60\,k\sqrt{s_o}}$$

where T = travel time, in minutes
L = flow length, in feet
60 = conversion factor from seconds to minutes
k = velocity factor, in feet per second (Table 4-4)
s_o = slope of flow path, in feet per foot
V = $60\,k\sqrt{s_o}$, average velocity, in feet per second

Table 4-3 MANNING'S COEFFICIENTS/"K" FACTORS		
"n" AND "k" Value Used in Time Calculations for Hydrographs "n_s" Sheet Flow Equation Manning's Values (for initial 300 ft. of travel)		n_s
Smooth surfaces (concrete, asphalt, gravel, or bare hand packed soil)		0.01
Fallow fields or loose soil surface (no residue)		0.05
Cultivated soil with residue cover (s□□□ < 0.20 ft/ft)		0.06
Cultivated soil with residue cover (s > □0.20 ft/ft)		0.17
Short prairie grass and lawns		0.15
Dense grasses		0.24
Bermuda grass		0.41
Range (natural)		0.13
Woods or forest with light underbrush		0.40
Woods or forest with dense underbrush		0.80
* Manning values for sheet flow only, from Overton and Meadows 1976 (See SCS's TR-55, 1986) "k" Values Used in Travel Time/Time of Concentration Calculations Shallow Concentrated Flow (After the initial 300 ft. of sheet flow, R = 0.1)		k_s
1.	Forest with heavy ground litter and meadows (n = 0.10)	3
2.	Brushy ground with some trees (n = 0.060)	5
3.	Fallow or minimum tillage cultivation (n=0.040)	8
4.	High grass (n=0.035)	9
5.	Short grass, pasture, and lawns (n=0.030)	11
6.	Nearly bare ground (n=0.025)	13
7.	Paved and gravel areas (n=0.012)	27
** Channel flow (intermittent) (At beginning of visible channels R=0.2)		k_c
1.	Forested swale with heavy ground litter (n=0.10)	5
2.	Forested drainage course/ravine with defined channel bed (n=0.050)	10
3.	Rock-lined waterway (n=0.035)	15
4.	Grassed waterway (n=0.030)	17
5.	Earth-lined waterway (n=0.025)	20
6.	CMP pipe (n=0.024)	21
7.	Concrete pipe (0.012)	42
8.	Other waterways and pipe 0.508/n	
Channel flow (Continuous stream, R=0.4)		k_c
9.	Meandering stream with some pools (n=0.040)	20
10.	Rock-lined stream (n=0.035)	23
11.	Grass-lined stream (n=0.030)	27
12.	Other streams, man-made channels and pipe 0.807/n **	
** See Table 6-3 for additional Mannings "n" values for open channels.		

Table 4-3 lists Manning's roughness coefficient, "n_s," for sheetflow and also velocity factor "k" for shallow concentrated flow and open channel flow. The factors in Table 4-3 should be used for either the SCS or SBUH methods. Note that the "n_s" values given in Table 4-3 are only appropriate for sheetflow conditions.

Time of concentration, for input in either the SCS method or the SBUH method, is the sum of the travel times for sheetflow, shallow concentrated flow and channel (intermittent) flow.

In computing the time of concentration, it is important to note that, except for very large basins, the largest and most significant component in the total time of concentration is that portion of the time devoted to sheetflow. For this reason, extreme care should be given to realistically determining the true travel time for the sheetflow component of the time of concentration.

In calculating total time of concentration, the following limitations will apply:

1) The flow segment used for the sheetflow component of the total time of concentration should not extend for more than 300 feet. The use of a distance of less than 200 feet on a pre-developed land use will require supporting documentation, such as photographs showing evidence of shallow concentrated flow at the point of transition.

2) For segments of the Tc route flowing through closed conveyance facilities, such as pipes and culverts, standard hydraulics formulas should be used for establishing velocity and travel time.

3) For segments of the Tc route flowing through lakes or submerged wetlands, travel time is normally very short. The travel time can be determined using an appropriate storage routing technique, or it can be assumed to be "zero."

4.1.4 Design Strategies

In order to aid the project engineer in designing runoff quantity or quality control facilities, the following comments are offered. The City encourages innovative design to stormwater management; therefore, the City Engineer will consider other reasonable design strategies. These innovative designs shall provide results at least equal to results provided by the methods identified in this document.

4.1.4.1 Drainage Basin Delineation

Within an overall drainage basin, which is contributing stormwater to a runoff control facility, it may be necessary to delineate separate sub-basins and to then generate separate hydrographs for each sub-basin. Sub-basins must be delineated when there are areas within a larger basin that are hydraulically self-contained, or that have similar land use and/or runoff characteristics. When several sub-basins are contributing runoff to a single runoff control facility, the individual hydrographs from each sub-basin should be added together to produce a single hydrograph representing runoff flows to the facility. When adding hydrographs, it is important that the travel time be taken into consideration, from the discharge point of a given sub-basin to the runoff control facility.

4.1.4.2 Off-site Contributing Runoff

Designers should consider off-site flows through the property in an integrated approach.

Off-site contributing runoff shall only be routed through the runoff control facility if the pre-development peak 2-year and 25-year flow rates from the off-site contributing area do not exceed the pre-development on-site peak flow rates for the same storm events. Otherwise, off-site flows shall be routed through, or around, the project site separate from the on-site flows. If off-site flows are to be routed through the runoff control facility, orifice sizes shall not be increased to accommodate off-site flows. Instead, additional freeboard shall be provided so that offsite flows are discharged through the control structure without overtopping the secondary/emergency overflow spillway.

However, the City recognizes that some sites may have constraints where it is not possible to separate flows for the project site from flows from a large off-site contributing area. When these cases occur, the City requires a more complex model such as HEC-1 or SWMM (EPA-SWMM, CaiCE™, Visual SWMM, or other variants of SWMM) be used to do hydrologic and hydraulic analysis. Should a situation of this nature occur, a pre-design conference (preferably during the planning review stage of design) shall be set up with the City Engineer. The City may hire outside consultants to review complex hydrologic and hydraulic models at the applicant's expense.

4.1.4.3 Bypass Areas

Runoff from portions of a development site may be permitted to be released at post-development rates (uncontrolled) provided that:

4) The "bypass" area rejoins the predevelopment downstream drainage course within a relatively short distance downstream of the runoff control facility;

5) The project engineer has demonstrated in the downstream analysis and in capacity calculations, that the downstream drainage course, conveying the uncontrolled flows from the "bypass" area, will not be adversely impacted by the increased runoff rate;

6) Public Easements (as required) are obtained by the applicant from all downstream property owners, through whose property the undetained runoff flows, prior to rejoining the detained runoff from the site; and

7) The total release rate from the project site, including the "bypass" area, shall not exceed the total allowable release rates from the project site. In the event that the downstream drainage course will be adversely impacted by increased runoff from the "bypass" area, downstream improvements will be required, along with a public easement acquired by the applicant from the affected downstream property owners(s).

4.2 Facility Design Requirements

The term "detention facility" commonly refers to the temporary storage of water for eventual gradual release to a downstream point. Detention facilities usually take the form of open ponds, underground tanks, and vaults.

The term "retention facility," on the other hand, commonly refers to the permanent storage of stormwater. Actually, a retention facility also temporarily stores water for eventual gradual release through evaporation as well as infiltration to the groundwater system. Retention facilities are most often open ponds or other open depressions, or underground infiltration systems. The City Engineer may allow a retention system provided they are:

- Designed with some controlled release where it has been demonstrated that downstream conditions will not be adversely impacted by such a controlled release of stormwater; and/or
- Capable of infiltrating 150% of the 100-year design storm volume from the contributory area in a 48-hour period. This infiltration potential must be documented by soils testing performed by a qualified Oregon registered soils engineer.

All runoff quantity control facility designs must address overflow caused both as a result of plugging of the normal outlet and also as a result of stormwater conditions that exceed the design capacity of the facility. The engineering design of all runoff quantity control facilities must identify the route of overflow from a storage facility, following the corridor of least resistance, to the point where this overflow enters the existing downstream stormwater system. The engineering design shall also show how the infiltration facility will be protected from sediment laden runoff that may occur during the site construction process.

4.2.1 Ponds

The City of Cascade Locks encourages open ponds for runoff quantity control where feasible.

The City of Cascade Locks encourages the use of detention ponds that serve more than one development. A facility that serves more than one development will be referred as a sub-regional facility. Sub-regional facilities can be more effective in maximizing the development area, reducing the overall maintenance requirement, and minimizing the overall construction cost while enhancing water quality of the stormwater runoff.

4.2.2 Criteria For City Maintained Ponds

4.2.2.1 Site Constraints

All open ponds to be maintained by The City of Cascade Locks, shall be located in a separate tract dedicated to Cascade Locks. Open ponds shall not be located in dedicated public road right-of-way areas.

4.2.2.2 Design Goals

1) To have a stormwater facility that can be maintained using city-owned equipment. The city has the following list of equipment available for pond maintenance:
   - Two-wheel drive backhoe / front end loader.
   - Suction manhole cleaner with 64-foot sections of suction hose. The hose connection is located at the front of the truck, 8 feet above the ground. The boom arm, which is located above the cab, can swing up to 30 degrees either side of straight ahead. The truck is reported to have a 24-foot vertical suction capacity. The wheelbase of this truck is 205 inches. The outside wheel turning radius of this truck is approximately 40 feet.
   - Miscellaneous riding and push-type lawn mowers.
   - A two-yard and five-yard dump truck.
   - Standard full-size pickup truck.
   - Various hand tools.
2) To have a stormwater facility that is completely landscaped with no bare or exposed soil.
3) To have a stormwater facility that enhances stormwater quality that includes, but is not limited to, temperature, metals, hydrocarbons, trash and debris, sediments, and nutrients, that are introduced in the urban environment.
4) To have a stormwater pond that is designed in substantial conformance with the design criteria described in Table 4-4 for either the Type A or Type B detention ponds. Table 4-4 also describes some selected characteristics for both a Type A and Type B stormwater pond.
5) All stormwater facilities proposed for City maintenance shall have a Landscape Plan prepared, stamped, and signed by a Landscape Architect. In addition, a geotechnical engineering letter report will be required that discusses the site's suitability for the type of stormwater pond selected (see Table 4-4) or how the site will be improved to make the site suitable.

Table 4-4		
Characteristic	**Type A Stormwater Pond**	**Type B Stormwater Pond**
Stormwater Storage	Stormwater will be held in a pool approximately 0.5 feet to 0.75 feet deep. This volume is referred to as the dead storage.	Will generally not hold water. Water will infiltrate or drain away.
Slope of pond bottom	None. Relatively level.	First Cell - None. Second Cell – 3%
Pond Bottom Landscaping	Wetlands type plants	A grass surface – Native Plants
Interior and Exterior Side Slopes	4 horizontal : 1 vertical maximum, (except for localized area of sediment forebay with suction manhole cleaner access.)	4 horizontal : 1vertical maximum
How is Shading of Standing Water for Temperature Control of Impervious Surface Runoff Addressed?	Direct shading of standing water by wetlands plants. Shade trees located to the south/west of Sediment forebay. Direct shading to control temperature.	First flush will be sent to first cell, where, when water passes through the relatively pervious ground between cells 1 and 2, heat will be transferred to the ground.
How is Water Quality Enhanced?	Pre-sedimentation in the forebay; Sedimentation in the dead pool area	Build a pollution reduction facility (PRF).
Is Landscape Plan signed and sealed by Landscape Architect required?	Yes	Yes

4.2.2.3 Pond Geometry – Type "A" Stormwater Pond

It is important that for this type of pond an environment for wetlands-types of plants can be established. This type of pond is dependent on surface water runoff to help plant survivability during the summer. See Figure 4-3 for a graphical depiction showing one way to accomplish a Type "A" pond configuration. Figures 4.4 and 4.5 illustrate some design details for consideration in designing a Type "A" pond.

A. Inlet and Outlet Location

The inlet and outlet shall be located to maximize the travel time through the pond. A minimum effective length to width ratio of 3:1 for the water quality design storm flows should be obtained. (See Chapter 5 for definition of water quality design storm.) A length to width ratio of less than 3:1 for the design storm may be approved on a case by case basis if the project engineer can prove the proposed ratio provides an equal or better treatment. Flows of more than the water quality design storm flows may bypass the design flow route.

An acceptable alternative to meeting the length to width ratio within the pond area is the use of flow-splitting manholes. A flow-splitting manhole will be located on the in-coming storm drain pipe(s) of the pond. Flows that are less than the peak in the developed water quality design storm are sent directly to the water quality flow route. Flows more than the water quality design storm peak flow are bypassed to the upstream side of the flow control manhole. The goal of this design concept is:

- For the runoff from the majority of the (smaller) storms to go through the pond, where the pond's natural water quality improvement benefit can be realized.
- High flows from the bigger, but less frequent, storms will enter the storage element of the pond by way of backing out the pond's outlet. This configuration should result in less stirring up of the pond's deposited sediment.

B. Bottom Width

For ponds with an active storage depth of 3 feet or less, the minimum bottom width shall be 10 feet.

For ponds with an active storage depth of over 3 feet, the minimum bottom width shall be 15 feet.

An exception from this criterion may be approved on a case by case basis if required by topographical or physical boundary constraints. For this criterion, the active storage depth is defined as the vertical distance between the normal pool elevation (dead storage elevation) and the maximum 25-year design stormwater surface.

For the purposes of this bottom width measurement, the width shall be measured at the dead pool water surface elevation. In addition, any elevated berms used to increase the effective length to width ratio and whose top elevations are below the 2-year water surface can be ignored.

C. Interior Side Slopes

Interior side slopes shall be no steeper than four horizontal to one vertical (4h:1v), unless retaining walls are used. Side slopes above retaining walls shall not be steeper than four horizontal to one vertical (4h:1v).

Retaining walls are allowed for interior slopes of detention ponds. The perimeter shall consist of no more than 50% retaining walls without specific approval. Walls will be designed to withstand the differential fluid pressure that can result from a rapid draw down of the detention pond water surface. Walls must also be designed to withstand any active loading that may occur from the City's maintenance equipment. Walls taller than 30 inches shall have a barrier as determined by the most current edition of the Building Code required by the State of Oregon. Structural calculations shall be required for the following conditions:

- Walls with an exposed face (wet or dry) of over 48 inches, or
- Walls with an exposed face of over 30 inches with a sloped backfill of over six horizontal to one vertical (6h:1v).

Structural calculations shall bear the seal and original signature a professional engineer, registered in the State of Oregon. Two copies shall be provided for the City files.

D. Exterior Side Slopes

Exterior side slopes that have vegetated surfaces that require mowing shall be no steeper than four horizontal to one vertical (4h:1v).

Exterior side slopes that have vegetated surfaces that do not require mowing shall be no steeper than two horizontal to one vertical (2h:1v). These slopes shall be landscaped so that there is no exposed soil.

Retaining walls are allowed. In order to provide mowing access for mowing equipment, there shall be a 2.5-foot wide flat area (less than 5% slope) at the top and toe of the retaining wall. The retaining wall layout shall be configured to allow riding lawn mower access on either side of the retaining wall.

Retaining wall with more that a 30-inch exposed vertical face may be approved on a case by case basis. This height of retaining wall, if approved, shall have a barrier as determined by UBC.

The retaining wall design parameters and the structural calculation requirements described in the previous section also applies.

E. Top of Berm Width

See pond embankment section in Chapter 3.1.3.6.

F. Pond Depth

The maximum active storage depth is 4 feet.

For these criteria, the active storage depth is defined as the vertical distance between the normal pool elevation (dead storage elevation) and the maximum 25-year design stormwater surface. An exception from this criterion may be approved on a case by case basis if additional safety factors can be shown to address this issue.

G. Dead Storage

In the main area of the pond, provide between six to nine inches of dead storage. Twelve inches is required for an area of four feet in front of the primary pond outlet (lowest pond outlet). See Figure 4.4.

In the sediment forebay area of the pond, provide 18 to 24 inches of dead storage.

For this criterion, dead storage is the volume of storage between the normal pool (static water surface elevation) and the bottom of the pond. Typically, this is achieved by having the bottom of the pond located below the lip elevation of the lowest pond outlet structure.

H. Pond Inlet Energy Dissipation / Sediment Forebay Area

Energy dissipation is required.

The sediment forebay will consist of an area in which heavier sediments can accumulate and receive periodic maintenance to remove these sediments. Sediment removal is anticipated to be accomplished with the City's suction manhole cleaner, thus the forebay area must have a hard bottom as well as maintenance access. This hard bottom shall consist of either concrete, rock with a minimum weight of 50 pounds each, or some other suitable material that will work with this maintenance equipment. Some type of barrier shall separate the forebay area from the main area of the detention pond. The top of the barrier shall be set at three-inch minimum or six-inch maximum above the normal pool elevation of the main pool area. The barrier could be achieved with hand placed rock, gabions, concrete, or some other material that would accomplish the goal of the forebay area. The invert of the incoming storm drain pipe should be set at or above the top of barrier elevation and shall consider the pipe wall thickness.

The forebay size shall be engineered with respect to the anticipated flow rate. A minimum size of 20 square feet of water area is anticipated. See Figure 4.5 for a depiction of a forebay design concept using a precast concrete box. Pond inlets with a drainage area of less than one third-acre may not require a sediment forebay.

I. Secondary Pond Outlet

The detention pond shall have a secondary pond outlet structure. This secondary pond outlet will serve as a backup to convey stormwater to the flow control manhole should the primary pond outlet become blocked with debris. The lip elevation of the secondary pond outlet should be set at approximately the 2-year design water surface. See Figure 4-4 for a graphical depiction showing a secondary pond outlet.

J. Fencing

Designers are encouraged to minimize or eliminate the need for fencing, especially chain link fencing. If fencing is required or used, the designer should use an aesthetic wall or fence related to the building/ site architectural style. When chain link fencing is used, it must be screened with plantings that conform to the site design.

1) Public Facilities

Fences are required for all ponds with a permanent pool greater than 18 inches deep, interior side slopes steeper than 3H:1V, or any walls/bulkheads greater than 24 inches in height. However, a pond with gently sloping sides (less than 3h:1v) and a 10-foot wide safety earth bench around the facility at the point of slope transition would not require a fence.

When required around a pond, fencing shall consist of a minimum 4-foot high chain link fence. A minimum of one locking access gate shall be provided that is 16 feet wide, consisting of two swinging sections each 8 feet in width. At least one pedestrian gate must be provided, with a minimum 4 foot width. Fence material shall be No. 11 gauge galvanized steel fabric with bonded vinyl coating. Vinyl coating shall be a color designed to blend with the surrounding area (likely green, brown, or black). Fence posts shall be galvanized steel, with top caps, and set a minimum of three feet deep in concrete. Crossbars shall connect adjacent fence posts, with diagonal braces at corners and ends. All posts, cross bars and gates shall be painted or coated the same color as the vinyl clad fence.

2) Private Facilities

Fencing for privately owned facilities is at the discretion of the owner; however, the owner may want to use the City criteria for public facility fencing.

3) General

Where fences are required, they must be at least 4 feet high, unless certain elements of the stormwater facility design dictate a higher fence.

Fencing materials and colors shall be complementary to the site design. If chain link fencing is proposed for a public facility, it must be designed to City construction standards and this chapter's aesthetic requirements.

Stormwater detention pond designs that require fencing are generally discouraged.

K. <u>Signing</u>

All ponds shall have signs placed so that at least one is clearly visible and legible from all adjacent streets, sidewalks, or paths. Applicants may add an indigenous, native wild bird(s) or wild animal(s) logo or cartoon figure on the sign. Sign spacing shall be approved by the City Engineer. The sign shall read:

Please Do Not Disturb the Vegetation or Wildlife	(larger lettering)
Cascade Locks Stormwater Management Facility	(larger lettering)
For More Information, Call Cascade Locks Public Works At 374-8484	(smaller lettering)

The minimum sign size shall be 12-inches x 18-inches. The maximum sign size shall be 24-inches by 30-inches. The material shall be aluminum with green reflective sheeting and silk screen lettering or equal as approved by the City Engineer. The signs shall be installed on an 8-foot long by 6-inch by 4-inch treated lumber (0.40 cca) post which is set in concrete and buried 30 inches into the ground.

The developer shall install these signs before the City's final acceptance of the pond.

L. <u>Berm Embankment</u>

See pond embankment section in Chapter 3.1.3.6.

M. <u>Maintenance Access to Pond</u>

Access to bottom of pond: The design shall provide an access road to the pond bottom. This access road shall be in close vicinity of the outlet structures of the pond. This access road shall have a vertical and horizontal alignment that will accommodate the City's two-wheel drive backhoe. The access road shall have a maximum slope of 20% and a 10-foot minimum width. This access road shall be orientated so that:

- The backhoe can excavate material from pond and then load a dump truck from the side.
- No turning movement is required for the backhoe with full bucket on non-level ground.

Access to flow control structure and sediment forebay: This access road shall have a vertical and horizontal alignment that will accommodate the City's suction manhole cleaner truck. The access road shall have a maximum slope of 18%, a ten-foot minimum width and an alignment to allow "head in" access to these facilities. Curved alignments shall have a wider pavement width to accommodate the truck's turning radius. Access roads longer than 300 feet from a public right-of-way shall provide for a truck turn-around area. See Figure 4-5 for depiction of an access to a sediment forebay area.

Bollards shall limit vehicle access. Bollards shall consist of a fixed bollard on each side of the access road and two lockable, removable bollards equally located between the fixed bollards.

The City desires to not create additional impervious surfaces for pond access roads. Therefore, pond access roads shall be constructed of a landscape block surface by removing all unsuitable material, laying a geotextile fabric over the native soil, placing landscape blocks, filling the honeycombs with topsoil, and planting appropriate zone grass. This surface may be constructed of other similar types of design which meet the intent. Designer shall submit the alternate material specifications to show they meet vehicle wheel load requirements.

N. <u>Flow Control Outlet Structure</u>

All ponds shall have an outlet control structure designed to meet the following criteria:

- Locate the outlet control structure(s) outside the open water storage area.

- Provide an all weather maintenance access as described above. The outlet control structure shall require little to no attention for normal operation.
- Flow Control Outlet structures will be approved on a case by case basis.
- The controlling outlet elevation from the flow control structure shall be no more that two feet lower than the dead storage water surface elevation.
- See Section 4.2.6 for applicable additional criteria.
- Appendix 4-1 contains a control structure analysis.

O. Primary Overflow System

All ponds shall have a primary overflow designed to meet the following criteria:

- The primary overflow system will be sized to convey the peak release rate for the post-development design storm for which they are designed (typically 25-year or 100-year – regional only). Assume that there is no other outflow from system (the flow control orifices are plugged) and the hydraulic grade line of the pond is at or below the secondary (emergency overflow) spillway.
- Locate the primary overflow system in the outlet control structure and ensure it is accessible to maintenance workers and equipment.
- The primary overflow system shall provide controlled discharge directly to the downstream conveyance system.

P. Secondary (Emergency) Overflow System

All ponds shall have a secondary overflow system that will safely pass runoff from a post-developed 100-year design storm through or around, the detention pond and direct flows to the downstream conveyance system. The design intent of the secondary overflow system is to protect the integrity of the pond, as well as associated embankments and down stream properties, during large (rare) rainfall events and/or failure of the flow control structure.

Secondary Spillway. Secondary spillway shall meet the following criteria:

- Locate the spillway to direct overflows safely toward the downstream conveyance system.
- Locate the spillway in existing soil wherever possible. Protect the spillway with riprap or an approved material that extends to, and an appropriate distance beyond, the bottom of the berm embankment. Fill the voids of the riprap with soil and vegetate the spillway with grass or ground cover. The selection of the vegetation on the spillway shall consider the required design capacity.
- The invert elevation of the spillway shall be a minimum of 6 inches above the primary overflow elevation.

- The minimum spillway depth shall be nine inches from the top of the berm. The free board during the design storm event shall be a minimum of 6 inches.

Other Types of Secondary Overflow Systems. Alternate methods to accomplish the design intent of the secondary overflow system will be acceptable as long as they accomplish the same level of protection and the following criteria is met and approved by the City Engineer.

- Overflows will be directed safely towards the downstream conveyance system.
- The invert elevation of the secondary overflow system shall be a minimum of 6 inches above the primary overflow elevation.
- The capacity of the secondary overflow system shall operate with free board during the design storm of six inches minimum with respect to the top of berm elevation.

Q. 100-year Overflow Downstream Path.

Provide a narrative of where the 100-year overflow goes and the storage capacity during the 100-year event.

R. Top Soil Requirements

See Chapter 3, Section 3.1.3.8.

S. Landscaping Requirements.

It is critical that selected plant materials are appropriate for soil, hydrologic, and other facility and site conditions. Plantings should be designed to minimize or eliminate the need for herbicides, fertilizers, pesticides, or soil amendments at any time before, during, or after construction or on a long-term basis. Plantings should be designed to minimize or eliminate the need for frequent mowing and irrigation.

All soil areas must be covered with specified plants and mulch. Plantings must be maintained to ensure healthy establishment within 2 years. Soil areas must be covered with approved mulch or other measures to prevent erosion.

Seed may be applied at the rates specified by the suppliers, but the plants must be established at the time of substantial completion of the stormwater facility portion of the project. If plant establishment cannot be achieved, the contractor must plant the area with sod or some other means to complete the specified plantings, unless the City approves another approach.

All plant materials and planting practices must conform to these requirements.

Mulch

To prevent pollution of a facility and ensure its proper performance, organic materials such as compost, bark mulch, leaves, sawdust, straw, or wood shavings are not allowed within the facility area. Approved permanent mulching materials include round river gravel or other inert materials that do not leach out nutrients or other potential pollutants to the facility or site. This requirement does not apply to landscape infiltration facilities.

For other site areas that drain into the facility area, mulching materials must be applied in a way that prevents any flow into a facility.

Irrigation

Temporary irrigation systems or other means of ensuring establishment of the landscape must be specified. Permanent irrigation systems are discouraged unless they are needed to meet an aesthetic goal of the project design. Innovative methods of using facility water during the dry season are encouraged.

Dead storage area of the stormwater pond.

Plant with vegetation that will provide dense plant growth. The landscape architect shall specify a mixture of vegetation that is suited to the growing conditions in the pond.

When planting wetland vegetation, use nursery plant stock or dormant rhizome nursery transplants. Wetland plants shall have stems at least six to twelve inches long and root plugs at least four inches wide and long. These plants shall be planted in clumps of the same species throughout the dead storage area of the detention pond. Plant bare-rooted plants 4 to 6 inches deep and peat pots and plugs as deep as the pot or plug.

Seasonally Saturated/Temporarily Inundated Zone (up to the elevation that will receive periodic inundation above the dead storage water surface level).

Seed Mix: A mixture similar to Pro-time 710, 830 and 840 or equal. See Appendix 4-2.

Plant Materials: Native shrubs appropriate to the local area that are adaptable to riparian zones should be planted to vegetate 100% of all disturbed and bare areas along the pond's interior side slopes except for clear maintenance access areas. Provide healthy nursery stock, well branched and rooted, full foliaged when in leaf, free of disease, injury, insects, and weeds. Bare root and small-containerized stock and tubelings are acceptable for plant sizes. Seed all areas in and around plantings. Refer to suggested plant list.

Warranty: Plant materials must be in healthy condition at the end of a 1-year warranty period, or for one full growing season from date of substantial completion, whichever is longer. Contractor is responsible to assume liability for all plant material and to guarantee plants against disease, insect infestation, desiccation, sunscald, freeze damage, or any other condition that would cause plants to be unhealthy or to die.

Upland Zone (above the elevation of the area receiving periodic inundation).

Seed Mix: A mixture similar to Pro-time 710, 835 and 840 or equal. See Appendix 4-2

Plant Materials: Plant native and drought-tolerant shrub and tree species appropriate to the local area. These plants must be able to tolerate a drier site. Vegetate 100% of all disturbed and bare areas along the pond's interior side slopes except for clear maintenance access areas. Provide healthy nursery stock, well branched and rooted, full foliaged when in leaf, free of disease, injury, insects, and weeds. Bare root and small-containerized stock and tubelings are acceptable for plant and tree sizes. Seed all areas in and around plantings. Refer to suggested plant list.

Guarantee: Plant and tree materials must be in healthy condition at the end of a 1-year guarantee period, or for one full growing season from date of substantial completion, whichever is longer. Contractor is responsible to assume liability for all plant material and to guarantee plants against disease, insect infestation, desiccation, sunscald, freeze damage, or any other condition that would cause plants to be unhealthy or to die.

Mulch: Organic materials such as compost, bark mulch, leaves, sawdust, straw or wood shavings cannot be used within any portion of the landscape area that might drain into a wet pond or wetland.

4.2.2.4 POND GEOMETRY – TYPE "B" STORMWATER POND

It is envisioned that this pond will be grass lined and would require regular mowing during the growing season. See Figure 4-6 for graphical depiction showing one way to accomplish a Type "B" pond configuration.

A. Description of Operation Characteristics

This pond is divided into two cells: the first will receive all flow until the volume equal to 2/3 of the water quality design storm is stored (assume no infiltration in cell one for this volume calculation). Since the water surface of the stored volume will be at the same elevation as the weir in the high flow bypass manhole, additional stormwater will essentially bypass cell one on its way to cell two. This bypass water will enter cell two via the upstream side of the flow control manhole and back flow out the pond outlet structures located in cell two. This back flow out the outlet structures should minimize the amount of erosion in second cell as well as allowing trapping of sediments in the sump of the flow control manhole. Table 4-4 describes how the facility will function during the smaller water quality design storm events. See Chapter 5 for details on the water quality design storm.

B. Inlet and Outlet Location

See Figure 4-6.

C. Bottom Width

For pond with an active storage depth of 3 feet or less, the minimum bottom width shall be 10 feet.

For pond with an active storage depth of over 3 feet, the minimum bottom width shall be 15 feet.

D. Bottom Slope

First Cell – none. Second cell – 3%.

E. Interior and Exterior Side Slopes

Same as for a Type "A" Stormwater Pond. The requirement for riding mower access applies to both the interior and exterior slopes.

F. Top of Berm Width

See pond embankment in section in Chapter 3.1.3.6.

G. Pond Depth

The maximum active storage depth is 5 feet.

For this criteria, the active storage depth is defined as the vertical distance between the lowest outlet control elevation and the maximum 25-year design stormwater surface. An exception from this criterion may be approved on a case by case basis.

H. Secondary Pond Outlet

Similar to a Type "A" Stormwater Pond.

I. Fencing

Same as for a Type "A" Stormwater Pond.

J. Signing

Same as for a Type "A" Stormwater Pond.

K. Berm Embankment

See pond embankment section in Chapter 3.1.3.6.

L. Maintenance Access to Pond

Same as for a Type "A" Stormwater Pond.

M. Flow Control Outlet Structure

Same as for a Type "A" Stormwater Pond.

N. Primary Overflow System

Same as for a Type "A" Stormwater Pond.

O. Secondary / Emergency Overflow System

Same as for a Type "A" Stormwater Pond.

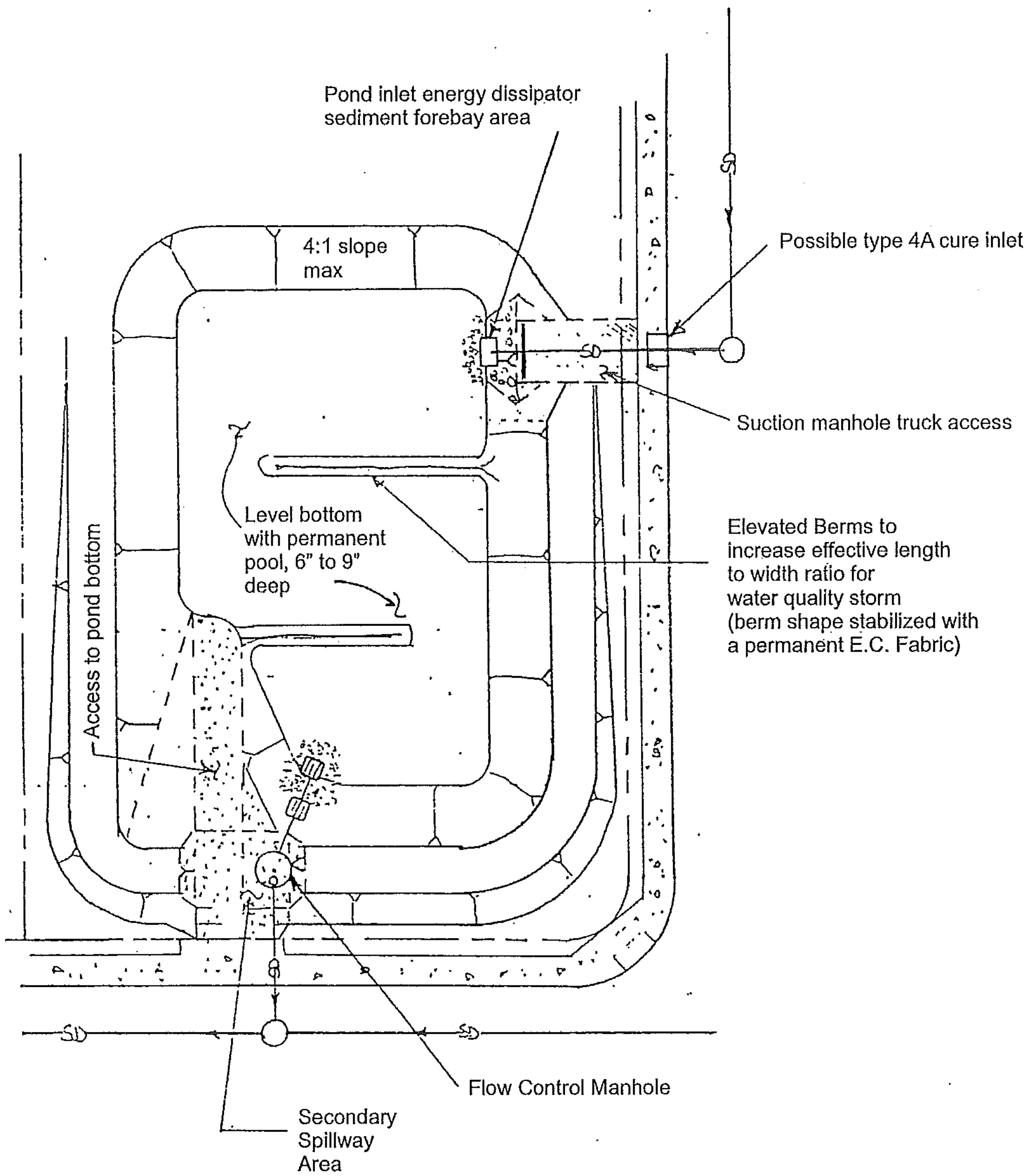
P. Top Soil Requirements

See Chapter 3, Section 3.1.3.8.

Q. Landscaping Requirements

Same as for a Type "A" Stormwater Pond for the temporarily inundated zone and upland zone.

FIGURE 4-3



Graphic Illustration Depicting One Way to Accomplish a Type "A" Pond Configuration

FIGURE 4-4

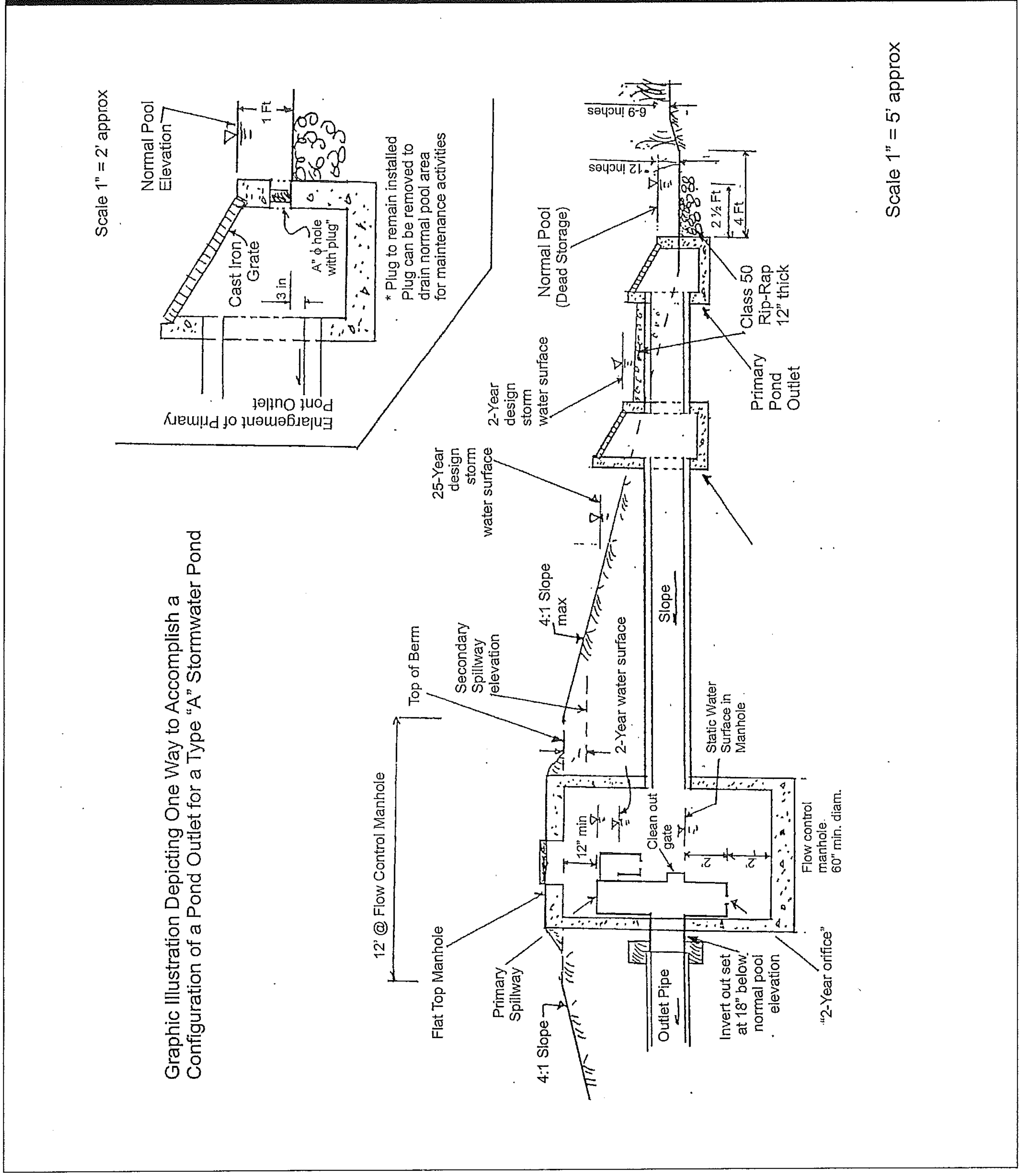
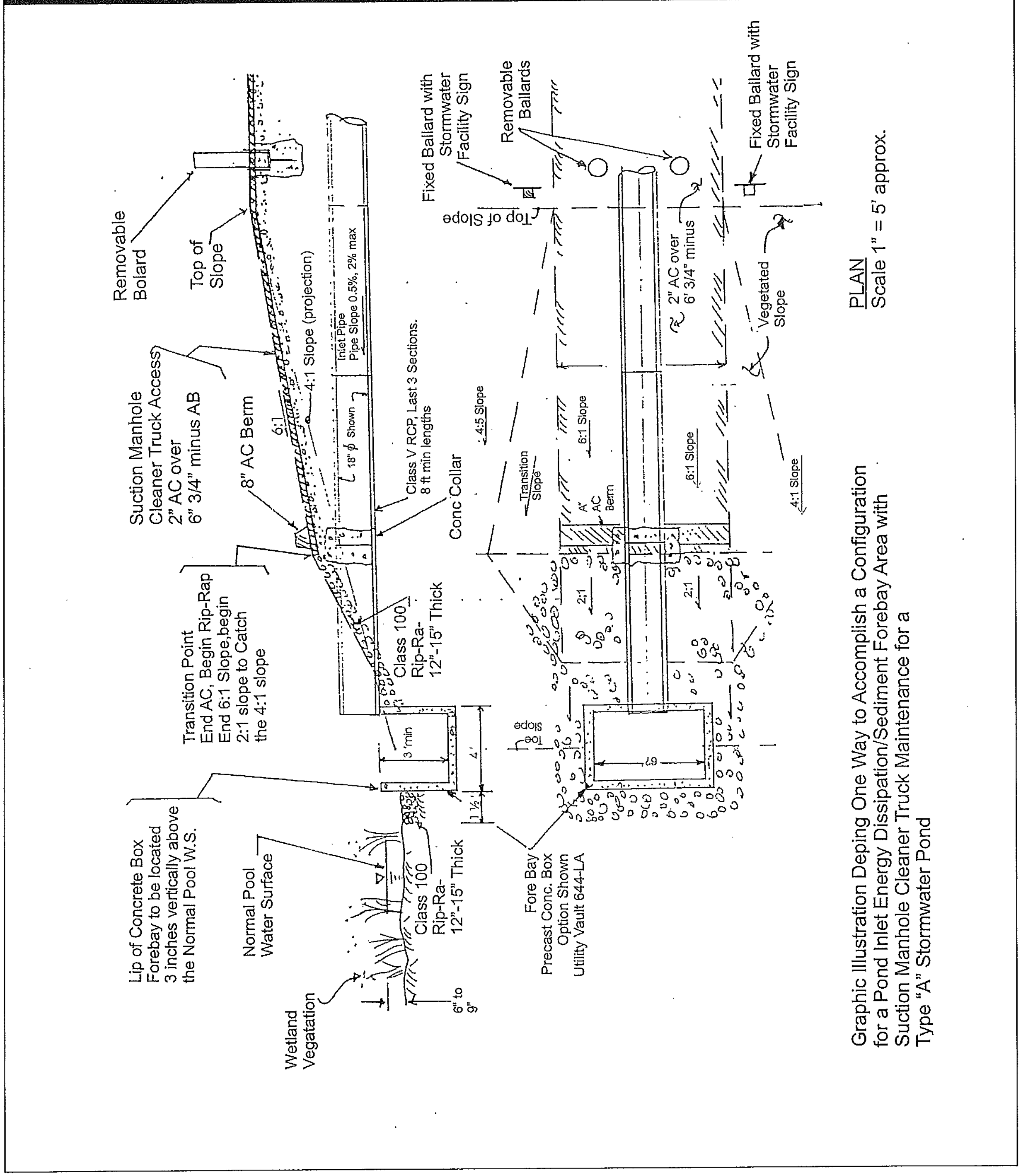
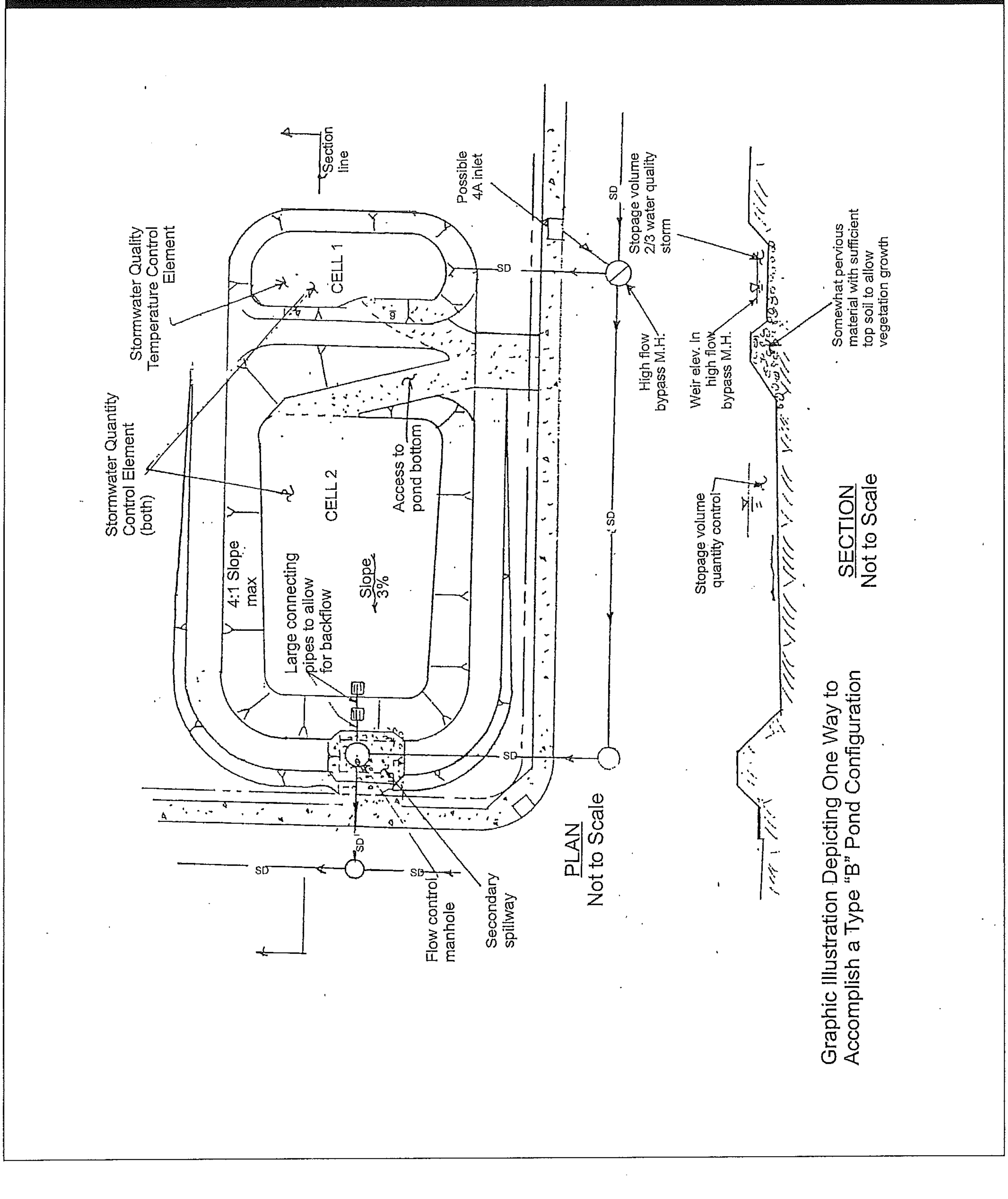

Graphic Illustration Depicting One Way to Accomplish a Configuration of a Pond Outlet for a Type "A" Stormwater Pond
Scale 1" = 2' approx
Normal Pool Elevation
1 Ft
Cast Iron Grate
3 in
A" ϕ hole with plug*
* Plug to remain installed Plug can be removed to drain normal pool area for maintenance activities
Enlargement of Primary Pont Outlet
Scale 1" = 5' approx
6-9 inches
12 inches
2 ½ Ft
4 Ft
Normal Pool (Dead Storage)
Class 50 Rip-Rap 12" thick
Primary Pond Outlet
2-Year design storm water surface
25-Year design storm water surface
4:1 Slope max
Slope
Top of Berm
Secondary Spillway elevation
2-Year water surface
Static Water Surface in Manhole
12' @ Flow Control Manhole
12" min
Clean out gate
Flow control manhole. 60" min. diam.
Flat Top Manhole
Primary Spillway
4:1 Slope
Outlet Pipe
Invert out set at 18" below normal pool elevation
"2-Year orifice"

FIGURE 4-5



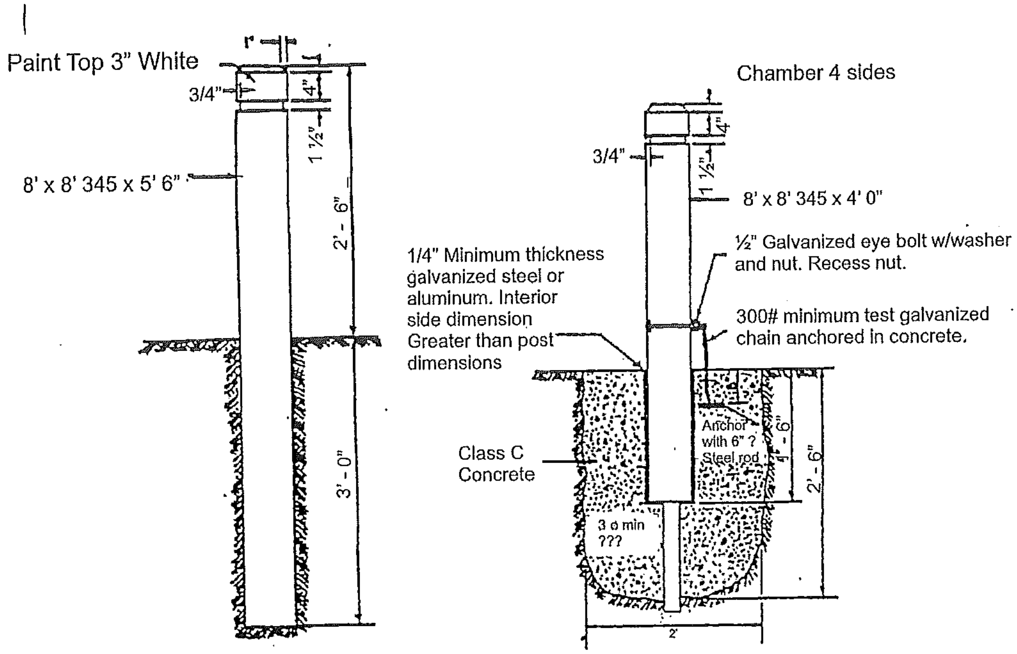
Graphic Illustration Deping One Way to Accomplish a Configuration for a Pond Inlet Energy Dissipation/Sediment Forebay Area with Suction Manhole Cleaner Truck Maintenance for a Type "A" Stormwater Pond

FIGURE 4-6



Section line
Stormwater Quality Temperature Control Element
Stormwater Quantity Control Element (both)
CELL 1
CELL 2
Possible 4A inlet
SD
Stopage volume 2/3 water quality storm
High flow bypass M.H.
Weir elev. In high flow bypass M.H.
Somewhat pervious material with sufficient top soil to allow vegetation growth
Access to pond bottom
4:1 Slope max
Large connecting pipes to allow for backflow
Slope 3%
Stopage volume quantity control
SECTION
Not to Scale
PLAN
Not to Scale
Flow control manhole
Secondary spillway
Graphic Illustration Depicting One Way to Accomplish a Type "B" Pond Configuration

FIGURE 4-7 – BOLLARDS



FIXED BOLLARD   REMOVABLE BOLLARD

NOTES:

1. TIMBER SHALL BE DOUGLAS FIR DENSE CONSTRUCTION GRADE, AND SHALL BE PENTACHLOROPPHENOL PRESSURE TREATED BY EMPTY CELL PROCESS WITH MINIMUM NET RETENTION OF 0.05 LBS/CU FOOT OF THE DRY SALT. (USE LIGHT PETROLEUM SOLVENT.)
2. STEEL TUBE SHALL CONFORM TO ASTM A53 OR ASTM A53 GRADE A.
3. NUTS, BOLTS, & WASHERS SHALL CONFORM TO ASTM A307.
4. ALL STEEL PARTS SHALL BE GALVANIZED.
5. CONCRETE SHALL BE CLASS C.

4.2.3 Privately Owned and Maintained Stormwater Detention Ponds

There are no pond geometric requirements stipulated in this manual provided that the design complies with the following:

1) The pond meets or exceeds the peak rate control performance criteria as stipulated in Section 4.1.2 (Runoff Control). The hydrologic and hydraulic performance of the stormwater detention facility shall be documented as stipulated in Section 2.3 (Drainage Report) of this document.
2) Proposed design for detention pond area is included in the erosion control plan.
3) The proposed grading plans show the pond berm embankments constructed per Chapter 3.
4) Topsoil is provided in the stormwater facility area per Chapter 3.
5) The detention control facility shall provide oil/water separation prior to discharge per Section 4.2.6.
6) A fully executed maintenance covenant is provided. An attachment to this maintenance covenant shall be the operations and maintenance manual as described in Chapter 7. A fully executed maintenance covenant shall be on file with the City prior to the release of the development plans for plumbing permit review.
7) Landscaping shall be as required in 4.2.2.3 S.

4.2.4 Parking Lot Ponds (privately owned and maintained)

Parking lot ponds, as well as any pond having a paved bottom (tennis courts, etc), are a variation on the concept of a multi-purpose facility for runoff quantity control. However, because a parking lot is usually a land use permit requirement, it is essential that any secondary design of a parking lot as a pond for runoff quantity control be compatible with the parking lot use.

Parking lot ponds shall be designed to maintain site access and not encroach into established pedestrian crossways and fire access lanes.

The following are criteria specific to parking lot pond design:

1) The maximum depth of water shall not exceed eight tenths of a foot at any location in the parking lot.
2) The limits of ponded water at maximum water depth shall not encroach into any established pedestrian crossings, fire lanes, or principal ingress/egress lanes.
3) Signs shall be erected adjacent to the parking lot pond area identifying the area as a stormwater detention control area subject to ponding, and identifying the specific parking spaces subject to flooding.

4) The parking lot pond shall be designed so that it will completely drain, leaving no areas of entrapped water in puddles or behind curbs.

5) Overflow control shall be provided on the perimeter of the parking lot pond area, with the design overflow elevation equal to the water surface elevation maximum.

4.2.5 Detention Tanks and Vaults

Tanks are typically constructed of corrugated pipe, whereas vaults are usually constructed of reinforced concrete. Both function to provide underground storage of stormwater as part of a system for runoff quantity control.

It is important, as with any underground structure, that tanks and vaults are designed for their function as facilities for runoff quantity control. They shall also be constructed to withstand an environment of periodic inundation, potentially corrosive chemical or electro-chemical soil conditions, and heavy ground surface loading. In addition, they shall be accessible for maintenance.

Tanks and vaults can be used in conjunction with other detention storage facilities, such as ponds or parking lot ponds, to provide initial or supplemental storage.

The following are criteria specific to detention tank and vault design:

4.2.5.1 General Design Criteria

1) Public detention tanks and vaults are not permitted outside public street rights-of-way when such facilities serve more than one lot, such as a subdivision or minor partition. Privately owned and maintained detention tanks and vaults shall not be located in the public right of way nor shall they be located on public property.

2) All tanks and vaults shall be designed as flow through systems unless separate sediment containment is provided.

3) The minimum pipe size for a detention tank is 36 inches (42 inches for a publicly maintained facility). If the collection pipe is designed to also provide storage, the resulting maximum water surface elevation shall maintain a minimum 1 foot of freeboard in any catch basin below the catch basin grate (or flowline for curb opening inlets) during the 25-year design storm event. Pipe capacity analysis of the contributory system shall be verified using a backwater analysis.

4) Detention Tanks and vaults shall have a minimum of one-half-foot of dead storage. The bottom of the tank or vault shall be laid flat. See Chapter 5 for conditions when the minimum depth of dead storage must be increased for water quality concerns.

5) The minimum internal height of a vault or tank shall be 3 feet and the minimum width shall be 3 feet (3.5 feet minimum for publicly maintained facilities). The maximum depth to the vault invert shall be 20 feet.

4.2.5.2 Materials and Structural Stability

1) Pipe material and joints for tanks and vaults shall have a protective treatment. Pipe material shall be one of the following: reinforced concrete pipe, aluminum coated (corrugated or spiral rib) steel pipe, or aluminum (corrugated or spiral rib) pipe. For public facilities, detention tank pipe material and surface treatment shall conform to the standards in Table 6-4, Approved Pipe Materials.

2) All tanks and vaults shall meet structural requirements for overburden support and traffic loading, if appropriate. AASHTO HS-20 live loads shall be accommodated for tanks and vaults lying under roadway or parking areas. Metal tank end plates shall be designed for structural stability at maximum hydrostatic loading condition. Flat end plates generally require thicker gage material than the pipe and/or require reinforcing ribs. Tanks and vaults shall be placed on stable, well-consolidated native material with a suitable bedding. Tanks and vaults shall not be allowed in fill slopes, unless analyzed in a soils report for stability and construction practices.

3) Detention Vaults shall be constructed of minimum 3000-psi structural reinforced concrete. All construction joints shall be provided with water stops. A Professional Engineer shall design all vaults. Structural designs for private system cast-in-place vaults require a separate commercial building permit issued by the City's Building Division. Vaults shall be placed on stable, well-consolidated native material with suitable bedding. Vaults shall not be allowed in fill slopes, unless analyzed in a soils report for stability and construction practices.

4) In moderately pervious soils where seasonal groundwater may induce flotation, buoyancy tendencies shall be balanced by providing ballast of earth backfill or concrete backfill, by providing concrete anchors or by increasing the total weight. Calculations shall be required which demonstrate stability.

4.2.5.3 Access

1) All areas of the tank or vault shall be within 50 feet of a minimum 36-inch diameter access with 24-inch diameter cover. A ladder or a set of steps to the bottom of the vault is required.

2) CMP access risers: Outside of any areas subject to vehicular loads, 36-inch minimum diameter CMP access risers of the same gage as the tank material may be used for access along the length of the tank and at the upstream terminus of the tank if the tank is designed with a common inlet/outlet so that it is a backup system rather than flow through system. The City Engineer may allow risers in traffic areas with an appropriate traffic bearing design.

3) All tank and vault access openings shall have round, solid, locking lids

4) Conveyance pipes shall be connected to the detention tanks as follows:

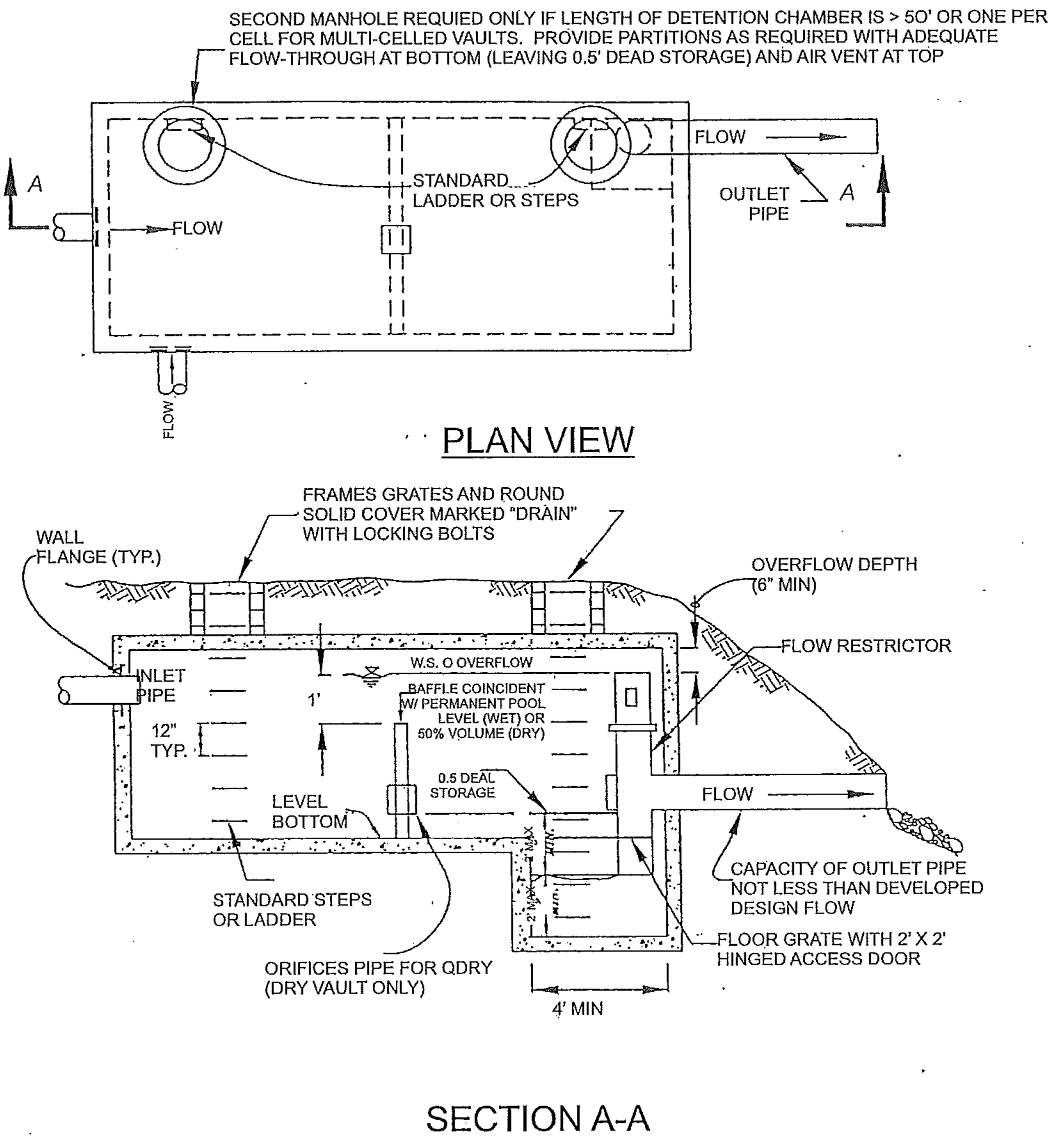
    a. If tank diameter is 48 inches or less, then a 48-inch access manhole at each end are required.

b. If tank diameter is greater than 48 inches, then access ports may be substituted for 48-inch manholes at each end of the tank.

c. Roof / foundation drains may be directly connected to the top quarter of the tank.

5) Access roads are required to all publicly maintained detention tanks and vault access openings and control structures not located in improved public rights-of-way. See Section 4.2.2.3 M. for access requirements.

FIGURE 4-8 – DETENTION VAULT DETAIL

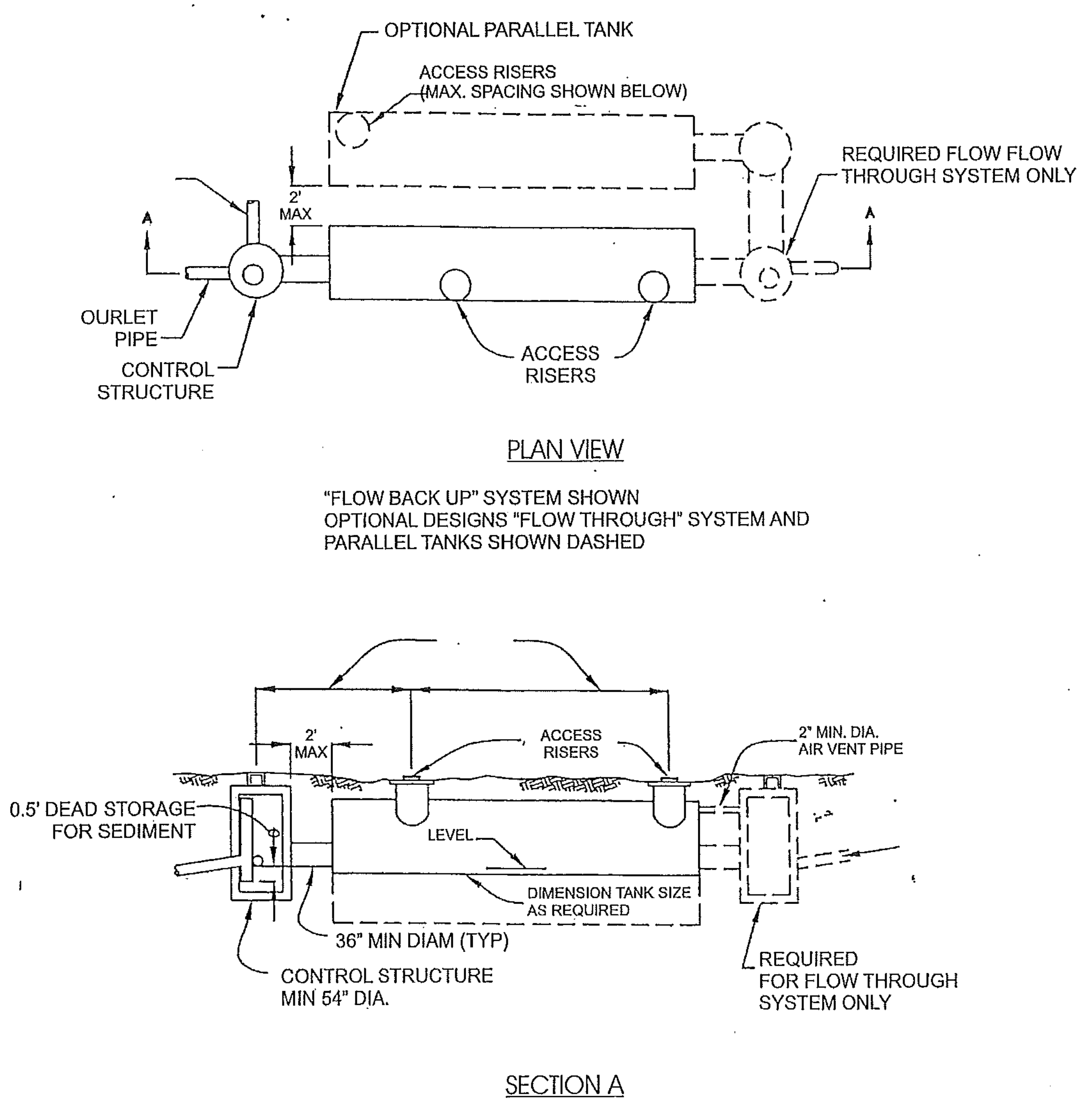


NOTES:

1. PLANS MUST BE DESIGNED AND STAMPED BY A REGISTERED PROFESSIONAL STRUCTURAL ENGINEER.
2. ALL METAL PARTS SHALL BE CORROSION RESISTANT.
3. PROVIDE WATERSTOP AT ALL CAST-IN-PLAACE CONSTRUCTION JOINTS. PRECAST FAULTS SHALL HAVE APPROVED RUBBER GASKET SYSTEM.

NTS

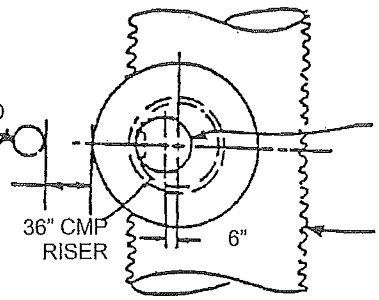
FIGURE 4-9 – DETENTION TANK DETAIL



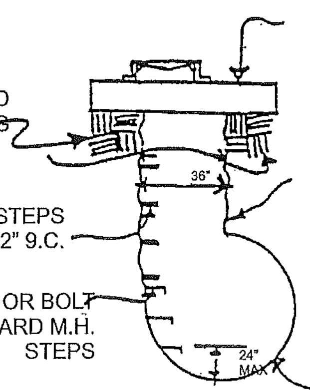
NOTE:
ALL METAL PARTS CORROSION RESISTANT STEEL PARTS
GALVINIZED AND ASPHALT COATED (TREATMENTS 1 OR BETTER).

FIGURE 4-10 – DETENTION TANK ACCESS RISER

RESTRICTIONS FOR APPLICATION: USE ONLY FOR ACCESS TO DETENTION TANKS. NOT ALLOWED FOR USE IN ROADWAYS DRIVEWAYS, PARKING STALLS OR WHERE VEHICULAR LOADS WOULD OCCUR.



PLAN VIEW
nts



SECTION
nts

NOTES:
1. USE ADJUSTING BLOCKS AS REQUIRED TO BRING FRAME TO GRADE.
2. ALL MATERIALS MUST BE CORROSION RESISTANT.
3. MUST BE CONVENIENTLY LOCATED FOR MAINTENANCE VEHICLE ACCESS.

4.2.6 Control Structures

Detention control structures may be either weir structures or orifice structures. Weir structures may be either enclosed in a catch basin or vault, or they may be installed in the open, provided that they are accessible for maintenance and are not exposed to damage.

All detention control facilities shall provide oil/water separation prior to discharge. This can be accomplished by incorporating oil/water separation into the design of the control structure or by installing a separate spill containment (SC) oil/water separator vault.

4.2.6.1 Control Structure Design Criteria

1) Flow control manholes shall have solid locking covers. Open grates shall not be permitted in control manholes.
2) Multiple orifices are usually necessary in order to meet the 50% of 2-year, 5-year and 25-year performance requirements for a detention system. Usually, no more than two orifices will be necessary in order to achieve the required performance. However, high flow rates may result in excessively large orifice sizes that are impractical to construct. In such cases, several orifices may be located at the same elevation to reduce the size of each individual orifice. Minimum orifice size is three fourths of an inch.
3) Orifices may be constructed on a "Tee" riser section as shown in Figure 4-11 or on a baffle as shown in Figure 4-12.
4) When it is required that the release rate from a 2-year, 24-hour storm event be limited to 50% of the pre-development 2-year release rate, there may be instances where the 2-year water surface elevation is too high to physically construct an upper orifice above the 2-year storage elevation. In such an instance, a notch weir in the riser pipe may be used to meet performance. See Figure 4-13 for design and sizing criteria. Formulas for rectangular notched weirs and notched weirs are as follows:

<u>RECTANGULAR NOTCHED SHARP CRESTED WEIR (See Figure 4-12)</u>

$$Q = C\,(L - 0.2H) * H^{1.5}$$

Where:

Q = Weir discharge, cubic feet per second (cfs)
C = 3.27 + 0.40*H/P, feet
P = Height of weir bottom above downstream water surface, feet
H = Height from weir bottom to crest, feet
L = Length of weir, feet*

* For weirs notched out of circular risers, length is the portion of the riser circumference not to exceed 50% of the circumference.

V-NOTCHED SHARP CRESTED WEIR (See Figure 4-12)

$$Q = C_d\ (\text{Tan}\ \Theta/2) * H^{5/2}$$

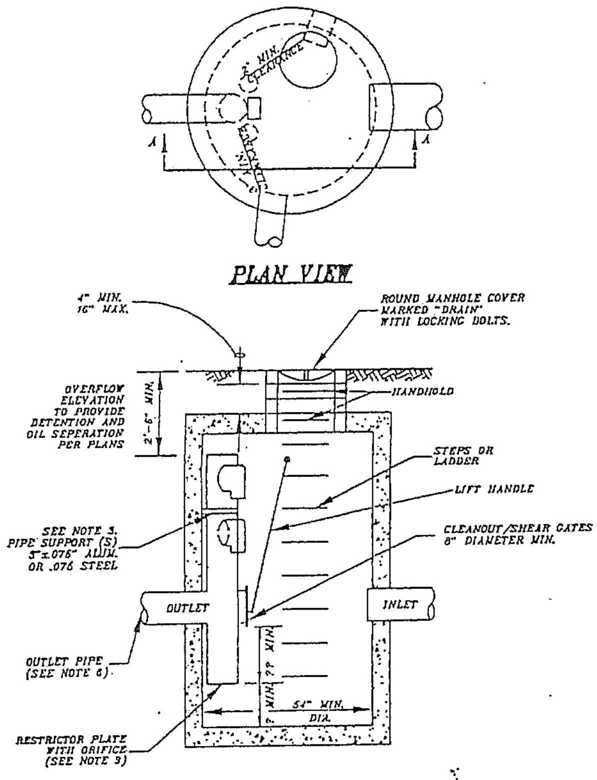
Where:

Q = Weir discharge, cubic feet per second (cfs)
C_d = Contraction coefficient, feet (range of values 0.597 – 0.625, suggested value = 0.600)
Θ = Internal angle of notch, degrees
H = Height from weir bottom to crest, feet

5) Where flow control is provided using weir control rather than orifice control, an alternative method shall be used for providing oil/water separation. Either an oil/water separation baffle shall be installed (see Figure 4-13), or a separate oil/water separation structure shall be provided.

6) The control structure shall be designed to pass the 25-year design storm event as overflow without causing flooding of the contributing drainage area and without allowing runoff to discharge through the secondary overflow spillway.

FIGURE 4-11 – ORIFICE LOCATION – TEE RISER



NOTES:

1. EXCEPT AS SHOWN OR NOTED, UNITS SHALL BE CONSTRUCTED IN ACCORDANCE WITH THE REQUIREMENTS FLOW CONTROL STRUCTURE. 60" MINIMUM DIAMETER.

2. FOR DETAILS SHOWING GRADE RING, LADDER, STEPS, MANHOLES, AND TOP SLABS, SEE STANDARD PLAN 4-08-1

3. PIPE SUPPORTS AND RESTRICTOR/SEPARATOR SHALL BE OF THE SAME MATERIAL AND BE ANCHORED AT 3' MAX. SPACING BY 1/8" DIA. STAINLESS STEEL EXPANSION BOLTS OR EMBEDDED 2" IN WALL.

4. THE RESTRICTOR/SEPARATER SHALL BE FABRICATED FROM .060" ALUMINUM, OR .064 ALUMINIZED STEEL, OR .064" GALVANIZED STEEL PIPES IN ACCORDANCE WITH AASHTO M-36, M-196, M-197, AND M-214.

6. OUTLET SHALL BE CONNECTED TO CULVERT OR SEWER PIPE WITH A STANDARD COUPLING BOND OR GROUTED INTO THE BELL OF THE CONCRETE PIPE.

6. THE VERTICAL RISER STEM OF THE RESTRICTOR/SEPARATOR SHALL BE THE SAME DIAMETER AS THE HORIZONTAL OUTLET PIPE, WITH AN 8" MINIMUM DIAMETER.

7. FRAME AND LADDER OR STEPS ARE TO BE OFFSET SO THAT:
   A. CLEANOUT GATE IS VISIBLE FROM TOP.
   B. CLIMB-DOWN SPACE IS CLEAR OF RISER AND GATE.
   C. FRAME IS CLEAR OF CURB (IF ANY EXISTS).

8. MULTI-ORIFICE ELBOWS MAY BE LOCATED AS SHOWN OR ALL ON ONE SIDE OF RISER TO ASSURE LADDER CLEARANCE. SIZE OF ELBOWS AND PLACEMENT TO BE DETERMINED BY THE ENGINEER.

9. RESTRICTOR PLATE WITH ORIFICE AS SPECIFIED IN THE CONTRACT PLANS. OMIT PLATE IF FOR OIL POLLUTION CONTROL ONLY. SPECIFIED OPENING TO BE CUT ROUND AND SMOOTH.

10. CLEANOUT/SHEAR GATE:
ALUMINUM ALLOY PER B-26-28-32E OR CAST IRON ASTM A48 CLASS 30B AS REQUIRED. LIFT HANDLE EITHER SOLID OR TUBING WITH ADJUSTABLE HOOK AS REQUIRED. NEOPRENE RUBBER GASKET REQUIRED BETWEEN RISER MOUNTING FLANGE AND GATE FLANGE. MATING SURFACES OF LID AND BODY TO BE MACHINED FOR PROPER FIT. FLANGE MOUNTING BOLTS SHALL BE 3/4" DIA. STAINLESS STEEL.

11. GATE SHALL NOT OPEN BEYOND THE CLEAR OPENING BY LIMITED HINGE MOVEMENT, STOP TABS, OR SOME OTHER DEVICE.

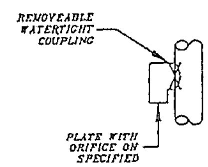
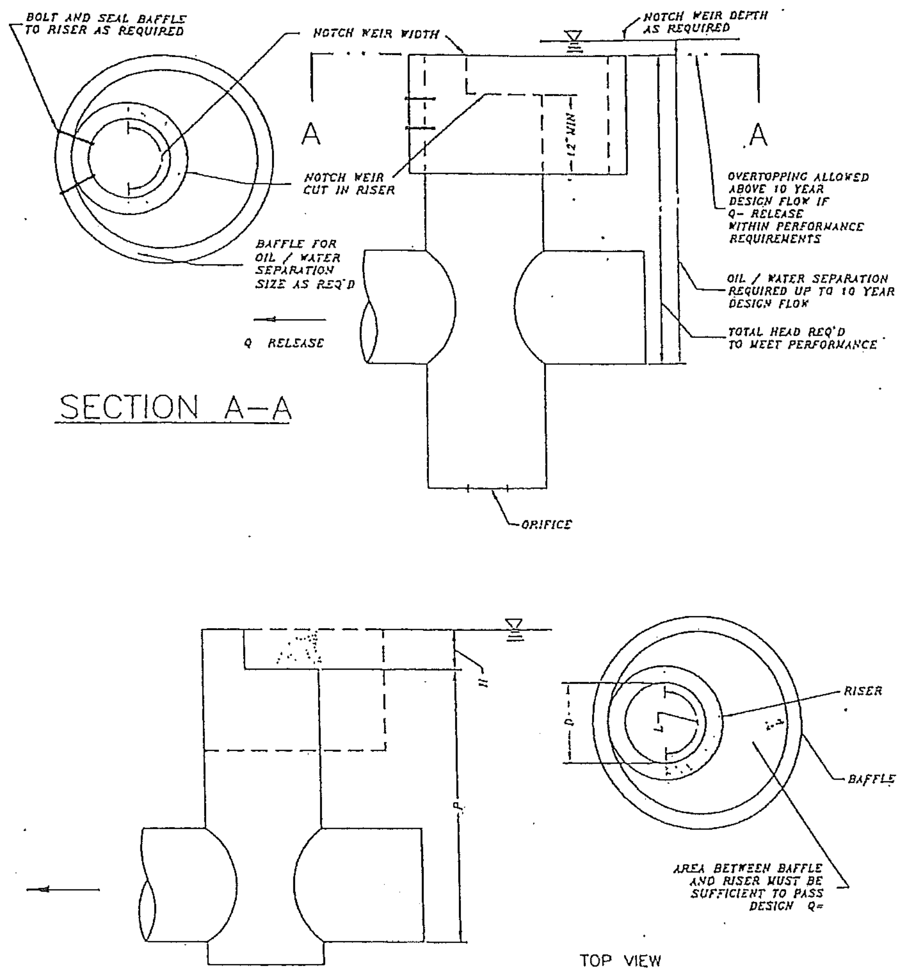


FIGURE 4-12 – TEE SECTION WITH NOTCH WEIR & BAFFLE



SIDE VIEW

$Q = C(L - 0.2H)H^{3/2}$ CFS

WHERE $C = 3.27 + 0.40\ H/P$ (IN FEET).

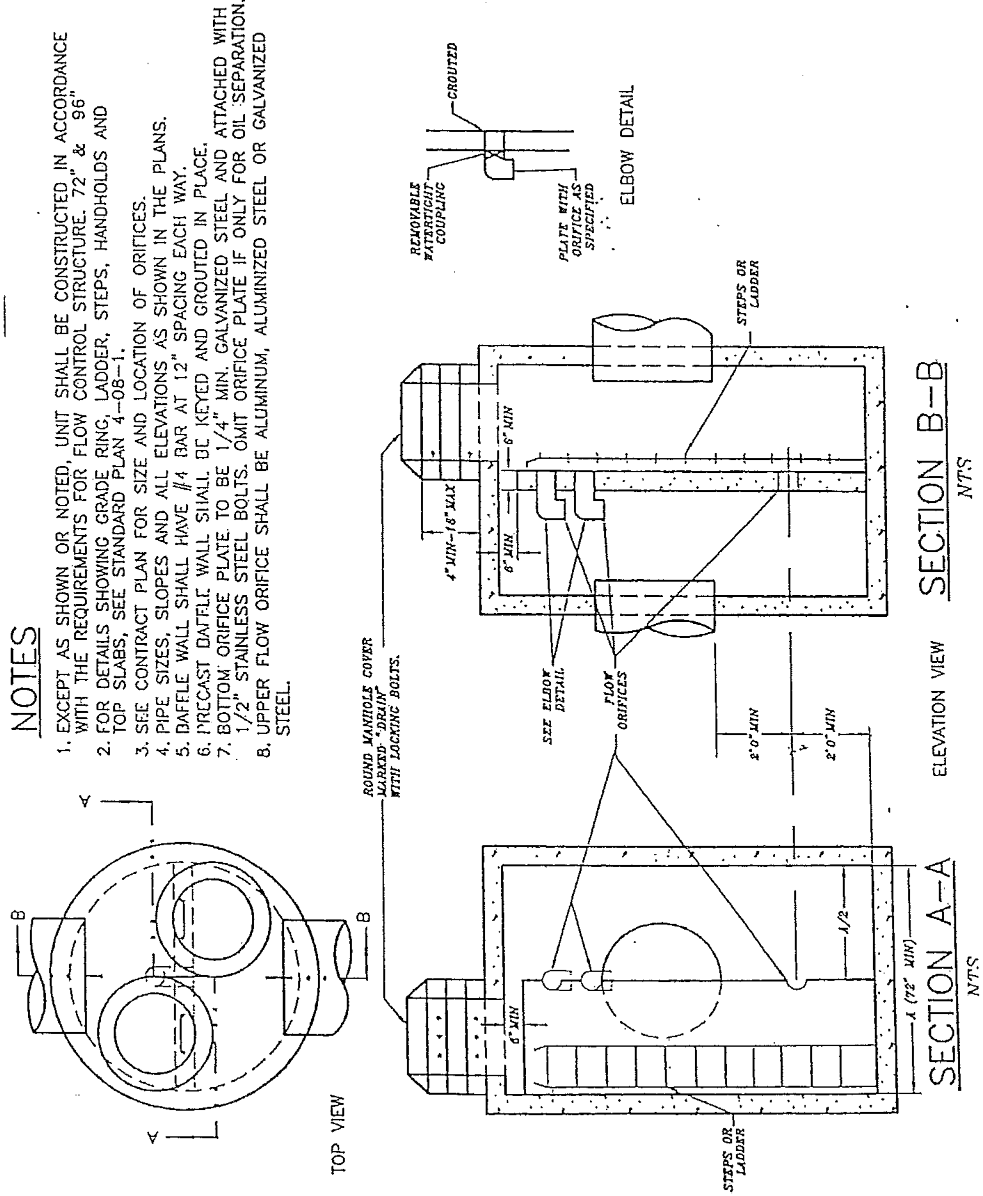
L = LENGTH OF THE PORTION OF THE RISER CIRCUMFERENCE AS NECESSARY (IN FEET). NOT TO EXCEED 50% OF THE CIRCUMFERENCE.

H & P AS SHOWN ABOVE.

D = INSIDE RISER DIAMETER.

NOTE THAT TO ACCOUNT FOR SIDE CONTRACTIONS, SUBTRACT 0.1 H FROM L FOR EACH SIDE OF THE NOTCH WEIR.

FIGURE 4-13 – ORIFICE LOCATION – BAFFLE RISER



NOTES

1. EXCEPT AS SHOWN OR NOTED, UNIT SHALL BE CONSTRUCTED IN ACCORDANCE WITH THE REQUIREMENTS FOR FLOW CONTROL STRUCTURE. 72" & 96"
2. FOR DETAILS SHOWING GRADE RING, LADDER, STEPS, HANDHOLDS AND TOP SLABS, SEE STANDARD PLAN 4-08-1.
3. SEE CONTRACT PLAN FOR SIZE AND LOCATION OF ORIFICES.
4. PIPE SIZES, SLOPES AND ALL ELEVATIONS AS SHOWN IN THE PLANS.
5. BAFFLE WALL SHALL HAVE #4 BAR AT 12" SPACING EACH WAY.
6. PRECAST BAFFLE WALL SHALL BE KEYED AND GROUTED IN PLACE.
7. BOTTOM ORIFICE PLATE TO BE 1/4" MIN. GALVANIZED STEEL AND ATTACHED WITH 1/2" STAINLESS STEEL BOLTS. OMIT ORIFICE PLATE IF ONLY FOR OIL SEPARATION.
8. UPPER FLOW ORIFICE SHALL BE ALUMINUM, ALUMINIZED STEEL OR GALVANIZED STEEL.

4.2.7 Sumps and Sedimentation Manholes

1) Sumps are used in lieu of a storm sewer system to provide street drainage by collecting and recharging stormwater runoff into the ground. Sumps are highly dependent on soil type and height of groundwater table.

2) Sumps are recognized as a disposal method for managing stormwater runoff. They are not used to meet pollution reduction requirements. Sedimentation and sump systems are excluded from use within major City traffic streets, including major truck streets.

3) Sedimentation manholes receive runoff from inlets before stormwater enters the sumps. The sedimentation manholes settle out most of the heavy particulate material that can clog a sump's drainage holes, decreasing maintenance needs and increasing long-term effectiveness. A "sump system" (see Figure 4-14) is the total of all sump components at a single location (e.g., an intersection) and consists of inlets, piping, a sedimentation manhole, and one or more sumps. If one sump lacks adequate capacity to handle the design flow, a second sump may be placed in series with the first to provide additional capacity.

4) When constructed according to the standard design procedures, the sump system achieves both flow control and pollution reduction benefits. The system reduces pollution through removal of sediment, oil, and grease. Removal of these materials is consistent with the water quality requirements for areas outside the excluded areas described above.

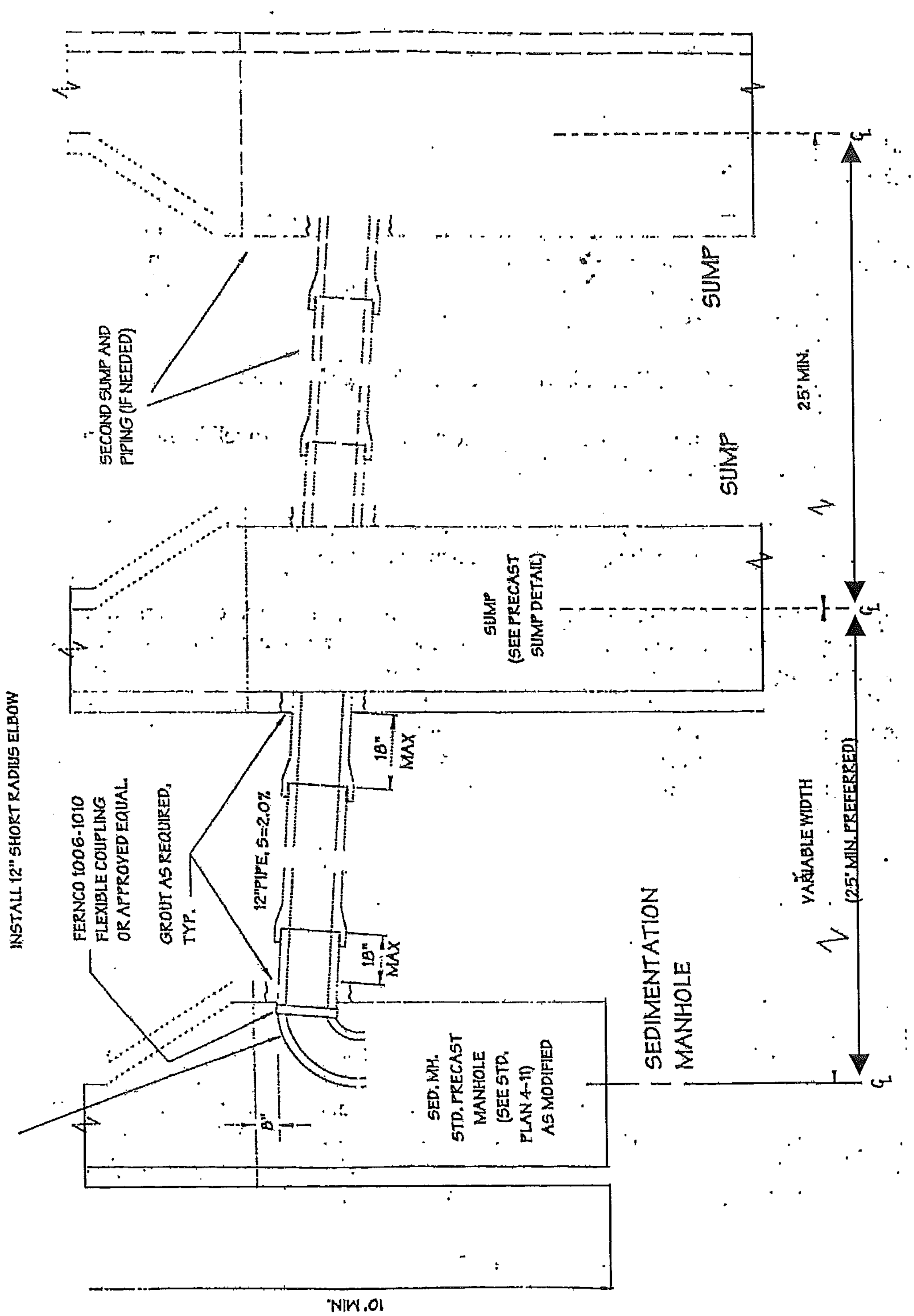
5) Soil conditions are critical to the success of sump systems. The use of sumps will not be approved without supporting geotechnical evidence and a documented sump test to demonstrate they will work in that area. The geotechnical evidence must include test sump data to provide local underground information about soil conditions and the potential infiltration capacity of the surrounding soil. Before being accepted by the City, all sumps must be tested to assure they meet or exceed the design capacity.

6) Detail drawings of a standard sump and standard sedimentation manhole can be found in Figure 4-14.

4.2.7.1 General Design Criteria

- A sump system shall be designed to handle twice the flow from the calculated design storm.
- Sumps are not allowed on major streets.
- A maximum of two sumps shall be used in a series.
- The minimum distance between sumps shall be 25 feet.

FIGURE 4-13 – ORIFICE LOCATION – BAFFLE RISER



- The desired distance between the sump and the sedimentation manhole is 25 feet. This figure is a guideline and depends on site conditions.
- Sumps shall not be located within 200 feet from the tops of slopes more than 10 feet high and steeper than 2h:1v.
- The sedimentation manhole depth shall be 10 feet.
- The sump depth shall be 30 feet, unless otherwise approved by the City Engineer.
- The diameter of pipe between the sump and sedimentation manhole shall be 12 inches. (Note: the pipe leaving the sedimentation manhole is fitted with a 90-degree short-radius elbow; see Figure 4-14.
- The pipe type between the sump and sedimentation manhole shall be ASTM C-14 class 3 CSP or HDPE SDR 26, conforming to ASTM F-714 and ASTM D-3350.

4.2.7.2 Method of Analysis

- Hydraulic calculations for sumps are typically done with the Rational Method. Other methods must be approved by the City Engineering. Information on the use and application of the Rational Method is found in Chapter 6.
- Sumps shall be designed for a 10-year design storm event.
- The minimum time of concentration for sump design shall be 5.0 minutes.

4.2.7.3 Operation and Maintenance Requirements

See Section 7.2.7.

4.2.8 Horizontal Infiltration Trenches

7) Horizontal infiltration trenches are designed to store runoff while allowing it to infiltrate into native soils where it can recharge groundwater while at the same time reducing total flow into the streets.

8) Shallow horizontal infiltration trenches are allowed for minor partition residential lots. They are also allowed, by exception and approval by the City, in subdivision and planned unit development residential lots when topographical or other constraints dictate this method. These exceptions would be driven by unusual drainage circumstances (e.g., cannot drain roof and/or foundation drains to street or approved alternative swale or ditch). The property owner is responsible for the maintenance of all private systems and will bear the cost of the facility replacement.

9) Infiltration facilities shall not be operated (e.g., connected to roof and/or foundation drains), and no surface runoff shall enter the system, until all project improvements that produce surface runoff are completed and all exposed ground surfaces are stabilized by revegetation or landscaping.

4.2.8.1 General Design Criteria

1) Infiltration trenches shall meet the following setback requirements for slopes, to the extent the site allows:

- Minimum of 100 feet from slopes of 10%; add 5 feet of setback for each additional 1% of slope up to 30%;
- 200-foot setback for slopes of 30%;
- No facilities allowed near slopes > 30%.

2) The infiltration surface must be in native soil excavated at least one-foot in depth.
3) Infiltration trenches shall have an overflow outlet that flows into riprap or other appropriate scour and velocity control material for the flows above the 2-year storm.
4) Infiltration systems shall not use fill material nor placed over fill soils.
5) Infiltration facilities shall be designed for a 2-year, 24-hour duration storm event.

4.2.8.2 Operation and Maintenance Requirements

See Section 7.2.8.

APPENDIX 4-1

Discussion on a Control Structure Analysis

City of Cascade Locks Stormwater and Grading Design Standards

III-2.4.1 Methods of Analysis

The methods of analysis for detention storage volume and discharge rates shall be in accordance with the hydrologic methods described in Chapter III-1.

Flow analysis of orifices and weirs may be done using the following methods:

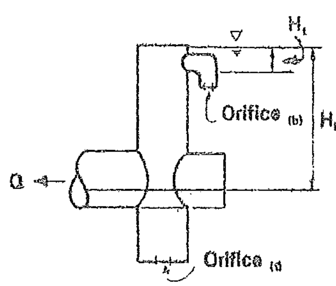
Orifices: Flow-through orifice plates in a standard "tee" section or turn-down elbow may be approximated by the general equation:

$$Q = CA \quad (2gh)^{0.5} \quad \text{in cfs}$$

where:
- A = area of orifice, ft^2
- C = 0.62, coefficient of discharge
- h = hydraulic head in feet
- g = acceleration of gravity = 32.2 ft/sec^2

Figure III-2.32 illustrates this simplified application of the orifice equation.

Figure III-2.32 Simple Orifice



$$Q = C\ A_b\ (2gh_b)^{1/2} + C\ A_t\ (2bh_t)^{1/2}$$

$$= C\ (2g)^{1/2}\ (A_b(h_b)^{1/2} + A_t\ (h_t)^{1/2}) \quad \text{cfs}$$

h_b = distance from hydraulic grade line at the 2 year flow of the outflow pipe to the overflow elevation

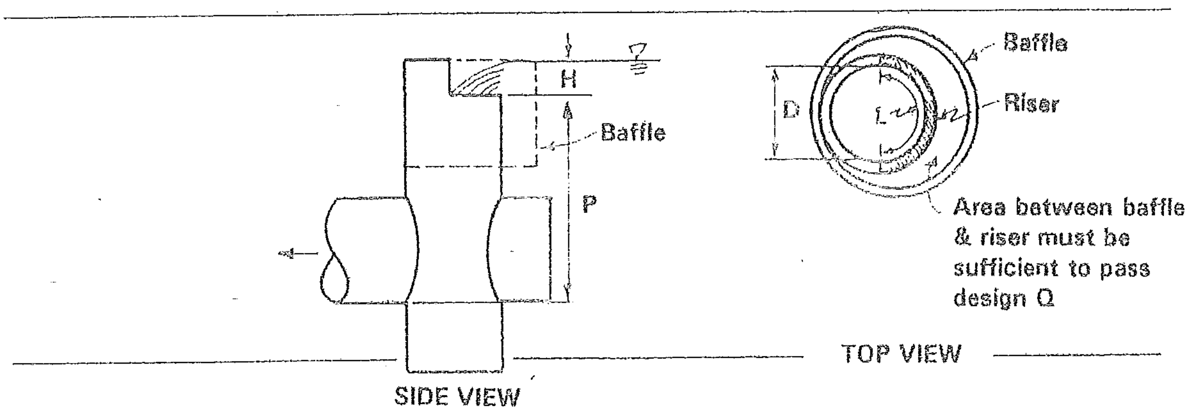
Rectangular, Sharp Crested Weir: The notch weir design shown in Figure III-2.33 may be analyzed using standard weir equations for the fully contracted condition.

$$Q = C(L-0.2H)H^{3/2} cfs$$

where:
- C = 3.27 + 0.40 H/P (in feet).
- L = Length of the portion of the riser circumference as necessary (in feet), not to exceed 50 percent of the circumference.
- H and P as shown in the figure
- D = Inside riser diameter

Note that to account for side contractions, subtract 0.1 H from L for each side of the notch weir.

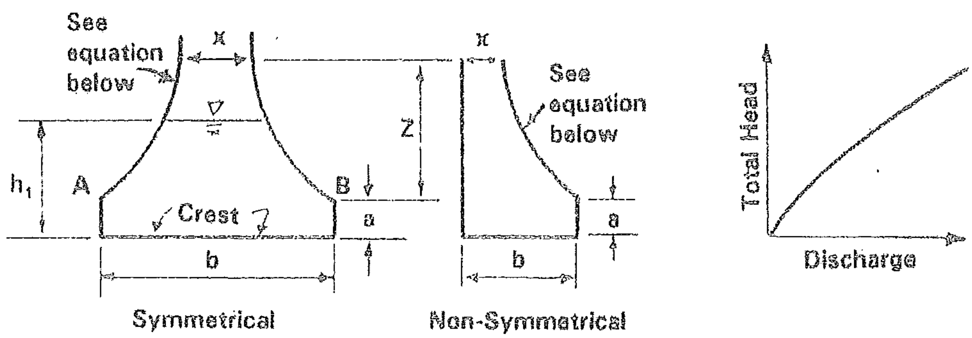
Figure III-2.33 Notch Weir



Proportional or Sutro Weir: This weir is designed so that the discharge is proportional to the total head. This design may be useful in some cases to meet required performance.

The Sutro Weir consists of a rectangular section joined to a curved portion which provides proportionality for all heads above a line connecting points A and B (see Figure III-2.34).

Figure III-2.34 Sutro Weir



The head-discharge relationship is:

$$Q = C_d\ b\ (2ga)^{0.5}\ (h_1 - a/3)$$

Values of C_d for both symmetrical and non-symmetrical Sutro Weirs are summarized below in Table III-2.9 (Note that when $b > 1.50$ or $a > 0.30$ use $C_d = 0.6$.):

Table III-2.9 Values of C_d for Sutro Weirs

C_d Values, Symmetrical

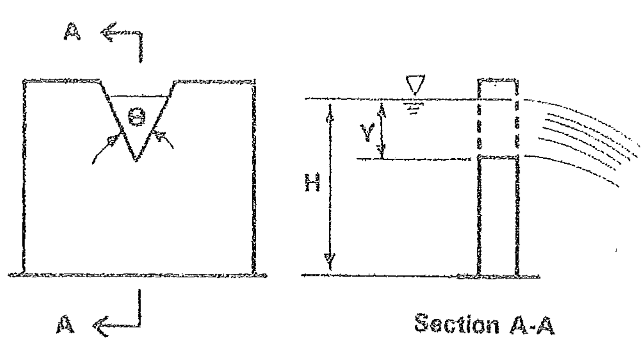
	b, ft.				
a (ft)	0.50	0.75	1.0	1.25	1.50
0.02	0.608	0.613	0.617	0.6185	0.619
0.05	0.606	0.611	0.615	0.617	0.6175
0.10	0.603	0.608	0.612	0.6135	0.614
0.15	0.601	0.6055	0.610	0.6115	0.612
0.20	0.599	0.604	0.608	0.6095	0.610
0.25	0.598	0.6025	0.6065	0.608	0.6085
0.30	0.597	0.602	0.606	0.6075	0.608

C_d Values, Non-Symmetrical

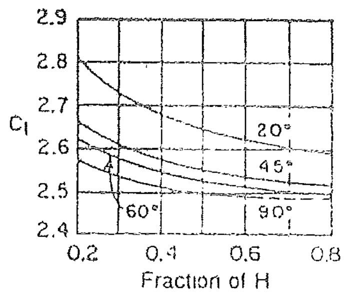
	b, ft.				
a (ft)	0.50	0.75	1.0	1.25	1.50
0.02	0.614	0.619	0.623	0.6245	0.625
0.05	0.612	0.617	0.621	0.623	0.6235
0.10	0.609	0.614	0.618	0.6195	0.620
0.15	0.607	0.6115	0.616	0.6175	0.618
0.20	0.605	0.610	0.614	0.6155	0.616
0.25	0.604	0.6085	0.6125	0.614	0.6145
0.30	0.603	0.608	0.612	0.6135	0.614

V-Notch, Sharp Crested Weir: V-Notch weirs, as shown in Figure III-2.35, may be analyzed using standard equations for the fully contracted condition.

Figure III-2.35 V-Notch, Sharp Crested Weir



Where values of C_d may be taken from the following chart:



$Q = C_d(\mathrm{Tan}(\Theta/2))H^{5/2}$, in cfs

Details

Standard control structure details are shown in Figures III-2.36 and III-2.37.

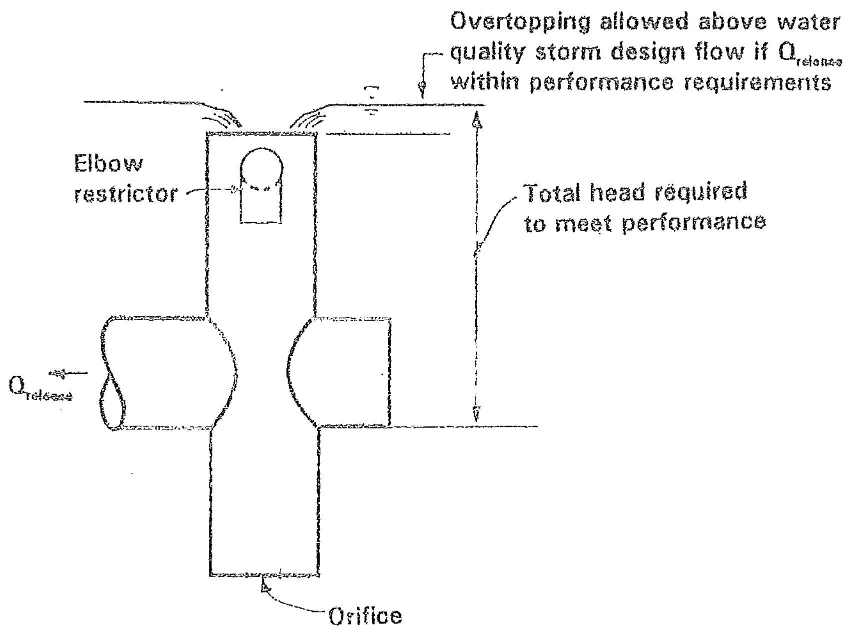
III-2.4.3 Maintenance of Control Structures

Control structures and catch basins have a history of maintenance-related problems and it is imperative that a good maintenance program be established for their proper functioning. A typical problem is that sediment builds up inside the structure which blocks or restricts flow to the inlet. To prevent this problem these structures should be routinely cleaned out a least twice per year. Regular inspections of control structures should be conducted to detect the need for non-routine cleanout, especially if construction or land-disturbing activities are occurring in the contributing drainage area.

A 15-foot wide access road to the control structure should be installed for inspection and maintenance.

Table III-2.10 provides maintenance recommendations for control structures and catch basins.

Figure III-2.36 Standard Control Structure Detail - Orifice Control



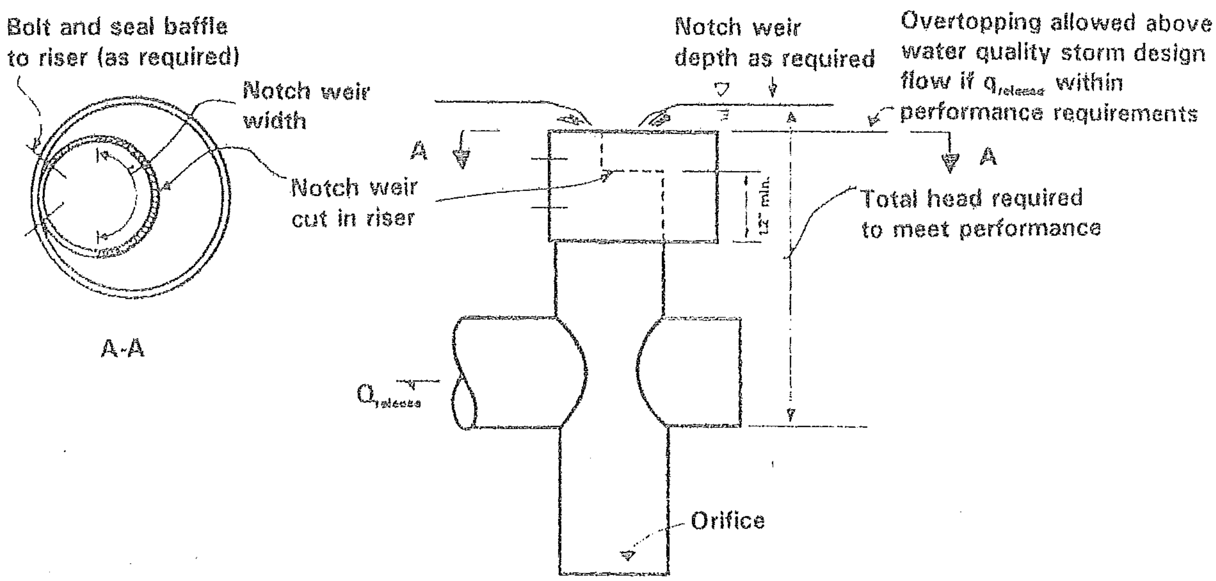


Figure III-2.37 Standard Control Structure Detail - Notch Control

APPENDIX 4-2

Ground Cover Seed Mixture Data

Source: Hobbs & Hopkins LTD

City of Cascade Locks Stormwater and Grading Design Standards

BIO-FILTER SPECIFICATIONS

Pro-Time 835 Bio Filter Summer Green Vegetative Cover

Designed to provide a green cover year round. This mix combines hardy, drought tolerant herbaceous plants with low growing grasses for a self sustaining filtration cover.

Seeding Rate: 2 lbs. per 1000 square feet

PR8820 Perennial Ryegrass	*Lolium Perenne 'PR8820'*	60%
Eureka Hard Fescue	*Festuca ovina duriuscula 'Eureka'*	15%
Dwarf White Yarrow	*Yarrow millefolium*	8%
Dutch White Clover	*Trifolium repens*	8%
Salinas Strawberry Clover	*Trifolium Faglferum 'Salina'*	5%
Sweet Alysuum	*Alyssum maritimum*	4%

Pro-Time 840 Native Bio-Filter (Wetlands) Mix

Seeding Rate: 20 – 40 lbs. per acre

Blue Wildrye	*Elymus glaucus*	47%
Meadow Barley	*Hordeum brachyantherum*	40%
Tufted Hairgrass	*Deschampsia caespitosa*	10%
Western Mannagrass	*Glyceria occidentals*	2%
American Sloughgrass	*Beckmannia syzigachne*	1%

Pro-Time 820 Bio-Filter Grass Cover

This mixture will establish quickly to form an effective filtering system. For use in low-maintenance situations where taller a cover is acceptable.

Seeding Rate: 5 lbs. per 1000 square feet

Forage Tall Fescue	*Festuca arundinacea*	67%
R.2 Perennial Ryegrass	*Lolium perenne 'R.2'*	25%
Cindy Creeping Red Fescue	*Festuca rubra 'Cindy'*	5%
New Zealand White Clover	*Trifolium repens*	3%

Mixes are subject to change without notice due to availability.

Hobs & Hopkins LTD – 1712 S.E. Ankeny – Portland, OR 97214 – (503) 239-7518 – (800) 345-2395

Pro-Time 825 Dwarf Bio-Filter Grass Mix

A low growing mixture that is designed for use in mowed areas where a more manicured look is desired. If left unmowed, this mix will not grow over approximately 18 inches. Establishes quickly to form an effective filtering system.

Seeding Rate: 5 – 7 lbs. per 1000 square feet

PR8820 Perennial Ryegrass	*Lolium Perenne 'PR8820'*	70%
Creeping Red Fescue	*Festuca rubra*	20%
Highland Colonial	*Bentgrass Agrostis tenuis*	10%

Pro-Time 830 Bio-Filter Mix for Wet & Shady Areas

This special mixture will persist in wet soils and is extremely shade tolerant. It is low growing for use in mowed or unmowed situations.

Seeding Rate Mowed: 5 lbs. per 1000 square feet

Seeding Rate Unmowed: 3 lbs. per 1000 square feet

PR8820 Perennial Ryegrass	*Lolium Perenne 'PR8820'*	60%
Cindy Creeping Red Fescue	*Festuca rubra 'Cindy'*	25%
RedTop Bentgrass	*Agrostis Alba*	5%
Highland Colonial	*Bentgrass Agrostis tenuis*	5%
Sabre II Rough Stalk Bluegrass	*'Poa trivialis Sabre II'*	5%

Mixes are subject to change without notice due to availability.

Hobs & Hopkins LTD – 1712 S.E. Ankeny – Portland, OR 97214 – (503) 239-7518 – (800) 345-2395

ProTime 705 PDX Ecology Feed Mixture

Flexibility is the key word when describing PDX Seed Mixture. From unmowed highway banks to the casual backyard lawn, PDX provides year round green cover under all levels of maintenance; mowed or unmowed. This is the alternative to tall grass and lawns that turn brown during the summer.

Seeding Rate: 1.5 – 2.0 lbs per 1000 square feet

PR8820 Perennial Ryegrass	*Lolium Perenne 'PR8820'*	60%
Eureka Hard Fescue	*Festuca ovina duriuscula 'Eureka'*	15%
Dwarf White Yarrow	*Yarrow millefolium*	8%
Dutch White Clover	*Trifolium repens*	8%
Salinas Strawberry Clover	*Trifolium Faglferum 'Salina'*	5%
Sweet Alysuum	*Alyssum maritimum*	4%

PR8820 Dwarf Perennial Ryegrass and Eureka Hard Fescue, combine with low-growing herbaceous plants and clovers to produce a green cover without supplemental irrigation....and normally requires no fertilizer after establishment.

Eureka is the outstanding new generation hard fescue bred for a reduced rate of vertical growth, excellent density, superior disease resistance and an adaptability to a wide range of soil and climatic conditions, including sun and shade. Eureka has a lower demand for water and fertilizer when compared with most other cool season grasses. PR8820, coupled with Eureka Hard Fescue, forms the perfect foundation for the herbaceous plants and clover in this mixture.

Yarrow Millefolium is a small type with soft feather-like foliage. Unmowed, it will bloom all summer with an attractive small white flower. It provides green cover when the grasses go dormant. Alyssum also provides green color and produces tiny white flowers throughout the first season.

Dutch White Clover forms a lush green cover in summer. Salina Strawberry Clover does the same with an added bonus of dainty pink flowers. Both are nitrogen fixing legumes.

Mixes are subject to change without notice due to availability.

Hobs & Hopkins LTD – 1712 S.E. Ankeny – Portland, OR 97214 – (503) 239-7518 – (800) 345-2395

ProTime 710 PDX-Plus Green Cover Plus Flowers

PDX Plus combines the low-growing green cover of PDX with colorful wildflowers to provide an aesthetically pleasing ground cover for soil stabilization or low maintenance areas. From unmowed highway banks to the casual meadow, PDX Plus provides green cover year round without supplemental irrigation, and with the added bonus of colorful wildflowers.

PDX Plus is designed to be unmowed.

Seeding Rate: 1.5 – 2.0 lbs per 1000 square feet, depending upon slope.

PR8820 Perennial Ryegrass	*Lolium Perenne 'PR8820'*	60%
Eureka Hard Fescue	*Festuca ovina duriuscula 'Eureka'*	15%
Dwarf White Yarrow	*Yarrow millefolium*	7.5%
Dutch White Clover	*Trifolium repens*	6%
Perennial Lupine	*Lupinus perennis*	4.5
Salinas Strawberry Clover	*Trifolium Faglferum 'Salina'*	3%
California Poppy	*Eschcholzia californica*	3%
Sweet Alysuum	*Alyssum maritimum*	2%
Shasta Daisy	*Chysanthemum maximum*	1.5%
Godetia	*Clarkia amoena*	1.5%

Eureka Hard Fescue and PR8820 Dwarf Perennial Ryegrass, combine with herbaceous plants, clovers and wildflowers to produce a green cover without supplemental irrigation and normally requires no fertilizer after establishment.

Yarrow, Lupine, Cal Poppy, Daisy and Godetia will bloom all season with attractive flowers, and yarrow foliage will stay green when the grasses go dormant. Alyssum also provides green color and produces tiny white flowers throughout the first season.

Dutch White Clover forms a lush green cover in summer. Salina Strawberry Clover does the same with an added bonus of dainty pink flowers. Both are nitrogen fixing legumes.

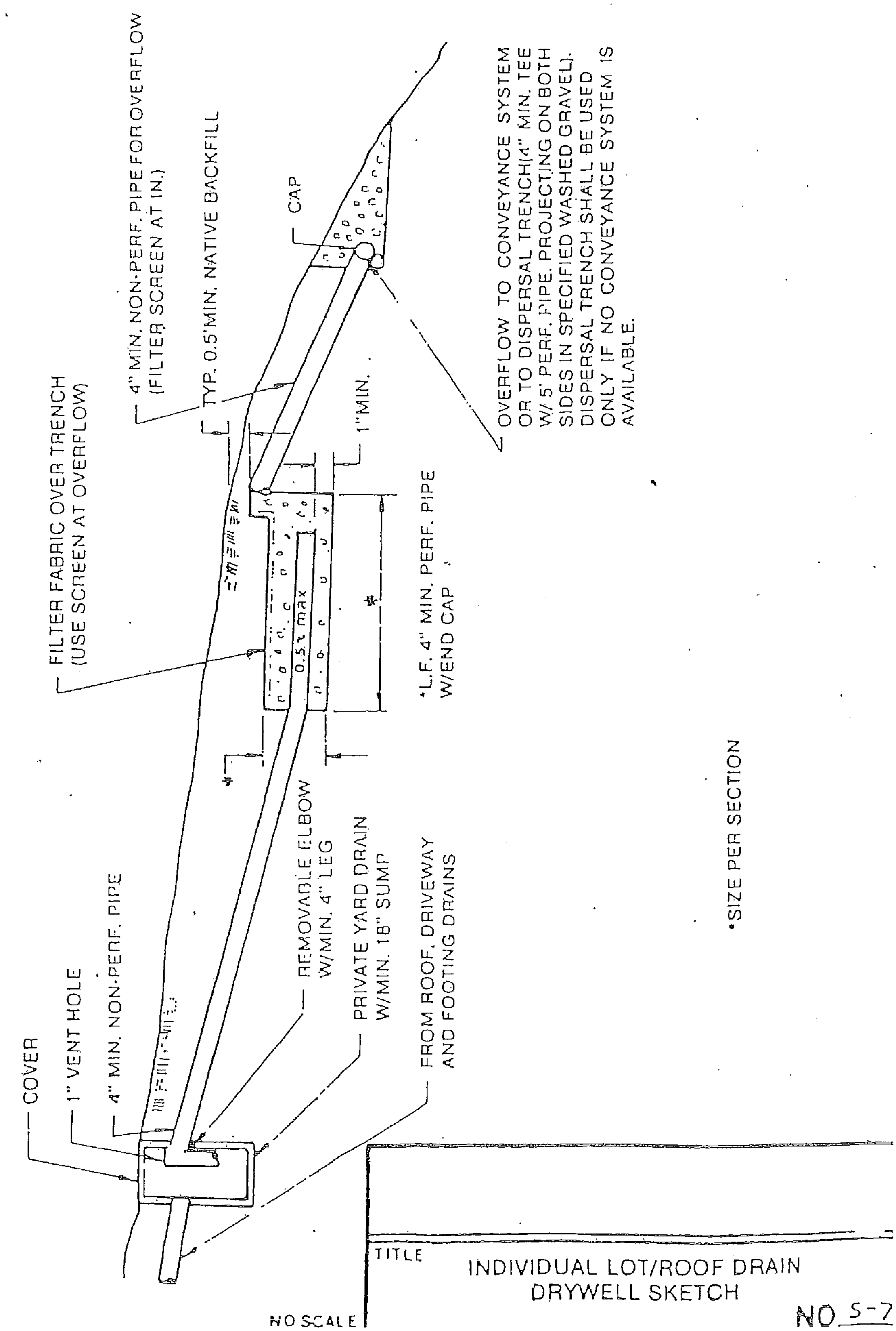
Mixes are subject to change without notice due to availability.

Hobs & Hopkins LTD – 1712 S.E. Ankeny – Portland, OR 97214 – (503) 239-7518 – (800) 345-2395

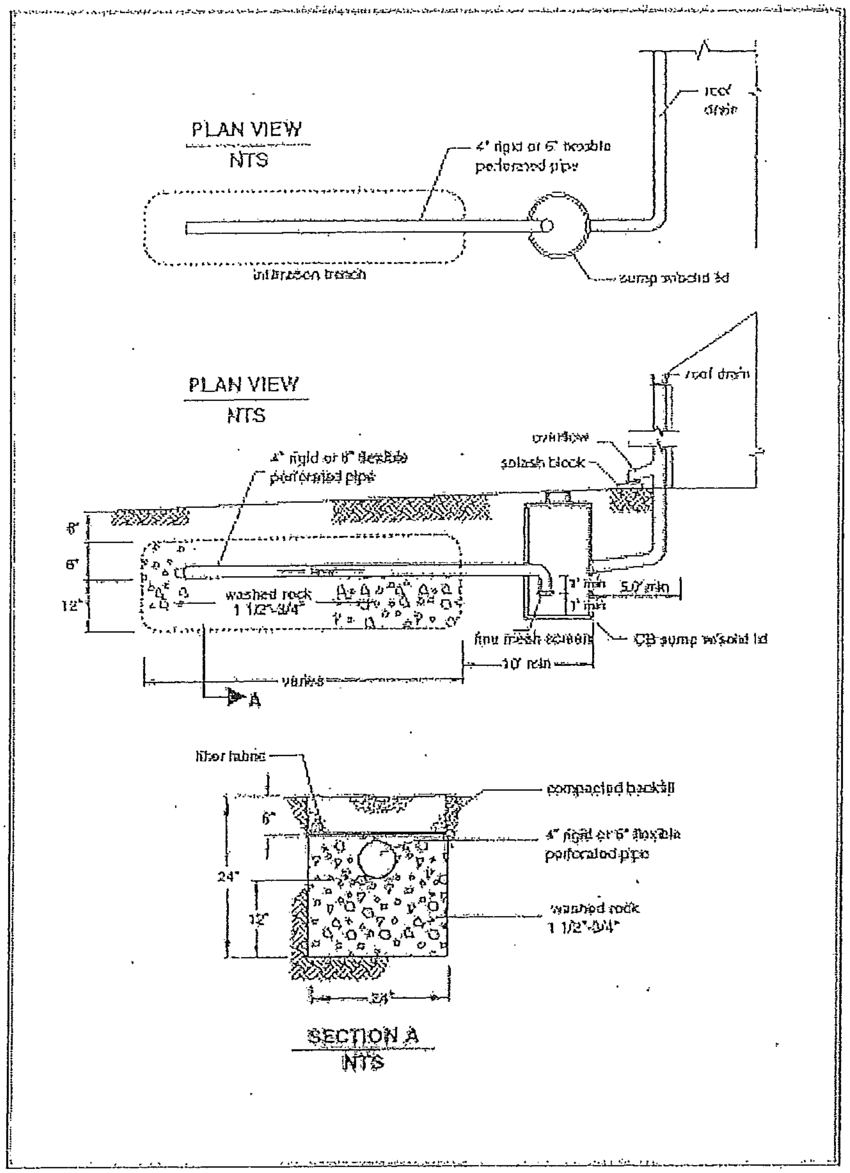
APPENDIX 4-3

Samples of Infiltration Structures

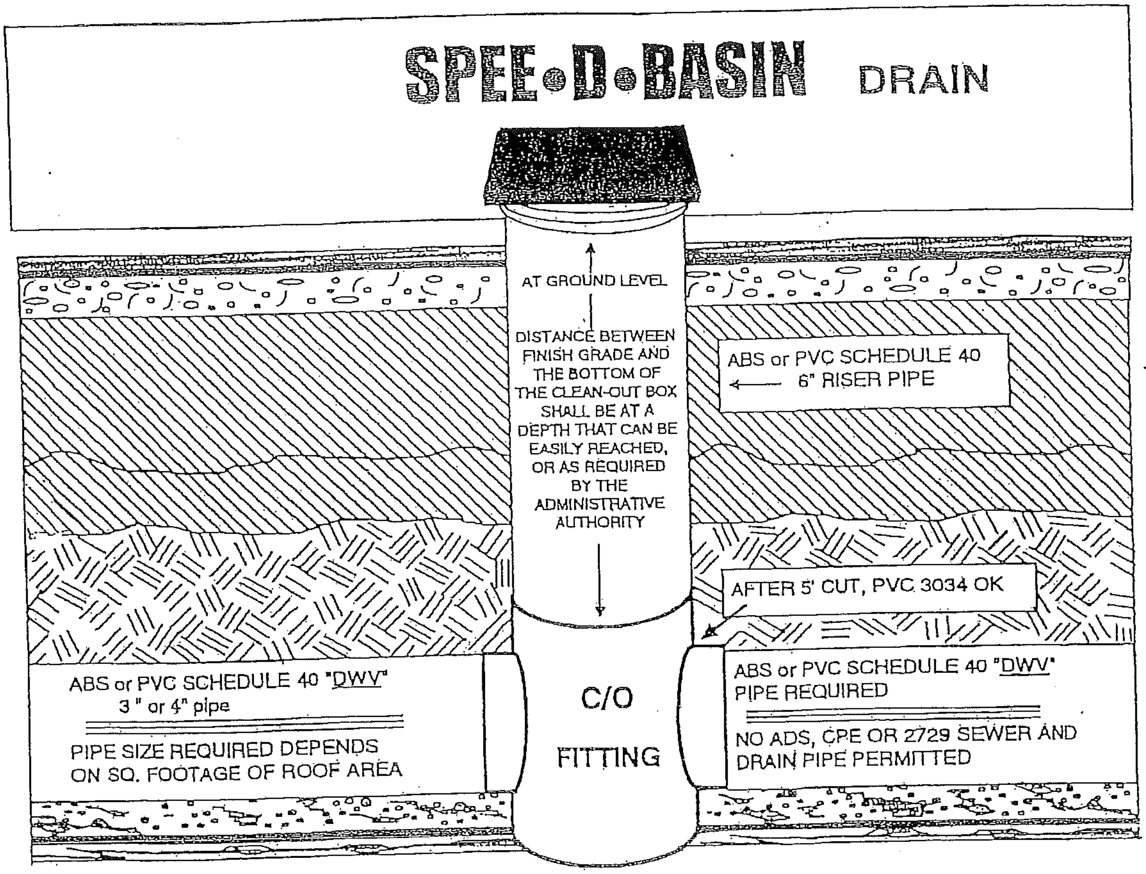
City of Cascade Locks Stormwater and Grading Design Standards


4" MIN. NON-PERF. PIPE FOR OVERFLOW (FILTER SCREEN AT IN.)
TYP. 0.5' MIN. NATIVE BACKFILL
CAP
OVERFLOW TO CONVEYANCE SYSTEM OR TO DISPERSAL TRENCH(4" MIN. TEE W/ 5' PERF. PIPE. PROJECTING ON BOTH SIDES IN SPECIFIED WASHED GRAVEL). DISPERSAL TRENCH SHALL BE USED ONLY IF NO CONVEYANCE SYSTEM IS AVAILABLE.
FILTER FABRIC OVER TRENCH (USE SCREEN AT OVERFLOW)
1" MIN.
0.5% max
*L.F. 4" MIN. PERF. PIPE W/END CAP
*SIZE PER SECTION
COVER
1" VENT HOLE
4" MIN. NON-PERF. PIPE
REMOVABLE ELBOW W/MIN. 4" LEG
PRIVATE YARD DRAIN W/MIN. 18" SUMP
FROM ROOF, DRIVEWAY AND FOOTING DRAINS
NO SCALE
TITLE
INDIVIDUAL LOT/ROOF DRAIN DRYWELL SKETCH
NO S-7

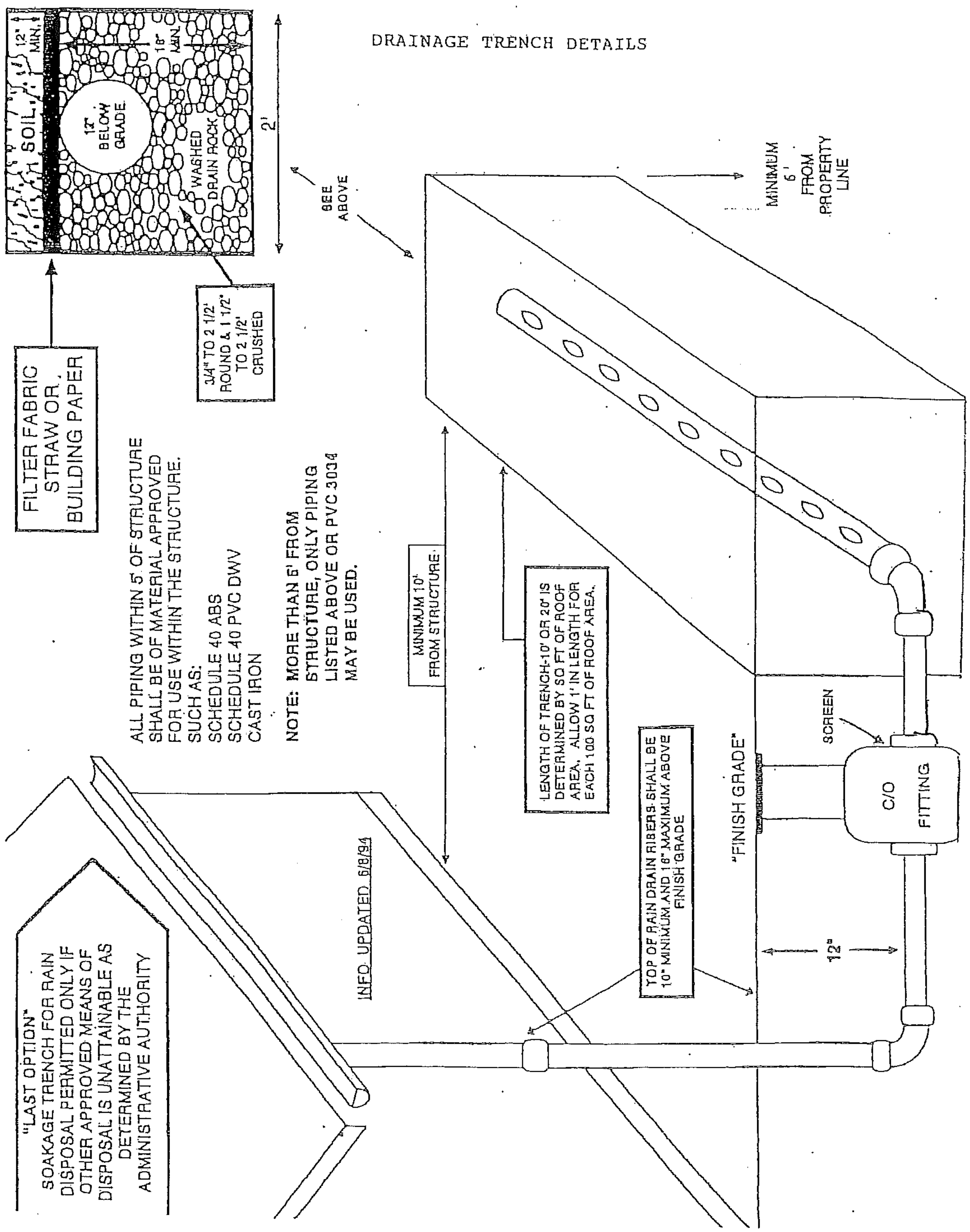
INDIVIDUAL DOWNSPOUT INFILTRATION SYSTEM



MATERIAL REQUIREMENTS PERMITTED
FOR CLEAN-CUT USED ON "LAST OPTION"
SOAKAGE TRENCH



IF FURTHER INFORMATION IS NEEDED,
PLEASE CONTACT THE PLUMBING DEPARTMENT


DRAINAGE TRENCH DETAILS
SOIL
12" MIN.
18" MIN.
12" BELOW GRADE
WASHED DRAIN ROCK
2'
SEE ABOVE
FILTER FABRIC STRAW OR, BUILDING PAPER
3/4" TO 2 1/2' ROUND & 1 1/2" TO 2 1/2' CRUSHED
MINIMUM 5' FROM PROPERTY LINE
ALL PIPING WITHIN 5' OF STRUCTURE SHALL BE OF MATERIAL APPROVED FOR USE WITHIN THE STRUCTURE. SUCH AS: SCHEDULE 40 ABS SCHEDULE 40 PVC DWV CAST IRON
NOTE: MORE THAN 5' FROM STRUCTURE, ONLY PIPING LISTED ABOVE OR PVC 3034 MAY BE USED.
MINIMUM 10' FROM STRUCTURE
LENGTH OF TRENCH-10' OR 20' IS DETERMINED BY SQ FT OF ROOF AREA. ALLOW 1' IN LENGTH FOR EACH 100 SQ FT OF ROOF AREA.
SCREEN
C/O FITTING
"FINISH GRADE"
TOP OF RAIN DRAIN RISERS SHALL BE 10" MINIMUM AND 16" MAXIMUM ABOVE FINISH GRADE
12"
INFO UPDATED 6/8/94
"LAST OPTION" SOAKAGE TRENCH FOR RAIN DISPOSAL PERMITTED ONLY IF OTHER APPROVED MEANS OF DISPOSAL IS UNATTAINABLE AS DETERMINED BY THE ADMINISTRATIVE AUTHORITY

DISTANCES FROM SOAKAGE TRENCH TO:

"Septic Tank"

10' - Downslope or Parallel

25' - Upslope

"Drainfield"

25' - Downslope

50' - Upslope

10' - To Open Approved Ditch

Tight Line - 10' Drainfield

Tight Line - Stay Off of Top of Tank

CHAPTER 5
STORMWATER QUALITY TREATMENT FACILITIES

TABLE OF CONTENTS

CHAPTER 5 – STORMWATER QUALITY CONTROL FACILITIES

5.1 INTRODUCTION

A. This chapter describes the minimum requirements for water quality treatment from development activities. These requirements apply to all stormwater quality facilities or pollution reduction facilities (PRF) within the City of Cascade Locks's jurisdiction. All facilities shall be designed to conform to the City's rules, regulations, and specifications for stormwater systems construction and the City's interpretations of these requirements.

B. The City of Cascade Locks requires that all new development and redevelopment projects address their potential impacts on the quality of surface water runoff that would eventually feed receiving waters.

C. Except as otherwise provided, pollution reduction facilities to serve any parcel/land shall be developed by and at the expense of the property owner or on behalf of the property owner by the project developer.

D. The City's guidelines determine the minimum treatment requirements for stormwater runoff from new developments before that runoff enters the City's stormwater system and streams. The City may determine that additional controls are necessary in basins that drain to sensitive receiving water bodies, such as defined by DEQ's 303(d) list and/or proposed Total Maximum Daily Load (TMDL), requirements for water quality-limited streams or threatened and endangered fish listings. These requirements could include larger facility designs and additional types of water quality controls.

E. Generally, facilities for water quality treatment are intended to address the commonly predictable stormwater problems of a development. It is essential that the site planner and the design engineer consider the future uses of a site and provide solutions for any predictable water quality problems.

F. Submittal of engineered drainage plans and a drainage report, per Chapter 2, is necessary for all developments that are required by the City to contain stormwater quality facilities.

5.2 GENERAL CONCEPTS AND PRINCIPLES

A. Urbanization impacts the water quality of urban streams. As an area is developed, impervious surfaces and stormwater runoff increase. The runoff collects and transports pollutants to downstream receiving waters. This type of pollution is sometimes called "non-point source" pollution.

B. When it rains, water washes over driveways, roofs, agricultural lands, streets, lawns, construction sites, and logging operations picking up soil, garbage, metals, hydrocarbons and other chemicals, and heat. Pollution is carried by rainwater, snowmelt and irrigation water flowing into streams and lakes, and through the soil into groundwater is much larger than pollution from industry.

C. Polluted runoff causes damage to fish, wildlife, and their habitat; damages drinking water supplies; promotes excessive weed growth; and degrades Oregon's scenic beauty and recreational opportunities.

D. Pollution from surface water runoff is hard to detect and control because it doesn't come from a point source, like a factory or sewage treatment plant. Instead, many everyday activities and traditional land use practices degrade aquatic habitat by causing soil erosion, increasing stream temperatures, and by allowing pollutants to wash into our waters. Polluted runoff comes from:

1) Household chemicals and soaps running off driveways, roofs and yards into streets and down storm drains;

2) Fertilizers and pesticides running off agricultural lands and urban areas such as yards, parks, golf courses and landscaped areas;

3) Oil, anti-freeze and other toxic materials running off roadways into storm drains;

4) Soil erosion, which typically comes from construction sites, logging activities and agricultural lands;

5) Failing septic tanks that cause both surface and groundwater pollution; and

6) Pets and livestock that pollute the water with bacteria (fecal coliform) and cause erosion.

E. The primary constituents of pollution in urban runoff include:

1) Sediments: Sediments are fine particles of soil that settle to the bottom of rivers, streams and lakes, blanketing fish spawning areas and smothering organisms that fish consume. Sources of soil erosion include forestry, construction, agriculture, and mining.

2) Bacteria: High bacteria levels indicate the presence of disease causing microorganisms. Sources of bacteria include failing septic systems, poorly treated sewage, sewage bypassed from treatment plants during heavy rains, pet feces, and manure from farm animals.

3) Toxics: Toxics can include pesticides, heavy metals, petroleum products from vehicles, parking lots, and roads, solvents, and water runoff from hazardous waste disposal sites and landfills. The greatest sources of toxics are sewage and industrial wastewater, but toxics are also found in runoff from forests, farms, and urban areas.

4) Dissolved oxygen: Dissolved oxygen is necessary for fish and aquatic life to survive. Low levels of dissolved oxygen result from nutrient enrichment and the decay of large amounts of organic matter.

5) Biological Oxygen Demand (BOD) and Chemical Oxygen Demand (COD): Oxygen-demanding compounds that remove oxygen from water are found in urban runoff in the

form of BOD and COD. These compounds can "take" oxygen from water, resulting in the depletion of oxygen to a level where aquatic life forms such as fish can die.

6) Nutrients: Excessive nutrients such as phosphorus can cause increased growth of algae and weeds and often make water aesthetically unpleasant or unusable. Nutrients enter water mainly through discharges of treated domestic sewage, faulty septic tank systems and from fertilizers washed into water by rain or irrigation.

7) Nitrates: Nitrates originate from human and animal wastes and fertilizers. Drinking water contaminated with high levels of nitrates can harm humans and livestock.

5.3 SPECIAL WATER QUALITY REQUIREMENTS FOR SENSITIVE RECEIVING WATER BODIES

A. In response to water quality impacts of urbanization, Congress passed the Clean Water Act (CWA) amendment of 1987, mandating the U.S. Environmental Protection Agency (EPA) to issue regulations to control urban storm water pollution. The Department of Environmental Quality (DEQ) is the state agency responsible for protecting Oregon's public water for a wide range of uses. DEQ sets water quality standards to protect "beneficial uses" such as recreation, fish habitat, drinking water supplies, and aesthetics. Protection is assured through monitoring, education, and enforcement.

B. Until recently, DEQ's approach to water quality has focused on treating sewage and industrial wastewater. Currently, most industries and communities apply the best standard technology for treatment available. However, this approach has not been enough for all public waters. Under DEQ's new approach, when particular streams consistently fail to meet water quality standards, they are declared "water quality limited," and a new strategy called Total Maximum Daily Load (TMDL) is used to protect them.

C. TMDLs determine how much pollution a river can handle from all sources, and then allocate the amount of a particular pollutant that will be allowed to enter the water. This new strategy may require strategies such as upgrading treatment facilities, holding wastes in lagoons in the summer or applying wastewater and sludge on land.

D. Oregon administrative rules prohibit new or increased discharges to streams listed as "water quality limited" under the Department of Environmental Quality's (DEQ) 303(d) list. The exception to this rule is if the proposed discharge is unrelated to the pollutant(s) that has caused the listing [Oregon Administrative Rule 340-41-026 (3) B & C]. The 303(d) list identifies the impacted beneficial uses and parameters of concern for each of the water bodies.

E. Once "total maximum daily loads" (TMDLs) for pollutants are established for a water body, additional discharge requirements may be set. If the permitted limits appear nevertheless to allow a stream segment to exceed its water quality standards, existing permits must be adjusted downward.

5.4 POLLUTION REDUCTION FACILITY OVERVIEW

A. The information presented in subsequent sections is for basic design information and general guidance. It is not intended to provide in-depth design details. A number of experimental and innovative facilities not presented here are becoming available. Designers may consider experimental and innovative facilities such as leaf compost filters and other pollutant reduction facilities. However, the applicant carries the burden of proof, facilities through the use of models and/or other study results, for demonstrating pollutant removal effectiveness. If an experimental or proprietary facility is being considered, it is necessary to obtain conceptual approval from the City before finalizing the design. The City is committed to working cooperatively with developers and designers during the development review and permitting process to improve stormwater quality.

B. Pollution reduction facilities fall into four general categories – ponds and settling basins, infiltration facilities, stormwater filters and constructed wetlands. Pollution reduction facilities and related infrastructure that will be publicly maintained shall be designed by a professional engineer registered by the State of Oregon with a landscape plan prepared and signed by a landscape architect registered by the State of Oregon. All such facilities shall be subject to approval by the City. In addition, maintenance plans and maintenance cost estimates shall be submitted for City review and approval.

1) Ponds and Settling Basins

Design of ponds requires consideration of pond shape, depth, surface area, inlet distribution, outlet collection, and sediment removal procedures. Information about particle size distribution is critical in the selection of the pond's appropriate length and depth.

Ponds include wet ponds and extended wet ponds. Both work primarily through the settling of pollutants and some biological processes. Ponds typically require more space than other pollution reduction facilities but they serve a larger drainage basin. Usually, ponds require low maintenance.

2) Stormwater Filters

Stormwater filters include bio-swales (grassy swales), sand filters and compost filters. Filters remove suspended solids from water by a complex interaction of physical straining, sedimentation and biological action. First, particles larger than the filter pore size are removed. As the filter mat builds, smaller particles can be removed. Biological actions become important when a portion of the materials removed are organic and the filter mat is left in place for long time. In general, stormwater filters can require little space, however, they may incur slightly higher maintenance costs than other pollution reduction facilities.

3) Infiltration Facilities

Infiltration facilities include infiltration trenches and infiltration basins. These facilities rely on the percolation of stormwater into existing soils for water quality improvement. There are two important criteria to be evaluated when considering infiltration facilities.

1) the ability of the native soil to drain the stormwater and 2) groundwater protection. Infiltration facilities generally require little maintenance, but may be considered less aesthetically pleasing than other pollution control devices. Infiltration facilities tend to require more horizontal space than ponds, but less than stormwater filters. Infiltration filters are considered impractical for much of the native soil conditions in Cascade Locks, however, some applications may be valid.

4) Constructed Wetlands

Constructed wetlands, like natural wetlands, remove pollutants through sedimentation and biological processes. The pollutant removal processes include:

a. gravity removal of suspended particles,

b. removal of suspended particles through filtration or straining,

c. removal of phosphorous and nitrogen compounds by incorporation of bacterial, algal and higher plant matter through photosynthesis,

d. partial removal of organic and inorganic compounds through adsorption and ion exchange with thick benthic soil layers and

e. biological degradation.

Wetlands typically have shallow water depths and they provide habitat for plants and wildlife. Wetlands tend to cost more than pond facilities both in construction and maintenance. However, shallow constructed wetlands do not require fencing, and constructed wetlands may be more effective than other pollution control devices at treating a wider range of pollutants.

5.5 WATER QUALITY AND TEMPERATURE CONTROL DESIGN STORMS

A. The water quality design storm, to be used in the design of treatment facilities, shall be one third of the SCS 2-year / 24-hour design storm.

B. A temperature control design storm has not been quantified with this revision of the Stormwater and Grading Design Standards.

C. During sunny weather conditions, many impervious surfaces become warm. When rain showers occur, this heat is transferred to the stormwater runoff. Where impervious surfaces connect directly to the stormwater system (such as with many streets and rooftops), the water in the stormwater system can become much warmer than if there were no impervious surfaces directly connected to the stormwater system. This increase in stormwater temperature can negatively affect the aquatic ecosystem.

D. In part to address increases in stormwater temperature, the City of Cascade Locks has defined landscaping requirements for new developments and for redevelopment projects. Section 5.9 and Section 5.10 describe these requirements.

5.6 RECOMMENDED STORMWATER QUALITY FACILITIES

Depending on the location of the development, a particular water quality facility may be more appropriate than another. The following is a summary of some recommended stormwater quality facilities.

All stormwater quality facilities must provide for maintenance access.

5.6.1 Ponds and Settling Basins

5.6.1.1 Wet Ponds

Wet ponds are constructed ponds with a permanent pool of water called dead storage. Pollutants are removed from stormwater through gravitational settling and biological processes.

A. General Requirements

Area to be served:	5 to 150 acres
Soils requirements (NRCS Classification)	C, D (A & B with liners)
Maximum ground slopes	8%
Maximum maintained side slopes:	4 horizontal (min.) to 1 vertical
Water application rate:	Base flow must exceed summer evapotranspiration rate

B. Design Criteria: (Figure 5-1 is an example of a wet pond design)

1) Hydraulic residence time shall be a minimum of 48 hours for the water quality design storm. The maximum depth of the pond area shall be 3 feet above the dead storage elevation.

2) The outfall orifice must be protected from plugging.

3) The wet pond facility shall have an outflow device to allow draining the water from dead storage within 24 hours for maintenance.

4) The pond bottom should be near level (six inches ±) to facilitate sedimentation.

5) Retaining walls are permitted, so long as they are located beyond the dead storage area and do not encompass more than 50% of the perimeter. All retaining walls must comply with the most current edition of the Building Code as required by the state of Oregon for structural protection. Retaining walls shall be designed to withstand rapid changes in the water surface elevation.

6) A minimum of 2 inches of topsoil shall be incorporated into the top 12 inches. This area shall extend to the outer edge of the extended wet pond features.

7) Vehicular access to the pond, the outlet structure and the overflow device is required.

8) Plantings are required to cover the entire landscape area (as defined by the topsoil limits). All soil areas must be covered with mulch until plantings are established. Vegetation shall meet the following amounts per 1,000 square feet of landscape area:

Evergreen trees	3 each	minimum height, 4 feet
Deciduous trees	2 each	minimum caliper, 2 inches at 6 inches above base.
Shrubs	10 each	minimum container, 1 gallon or live cuttings

9) Organic materials used as mulch such as compost, bark mulch, leaves, sawdust, straw or wood shavings cannot be used within any portion of the landscape area that might drain into a wet pond or wetland. Approved mulching materials include round river gravel or other inert materials that do not leach nutrients or other potential pollutants to the pond or site. For areas that drain from a landscape area, mulching materials must be applied in such a way to prevent any flow into a wet pond.

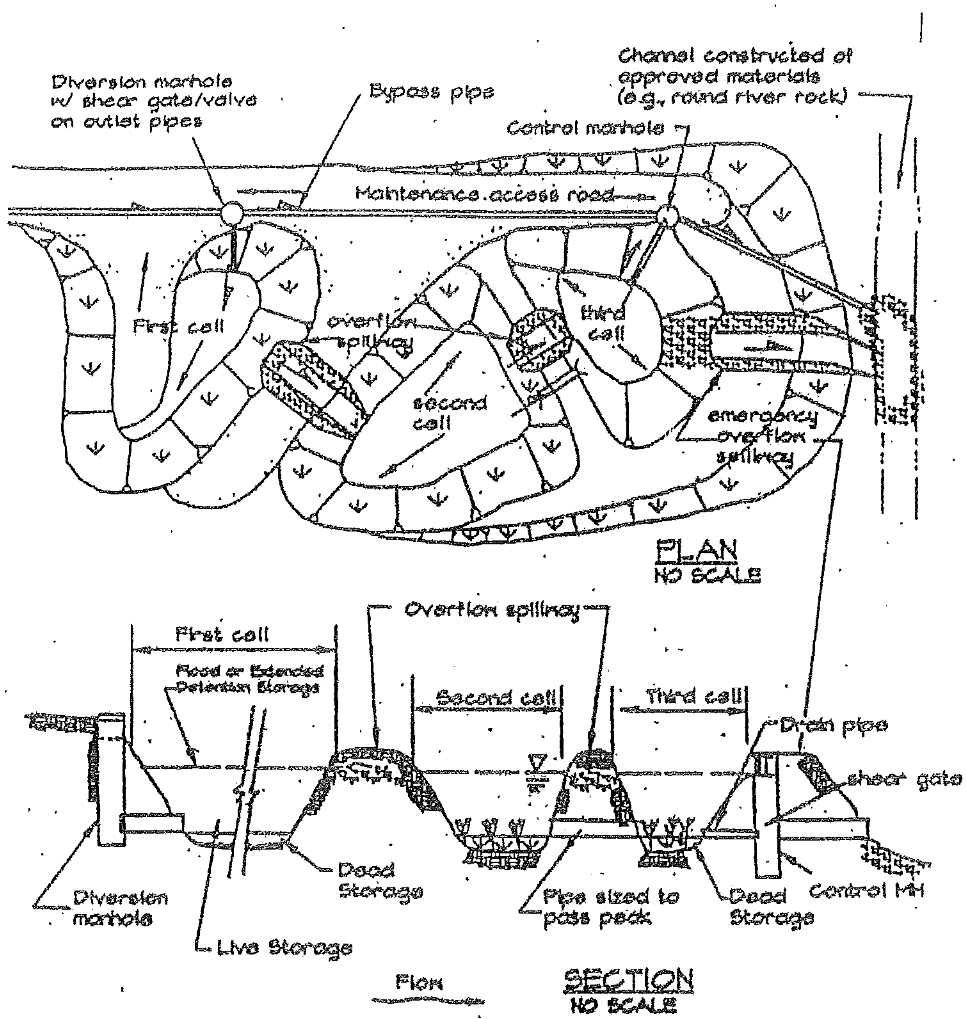
10) Seed for wildflowers, grasses, and ground cover may be applied at the rates specified by the supplier, but the plants must be established (at least 3 months after seeding) at the time of substantial completion of the stormwater facility portion of the project. If establishment cannot be achieved with seeding, then the contractor must use a mature grass or wildflower sod.

11) Vegetation shall be established, as anticipated on the approved plans, before the City's Building Division will grant occupancy of structures that may be a part of the development. In the event that this is not possible, an agreement with the City regarding monitoring and a schedule for vegetation establishment (with appropriate performance guarantee) would be considered.

12) It is acceptable to use a wet pond as part of a stormwater quantity facility. This can be accomplished by "stacking" the detention volume on top of the water quality volume. (See also Chapter 4.) If this dual use is proposed, a landscape plan, prepared and signed by a Registered Landscape Architect, will be required for the detention pond.

13) All on-line ponds shall have an emergency overflow structure that will safely pass runoff from a post-developed SCS 100-year / 24-hour design storm to the downstream conveyance system. The design intent of the secondary overflow system is to protect the integrity of the pond during large (less frequent) storm events and/or failure of the flow control structure.

Figure 5-1
Wet Pond Design



C. Secondary Spillways:

Secondary spillways shall meet the following criteria:

1) The spillway shall be located to direct overflows safely toward the downstream conveyance system.

2) The spillway shall be located in existing soil wherever possible. The spillway shall be armored with riprap or an approved material that extends to, and an appropriate distance beyond, the bottom of the berm embankment. Voids in the riprap shall be filled with soil and the spillway shall be vegetated with grass or ground cover.

3) The invert elevation of the spillway shall be a minimum of six inches above the primary overflow elevation.

4) The minimum spillway depth shall be nine inches from the top of the berm. The freeboard during the design storm event shall be a minimum of six inches.

Alternate methods to accomplish the design intent of the secondary overflow system will be acceptable as long as they achieve the necessary level of protection. Design shall be prepared and signed by a Registered Landscape Architect or Professional Engineer.

5.6.1.2 Extended Wet Ponds

Extended wet ponds are constructed ponds that have both a permanent pool of water and extended detention.

A. General Requirements

Area to be served:	5 to 150 acres
Soils requirements (NRCS Classification)	C, D (A & B with liners)
Maximum ground slopes	8%
Maximum maintained slide slopes:	4 horizontal (min.) to 1 vertical
Water application rate:	Base flow must exceed summer evapotranspiration rate

B. Design Criteria:

All design criteria for wet ponds shall apply to extended wet ponds, as well as the following additional criteria:

1) Determine total storage volume using the dead storage calculations for wet ponds.

   a. Determine total storage volume using the dead storage calculations for wet ponds.

b. Take one-half of the total storage volume. This is the minimuis the minimum volume for the permanent pool.

2) The remainder of the volume shall be released through an orifice. The outlet orifice shall be designed to prevent debris from plugging it.

3) The orifice shall be sized to allow the detained portion of the volume to be released in no less than 12 hours for up to 4 feet of detained depth, or 24 hours for 4 to 8 feet of detained depth.

Figure 5-2 gives an example of an extended wet pond design.

5.6.2 Stormwater Filters

Treatment of stormwater pollutants can be provided by flowing water through various types of filter media. The filtering materials include vegetation, sand and synthetic materials. Acceptable treatment facilities include bio-swales (grassy swales), filter strips, sand filters and the proprietary Stormwater Management Stormfilter™ or equal.

Stormwater filters may require more maintenance than other types of stormwater treatment facilities, except in cases where self-sustaining native vegetation is used as filter media.

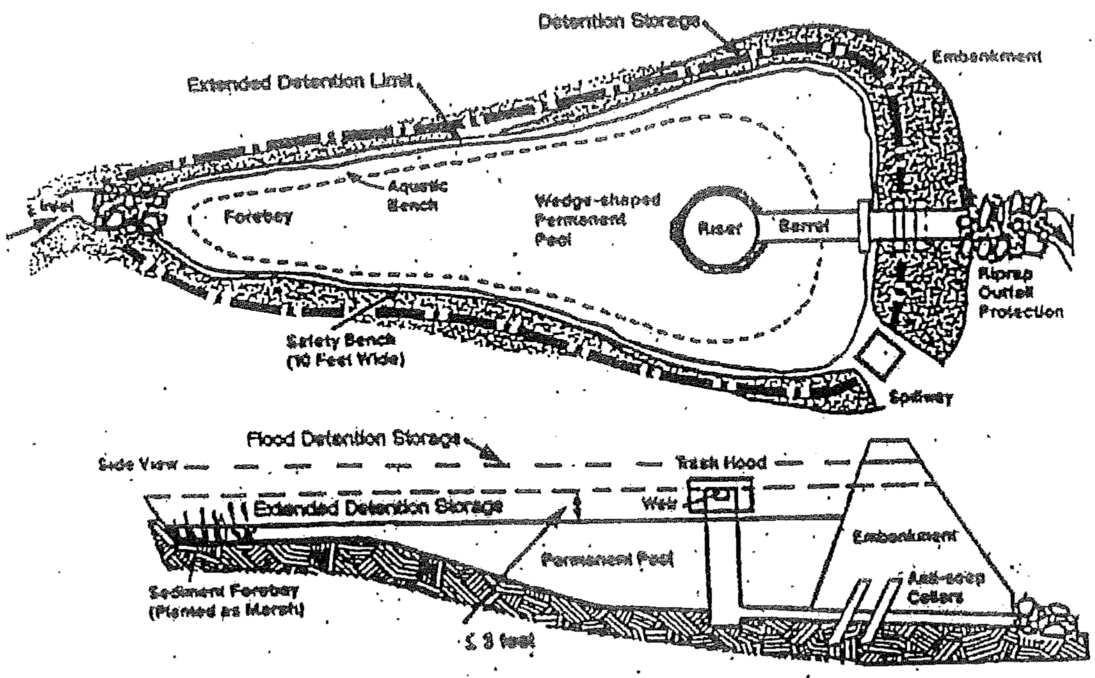
5.6.2.1 Grassy Swales

Grassy swale designs based on design criteria other than outlined below will be considered by the City if sufficient supporting data is submitted for review.

A. General Requirements:

Area to be served:	Less than 10 acres
Soils requirements (NRCS Classification)	C, D (A & B with liners)
Maximum ground slopes	NA
Maximum maintained slide slopes	4 horizontal to 1 vertical
Water application rate	Peak flow rate from water quality design storm

Figure 5-2
Extended Wet Pond Design



B. Design Criteria:

The swale width and profile shall be designed to convey the Water Quality Design Storm event at a maximum design depth of 0.33 foot and maximum design velocity of 0.9 foot per second. It shall be designed using a Manning "n" value of 0.25 with a minimum of 4:1 (or flatter) side slopes in the treatment area.

1) Minimum treatment length shall be 100 feet for any runoff from impervious surface areas that are open to automotive traffic or roof areas. Figures 5-3 through 5-5 show required treatment lengths for 1.5%, 3.0% and 5.0% slopes. For other slopes, required treatment length should be extrapolated.

2) The swale bottom shall be smooth with uniform longitudinal slope. Bottom width shall be between 2 feet and 10 feet.

3) The channel slope shall be between 1.5% and 5%. For slopes greater than 5%, check dams shall be used.

4) A minimum of one foot of freeboard above the standard stormwater surface shall be provided for facilities not protected by high-flow diversion devices.

5) Velocity through the facility shall not exceed 3 feet per second during the high flow events.

6) For end-of-pipe types of facilities, the use of a flow splitter to bypass flows that are more than the water quality storm may be required.

7) Biodegradable erosion control matting appropriate for low-velocity flows (approximately 1 fps) shall be installed in the flow area of the swale prior to allowing water to flow through the swale.

8) The minimum hydraulic residence shall be 9 minutes in the active treatment area for the water quality design storm.

9) Woody or shrubby vegetation shall not be planted in the active treatment area of the swale. The active treatment area for this criterion is 1.5 feet above the flow line.

10) Retaining walls are permitted, so long as they are located beyond the active treatment area of the swale and do not create shading conditions that may adversely affect the vegetation growth in the active treatment area. All retaining walls must comply with the most current edition of the Building Code as required by the state of Oregon for fall protection.

Figure 5-3
Grassy Swale Treatment Dimensions – 1.5% Slope

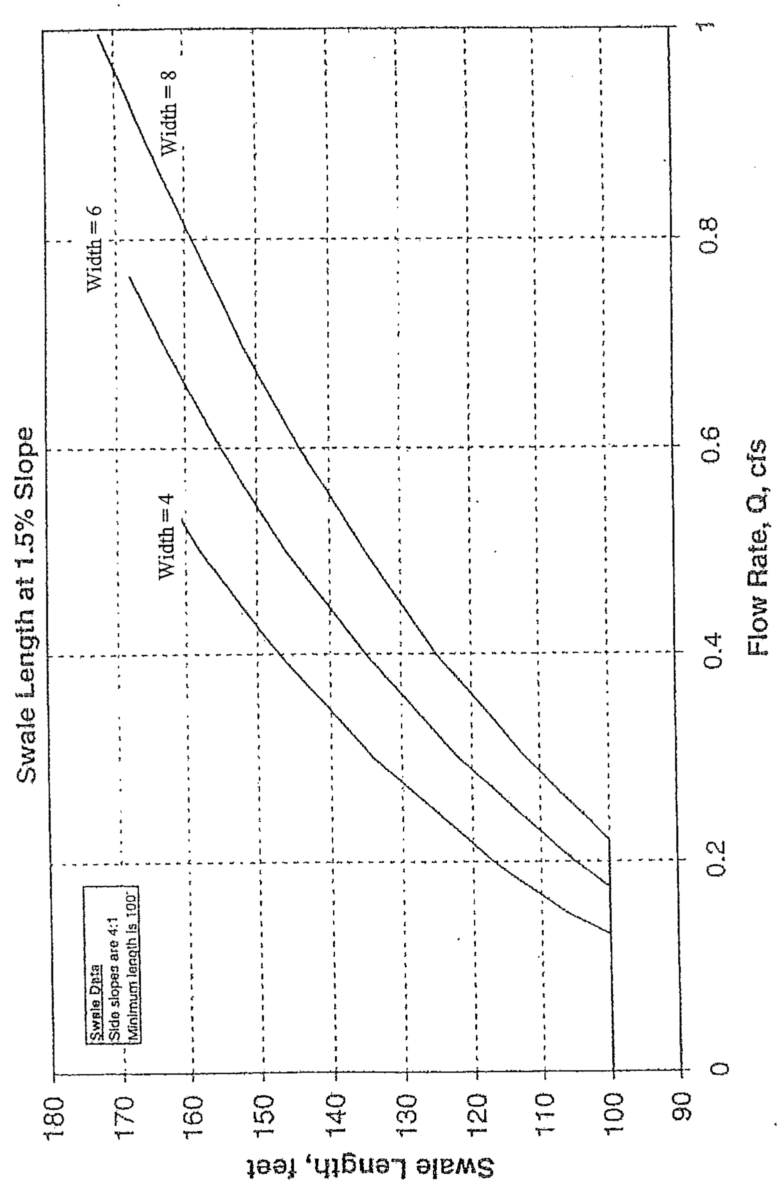


Figure 5-4
Grassy Swale Treatment Dimensions – 3.0% Slope

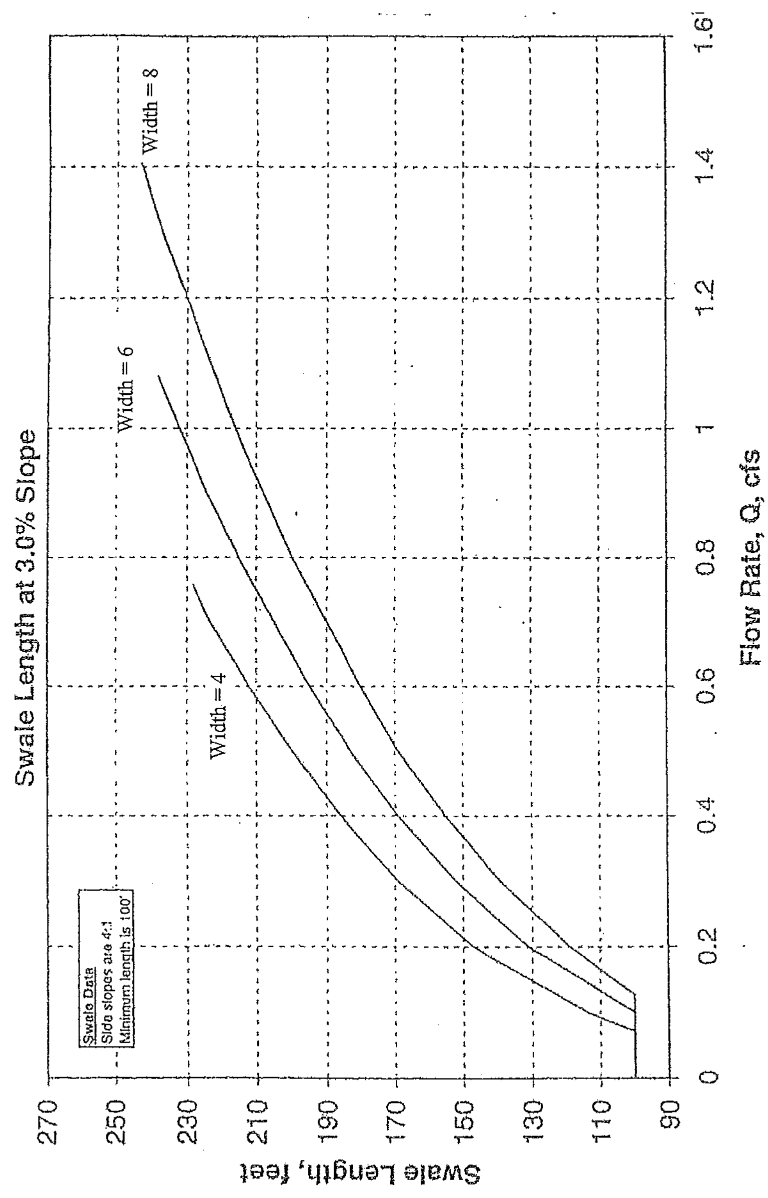
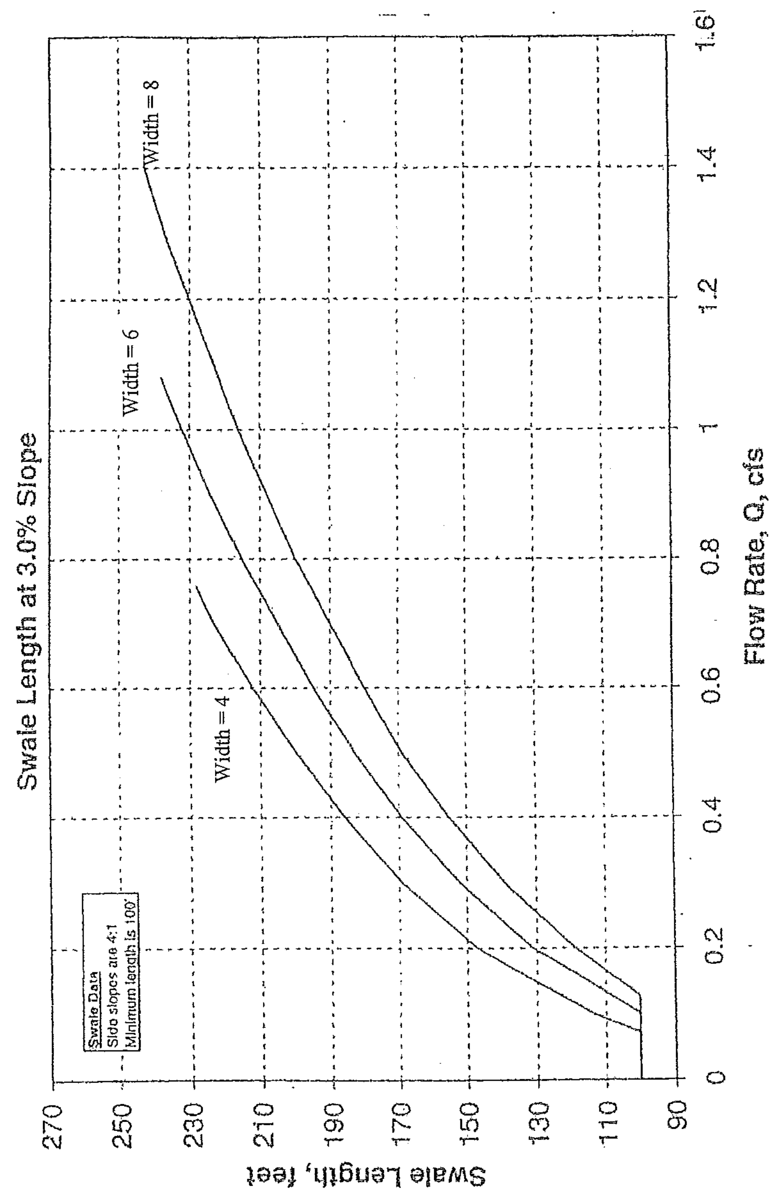


Figure 5-5
Grassy Swale Treatment Dimensions – 5.0% Slope



11) The swale shall incorporate a flow-spreading device at the inlet. The flow spreader shall provide a uniform flow distribution across the swale bottom. In swales with a bottom width greater than 3 feet, a flow spreader shall be installed every 50 feet. These flow spreaders can also serve as grade control structures during the swale construction process.

12) Grasses shall be established as soon as possible after the completion of the swale. The initial rate of application shall be 5 pounds of seed mix per 1,000 square feet or as approved by the City.

13) The swale area shall incorporate a minimum of 2 inches of topsoil into the top 12 inches and shall extend, at a minimum, to the outer edge of the swale features.

14) Landscaping in the swale area shall be established, as anticipated on the approved plans, before the City's Building Division will grant occupancy of structures that may be part of the development. In the event that this is not possible, an agreement with the City regarding monitoring and a schedule for vegetation establishment (with appropriate performance guarantee) would be considered.

15) Criteria modification for commercial developments where surface water runoff from parking areas will drain directly into a water quality swale:

   a. The minimum hydraulic residence time shall be a weighted average of 9 minutes for the water quality design storm.

   b. The minimum treatment length can be reduced to 25 feet, however this must be considered in the aforementioned weighted average calculation.

   c. Minimum slope may be lowered (approved on a case by case basis) to a minimum of 0.75% in the areas where the minimum treatment length is being achieved.

C. Grass Seed Mix Characteristics for Vegetated Swales

This list below describes the primary characteristics that should be considered when formulating a grass seed mix for a vegetated swale. These characteristics have been obtained from Publication 657, Bio-filtration Swale Performance, Recommendations, and Design Considerations, a Washington State Department. of Ecology publication. Swale vegetation should also be based on soil type and swale slope.

1) The grass shall have the ability to form densities between 600 and 1,600 blades per square foot.

2) The seed mix shall form a uniform distribution of grass. For example, the grass should not grow in clumps where there will be patches of exposed soil between clumps.

3) The grass shall provide erosion resistance given the peak design velocities.

4) The grass shall have the ability to grow up through thin deposits of sediment.

5) The grass shall have the ability to survive in periods of temporary inundation by water. The period of inundation will depend on the swale slope and the outlet structure. If a swale is located in an area of groundwater interception, a wetland type grass is recommended.

6) The grass shall have the ability to survive through this region's typical seasonal drought.

7) The grass mix should reach 6 inches in maximum height (at least twice the design flow depth recommended for swales).

Seed mixes other than those given in this chapter should be designed using the above grass characteristics. To receive approval of a seed mix, it must be reviewed and approved by a registered landscape architect or seed specialist for these characteristics. A designer unable to comply with the following list of characteristics must seek approval for exception.

D. Recommended Grass Seed Mixes for Swales

The grass mixes recommended below have been reported to have desirable characteristics of swale grasses. The City recommends the use of one of these mixes or a mix that meets the desirable characteristics outlined on the section titled Grass Seed Mix Characteristics for Vegetated Swales.

Grass mixes being used in Water Quality Resource Areas shall use an approved mix of plants. Examples of these are listed below.

<u>Non-Native Mixes</u>

Hobbs and Hopkins, Pro-Time 835, Bio-Filter Summer Green Vegetation Cover (or equivalent)

PR8820 Perennial Ryegrass	60%
Eureka Hard Fescue	15%
Dwarf White Yarrow	8%
Dutch White Clover	8%
Salinas Strawberry Clover	5%
Sweet Alyssum	4%

Washington State Department of Ecology **Publication 657**, Montlake Terrace Mix

Tall Fescue	67%
Seaside Bentgrass	16%
Meadow Foxtail	9%
Alsike Clover	6%
Marshfield Big Trefoil	1%
Inert Matter	1%
Weed Seed	0.5%

Native Seed Mix

Hobbs and Hopkins, Pro-Time 840, Native Bio-Filter Mix (or equivalent)

Blue Wildrye	47%
Meadow Barley	40%
Tufted Hairgrass	10%
Western Mannagrass	2%
American Sloughgrass	1%

5.6.2.2 VEGETATED FILTER STRIPS

Vegetated filter strips provide stormwater quality treatment of conventional pollutants, but not nutrients. Vegetated filter strips are to be used primarily along parking lots and driveways, where sheet flow from the impervious area will pass through the filter strip before entering a conveyance system or quantity control facility.

A. Design Criteria

1) The filter strip shall be at least 10 feet wide with a transverse slope between 1% and 15%.

2) Filter strips may be place 3 to 4 feet from the edge of pavement, provided that no vegetation exists between the strip and the pavement.

3) Vegetated filter strips must receive runoff as sheet flow. Strips must not receive concentrated flow discharges.

4) Vegetated filter strips shall not be used on parking lots and driveways with a longitudinal slope greater than 2%.

5) The flow path draining to the filter strip shall not exceed 150 feet.

6) Vegetated filter strips should be constructed after all other portions of the projects are completed.

7) Vegetated filter strips shall only receive sheet flow and must not receive concentrated flow.

5.6.2.3 SAND FILTERS

A sand filter removes pollutants by filtration. As stormwater passes through the sand, pollutants are trapped in void spaces between sand grains or are adsorbed to the sand surface. Some biological activities may also occur, as soil bacteria will grow in the sand bed.

Because filtration facilities are susceptible to clogging, a pre-settling (e.g., pond, vault, etc.) must be provided before stormwater enters a filtration facility. The required minimum volume of the pre-settling facility must equal 25% of the water quality design storm. The sand filters consists of an inlet structure, sand bed, underdrain piping, and basin liner.

A sand filter can be used in most residential, commercial, and industrial developments where site topography and drainage provide adequate hydraulic head to operate the filter. Sand filters are designed to prevent water from backing up into the sand layer (the underdrain system must drain freely). Therefore, a sand filter is more difficult to install in areas with high water tables where groundwater could potentially flood the underdrain system.

A. General Requirements:

Maximum area to be served	80 acres
Soils requirements (NRCS Classification)	N/A
Maximum ground slopes	N/A
Maximum maintained side slopes	4 horizontal (min.) to 1 vertical
Water application rate	0.0012 cfs / sq. ft. at 3 feet of head

Facilities proposed for public maintenance shall have a landscape plan for the area surrounding the filter prepared and signed by a Registered Landscape Architect and approved by the City.

B. Design Criteria

A sand filter is designed with two parts: (1) a temporary storage reservoir to store runoff and (2) a sand filter bed through which the stored runoff must percolate. The sand filter must be sized properly and consists of an inlet structure, sand bed, underdrain piping and basin liner. No drainage shall be allowed directly to the filter. The runoff must flow through a catch basin, inlet, sedimentation manhole or similar large debris collection device before entering sand filter facility. The following criteria should be considered in designing sand filters:

1) The sand filter shall infiltrate the entire design storm without overflow. Sand depth shall be 18 inches minimum.
2) 2. A sedimentation chamber volume equal to or greater than the filter bed area is required.
3) 3. The active portion of the filter bed will have between 150 and 300 square feet of surface area per impervious acre.
4) 4. The drawdown period for sand filters shall not exceed 24 hours.

5). Depth of storage over the filter media shall be 6 feet maximum.

The sand filter design is based on Darcy's Law:

$$Q = KiA$$

Where Q = water quality design storm
K = hydraulic conductivity, 0.00002315 feet per second
A = sand filter surface area
i = hydraulic gradient for a constant head, $i = (h+d)/l$

Where h = average depth of water above water (ft), d = maximum storage depth above filter (ft), and l = thickness of sand media (ft).

The use of sod-covered filters will not be permitted. The use of a dirt cover contributes to filter media clogging and precludes that ability to replace the sand media.

C. Filter Area Sizing

The following three steps describe the sizing of filter area:

Step 1: Determine the maximum depth of water storage above the sand filter.

Step 2: Calculate the minimum required surface area for the sand filter, $A = (0.7Q)/ki$

Step 3: Size the underdrain system; this is sized to convey the peak-filtered flow to the outlet.

D. Inlet Structure

The inlet structure shall spread the flow of incoming water uniformly across the surface of the filter medium during all anticipated flow conditions. This flow shall be spread in a manner that prevents roiling, or otherwise disturbing, the filter medium.

Flows in excess of the water quality design storm should be designed to bypass the filter media.

E. Sand Bed - Filter Medium

1) The length to width ratio shall be 2:1 or greater
2) The sand bed may be either of the two configurations shown in Figure 5-6.
3) Sand used as filter medium shall be certified by a certified testing laboratory as meeting or exceeding the specification presented below in Table 5-1. The filter bed medium shall consist of clean medium to fine sand with no organics, frozen pieces or other deleterious materials and meeting the following gradation:

Table 5-1: Filter Medium Gradations	
Sieve Size	**% Passing**
#4	95-100
#8	70-100
#16	40-90
#30	15-75
#50	0-25
#100	<4

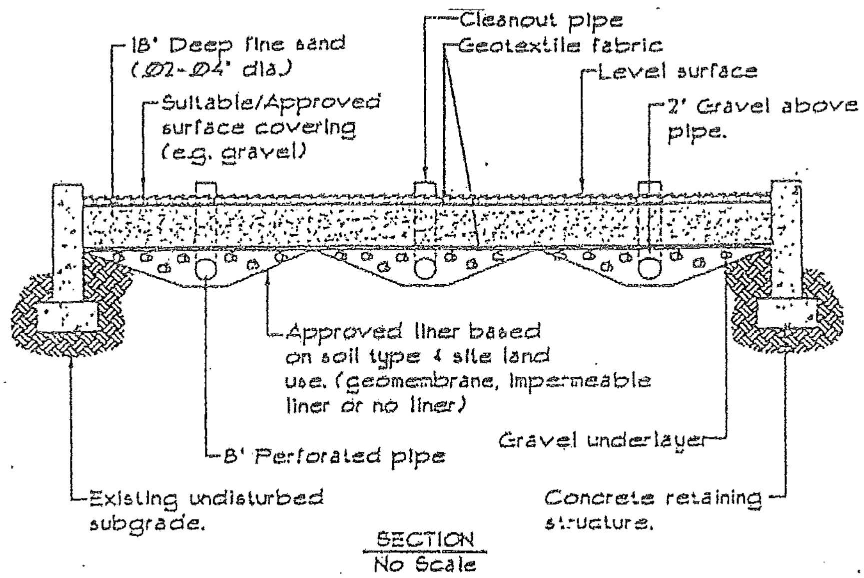
4) Depth of sand filter media shall be a minimum of 18 inches. The surface of the filter medium shall be level with no grade.

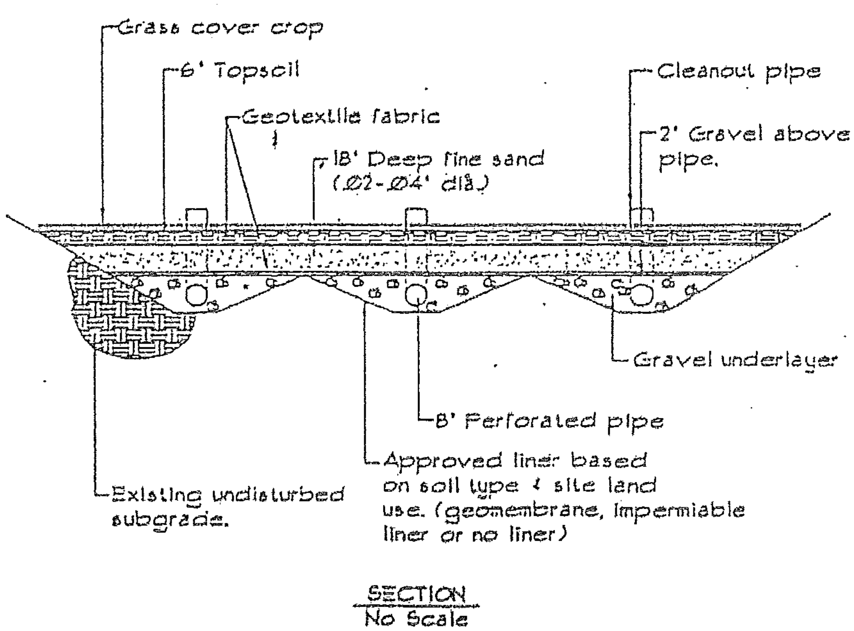
5) Access shall be provided to and within the sand filter for future maintenance. An observation well shall be included to observe how quickly the filter dewaters during a storm. This will help determine maintenance frequency to ensure optimum effectiveness.

F. Sand Bed with Gravel Layer

The top layer shall be a minimum of 18 inches of approved sand. The sand shall be placed over an acceptable geo-fabric material covering a layer of 0.5-inch to 2-inch well-graded washed drain rock. The finished depth of this drain rock shall be sufficient to provide a minimum of 2 inches of cover over the underdrain piping system. No gravel is required below the underdrain piping system.

Figure 5-6:
SAND FILTER





G. Underdrain Piping

The underdrain piping system shall consist of appropriately sized (minimum 4" diameter) collector manifolds with perforated lateral branch lines. Each row of perforations shall have four 3/8" diameter holes, spaced equally around the pipe, with the rows spaced at 6 inches along the lateral dimension of the pipe. The pipe used in this system shall be schedule 40 polyvinyl chloride material or approved equivalent. Lateral spacing shall not exceed 10 feet between laterals.

The underdrain laterals shall be placed with positive gravity drainage to the collector manifold. The collector manifold shall have a minimum 1% grade toward the discharge point.

All laterals and collector manifolds shall have cleanouts installed, accessible from the surface without the necessity of removing, or disturbing, filter media.

H. Basin Liner

An impermeable liner is required for all sand filter systems. This liner should cover the entire bottom of the facility. This liner may be structural concrete or an impervious geomembrane.

Concrete Liner – A concrete liner with approved sealer or epoxy coating shall be at least five inches thick Class A or better and reinforced with steel wire mesh. (Use six or larger gage wire and six-inch by six-inch or smaller mesh.)

Geomembrane Liner – Geomembrane liners shall be at least 30 mm thick, resistant to ultraviolet and protected from puncture, tearing, and abrasion such as by placing a layer of geotextile fabric on the top and the bottom of the geomembrane. The liner shall be placed on a smooth, compacted bed of sand no less than 6 inches in thickness, graded as necessary to facilitate the hydraulic performance designed into the facility.

Figures 5-6 through 5-10 show variations of sand filter design. Although only the sand filter shown in Figure 5-6 has been explicitly discussed, additional information has been provided. The level spreader and pre-treatment cell shown in Figures 5-7 through 5-10 are intended to suggest that alternative or additional water quality facilities may be acceptable.

Figure 5-7:
SAND FILTER WITH LEVEL SPREADER

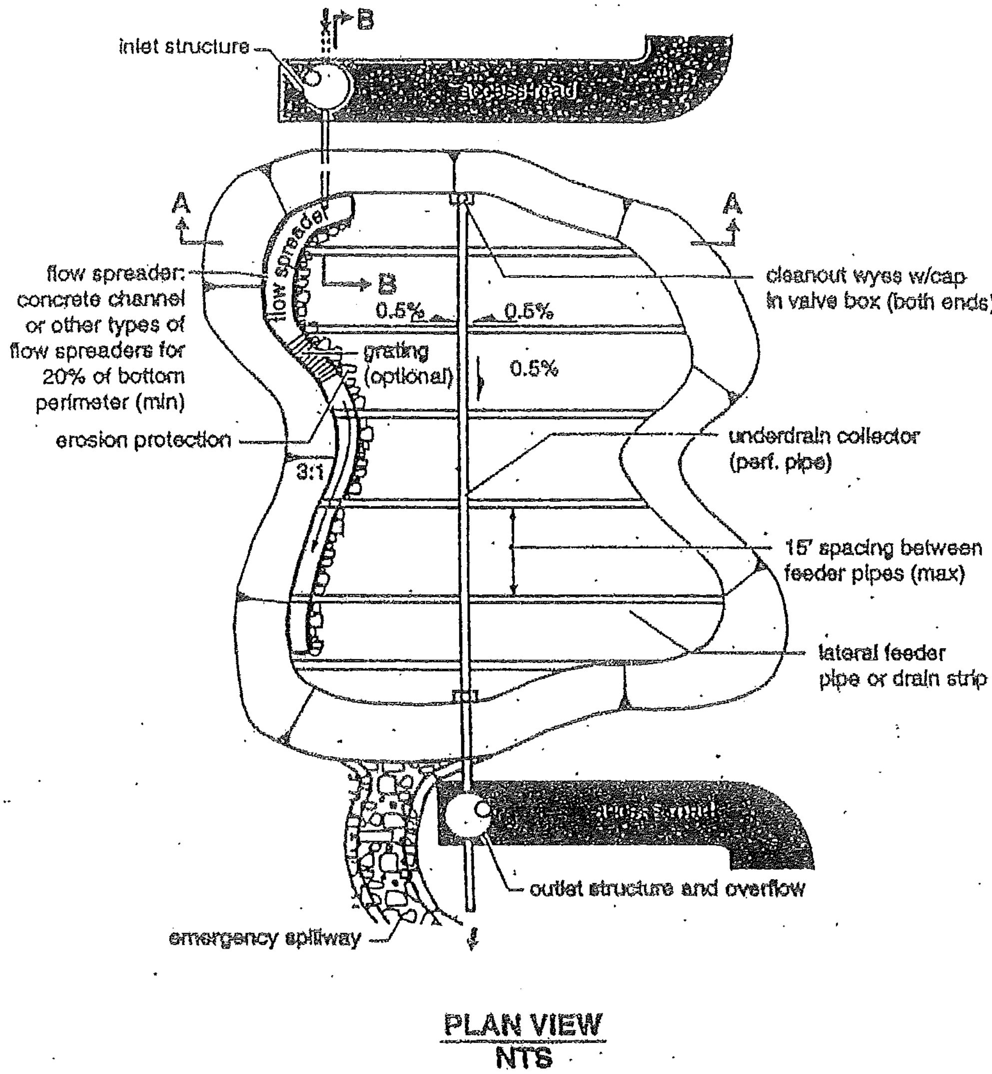


Figure 5-8:
SAND FILTER WITH LEVEL SPREADER DETAILS AND SECTIONS

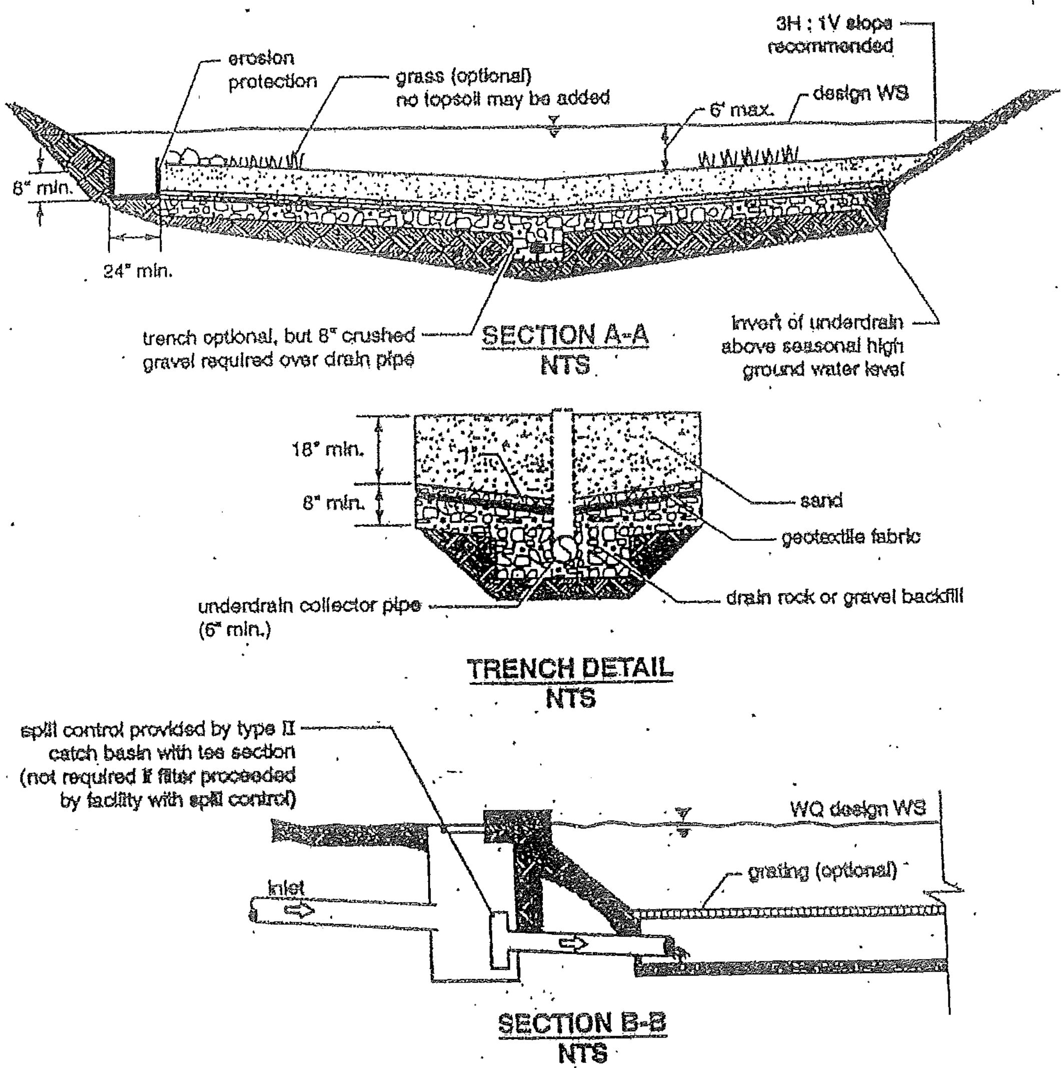
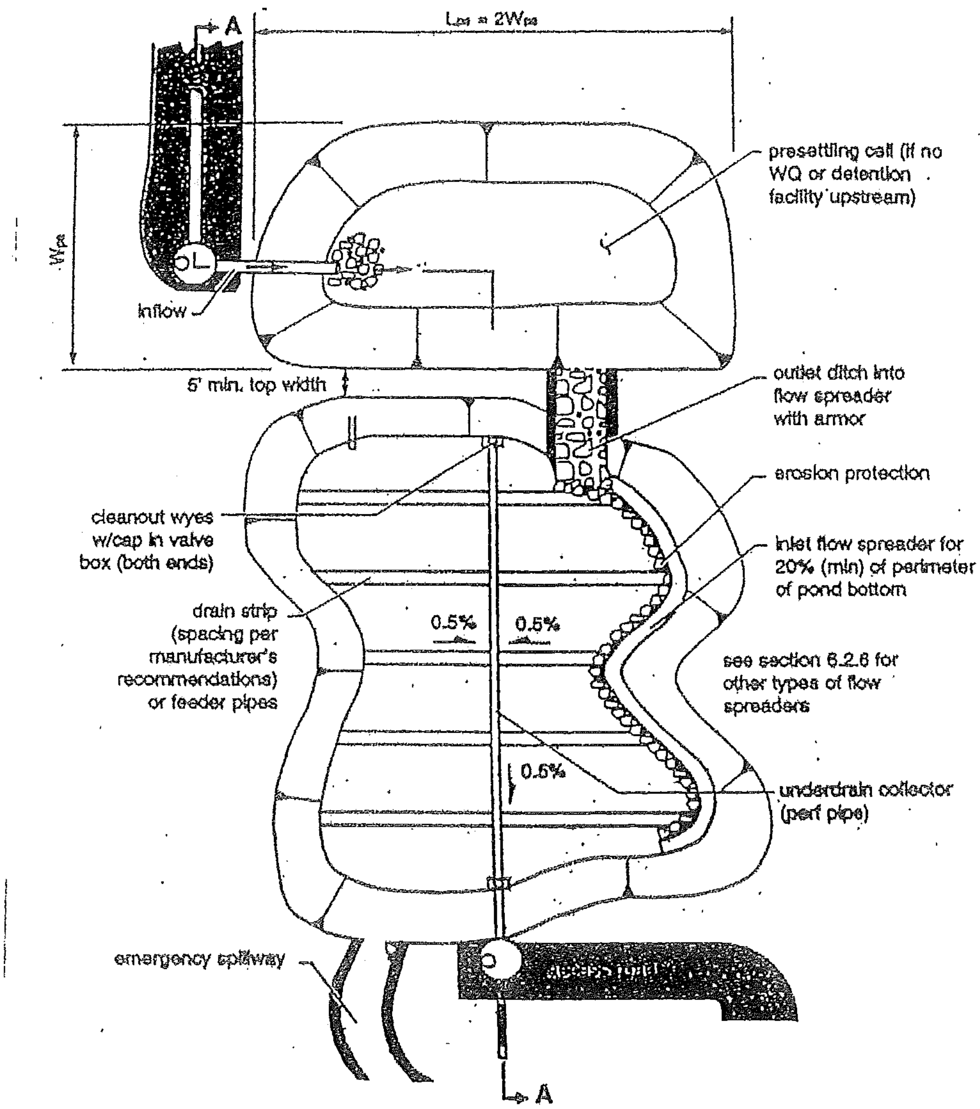
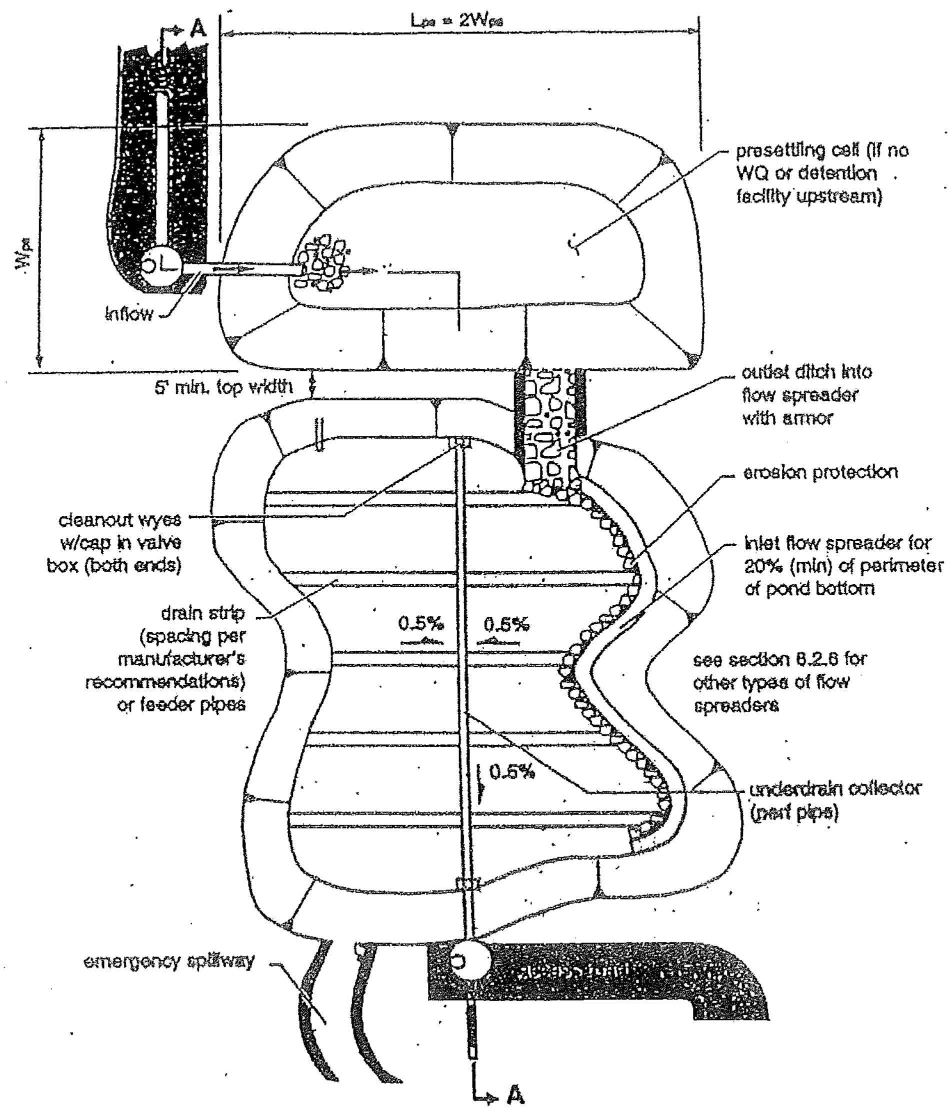


Figure 5-9: SAND FILTER WITH PRE-TREATMENT CELL



PLAN VIEW
NTS

Figure 5-10: SAND FILTER WITH PRE-TREATMENT CELL SECTION



PLAN VIEW
NTS

5.6.3 Stormwater Management^{tm} Stormfilter^{tm} Or Equal

A. General requirements

Area to be served	Dependent on impervious area
Soils requirements (NRCS Classification)	Meet manufacturer's requirements
Maximum ground slope	N/A
Maximum maintained slide slope	N/A
Water application rate	15 gal/min peak flow per filter cartridge

One such stormfilter is manufactured by STORMWATER MANAGEMENT™ of Portland, Oregon These are vault structures fitted with rechargeable filter cartridges to remove pollutants from stormwater runoff. For criteria such as design specifications, access requirements, and operation and maintenance requirements of the Stormfilter™, contact the manufacturer directly. These facilities require maintenance on annual or semi-annual basis. The City will entertain submittals of other stormfilters proposed to be "equal" to the Stormfilter™. Such submittals shall contain the proposed product's criteria such as design specifications, access requirements, and operation and maintenance requirements.

5.7 TREATMENT "IN KIND" PROVISION / OFF-SITE TREATMENT

Certain site constraints may physically limit the ability to convey a part of a development's stormwater runoff through one of the listed water quality facilities. The City Engineer, in these circumstances, may allow the treatment of a nearby area, if in the City Engineer's opinion, a net overall improvement in the quality of the stormwater runoff will occur with respect to the pre-developed condition. The details and proof must be explained in narrative form in the Drainage Report. The net improvement **must occur in the same basin** the project is located in and cannot provide improvements across basin boundaries.

5.8 MAINTENANCE CRITERIA FOR STORMWATER FILTER FACILITIES

In addition to maintenance criteria described in Chapter 8, the following apply:

A. Facility Inspection

1) Inspect vegetated swales at least three times per year, especially after heavy runoff.
2) Inspect sand filters at least annually. Maintenance may be needed if drawdown does no occur within the time specified by the design.
3) Keep inspection records.

B. Sediment Removal

1) Remove sediment from vegetated swales when it builds up to six inches deep at any location or causes grass to die. It is particularly important to remove sediment deposit in the upper portion of the swale during high intensity storm events.

2) Remove sediment from vegetated swales by hand (e.g., with a flat-bottomed shovel) to minimize damage to vegetation. Remove sediment as necessary, or in the summer to allow disturbed vegetation to re-stabilize before winter flows.

C. Infiltration Facilities

Infiltration Testing: Where soil infiltration is part of the required operation of the proposed facility, the infiltration rate shall be determined using the standard test method for "field measurement of infiltration rate. This test shall be performed by a certified geotechnical laboratory using a double ring infiltrometer with a sealed-inner ring" (ASTM D5093-90). The test shall be performed in the strata in which infiltration is anticipated to occur. In areas where infiltration is not allowed or it is unlikely to be successful, infiltration may be used for stormwater disposal for purposes of water quantity control. In those cases, the stormwater must first be treated by a method that does not depend on the filtering process of infiltration for its treatment effectiveness.

D. Infiltration Trenches

An infiltration trench is a shallow trench in permeable soil that is backfilled with sand and coarse stone and lined with filter fabric.

1) General requirements

Area to be served	15 acres
Soils requirements (NRCS Classification)	A or B for publicly maintained facilities, C & D may be used for privately owned facilities if drawdown standards are met
Maximum ground slopes for	
Surface trenches	5%
Buried trenches	16%
Maximum maintained slide slopes	3 horizontal to 1 vertical
Water application rate	50% of soils capacity (ASTM D5093-90).

2) Design Criteria

a. The infiltration trench shall infiltrate the entire design storm without overflow.

b. Infiltration trenches shall meet the following setback requirements: minimum of 100 feet from slopes of 10%, add 5 feet of setback for reach additional percent of slope up to 30%.

c. Provide an overflow structure to transport the design capacity of water delivery system through facility to an approved stormwater receiving system (e.g., stream, lake, storm sewer).

d. Each infiltration trench shall have one slotted observation pipe (4-inch) that extends to the bottom of the trench, located at a point approximately halfway along the trench. The observation pipe shall have a threaded or hinged cap or plug.

e. Drain medium shall have filter fabric between the medium and native soils or backfill.

f. A soil scientist working under the supervision of a licensed engineer shall inspect installation of the trench facility to meet anticipated infiltration rate.

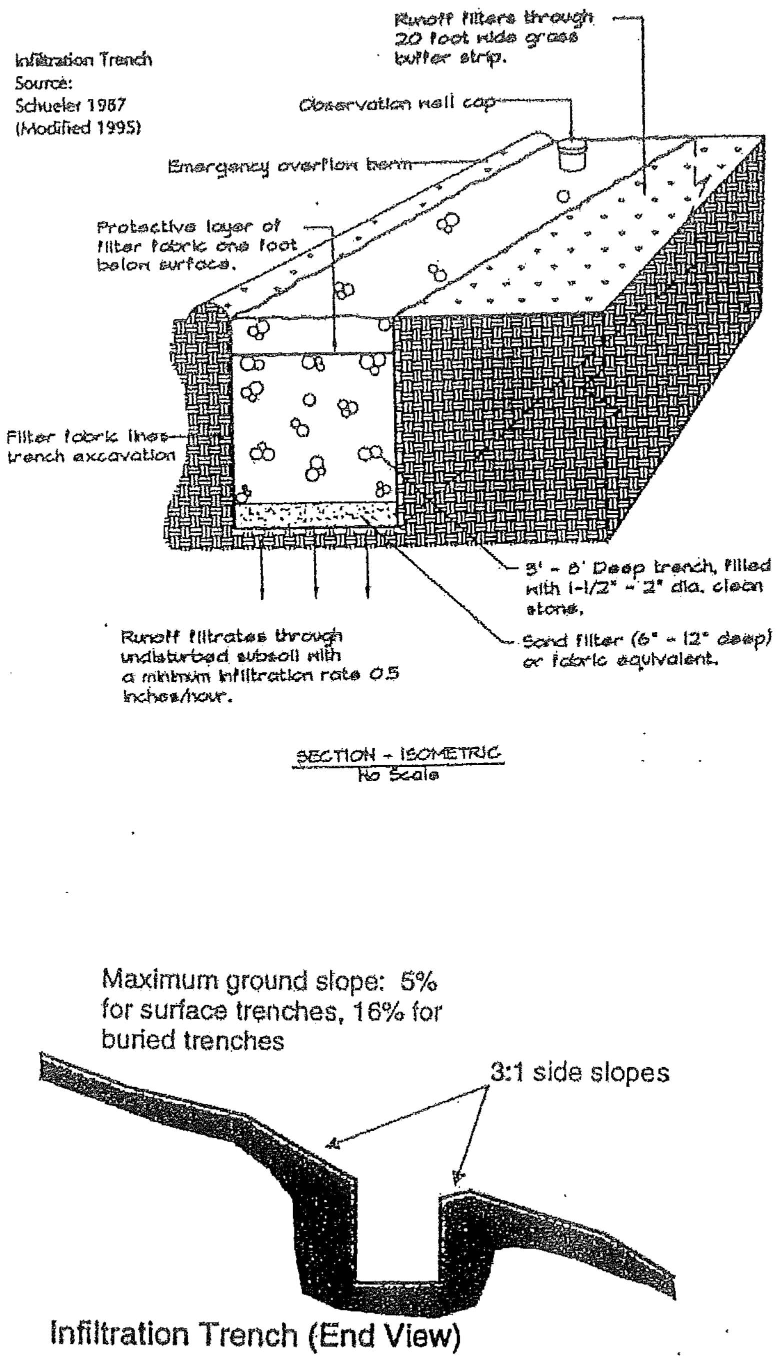
g. Infiltration facilities shall not be accepted in soils with a tested infiltration rate of less than 0.50 inches per hour.

h. There shall be no less than 3 feet of undisturbed depth of infiltration medium between the bottom of the facility and any imprevious layer (e.g., hardpan, solid rock, high groundwater levels, etc.)

i. Maximum drawdown time shall be 24 hours under the water quality design storm.

Figure 5-11 shows an infiltration trench.

Figure 5-11:
INFILTRATION TRENCH



5.9 INFILTRATION BASINS

An infiltration basin is a depression created by excavation, berms, or small dams to provide for short-term ponding of surface water runoff until it percolates into the soil.

A. General requirements

Area to be served	50 acres
Soils requirements (NRCS Classification)	A or B for publicly maintained facilities, C & D may be used for privately owned facilities if drawdown standards are met
Maximum ground slopes	5%
Maximum maintained slide slopes	3 horizontal to 1 vertical
Water application rate	50% of soils (ASTM D5093-90).

B. Design Criteria

1) The infiltration basin shall infiltrate the entire water quality design storm without overflow

2) Infiltration trenches shall meet the following setback requirements: minimum of 100 feet from slopes of 10%, add 5 feet of setback for reach additional percent of slope up to 30%, 200 feet setback for slopes of 30%.

3) Provide an overflow structure to transport the design capacity of water delivery system through facility to an approved stormwater receiving system (e.g., stream, lake, storm sewer).

4) Drain medium shall have filter fabric between the medium and native soils or backfill.

5) Two staff gauges shall be installed, at opposite ends of the basin, to measure the depth of accumulated silts.

6) A soil scientist working under the supervision of a licensed engineer shall inspect installation of the trench facility to meet anticipated infiltration rate.

7) Infiltration facilities shall not be accepted in soils with a tested infiltration rate of less than 0.50 inches per hour.

8) Maximum drawdown time shall be 24 hours under the water quality design storm.

Figure 5-12 shows an infiltration basin.

5.10 CONSTRUCTED TREATMENT WETLANDS

A. General Requirements

Area to be served:	No less than 10 acres
Soils requirements (NRCS Classification)	C and D (A and B with lines)
Maximum ground slope	NA
Maximum maintained slide slopes:	4 horizontal to 1 vertical
Water application rate:	Base flow must exceed summer evapotranspiration rate

B. Design Criteria

1) The detention time shall be no less than 36 hours.

2) The volume of water to be treated shall be allocated over the treatment area of the facility as follows:

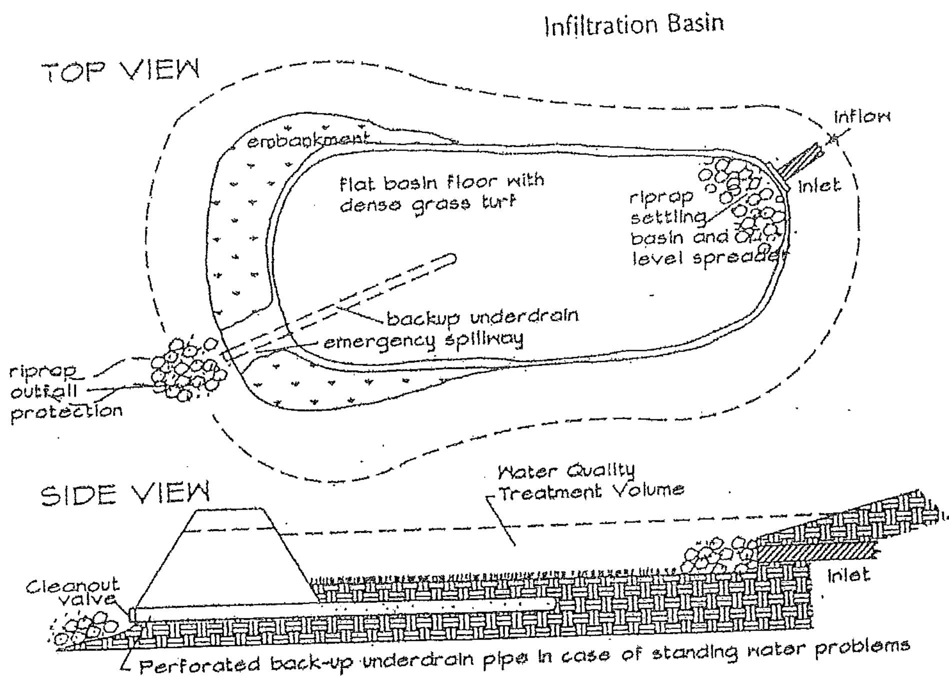
Component	% of Design Volume	% of Facility Surface Area
Forebay	10	5
Micropool	10	5
Deep water	50	40
Deep wetland	20	25
Shallow wetland	10	25

The minimum length-to-width ratio shall be 3:1.

3) The side slopes shall be no steeper than three horizontal to 1 vertical (3h:1v).

4) A perimeter zone approximately 10-20 feet wide, which is flooded temporarily during storm events, shall be provided.

Figure 5-12:
INFILTRATION BASIN



5) Flow velocity through the wetland shall be less than one tenth of a foot per second for water quality design storm.

6) The forebay area shall have a water depth of about 3 feet and have between 10% and 25% of the total treatment wetland volume.

5.11 FLOW BY-PASS FACILITIES

Most water quality facilities can be designed as flow-through (on-line) systems with flows above the water quality design flow or volume simply passing through the facility untreated. However, it is sometimes desirable to restrict flows to water quality treatment facilities and to bypass the remaining higher flows around them (off-site facilities). This can be accomplished by splitting flows in excess of the water quality design flow upstream of the facility and diverting higher flows to a bypass pipe or channel. The bypass typically enters a detention pond or the downstream receiving drainage system, depending on flow control requirements.

Flow splitters may be modeled using a two-outlet reservoir routine. The stage/discharge relationship of the outflow pipes should be determined using backwater analysis.

Two flow splitter designs are shown in Figure 5-13 and Figure 5-14.

A. Design Criteria

1) A flow splitter shall be designed to deliver the required water quality design flow rate to the water quality treatment facility

2) The top of the weir shall be located at the water surface for the design flow. Remaining flows enter the bypass line.

3) The maximum head shall be minimized for flows in excess of the water quality design flow.

4) Either design shown in Figure 5-13 or 5.14 may be used. Equivalent designs are also acceptable.

5) Special applications, such as roads, may require the use of a modified flow splitter.

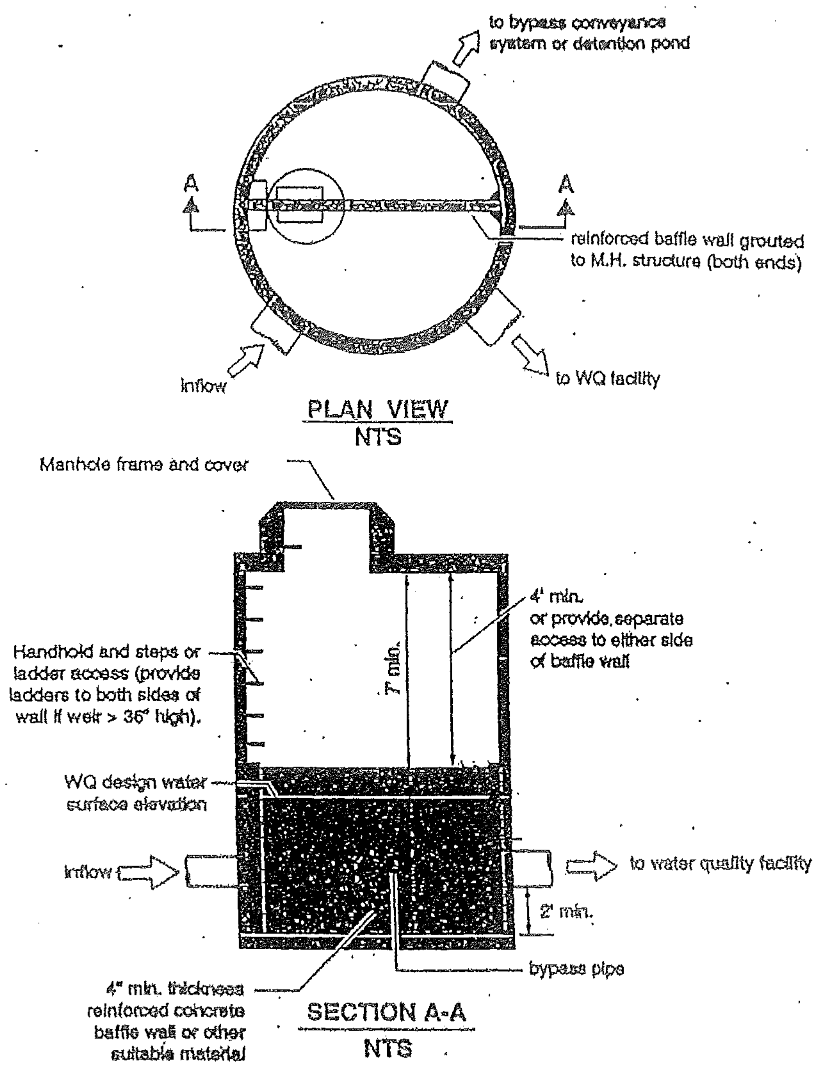
6) For ponding facilities, backwater effects must be included in designing the height of the standpipe in the catch basin.

7) Ladder or step and handhold access shall be provided.

B. Material Requirements

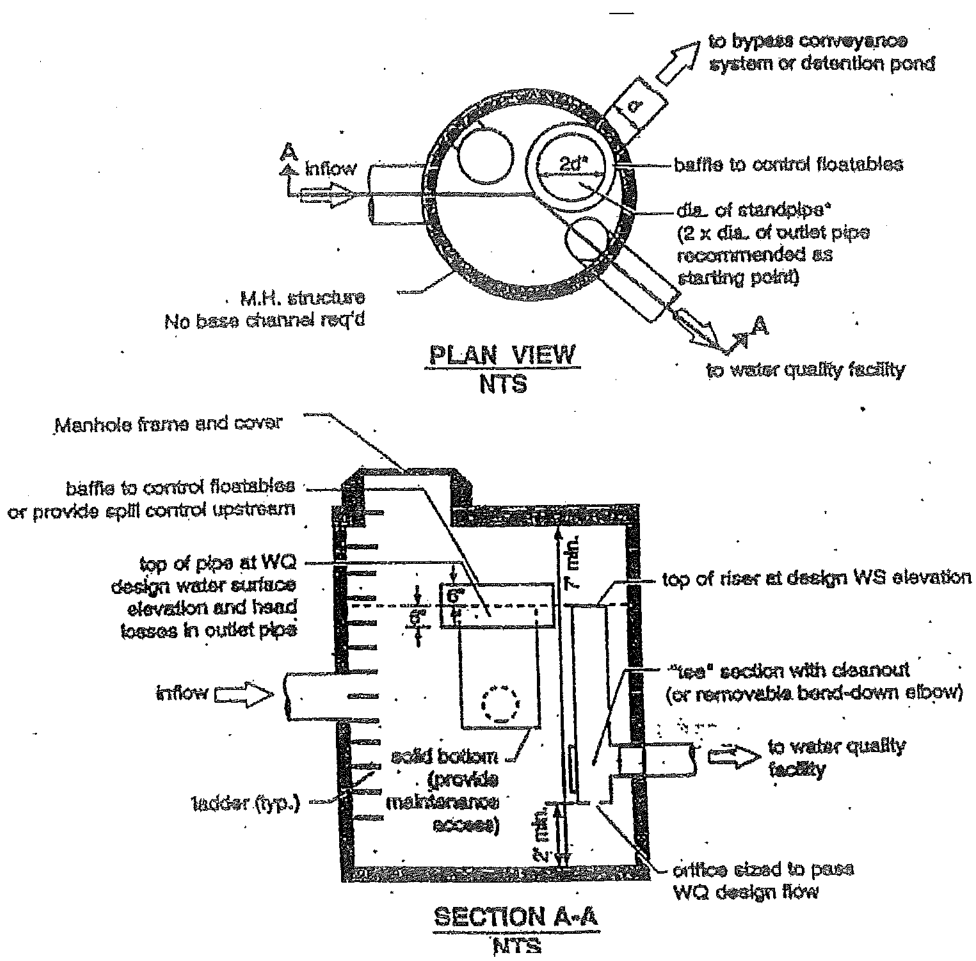
1) The splitter baffle shall be installed in suitable catch basin or vault.

Figure 5-13:
FLOW SPLITTER, OPTION A



Note: The water quality discharge pipe may require an orifice plate be installed on the outlet to control the height of the design water surface (weir height). The design water surface should be set to provide a minimum headwater/diameter ratio of 2.0 on the outlet pipe.

Figure 5-14:
FLOW SPLITTER, OPTION B



* NOTE: Diameter (d) of standpipe should be large enough to minimize head above WQ design WS and to keep WQ design flows from increasing more than 10% during 100-year flows.

2) The baffle wall shall be made of reinforced concrete or another suitable material resistant to corrosion, and shall have minimum thickness of 4-inches.

All metal parts shall be corrosion resistant.

5.12 GENERAL LANDSCAPE REQUIREMENTS AND RECOMMENDATIONS

See Section 4.2.2.3 S. for landscaping requirements.

5.13 FACILITY-SPECIFIC LANDSCAPE REQUIREMENTS

See Section 4.2.2.3 S. for landscaping requirements.

5.14 BEST MANAGEMENT PRACTICES FOR COMMERCIAL, INDUSTRIAL, AND MULTI-UNIT DWELLING LAND USES

These policies apply to all new development or significant redevelopment with these site uses or characteristics, regardless of size.

Some of the areas and activities associated with commercial facilities, industrial facilities, and multi-unit dwellings have the potential to generate pollutants. These pollutants may not be addressed solely through implementation of the storm water quality and quantity management practices presented in this document. This chapter presents the policies and management practices required for facilities that generate, or have the potential to generate specific pollutants due to site characteristics or use.

5.14.1 Applicability

Management practices required for site uses and characteristics defined in this chapter are required in addition to the general requirements for storm water quality and quantity management. These policies apply to all new development regardless of size, and re-development.

Management practices in this section are applicable to specific site uses or characteristics:

A. Fuel Dispensing Facilities

B. Bulk Petroleum Storage in Multiple Stationary Tanks

C. Covered Waste Storage Areas

D. Loading and Unloading Docks

E. Covered Vehicle Parking

F. Equipment and/or Vehicle Washing Facilities

G. Interior Floor Drains

The development of the specific requirements were based on the following goals and objectives:

- Prevent storm water contamination by eliminating pathways that may introduce pollutants into storm water.
- Drain wastewater discharges and areas with potential to have wastewater discharges or acute releases to the sanitary or combined sewer system.
- Contain spills on-site (or allow for the potential).
- Minimize low-level chronic loading to the environment.
- Emphasize structural controls over operational procedures.
- Address multiple site uses and tenant turnover.

5.14.1.1 PERFORMANCE APPROACH

The performance approach may be utilized as a substitute to the policy requirements presented in this section. To receive approval, all performance based system designs shall satisfy all the objectives stated above, as they apply to the subject site.

5.14.1.2 MULTIPLE BMP REQUIREMENTS

More than one policy may apply at a single site as necessary to address the characteristics and uses encountered at the site.

5.14.2 Fuel Dispensing Facilities

5.14.2.1 APPLICABILITY:

The following policy applies to all new or significantly redeveloped fuel dispensing facilities. A fuel dispensing facility is defined as the area (including fuel islands, aboveground fuel tanks, fuel pumps, and the surrounding pad) where fuel is transferred from bulk storage tanks to vehicles, equipment, and/or mobile containers.

5.14.2.2 ISSUE:

Fuel dispensing facilities are a potential source of chronic loading and acute releases to the environment. Storm water runoff from fuel dispensing facilities may be contaminated with oils and greases, heavy metals, and other pollutants.

5.14.2.3 POLICY:

A. Cover. The fuel dispensing facility shall be covered with a permanent canopy or roof. The cover prevents stormwater contamination and minimizes the volume of stormwater entering the area. Direct the clean rainwater from the cover to an approved stormwater disposal system..

Covers 10 feet high or less must have a minimum overhang of 3 feet on each side. The overhang will be measured relative to the berm or pavement break required in Section 2 of this policy.

Covers greater than 10 feet high must have a minimum overhang of 5 feet on each side. The overhang will be measured relative to the berm or pavement break required in Section 2 of this policy.

B. Drainage. Drainage from the area beneath the cover shall be directed to a dead-end consisting of an approved on-site containment structure or to the sanitary sewer system via an API- or CPS-type oil/water separator. The area beneath the canopy or roof shall be reverse-graded or bermed from other portions of the facility to minimize the amount of stormwater runoff accumulating beneath the cover.

C. Spill Prevention. To prevent spills from entering the sanitary sewer system, an automatic or manual shut-off valve shall be installed in the discharge line prior to the connection with the sanitary sewer. Appropriate signage and employee training shall be provided. The City requires that spill response supplies, such as absorbent material, be stored at the transfer area.

D. Exceptions.

1) **One single above ground tank (AST) with local dispensing location:** Both the tank and the dispensing area must follow the requirements set forth in sections 1 and 2 of this policy. Spill protection and crash guards are required for all single tanks with a local dispensing location. Fuel must be dispensed directly from the tank, typically through a flexible hose.

2) Traffic protection bollards shall be placed at a maximum spacing of 5 feet on all sides of the tank where traffic patterns may exist and a containment wall is not present. ASTs regulated by the Uniform Fire Code and/or other regulations shall also comply with those applicable requirements.

3) One single AST with remote dispensing location:

4) Spill protection and crash guards are required for all single tanks with a remote dispensing location. Fuel must be transported from the AST to the remote dispensing location through a permanent hard piped system.

5) Traffic protection bollards shall be placed at a maximum spacing of 5 feet on all sides of the AST where traffic patterns may exist and a containment wall is not present. ASTs regulated by the Uniform Fire Code shall also conform to all applicable UFC requirements such as containment, installation, etc.

6) Propane tanks

7) Propane tanks are exempt from this policy.

E. Definitions

1) **An AST** is defined as a stationary container, vessel, or other permanent holding device designated to the storage and/or distribution of a product.

2) **A bulk fuel terminal** is **any** terminal whose primary function is designated to the storage and distribution of fuel to distributors such as gas stations.

3) **A local dispensing location** is a area within 15 feet of the tank and used to dispense fuel directly from the from the AST, typically through a flexible hose.

4) **A remote dispensing location** is an area designated to transfer fuel from the AST to another object such as a container, vehicle, tanker, etc. Fuel is transported from the AST to the remote dispensing location through a permanent hard piped system.

5) **A traffic pattern** is any **thoroughfare** where traffic is capable and likely to travel. Traffic includes forklifts, vehicles, farm machinery, and any other machine capable of damaging the AST.

5.14.3 Bulk Petroleum Storage In Multiple Stationary Tanks

5.14.3.1 APPLICABILITY:

The following policy applies to all new or significantly redeveloped areas that store any type of bulk liquid petroleum products or waste materials outside in multiple above ground storage tanks (AST). Multiple ASTs are defined as two or more tanks that are within the same secondary containment structure. If the tanks are within 20 feet of each other but have separate secondary containment because the materials are incompatible, they will also be addressed by this policy.

5.14.3.2 ISSUE:

Stationary tanks that store liquid petroleum products or waste materials have the potential to leak toxic compounds, oil and grease, heavy metals, and other chemicals. In addition, spills may occur during liquid transfer operations or tank failure.

5.14.3.3 POLICY:

A. Cover. Stationary ASTs shall be covered with a canopy or roof. The cover minimizes stormwater contact with the ASTs and associated piping, and reduces the volume of stormwater that is discharged to the sewer, stormwater system, or wastewater recycling system which receives drainage from the facility. Clean rainwater from the roof shall be directed to an approved stormwater system.

OR

Cover all couplings, pumps, and other potential drip and spill locations with rain shields. Place drip pans under the rain shields. Any collected liquids or soiled absorbent materials must be reused, recycled, or disposed of properly. As an alternative, the areas under the rain shields may be plumbed to a dead end sump, to the sanitary sewer, or to another approved containment structure. All discharges to the sanitary sewer must receive pretreatment. At a minimum, this will include and oil/water treatment device. Other pretreatment may be required depending on the nature of the discharge. Refer to steps 3 and 5 of this policy for evaluation and discharge requirements.

B. Drainage. If a cover is constructed, drainage from the area beneath the cover shall be directed to the sanitary sewer, dead-end sump or other approved on-site containment structure. The area beneath the canopy or roof shall be reverse-graded, bermed, or drained from other portions of the facility to minimize the amount of stormwater runoff accumulating beneath the cover.

C. Evaluate. All proposed wastewater discharges to the sanitary sewer must be evaluated prior to discharge. Certain types of discharges may require a permit and/or receive pretreatment prior to discharge to a sanitary sewer.

D. Spill Containment. The facility design shall include adequate storage capacity for spill containment of at least 110% of the largest tank, or 10% of the total volume of material stored, whichever is largest. The City requires that spill response supplies, such as absorbent material, be available on site.

E. Discharge. If the spill containment structure accumulates rainwater, it shall be inspected by the owner/operator for a sheen of petroleum. If a sheen is present, use absorbent pads to remove the sheen, direct the discharge through an oil/water treatment device prior to discharge, or contact a licensed provider for disposal. Dispose of the accumulated stormwater by discharge to a sanitary sewer or through a licensed provider. All batch discharges to the sanitary sewer must be evaluated by the Sanitary Sewer service provider before discharge

   Accumulated stormwater can be discharged to a storm system when there is no sheen present, and there is no reason or evidence that would indicate stormwater has been impacted by pollutants.

F. Additional Requirements. Storage of reactive, ignitable, or flammable liquids must comply with the Uniform Fire Code as adopted by the State of Oregon. BMPs presented in this policy are intended to complement not conflict with, current Fire Code requirements. None of these policy requirements shall exclude or supersede any other requirements in this document, other city permit requirements, or state and federal laws pertaining to water quality.

5.14.4 SOLID WASTE STORAGE AREAS

5.14.4.1 APPLICABILITY:

The following policy applies to all proposed new or significantly redeveloped solid waste storage areas. A solid waste storage area is a place where solid waste containers are stored. Solid waste containers include trash compactors, solid waste dumpsters, and garbage cans.

5.14.4.2 Issue:

Pollutants may be introduced into stormwater if the stormwater mixes with the solid waste, or fluids leaking from waste containers. These pollutants are not appropriate to dispose of in a stormwater facility. Solid waste storage areas and solid waste containers that are properly constructed and maintained prevent the introduction of pollutants into stormwater.

5.14.4.3 Policy:

A. Cover. All solid waste containers shall be covered with a lid.

B. Drainage.

For Dumpsters and Garbage Cans:

If available, only leak-proof dumpsters and/or garbage cans shall be utilized. If fluids have leaked from a garbage can or dumpster, repair or replace the solid waste container (If the solid waste container is supplied by a solid waste hauler, ask them to replace or repair the container). If fluids continue to leak from the solid waste container, the City requires that the solid waste container be placed on a covered, impervious surface, with drainage beneath the covered area directed to a sanitary sewer, a dead-end sump, or other approved on-site containment structure. Stormwater drainage from the cover shall be directed to an approved stormwater disposal system.

For Trash Compactors:

Trash compactors shall be covered with a canopy or roof to prevent stormwater contact and minimize the quantity of stormwater to be discharged to a sanitary sewer, dead-end sump, or other approved on-site containment structure. The area beneath the cover shall be graded or bermed, with drainage directed to a sanitary sewer, a dead-end sump, or other approved on-site containment structure. Clean rainwater from the cover shall be directed to an approved stormwater disposal system.

C. Clean. If the solid waste storage area and/or solid waste containers are washed, the wastewater shall be directed to a sanitary sewer, or contained and disposed of properly. Do not allow this washwater to enter a stormwater system.

5.14.5 Loading/Unloading Docks

5.14.5.1 Applicability:

The following policy applies to all proposed new or significantly redeveloped loading/unloading docks.

5.14.5.2 ISSUE:

Pollutants can be inadvertently discharged to the environment at loading/unloading docks through acute and chronic releases of materials present in these areas. If releases occur, they are expected to happen during transfer, and within 5 to 7 feet of a truck/trailer end.

Stormwater runoff from transfer areas may also contain oil, grease, chemicals, heavy metals, and a variety of other parameters that may degrade water quality. Spilled materials and stormwater contacting these areas are not appropriate for discharge into a stormwater system.

5.14.5.3 POLICY:

A. Cover. Loading/unloading docks shall be covered with a canopy, roof or other permanent overhang which must extend a minimum of 7 feet over the trailer/truck end. The cover will minimize the volume of stormwater discharged to the sanitary sewer, dead-end sump, or other approved on-site containment structure. Clean stormwater from the cover shall be directed to an approved stormwater system.

B. Drainage. Drainage from beneath the cover shall be directed to either a dead-end consisting of an approved on-site containment structure or to the sanitary sewer system via an API or CPS-type oil/water separator. Stormwater shall be prevented from entering the area beneath the cover through the use of berms, grading, or drains.

C. Pretreat. Discharges from loading/unloading docks to the sanitary sewer shall undergo a discharge evaluation prior to implementation. At a minimum, all discharges shall be directed through an oil/water separator before discharge

D. Spill Prevention. To prevent spills from entering the sanitary sewer system, an automatic or manual shut-off valve shall be installed in the discharge line prior to the connection with the sanitary sewer. Appropriate signage and employee training shall be provided. The City requires that spill response supplies, such as absorbent material, be stored at the transfer area. Industrial users that handle, store, or use hazardous, dangerous, and/or toxic substances on their sites may be required to implement additional measures.

5.14.6 Covered Vehicle Parking Areas

5.14.6.1 APPLICABILITY:

The following policy applies to all proposed new or significantly redeveloped covered vehicle parking areas.

5.14.6.2 ISSUE:

Wastewater such as washwater and automotive fluids may be present within the interior of a covered vehicle parking area. This wastewater may contain elevated levels of pollutants which shall not be discharged to a stormwater system. Stormwater would not be present in significant quantities within a properly constructed, covered vehicle parking area.

5.14.6.3 POLICY:

A. Drainage. Drainage from the cover or the top floor of a multi-level parking structure shall be directed to an approved stormwater management system. Any drains located beneath the covered portion of a multi-level vehicle parking area shall be connected to a sanitary sewer. If a sanitary sewer is not available, drainage from beneath the covered area shall be directed to either a dead-end consisting of an approved on-site containment structure. The City Engineer may approve drainage to the stormwater system, via an API or CPS-type oil/water separator, on a case by case basis.

B. Prevention. Stormwater runoff from adjacent, uncovered portions of the facility (if present) shall be prevented from entering the covered vehicle parking area(s) using berms, drains, or grading.

C. Other Uses. If fuel dispensing and/or vehicle washing will also occur in the covered parking area, the respective policies that regulate these uses shall also apply.

D. Exceptions for Residential/Multi-unit Structures/Multi-unit Developments. All single level covers, canopies, carports, overhangs, or under-building parking utilized for vehicle shelter associated with residential and multi-unit structures/developments are exempt from the requirement to direct drainage from beneath the cover to a sanitary system. Drains present in these areas must conform to the high traffic policy provided in this chapter.

5.14.7 Equipment And/Or Vehicle Washing Facilities

5.14.7.1 APPLICABILITY:

The following policy applies to all proposed new or significantly redeveloped facilities where equipment and/or vehicles are washed.

5.14.7.2 ISSUE:

Wastewater from equipment and/or vehicle cleaning contains pollutants that are not appropriate for disposal in a stormwater system. Discharges resulting from these activities must be recycled or disposed of properly.

5.14.7.3 POLICY:

A. Cover. The equipment and/or vehicle washing facility shall be covered with a canopy or roof. The cover prevents stormwater contact and minimizes the volume of stormwater that is discharged to the sanitary sewer or wastewater recycling system that receives drainage from the washing facility. Direct the clean rainwater from the roof to an approved stormwater system.

B. Drainage. Drainage from the equipment and/or vehicle washing facility shall be directed to a sanitary sewer or to a wastewater recycling system. The equipment and/or vehicle washing facility shall be reverse-graded or bermed from other portions of the facility to prevent stormwater runoff from entering the area.

C. Pretreat. Pretreatment requirements shall be evaluated on a case-by-case basis due to the variety of pollutants that may be generated from these activities. At a minimum, wastewater discharged to a sanitary sewer from equipment and/or washing facility shall be directed through an oil/water pretreatment device prior to discharge.

D. Sampling. A sampling manhole or other suitable wastewater monitoring access point may be required. This will be determined in the Plan review process.

5.14.8 Interior Floor Drains

5.14.8.1 APPLICABILITY:

The following policy applies to all new or significantly redeveloped buildings and facilities with interior floor drains.

5.14.8.2 ISSUE:

A variety of wastewaters generated by floor washing, accidental spills, and other activities may be present near interior floor drains. Directing the drainage from interior floor drains to a sanitary sewer or to a dead-end sump (or other approved on-site containment structure) provides proper wastewater treatment or spill containment.

5.14.8.3 POLICY:

E. Drainage. All drainage from floor drains within buildings or beneath covered areas shall be directed to a sanitary sewer, dead-end sump, or other approved on-site containment structure.

   NOTE: Interior floor drains are prohibited in all areas designated for manufacture, storage, or processing of materials that are required to be permitted under the Uniform Fire Code (UFC), or regulated by the: Resource Conservation and Recovery Act (RCRA); the Toxic Substances Control Act (TSCA); the Comprehensive Environmental Response, or the Compensation and Liability Act (CERCLA).

   If chemical use or chemical waste generation may occur at a site, the user shall consult the regulations listed above for further information.

F. Prevent. Stormwater runoff from adjacent, uncovered portions of the facility shall be prevented from entering the covered/interior area through the use of grading or berms.

G. Evaluate. All wastewater that may/will be discharged to interior floor drains shall be evaluated before discharge. Certain types of discharges may require a permit and/or receive pretreatment before discharge to a sanitary or storm sewer.

CHAPTER 6
COLLECTION AND CONVEYANCE FACILITIES

TABLE OF CONTENTS

CHAPTER 6 – COLLECTION AND CONVEYANCE FACILITIES

6.1 PURPOSE AND SCOPE

This presents the City policy concerning the selection, design, sizing and construction of stormwater collection and conveyance facilities, including open channels, and ditches, culverts, piped storm drains, inlet and junction structures and outfalls. Some facilities function as both water quality and conveyance facilities (e.g., biofiltration swales and oil/water separators).

Design criteria for these facilities are found in Chapter 5, Stormwater Quality Control Facilities. Some outfall structures also function as part of runoff control facilities (e.g., control manholes and emergency overflow spillways). Design criteria for these facilities are found in Chapter 4, Stormwater Quantity Control Facilities.

6.2 GENERAL DESIGN CRITERIA

6.2.1 General Design Considerations

Storm drainage design within a development area must include provisions to adequately control runoff from all public and private streets and the roof, footing, and area drains of residential, multi-family, commercial or industrial buildings. It must also ensure future extension of the current drainage system.

Some general stormwater system considerations include:

A. Surface water or subsurface drainage shall not be allowed to flow over adjacent public or private property at a rate, volume or location materially different from that which existed before development occurred.

B. Surface water entering or exiting the subject property shall be received and discharged at naturally occurring locations with no diversion at any of these points unless written permission is obtained from the affected property owners. Surface water exiting the subject property shall be discharged, with approved energy dissipaters and runoff quantity controls. Discharge facilities shall be designed and constructed so as to minimize downstream damage and erosion.

C. The approved point of discharge for all developments will depend upon the prevailing site conditions, capacity of existing downstream facilities, and feasibility of alternate designs. The City Engineer must approve all points of discharge.

D. When private property must be crossed in order to reach an approved point of disposal, it shall be the developer's responsibility to acquire, from the property owner, a recorded drainage easement meeting the approval of the City Engineer. Dimensions shall be in accordance with those included in Section 6.10. Temporary drainage ditch facilities, when approved, must be engineered to contain the stormwater without causing erosion or other adverse effects to the private property being crossed.

E. Drainage provisions shall be made for building roofs and foundation drains in a development.

1) For commercial or industrial developments, these drains shall be piped directly to a storm drain system other than a street gutter. Provisions must be taken so that the design hydraulic grade line of the receiving stormwater facility does not back up into the foundation drain.

2) For single family residential developments, these drains may be piped to the street through a plastic pipe, as required by applicable code, set in the curb under the following circumstances:

   a. The building's top of foundation elevation for the first floor is at least two feet above the top of the existing street curb, and

   b. The existing street section will not permit runoff to flow across the street.

3) Otherwise, these drains shall be piped directly to a storm drain system other than a street gutter. Should site topography prevent connecting foundation and roof drains directly to a public storm drain system, these drains for one (1) or more lots shall be piped through a private system to the public storm drain system. This private system shall be located in a dedicated private drainage easement. Provision shall be made to inform the owners, their heirs, successors or assigns of the lots impacted by this private drainage easement of the existence of this easement and the responsibilities of the private system maintenance (such as, but not limited to a note on the plat). Any storm drain piping shall conform to Uniform Plumbing Code.

4) Dry wells will be allowed only in instances where the suggested private drainage system can not be discharged to a public drainage system. A percolation test of the remaining original ground will be required. A successful percolation test will show the ability of the soil to accept flow equal to 200% of the expected 100-year storm. This test shall be conducted and documented by a professional civil engineer. In addition, the professional engineering geologist must document that the proposed site is not in a known geologic hazard area. No dry well dispersal will be allowed into fill material. To ensure this, the dry well casing must be solid through the fill area. Dry wells should be protected from sediment during the site construction process.

5) Drains shall not discharge horizontally more than two feet beyond discharge point (This is to prevent wetting the road surface, especially during freezing events).

F. Provision shall be made for conveyance of stormwater generated by future development upstream.

G. The design storm peak discharge from the subject property's post-development condition may not be increased from the conditions that existed in the pre-developed condition, and for some design storms, the peak discharge may have to be reduced. See Chapter 4 for a further discussion on this topic.

H. Vegetation shall be established in areas disturbed by construction to minimize erosion, in accordance with the latest section of the Oregon Standard Specifications for construction.

6.3 DETERMINATION OF DESIGN FLOW (Hydrology)

6.3.1 Design Event

Refer to Appendix 6-1 for a matrix showing which design storm event to use for several particular situations. This matrix was copied from the 1988 Drainage Master Plan. These storm recurrence intervals are for "non-pressure flow" or "open channel flow" conveyance design. See Section 6.4.3 for a discussion of design requirements where conduits are in pressure flow.

6.3.2 Design Methodology

Use the Rational Method for all existing and proposed conveyance systems receiving drainage from: 1) A contributing area of 25 acres or less and 2) Having a time of concentration of 100 minutes or less. For all other conditions, an approved hydrograph method(s) discussed in Chapter 4, Stormwater Quantity Control Facilities, must be used.

6.3.3 Rational Method

The traditional Rational Method, as described in most engineering manuals, is preferred by the City for designing systems serving smaller contributing basins primarily because it tends to provide higher runoff rates than hydrograph methods do, resulting in a more conservative design with a built-in factor of safety.

With the traditional Rational Method, peak runoff rates can be determined using the following formula:

$$Q = C I A$$

where Q = Runoff in cubic feet per second   I = Rainfall intensity in inches per hour

C = Runoff coefficient   and   A = Contributing area in acres

The runoff coefficient (C) should be from Table 6-1, Runoff Coefficients - 'C' Values for the Rational Method.

Table 6-1 RUNOFF COEFFICIENTS - "C" VALUES FOR THE RATIONAL METHOD

UNDEVELOPED LAND	"C" FLAT (0-5%)	"C" ROLLING (>5%)
Wood & Forest	0.05	0.10
Sparse Trees & Ground Cover	0.10	0.15
Light Grass to Bare Ground	0.15	0.20
DEVELOPED LAND		
Pavement & Roofs	0.90	0.90
Gravel Roads & Parking Lots	0.75	0.80
City Business	0.85	0.90
Apartment Dwelling Units	0.80	0.85
Industrial Areas (Heavy)	0.70	0.80
Industrial Areas (Light)	0.60	0.70
Earth Shoulder	0.50	0.50
Playground	0.25	0.30
Lawns, Meadows & Pastures	0.20	0.25
Parks & Cemetery	0.15	0.20

SINGLE FAMILY RESIDENTIAL AREAS (Density is in Dwelling Units per Gross Acre [DU/GA])	"C"
1.0 DU/GA	0.30
2.0 DU/GA	0.36
3.0 DU/GA	0.42
4.0 DU/GA	0.48
6.0 DU/GA	0.60
9.0 - 15.0 DU/GA	0.70

The rainfall intensity (I) should be based on the Rainfall Intensity-Duration Curve located in Appendix 6-1. This figure was copied from the Oregon State Highway Division Hydraulics Manual.

The rainfall intensity is based on the time of concentration, in minutes. The time of concentration should be computed from the most hydraulically distant point in the contributing basin to the structure being designed. See Chapter 4 for a discussion on the calculation of the time of concentration.

6.4 PRESENTATION OF DESIGN FLOW CALCULATION REPORT

6.4.1 Basics of Presentation.

Design hydrologic data for each reach of a proposed storm drain system shall be included in the Design Flow Calculation Report in tabular form. This tabular form shall contain the minimum of the following items:

1) Description and sketch of the storm drain system reach.

   Design flow rate

   Description and sketch of the contributory area, (C value or equivalent, as well as the size)

   Time of concentration

This presentation of design data shall be part of the drainage report discussed in Chapter 2.

Refer to Appendix 6-2 for a sample presentation of a rational method analysis.

6.4.2 Capacity Analysis (Hydraulics)

6.4.2.1 Non Pressure Flow Analysis

Storm drains that are designed to operate at full or partial-full conditions during the design storm are considered open channel flow.

The capacity of pipe systems and open channels, for open channel flow conditions, can often be estimated using the Manning equation for steady uniform flow as follows:

MANNING'S EQUATION

$$Q = (1.486/n)\ A\ R^{2/3}\ S^{1/2}$$

or

$$V = (1.486/n)\ R^{2/3}\ S^{1/2}$$

Where Q = flow in cubic feet per second

n = coefficient of roughness

A = cross sectional area of flow in square feet

V = Velocity, in feet per second

R = hydraulic radius in feet = A/WP (WP = wetted perimeter = length, in feet, of the wetted contact between a stream of water and its containing channel, measured at right angles to the direction of flow)

and S = hydraulic slope (or hydraulic grade line) in feet per foot

The hydraulic slope or hydraulic grade line is defined by the elevations to which water would rise in small vertical pipes, located at various locations along the flow. Often, in a "non-pressure flow" condition, the hydraulic slope can be assumed to be parallel with the flow line slope. The hydraulic grade line is separated from the energy line by the velocity head. The energy grade line is the sum of the hydraulic grade line, the velocity head, friction loss, and the incidental losses.

Typical values for the Manning roughness coefficient "n" can be found in Tables 6-2 and 6-3.

This capacity estimate using the Manning equation may be acceptable for final design purposes. This is if the conveyance system contains no flow restrictions such as tailwater (such as discharge into a partially full detention basin) or abrupt changes in channel cross-section or slope that might cause non-uniform flow. It should also be noted that the Manning equation does not take into account entrance, exit, bend, and junction losses within catch basins or manholes.

6.4.2.2 PRESSURE FLOW ANALYSIS

A backwater analysis shall be included in the Design Flow Calculation Report for the following circumstances:

1) Where uniform flow is not expected or where losses within the system may cause surcharging of water, or
2) A discharge into a tail water condition, such as a partially full stormwater detention pond or into a partially full channel, or
3) Culvert entrances, or
4) Ditch inlet location where backwater effect could cross a property line, or
5) Other locations as determined by the City Engineer.

The backwater analysis shall be to a point where "non pressure flow" at the design storm flow rate is re-established. Appendix 6-3 contains a photocopied section from the Stormwater Management Manual for the Puget Sound Basin that discusses a backwater analysis method.

When a backwater condition exists, the storm drain system shall be designed to convey and contain at least the peak runoff for the 25-year design storm. Structures for proposed pipe systems must be designed to provide a minimum of one foot of freeboard between the hydraulic grade line and the top of the stormwater structure and appurtenances or finish grade above the pipe for the 25-year peak rate of stormwater runoff. Surcharge in pipe systems shall not be allowed if it will cause flooding in portions of a structure, including below-floor crawl spaces and basements.

It is the responsibility of the project engineer to determine the appropriate method of analysis in determining the capacity of the proposed conveyance system. It is also the responsibility of the project engineer to determine the best way to document the design analysis for presentation in the report.

Table 6-2 VALUES OF THE ROUGHNESS COEFFICIENT - "n" FOR PIPES

TYPE OF PIPE MATERIAL	"n"
Concrete	0.012
Ductile Iron	0.012
Corrugated Metal (CMP) - Annular - 2-2/3 inch x ½ inch	0.024
Corrugated Metal (CMP) - Annular – 3 inch x 1 inch	0.027
Corrugated Metal (CMP) - Annular – 6 inch x 2 inch	0.030
Corrugated Metal (CMP) - Helical- 2-2/3 inch x ½ inch	
12-inch diameter	0.011
18-inch diameter	0.013
24-inch diameter	0.015
36-inch diameter	0.018
48-inch diameter	0.020
60-inch diameter and larger	0.021
Corrugated High Density Polyethylene (CPEP) - single wall	0.024
Corrugated High Density Polyethylene (CPEP) - smooth wall	0.012
Spiral Rib Metal (SRP)	0.011
Polyvinyl Chloride (PVC)	0.011
High Density Polyethylene (HDPP) - butt fused	0.009

Table 6-3 VALUES OF THE ROUGHNESS COEFFICIENT - "n" FOR OPEN CHANNELS

Type and Channel and Description	Manning's "n" (Normal)	Type and Channel and Description	Manning's "n" (Normal)
A. Constructed Channels a. Earth, straight & uniform 1. Clean, recently completed 2. Gravel, uniform section, clean	 0.018 0.025	6. Sluggish reaches, weedy deep pools 7. Very weedy reaches, deep pools, or floodways with heavy stand of timber and underbrush	0.070 0.100
3. With short grass, few weeds b. Earth, winding and sluggish 1. No vegetation 2. Grass, some weeds	0.027 0.025 0.025 0.030	b. Mountain streams, no vegetation in channel, banks usually steep, trees and brush along banks submerged at high stages	
3. Dense weeds or aquatic plants in deep channels	0.035	1. Bottom; gravel, cobbles, and few boulders	0.040
4. Earth bottom and weedy banks	0.030	2. Bottom; cobbles with large boulders	0.050
5. Stony bottom and weedy banks	0.040	B-2 Flood Plains	
6. Cobble bottom and clean sides	0.035	a. Pasture, no brush	
c. Rock lined		1. Short grass	0.030
1. Smooth and uniform	0.080	2, High grass	0.035
2. Jagged and irregular	0.050	b. Cultivated areas	
d. Channels not maintained, weeds and brush uncut	0.050	1. No crop 2. Mature row crops	0.030 0.035
1. Dense weeds, high as flow depth	0.100	3. Mature field crops	0.040
2. Clean bottom, brush on sides		c. Brush	
3. Same, highest stage of flow		1. Scattered brush, heavy weeds	0.050
4. Dense brush, high stage		2. Light brush and trees	
B. Natural Streams	0.030	3. Medium to dense brush	0.060
B1. Minor Streams (top width at flood stage less than 100 feet)	0.035	4. Heavy, dense brush d. Trees	0.070 0.100
a. Streams on plain		1. Dense willows, straight	
1. Clean, straight, full stage no rifts or deep pools	0.040	2. Cleared land with tree stumps, no sprouts	0.150
2. Same as above, but more stones and weeds	0.040	3. Same as above, but with heavy growth of sprouts	0.060
3. Clean, winding, some pools and shoals 4. Same as above, but some weeds		4. Heavy stand of timber; a few downed trees, little under-growth, flood stage below branches	0.100
5. Same as 4, but more stones		5. Same as above, but with flood stage reaching branches	0.120

Note: These "n" values are "normal" for use in analysis of channels. For conservative design of channel capacity, the "maximum" values listed in other references should be considered. For channel bank stability, the minimum values should be considered.

6.5 DESIGN CRITERIA FOR OPEN CHANNEL

6.5.1 Geometry

Channel side slopes shall be no steeper than two-horizontal to one-vertical (2:1) for undisturbed ground (cuts), as well as for disturbed ground (embankments). All constructed channel slopes shall be compacted to a minimum 90% compaction (ASTM D1557).

A low flow channel, within the main channel, designed to carry 10% of the design storm, will be required for channels with a design flow of greater than 20 cubic feet per second (cfs). Side slopes for the low flow channel shall not exceed two-horizontal to one-vertical (2h:1v), and shall be stabilized to the satisfaction of the City Engineer. The minimum stabilization material shall be seeded matting.

Channel design along curves shall be curvilinear with a 100-foot minimum radius. Tighter curves may be used if the City Engineer determines that sufficient erosion control has been incorporated into the design to maintain stable bank conditions following development.

6.5.2 Freeboard

Channels shall be designed to provide sufficient freeboard so as not to saturate any adjacent public road base with design storm peak flows. Channels shall have a minimum freeboard of one half foot when the design discharge is 10 cfs or less and 1-foot when the design discharge is greater than 10 cfs. Extra freeboard may be required for curved segments of an open channel.

6.5.3 Channel Lining And Biofiltration

It is encouraged that every opportunity be taken to design open channels to provide biofiltration throughout an entire drainage system and not just at the downstream end of the system. Engineers are also encouraged to consider innovative means of collecting and conveying runoff to incorporate biofiltration into the drainage system design.

Channels shall be rock-lined with riprap or shall incorporate energy dissipation devices designed by a qualified professional engineer if the channel has:

- A flow line slope of 6% or greater; or
- A peak design velocity exceeding the grass-lined channel flow velocity of 4.0 feet per second.

Stone linings will be placed over a gravel layer. The use of a geotextile fabric over erodible or soft soils is encouraged.

All channel sides and bottoms shall be seeded, sodded, or rock lined immediately following excavation, regardless of mean flow velocity.

6.5.4 Biofiltration Swale Location

New biofiltration swales in residential areas shall be in private or public easements and recorded on plats with restrictions. These locations are difficult to access for maintenance and tend to be misused or altered by property owners. Minimum restrictions are:

- Property owner shall not alter drainage way without approval of the City Engineering Division.
- Property owner shall not place any structure or fence within the normal high water area of the swale.
- Property owner shall not introduce foreign material such as grass clippings within the high water area of the swale.

6.5.5 Check Dams

Check dams are not generally recommended for use in open channels due to the problems they pose for routine maintenance operations. However, check dams are recommended for use in temporary or permanent channels as an erosion and sedimentation control device and for stepping down channels being used for biofiltration. Where check dams are proposed, they shall be spaced at maximum 2-foot elevation intervals.

6.5.6 Work Near Existing Natural Channels

All work near natural channels shall be consistent with OCMC Water Quality Resource Area and/or Flood Management Area requirements.

6.6 DESIGN CRITERIA FOR CULVERTS

Culverts, for the purposes of this manual, are single runs of pipe that are open at each end and that do not have structures such as catch basins or manholes. It should be noted that culverts designed for fish passage, as governed by the Department of Fish and Wildlife, often require additional design considerations such as depth of flow and velocity that may differ considerably from the design requirements included in this chapter.

6.6.1 Acceptable Pipe Material

The pipe materials contained in Table 6-4 are approved for use for culverts, subject to the limitations indicated either on Table 6-4 or in Section 6.6.3.

6.6.2 Headwalls

Concrete headwalls are required for all culverts. For detail, see Figure 6-1, Concrete End Protection. No plastic pipes shall be exposed.

6.6.3 General Culvert Design Criteria

1) Maximum design headwater depth shall be one and a half times the diameter of the culvert, with no saturation of roadway subgrade.

2) Minimum culvert diameters are as follows:

   a. For cross culverts under public and private roadways – min. 18 inches.

   b. For all other roadway culverts, including driveway culverts – min. 12 inches.

3) No bends shall be permitted in culvert pipes.

4) Minimum cover:

   a. 2-foot minimum cover under collector and above roads, as measured from the roadway subgrade.

   b. If Class 52 ductile Iron pipe or Class V concrete pipe is used, the cover may be reduced to one foot, as measured from the roadway subgrade.

   c. PVC and HDPE shall require a 2-foot minimum cover, as measured from the roadway subgrade in any public roadway area.

   d. Pipe covers of less than the above stated minimums may be permitted on a case by case basis. These cases may require a designed reinforced concrete cover that will distribute roadway use (traffic) forces to a foundation area to the sides of the pipe.

   e. Reinforced Concrete Box (RCB) culverts may be permitted with no cover requirement on a case by case basis. Signed and sealed structural design calculations shall be submitted for review (this requirement may be waived for pre-cast RCB where the cover is greater than 2 feet). In cases of no cover, the clearance from the roadway surface to the reinforcing steel shall be no less than three inches and the 30-day concrete strength shall be no less than 4,500 psiMaximum culvert length without access structures: 300 feet.

1. Maximum culvert length without access structures: 300 feet.

5) Minimum separation from other utility pipes and conduits (as measured from the outside edge of pipe): six-inch vertical, three-foot horizontal (6h:3v), unless otherwise specified by the purveyor of the utility in question.

6) Pipe bedding and backfill shall conform to ODOT Standard Drawing RD 313.

7) The entrances and outlets to all culverts shall be stabilized with quarry rock or other energy dissipation in order to minimize scouring of the channel bottom and sides. Appendix 6-3 contains a photocopied section from the Stormwater Management

Manual for the Puget Sound Basin that discusses riprap sizing and placement methods at outlets.

8) Rock protection at entrances should extend upstream a minimum of 5 feet and shall have a minimum height 1 foot above the design headwater elevation. Rock protection at the outlet shall have the greater of:

   a. A minimum height of 1 foot above the design tailwater elevation; or

   b. 1 foot above the crown of the pipe.

9) When two parallel pipes are installed, the minimum separation between the pipes shall be two feet or one-half the diameter, whichever is greater. This requirement may be reduced to 1 foot if back filled to six inches above spring line with controlled density fill (CDF) or other methods as approved by the City Engineering Division.

6.6.4 Presentation Of Culvert Design Analysis For City Review

Culvert design data shall be presented in a drainage report as described in Chapter 2. Appendix 6-3 contains a photocopied section from the Stormwater Management Manual for the Puget Sound Basin that discusses the topic of culvert analysis.

Table 6-4 APPROVED PIPE MATERIALS

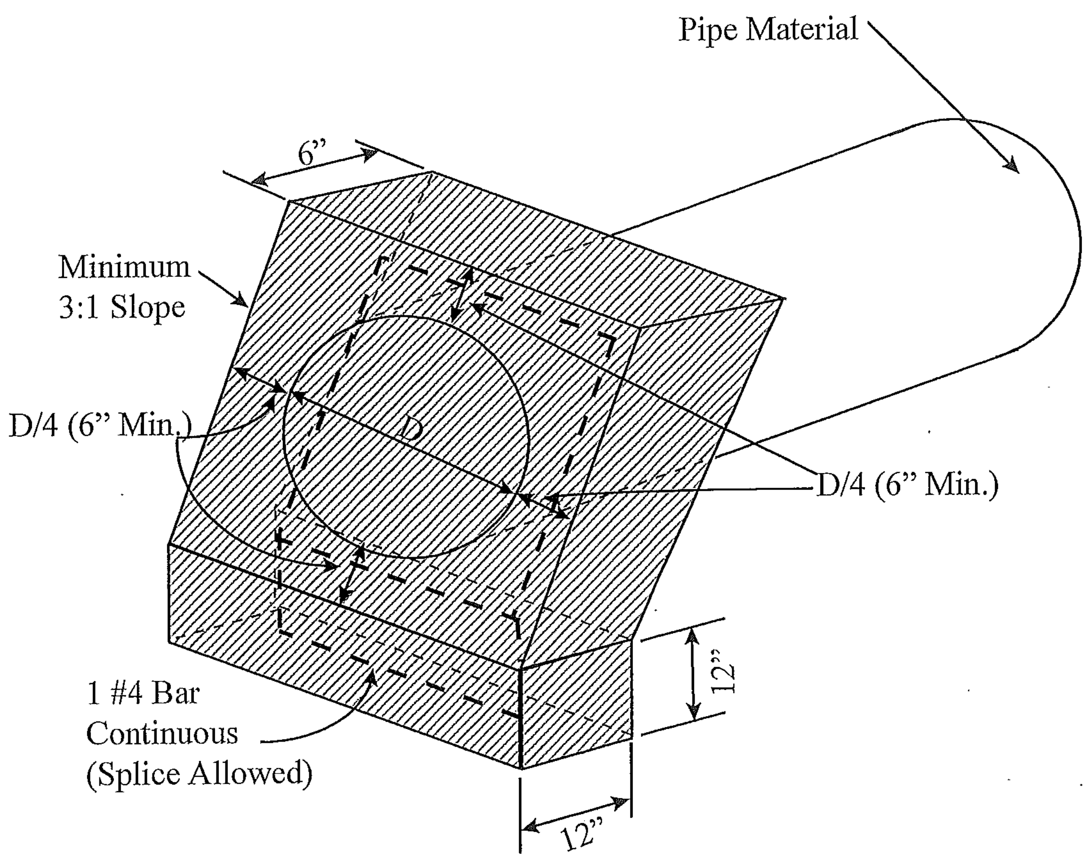
Materials allowed for public storm drainage conveyance systems:

- Concrete pipe, ASTM C-14, Class III minimum. Water tight joints required.
- Reinforced Concrete Pipe, ASTM C-76, Class III minimum. Water tight joints required.
- Ductile Iron; Class 50 wall thickness for pipe sizes up to 12 inches; Class 51 wall thickness for 14 inch and larger; water tight gaskets required.
- Corrugated high-density polyethylene pipe (HDPE) – smooth interior (ADS N-12 or equivalent, maximum 30-inch diameter conforming to AASHTO M-294, Type S) with watertight gaskets. Concrete headwalls are required for any exposed ends.
- Polyvinyl chloride (PVC), seamless pipe with water tight gaskets:
  - ASTM 3034 SDR 35 for pipes up to 15-inch diameter
  - ASTM F679, for pipes 18 to 27-inch diameter
  - ASTM C900 DR18 for pipes up to 12 inches.
  - ASTM C905 DR 25 for pipes 14 to 30-inch diameter
  - ASTM F-794 for pipes up to 30-inch diameter

Concrete headwalls are required for any exposed ends.

- Aluminized Type 2, 14 gage minimum, corrugated or spiral ribbed, steel meeting AASHTO treatment M274 and M56. Water tight gaskets required. Band couplers shall be connected with stainless steel bolts of not less that one half inch diameter. Pipe materials that will for publicly maintained storm drain facilities shall be coated uniformly inside and out with asphalt (reference '96 ODOT Std Specification 02420.2). May only be used on culverts less that 200 feet in length and for stormwater detention tanks.
- Aluminum corrugated or spiral ribbed pipe meeting the applicable requirements of ASSHTO M 196M. Water tight gaskets required. 16 gage minimum. May only be used on culverts less that 200 feet in length and for stormwater detention tanks.
- The City Engineer may adopt or approve other pipe materials or specifications due to technology developments.

Figure 6-1 CONCRETE END PROTECTION



NOTE:
Reinforced steel shall have 1 1/2-inch clear cover to all concrete surfaces and shall be Grade 40 or Grade 60.

Not to Scale

6.7 DESIGN CRITERIA FOR PIPE SYSTEMS

Pipe systems, for the purposes of this manual, are systems comprising more than one run of pipe and including at least one junction type of structure such as a catch basin or manhole.

6.7.1 Pipe Alignment

Storm drains shall be laid on a straight alignment. Horizontal curves conforming to the street curvature may be approved if the following conditions are met:

> Joints with rubber gaskets shall be used for all curved storm drains. Minimum radii shall be 115% of the pipe manufacturer's recommendation.

Changes of alignment greater than 45 degrees at any main flow structure for the main flow are undesirable. Changes of alignment greater than 90 degrees for the main flow will not be allowed.

Side pipes will join in such a manner that all flows entering the manhole point downstream. Side pipes with discharges pointed in an upstream direction will not be allowed.

6.7.2 Acceptable Pipe Material

The pipe materials contained in Table 6-4 are approved for use in pipe systems, subject to the limitations indicated either on this table or in Section 6.7.4

6.7.3 Connections To Pipe Systems

For all piped public drainage systems, excluding roof and foundation line, connections may only be made at a structure, such as a catch basin or manhole. Tees, wyes, saddles, or other types of connections to storm drainage pipes for other than roof and foundation line will not be permitted.

6.7.4 General Pipe Criteria

1) Minimum pipe cover:

   a. 2-foot minimum cover under collector and above roads, as measured from the roadway subgrade.

   b. If Class 52 ductile Iron pipe or Class V concrete pipe is used, the cover may be reduced to 1 foot, as measured from the roadway subgrade.

   c. PVC and HDPE shall require a 2-foot minimum cover, as measured from the roadway subgrade in any public roadway area.

   d. In areas of relatively flat terrain, the project engineer must show that sufficient depth is provided at the boundary of the development to properly drain the remainder of the upstream basin area tributary to the site.

e. Please note that on private property where the system will be privately maintained, there is a minimum of 1 foot required.

f. Pipe covers of less than the above stated minimums may be permitted on a case by case basis. These cases may require an engineered design approved by the City Engineer.

2) Minimum velocity: 2.5 feet per second at design flow rate.

3) Maximum velocity: 15 feet per second at design flow rate.

4) Where velocities greater than 10 feet per second are attained, special provision shall be required to protect structures against pipe erosion and displacement by shock. Energy dissipators located on sloping land are of particular concern. In each of these cases, this condition will be studied and the results of the study shall be documented in the drainage report.

5) Minimum pipe diameter: 12-inch

6) Maximum pipe length between access structures: 400-feet

7) Minimum separation from other utility pipes and conduits: six-inch vertical, three-foot horizontal (6h:3v), unless otherwise specified by the purveyor of the utility in question. The separation shall be measured from the outside edged of pipe.

8) Debris grates shall be installed at all inlets where an open channel discharges to a piped drainage system. Additionally, debris grates are required at all outlets of piped systems where the pipe is 18-inch in diameter or larger. This additional requirement is to deter small children from crawling up the pipe.

9) All pipe lengths and slopes shown on construction plans shall be based on measurements from center of structure to center of structure.

10) Pipe trench backfill: Bedding and backfill shall conform to ODOT Standard Drawing RD 300.

11) Storm drains laid on slopes of 20% or greater shall be secured by anchor walls. Concrete pipe shall not be used when slopes exceed 25% due to joint displacement from differential settlement. The Drainage Report shall address hydrostatic pressures on anchor walls.

6.7.5 Location

Where storm drains are being designed for installation parallel to other utility pipe or conduit lines, the vertical location shall be in such a manner that will permit future connections. The design must also avoid conflicts with parallel utilities without abrupt changes in vertical grade.

1) Storm Drains in Streets or Easement

a. Under normal conditions, they may be 5 feet from the centerline on the South and East side of the street. Storm drains may also be located in the street right-of-way, preferably on the low side of the street, within 4 feet of the face of curb under the pavement on the North and West side of the street. All exceptions shall be reviewed by the City Engineer on a case-by-case basis for approval. All public storm drains not in streets shall be in easements.

b. If streets have curved alignments, whenever possible, the storm drain alignment shall be parallel with water and sanitary lines with a minimum separation of 10 feet with sanitary and 6 feet with water. The intent is to prevent conflict with sanitary and water lines while still providing for the least number of manholes required to traverse on curve, and prevent a conflict with survey monuments.

c. Storm drains in easements will be allowed only after all reasonable attempts to place the drains in the right-of-way have been exhausted. Provisions shall be made for vehicular access to manholes for preventative maintenance and emergency service. See Section 6.10 for more discussion on easements.

2) Relation to Creeks and Drainage Channels

Storm drain lines shall enter a creek or drainage channel at 90 degrees or less to the direction of the flow. The outlet shall have a head wall and scour pad or riprap to prevent erosion of the existing bank or channel bottom. The size of the pipe and channel being entered will govern which protective measures are required.

6.7.6 Manholes

1) Manholes or curb inlets with manhole-type access shall be installed at all pipe junctions where the depth from rim to invert exceeds 4 feet or where the pipe is 18 inches in diameter or greater.

2) Manholes shall conform to the ODOT Standard drawings.

3) Where minimum fall is proposed between inlet and outlet pipes in a manhole (or inlet structure serving as a junction structure), pipes must be aligned vertically by one of the following criteria, in order of preference:

   a. Match Pipe crowns.

   b. Match 80% diameter of pipes.

   c. Perform backwater analysis.

4) Manholes shall be required at, but not limited to, the following locations:

   a. Changes in vertical grade or horizontal alignment of storm drain pipes.

   b. Change in size of storm drain pipes.

   c. Uppermost extent of storm pipe not opened (daylighted) to receive ditch or other open conveyance flows. Cleanouts are not allowed in this situation.

5) Manholes with pipe horizontal alignment changes of more than 30 degrees in angle shall have the outlet pipe invert at least two-tenths of a foot in elevation lower than all inflow pipe inverts. This is in addition to the normal grade crossing the manhole.

In addition, there should be a minimum of 3-foot elevation difference between the rim and the top of pipe at all manholes with more than thirty degrees of alignment change. This is to allow for containment of turbulence generated during high flows by such abrupt changes of alignment.

6) Standard depth manhole rim frames shall be installed in all paved street locations.

7) Outside drop manholes shall be used where the difference in the flow line elevations between intersecting storm sewers, except inlet runs, exceeds 24 inches. The purpose of a drop manhole is to prevent splashing which might interfere with work in the manhole. They also prevent water from dropping on the workers in the manhole. They are only effective during low flows. Inside drop manholes are prohibited.

8) Manhole rims not in pavement areas, and not in the roadway right-of-way of a paved road, shall be set 6 inches above finished grade and shall have an aluminum manhole ring and cover. Cover shall be bolted down with a minimum of 2 stainless steel bolts.

6.8 CRITERIA FOR INLET STRUCTURES

1) Inlet structures shall be located at the following locations, but in no case shall they be spaced further than 400 feet apart:

   a. At the ends of all dead-end streets with a descending grade.

   b. At intermediate locations so that the maximum gutter flow does not exceed the shoulder width plus 2 feet of the travel lane. This maximum flow is for a 5 minute, 10-year design storm, or 3 inches in depth (measured at the curb face), whichever is less.

   c. At all sag points (low points) in vertical curves.

   d. Handicap ramps shall have an inlet on the uphill side within 20 feet.

2) Inlet structures shall not be located where they will interfere with a handicap ramp.

3) Inlet structures located in street sections where there is curb and gutter shall be equivalent to a curb inlet CG-3 per ODOT Standard Drawing RD 372, unless otherwise approved by the City Engineer.

4) Inlet structures that have an outlet pipe located lower than 4 feet below the street flow line shall have minimum inside dimensions of 3 feet-3 inches by 2 feet-3 inches.

5) Inlet structures may be used in lieu of manholes for the junction of pipes 15 or less in diameter, where the depth from rim to invert is less than 4 feet. Pipelines 18 inches in diameter may be connected to the larger dimension of the structure (catch basin) when the structure is formed and poured around the pipe during new construction. The

minimum size for a catch basin/inlet structure being used in this situation shall be a CG-3 per ODOT Standard Drawing RD 372.

6) Any closed storm sewer system collecting runoff from paved parking areas in public or private property shall provide oil/water separation prior to discharge of the system to any off-site storm sewer conveyance system.

7) Catch basins with connector storm drains shall connect to a receiving conveyance pipe with a manhole or another catch basin, or gutter inlet.

8) Gutter tapers are required for all catch basins and gutter/curb inlets and shall conform to the ODOT Standard Drawings.

9) Ditch and/or area inlets shall be required to intercept existing flows.

6.9 DESIGN CRITERIA FOR OUTFALLS

Outfalls from drainage facilities shall be designed with adequate energy dissipaters to minimize downstream damage and erosion. All outfalls with exit velocities more than 4 feet per second shall be examined with respect to soil type to ensure adequate erosion control. Unless otherwise approved, an outfall elevation shall be submerged by the receiving creek or channel during a 10-year storm event.

Use of ordinary riprap in an urban setting has proven to be a maintenance problem due to neighborhood children playing with the riprap. This problem with the use of riprap should discourage the selection of ordinary riprap in urban areas except for unusual cases. In lieu of ordinary riprap, the designer should consider grouted riprap, or riprap enclosed in wire baskets, or manhole riser type of energy dissipator.

Storm drain lines shall enter a creek or drainage channel at 90 degrees or less to the direction of the flow. The outlet shall have a head wall and scour pad or riprap to prevent erosion of the existing bank or channel bottom. The size of the pipe and channel being entered will govern which protective measures are required. Field experience has shown that for a riprap layer to work most effectively it should be about one and one-half times or more as thick as the dimension of the large rocks. The riprap should be placed over a gravel layer and/or suitable filter fabric. Riprap should be no less than Class 100. See Appendix 6-3 for a discussion of riprap sizing and placement methods.

Existing channels approved for the point of disposal for storm drains and culverts shall be provided with rock-lined bottoms and side slopes at the discharge point of storm drain or culvert. The rock shall extend for a minimum distance of ten times the pipe diameter downstream from the end of the storm drain or culvert. Alternately, the rock shall extend to where flow velocities are less than 10 feet per second, whichever is greater, when a riprap pad type of outfall is selected.

If the outfall is located in a Water Quality Resource Area, or a Flood Management Area, see Chapter 5 for additional criteria.

In many cases, a permit from the Corps of Engineers and/or the Division of State Lands may be required. The proponent for the development is responsible to obtain the proper permit from these agencies.

6.10 EASEMENTS AND SETBACKS

1) Drainage easements shall be provided in a proposed development for all stormwater facilities that are not located in public rights-of-way or tracts. Said drainage easements shall be granted to the parties responsible for providing on-going maintenance of the stormwater facilities.

2) Stormwater facilities that are to be maintained by the City, together with maintenance access roads to said facilities, shall be located in public right-of-way, separate tracts dedicated to the City, or drainage easements located in designated Open Space.

3) For City review items, all drainage easements, public and private, must have a minimum width of 15 feet, with the exception that private roof and yard drain systems may be located within 10 foot easements. Drainage easements, or linear tracts that serve the same purpose as a drainage easement, shall have the following characteristics:

   a. All pipes must be located within the easement so that outside edge of pipe, or top edge of channel, is no closer than 5 feet from its adjacent easement boundary (roof and yard drain pipes shall be centered in the easement).

   b. Open channels shall be located within the easement so that the water surface elevation at the top of freeboard is no closer than 5 feet from each easement boundary.

   c. For pipes larger than 3 feet in diameter and for channels having a top width at freeboard wider than 5 feet, the easement width must be accordingly larger than the minimum 15 feet , in 5-foot increments, in order to meet the required setbacks from the easement boundaries.

   d. Storm drains with more than a 7 -foot depth to the invert shall require wider easements. A slope of one horizontal to one vertical (1h:1v) from the storm drain invert to the ground surface shall be used in determining easement width. Easement widths must be accordingly larger than the minimum 15 feet. The width shall normally be increased in 5-foot increments.

   e. For constructed channels that are to be publicly maintained, the easement (or linear tract) width shall be wide enough to accommodate a 15-foot wide maintenance access.

   f. Alternate design that results in narrower easement widths may be considered by the City Engineer and Public Works.

4) All easements must be furnished to the City for review and approval prior to recording. The City has standard utility easement document forms and guidelines for preparation of descriptions and sketches that shall be used for City easements.

6.11 SLOPE INTERCEPT DRAINS

Slope intercept drains are allowed at the following locations:

1) Along the upper boundaries of a development where the natural ground slope exceeds 10% to prevent drainage from the tributary area above the site.

2) Along the top of all cut slopes which exceed 2:1 where the tributary drainage area above the cut slope has a drainage path greater than 40 feet as measured horizontally from the hinge point of the cut.

6.12 SUBSURFACE DRAINAGE

Subsurface drains (under drains) shall be provided at the following locations:

1) For stability on cut and fill slopes, when required by the City Engineer.

2) For all existing springs or springs intercepted during construction activity for other facilities.

3) Where high ground water exists or when it is necessary to reduce the piezometric surface to an acceptable level to prevent land slippage or under floor flooding of buildings.

Where possible, a minimum slope of 0.15 feet per 100 feet should be used. The subdrain must be installed below the water flow to function properly. The use of a geotextile fabric to line the trench is recommended.

6.13 DESIGN CRITERIA FOR STORMWATER PUMPS

Stormwater pumps will be permitted after approval by the City Engineer. Any stormwater pumps so permitted must, at a minimum, meet the following criteria:

1) The proposed pump system is not intended to circumvent other drainage requirements.

2) The proposed pump system is the only feasible alternative to flooding.

3) The pump system must provide storage for a minimum of 25% of the runoff volume from a 2-year, 24-hour storm event. An emergency backup power source may be required, at the discretion of the City Engineer.

4) The pump system must include dual pumps with an external alarm system and be capable of discharging a 100-year storm event.

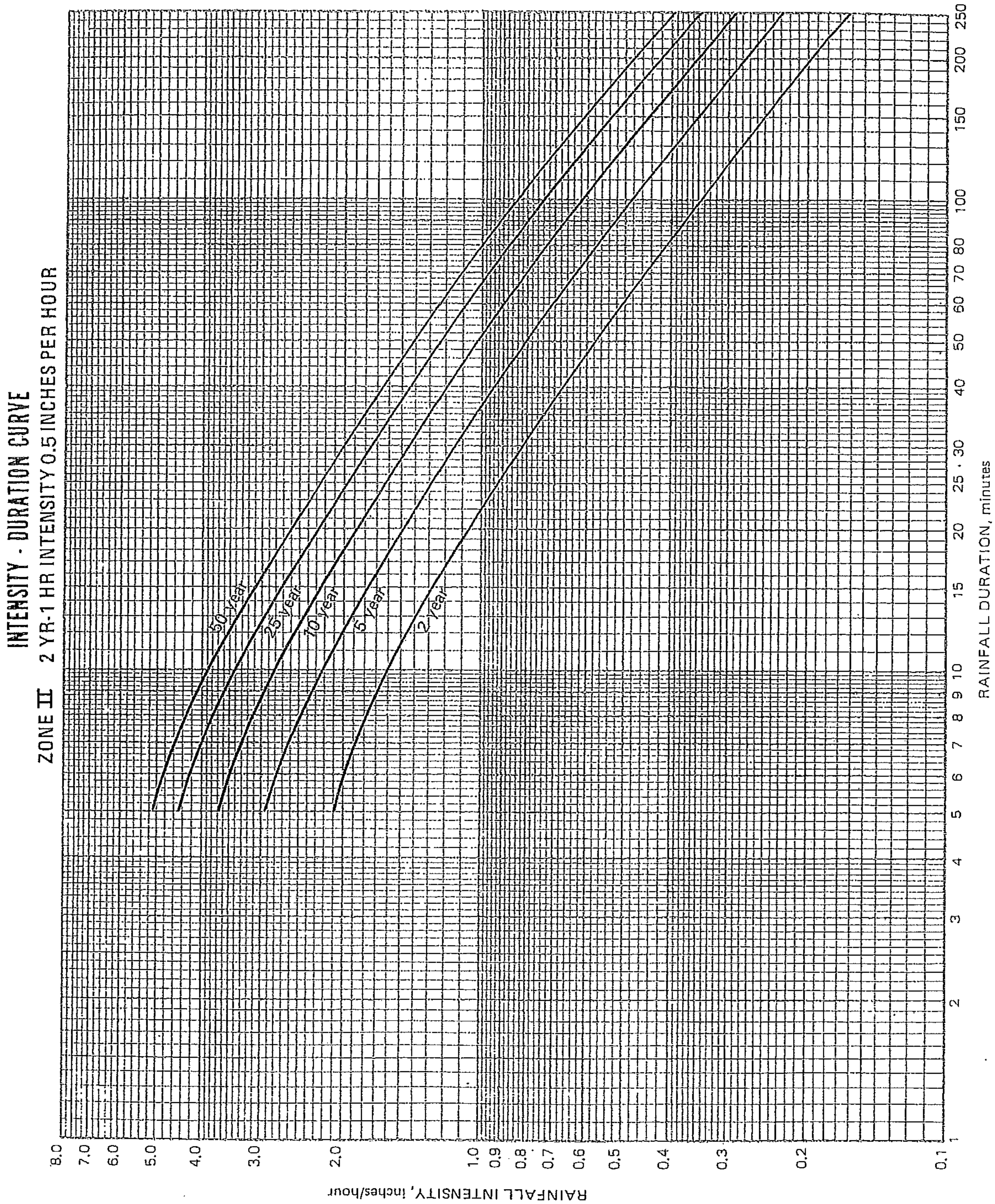
5) Pump systems serving commercial and/or multi-family developments and individual single-family building sites must be privately operated and maintained. Prior to final approval of the project served by such a pump system, an agreement establishing

responsibility for payment of costs resulting from the operation and maintenance of the pump system must be approved by the City and must be legally recorded.

APPENDIX 6-1

Storm Recurrence Interval Matrix for Determination of Design Storm Magnitude and Rainfall Intensity Duration and Frequency Curves

City of Cascade Locks Stormwater and Grading Design Standards


INTENSITY - DURATION CURVE
ZONE II 2 YR-1 HR INTENSITY 0.5 INCHES PER HOUR
50 year
25 year
10 year
5 year
2 year
RAINFALL DURATION, minutes
1
2
3
4
5
6
7
8
9
10
15
20
25
30
40
50
60
70
80
100
150
200
250
RAINFALL INTENSITY, inches/hour
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1

APPENDIX 6-2

Sample Rational Method Analysis

City of Cascade Locks Stormwater and Grading Design Standards

10 YEAR EVENT - RATIONAL METHOD HYDROLOGY
Typical Development Project (under 25-acre drainage area) in Oregon City

Prepared by: XYZ Engineering

This sample was derived from an analysis of a privately maintained storm drain system. The presentation is applicable to a public storm drain system where the minimum pipe size is 12-inch inside diameter.

IMPERVIOUS C = 0.85
PERVIOUS C = 0.30

DEFAULT n = 0.013

Rational Hydrology											Pipe Sizing (via application of the Manning's equation, full flow)										
Pipe	Upstream Node	Downstream Node	Initial Subarea Tc (min)	Total Tc (min)	I in/hr (in/hr)	A IMPERV. (acre)	A PERV. (acre)	C*A Incr. (acre)	Total C*A (acre)	Q CIA (cfs)	Upstream Invert Elevation (ft)	Downstream Invert Elevation (ft)	Len. (ft)	Slope %	Dia. in (in)	n	Q Cap. (cfs)	V (fps)	Flow Time (min)	This Reach's Tc at Downstream Node (min)
1	A1	AJ1	5.00	5.00	2.80	0.30	0.34	0.36	0.36	1.00	209.08	205.48	90.0	4.00	8	0.013	2.42	6.92	0.22	5.22
2	A2	AJ1	5.00	5.00	2.80	0.30	0.13	0.29	0.29	0.82	207.15	205.48	22.0	7.59	6	0.013	1.55	7.87	0.05	5.05
3	AJ1	AJ2	N/A	5.22	2.76				0.65	1.80	205.48	202.84	66.0	4.00	8	0.013	2.42	6.92	0.16	5.38
4	A3	AJ2	5.00	5.00	2.80	0.31	0.31	0.36	0.36	1.00	205.57	202.84	22.0	12.41	8	0.013	4.26	12.19	0.03	5.03
5	AJ2	AJ3	N/A	5.38	2.76				1.01	2.79	202.67	200.35	40.0	5.80	8	0.013	2.91	8.33	0.08	5.46
6	A4	AJ3	5.00	5.00	2.80	0.15	0.05	0.14	0.14	0.40	212.75	200.58	200.0	6.08	6	0.013	1.38	7.05	0.47	5.47
7	A5	AJ3	5.00	5.00	2.80	0.15	0	0.13	0.13	0.36	202.15	200.58	22.0	7.14	6	0.013	1.50	7.63	0.05	5.05
8	AJ3	AJ7	N/A	5.47	2.73				1.28	3.49	200.25	193.75	130.0	5.00	8	0.013	2.70	7.74	0.28	5.75
9	A6	AJ4	5.00	5.00	2.80	0.20	0.20	0.23	0.23	0.64	202.87	200.63	66.0	3.39	6	0.013	1.03	5.26	0.21	5.21
10	A7	AJ4	5.00	5.00	2.80	0.20	0.13	0.21	0.21	0.59	202.13	200.63	4.0	37.50	6	0.013	3.43	17.49	0.00	5.00
11	AJ4	AJ5	N/A	5.21	2.76				0.44	1.21	200.46	198.23	68.0	3.28	8	0.013	2.19	6.27	0.18	5.39
12	A8	AJ5	5.00	5.00	2.80	0.19	0.11	0.19	0.19	0.54	[illegible]	198.31	4.0	75.50	6	0.013	4.87	24.82	0.00	5.00
13	AJ5	AJ6	N/A	5.39	2.76				0.63	1.75	198.23	195.45	71.0	3.92	8	0.013	2.39	6.85	0.17	5.56
14	A9	AJ6	5.00	5.00	2.80	0.14	0.04	0.13	0.13	0.37	198.75	195.53	19.0	16.95	6	0.013	2.31	11.76	0.03	5.03
15	AJ6	AJ7	N/A	5.56	2.73				0.76	2.09	195.28	193.83	37.0	3.92	8	0.013	2.39	6.85	0.09	5.65
16	AJ7	AJ8	N/A	5.75	2.69				2.04	5.50	193.33	189.63	148.0	2.50	10	0.013	3.46	6.35	0.39	6.14

Pipe sizing calculations may not be valid for backwater type hydraulic conditions (where HGL is above the soffit of the pipe).

In this sample, full flow velocity was assumed. For storm drain systems where the minimum pipe size is 12-inches, it may be appropriate to use the partial flow velocity.

04-Feb-98 / PL.WB2 / "Name of Design Engineer"

APPENDIX 6-3

Discussion on a Backwater Analysis Method

and

Discussion on a Culver Analysis Method

Source: Stormwater Management Manual for the Puget Sound Basin

City of Cascade Locks Stormwater and Grading Design Standards

CHAPTER 7
OPERATION AND MAINTENANCE OF PRIVATE FACILITIES

TABLE OF CONTENTS

CHAPTER 7 - OPERATION AND MAINTENANCE OF PRIVATE FACILITIES

Proper operation and timely maintenance are essential for stormwater quantity and quality control facilities to achieve their intended results.

The permanent responsibility for operation and maintenance of stormwater facilities rests with the property owner for most developments, other than single-family residential. Sections 7.1-7.2 apply to this situation.

7.1 OPERATION AND MAINTENANCE MANUAL

A fully executed maintenance covenant shall be on file with the City prior to the release of the development plans with privately owned and maintained stormwater facilities for plumbing permit review. An Operation and Maintenance (O&M) Manual shall be an attachment to this maintenance covenant. The O&M Manual shall be prepared by a professional engineer and shall address all proposed stormwater quantity and quality control facilities. This manual should be brief and simply written so it can be effectively followed by those persons who will be responsible for operating and maintaining the facilities.

The following basic outline should be followed in the preparation of the Operation and Maintenance Manual:

7.1.1 General Information

A. Purpose of O&M Manual – briefly introduce the O&M Manual and provide a general statement on the overall purpose of operation and maintenance of the facility.

B. Location and Access to Facility – Name of stream/tributary/lake, etc., that facility discharges to; nearest city/town; traveling directions to facility, including location of maintenance access roads. Include a vicinity map.

C. Purpose of Facility (e.g., peak rate runoff control, water quality, etc.)

D. General Description of Facility (e.g., detention pond, biofiltration swale, etc.)

E. Ownership – Name, address and telephone number of owner of facility.

F. Project History – Mention the development for which the facility was constructed, date of construction, original project engineer and contractor, and any significant modifications that have taken place during the life of the facility.

G. Project Data Sheet – Lists all major features of the facility in an easy-to-follow tabular format, including catchment area, impervious area, off-site contribution of runoff, storage volume, orifice sizes, and designed release rates.

7.1.2 Facility Operation

This section provides detailed procedures for normal "day-to-day" operation as well as emergencies.

A. Operation Instruction for Normal Operation

H. Emergency Action Plan – Special operation procedures to be followed during emergency conditions resulting from extreme weather conditions or structural failure of the facility. Include a 24-hour telephone number for emergency contact.

7.1.3 Facility Maintenance

This section details information and instruction on performing periodic maintenance of the facility.

A. Regularly Scheduled Maintenance – Mmaintenance tasks performed on a regularly scheduled basis.

B. Monitored Maintenance – Involves periodic surveillance of facility and making repairs and modification as needed.

C. Maintenance Plan – Instructions for performing periodic maintenance should be given in detail, so that new personnel can understand the tasks and experienced personnel can verify that the work has been performed properly. All regularly scheduled and monitored maintenance should be identified and listed in a maintenance plan section of the O&M Manual.

D. Unscheduled Maintenance – Despite having a proper maintenance program, unexpected deficiencies can occur at any time, prompting the need for repairs and maintenance (e.g., repairing and reseeding eroded areas on embankments). Although unscheduled maintenance cannot be planned for in a maintenance plan, an owner should anticipate the need for repair or rehabilitation of unexpected deficiencies. To this end, a section should be provided in the maintenance plan that gives instructions for dealing with unscheduled maintenance.

7.1.4 Facility Inspection

This section specifies required frequency intervals for inspections and includes an inspection checklist and an inspection report form.

A. Routine Inspections – A brief, visual inspection of the major features of the facility, performed on a frequent, informal basis (e.g.. weekly, monthly).

B. Periodic Inspection – A periodic inspection is a more detailed inspection, during which all features and equipment at the facility are evaluated at regularly scheduled intervals. A checklist should be provided to ensure that all critical features are examined.

C. Inspection Report Form – A simple form, to be completed by the person(s) performing the periodic inspection, reporting the date of inspection, person(s) performing inspection, findings, inspection checklist.

7.2 OPERATION AND MAINTENANCE REQUIREMENTS

Minimum requirements for operation and maintenance of stormwater facilities shall be incorporated into the Operation and Maintenance Manual.

7.2.1 Responsibility for Maintenance

Property owners are responsible for the maintenance, operation or repair of stormwater drainage systems and BMPs. Property owners shall maintain, operate and repair these facilities in compliance with the requirements of this document.

7.2.2 Maintenance Frequency

Stormwater facilities shall be inspected and maintained routinely and cleared of debris, and sediment. Immediate action shall be taken to correct a problem where lack of maintenance is causing or contributing to a stormwater-related problem.

7.2.3 Disposal of Waste from Maintenance Activities

Disposal of waste from maintenance activities shall be conducted in accordance with local and state requirements.

7.2.4 Control Structures and Catch Basins

Control structures and catch basins have a history of maintenance-related problems and it is imperative that a good maintenance program be established for their proper functioning. A typical problem is that sediment builds up inside the structure, which blocks or restricts flow to the outlet. To prevent this problem, these structures should be routinely cleaned out. Regular inspections of control structures should be conducted to detect the need for non-routine cleaning, especially if construction or land-disturbing activities are occurring in the contributing drainage area.

7.2.5 Detention Ponds, Vault and Tanks

7.2.5.1 GENERAL

Maintenance is of primary importance if detention ponds are to continue to function as originally designed.

7.2.5.2 VEGETATION

Pond vegetation shall be periodically inspected and maintained routinely. Since decomposing vegetation can release pollutants captured in the pond, especially nutrients, it may be necessary to harvest dead vegetation annually prior to the winter wet season. Otherwise, the decaying vegetation can export pollutants out of the pond and can cause nuisance conditions to occur. The manual shall address vegetation maintenance.

It is permissible to temporarily drain wet ponds, or ponds with wetlands vegetation, during late Spring (May) and Summer if there is sufficient concern regarding insect breeding. However, it is imperative that vegetation in shallow marsh areas not die off during drawdown periods.

Otherwise, the pollutant removal effectiveness of the wetpond can be severely impacted. In addition, the decaying vegetation can create nuisance conditions.

Landscaped areas shall be inspected and maintained routinely.

7.2.5.3 SEDIMENT

Maintenance of sediment forebays requires attention to sediment accumulation within the ponds, vaults, and tanks. Sediment deposition should be continually monitored in the basin.

7.2.5.4 ACCESS

Maintenance access must be provided at all times to detention storage facilities, control structures, etc. Access roads must be maintained to provide access by heavy vehicles. Gravel surfaces must be maintained and repaired and vegetation removed which would otherwise restrict the 10-foot width of the road, the 40-foot minimum outside turning radius, or the turnaround areas. Fences and gates must be repaired as necessary to maintain security. Where no fence is provided, bollards must be installed at all times to restrict vehicle access. All signs shall be in place and readable. Any damage resulting from vandalism shall be repaired. All manhole and catch basin lids shall be in place and locked (where locks are provided). Refer to Chapter 4, Stormwater Quantity Control Facilities, for design requirements for access facilities.

7.2.5.5 NUISANCE CONDITIONS

The presence of wet ponds in established urban areas is perceived by many people to be undesirable. They are often thought of as mud holes where mosquitoes and other insects breed (and for many improperly constructed wetponds, such as a hole carved out of nearly sterile mineral soil, they might be right).

If the wet pond has a shallow marsh established, the pond can become a welcomed addition to an urban community. Constructed fresh water marshes can provide miniature wildlife refuges, and while insect populations are increased, insect predators also increase, often reducing the problem to a tolerable level.

7.2.6 Oil/Water Separators

Oil/water separators must be cleaned frequently to keep accumulated oil from escaping during storms. They must be cleaned by October 1 of each year to remove material that has accumulated during the dry season, and again after each significant storm. In addition:

A. The facility shall be inspected weekly by the owner.

B. Waste oil and residuals shall be disposed of in accordance with current State and Federal law.

C. Any standing water removed during the maintenance operation must be disposed of to a sanitary sewer at a discharge location approved by the local Sewer District.

7.2.7 Sumps and Sedimentation Manholes

Sumps and sedimentation manholes must be cleaned frequently to keep accumulated sediment from disrupting the function of the structure during storm events. They must be cleaned by October 1 of each year to remove material that has accumulated during the dry season, and again after each significant storm. In addition:

A. The facility shall be inspected weekly by the owner during the wet season.

B. Waste oil and residuals shall be disposed of in accordance with current State and Federal law.

C. Any standing water removed during the maintenance operation must be disposed of in a sanitary sewer at a discharge location approved by the local Sewer District.

7.2.8 Infiltration Trenches

Infiltration trenches will normally only receive roof and foundation drainage and should not experience severe sedimentation problems. However, the owner must monitor the outfall structure/area for any visual problems. They must be cleaned by October 1 of each year to remove material that has accumulated during the dry season, and again after each significant storm. In addition:

A. The facility shall be inspected weekly by the owner during the wet season.

B. Waste oil and residuals shall be disposed of in accordance with current State and Federal law.

C. Any standing water removed during the maintenance operation must be disposed of in a sanitary sewer at a discharge location approved by the local Sewer District.

7.2.9 Signs

Advisory signs shall be maintained to provide a readable text from a distance of 15 feet with the naked eye. Signs shall be cleaned with soap and water (either manually or with a power washer) annually.

CHAPTER 8
STANDARD PLANS

The City of Cascade Locks has adopted the ODOT Standard Drawings as their Standard Plans. These can be obtained off the Internet at http://www.odot.state.or.us/tsroadway/std-dwg-02.htm.