City of Coos Bay
Coos County, Oregon

STORM WATER MASTER PLAN

SEPTEMBER 2004

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City of Coos Bay

Storm Water Master Plan

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Executive Summary

The Dyer Partnership, Engineers and Planners was authorized by the City of Coos Bay to provide a comprehensive Storm Water Master Plan for the downtown/central portion of the City. This master plan will provide the City with a reference that can be used to systematically upgrade its storm water system. The master plan identifies deficiencies within the system, as well as potential deficiencies created by development.

The existing storm water system, serving the 2,300-acre study area, includes approximately 30 miles of piping. Most of the piping was concrete, with corrugated metal piping used for large culverts and outfalls. The majority of the concrete piping was in fair to good condition; the CMP piping was in poor condition.

A significant portion of the study area is below the higher high tide level and is protected by dikes. A tidegate and outfall inventory for the system is located in Section 3. Over 30 tidegates were identified, with many needing repair or replacement due to the poor performance of the tidegates. Many active outfalls without tidegates were identified, but not found on City records or maps.

Record drawings, electronic data, and field investigations were used to model and analyze the existing storm water system. The existing system was divided into 30 watershed basins, and each basin was modeled under current development conditions, as well as 20-yr build out. Each basin was modeled under a 25-yr and 50-yr rainfall event. In basins affected by tidal activity, the basins were modeled with an average high tide of 8 feet, coinciding with peak rainfall runoff. Sections 5 and 6 include the Hydraulic Analysis and Storm Drain Model.

The modeling data was used to identify deficiencies within the City of Coos Bay's storm water system. The problem areas were identified, and project costs for the repairs were generated in Section 7. Each project was assigned a priority number, with Priority 1 Projects having the highest priority, and Priority 3 Projects having a lower priority.

Many of the projects identified were for storm water outfall repairs and upsizing. Field investigations revealed old corrugated metal pipes, and failing tide gates. Due to the low elevations within the City, four new pump stations are recommended to prevent flooding during high tides and rainfall events. Storm water storage options (detention ponds) were explored as an alternative to pump stations, but adequate land within the City was not found.

Detailed cost estimates for each recommended project are located in Section 7. Projects totaling $11.25 million are recommended, of which $8.35 million are Priority 1. A combination of storm water utility fees, system development charges, and grants are recommended to finance the projects.

Introduction

Section 1

Section 1

Introduction

1.1 Background and Need

The City of Coos Bay is a growing community in Coos County, Oregon located along U.S. Highway 101, approximately 30 miles south of Reedsport, and 21 miles north of Bandon. The city is situated on the bay of the Coos River, also named Coos Bay. The current and historical commercial center for the southern coast, Coos Bay and neighboring North Bend form the largest urban area on the Oregon Coast.

Coos Bay is the largest deep-draft coastal harbor between San Francisco Bay and the Puget Sound, and is Oregon's second busiest maritime commerce center. The economy of the area has shifted from the natural resource base of logging and fishing, at its height in the 1970s when Coos Bay was the largest timber shipping port in the world, to manufacturing, tourism, and services.

Visitors attracted to the area enjoy the bay views and access to local beaches, dunes, and outdoor sports. In recent years, the qualities that have made the City a tourist attraction have also drawn new residents and commercial enterprises. While development has provided many benefits to the City and its economy, it has also placed an increased burden on the existing infrastructure. In order to protect the quality of life that has attracted people and commerce, the City has placed a greater emphasis on infrastructure maintenance and improvements. Subsequently, several engineering investigations, road, and sewer improvements have been implemented. Of particular interest to this study is the existing storm drainage system.

Recent growth trends within the City have placed increased demand on the existing storm drain system. In anticipation of continued growth in the near future, the City needs a plan to ensure that new development does not create hydraulic overloads in the older (lower) sections of the storm system. A prioritized list of storm drainage improvement projects that accommodate growth within each section of the City, as well as correct existing system deficiencies, is incorporated into this plan.

1.2 Scope of Engineering Services

The Dyer Partnership has been authorized by the City of Coos Bay to provide master planning and engineering services as further described below. These services will develop a comprehensive Storm Water Master Plan for the downtown/central portion of the City that the City of Coos Bay can use to systematically upgrade its storm water system. The following scope describes the comprehensive approach to planning and addressing storm drainage facilities.

Task 1 – Prepare a watershed map of the subject drainage basins.

A map of the watershed basin will be developed based on current topographic maps, aerial photos, field investigations, city staff information, and site surveys as required. The existing drainage system will be incorporated based on as-built drawings, surface investigation, and city staff knowledge. The map will include the boundaries of sub-basins, direction of drainage, improved streets, existing storm drain facilities, and waterways. The map will be developed in AutoCad 2002 format with 11" x 17" copies bound in the report and one foam board mounted 24" x 36" display copy.

Task 2 – Conduct a hydrology study of the storm runoff in the drainage sheds. Hydrology will consider existing and projected future land uses.

A hydrology study of the area will be performed including an assessment of local soils based on current Coos County soils maps, estimated existing development and impervious area, projected development based on current city planning documents, local topography, city staff input, site investigations, and hyetograph data. A survey crew will be used to site verify elevations as required. The drainage area will be broken into appropriate sub-basins and the information for each basin presented in tabular format. A workshop will be held with city staff to review the hydrology information.

Task 3 – Prepare a hydraulic model of the existing drainage system to determine capacity and inefficiencies within these systems and to identify all current and future flooding problems. Calibrate model based on historic information on flooding.

The information from Task 1 and Task 2 will be used to build a hydraulic model of the drainage system using XP-SWMM 2000 computer software. The model will be calibrated for the existing system using historic data provided by the City, direct field flow measurement for select locations with pipe diameters less than 14-inches during at least one high rainfall period, and with flows calculated from field measurements for select locations for pipes larger than 14-inches. The model will include data sets for 25-year and 50-year storms for both existing and projected conditions based on a 20-year study period. The model input and output data will be tabulated and presented in the Master Plan. Areas of current and future projected deficiencies will be identified and discussed. A drainage basin map will be developed illustrating the location of each deficiency. The results from Task 3 will be presented to the city public works staff prior to developing alternatives for correcting deficiencies.

Task 4 – Identify alternative solutions to drainage and flooding problems, including localized flooding. Prepare cost estimates adequate for comparing alternatives.

Alternatives for each deficiency will be developed, including construction method, cost estimates, present value costs, and pros and cons for each solution.

Task 5 – Evaluate alternative solutions and drainage facilities and make recommendations. Discuss alternatives and recommended facilities with the City and provide supporting data.

The information developed in Task 4 will be presented to the City for discussion and selection of the recommended alternatives. Anticipated future regulations and the general impact of EPA Phase II requirements for MS4 will be presented for guidance. Information on Best Management Practices and current technology will be presented and incorporated into the Master Plan.

Task 6 – Recommend drainage facilities and programs and set priorities for the capital improvement plan.

The alternatives selected in Task 5 will be prioritized and described. A map delineating the existing system with recommended remediation and expansion projects will be prepared for inclusion in the Master Plan. A tabular presentation of the projects in priority order will be prepared. Final cost estimates will include a breakout between anticipated City costs, Developer costs, and costs eligible for SDC funding. An implementation schedule will be provided.

Task 7 – Prepare draft and final master plan reports.

Six copies of the draft plan will be prepared and submitted to the City for review. One copy will be unbound to allow for reproduction by the City. The draft information will be presented at a staff workshop and a public meeting. The draft plan will be revised to incorporate the review comments by the City and address concerns from the public. Ten copies of the final Master Plan will be presented to the City. A presentation will be made at a City Council meeting summarizing the findings. A 24" x 36" map of the drainage system with recommended projects highlighted will be provided as part of the presentation.

Task 8 – Review existing storm water ordinances and funding methods.

The existing storm water ordinances will be reviewed and suggestions made for incorporating clauses to address issues that are discovered during the process of compiling the Master Plan. The effects, based on current funding methods, of recommended improvements will be calculated, and alternative-funding options will be presented.

1.3 Authorization

The firm of THE DYER PARTNERSHIP ENGINEERS & PLANNERS, INC. was retained by The City of Coos Bay to prepare a "Storm Water Master Plan". The Consultant was authorized to proceed with services on November 18, 2003.

1.4 Funding Agency Acknowledgment

This project was funded, in whole, by the City of Coos Bay and the Urban Renewal Agency for the City of Coos Bay.

1.5 Acknowledgments

This plan is the result of contributions made by a number of individuals and agencies. We wish to acknowledge the efforts of Chuck Knight; City Manager; Karen Turner, Engineering Service Coordinator; Steve Doty, Engineering Service Coordinator; Suzanne Baker, Administrative Assistant; Mike McDaniels, Assistant Project Manager for OMI, and Larry Artman, Collection System Manager for OMI.

The Dyer Partnership staff that contributed to this report includes: Michael Erickson, Aaron Speakman, Janette Kerbo, and Rachel Arbuckle.

Study Area

Section

2

Section

2

Study Area

2.1 Location and Definition

The study area is located within the city limits of the city of Coos Bay, Oregon. The project location and boundary for the storm water drainage area of this study is illustrated in Appendix A and includes the central portion of the city bordering the Bay and Isthmus and Coalbank Sloughs. The predominant geographic feature is the tidally influenced portion of Coos River. To avoid confusion with the name of the City, the bay formed by Coos River will be referred to as the "Bay". Elevations used in this plan are based on the NAVG 1988 datum.

2.2 Climate

Regional weather patterns of Coos Bay are affected by the presence of the Coast Range Mountains to the east and the Pacific Ocean to the west. The area has a moderate climate with marked seasonal characteristics.

Coos Bay has a mild marine climate with few temperature extremes. The monthly average low temperature is 38° F and the average monthly high is 67° F. Record lows in the teens have occurred during the months of December and January; and, record highs in the 90's have occurred during the months of August, September, and October. Prevailing winds in the summer are from the northwest with winter storms predominantly from the southwest.

Area precipitation is directly related to ocean formed storms and the prevailing weather patterns that bring these storms ashore. Annual average rainfall is about 64 inches with July being the driest month and December the wettest. Record annual precipitation was 94 inches in 1983 and record daily precipitation was in November 1996 with 6.25 inches falling on one day. Snowfall during the year is minimal--the mean yearly total being nine tenths (0.9) of an inch--and generally occurs during the months of December and January.

The presence of the Pacific Ocean to the west directly affects prevailing wind patterns in the region. Daytime heating produces warm temperatures inland and establishes a convective heating pattern that leads to the development of onshore winds. During the nighttime hours, as land surfaces cool, the reverse occurs and offshore winds develop.

Fog is often present in the area, particularly during the morning hours. Again, the presence of the Pacific Ocean influences the development of this weather phenomenon. The fog may develop as warm moist air meets cooler land surfaces or it may form at sea and move inland.

2.3 Natural Drainage Courses

Coos Bay is situated on the Bay of Coos River and much of the existing study area is built on fill in the river estuary. The Bay is tidally influenced by the Pacific Ocean, and a portion of the study area is at an elevation below the higher high tide line. Principal drainage courses that flow into the Bay through the study area are Blossom Gulch Creek, Isthmus Slough, and Coalbank Slough. Unnamed minor streams drain into Coalbank Slough in the Englewood neighborhood and Mingus Pond. Tributaries of Pony Creek are within the study area, but the creek flows north, through the City of North Bend before discharging into the Bay.

2.4 Major Drainage Basins

Basin boundaries and runoff patterns were defined from available aerial photography, USGS mapping, City topographic maps, existing survey data, and points surveyed for this plan. For the purposes of this plan, the study area was divided into 27 major drainage Basins. Portions of some drainage basins may extend out of the study area. The basins are described in Section 6. A basin map is included in Appendix A.

2.5 Topography and Soils

The majority of land bordering the Bay and west to 5th Street is fill that was placed prior to 1930 in native salt marshes. The downtown and commercial districts are located in this area with an elevation of about 10 feet. The surface elevation rises west of 4th Street, with most of the developed property located below an elevation of 120 feet on a series of hillsides with slopes of less than 30%. The highest elevation in the vicinity is at about 560 feet. The Pacific Ocean is located approximately four miles west of the study area.

Soils in the study area are mainly silt loams, with sandy loams in the basins west of 14th Street and north of Myrtle Avenue. Most of these soils have moderate permeability, with isolated areas of slow moderate permeability. Clay loam soils are found in the south section of the Englewood neighborhood, along Coalbank Slough. Erosion potential is moderate in most areas, although there have been slides along the steep road cut for Highway 101 at the north end of the study area.

Areas that are currently not developed are forested in second or third growth Douglas fir and alder. A soils map is included in Appendix A.

2.6 Flooding Hazards

A large portion of the land along the Bay and Coalbank Slough is reclaimed estuary. The elevations of the original downtown area east of 4th Street, the pastureland along Coalbank Slough, and the residential neighborhood along Blossom Gulch Creek are below the highest recorded high tide level of 11 feet.

Dikes along the bay front have reduced the occasions of flooding in the downtown area. Stormdrains serving most of the study area penetrate the dikes. Most stormdrains, but not all, are equipped with tidegates to prevent backflow at high tide. During periods of high rain when the tidegates are closed due to high tide, the stormwater backs up and floods localized areas. Several of the tidegates are in poor condition, allowing tidewater to flow upstream through the stormdrains creating localized flooding.

Construction of dikes along Coalbank Slough allowed the year round use of the reclaimed land as pasturelands and several homes were built just above the pastures in what was then a rural unincorporated area. Portions of the dikes are now in disrepair and are breaching at higher tides, allowing flooding of the pastures and potentially threatening homes in the area. As the dikes were built prior to incorporation into the City and many of the dikes are outside of the city limits, no clear-cut jurisdiction for repair of the dikes exists. Repairs are underway for the collapse of a drainage culvert for a small stream discharging into Coalbank Slough near Dakota Street that has caused flooding west of Southwest Boulevard.

An unnamed stream discharges into Coalbank Slough through a culvert at 5th Street. Properties along the stream course are below the record high tide level. During periods of higher tides and rainfall the stream overflows its banks, flooding neighborhood streets and properties. The portion of this neighborhood south of Johnson Avenue, between 10th and 4th Streets is at an elevation below 10-feet and floods regularly.

Blossom Gulch Creek bisects the study area from east to west. The creek is confined in a box culvert from 10th Street at Curtis Avenue to its discharge into the Bay through a tidegate. The creek has a drainage basin of about 650 acres and is considered a fish-bearing stream. During extremely high tides combined with periods of heavy rain (above one inch in 24 hours) the creek actually flows backward from the culvert as storm water from other areas, particularly from Mingus Park, discharges into the box culvert when the tidegate is closed. Residences along the creek with elevations below the record high tide level have experienced flood damage and portions of Blossom Gulch Road are submerged when these conditions occur.

All bay front properties along Highway 101 are located in the 100-year floodplain for the Bay. In addition, the 100-year floodplain follows the current and historical streambed of Blossom Gulch Creek, including the commercial district bounded on the north by Market Avenue, on the south by Curtis Avenue, on the east by the Bay, and on the west by 7th Street. A map illustrating flood hazard areas is included in Appendix A.

2.7 Land Use

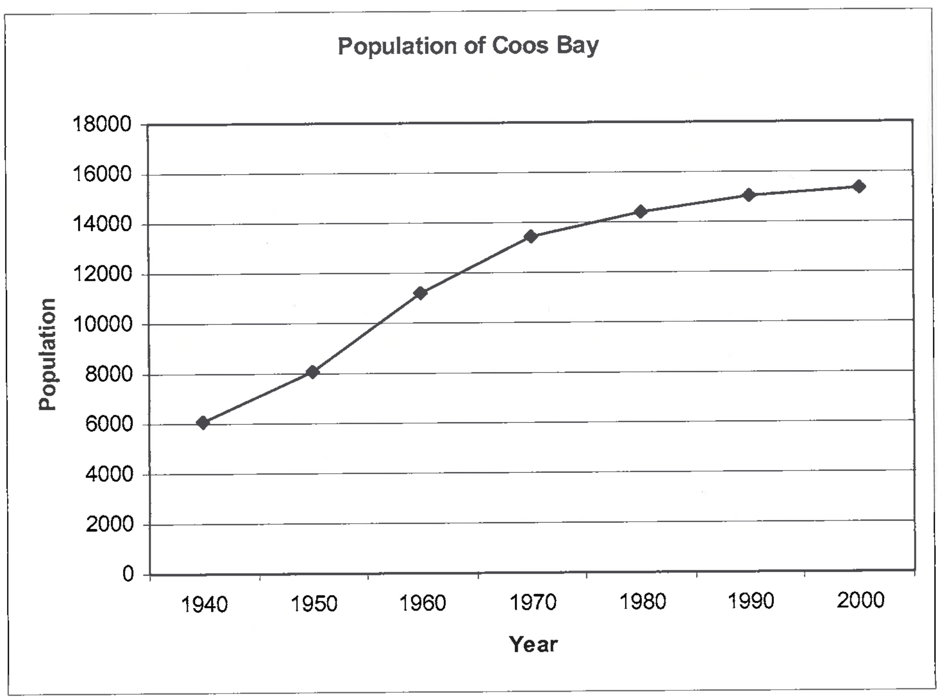
Land use planning and zoning maps from the 2000 Comprehensive Plan as revised in January 2004 were used to determine existing and future development conditions. Digitized data from aerial photos were used to confirm development density, approximate impervious areas, and vegetation for each basin.

Land use designations for the City include high and low density residential, commercial, industrial, medical park, and quasi-public. Most existing residential neighborhoods are zoned low density residential, with newer neighborhoods and land reserved for residential expansion zoned for high-density development. The main commercial zones include land on both sides of Highway 101, the area south of Highland and east of 4th Street, land bordering Southwest Boulevard and Lockhart Street, and a small section north of Thompson road bordering Woodland Drive. The industrial area is the waterfront north of Ivy Avenue and south of Commercial. Land surrounding Bay Area Hospital has been designated medical park and roughly includes the land between Woodland Drive and 16th Street north of Myrtle Avenue to the City limits. Quasi-public zones include schools and parks. A map illustrating projected land use is included in Appendix A.

2.8 Population

The current population estimate from the Portland State University Center for Population Studies for the City of Coos Bay is 15,620. Coos Bay experienced a moderate growth rate of about 3% prior to 1970. Job losses in the timber and fishing industries caused a general outward migration of population in Coos County in the 1980s, but the population in Coos Bay held fairly steady in the 1980s and 1990s and is now experiencing a small upward swing of just under 1% per year. The population data for Coos Bay is graphed in Figure 2.4.1.

FIGURE 2.4.1
COOS BAY POPULATION



Population is used indirectly for planning storm water systems. While the rate of population growth is indicative of the amount of land that would be developed for residential and commercial use, land use and zoning is employed for forecasting hydraulic loads in storm drain analysis.

Existing System

Section 3

Section
3

Existing System

3.1 HISTORY

Prior to 1948 the storm drain system was part of a combined sewer/storm drain system that discharged directly into the Bay. During overflow conditions, raw sewage would back up and run across the public streets. Plans were started in 1949 to provide a separate sanitary sewer collection and treatment system and by 1954 most of the sanitary sewers were redirected to a sewer treatment facility.

3.2 INVENTORY

Record drawings for the storm drain system are only available for a few sections of the City. The inventory in this plan was based on electronic data provided by the City of Coos Bay in the form of system maps overlaid on topographic data from aerial orthophotos. Where pipe sizes were unlabeled, the size of the adjacent pipe was used. Catch basins and manholes not located in the public right-of-way or on a storm sewer line were not counted. Some discrepancies were noted between information on the electronic infrastructure drawings and actual installations. The City may adjust the inventory as the drawings are updated to maintain a more accurate count.

Piping

The majority of the piping material in the storm water system is concrete, with corrugated metal pipe (CMP) used for large culverts and outfalls. A few newer installations were made with PVC and HDPE pipe, including most of the six-inch pipe. The system serving the study area includes approximately 30 miles of pipe, 556 manholes, and 1,073 catch basins. The collection system inventory is detailed in Tables 3.2.1 and 3.2.2. Maps of the collection system are included in Appendix B.

All manholes and catch basins that were accessed during the course of the study were of concrete construction, although brick risers were noted on manholes at the Mill Slough Box. Spot inspections of the concrete pipe and manholes found no serious deficiencies in general, with the exception of those listed below. The CMP pipe that was inspected, particularly at Bay outfalls, was deteriorating, with several sections requiring repair. CMP would not be recommended for future installations.

The culvert crossing Thompson Road has flattened to an oval shape. There are no indications at this time that the culvert is unstable, but monitoring of the culvert for further distortion is recommended. If the soils surrounding the culvert become unstable or the culvert deteriorates further, then the culvert should be replaced.

Blossom Gulch Creek and Mingus Pond drain into concrete box culverts (the Mill Slough Box) that join at 7th Street and Bennett Avenue, prior to discharging through a tide gate into the Bay at Curtis Avenue. Construction documents for the Slough Box date to 1915. The design life for concrete pipe is normally considered to be 100 years, and portions of the Slough Box are already 89 years old. Site inspections and field measurements found that the dimensions in the Slough Box vary considerably from the original construction drawings and verification of actual conditions is recommended prior to design of future projects involving reuse of the Slough Box.

There are several known problems with the Mill Slough Box. The seams of the box culvert have developed gaps and repair of past sinkholes above the slough box make it likely that reinforcement and repair is needed. Cracks allow water to short circuit the tide gate. Flow through these cracks has caused erosion of the soils below the tidegate. Eight to twelve inches of sand and gravel have built up in the bottom of the culvert on Bennett Avenue between 7th and 6th Streets, reducing the flow capacity.

In addition, several gravity sewer lines penetrate the upper portion of the Slough Box, causing reduced storm water capacity at high flows. These sewer pipes show signs of past repairs, indicating that strong flows and impact of debris have damaged the sewer pipe. It is recommended that a manual inspection and concrete testing of the Slough Box be made to determine the interior condition of the box culvert, the remaining strength of the concrete, and the condition of the gravity sewer lines that traverse the culvert during low stream flows in September. The City may want to consider installing metal protective shielding over the existing concrete and transite sewer pipes.

Wastewater treatment plant number 1 (WWTP1) has a 42-inch diameter outfall that discharges under the Coast Guard Cutter Orcas opposite Koosbay Boulevard. The storm drain lines serving the upper portion of Basin 4 discharge into the outfall at 6th Street. The outfall has marginal capacity for a 50-year storm for the storm water alone. Plant operators noted that during extreme rain conditions and high tides the combined storm water effluent mixture overflows at 7th and 6th and flows in the gutter to Highway 101. Separation of the storm water system from the outfall is recommended.

The 42-inch CMP culvert crossing Southwest Boulevard at Dakota Street has deteriorated and flow bypasses the tidegate through a hole near Coalbank Slough. Salt water draining back through the hole has damaged landscaping at adjacent homes. The computer model indicates that a 48-inch PVC culvert would be needed to meet future flows. Lining of the existing pipeline and replacement of the tidegate is planned during the summer of 2004.

Concrete wastes from construction projects have been washed into the storm drains in at least three locations and have hardened to form obstructions. These obstructions should be removed to restore design capacity to the storm sewers. One obstruction is located at 4th and Anderson, in front of the fire hall. The others are in front of the Post Office and the Egyptian Theater. In addition to removing the existing obstructions, the City should add language to its ordinances to prohibit washing concrete wastes into the storm drains.

Piping in several areas, including the Mill Slough Box, is undersized for current flows. Pipe capacities and recommended upsizing for specific areas are discussed in Section 6.

TABLE 3.2.1
COLLECTION SYSTEM APPURTANANCE INVENTORY

Item	Quantity
Manholes	556
Catch Basins	1,073
Cleanouts	7
Tideboxes	4
Tidegates	13
Ungated Outlets	20

TABLE 3.2.2
COLLECTION SYSTEM PIPING INVENTORY

Item	Pipe Size	Quantity (Feet)
Culvert pipe	6-inch	1,308
Culvert pipe	8-inch	28,554
Culvert pipe	10-inch	19,608
Culvert pipe	12-inch	33,160
Culvert pipe	15-inch	9,582
Culvert pipe	18-inch	11,603
Culvert pipe	21-inch	3,309
Culvert pipe	24-inch	4,324
Culvert pipe	27-inch	834
Culvert pipe	30-inch	3,228
Culvert pipe	33-inch	606
Culvert pipe	36-inch	4,825
Culvert pipe	42-inch	1,491
Culvert pipe	48-inch	1,153
Box Culvert	18"x27"	36
Box Culvert	10"x17"	262
Box Culvert	12"x16"	250
North Branch Mill Slough Box	42-inch	1,452
Box Culvert	4'x6'	1,150
Box Culvert	8'x5'	2,262
Forcemain	20-inch	28
Lateral pipe to Catch Basins	6 to 12-inch	30,696
Pipe Total		159,721

Dikes

A series of dikes provides protection for low-lying properties that front the Bay and sloughs from tidewaters.

Englewood and Libby Dikes front Coalbank Slough. Englewood Dike extends from South of Oregon Avenue to Old Wireless Lane and Libby Dike continues from that point to Red Dike Road. The dikes were privately built prior to 1920 of earthen construction. Their combined length is approximately 5,500 feet and they protect about 74 acres, of which 11 are residential lands. The dikes are currently privately owned and are maintained by the Englewood Diking and Libby Drainage Districts respectively. Tidewaters breach the dikes often, most recently in 2003. A study completed in 1987 by the US Army Corps of Engineers recommends removing the dikes and approximately 15 residences in the associated floodplain and restoring the land to wetland estuary. Portions of the Englewood and Libby dikes are in poor condition. The current has undercut the bank on the waterside of the dikes, creating unsupported overhangs and reducing the overall width of the dikes by up to three-feet.

Additional dikes follow the north bank of Coalbank Slough from 7th Street to the confluence with Isthmus Slough. The City has recently upgraded the dike between 7th and 5th Streets as part of a tidegate improvement program. Property owners east of Broadway have armored the dike with concrete and rock rubble.

From Coalbank Slough to Commercial Avenue is the most developed dike, which includes the Coos Bay Boardwalk. Raising the level of the dike from the boardwalk to Johnson Avenue, and installation of a paved footpath in the 1990's has reduced the incidents of flooding in the downtown area. This dike is in very good condition.

Tidegates

A series of tidegates and tideboxes limit flow from the Bay to the city side of the dikes at high tides. The waterfront was walked between the City limits at Yew Street on the north and Newport Avenue on the south on November 24, 2003 and on January 12, 2004. Observed outfalls were noted, including the presence and condition of tidegates. A summary of outfall and tidegate locations and conditions is included in Table 3.2.3. All of the tidegates, except Tidegate 5 are flapper style, either mounted at a headwall or on the end of the outfall pipe. Tidegate 5 is a flexible duckbill style. Tidegates are numbered consecutively from south to north, starting with the gate at the Englewood Market opposite Dakota Avenue. Additional tidegates are in the jurisdiction of the Englewood Diking and Libby Drainage Districts and are not discussed in detail in this report, but are listed in Table 3.2.4. Tidegate photos are included in Appendix C.

Most of the tidegates themselves were in operating condition, but the CMP piping and in a few cases the headwall were in poor condition. In several locations outfalls currently have no backflow prevention. Backflow prevention is recommended for all outfalls that have collection openings in the system below an elevation of 10 feet.

Tidegate 1

Tidegate 1, located at the Englewood Market currently has failing 42-inch CMP pipe with a hole on the Coalbank Slough side of the dike that allows salt water to backflow onto neighboring properties. This tidegate is difficult to access due to the steep banks of the dike surround it, and tends to silt in and catch debris. The gate itself appears to be in good condition. This gate is scheduled for replacement in the summer of 2004.

Tidegate 2
Tidegate 2 is located at 7th Street and is mounted on a 12-inch concrete pipe. The pipe and gate are in good condition, but subject to silting in, and currently need cleaning.

Tidebox 3
Tidebox 3 is located on Lockhart Avenue at 5th Street. Two tidegates are located in the tidebox, 36-inch Tidegate 3 and 12-inch Tidegate 3A. A 36-inch corrugated plastic outfall line discharges from the box under the dike to Coalbank Slough. This tidebox was refurbished in 2003.

Tidegate 3B
Tidegate 3B is located at 7th Street and Kruse Avenue. The 8-inch tidegate is installed in the side of an elevated catch basin that is the overflow point for a natural drainage swale or unnamed creek. A piece of plywood had been placed over the top of the catch basin and weighted with rocks, apparently in an attempt to prevent backflow through the basin. The basin was plugged with woody debris, which may be preventing the tidegate from closing properly. The tidegate is undersized and not laid out in a manner to promote self-cleaning.

Tidegate 3C
Tidegate 3C is located at 5th Street and Coalbank Slough on the 36-inch outfall line from Tidebox 3. The gate is submerged, even at minus tides and was observed from the bank. The Tidegate appears to be in good condition. This tidebox was refurbished in 2003.

Tidegate 4
Tidegate 4 is located on Coalbank Slough at 5th Street. This tidegate was upgraded in 2001 with a new 24-inch PVC outfall. A CMP outfall pipe is located just east of this gate, which was abandoned after the upgrade.

Tidegate 5
Tidegate 5 is the only duckbill tidegate in the system. The 12-inch Tideflex gate is attached to a PVC outfall at Coalbank Slough south of 2nd Street. This gate appears to be in good condition.

Tidegate 6
Tidegate 6 is located on Coalbank Slough at Broadway. The 24-inch gate is attached to a HDPE outfall pipe and is in good condition.

Tidegate 7
Tidegate 7, located on Coalbank Slough east of Broadway and south of Les' Sanitary Service, is in good condition. This 24-inch outfall has a sediment basin with trash grates. The yard and parking area of Les' drains into the basin through an oil-water separator that is pumped annually. The incoming trash grate is plugged with plastic jugs and needs to be cleaned. The basin appears to work well at retaining sediment and currently is full and in need of servicing.

Tidegate 7A
Tidegate 7A is located on Coalbank Slough south of Front Street, behind Les' Sanitary Service. This 12-inch outfall has a sediment basin that currently is full and in need of servicing.

Tidegate 8
Tidegate 8 is located in Johnson Avenue at Front Street, next to Fred Meyers. The 42-inch gate is inside a vault next to Pump Station 15. While the gate is in good shape, the vault leaks around the frame of the door support. When the pumps discharge into the vault, water blows gravel away from the vault wall, leaving a pothole. The City grouted the void where the frame mounts to the vault during the course of this study, but a permanent repair would involve removing the flange, saw cutting the concrete riser, and pouring a new opening to properly fit the frame. The vault discharges to Isthmus Slough at Johnson Avenue, east of the vault.

Tidebox 9
Tidegates 9 and 9A are located in a tidebox in Highway 101 at Golden Avenue. Tidegate 9 is 36-inch diameter and serves the downtown storm drains. Tidegate 9A is the old 15-inch raw sewer overflow. While Tidegate 9A has been plugged at the connection to the sanitary sewer and is not shown as connecting to any catch basins or storm lines, it still has flow, indicating that it provides a path to drain groundwater from under the highway. A 36-inch steel discharge line drains the tidebox to Isthmus Slough. The City has had trouble sealing the vault doors in the past, and a large amount of silicon sealer was chiseled out before the door would open. A fixed gasket is recommended to seal the vault door so that it is easier to access the vault for gate inspection.

Tidegate 10
Tidegate 10 is located about 200 feet north of Golden Avenue. A 12-inch CMP pipe drains an area around the railroad tracks. While records indicate a spigot style tidegate on the end of the pipe, the pipe has holes and the flapper is missing off the gate. Replacement of both the CMP pipe and tidegate are recommended.

Tidegate 11
Tidegate 11 is located on Isthmus Slough at Elrod Avenue. City records show this gate as a 12-inch spigot type installed on an outfall prior to 1940. A 12-inch wood culvert with flow, but no gate and in poor condition was discovered at this location, but it is not known if this is the outfall shown on the City plans. It is possible that there is an additional outfall installed deeper than a minus 1.7 foot tide would uncover. The area served by this outfall flooded until a bypass was installed diverting high flows to Pump Station 15. It is recommended that this outfall be dye tested to verify that there is not another outfall. If this is the main outfall then it should be replaced and a tidegate installed.

Tidegate 12
Tidegate 12 is at the discharge of the Mill Slough Box into Isthmus Slough at Curtis Avenue. The tidegate is a 6-foot by 8-foot wood flapper gate with a concrete headwall. The wood gate shows minor deterioration and should be monitored at least annually. Tidewater bypasses the gate through cracks in the concrete box culvert and has eroded a space under the culvert.

Tidegate 13

Tidegate 13 is located at Anderson Avenue and the Boardwalk. This gate was not accessible due to elevation below the low tide line. City records list the gate as a 12-inch spigot type.

Tidegate 14

Tidegate 14 is located at Central Avenue and the Boardwalk. This gate is supported by two pilings and appears to have a concrete spillway for erosion protection. The gate and pipe appear to be in good condition, although there was debris wedged in the gate at the time of observation. There are actually three outfalls at this location: a 24-inch concrete, an 18-inch CMP, and an abandoned pipe under the CMP. No tidegates were evident on any of these pipes. The 18-inch CMP has a broken end and is in poor condition

Tidebox 15

Tidebox 15 is located at 3rd Street and Commercial Avenue adjacent to Pump Station 11. Two tidegates are located in the box, a 12-inch and a 24-inch diameter flapper gate. The gates are sited to prevent backflow to the upper reaches of the gravity storm system when the pump station is activated. The gates appear to be in good condition.

Tidegate 16

Tidegate 16 is located at Commercial Avenue and the boardwalk. The 36-inch gate is mounted on a concrete outfall with stainless steel supports. The gate is in good condition.

Tidegate 17

Tidegate 17 is located at Market Avenue and Front Street in a tidebox in the Sause Brother's parking lot. This 30-inch gate shows signs of corrosion, but is otherwise in good condition. The vault cover has a grating to drain water from the parking lot. Sause Brother's personnel stated that there is no history of tidewaters backing up through the grate.

Tidegate 18

Tidegate 18 is depicted on City maps at Birch Avenue and Front Street in a tidebox. The manhole located at the mapped location does not have a tidegate. There is no tidegate on the existing outfall. This manhole previously was the overflow point for the sanitary sewer. The sanitary overflow has been plugged with concrete. The tidegate was likely removed as part of the program to remove raw sewage overflow points.

Tidegate 19

Tidegate 19 is located at Ivy Avenue and Bayshore Drive in a tidebox. The tidebox vault has filled with sand and debris to the point that less than 40% of the outfall is open. The tidegate does not appear to be able to fully close due to debris.

Tidegate 20

Tidegate 20 is located at Koosbay Boulevard under the Coast Guard Dock. This 12-inch CMP outfall and gate appear to be in good condition. There are signs of corrosion in the CMP where the collar of the gate is mounted. This gate should be monitored at least annually and the pipe replaced if the corrosion goes through the pipe.

Tidegate 21
Tidegate 21 protected the sanitary sewer overflow to the storm sewer from tidewaters. The gate was removed and the opening cemented in as part of a program to eliminate raw sewer overflows. The tidebox vault remains at Koosbay Boulevard and 6th Street and now serves storm water only. The original 24-inch CMP outfall pipe has been lined with 18-inch PVC and has no backflow protection. The outfall discharges about 25 feet north of the Coast Guard dock.

Tidegate 22
Tidegate 22 is located at Kingwood Avenue and the Bay. This 18-inch gate is mounted in a concrete headwall and appears to be in very good condition.

Tidegate 23
Tidegate 23 is located at Myrtle Avenue and the Bay. This 15-inch gate is mounted on a CMP pipe that is in extremely poor condition, with all flow bypassing the gate through holes in the pipe.

Tidegate 24
Tidegate 24 is located at Pine Avenue and the Bay. This 24-inch gate is mounted on a CMP pipe and appears to be in good condition. This gate had consistent flow when checked during dry weather.

Tidegate 25
Tidegate 25 is located near Wastewater Treatment Plant #2 and is not in the study area.

Tidegate 27
Tidegate 27 is located at the Bay across Highway 101 from the Union 76 tanks. This 24-inch CMP outfall has a concrete headwall. Both the pipe and tidegate are in poor condition.

Tidegate E1
Tidegate E1 is located in Englewood directly east of Montana Avenue, where Middle Creek meets the dike at Coalbank Slough. The 60-inch tidegate has a wood headwall in good condition. The old 48-inch CMP culvert was replaced with a corrugated PVC pipe in the last three years. Both the gate and pipe are in very good condition. The Englewood Diking District maintains this tidegate.

Tidegate E2
Tidegate E2 is located in Englewood directly east of Pennsylvania Avenue, at Coalbank Slough. The Englewood Diking District maintains this 36-inch tidegate, which was installed approximately 10 years ago.

Tidegates E3, E4, & E5
Tidegates E3, E4, and E5 are located in Englewood on Middle Creek, west of Southwest Boulevard and north of Illinois Avenue. These 12-inch tidegates were installed by the City in 2002 to protect individual properties and are maintained by the City.

Outfalls

There are a number of documented and undocumented outfalls that do not have tidegates. The majority of the undocumented outfalls appear to drain individual or small groups of catch basins near the railroad tracks or on Highway 101. Outfalls that serve areas with drainage openings lower than 10-foot elevation require tidegates to prevent backflow of tidal waters. Outfalls that meet these conditions include numbers 0b, 8a, 11a, 17a, 17c, and 17d. There may be other outfalls that were submerged or otherwise not apparent during the dike inspections and so are not listed. Specific outfalls with deficiencies are listed below:

Outfall 9
Outfall 9 at Golden Avenue is a 36-inch concrete pipe. While the end section of the pipe has broken off, the outfall appears to be long enough to function well at this time. If the remaining pipe shows signs of failure in the future, then this pipe should be replaced.

Outfall 19
Outfall 19 at Ivy Avenue is a 24-inch CMP pipe in poor condition. This outfall is recommended for replacement.

Outfall 21A
Outfall 21A at Koosbay Boulevard is a combined storm/effluent outfall. A separate storm water outfall is recommended.

Outfall 23A
Outfall 23A is a 12-inch concrete outfall located just north of Myrtle Avenue. This outfall is semi-buried but otherwise is in good condition.

Outfall 24A
Outfall 24A just north of Pine Avenue is a 12-inch CMP pipe in poor condition. This outfall is recommended for replacement.

Outfall 26
Outfall 26 is located at Teakwood Avenue and does not have a tidegate. The concrete 18-inch outfall is in good shape, although partially silted in and in need of cleaning. This outfall serves areas above the high tide line and should not need a gate.

Outfall 26A
Outfall 26A, located just north of Teakwood is a 12-inch CMP pipe in poor condition. This outfall is part of the ODOT system and is recommended for replacement.

Outfall 26B
Outfall 26B, approximately 175 feet north of Teakwood is a 15-inch CMP pipe in poor condition. This outfall is part of the ODOT system and is recommended for replacement and extension to the tide line.

TABLE 3.2.3
OUTFALL/TIDEGATE INVENTORY

Map #	Location	Size	Gate Type	Age	I. E.	Condition/Material
	Coal Bank Slough					
0a	North of Oregon	24"	None			?
0b	75' south of Dakota	36"	None			Plugged and abandoned
1	Dakota Ave	42"	Spigot	1964	4.14	Good/ CMP flattened
2	South 7th	12"	Spigot	1963	0.90	Good/ Concrete
3	S. 5th @ Dike	36"	Spigot	2003	-5.15	Good/ HDPE
3a	S. 5th @ Lockhart	36"	Tidebox	2003	-2.15	Good
3b	S7th @ Kruse	8"	Tidebox			Undersized –backflows-bad layout
4	S. 5th @ Dike	21"	Spigot	2001	-4.44	Good/ HDPE
5	S. 2nd	12"	Tideflex			Not accessible
6	S. Broadway	24"	Spigot	1997		Good/ HDPE
7	S. 1st	24"	Spigot	1997		Maintenance problem-debris/ HDPE
7a	Front	12"	Spigot			Maintenance problem-debris/ HDPE
	Isthmus Slough					
8	Johnson @ Front	42"	Headwall	1974	-3.47	Tidebox leaks @ pavement/concrete
8a	Golden	12"	None			Poor-replace/ CMP
9	Golden @ 1st	36"	Headwall			Good/ concrete outfall has broken end
9A	Golden @ 1st	15"	Headwall			Good
10	North of Golden	12"	Spigot			Bad/ CMP, needs replacement
11	Elrod	12"	Spigot			
11a	Elrod	12"	None			Poor/ Wood
11b	150' north of Elrod	12"	None			?
12	Curtis (Mill Slough)	5'x8'	Headwall			Good / wood gate-concrete culvert
13	Anderson	12"	Spigot			Collar needs replacing/ ductile iron
13a	100' South of Central					Poor/CMP, Possibly abandoned
14	Central	18"	Spigot			Good/CMP
14a	Central	18"	Spigot			CMP in poor shape, Tidegate missing
14b	Central	24"	None			Good/ Concrete
15	3rd @ Commercial	12"	Tidebox			Good
15a	3rd @ Commercial	24"	Tidebox			Good
16	Commercial	36"	Headwall			Good
17	Market @ Front	30"	Headwall			Good
17a,b&c	Alder	?	None			?
17d	Birch	18"	None			Good/CMP
18	Birch @ Front	24"		1958		Plugged/ CMP
	Coos Bay					
18a	Cedar St.	12"	None			Concrete
18b	Date St		None			Submerged
18c	Fir St	10	None			HDPE
19	Ivy @ Bayshore	24"	Tidebox	1959		Corrugated Iron
19a	Ivy Outfall	24"	None	1959		Poor/ CMP
20	Koosbay Blvd.	12"	Spigot			Good/ CMP
21	Koosbay @ N. 6th	18"	None			Good/18" PVC in 24" CMP
21a	Koosbay Blvd.	42"	None			Combined WWTP/Storm outfall
22	Kingwood	18"	Headwall		1.62	Very good/ CMP w/ concrete headwall
23	Myrtle	15"	Spigot	1981	1.02	Very Poor/ CMP, needs replacement
23a	80' North of Myrtle	12"	None			Good/Concrete
24	Pine	24"	Spigot	1954	1.46	Good/ CMP
24a	50' North of Pine	12"	None			Poor/ CMP
26	Teakwood	18"	None			Concrete w/ headwall
26a	100' N of Teakwood	12"	None			Poor/ CMP
26b	175' N of Teakwood	15"	None			Poor/ CMP
27	Union 76 Tanks	24"	Headwall			Poor/ CMP, 6" holes in CMP

TABLE 3.2.4
ENGLEWOOD OUTFALL/TIDEGATE INVENTORY IN CITY LIMITS

Map #	Location	Size	Gate Type	Age	Maintained By	Condition/Material
	Coal Bank Slough					
E1	East of Montana	60"	Headwall	2001	Diking District	Very Good/CPP
E2	East of Pennsylvania	36"	Spigot	1994	Diking District	Unknown/CPP
E3	Middle Creek	12"	Spigot	2002	City	Good
E4	Middle Creek	12"	Spigot	2002	City	Good
E5	Middle Creek	12"	Spigot	2002	City	Good

Pump Stations

The City has two storm water pump stations, Pump Station 15 located next to Fred Meyers on the vacated portion of Johnson Avenue, and Pump Station 11, located on the southeast corner of Third Street and Commercial Avenue.

Pump Station 15

Pump Station 15 was built in 1974 and serves the area surrounding Highway 101 between Curtis and Kruse Avenues west to 4th Street. The station is located next to the Fred Meyer store on vacated Johnson Avenue, east of Highway 101. The 42-inch concrete forcemain discharges into Coalbank Slough directly east in the vacated Johnson Avenue right of way. Storm water flows into a vault in vacated Johnson Avenue, north of the station. During low tide storm water flows directly through a tidegate that bisects the vault and gravity flows to the slough. When tidal pressures close the tidegate, flow is diverted into the wetwell of the pump station, where it is pumped around the tidegate, pressurizing the slough side of the vault in Johnson Avenue.

The station has a brick pump house located over the wetwell, housing three Byron Jackson pumps. The two 15 HP pumps were replaced last year and had soft start motor controls added this year. The 30 HP pump was rebuilt two years ago, and also had a soft start added. A 75 kW Onan generator provides backup power. While no deficiencies were noted for the pump station, leakage in the pressurized vault has eroded soils around the vault access, and water sprays through gaps in the concrete when the pumps are activated. A photograph of this station is included in Figure 3.2.1 and the operating parameters are detailed in Table 3.2.5.

Two draw down capacity tests were attempted for this station. The first test was attempted on an outgoing tide, and since the wetwell level varied with the tide we were unable to determine how much of the level change was due to the pumps and what portion was tidal. The second attempt was made at a slack high tide. While wetwell levels remained stable, the results of the measurements and calculations were that the station capacity was only 1,500 gpm, less than 40% of the factory rating for one of the smaller pumps alone. The collection system serving this station has a fairly flat profile and the collection system acts as storage, which would need to be taken into account when calculating the volume pumped down during a draw down test. The actual volume pumped cannot be calculated from measuring the wetwell dimensions only, and accurate record drawings and elevations are not available for the collection system. The capacity of this station could be checked by calculating the volume of the outfall line and vault and placing dye in the wetwell, but to check

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each pump would be a time consuming process, and would require a large amount of dye to be discharged to the Bay. As the two 15-HP pumps are new and the maintenance crew feels that the larger pump operates satisfactorily, no further attempts were made to verify capacity.

FIGURE 3.2.1
PUMP STATION 15

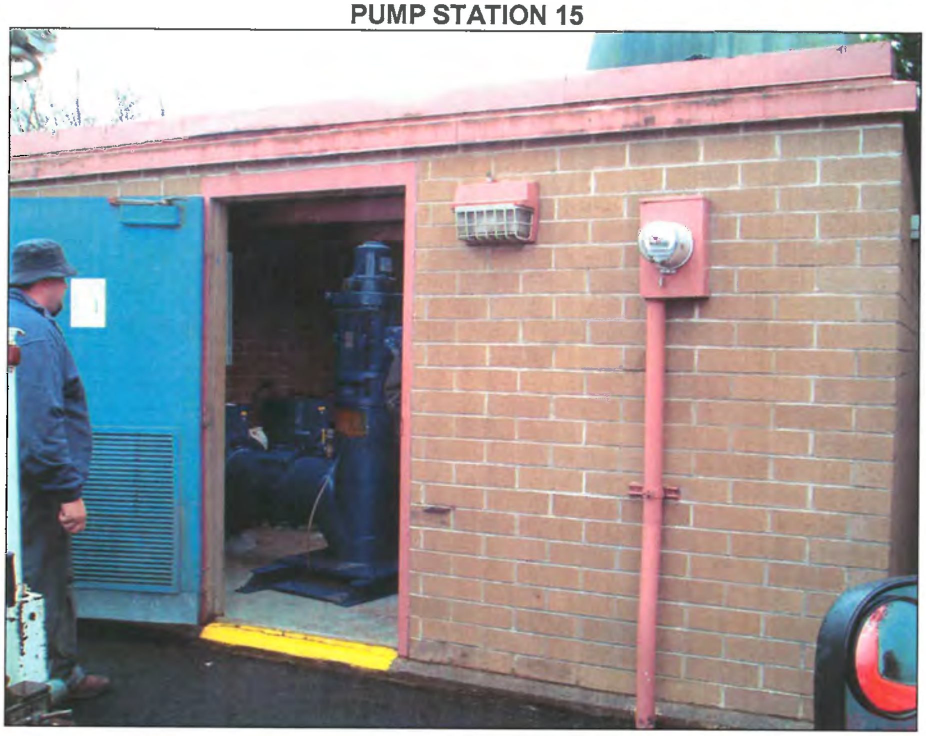

FIGURE 3.2.2
PUMP STATION 11

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TABLE 3.2.5
PUMP STATION 15 DATA

Parameter	Value
Construction Date	1974
Number of Pumps	3
Type	Constructed over wetwell
Level Control	Float Switches
Discharge Point	Coalbank Slough @ Johnson
Backup Power	75 kW generator
PUMP 1	
Type	Vertical Turbine
Design Capacity (GPM@FT head)	Est. at 11,000 @11' *
Motor HP	30
Manufacturer	Southern Well
Year of Last Upgrade (1989 install)	2002
Current Output (GPM)	unknown
PUMP 2	
Type	Vertical Turbine
Design Capacity (GPM@FT head)	4,350 @ 8
Motor HP	15
Manufacturer	Byron Jackson
Year of Last Upgrade	2003
Current Output (GPM)	unknown
PUMP 3	
Type	Vertical Turbine
Design Capacity (GPM@FT head)	4,350 @ 8
Motor HP	15
Manufacturer	Byron Jackson
Year of Last Upgrade	2003
Current Output (GPM)	unknown

* Design data for this pump is not available. Capacity estimated from similar pump curve.

Pump Station 11

Pump Station 11 was built in 1969 and serves the downtown area between 2nd and 4th Streets and Commercial and Curtis Avenues. The 20-inch diameter force main discharges into the gravity storm drain on Commercial Avenue. Storm water gravity flows from the station into the storm drain until the level in the station exceeds a preset height, at which point the pumps are activated. The station has duplex pumps with a drywell over wetwell configuration. The drywell is considered a confined space and requires a minimum of two personnel to access. The controls and electric service are located in the drywell. A photograph of this station is included in Figure 3.2.2 and the operating parameters are detailed in Table 3.2.6.

The pump output for each pump exceeded the original design specifications when tested on March 8, 2004. The combined output for both pumps operating together was just under 4,500 gpm. While the pumps are currently operating well, the original equipment has exceeded their recommended life and obtaining replacement parts is difficult. The below grade wetwell makes access cumbersome and the electric components are at risk of flooding in the case of power or pump failure. The controls and electrical components are outdated and worn. There is no connection for a generator. When the pumps are replaced, it is recommended that the City consider eliminating the drywell and building an above ground pump house.

TABLE 3.2.6
PUMP STATION 11 DATA

Parameter	**Value**
Construction Date	1969
Number of Pumps	2
Type	Wetwell/Drywell
Level Control	Float Switches
Discharge Point	Commercial Ave. Storm Drain
Force Main Diameter (inches)	20
Backup Power	None
PUMP 1	
Type	Turbine
Design Capacity (GPM@FT head)	2,680 @ 11
Motor hp	15
Manufacturer	Paco
Year of Last Upgrade	unknown
Current Output (GPM)	2,970
PUMP 2	
Type	Turbine
Design Capacity (GPM@FT head)	2,680 @ 11
Motor hp	15
Manufacturer	Paco
Year of Last Upgrade	unknown
Current Output (GPM)	3,600

Planning Criteria

Section

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Section 4

Planning Criteria

4.1 Federal and State Regulations

The Environmental Protection Agency requires permits for some storm water discharges in the National Pollutant Discharge Elimination System (NPDES) program. The permit process is described in 40 CFR 122.26. The purpose of the program is to prevent storm water runoff from polluting public waters. The Department of Environmental Quality administers the federal codes in Oregon.

With respect to the City of Coos Bay, permits are not required at this time from incorporated municipalities of populations less than 50,000 when discharges are composed entirely of storm water. Local industrial and commercial facilities may require permits for their particular storm water discharge. These facilities should already be regulated by the DEQ according to CFR regulations. With this exception, clean storm water discharge from the city is not regulated at this time by external agencies.

EPA is implementing Phase II storm water rules for small municipalities in urbanized areas. The storm drain system administered by the City is classified as a small municipal separate storm sewer system (MS4). Phase II regulations cover MS4 systems that are in an urbanized area, or that has a residential population of at least 50,000, or a density of 1,000 people per square mile, or that has been designated Phase II by the NPDES permitting authorities. The metropolitan area comprised of the cities of Coos Bay and North Bend and surrounding development fall below the population cutoff and Coos Bay has not been designated a Phase II community. The City is likely to be considered for designation as a Phase II area in the future based on population density or as a part of the effort to improve water quality in the Coos River basin.

The Bay, Isthmus Slough, Coalbank Slough, and lower Pony Creek are all considered bacteria limited under the Clean Water Act, Section 303d water quality listing. In addition Isthmus Slough is considered oxygen limited due to the high quantities of oxygen depleting sediments. Blossom Gulch Creek is not 303d listed at this time, but is a candidate for future listing. All of the above waterways are designated as Essential Fish Habitat due to the current or historical presence of coastal coho salmon, which are listed as a threatened species under the Endangered Species Act.

The Bay is considered bacteria limited and concerns have been raised about levels of petroleum and metals in bay sediments. Deep water dredging of the Bay to maintain the shipping channel removes sediments from the deeper portions of the channel, but the dredge spoils are deposited on other sites without remediation for pollutants. In addition pollutants are present in the mudflats that are not subject to dredging. Possible sources of the pollutants include current and former industrial operations, wastewater treatment plant outfalls, maritime use of the Bay and sloughs, log storage activities, and urban runoff from storm water. Bacteria levels in the Bay are of particular concern due to the potential effects on oyster farms and natural shellfish populations in the Bay that are harvested for human consumption.

Isthmus Slough is considered both bacteria and oxygen limited. DEQ is scheduled to set a total mass daily load (TMDL) for the slough in 2006. The slough is fairly stagnant in the summer and the velocity of water during most of the year is not high enough to provide a scouring action. An anoxic sediment layer has built up that reduces the oxygen level in the water. The slough has been historically and is currently used for log storage, which is a suspected major source of the anoxic sediments. Potential bacteria sources include septic systems, agricultural runoff, pets, urban storm water runoff, and wildlife.

Coalbank Slough is also scheduled for a TMDL in 2006 for bacteria. Potential bacteria sources include septic systems, industrial runoff, pets, agricultural runoff, urban storm water runoff, and wildlife.

A portion of the lower Pony Creek drainage area is located in the study area. Although the outlets and lower drainage basin are located outside of the study area, activities in the study area have a major impact on downstream water quality and flooding.

At this time, no data is available on the characteristics of storm water discharged into local streams and rivers. It is recommended that the City develop a self-monitoring program of sampling and testing storm water discharges from highly developed areas in order to build a baseline database that may be used to guide future storm water treatment decisions.

4.2 Local Ordinances

Internally, the City of Coos Bay has no direct ordinances pertaining to storm water, but follows DEQ requirements. Although the city requires developers to deal with storm water by providing adequate facilities for runoff from the proposed site, the review practice may not adequately address all effected portions of the storm drainage basin.

Consequently, a new development could discharge to an existing storm system regardless of whether the system can handle the flows, even if flooding would likely occur. Similarly, a new development could construct undersized drainage elements, which cause flooding when new, upstream developments increase flows.

The local code officials rely on restrictions in state building codes, specifically Section R327 of the 2000 Oregon Dwelling Specialty Code based on the International Residential Code (IRC) to prevent damage to structures in the floodplain for residential construction. The IRC allows construction in floodplains, but requires occupied spaces and construction materials subject to water damage to be elevated at least one foot above the 100-year flood level. The City implements this provision by requiring residential construction to be above the 10-foot elevation. The new 2003 version of IRC will be adopted by Oregon in October 2004, but an amendment changes the requirements in Section R327 from statewide, to requiring adoption of this section by each municipality. It is recommended that Coos Bay adopt section R327 by passage of a local ordinance.

The Uniform Building Code (UBC) governs nonresidential construction with provisions for construction in areas prone to flooding as delineated in the approved flood hazard maps used by the jurisdiction. Chapter 31 details the requirements for flood resistant construction for structures built in areas prone to flooding, which are generally directed at preventing damage to the structure.

4.3 Storm Drain Ordinances for Development

Storm drain ordinances ask that developers examine larger drainage issues related to their site. The goal of the ordinances is to provide responsible drainage that deals with upstream and downstream concerns for the present and the future. Large portions of the drainage basins with outlets in the City are located in the County. Coordination of ordinances is recommended between the City and County to provide the best protection for property owners along major drainage ways.

Below is an example of a set of drainage ordinances.

General Provisions

1. *The review body shall approve a development request only when adequate provisions for storm and floodwater runoff have been made as determined by the City Engineer.*
2. *The storm water drainage system shall be separate and independent of any sanitary sewerage system.*
3. *Where possible, inlets shall be provided; ensuring surface water is not carried across intersections or allowed to flood streets.*
4. *Surface water drainage patterns and proposed storm drainage shall be shown on every development proposal plan.*
5. *All proposed storm sewer plans and systems shall be approved by the City Engineer as part of the tentative plat or site plan review process.*
6. *Ditches will not be allowed without specific approval of the City Engineer. Open natural drainage ways of sufficient width and capacity to provide for flow and maintenance may be permitted. By definition, an open natural drainage way is a natural path, which has the specific function of transmitting natural stream water or storm water run-off from a point of higher elevation to a point of lower elevation.*

Easements

Where a subdivision or development property is traversed by a water course, drainage way, channel or stream, there shall be provided a public storm water easement or drainage right-of-way conforming substantially with the lines of such *water course and such further width as the City Engineer determines will be adequate for conveyance and maintenance. Improvements to the drainage way, or streets or parkways parallel to the watercourse may be required.*

Accommodation of Upstream Drainage

1. *A culvert or other drainage facility shall be large enough to accommodate potential runoff from its entire upstream drainage area, whether inside or outside of the development.*
2. *The City Engineer shall review and approve the size required of the facility, based on provisions of the Storm Drain Master Plan, and sound engineering principles, assuming conditions of maximum potential watershed development permitted by the Plan.*

Effect on Downstream Drainage

Where it is anticipated by the City Engineer that additional runoff resulting from the development will overload an existing drainage facility, the review body shall withhold approval of the development until provisions have been made for improvement of said potential condition.

In many communities, ordinances require developments to ensure that downstream drainage is not impacted by upstream projects. This can either be imposed by requiring the development to ensure adequate drainage throughout the system (including lower areas) or requiring that storm water generated from the post-development conditions be retained and discharged at rates controlled to predevelopment conditions.

Drainage Management Practices

Development must employ drainage management practices approved by the City Engineer, which minimize the amount and rate of surface water run-off into receiving streams or drainage facilities, or onto adjoining properties. Drainage management practices must include, but are not limited to, one or more of the following:

1. *Temporary ponding or detention of water;*
2. *Permanent storage basins;*
3. *Minimization of impervious surfaces;*
4. *Emphasis on natural drainage ways;*
5. *Prevention of water flowing from the development in an uncontrolled fashion;*
6. *Stabilization of natural drainage ways as necessary below drainage and culvert discharge points for a distance sufficient to convey the discharge without channel erosion;*
7. *Run-off from impervious surfaces must be collected and transported to a natural drainage facility with sufficient capacity to accept the discharge; and*

8. *Other practices and facilities designed to transport storm water and improve water quality.*

Design Requirements for New Development.

All new development within the City must, where appropriate, make provisions for the continuation or appropriate projection of existing storm sewer lines or drainage ways serving surrounding areas. Extensions may be required through the interior of a property to be developed where the City Engineer determines that the extension is needed to provide service to upstream properties.

NPDES Permit Requirements.

A National Pollutant Discharge Elimination System (NPDES) permit must be obtained from the Department of Environmental Quality (DEQ) for construction activities including clearing, grading, and excavation that disturb one or more acres of land and for industrial users that discharge other than clean storm water.

4.4 Civil Laws

While storm drainage for small cities is not regulated by state or federal agencies, the State of Oregon has civil laws about drainage. The drainage laws, in part, compensate for the lack of ordinances protecting city drainage facilities. A discussion of drainage laws is provided below.

The Oregon Department of Transportation Hydraulics Manual provides a summary of Oregon's drainage law. Below are three basic elements of drainage that must be followed according to civil law as interpreted by ODOT:

1. A landowner may not divert water to adjoining land that would not otherwise flow there. Diverted water is further described by ODOT as water routed from one drainage area to another and water collected and discharged that would normally infiltrate, pond, or evaporate.
2. A landowner may not divert or change the place where water flows onto a lower property. ODOT interprets this element to limit diversion of water from grading and paving work and/or improvements to storm water collection systems.
3. An upper landowner may not accumulate large quantities of water, and then release it, greatly accelerating the flow onto a lower property. The ODOT interpretation notes that noncompliance with this element occurs when the flow of water has been substantially increased.

Some violations of Oregon's drainage law are subjective. Where questions arise, ODOT recommends that its engineering staff acquire easements to avoid the potential for litigation.

Historic or natural drainage ways, which are impacted by development, may no longer be apparent. In such cases, drainage projects should be particularly sensitive to routing drainage across properties that cannot be proven to be the original drainage way. Future developments or improvements to the existing drainage system should be consistent with the city's legal interpretation of the Oregon drainage law. Generally, the city should acquire easements.

4.5 Future Development

Information provided by City staff was used to project future development. The current zoning maps from the City's Comprehensive Plan were used to project development density and type. For the purposes of this plan and sizing storm drains, areas of future development were considered for both current conditions and at full build out.

Section 5

Hydrological Analysis

Section
5

Hydrological Analysis

5.1 Storm Frequency

An essential part of storm water analysis is selection of the design storm or storm frequency that will be used. Selection of the design storm includes economic and statistical relations. The frequency chosen for a storm depends upon such factors as the existing drainage system, the nature of the contributing areas, and the cost of storm drainage improvements.

The design storm is the total amount of rainfall that will occur over a period of time based on the statistical evaluation of precipitation records. Typical intervals for storm frequencies are 2, 5, 10, 25, 50, and 100 years. A 25-year storm can be expected to occur once within a 25-year period. The 25-year storm could occur any year during a 25-year time span, although each year it only has a 4 percent chance of occurring. The 25-year storm could conceivably occur for several years, or even twice in a given year, even though, statistically, it would not be probable.

Economic factors are considered when selecting the design storm in the engineering analysis. For instance, a drainage system sized for the 100-year storm will result in a larger, more costly drainage system than for a more frequent storm. Conversely, a drainage system designed for the frequent storm, though less costly, may not prevent property flooding, damage to public facilities, and the potential loss of life. Costs of improvements must be compared to the potential risks.

Selection of the storm frequency for this analysis is based on individual basins and projects. Based on the State of Oregon Department of Transportation Hydraulics Manual, a 50-year recurrent storm should be utilized for facilities draining through state highways and a 25-year storm can be used for smaller city streets. In cases where roadway overtopping is a problem, the 100-year storm, may be used.

Design storm precipitation totals for the City of Coos Bay are shown below.

TABLE 5.1.1
DESIGN STORM RAINFALL TOTALS AND ANALYSIS AREAS

DESIGN STORM FREQUENCY	RAINFALL TOTAL	REQUIRED FOR DRAINAGE BASINS
25 year storm	5.5 inches	City Streets and Neighborhoods
50 year storm	6.0 inches	Major City Streets

5.2 Channelization

As storm water flows downstream, it travels in some type of channel, for example, ditch, culvert, natural creek, and pipes. A common mathematical formula used to characterize the hydraulic behavior of these conduits is the Manning's Equation, which is generally expressed as:

$$Q=(1.49/n)*A*R^{2/3}*S^{1/2}$$

Where:
Q=Channel Flow (cfs)
A=Cross-Sectional Area (sf)
R=Hydraulic Radius=A/P (ft)
P=Wetted Perimeter (ft)
S=Channel Slope (ft/ft)
n=Manning's Roughness Coefficient

Channels vary widely in their hydraulic performance. The roughness coefficient, n, is used to describe the texture of the channel in terms of the material of construction. Materials differ in surface friction. If a channel is made up of a rough surface, there is more friction as the water flows through the channel and more energy is used to overcome that friction. The result is lower water velocities and therefore lower flows. Table 5.2 lists some commonly used Manning's "n" values for different pipe and channel surfaces.

TABLE 5.2.1
TYPICAL MANNING'S ROUGHNESS COEFFICIENTS

SURFACE OR MATERIAL	MANNING'S "n"
Finished Concrete	0.012
Unfinished Concrete	0.014
Plastic Pipe	0.009
Brick	0.016
Cast Iron	0.015
Concrete Pipe	0.015
Bare Earth	0.022
Corrugated Metal Flumes	0.025
Corrugated Metal Pipe	0.026
Rubble	0.030
Earth with Stones and Weeds	0.035

5.3 Analysis Method

The term "storm water" typically refers to rainfall runoff, snowmelt runoff, and surface runoff and drainage. Effective storm water management includes the accurate sizing of storm water conveyance systems; specifically, culverts, catch basins, detention/retention ponds, and storm drainage pipelines. Sizing for conveyance systems is generally estimated by using instantaneous peak runoff from a storm of specified frequency.

There are numerous methods for estimating peak runoff. For purposes of this study, the Rational Method and the Soil Conservation Service Runoff Method (TR-20 model) are used to estimate peak runoff values.

While the Rational Method is in common use for engineering analysis of drainage basins, its use is most applicable for analyzing areas with simple drainage systems. For this study, an alternate analysis tool, the SCS Method was used for developed areas with complex drainage system.

The following sections describe the methods in the analysis.

Rational Method

The Rational Method is based upon the concept of mass balance and relates rainfall intensity to runoff intensity. The Rational Method incorporates the use of the rational formula, which is generally expressed as:

$$Q_p = CIA$$

Where:
Q_p = peak discharge (cfs)
C = runoff coefficient (dimensionless)
I = rainfall intensity (in/hr)
A = watershed area (ac)

Once values for runoff coefficient, rainfall intensity, and watershed area have been determined, peak discharge (Q_p) values for drainage basins in the area are calculated. Each of the parameters in the formula is described below.

Runoff Coefficients
Values for C, the runoff coefficient, are readily available in most hydrology or engineering handbooks. Some common C values are listed in Table 5.3.1.

TABLE 5.3.1
COMMON RUNOFF COEFFICIENTS

AREA DESCRIPTION	RUNOFF COEFFICIENT
Downtown Business	0.70 to 0.95
Neighborhood	0.50 to 0.70
Single Family (Residential)	0.30 to 0.50
Detached Multi-units (Residential)	0.40 to 0.60
Attached Multi-units (Residential)	0.60 to 0.75
Light Industrial	0.50 to 0.80
Parks, Cemeteries	0.10 to 0.25
Unimproved	0.10 to 0.30

Rainfall Intensity
Rainfall intensity (I) is the intensity (inches per hour) of rainfall for a given design storm at a given time in the storm. Intensity is typically determined from Rainfall Intensity, Duration, Frequency (IDF) curves. IDF curves are used to determine rainfall intensity associated a specific storm frequency. The IDF curves for Coos Bay are provided in Appendix A.

Time of Concentration
Rainfall duration in a drainage basin is computed by determining the time of concentration for that drainage basin. Time of concentration (t_c) is defined as the longest travel time it takes a particle of water to reach a discharge point in a watershed. While traveling towards a discharge point, a water particle may experience sheet flow, shallow concentrated flow, open channel flow, or a combination of these. Once the drainage route and surfaces have been identified, Manning's equation is used to calculate the travel time of a water particle through a drainage basin.

$$T_c = \frac{L}{.6} \quad \text{where} \quad L = \frac{l^{8}\,(s+1)^{7}}{1900\,Y^{5}}$$

$$\text{and} \quad S = \frac{1000}{CN} - 10$$

T_c = Time of concentration [hours]
L = Lag time [hours]
l = Hydraulic length of watershed [feet]
Y = Average land slope [percent]
S = Potential maximum retention [inches]
CN = Weighed Curve Number

Area
The final variable in the rational formula is the watershed area (A). Watershed area is determined from topographic maps of the area.

Soil Conservation Service Method

The SCS method, commonly referred to as SCS TR-20, is a more sophisticated storm water analysis tool than the Rational Method. Rather than simply determining the peak discharge, TR-20 utilizes a synthetic rainfall distribution to generate a hydrograph showing the runoff peak and volume. This method provides a more accurate assessment of the runoff volume because it sums the total volume discharged from the basin, rather than just the peak discharge.

The SCS method is based on combining unit hydrographs resulting from bursts of rainfall that vary in magnitude, but occur in a predictable pattern. This pattern is defined by SCS as a rainfall distribution curve. Though variations in the storm intensity are synthetic, runoff generated from the storm is based on local characteristics, such as; regional rainfall totals, soil permeability classifications, intensity of development, drainage slopes, area of impact, and even the time lag created by conveyance of flows through the drainage elements.

The benefits of the SCS method is that areas within a basin, called subbasins, can be simultaneously modeled with other subbasins by combining hydrographs using excess runoff and time to peak runoff. This process allows for a more accurate prediction of the peak discharge and calculation of the total runoff volume.

In comparison, the simplicity of the Rational Method requires the results to be more conservative than the SCS Method. Consequently, using the more complex method smaller pipe may be used if sufficient detail of the basin is available. A brief description of the fundamentals of the SCS method is provided below.

Synthetic storm distribution
The basis of the TR-20 Method is the "synthetic storm." This storm is based on SCS research that suggests the intensity of rainfall within a storm occurs in a predictable pattern. The SCS has applied this to the entire continental United States and developed rainfall mass distributions for four geographic locations. Storms occurring in Coos Bay and most of the Pacific Northwest have been classified as type 1A storms. Type 1A storms represent the Pacific maritime climate with wet winters and dry summers. Rainfall gradually increases until about 10 hour point and then gradually decreases. The NRCS storm type distribution is illustrated in Figure 5.3.1. The rainfall distribution hydrograph for a Type 1A 24-hour storm is illustrated in Figure 5.3.2.

FIGURE 5.3.1
NRCS RAINFALL DISTRIBUTIONS

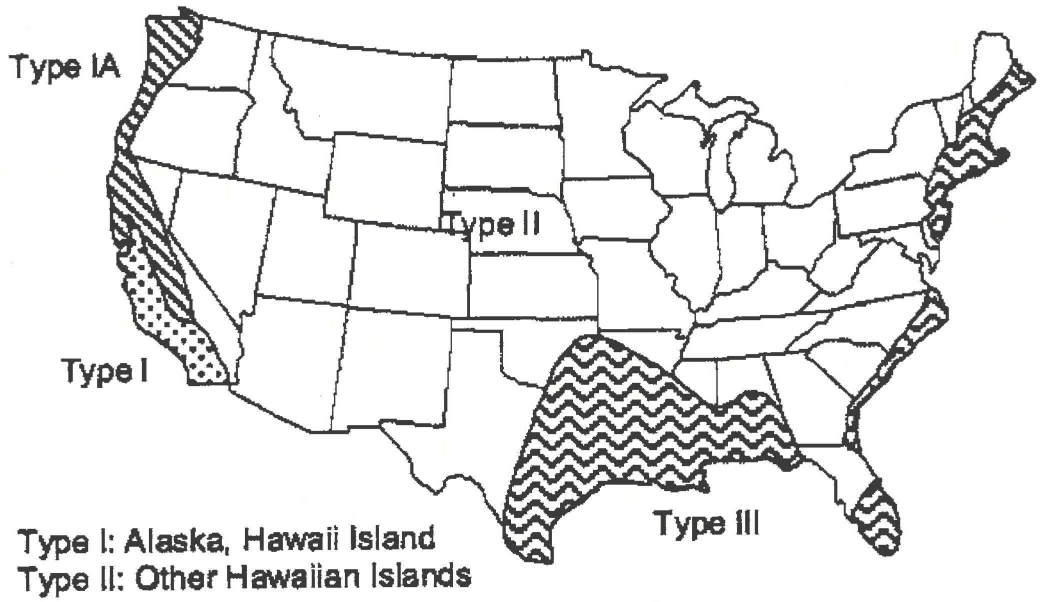
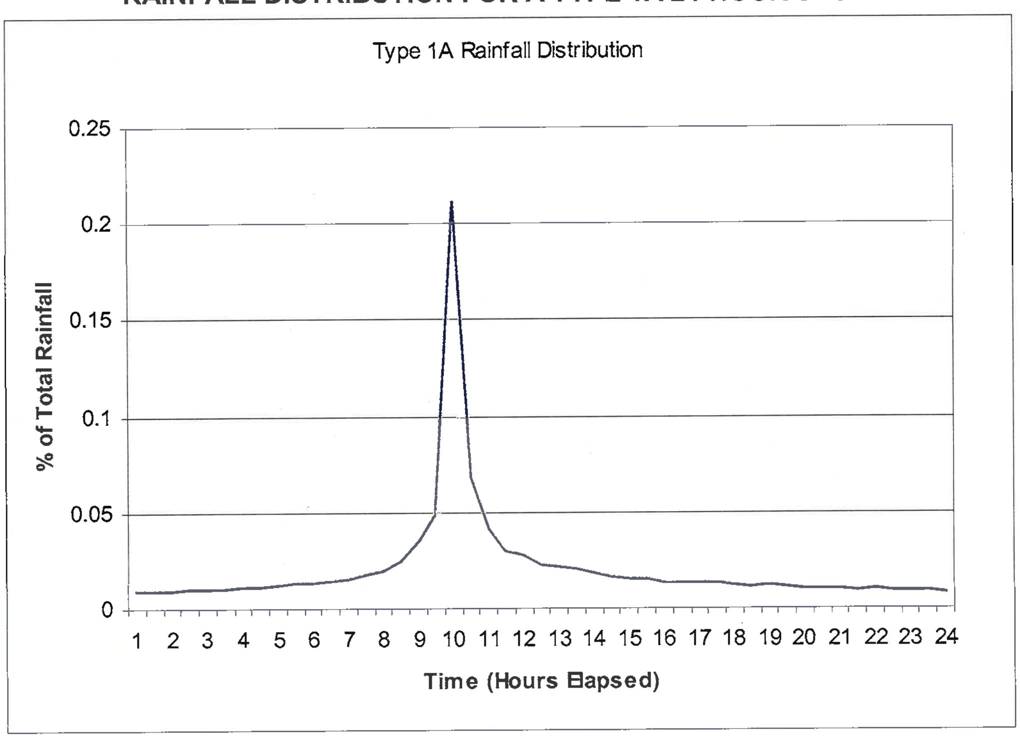


FIGURE 5.3.2
RAINFALL DISTRIBUTION FOR A TYPE 1A 24-HOUR STORM



Soil classification

The type of soil and ground cover occurring within a basin are used in the SCS Method. This information determines the amount of rainfall retained on the surface and the excess rainfall generating runoff. Soil and ground covers are classified by curve numbers (CN) similar to the coefficient of runoff, C, used with the Rational Method. Typical CN values used for the City of Coos Bay are provided below in Table 5.3.2. Since most of the soil within the City is classified as well draining, curve numbers for soil groups B and C were utilized in the analysis of the city's drainage system. A few soils were modeled at type D. Existing fill was modeled at type B.

TABLE 5.3.2
TYPICAL CN VALUES

GROUND COVER CHARACTERISTICS		CURVE NUMBER FOR SOIL GROUP			
Ground Cover Type and Condition	Percent Impervious	A well drained	B moderate	C poor	D very poor
Streets, Roads, Parking Lots	100	98	98	98	98
Urban Commercial Districts	85	89	92	94	95
Residential: 1/8 acre or less	65	77	85	90	92
Residential: 1/4 acre	38	61	75	83	87
Residential: 1/3 acre	30	57	72	81	86
Residential: > acre	25	54	70	80	85
Wooded: No Forest Litter	Poor	45	66	77	83
Wooded: Some Forest Litter	Fair	36	60	73	79
Wooded: Heavily Forested	Good	30	55	70	77

Rainfall

Storm rainfall is determined from the design frequency or design storm as previously mentioned. Total rainfall for the design storm used in Coos Bay is based on the National Oceanic and Atmospheric Administration (NOAA) Precipitation Maps for the Western United States. NOAA precipitation maps for Oregon are provided in Appendix B.

Time of concentration

As in the Rational Method, the time of concentration is an important parameter in the SCS Method. Unlike the Rational Method, the SCS utilizes t_c to determine the time to peak discharge rather than the time of peak rainfall.

Time to Peak

The Time to Peak, T_p, is the amount of time to the peak discharge. The time to peak is calculated with the unit hydrograph and time of concentration. The time to peak is not equal to the time of concentration.

Peak Runoff

The peak runoff is the peak amount of runoff discharged during a rainfall event. The peak runoff is calculated with the SCS method, and varies greatly with the slope and land use of the area in the drainage area. The peak flow is usually in cubic feet per second, and is used to size structures associated with the storm drain system.

$$Q = \frac{(P - .2S)^2}{P + .8S} \qquad (Q = 0 \;\; if \;\; P < .2S)$$

$$where \qquad S = \frac{1000}{CN} - 10$$

Q = Precipitation excess (runoff) [inches]
P = Cumulative precipitation [inches]
S = Potential maximum retention [inches]
CN = SCS Curve Number[1]

Unit Hydrograph

Runoff generated from a storm can be described by a hydrograph. A hydrograph is a predicted discharge wave that, similar to a bell curve, starts slowly then increases with time to a peak before decreasing to its pre-storm levels.

A unit hydrograph is a dimensionless hydrograph, hypothetically generated by one inch of excess precipitation resulting from a uniformly distributed storm of uniform duration over a uniform area. The peak discharge (the y ordinate) and the time of peak discharge (the x axis) for the unit hydrograph is plotted as fractions of the peak and time to peak runoff, respectively. This standardized hydrograph is used to generate site-specific hydrographs by combining rainfall and time to the unit values. The calculation, called runoff generation, is performed as described below.

Runoff Generation

In order to dimension the unit hydrograph and generate runoff according to TR-20 predictions, rainfall is assumed to fall on an area in a “burst." The burst of rain is assumed to flow downstream where it is collected and discharged from the area over an extended time interval.

The duration of the discharge is extended because not all of the rainfall reaches the discharge at the same time. Some of the flow is retained because of soil characteristics; some is delayed because of distance and velocity of travel.

At the same time that the water from farthest point of the basin reaches the discharge point, the lower areas of drainage are also contributing to the flow. The sum creates the peak discharge, which is shown on the y-axis of the hydrograph. The time of the peak is similarly based on the time of travel and plotted as the x-axis. Both the discharge and time of travel are utilized to dimension the unit hydrograph.

Once dimensioned, the unit hydrograph provides the runoff from one interval of the storm's duration. To predict the impact from an entire storm, it is necessary to generate and sum hydrographs for each storm interval. Each new hydrograph generated is based on the mass of rainfall occurring at that particular time, as predicted by the SCS synthetic rainfall distribution curve. As each burst of rainfall generates a new runoff hydrograph, it is added to the preceding hydrograph with its axis displaced by the time between bursts. Once the entire storm is summed, a single hydrograph results. This hydrograph depicts the runoff prediction for that subbasin.

Hydrograph routing.
Within each basin, there are often several subbasins, each generating a runoff hydrograph. In order to observe the effects of a storm on an entire basin, it is necessary to route each subbasin hydrograph throughout the system. Since each hydrograph is based on the time of concentration, it is possible to add each subbasin hydrograph at its discharge point. The process is repeated until all of the hydrographs have been routed through the entire basin and summed at the point of discharge. This process is called hydrograph routing.

Computer Model

The storm drain analysis was done using HydroCad™, WaterCad, and XP-SWMM 2000, packaged computer applications. Consequently, a large level of detail was applied to establish runoff characteristics. In addition to calculating the peak discharge, the SCS method can also calculate the total quantity of water produced from the storm. This information is useful to determine the extent of downstream flooding or the size ponds to contain and release runoff without creating significant increases in the quantity of discharged water. Data sheets from the computer model are included in Appendix D.

Storm Drain Model

Section

6

Section

6

Storm Drain Model

6.1 Projecting Developed Conditions

To establish future demands on the storm water system, zoning and land use maps from the 2000 Comprehensive Plan (See Appendix A) were used. The maps provided the basis for storm runoff forecasts. A summary of the curve numbers (CN) for City zoning requirements is provided in Table 6.1.1.

TABLE 6.1.1
HYDROLOGIC CURVE NUMBERS FOR
FUTURE GROWTH BASED ON LAND USE

USE	EXAMPLE	HYDROLOGIC CN*
Residential	Single Family and Multi-Family Units	75 85
Commercial	Retail Commercial W/ Parking	 92
Industrial	Light Industrial	88
Open Areas	Timber, Cultivated Areas	70 77
Planned Development	Planned Development RV Parks	94 98

* CN reflects fair draining soil characteristics rated as Class B.

6.2 Discharge Estimates

Present and future discharge estimates for each drainage basin were developed according to the methodology in Section 5. The HydroCad™ and XP-SWMM2000 computer models were used to forecast peak storm flows for both existing and urbanized conditions. A summary of the flow projections for existing and fully urbanized land-use in each major basin is provided below in Table 6.2.1.

TABLE 6.2.1
CITY OF COOS BAY
PREDEVELOPMENT AND POSTDEVELOPMENT PROJECTED PEAK FLOWS

BASIN NUMBER	BASIN AREA (Ac)	EXISTING Q, FLOWS (cfs)		POST-DEVELOPMENT Q, FLOWS (cfs)	
		25-YEAR	50-YEAR	25-YEAR	50-YEAR
1	40.0	23.0	26.7	23.0	26.7
2	35.6	20.6	23.6	20.6	23.6
3	5.4	3.3	3.8	3.3	3.8
4	81.0	50.4	58.1	50.4	58.1
5	65.7	34.9	40.4	34.9	40.4
6	4.5	4.4	5.0	4.4	5.0
7	22.2	19.8	22.4	19.8	22.4
8	12.3	14.1	15.7	14.1	15.7
9	14.4	15.1	16.9	15.1	16.9
10	33.7	24.3	27.9	24.3	27.9
10A	14.40	16.1	17.9	16.1	17.9
11	7.7	7.4	8.3	7.4	8.3
12A	300.0	66.9	78.6	66.9	78.6
12B	660.0	121.9	156.7	158.8	198.5
12C	44.6	53.3	59.0	53.3	59.0
13	15.8	17.3	19.2	17.3	19.2
14	123.8	50.1	58.7	59.3	68.6
15	74.0	68.3	75.7	68.3	75.7
16	29.0	24.1	26.9	24.1	26.9
17	132.3	77.9	90.2	122.4	136.9
18	73.4	32.3	39.0	75.0	84.1
19	102.6	36.4	44.0	58.7	68.2
20	35.0	35.8	40.1	35.8	40.1
21	2.5	1.8	2.1	1.8	2.1
22	105.0	36.5	44.6	36.5	44.6
23	16.0	7.0	8.5	7.0	8.5
24	29.0	13.0	15.6	13.0	15.6
25	128.0	48.4	58.0	48.4	58.0
26	69.0	38.3	44.9	51.4	58.8
27	25.0	6.2	7.0	6.2	7.0

6.3 Basin Descriptions

The following subsection describes each basin individually. The description is contained in one page, which contains a summary of the flow conditions, the existing system with present day problems, and the future system with recommended projects. The basin descriptions are intended as a narrative for the mapping in Appendix A.

Basin No. 1

Basin 1 is a 40-acre parcel bound to the west by Koosbay Blvd, by Yew Ave. to the north, the Bay on the east, and Pine Avenue on the south. Most of the drainage area flows down to Teakwood Ave., where it is then transported across Highway 101 by an 18-inch concrete culvert into the Bay.

Soil Type
Templeton Silt Loam
Udorthents, (Artificial Fill)

Slope
0-30%

Current Land-use
9.20 Acres Commercial
8.00 Acres Industrial
14.0 Acres Small Residential
8.60 Acres Forest/Brush

Peak Runoff
25-Year Storm: 23.0 CFS
50-Year Storm: 26.7 CFS
Future 25-Year Storm: 23.0 CFS
Future 50-Year Storm: 26.7 CFS

Existing System
The general route of runoff appears to be overland surface flow with localized channels, such as driveway culverts in the uplands. In the lower areas, near Highway 101, the water is transported to the Bay through culverts and outfall lines. Approximately 80% of the surface area of the catchment is west and above the highway. Approximately half of the basin's runoff flows under the highway through an 18" diameter concrete pipe on its way to the Bay. The outfall has no tidegate. ODOT is responsible for the highway culverts, ditches, and catch basins.

Present Day Problems
The existing outfall at Teakwood does not have a tide gate installed. The hydraulic analysis indicated that the existing 18" diameter outfall along Teakwood should be upgraded to an 18" diameter PVC or equivalent pipe.

Future System
No development is predicted for this basin throughout the planning period.

Basin No. 2

Basin 2 is approximately 36 acres located to the south of Basin 1. The basin drains to the east, into the Bay. The upper portion of the basin is bound to the west near 14th Street, and to the south by Myrtle and Nutwood Avenues, from which it then extends to the Bay.

Soil Type
Templeton Silt Loam
Udorthents, (Artificial Fill)
Geisel Silt Loam

Slope
0-30%

Current Land-use
11.30 Acres Commercial
2.10 Acres Industrial
21.86 Acres Small Residential
0.35 Acres Forest/Brush

Peak Runoff
25-Year Storm: 20.6 CFS
50-Year Storm: 23.6 CFS
Future 25-Year Storm: 20.6 CFS
Future 50-Year Storm: 23.6 CFS

Existing System
Most of the runoff in Basin 2 follows the natural contours of the basin in its route to the Bay. Along the way, some of the water is collected in roadway piping and transported to the Bay. The lower portion of the basin is affected by tides, which at times creates surcharging within the storm water system. Storm drainage from approximately 12.5 acres of the basin along Koosbay Blvd. is transported to Basin 4 through 10" diameter piping. The remaining water enters the Bay through a 24" diameter CMP outfall along Pine St.

Present Day Problems
The existing 24" diameter CMP outfall along Pine St. needs to be lined with PVC or equivalent piping to increase flows during high tide events. The 18"diameter piping located upstream of the existing 24" diameter CMP outfall along Pine Avenue is of an unknown material, and should be PVC or equivalent pipe to handle storm flows.

Future System
No significant development is predicted for this basin throughout the planning period.

Basin No. 3

Basin 3 is approximately nine acres located to the south of Basin 2. The basin drains to the east, into the Bay. The upper portion of the basin is bound to the west by 8th Street, and to the south by Koosbay Blvd.

Soil Type
Templeton Silt Loam
Udorthents, (Artificial Fill)

Slope
0-30%

Current Land-use
5.30 Acres Commercial
3.70 Acres Small Residential

Peak Runoff
25-Year Storm: 3.3 CFS
50-Year Storm: 3.8 CFS
Future 25-Year Storm: 3.3 CFS
Future 50-Year Storm: 3.8 CFS

Existing System
The runoff water in the basin is collected in catch basins along Myrtle Ave. and discharged to the Bay through a 15" diameter pipe. The existing outfall pipe is CMP with a flapper style tidegate.

Present Day Problems
The pipe is adequately sized for flow, but the outfall pipe has holes large enough to allow all flow to bypass the tidegate.

Future System
No development is predicted for this basin throughout the planning period.

Basin No. 4

Basin 4 is approximately 81 acres located to the south of Basin 3. The basin drains to the east, into the Bay. The upper portion of the basin is bound to the west by 14th Street, and to the south by Hemlock and Ivy Avenues, from which the southern boundary extends to the Bay.

Soil Type
Templeton Silt Loam
Udorthents, (Artificial Fill)
Geisel Silt Loam

Slope
0-30%

Current Land-use
20.61 Acres Commercial
2.30 Acres Industrial
52.13 Acres Small Residential
6.00 Acres Forest/Brush

Peak Runoff
25-Year Storm: 50.4 CFS
50-Year Storm: 58.1 CFS
Future 25-Year Storm: 50.4 CFS
Future 50-Year Storm: 58.1 CFS

Existing System
Most of the runoff in Basin 4 follows the natural contours of the basin in its route to the Bay. Along the drainage path, the water is collected in roadway piping on Juniper Avenue, and then transported to 6th Street and Koosbay Blvd through 24-inch concrete piping. At this intersection the storm water piping ties into the 42-inch wastewater plant effluent outfall, which discharges in the Bay under the Orcas mooring. The lower portion of the basin is affected by tides, which at times creates surcharging within the storm water system. The material of pipe used in the outfall is unknown. Two additional outfalls serve the lower portion of the basin, a 12-inch line draining the highway and around the Motel 6, and a 24-inch CMP with an 18-inch PVC liner serving west of Koosbay Blvd between 6th and 8th Streets. The 12-inch line has a flapper tidegate; the 18-inch line has no gate.

Present Day Problems
Surcharging was reported in the 42-inch outfall which overflows storm water and effluent through catch basins on Koosbay Blvd at 6th and 7th Streets. The modeled flows would require a 36" PVC or equivalent outfall line for storm water.

Future System
No significant development is predicted for this basin throughout the planning period.

Basin No. 5

Basin 5 is approximately 66 acres located to the south of Basin 4. The basin drains to the east, into the Bay. The upper portion of the basin is bound to the west by 10th Street, and to the south by Date Avenue, from which the southern boundary extends to the Bay.

Soil Type
Templeton Silt Loam
Udorthents, (Artificial Fill)
Geisel Silt Loam

Slope
0-50%

Current Land-use
10.30 Acres Commercial
55.40 Acres Small Residential

Peak Runoff
25-Year Storm: 34.9 CFS
50-Year Storm: 40.4 CFS
Future 25-Year Storm: 34.9 CFS
Future 50-Year Storm: 40.4 CFS

Existing System
Most of the runoff in Basin 5 follows the natural contours of the basin in its route to the Bay. Along the drainage path, the water is collected in roadway piping on Ivy Avenue and other arterial roadways, and then is transported to the Bay through a 24" diameter CMP piping. The 24-inch line has a tidegate in a vault just west of Highway 101. The lower portion of the basin is affected by tides, which at times creates surcharging within the storm water system.

Present Day Problems
No problems were reported although modeling of the basin indicate that the pipe on Ivy Ave. needs upsizing to 30" PVC or equivalent pipe to adequately meet the 50-year design flows.

Future System
No development is predicted for this basin throughout the planning period.

Basin No. 6

Basin 6 is approximately 4.5 acres located to the south of Basin 5. The basin drains to the east, into the Bay. The upper portion of the basin is bound to the west by 4th Street and Basin 5 and to the south the boundary runs just south of the Lumberman's store, from which the southern boundary extends to the Bay.

Soil Type
Udorthents, (Artificial Fill)
Geisel Silt Loam

Slope
0-30%

Current Land-use
0.61 Acres Commercial
3.92 Acres Industrial

Peak Runoff
25-Year Storm: 4.4 CFS
50-Year Storm: 5.0 CFS
Future 25-Year Storm: 4.4 CFS
Future 50-Year Storm: 5.0 CFS

Existing System
Most of the runoff in Basin 6 follows the natural contours of the basin in its route to the Bay. Along the drainage path, the water is collected in 12" diameter piping on Hemlock Ave. and Highway 101. The water is then is transported to the Bay through 18" diameter CMP outfall pipe, although ODOT drawings show the section under the highway to be 18-inch concrete. The lower portion of the basin is affected by tides, which at times creates surcharging within the storm water system.

Present Day Problems
Portions of Highway 101 in this basin have historical flooded during high tide events, coinciding during times of rain. Field investigation indicates that the outfall does not have a tide gate installed. Modeling of the basin indicates that a 18" PVC outfall or equivalent is needed to meet the 50-year rainfall event.

Future System
No development is predicted for this basin throughout the planning period.

Basin No. 7

Basin 7 is approximately 22 acres located to the south of Basin 6. The basin drains to the east, into the Bay. The upper portion of the basin is bound to the west by N. 2nd Ct. and Basin 5. The southern boundary roughly follows Elm Avenue.

Soil Type
Udorthents, (Artificial Fill)
Geisel Silt Loam

Slope
0-50%

Current Land-use
5.96 Acres Commercial
8.05 Acres Industrial
8.20 Acres Small Residential

Peak Runoff
25-Year Storm: 19.8 CFS
50-Year Storm: 22.4 CFS
Future 25-Year Storm: 19.8 CFS
Future 50-Year Storm: 22.4 CFS

Existing System
Most of the runoff in Basin 7 follows the natural contours of the basin in its route to the Bay. Along the drainage path, the water is collected in roadway piping and transported towards Highway 101 and the Bay. The water is then is transported to the Bay through 18" diameter pipe of unknown material which is approximately 520 feet south of Hemlock Ave. on Highway 101 South. The lower portion of the basin is affected by tides, which at times creates surcharging within the storm water system.

Present Day Problems
Portions of Highway 101 in this basin have historical flooded during high tide events, coinciding during times of rain. Records do not indicate if a tide gate is installed on the outfall pipe. Modeling of the basin indicates that the existing 18" diameter outfall pipe 520 feet south of Hemlock Ave. on Highway 101 does not meet the 50-year rainfall event. A 24" diameter PVC or equivalent pipe should be installed to meet 50-year rainfall runoff.

Future System
No development is predicted for this basin throughout the planning period.

Basin No. 8

Basin 8 is approximately 12.3 acres bound to the north by Basin 7, Broadway to the west, and the Bay to the east. The southern boundary runs just south of Birch Avenue.

Soil Type
Udorthents, (Artificial Fill)
Geisel Silt Loam

Slope
0-10%

Current Land-use
7.29 Acres Commercial
5.02 Acres Industrial

Peak Runoff
25-Year Storm: 14.1 CFS
50-Year Storm: 15.7 CFS
Future 25-Year Storm: 14.1 CFS
Future 50-Year Storm: 15.7 CFS

Existing System
Runoff in the basin is collected along roadways in the basin, and then transported to the Bay through two outfalls. One of the outfalls is a 24" diameter pipe of unknown material that runs along Birch Ave. A tidegate shown in record drawings as located in a vault at Front Street and Birch has been removed. The other outfall is a 12" diameter pipe of unknown material that is located on Date Ave.

Present Day Problems
Records do not indicate if a tide gate is installed on either of the outfall pipes. Modeling of the basin indicate that the existing 24" diameter pipe needs to be PVC or equivalent material to meet a 50-year rainfall event. Modeling results indicate that the 12" diameter outfall on Date Ave. needs to be sized to 14" diameter PVC or equivalent to meet the 50-Year Rainfall event. The 12" diameter outfall on Date Ave. does meet the 25-year rainfall event.

Future System
No development is predicted for this basin throughout the planning period.

Basin No. 9

Basin 9 is an "L" shaped parcel of approximately 14 acres wrapping around the west and south sides of Basin 8. The boundary starts at Date Avenue and North 2nd Street and continues south following North 2nd Street to Park Avenue. At Park Avenue, the boundary jogs east to Broadway and then south again to Highland Avenue, following Highland to the Bay. Basin 9 is bound on the other borders by Basins 7 and 8 and the Bay.

Soil Type
Udorthents, (Artificial Fill)
Geisel Silt Loam

Slope
0-20%

Current Land-use
2.40 Acres Commercial
11.0 Acres Industrial
1.00 Acres Small Residential

Peak Runoff
25-Year Storm: 15.1 CFS
50-Year Storm: 16.9 CFS
Future 25-Year Storm: 15.1 CFS
Future 50-Year Storm: 16.9 CFS

Existing System
Runoff in the basin is collected along roadways in the basin, and then transported to the Bay through an 8" diameter pipe of unknown material on Alder Ave. Three outfalls were identified at Alder Avenue; although two of these may serve local and highway catch basins only.

Present Day Problems
Records do not indicate if a tide gate is installed on the outfall pipe. Modeling of the basin indicate that the existing 8" diameter pipe on Alder Ave. needs to be 12" diameter PVC pipe or equivalent to meet a 50-year rainfall event.

Future System
No development is predicted for this basin throughout the planning period.

Basin No. 10

Basin 10 is approximately 33.7 acres. The basin boundary starts at Date Avenue and North 2nd Street and runs diagonally southwest to the intersection of Telegraph Drive and Signal Way, continuing south along Telegraph Drive to the intersection with Park Avenue. From this intersection the boundary goes southeast to the intersection of 2nd and Highland, following 2nd Street to just south of Market Avenue and then continuing west to the Bay. The remaining borders are formed by Basin 9 and the Bay.

Soil Type
Wintley Silt Loam
Udorthents, (Artificial Fill)
Geisel Silt Loam

Slope
0-50%

Current Land-use
9.60 Acres Commercial
0.70 Acres Industrial
23.40 Acres Small Residential

Peak Runoff
25-Year Storm: 24.3 CFS
50-Year Storm: 27.9 CFS
Future 25-Year Storm: 24.3 CFS
Future 50-Year Storm: 27.9 CFS

Existing System
Runoff in the basin is collected along roadways in the basin, and then transported to the Bay through a 30" diameter concrete pipe to the Bay.

Present Day Problems
No problems were reported, although some of the area within the basin is located in the flood plain. Modeling of the basin indicate that the existing 30" diameter concrete pipe needs to be 30" diameter PVC pipe or equivalent to meet a 50-year rainfall event.

Future System
No development is predicted for this basin throughout the planning period.

Basin No. 10A

Basin 10A is approximately 14.4 acres bound to the north by Basin 10 and to the west by the Bay. From the Bay, the south boundary roughly follows Central Avenue to 4th Street then jogs north on 4th to north of Commercial Avenue, continuing west to 6th Street and then north to Basin 10.

Soil Type
Wintley Silt Loam
Udorthents, (Artificial Fill)
Geisel Silt Loam

Slope
0-50%

Current Land-use
14.40 Acres Commercial

Peak Runoff
25-Year Storm: 16.09 CFS
50-Year Storm: 17.89 CFS
Future 25-Year Storm: 16.09 CFS
Future 50-Year Storm: 17.89 CFS

Existing System
Pump Station 11 is located in this basin. Runoff from the western portion of this basin and from areas adjacent to 3rd Street between Curtis and Market gravity feed to this station. At low tide the system gravity feeds to the Bay through a 36-inch outfall at Tidegate 16. At high tide, the station floats activate the two pumps and pressurize the downstream portion of the gravity system. Tidegates in the discharge vault next to the station prevent the station from pressurizing the upper portions of the gravity system. The pumps are rated at 2,700 gpm each.

Present Day Problems
No problems were reported, although part the basin is located in the flood plain and flooding occurs downstream of the pump station at the intersection of Bayshore Drive and Commercial Avenue during heavy rains at high tides. Installation of backflow valves at the catch basins downstream of the pump station is recommended to prevent flooding in this area.

Future System
No development is predicted for this basin throughout the planning period.

Basin No. 11

Basin 11 is approximately 7.7 acres bound to the north by Basin 10A, the east by the Bay, and the south by Curtis.

Soil Type
Udorthents, (Artificial Fill)

Slope
0-1%

Current Land-use
6.19 Acres Commercial
1.51 Acres Industrial

Peak Runoff
25-Year Storm: 7.4 CFS
50-Year Storm: 8.3 CFS
Future 25-Year Storm: 7.4 CFS
Future 50-Year Storm: 8.3 CFS

Existing System
One 18-inch CMP outfall line, on Central Avenue, drains Broadway from Commercial to Bennett Avenues and Central from 4th Street to the Bay. There are two other outfalls within 10-feet of this outfall (Tidegate 14) that do not show on City maps. A 24-inch concrete outfall located a few feet to the north was noted as having considerably higher flows than the 18-inch line on the plans.

Present Day Problems
No problems were reported, although some of the area within the basin is located in the flood plain and Broadway floods in front of the Egyptian Theater during unusually high tides. Modeling of the basin indicates that the existing CMP pipe on Central Avenue has inadequate capacity and needs to be 18" diameter concrete pipe or equivalent to meet a 50-year rainfall event. Without pumping, this area is subject to flooding during high tide high rain events.

Future System
No development is predicted for this basin throughout the planning period.

Basin No. 12A

Basin 12A is approximately 300 acres comprising the Mingus Park Lake drainage basin. This basin does not have direct access to discharge in the Bay except through culverts. The boundaries run from 14th and Juniper to Ocean Blvd and Butler, continuing south on Ocean Blvd to Central Avenue and thence east on Central to 7th Street and directly north to Basin 9. The other boundaries are formed by Basins 4, 5, and 9. Flows from this basin are conveyed via a 42-inch diameter concrete pipe to Basin 12C, where they join the Mill Slough Box. Basin 12A has the highest potential for creating retention storage areas of all of the areas in the City Limits.

Soil Type
Templeton Silt Loam
Udorthents, (Artificial Fill)
Geisel Silt Loam

Slope
0-50%

Current Land-use
36.00 Acres Commercial
180.00 Acres Small Residential
84.00 Acres Forest/Brush

Peak Runoff
25-Year Storm: 66.9 CFS
50-Year Storm: 78.6 CFS
Future 25-Year Storm: 66.9 CFS
Future 50-Year Storm: 78.6 CFS

Existing System
Most of the storm water runoff within the basin is collected at Mingus Lake. From Mingus Lake, the water spills over the lake weir and is transported through 36" diameter piping of unknown material to the north branch of the Mill Slough Box, a 42" diameter concrete pipe at the intersection of Commercial and North 8th Street.

Present Day Problems
The lake has a history of flooding the south end of Mingus Park and a resident reported that during high tide events, the water can back up into Blossom Creek as was observed during a February 2004 high tide. The storm water modeling indicates that the existing 36" diameter pipe of unknown material exiting Mingus Lake is undersized for the 50-year storm runoff. Modeling indicates that the 36" diameter pipe of unknown material would be adequate if it was 36" diameter PVC or equivalent pipe. The 42" diameter concrete pipe should be lined with PVC to meet the 50-year storm runoff.

Future System
No development is predicted for this basin throughout the planning period.

Basin No. 12B

Basin 12B is approximately 660 acres comprising includes the upper area of Blossom Gulch. The Basin follows the ridgeline dividing the Pony Creek Watershed from the Blossom Gulch Basin on the northwest and the City Limits south of Elrod on the east. Basins 5 and 12C bind the basin to the south and east. Basin 12A forms the western boundary. Most of this basin is outside of the city limits.

Soil Type
Templeton Silt Loam
Udorthents, (Artificial Fill)
Geisel Silt Loam
Nestucca Silt Loam

Slope
0-50%

Current Land-use
28.00 Acres Small Residential
632.00 Acres Forest/Brush

Peak Runoff
25-Year Storm: 121.9 CFS
50-Year Storm: 156.7 CFS
Future 25-Year Storm: 158.8 CFS
Future 50-Year Storm: 198.5 CFS

Existing System
As storm water travels down Blossom Gulch, it enters into a 4x5 foot box culvert, the Mill Slough Box, which transports the water towards the Bay. This culvert enlarges to 8x5 foot at 7th Street, where the drainage from Mingus Lake joins the stream.

Present Day Problems
During the coincidence of high tide and rainfall, water backs up Blossom Gulch behind Blossom Gulch Elementary School. The floodplain of Blossom Gulch Creek is below the higher high tide level and subject to flooding at tides over nine feet. Damage to structures has occurred and Anderson Avenue is periodically submerged, preventing access for residents west of the city limits. While the County has dredged Blossom Gulch Creek to provide storage, the amount gained is marginal, and the stream is fish bearing, limiting the work that may be done. Field investigation indicates that water from Mingus Lake will at times flow back into Blossom Gulch during high tide events. The results of modeling the basin demonstrate that the Mill Slough Box is undersized to handle existing flows, with higher flows projected due to development.

Future System
It is estimate that approximately 141 acres of existing forest will be developed into residential housing over the next 20 years.

Basin No. 12C

Basin 12C is the basin that conveys flows from Blossom Gulch Creek and Mingus Lake to the Bay, consisting of approximately 60 acres adjacent to the path of the Mill Slough Box. The east boundary is 10th Street from Elrod to Central Avenues and 7th Street north to Telegraph Drive. Basins 9, 10, and 11 form the northwest boundary. The south border runs from 10th and Elrod east to the Bay just south of Curtis Avenue in an erratic line.

Soil Type
Wintley Silt Loam
Udorthents, (Artificial Fill)
Geisel Silt Loam

Slope
0-30%

Current Land-use
60 Acres Commercial

Peak Runoff
25-Year Storm: 53.3 CFS
50-Year Storm: 59.0 CFS
Future 25-Year Storm: 53.3 CFS
Future 50-Year Storm: 59.0 CFS

Existing System
Stream flows from Blossom Gulch Creek and storm waters from Basins 12A and 12B are transported through Basin 12C in an 8x5 foot concrete box culvert, the Mill Slough Box, built on pilings between 1915 and 1920. Storm water in Basin 12C is transported through catch basins and piping to the box culvert. The culvert discharges into the Bay through a wood tide gate at Curtis Avenue. Gravity sewers penetrate the box culvert in several places. Grouting was done in the past to seal cracks and gaps discovered when sinkholes appeared on top of the culvert.

Present Day Problems
Water visibly bypasses the tidegate and has eroded soil from under the culvert at the gate. The bypasses may be due to cracks in the concrete. While the concrete appears to be in good condition, it is within 20 years of its rated life. Field investigations at 7th Street disclosed 8 to 12 inches of gravel and sand sediment in the culvert. The storm water modeling indicates that the existing 4x5 foot and 8x5 foot Mill Slough box sections are undersized for the 50-year rainfall event with 20-year build out. The gravity sewer pipes in the culvert further restrict the capacity so that the culvert is undersized for current 50-year flows. The system has very little storage and backs flows up into the creek at high tides. Gravity sewers crossing through the culvert show signs of damage and past repairs.

Future System
No development is predicted for this basin throughout the planning period.

Basin No. 13

Basin 13 is approximately 16 acres bound to the west by 4th Street. The basin is bound to the south by the Ferguson Avenue right-of-way, the west by the Bay, the east by Highway 101, and to the north by Basin 12C. The eastern section Elrod Ave. is located in this basin.

Soil Type
Udorthents, (Artificial Fill)

Slope
0-1%

Current Land-use
13.60 Acres Commercial
2.00 Acres Industrial
0.20 Acres Brushy/Fields

Peak Runoff
25-Year Storm: 17.3 CFS
50-Year Storm: 19.2 CFS
Future 25-Year Storm: 17.3 CFS
Future 50-Year Storm: 19.2 CFS

Existing System
Catch basins within the basin collect runoff water and transport it to the outfall line that flows to the Bay. The existing outfall pipe (Outfall 11) is a 12" diameter pipe of unknown material. A wood 12-inch outfall with flow was discovered during field investigations at the location shown on City plans, but may not be the outfall on the plans. This basin had a history of flooding, but installation of a 15-inch overflow to Pump Station 15 several years ago appears to have alleviated the problem. Due to the low elevation in the basin, it is not feasible to have a gravity flow system during a rainfall event coinciding with a high tide.

Present Day Problems
Sections of Highway 101 within the basin have been noted as flooding. Modeling indicate that the existing 12" diameter outfall is undersized for the 50 year rainfall event, and should be upsized to an 18" diameter PVC or equivalent pipe. The wood outfall is in extremely poor shape, is packed with gravel, and is missing a tidegate.

Future System
No development is predicted for this basin throughout the planning period.

Basin No. 14

Basin 14 is approximately 124 acres bound to the north and west by Basins 12B, 12C and 13. The south boundary starts at Basin 12B and roughly follows Ingersoll Avenue to 5th Street, turning south to follow 5th to Kruse, continuing east to 4th and following 4th north to Hall Avenue. The boundary continues east on Hall to Highway 101 and then angles southeast to the intersection of Coalbank and Isthmus Sloughs. The west boundary is the Bay. The high school, historic 5th Street neighborhood, and the area between Golden and Hall Avenues are in this basin.

Soil Type
Templeton Silt Loam
Udorthents, (Artificial Fill)
Wintley Silt Loam

Slope
0-30%

Current Land-use
36.00 Acres Commercial
7.00 Acres Industrial
33.00 Acres Small Residential
27.00 Acres Forest
20.80 Acres Grassy Fields

Peak Runoff
25-Year Storm: 50.1 CFS
50-Year Storm: 58.7 CFS
Future 25-Year Storm: 59.3 CFS
Future 50-Year Storm: 68.6 CFS

Existing System
Catch basins within the basin collect runoff water and transport it to the outfall line that flows to the Bay. The existing outfall on Golden Ave is a 36" diameter concrete pipe. Due to the low elevation in the basin, it is not feasible to have a gravity flow system during a rainfall event coinciding with a high tide. A tidegate is located at the intersection of Golden and Bayshore Drive.

Present Day Problems
Sections of Highway 101 within the basin and 2nd Street south of Golden Avenue flooded during the time of this study at high tides. Elevation maps indicate that this basin has little to no storage for storm water. Fill placed in the 1980's at Golden Field buried the storm water lines and manholes to an inaccessible depth for maintenance, new connections, or inspection.

Future System
It is estimated that approximately 27 acres of existing forest will be developed into residential housing over the next 20 years.

Basin No. 15

Basin 15 is approximately 74 acres that is bound to the north and west by Basin 14. The basin is bound to the south by Kruse Avenue and Highway 101. Coalbank Slough serves as the eastern boundary of the basin. The Fred Meyers and Safeway stores are located in this basin.

Soil Type
Templeton Silt Loam
Udorthents, (Artificial Fill)

Slope
0-7%

Current Land-use
68.10 Acres Commercial
2.40 Acres Industrial
3.52 Acres Small Residential

Peak Runoff
25-Year Storm: 68.3 CFS
50-Year Storm: 75.7 CFS
Future 25-Year Storm: 68.3 CFS
Future 50-Year Storm: 75.7 CFS

Existing System
Catch basins within the basin collect runoff water from the roadways and commercial lots and transport it to the outfall line that flows to the Bay. The existing outfall pipe on Johnson Ave. is a 42" diameter pipe of unknown material. Pump Station Number 15 is located approximately 150 feet east of the Johnson Avenue and Front Street intersection. The pump station is equipped with 3 pumps. The two smaller pumps have a design capacity of 4,350 gpm each and the larger pump has an estimated capacity of 11,000 gpm. Catch basins on Highway 101 northbound (Bayshore Drive and 1st Street) between Curtis and Johnson are piped to this station from Basins 13 and 14.

Present Day Problems
Sections of Highway 101 within the basin and the west Fred Meyer parking lot have been noted as flooding. Elevation maps indicate that this basin has little to no storage for storm water. The discharge vault of the pump station leaks where the frame meets the pavement.

Future System
No development is predicted for this basin throughout the planning period.

Basin No. 16

Basin 16 is approximately 29 acres that is bound to the north by Basin 15, and the west by the west side of 2nd Street. The basin is bound to the south and east by Coalbank Slough.

Soil Type
Udorthents, (Artificial Fill)

Slope
0-1%

Current Land-use
11.75 Acres Commercial
17.25 Acres Industrial

Peak Runoff
25-Year Storm: 24.1 CFS
50-Year Storm: 26.9 CFS
Future 25-Year Storm: 24.1 CFS
Future 50-Year Storm: 26.9 CFS

Existing System
Catch basins within the basin collect runoff water from the roadways and commercial lots and transport it to the outfall lines that flow to the Bay. Currently there are four outfall lines within the basin. A 12" diameter PVC line is located at S. 2nd St., and a 24" diameter HDPE pipe along Broadway, a 24" diameter HDPE pipe at S. 1st St., and a 12" diameter CMP line is located at Front Street. Due to the low elevation in the southeast sections of the basin, it is not feasible to have a gravity flow system during a rainfall event coinciding with a high tide. All outfalls have tidegates. The basins at Front Street and at 1st Street have sediment basins.

Present Day Problems
No problems were reported, although some of the area has elevations in the 9-foot range. Personnel at Les's Sanitary report flooding problems due to tidegates becoming fouled with debris, stating that they regularly clean debris from the gates. The sediment basins are plugged with accumulated sediment and debris.

Future System
Some of the existing commercial buildings may be removed and replaced with new commercial development and paving. No changes to the basic land-use are expected.

Basin No. 17

Basin 17 is approximately 132 acres that is bound to the north by Basin 14 at Ingersoll Avenue, and the east by Basins 14 and 16. Coalbank Slough forms part of the south boundary. The west boundary starts at Coalbank Slough and 9th Street and goes north to Lockhart Avenue. From 9th and Lockhart the boundary angles west-northwest to Basin 12B.

Soil Type
Templeton Silt Loam
Udorthents, (Artificial Fill)

Slope
0-30%

Current Land-use
31.00 Acres Commercial
6.25 Acres Industrial
44.00 Acres Small Residential
51.00 Acres Forest

Peak Runoff
25-Year Storm: 77.9 CFS
50-Year Storm: 90.2 CFS
Future 25-Year Storm: 122.4 CFS
Future 50-Year Storm: 136.9 CFS

Existing System
Storm water runoff in Basin 17 is transported to the Bay through two main outfall pipes. One of the pipes, a 24" diameter CMP pipe serves the northeast section of the basin, and a 36" diameter CMP pipe serves the rest of the basin. Both of the outfalls follow S. 5th St. on their route to the Bay. The 36" diameter pipe picks up a small creek that flows through the drainage. The 24" diameter pipe currently only collects water from the residential area in the northeast section of the basin, along Johnson from 9th to 5th Street. An additional 12-inch outfall serves catch basins at 7th and Lockhart Avenue. All of the lines have tidegates.

Present Day Problems
The tidegate located at 7th and Kruse is undersized and of a poor configuration for maintenance. Salt water has flooding yards north of the gate.

Future System
It is estimated that approximately 51 acres of existing forest will be developed into residential housing over the next 20 years.

Basin No. 18

Basin 18 is approximately 73 acres that is bound to the north and east by Basin 17, and the west by Basin 12B. The south boundary starts at Dakota Avenue and Coalbank Slough, following Dakota west to 13th Street, then 13th north to Minnesota Avenue and from there roughly northwest to Basin 12B.

Soil Type
Templeton Silt Loam
Udorthents, (Artificial Fill)
Langlois Silty Clay Loam

Slope
0-50%

Current Land-use
3.50 Acres Commercial
21.00 Small Residential
51.00 Forest/Brushy

Peak Runoff
25-Year Storm: 32.3 CFS
50-Year Storm: 39 CFS
Future 25-Year Storm: 75 CFS
Future 50-Year Storm: 84.1 CFS

Existing System
As runoff storm water travels from the upper-forested areas of the basin, the storm water is collected by catch basins along Minnesota Ave. and Southwest Blvd. The storm water is transported along Southwest Blvd. through a 15" diameter pipe of unknown material to the outfall at Tidegate 1.

Present Day Problems
Flooding was reported on the south side of Minnesota, east of S. 12th Street and on the north side of Minnesota, west of S. 13th Street.

Future System
It is estimate that approximately 51 acres of existing forest will be developed into residential housing over the next 20 years.

Basin No. 19

Basin 19 is approximately 103 acres that is bound to the north by Basins 18 and 12B. The ridgeline at the top of the hill forms the western boundary for the basin, and Basins 20 and 22 form the southern boundaries. The basin is bound to the east by Coalbank Slough. The south boundary runs from the slough, parallel to and north of Washington Avenue, to 20th Street and California Avenue and then follows California to Basin 12B.

Soil Type
Templeton Silt Loam
Udorthents, (Artificial Fill)
Langlois Silty Clay Loam

Slope
0-50%

Current Land-use
6.5 Acres Commercial
44 Acres Small Residential
52.5 Acres Forest

Peak Runoff
25-Year Storm: 36.4 CFS
50-Year Storm: 44.6 CFS
Future 25-Year Storm: 58.7 CFS
Future 50-Year Storm: 68.2 CFS

Existing System
As runoff storm water travels from the upper-forested areas of the basin, the storm water collects in the marshy areas along Southwest Blvd. If the tide is high, the water is stored until low tide, and during low tide, the water drains to the Bay. Water from Basin 18 is also stored in the marshy lowland areas during high tide because Basin 18's inlet pipe is behind the tide gate. The storm water is transported to the Bay through a 42" CPM pipe. The pipe does have a tide gate.

Present Day Problems
Dakota Avenue has been reported as a flooding area. The 42" diameter outfall pipe on Dakota Avenue has failed, and tidewater flows freely into the basin. Much of the basin is too low to promote a gravity system capable of meeting the 50-year storm runoff without flooding. A 48" diameter PVC outfall pipe is needed to meet the 50-year storm water runoff event.

Future System
It is estimate that approximately 28 acres of existing forest will be developed into residential housing over the next 20 years.

Basin No. 20

Basin 20 is approximately 35 acres that is bound to the north by Basin 19. From the southeast corner of Basin 19, the boundary follows Coalbank Slough south to Oregon Avenue and then continues south along Southwest Boulevard to Idaho Avenue. The boundary then turns west along Idaho, jumping to the north at 15th Street and continuing west midway between California and Idaho Avenues to 16th Street. The boundary then runs roughly north to 17th Street and the boundary with Basin 19.

Soil Type
Templeton Silt Loam

Slope
0-30%

Current Land-use
35.00 Acres Small Residential

Peak Runoff
25-Year Storm: 35.8 CFS
50-Year Storm: 40.1 CFS
Future 25-Year Storm: 35.8 CFS
Future 50-Year Storm: 40.1 CFS

Existing System
Runoff from the basin travels along natural drainage courses and roadways within the basin area. As water travels along California, Oregon, and Washington Avenues, it is collected in catch basins, and distributed downstream to an outfall pipe that is located approximately 125 feet north of the Southwest Blvd. and Oregon St. intersection. The outfall pipe is 24" diameter pipe of unknown material. No tide gate is needed due to the elevation of the outfall invert.

Present Day Problems
A broken pipe at the outfall, a sinkhole, and property damage was reported for this basin. Modeling of the basin indicates that the outfall piping should be increased to meet 50-year storm water runoff events. The pipe would need an equivalent diameter of 30" PVC pipe or equivalent.

Future System
No development is predicted for this basin throughout the planning period.

Basin No. 21

Basin 21 is approximately 2.5 acres that is bound to the north by Basin 20, and the south and west by Basin 22. This basin also drains to the Coalbank Slough.

Soil Type
Templeton Silt Loam

Slope
0-30%

Current Land-use
2.53 Acres Small Residential

Peak Runoff
25-Year Storm: 1.8 CFS
50-Year Storm: 2.1 CFS
Future 25-Year Storm: 1.8 CFS
Future 50-Year Storm: 2.1 CFS

Existing System
The runoff from this basin flows along Southwest Blvd., where it then crosses the roadway, and is diverted through natural drainage courses towards the Bay. The existing outfall pipe is 8" diameter pipe of unknown material.

Present Day Problems
No problems were reported for this basin.

Future System
No development is predicted for this basin throughout the planning period.

Basin No. 22

Basin 22 is approximately 105 acres that is bound to the north by Basins 19, 20, and 21. Southwest Boulevard forms the east boundary and the mountain ridgeline forms the western boundary of Basin 22. The south boundary runs from Southwest Boulevard, just south of Illinois Avenue, wraps around the north side of Englewood School, and ends at the ridgeline north of Pennsylvania Avenue.

Soil Type
Templeton Silt Loam
Langlois Silty Clay Loam

Slope
0-30%

Current Land-use
50.00 Acres Residential
55.00 Acres Forest

Peak Runoff
25-Year Storm: 36.5 CFS
50-Year Storm: 44.6 CFS
Future 25-Year Storm: 36.5 CFS
Future 50-Year Storm: 44.6 CFS

Existing System
This basin is the drainage basin for Middle Creek, draining to the east through a 48-inch culvert under Southwest Boulevard into a drainage ditch system in the reclaimed tidal lands currently used as pasturage. Two outfalls with tidegates at the dike on Coalbank Slough control drainage from the ditch system. These tidegates are located outside the City limits and are maintained by the Englewood Diking District.

Present Day Problems
Flooding problems for properties bordering Middle Creek, between Montana and Illinois Avenues were reported. These properties are below the high tide line and flood when water tops the dike along Coalbank Slough. The City has installed tidegates at the creek for three individual properties.

Future System
No development is predicted for this basin throughout the planning period.

Basin No. 23

Basin 23 is approximately 16 acres that is bound to the north by Basin 22 and includes the area surrounding the paved portion of Pennsylvania Avenue. The south boundary starts at Pennsylvania and Southwest Boulevard and angles southwest to 17th Street and Iowa Avenue, then heading northwest back to Pennsylvania at 19th Street.

Soil Type
Templeton Silt Loam
Langlois Silty Clay Loam

Slope
0-30%

Current Land-use
8.00 Acres Residential
8.00 Acres Forest

Peak Runoff
25-Year Storm: 7.0 CFS
50-Year Storm: 8.5 CFS
Future 25-Year Storm: 7.0 CFS
Future 50-Year Storm: 8.5 CFS

Existing System
The runoff from this basin flows along Southwest Blvd., where it then crosses the roadway, and is diverted through natural drainage courses towards Coalbank Slough. The existing outfall pipe is 8" diameter pipe of unknown material.

Present Day Problems
There is flooding on Southwest Boulevard frequently due to plugging of this catch basin and the undersized culvert.

Future System
No development is predicted for this basin throughout the planning period.

Basin No. 24

Basin 24 is approximately 29 acres and is the southernmost basin in the study area. Basins 22 and 23 bind the basin to the north and east. The west boundary runs about 300 feet to the west of 21st Street. The south boundary runs from 21st Street to Libby Lane.

Soil Type
Templeton Silt Loam

Slope
0-50%

Current Land-use
11.78 Acres Large Lot Residential
11.22 Acres Small Lot Residential
6.00 Acres Forest

Peak Runoff
25-Year Storm: 13.0 CFS
50-Year Storm: 15.6 CFS
Future 25-Year Storm: 13.0 CFS
Future 50-Year Storm: 15.6 CFS

Existing System
The storm water runoff follows natural contours and drainage ways within the basin.

Present Day Problems
No problems were reported for this basin.

Future System
No development is predicted for this basin throughout the planning period.

Basin No. 25

Basin 25 is approximately 128 acres. The boundary runs west from the Water Board on Ocean Boulevard to Cottonwood Avenue, following Cottonwood east to Juniper, and Juniper east to 14th Street. The boundary continues north on 14th Street to Pine Avenue and then angles northwest to 15th Street south of Teakwood, from which point it follows the south border of Bay Area Hospital then turns north to Kinney Road. The remaining boundaries are comprised of the boundary of the study area. The Hospital branch of Pony Creek flows north through this basin.

Soil Type
Geisel Silt Loam
Templeton Silt Loam
Bullards Sandy Loam

Slope
0-50%

Current Land-use
26.00 Acres Commercial
30.00 Acres Small Lot Residential
72.00 Acres Forest

Peak Runoff
25-Year Storm: 48.4 CFS
50-Year Storm: 58.0 CFS
Future 25-Year Storm: 48.4 CFS
Future 50-Year Storm: 58.0 CFS

Existing System
The storm water runoff follows natural contours and drainage ways within the basin and eventually collects in a gulley that crosses Kinney Rd. There is a 36" diameter CMP culvert which transitions into a 42" diameter CMP culvert under Kinney Rd.

Present Day Problems
No problems were reported for this basin. Modeling of the basin indicate that the existing culvert under Kinney road needs to be upgraded to a 36" diameter PVC or equivalent pipe to meet the 50-year rainfall event. Field investigation revealed that the culvert is partially filled with sediment, and is deformed at its northern end.

Future System
It is estimated that approximately 56 acres of existing forest will be developed into medical/commercial area over the next 20 years.

Basin No. 26

Basin 26 is approximately 69 acres bound to the south and west by Basin 25. The east boundary starts at Pine Street, approximately 130 feet east of 14th Street and runs north paralleling 14th to the north study area boundary north of Yew Avenue.

Soil Type
Bandon Sandy Loam
Geisel Silt Loam
Bullards Sandy Loam

Slope
0-12%

Current Land-use
11.50 Acres Commercial
43.00 Acres Small Lot Residential
14.50 Acres Forest/Brushy

Peak Runoff
25-Year Storm: 38.3 CFS
50-Year Storm: 44.9 CFS
Future 25-Year Storm: 51.4 CFS
Future 50-Year Storm: 58.8 CFS

Existing System
The storm water runoff follows natural contours and drainage ways within the basin until it reaches Thompson Rd. There is an n 18" diameter pipe of unknown material that transitions into a 21" diameter pipe of unknown material that transports the water down Thompson Rd. to the Kinney Rd culvert crossing in Basin 25.

Present Day Problems
No problems were reported for this basin. Modeling of the basin indicate that the 21" diameter pipe that enters into the Kinney Rd. crossing should be upgraded to a 21" diameter PVC pipe or equivalent.

Future System
It is estimated that approximately 15 acres of existing forest will be developed into medical/commercial area over the next 20 years.

Basin No. 27

Basin 27 is approximately 25 acres bound to the south by Basin 2. The basin is bound to the east by Basin 1, and to the North by the study boundary. Basin 26 forms the western edge of the boundary.

Soil Type
Geisel Silt Loam
Bullards Sandy Loam

Slope
0-12%

Current Land-use
25.00 Acres Small Lot Residential

Peak Runoff
25-Year Storm: 10.45 CFS
50-Year Storm: 12.81 CFS
Future 25-Year Storm: 10.45 CFS
Future 50-Year Storm: 12.81 CFS

Existing System
Approximately 6.4 acres of Basin 27 flows onto Thompson Rd. where it is collected in catch basins and transported to a natural gulley on the north side of Thompson Rd. The pipe is a 12" diameter pipe of unknown material. The remaining acreage within the basin follows natural drainage courses and contours of the basin.

Present Day Problems
No problems were reported for this basin. Modeling of the basin indicate that the 12" diameter pipe along Thompson Rd. should be increased to a 18" diameter PVC pipe or equivalent sized pipe to meet the 50-year rainfall event.

Future System
No development is predicted for this basin throughout the planning period.

Recommended Plan

Section 7

Section 7

Recommended Plan

7.1 Proposed Storm Drain Improvements

With the use of the hydraulic storm model and city staff input, a recommended improvement plan has been established for the City of Coos Bay Storm water system. This section contains the costs for each recommended project, the division of the financial responsibilities between city and development, and the priority of each project.

A number of outfalls and tidegates were discovered during site investigations that are not listed in current City records, many of them in poor condition. These outfalls and tidegates may be part of the City system, privately installed, old abandoned lines, or part of the ODOT drainage system for Highway 101. Projects were not developed for these outfalls and tidegates due to lack of information, however their condition is noted here and recommendations are made for follow up investigations that are outside the scope of this study.

A number of factors were considered in developing projects. In general the remediation measures included use of PVC or HDPE pipe in place of CMP to avoid future problems with corrosion. Lining or directional drilling were used where possible to install lines under the Central Oregon Pacific Railroad (CORP) lines and under Highway 101 to avoid problems associated with open trench construction in the right-of-ways. Duckbill tidegates are used in cost estimates due to the higher reliability and lower maintenance cost associated with this type of gate.

Projects in areas where the storm drain system currently has adequate capacity for a 50-year storm, but inadequate future capacity are rated Priority 3. Projects in areas where the system is currently at capacity or in poor condition, but no damage due to flooding problems have been reported, are generally rated as Priority 2. Projects in areas where there is currently flooding that affects structures or the use of the property, the system is significantly undersized for current flows, or where tidegates or piping are missing or non-operable are rated as Priority 1.

A map showing the location of individual projects is included in Appendix A. Projects are described below:

BASIN 1

Project 1-1 is recommended for Basin 1. The project includes replacing approximately 430 feet of 18" concrete piping with 18" PVC piping on Teakwood Avenue from N. 8th Street to Outfall 26 to improve system capacity. Approximately 90 feet of pipe replacement would be through pipe bursting to minimize affects on Highway 101 and CORP right-of-ways. This project is recommended as a Priority 3 Project. A project cost estimate is located below in Table 7.1.1.

TABLE 7.1.1
PROJECT 1-1 COST ESTIMATE

Item	Description	Units	No. Units	Unit Cost	Subtotal
1	Const. Fac. & Temp. Controls	LS	1	$5,000	$5,000
2	Demolition and Site Preparation	LS	1	$3,000	$3,000
3	18" Storm Drain Piping-Class C Backfill	LF	340	$50	$17,000
4	18" Storm Drain-Pipe Bursting	LF	90	$115	$10,350
6	Catch Basin	EA	3	$1,000	$3,000
7	AC R&R	LF	100	$20	$2,000
8	Rip Rap	TON	20	$50	$1,000
9	Misc. Appurtenances	LS	1	$6,470	$6,670

Project Subtotal	***$48,020***
Contingency	***$7,350***
Engineering	***$9,800***
Legal Admin.	***$1,440***
Permitting	***$4,000***
Project Total	***$70,610***

Notes: 1) Permits required from ODOT, CORP, and COE
2) Tidegate not required

Additional Outfall Problems for Basin 1

Outfall 26A just north of Teakwood is a 12-inch CMP pipe in poor condition with visible flow. Recommend dye-testing catch basins above this outfall to determine if it is tied to the storm drain system. If so, this outfall is recommended for lining under the highway and replacement on the Bay side.

Outfall 26B, approximately 175 feet north of Teakwood is a 15-inch CMP pipe in poor condition with visible flow. Recommend dye-testing catch basins above this outfall to determine if it is tied to the storm drain system. If so, this outfall is recommended for lining under the highway, and extension to below the high tide line.

Tidegate 27, located directly across from the tank farm, is a 24-inch gate in a concrete headwall with significant flow. Recommend dye testing catch basins above this outfall and at the tank farm to determine if it is tied to the storm drain system. If so, this outfall is recommended for lining under the highway, replacement on the Bay side and rehabilitation of the existing tidegate.

BASIN 2

Capital improvement Project No. 2-1 is recommended for this area. Project 2-1 involves replacement of the existing 18-inch storm drain and 24-inch outfall from 6th Street to Tidegate 24 along Pine Avenue. The new work would consist of approximately 235 lineal feet of PVC 18-inch storm drain and pipe bursting 115 lineal feet of existing 24-inch pipe with a 24-inch HDPE replacement. A new duckbill style tidegate would be installed. This project is recommended as a Priority 3 Project. A project cost estimate is located below in Table 7.1.2.

TABLE 7.1.2
PROJECT 2-1 COST ESTIMATE

Item	Description	Units	No. Units	Unit Cost	Subtotal
1	Const. Fac. & Temp. Controls	LS	1	$7,340	$7,340
2	Demolition and Site Preparation	LS	1	$4,410	$4,410
3	18" Storm Drain Piping-Class C Backfill	LF	235	$50	$11,750
4	24" Storm Drain-Pipe Bursting	LF	115	$145	$16,675
5	Tidegate-24"	EA	1	$8,000	$8,000
6	Manhole-Standard	EA	1	$4,000	$4,000
7	Catch Basin	EA	3	$1,000	$3,000
8	AC R&R	LF	235	$20	$4,700
9	Rip Rap	TON	20	$50	$1,000
10	Misc. Appurtenances	LS	1	$9,625	$9,625

Project Subtotal	***$70,500***
Contingency	***$10,580***
Engineering	***$14,100***
Legal Admin.	***$2,120***
Permitting	***$4,000***
Project Total	***$101,300***

Notes: 1) Permits required from ODOT, CORP, and COE

Additional Outfall Problems for Basin 2

Outfall 24A just north of Pine Avenue is a 12-inch CMP pipe in poor condition. Recommend dye-testing catch basins above this outfall to determine if it is tied to the storm drain system. If so, this outfall is recommended for lining under the highway and replacement on the Bay side.

BASIN 3

Project 3-1 is recommended for this area. This project involves lining the existing 130 feet of 15-inch storm line under Highway 101 at Myrtle Avenue, replacing 10 feet of 15-inch CMP with PVC pipe of a similar size on the Bay side, and refurbishing and reinstalling the existing tidegate. This project is recommended as a Priority 3 Project. A project cost estimate is located below in Table 7.1.3.

TABLE 7.1.3
PROJECT 3-1 COST ESTIMATE

Item	Description	Units	No. Units	Unit Cost	Subtotal
1	Const. Fac. & Temp. Controls	LS	1	$16,760	$16,760
2	Demolition and Site Preparation	LS	1	$10,780	$10,780
3	15" Storm Drain Piping-Class C Backfill	LF	10	$40	$400
4	15" CMP Lining	LF	130	$80	$10,400
5	Refurbishing of Existing Tidegate	LS	1	$500	$500
6	Concrete Headwall	EA	1	$8,000	$8,000
7	AC R&R	LF	20	$20	$400
8	Rip Rap	TON	30	$50	$1,500
9	Misc. Appurtenances	LS	1	$3,940	$3,940

Project Subtotal	***$52,680***
Contingency	***$7,900***
Engineering	***$10,540***
Legal Admin.	***$1,580***
Permitting	***$4,000***
Project Total	***$76,700***

Additional Outfall Problems for Basin 3

Outfall 23A is a 12-inch concrete outfall located just north of Myrtle Avenue. This outfall is semi-buried but otherwise is in good condition. Recommend dye-testing catch basins above this outfall to determine if it is tied to the storm drain system. If so, recommend cleaning line.

BASIN 4

Capital improvement Project No. 4-1 is recommended for this area. This project involves separation of the storm water system from the wastewater plant effluent outfall. This project is rated as a Priority 2 Project. A project cost estimate is located below in Table 7.1.4.

TABLE 7.1.4
PROJECT 4-1 COST ESTIMATE

Item	Description	Units	No. Units	Unit Cost	Subtotal
1	Const. Fac. & Temp. Controls	LS	1	$24,349	$24,349
2	Demolition and Site Preparation	LS	1	$13,590	$13,590
3	36" Storm Drain Piping-Class C Backfill	LF	500	$130	$72,500
4	Highway Crossing	LF	150	$250	$37,500
5	Tidegate36"	EA	1	$12,000	$16,000
6	Manhole-Standard	EA	4	$4,000	$16,000
7	Catch Basin	EA	4	$1,000	$4,000
8	Concrete Headwall	EA	1	$8,000	$8,000
9	AC R&R	LF	100	$20	$2,000
10	Rip Rap	TON	30	$50	$1,500
11	Misc. Appurtenances	LS	1	$23,700	$23,700

Project Subtotal	***$219,140***
Contingency	***$32,880***
Engineering	***$43,830***
Legal Admin.	***$6,570***
Permitting	***$4,000***
Project Total	***$306,420***

Notes: 1) Permits required from ODOT, CORP, DEQ, and COE

BASIN 5

Projects 5-1 and 5-2 are recommended for this basin. Project 5-1 includes the replacement of the existing 24-inch CMP outfall with approximately 290 feet of PVC and HDPE 30-inch pipe from the existing tidebox on Ivy Avenue east to the Bay. The section under Highway 101 and the railroad would be installed by pipe bursting the existing pipe to avoid open cuts in the right-of-ways. This project is recommended as a Priority 2 project. A project cost estimate is located below in Table 7.1.5.

TABLE 7.1.5
PROJECT 5-1 COST ESTIMATE

Item	Description	Units	No. Units	Unit Cost	Subtotal
1	Const. Fac. & Temp. Controls	LS	1	$8,660	$8,660
2	Demolition and Site Preparation	LS	1	$5,200	$5,200
3	30" Storm Drain Piping-Class C Backfill	LF	190	$110	$20,900
4	30" Storm Drain-Pipe Bursting	LF	100	$200	$20,000
5	New Tidegate	EA	1	$10,000	$10,000
6	Manhole-Standard	EA	1	$4,000	$4,000
7	AC R&R	LF	100	$20	$2,000
8	Rip Rap	TON	20	$50	$1,000
9	Misc. Appurtenances	LS	1	$11,380	$11,380

Project Subtotal	***$83,140***
Contingency	***$12,500***
Engineering	***$16,700***
Legal Admin.	***$2,500***
Permitting	***$4,000***
Project Total	***$118,840***

Notes: 1) Permits required from ODOT, CORP, and COE

Project 5-2 involves replacing approximately 520 feet of existing 15-inch storm drain with 18-inch PVC to provide increased capacity for future flows by trench excavation from the tidebox on Ivy Avenue west to North 7th Street. This project is recommended as a Priority 3 Project. A project cost estimate is located in Table 7.1.6.

TABLE 7.1.6
PROJECT 5-2 COST ESTIMATE

Item	Description	Units	No. Units	Unit Cost	Subtotal
1	Const. Fac. & Temp. Controls	LS	1	$7,710	$7,710
2	Demolition and Site Preparation	LS	1	$4,630	$4,630
3	18" Storm Drain Piping-Class C Backfill	LF	520	$50	$26,000
4	Manhole-Standard	EA	4	$4,000	$16,000
5	Catch Basin	EA	2	$1,000	$2,000
6	AC R&R	LF	370	$20	$7,400
7	Misc. Appurtenances	LS	1	$10,280	$10,280

Project Subtotal	***$74,020***
Contingency	***$11,100***
Engineering	***$14,800***
Legal Admin.	***$2,220***
Permitting	***$4,000***
Project Total	***$106,140***

BASIN 6

Project 6-1 is recommended for this basin. This project involves replacing approximately 430 lineal feet of existing 18-inch storm drain pipe with 18-inch PVC from Hemlock and Highway 101 to Outfall 18D in the Bay to increase the capacity of the system. Approximately 80 feet of pipe would be replaced through pipe bursting to avoid open cut trenches in the right-of-ways for Highway 101 and CORP. A tidegate would be installed at the outfall. This project is recommended as a Priority 2 project. A project cost estimate is located in Table 7.1.7.

TABLE 7.1.7
PROJECT 6-1 COST ESTIMATE

Item	Description	Units	No. Units	Unit Cost	Subtotal
1	Const. Fac. & Temp. Controls	LS	1	$5,430	$5,430
2	Demolition and Site Preparation	LS	1	$3,260	$3,260
3	18" Storm Drain Piping-Class C Backfill	LF	340	$50	$17,000
4	18" Storm Drain-Pipe Bursting	LF	90	$115	$10,350
5	Tidegate-18"	EA	1	$5,000	$5,000
6	Catch Basin	EA	1	$1,000	$1,000
7	AC R&R	LF	100	$20	$2,000
8	Rip Rap	TON	20	$50	$1,000
9	Misc. Appurtenances	LS	1	$7,070	$7,070

Project Subtotal	***$52,110***
Contingency	***$7,820***
Engineering	***$10,420***
Legal Admin.	***$1,560***
Permitting	***$4,000***
Project Total	***$75,910***

Notes: 1) Permits required from ODOT, CORP, and COE

BASIN 7

Capital improvement Projects No. 7-1 and 7-2 are recommended for this area. Project 7-1 consists of replacing the existing 18-inch storm drain outfall line, located to the south of Lumbermen's store, from Highway 101 to the Bay with approximately 330 lineal feet of 24-inch PVC and HDPE pipe to improve capacity. Approximately 100 feet of pipe would be replaced through pipe bursting to avoid open cut trenches in the right-of –ways for Highway 101 and CORP. A tidegate would be installed at the outfall. This project is recommended as a Priority 2 project. A project cost estimate is located in Table 7.1.8.

TABLE 7.1.8
PROJECT 7-1 COST ESTIMATE

Item	Description	Units	No. Units	Unit Cost	Subtotal
1	Const. Fac. & Temp. Controls	LS	1	$7,200	$7,200
2	Demolition and Site Preparation	LS	1	$4,320	$4,320
3	24" Storm Drain Piping-Class C Backfill	LF	230	$90	$20,700
4	24" Storm Drain-Pipe Bursting	LF	100	$145	$14,500
5	Tidegate-24"	EA	1	$8,000	$8,000
6	Catch Basin	EA	1	$1,000	$1,000
7	AC R&R	LF	150	$20	$3,000
8	Rip Rap	TON	20	$50	$1,000
9	Misc. Appurtenances	LS	1	$9,440	$9,440

Project Subtotal	***$69,160***
Contingency	***$10,370***
Engineering	***$13,830***
Legal Admin.	***$2,080***
Permitting	***$4,000***
Project Total	***$99,440***

Notes: 1) Permits required from ODOT, CORP, and COE

Project 7-2 consists of upsizing the existing 10" pipes within the basin to 12" diameter to improve capacity. This project is recommended as a Priority 3 project. A project cost estimate is located in Table 7.1.9.

TABLE 7.1.9
PROJECT 7-2 COST ESTIMATE

Item	Description	Units	No. Units	Unit Cost	Subtotal
1	Const. Fac. & Temp. Controls	LS	1	$6,680	$6,680
2	Demolition and Site Preparation	LS	1	$4,010	$4,010
3	12" Storm Drain Piping-Class C Backfill	LF	1085	$30	$32,550
4	Catch Basin	EA	2	$1,000	$2,000
5	AC R&R	LF	500	$20	$10,000
6	Misc. Appurtenances	LS	1	$8,910	$8,910

Project Subtotal	***$64,150***
Contingency	***$9,620***
Engineering	***$12,830***
Legal Admin.	***$1,920***
Permitting	***$4,000***
Project Total	***$92,520***

BASIN 8

Capital improvement Projects No. 8-1 and 8-2 are recommended for this area. Project 8-1 consists of replacing the existing outfall piping at Date Avenue with 12-inch PVC by pipe bursting and then installing a tidegate. This project is recommended as a Priority 3 project. A project cost estimate is located in Table 7.1.10.

TABLE 7.1.10
PROJECT 8-1 COST ESTIMATE

Item	Description	Units	No. Units	Unit Cost	Subtotal
1	Const. Fac. & Temp. Controls	LS	1	$3,410	$3,410
2	Demolition and Site Preparation	LS	1	$2,050	$2,050
3	12" Storm Drain-Pipe Bursting	LF	120	$75	$14,400
4	Tidegate-12"	EA	1	$3,500	$3,500
5	Manhole-Standard	EA	1	$4,000	$4,000
6	Rip Rap	TON	20	$50	$1,000
7	Misc. Appurtenances	LS	1	$4,380	$4,380

Project Subtotal	***$32,740***
Contingency	***$4,910***
Engineering	***$6,550***
Legal Admin.	***$980***
Permitting	***$4,000***
Project Total	***$49,180***

Notes: 1) Permits required from ODOT, CORP, and COE

Project 8-2 consists of replacing the existing 24-inch outfall at Birch Avenue and approximately 200 lineal feet of 12-inch by 16-inch box culvert with 24-inch PVC to improve capacity. This project is recommended as a Priority 2 project. A project cost estimate is located in Table 7.1.11.

Additional Outfall Problems for Basin 3

Outfall 17D, located just south of Birch, is not listed on the City plans, but is at an elevation that may require a tidegate. Recommend dye testing to verify which portions of the storm drains are connected to this outfall.

TABLE 7.1.11
PROJECT 8-2 COST ESTIMATE

Item	Description	Units	No. Units	Unit Cost	Subtotal
1	Const. Fac. & Temp. Controls	LS	1	$9,620	$9,620
2	Demolition and Site Preparation	LS	1	$5,770	$5,770
3	24" Storm Drain Piping-Class C Backfill	LF	430	$90	$38,700
4	Tidegate-24"	EA	1	$8,000	$8,000
5	Manhole-Standard	EA	2	$4,000	$8,000
6	AC R&R	LF	430	$20	$8,600
7	Rip Rap	TON	20	$50	$1,000
8	Misc. Appurtenances	LS	1	$12,660	$12,660

Project Subtotal	***$92,350***
Contingency	***$13,850***
Engineering	***$18,470***
Legal Admin.	***$2,770***
Permitting	***$4,000***
Project Total	***$131,440***

Notes: 1) Permits required from ODOT, CORP, and COE

BASIN 9

Capital improvement Project No. 9-1 is recommended for this area. Project 9-1 includes replacing the existing 12-inch outfall at Alder Avenue and 8-inch storm drain line servicing this basin with 12-inch PVC to increase capacity. This project is recommended as a Priority 1 project. A project cost estimate is located in Table 7.1.12.

Additional Outfall Problems for Basin 3

Outfalls 17A and 17C, located just north of Alder Avenue, are in an area where the ground elevation is below the higher high tide line. These outfalls may be a source of tidal water backflowing in the storm system. Recommend dye testing the system to verify elevations and configuration of drainage sources to verify if these outfalls require tidegates.

TABLE 7.1.12
PROJECT 9-1 COST ESTIMATE

Item	Description	Units	No. Units	Unit Cost	Subtotal
1	Const. Fac. & Temp. Controls	LS	1	$7,030	$7,030
2	Demolition and Site Preparation	LS	1	$4,220	$4,220
3	12" Storm Drain Piping-Class C Backfill	LF	550	$30	$16,500
4	Tidegate-12"	EA	1	$3,500	$3,500
5	Manhole-Standard	EA	3	$4,000	$12,000
6	Catch Basin	EA	3	$1,000	$3,000
7	AC R&R	LF	550	$20	$11,000
8	Rip Rap	TON	20	$50	$1,000
9	Misc. Appurtenances	LS	1	$9,200	$9,200

Project Subtotal	***$67,450***
Contingency	***$10,120***
Engineering	***$13,490***
Legal Admin.	***$2,020***
Permitting	***$4,000***
Project Total	***$97,080***

Notes: 1) Permits required from ODOT, CORP, and COE

BASIN 10

No projects are recommended for this basin.

BASIN 10A

Project 10A-1 is recommended for this basin. Project 10A-1 addresses problems associated with Pump Station 11. The pumps and controls at this station are at the end of their rated life. The station is also considered a confined space and is difficult to maintain. The station pressurizes a section of gravity line with catch basins downstream from the pump station. Water was observed backflowing from the catch basins during pump station operation. This project involves installing new submersible pumps to replace the existing turbine pumps, and relocating the control panel and electrical service to a pedestal mounted stainless steel control panel next to the wetwell. Backflow preventers would be installed at catch basins on Bayshore Drive.

TABLE 7.1.13
PROJECT 10A-1 COST ESTIMATE

Item	Description	Units	No. Units	Unit Cost	Subtotal
1	Const. Fac. & Temp. Controls	LS	1	$12,750	$12,750
2	Demolition and Site Preparation	LS	1	$7,650	$7,650
3	New 15hp Pumps	EA	2	$15,000	$30,000
4	Catch Basin Backflow Preventers	EA	10	$2,000	$20,000
5	Wetwell Retrofit	LS	1	$10,000	$10,000
6	Electrical Controls and Panels	LS	1	$25,000	$25,000
7	Misc. Appurtenances	LS	1	$17,000	$17,000

Project Subtotal	***$122,400***
Contingency	***$18,360***
Engineering	***$24,480***
Legal Admin.	***$3,670***
Permitting	***$4,000***
Project Total	***$172,910***

BASIN 11

Projects 11-1 and 11-2 are recommended for this basin. Project 11-1 consists of replacing approximately 660 feet of existing 12-inch storm drain line on Broadway, between Central and Curtis Avenues, that was determined by OMI staff to be in poor condition during system video taping. Also included is removal of concrete residue from catch basin lines in front of the Egyptian Theater. This project is recommended as a Priority 1 Project. A project cost estimate is located in Table 7.1.14.

TABLE 7.1.14
PROJECT 11-1 COST ESTIMATE

Item	Description	Units	No. Units	Unit Cost	Subtotal
1	Const. Fac. & Temp. Controls	LS	1	$5,250	$5,250
2	Demolition and Site Preparation	LS	1	$3,150	$3,150
3	12" Storm Drain Piping-Class C Backfill	LF	660	$30	$19,800
4	Catch Basin	EA	2	$1,000	$2,000
5	AC R&R	LF	660	$20	$13,200
6	Misc. Appurtenances	LS	1	$7,000	$7,000

Project Subtotal	***$50,400***
Contingency	***$7,560***
Engineering	***$10,080***
Legal Admin.	***$1,510***
Permitting	***$4,000***
Project Total	***$73,550***

Project 11-2 consists of replacing approximately 315 feet of existing 18-inch storm drain outfall at Central Avenue with 18-inch PVC to increase capacity. This project is based on the existing system drawings provided by the City. This project is recommended as a Priority 3 Project. A project cost estimate is located in Table 7.1.15.

TABLE 7.1.15
PROJECT 11-2 COST ESTIMATE

Item	Description	Units	No. Units	Unit Cost	Subtotal
1	Const. Fac. & Temp. Controls	LS	1	$4,140	$4,140
2	Demolition and Site Preparation	LS	1	$2,480	$2,480
3	18" Storm Drain Piping-Class C Backfill	LF	315	$50	$15,750
4	Tidegate-18"	EA	1	$5,000	$5,000
5	AC R&R	LF	300	$20	$6,000
6	Rip Rap	TON	20	$50	$1,000
7	Misc. Appurtenances	LS	1	$5,350	$5,350

Project Subtotal	***$39,720***
Contingency	***$5,960***
Engineering	***$7,940***
Legal Admin.	***$1,190***
Permitting	***$4,000***
Project Total	***$58,810***

Notes: 1) Permits required from ODOT, CORP, and COE

Additional Outfall Problems for Basin 11

Outfalls 14A and 14B are located at Central Avenue, but are not shown on the City infrastructure maps. Both outfalls were not directly accessible during the study period. Outfall 14A appears to be abandoned, but this should be confirmed by the City. Outfall 14B has significant flow and may provide the outlet for a large portion of the storm flows for this basin. This 24-inch concrete pipe does not have a tidegate. It is recommended that the City dye test in this basin to determine system flows and install a tidegate on Outfall 14B if drainage areas lower than 10-foot elevation are drained by this outfall. If this outfall does drain Basin 11, then Project 11-2 is not needed.

BASIN 12A

Capital improvement Project No. 12A-1 is recommended for this area. Project 12A-1 consists of replacing approximately 810 lineal feet of the existing 36-inch storm drain overflow from Mingus Park Pond to improve capacity. This project is recommended as a Priority 3 Project. A project cost estimate is located in Table 7.1.16.

TABLE 7.1.16
PROJECT 12A-1 COST ESTIMATE

Item	Description	Units	No. Units	Unit Cost	Subtotal
1	Const. Fac. & Temp. Controls	LS	1	$20,600	$20,600
2	Demolition and Site Preparation	LS	1	$12,360	$12,360
3	36" Storm Drain Piping-Class C Backfill	LF	810	$130	$105,300
4	42" Pipe Lining	LF	1200	$245	$294,000
5	Manhole- 36"	EA	4	$8,000	$32,000
6	Misc. Appurtenances	LS	1	$86,260	$86,260

Project Subtotal	***$550,520***
Contingency	***$82,580***
Engineering	***$110,110***
Legal Admin.	***$16,520***
Permitting	***$4,000***
Project Total	***$763,730***

BASIN 12B

There are no capital improvement projects recommended for this basin.

BASIN 12C

Capital improvement Projects No. 12C-1, 12C-2, 12C-3, and 12C-4 are recommended for this area. The first two projects address capacity issues with the Mill Slough Box. In addition to the recommended projects, it is recommended that a manual inspection and concrete testing of the Slough Box be made to determine the interior condition of the box culvert, the remaining strength of the concrete, and the condition of the gravity sewer lines that traverse the culvert during low stream flows in September. The City may want to consider installing metal protective shielding over the existing concrete and transite sewer pipes.

Project 12C-1 includes widening the Mill Slough Box at South 2nd Court where a 30-inch sewer pipe penetrates the box culvert. The Slough Box would be widened by approximately 6 feet over a gradual transition, with about 27 feet of the culvert affected. Widening the culvert is expected to restore the capacity lost due to the sewer pipe penetration. This project is recommended as a Priority 1 Project. A project cost summary is located in Table 7.1.17. A detailed cost estimate is included in Appendix E.

TABLE 7.1.17
PROJECT 12C-1 COST SUMMARY

Item	Amount
Total Construction Cost	$142,150
Contingency	$21,400
Administration/Legal	$2,900
Land Acquisition	N/a
Environmental Study/Permits	$15,000
Engineering	$28,500
Total Costs	**$209,800**

Project 12C-2 includes the installation of a storm water pump station at Blossom Gulch Creek and 10th Street with a force main following 10th Street north to Elrod Avenue and then following Elrod Avenue west to the Bay. The station would be sized to pump only those flows above the capacity of the Mill Slough Box, approximately 120 CFS with a head of 50 feet. This project is recommended as a Priority 1 Project. A project cost summary is located in Table 7.1.18. A detailed cost estimate is included in Appendix E.

TABLE 7.1.18
PROJECT 12C-2 COST SUMMARY

Item	Amount
Total Construction Cost	$1,786,700
Contingency	$268,000
Administration/Legal	$35,730
Land Acquisition	$100,000
Environmental Study/Permits	$75,000
Pre-Engineering Report	$40,000
Engineering	$357,340
Total Costs	**$2,662,770**

Project 12C-3 addresses removal of hardened concrete wastes that were dumped in the storm lines located at southwest corner of 4th and Anderson. The estimated cost for this project is $1,000. This project is considered a maintenance item and is not prioritized.

Project 12C-4 includes the installation of a manhole north of the Mill Slough Box to allow access to the storm system for cleaning the section on 4th Street from Anderson to Central Avenues. This section surcharges at the fire department due to built up debris in the system that cannot be removed due to lack of access. This project is recommended as a Priority 1 Project. A project cost estimate is located in Table 7.1.19.

TABLE 7.1.19
PROJECT 12C-4 COST ESTIMATE

Item	Description	Units	No. Units	Unit Cost	Subtotal
1	Const. Fac. & Temp. Controls	LS	1	$1,020	$1,020
2	Demolition and Site Preparation	LS	1	$600	$600
3	Manhole-Standard	EA	1	$6,000	$6,000
4	AC R&R	LS	1	$800	$800
5	Misc. Appurtenances	LS	1	$1,360	$1,360

Project Subtotal	***$9,780***
Contingency	***$1,470***
Engineering	***$1,960***
Legal Admin.	***NA***
Permitting	***NA***
Project Total	***$13,210***

BASIN 13

No capital improvement projects are recommended for this basin.
Additional Outfall Problems for Basin 13

A wood outfall with flow and in poor condition was located at Elrod Avenue in the location shown on plans as Outfall 11. Recommend dye-testing catch basins above this outfall to determine if it is tied to the storm drain system. If so, then this outfall should be capped upon completion of Project 14-1 to prevent tidal backflow into the storm system.

BASIN 14

Capital improvement Projects No. 14-1,14-2, and 14-3 are recommended for this area. Project 14-1 consists of installing a new pump station at Golden Avenue west of Front Street with a 36-inch outfall and tidegate. This station would have an estimated capacity of 150 CFS at 10 feet of head. This project is recommended as a Priority 1 Project. A project cost summary is located in Table 7.1.20. A detailed cost estimate is included in Appendix E.

TABLE 7.1.20
PROJECT 14-1 COST SUMMARY

Item	Amount
Total Construction Cost	$913,000
Contingency	$136,950
Administration/Legal	$18,260
Land Acquisition	$30,000
Environmental Study/Permits	$100,000
Engineering	$182,600
Total Costs	**$1,380,810**

Project 14-2 consists of piping to tie existing storm drain piping to the new Golden Avenue Pump Station, particularly flows from Elrod and Hall Avenues. Redirecting flows to the new station would reduce the load on Pump Station 15, which is near capacity. This project is recommended as a Priority 1 Project. A project cost estimate is located in Table 7.1.21.

TABLE 7.1.21
PROJECT 14-2 COST ESTIMATE

Item	Description	Units	No. Units	Unit Cost	Subtotal
1	Const. Fac. & Temp. Controls	LS	1	$29,510	$29,510
2	Demolition and Site Preparation	LS	1	$17,710	$17,710
3	18" Storm Drain-Pipe Bursting	LF	650	$115	$74,750
4	30" Storm Drain-Pipe Bursting	LF	500	$200	$100,000
5	Manhole-Standard	EA	4	$4,000	$16,000
6	Catch Basin	EA	6	$1,000	$6,000
7	Misc. Appurtenances	LS	1	$39,350	$39,350

Project Subtotal	***$283,320***
Contingency	***$42,500***
Engineering	***$56,660***
Legal Admin.	***$8,500***
Permitting	***$4,000***
Project Total	***$394,980***

Project 14-3 addresses removal of hardened concrete wastes that were dumped in the storm lines located at 4th and Golden, by the Post Office. The estimated cost for this project is $1,000. This project is considered a maintenance item and is not prioritized.

BASIN 15

Project 15-1 is recommended for this basin. Project 15-1 consists of repairs to the discharge vault for Pump Station 15 including removal of the vault doors and frame, cutting the existing concrete lip back and pouring a new lip to seat the existing frame. A concrete collar around the vault top would add additional weight and reinforcement to secure the frame. This project is considered a maintenance item and is not prioritized. The estimated cost for this project is $5,000.

BASIN 16

Project 16-1 is recommended for this basin. Sediment basins are located before Tidegates 7 and 7A. Both basins are silted in with sediments and in need of cleaning. Based on the basin sizes shown on the infrastructure drawings, and estimating an average sediment depth of two feet, approximately 250 yards of sediment would be removed. The cost estimate for this project is $2,000. This project is considered a maintenance item and is not prioritized.

BASIN 17

Capital improvement Projects No. 17-1, 17-2, and 17-3 are recommended for this area. These measures are interdependent in that Projects 17-1 and 17-2 are piping replacements that are sized based on the pump station in measure 17-3. If the pump station is not built then the areas served by this piping will likely flood, even with the larger piping installed.

Project 17-1 installs approximately 1,200 feet of 24-inch storm drain piping on Lockhart Street, from Broadway to 7th Street. This line would serve as the main interceptor line for Basin 16. This area is currently scheduled for development, making this a Priority 1 project. The cost estimate for the interceptor is presented in Table 7.1.22.

TABLE 7.1.22
PROJECT 17-1 COST ESTIMATE

Item	Description	Units	No. Units	Unit Cost	Subtotal
1	Const. Fac. & Temp. Controls	LS	1	$21,000	$21,000
2	Demolition and Site Preparation	LS	1	$12,600	$12,600
3	24" Storm Drain Piping-Class C Backfill	LF	1200	$90	$108,000
4	Manhole-Standard	EA	4	$4,000	$16,000
5	AC R&R	LF	800	$20	$16,000
6	Misc. Appurtenances	LS	1	$28,000	$28,000

Project Subtotal	***$201,600***
Contingency	***$22,460***
Engineering	***$29,950***
Legal Admin.	***$4,490***
Permitting	***$4,000***
Project Total	***$262,500***

Project 17-2 includes approximately 2,400 feet of 24-inch and 36-inch storm drain interceptor piping to serve Basin 17. Connecting Basin 17 to the pump station would alleviate the flooding problems along Lockhart and at Tidegate 3B. This project is recommended as a Priority 1 project. The cost estimate is presented in Table 7.1.23.

TABLE 7.1.23
PROJECT 17-2 COST ESTIMATE

Item	Description	Units	No. Units	Unit Cost	Subtotal
1	Const. Fac. & Temp. Controls	LS	1	$45,090	$45,090
2	Demolition and Site Preparation	LS	1	$27,050	$27,050
3	24" Storm Drain Piping-Class C Backfill	LF	1180	$90	$106,200
4	36" Storm Drain Piping-Class C Backfill	LF	1280	$130	$166,400
5	Manhole-Standard	EA	3	$4,000	$12,000
6	Manhole- 36"	EA	2	$8,000	$16,000
7	Misc. Appurtenances	LS	1	$60,120	$60,120

Project Subtotal	***$432,860***
Contingency	***$64,930***
Engineering	***$86,570***
Legal Admin.	***$12,990***
Permitting	***$4,000***
Project Total	***$601,350***

Project 17-3 includes installing a pump station at 7th Street and Lockhart Avenue on City owned property to provide drainage at high tide for properties in Basins 16 and 17. A large portion of these basins are below the higher high tide line. The station would have duplex axial pumps each sized for 90 CFS at 10 feet of head for a total capacity of 175 CFS. This project is recommended as a Priority 1 project. The cost estimate is presented in Table 7.1.24.

TABLE 7.1.24
PROJECT 17-3 COST SUMMARY

Item	Amount
Total Construction Cost	$1,002,000
Contingency	$150,300
Administration/Legal	$20,040
Land Acquisition	$30,000
Environmental Study/Permits	n/a
Engineering	$200,400
Total Costs	**$1,402,740**

BASIN 18

Capital improvement Project No. 18-1 is recommended for this area. This project includes installing a new 24-inch outfall at 11th Street and Southwest Boulevard to relieve flows from the existing 15-inch on Southwest Boulevard and increase overall system capacity. This outfall would not require a tidegate as the drainage openings are above the high water level. This project is recommended as a Priority 3 project. The cost estimate for this measure is presented in Table 7.1.25.

TABLE 7.1.25
PROJECT 18-1 COST ESTIMATE

Item	Description	Units	No. Units	Unit Cost	Subtotal
1	Const. Fac. & Temp. Controls	LS	1	$3,870	$3,870
2	Demolition and Site Preparation	LS	1	$2,322	$2,322
3	24" Storm Drain Piping-Class C Backfill	LF	220	$90	$19,800
4	Manhole-Standard	EA	1	$4,000	$4,000
5	AC R&R	LF	100	$20	$2,000
6	Misc. Appurtenances	LS	1	$5,160	$5,160

Project Subtotal	***$37,150***
Contingency	***$5,570***
Engineering	***$7,430***
Legal Admin.	***$1,120***
Permitting	***$4,000***
Project Total	***$55,270***

BASIN 19

Capital improvement Projects No. 19-1 and 19-2 are recommended for this area. Project 19-1 includes upsizing the existing 42-inch CMP culvert at Dakota Avenue and Southwest Boulevard to a 48-inch PVC pipe with a new 48-inch tidegate. The existing culvert is in poor shape and the tidegate is currently malfunctioning, making this a Priority 1 project. The cost estimate is presented in Table 7.1.26.

TABLE 7.1.26
PROJECT 19-1 COST ESTIMATE

Item	Description	Units	No. Units	Unit Cost	Subtotal
1	Const. Fac. & Temp. Controls	LS	1	$9,490	$9,490
2	Demolition and Site Preparation	LS	1	$5,690	$5,690
3	48" Storm Drain Piping-Class C Backfill	LF	170	$150	$28,900
4	Tidegate-48"	EA	1	$20,000	$20,000
5	Concrete Headwall	EA	1	$8,000	$8,000
6	AC R&R	LF	170	$30	$5,100
7	Rip Rap	TON	30	$50	$1,500
8	Misc. Appurtenances	LS	1	$12,400	$12,400

Project Subtotal	***$91,080***
Contingency	***$13,660***
Engineering	***$18,220***
Legal Admin.	***$2,730***
Permitting	***$4,000***
Project Total	***$129,690***

Project 19-2 includes the installation of a pump station at Dakota Avenue and Southwest Boulevard. The east portion of Basin 19 is below the higher high tide level and has experienced flooding during the study period. Upsizing the culvert and replacing the tidegate would reduce the incidence of flooding, but a pump station would be required to minimize floods. The recommended pump station has duplex pumps with a capacity of 75 CFS each at 10 feet of head for a total station capacity of 150 CFS. This project is recommended as a Priority 2 project. The cost summary is presented in Table 7.1.27 and a detailed cost estimate is included in Appendix E.

TABLE 7.1.27
PROJECT 19-2 COST SUMMARY

Item	Amount
Total Construction Cost	$825,000
Contingency	$123,750
Administration/Legal	$16,500
Land Acquisition	$30,000
Environmental Study/Permits	n/a
Engineering	$165,000
Total Costs	**$1,160,250**

Additional Outfall Problems for Basin 19

Outfall 0B is shown on City plans to run beneath the Englewood Market. This outfall was reported to have been abandoned, but possibly still drains the front lawn of a house across from the market. If this outfall were still active, then a tidegate would be required.

BASIN 20

Capital improvement Project No. 20-1 is recommended for this area. This project includes replacing the existing 24-inch outfall to Coalbank Slough, located between Washington and Oregon Avenues, with a new 30-inch PVC outfall. A tidegate is not needed for this outfall. This project is recommended as a Priority 2 project. The cost estimate for this measure is presented in Table 7.1.28. The City of Coos Bay is has slated a project for the summer of 2004 to alleviate the problems associated with this basin.

TABLE 7.1.28
PROJECT 20-1 COST ESTIMATE

Item	Description	Units	No. Units	Unit Cost	Subtotal
1	Const. Fac. & Temp. Controls	LS	1	$3,270	$3,270
2	Demolition and Site Preparation	LS	1	$1,960	$1,960
3	30" Storm Drain Piping-Class C Backfill	LF	180	$110	$19,800
4	AC R&R	LF	100	$20	$2,000
5	Misc. Appurtenances	LS	1	$4,360	$4,360

Project Subtotal	***$31,390***
Contingency	***$4,710***
Engineering	***$6,280***
Legal Admin.	***$940***
Permitting	***$4,000***
Project Total	***$47,320***

BASIN 21

No projects are recommended for this basin.

BASIN 22

Project 22-1 is recommended for this area. This project involves installation of a 48-inch tidegate on the existing culvert under Southwest Boulevard at the crossing of Middle Creek. This project is recommended as a Priority 3 project. The cost estimate for this measure is presented in Table 7.1.29.

TABLE 7.1.29
PROJECT 22-1 COST ESTIMATE

Item	Description	Units	No. Units	Unit Cost	Subtotal
1	Const. Fac. & Temp. Controls	LS	1	$3,000	$3,000
2	Demolition and Site Preparation	LS	1	$1,800	$1,800
3	Tidegate-48"	EA	1	$20,000	$20,000
4	Misc. Appurtenances	LS	1	$4,000	$4,000

Project Subtotal	***$28,800***
Contingency	***$4,320***
Engineering	***$5,760***
Legal Admin.	***$860***
Permitting	***$4,000***
Project Total	***$43,740***

Additional Outfall Problems for Basin 22

Basins 20 through 23 drain to Coalbank Slough indirectly through a series of drainage ditches and tidegates through the dike. Coalbank Slough frequently overtops the dike during high water, high wind conditions, flooding the low elevation pastures and the banks of Middle Creek in Basin 22. While the dikes are in the City limits, the Libby and Englewood Diking Districts currently have responsibility for dike maintenance. Further development in this area will likely cause pressure on the City to assume responsibility for dike maintenance. It is recommended that the City evaluate the dikes, their condition, and the property protected by the dike system to determine the roll that the City will play in future dike maintenance or development restrictions in this area.

BASIN 23

Capital improvement Project No. 23-1 is recommended for this area. This project includes replacing approximately 360 feet of the existing 12-inch storm drain line on the lower portion of Pennsylvania Avenue with 12-inch PVC to improve capacity for future flows. This project is recommended as a Priority 3 project. The cost estimate for this measure is presented in Table 7.1.30.

TABLE 7.1.30
PROJECT 23-1 COST ESTIMATE

Item	Description	Units	No. Units	Unit Cost	Subtotal
1	Const. Fac. & Temp. Controls	LS	1	$2,700	$2,700
2	Demolition and Site Preparation	LS	1	$1,620	$1,620
3	12" Storm Drain Piping-Class C Backfill	LF	360	$30	$10,800
4	AC R&R	LF	360	$20	$7,200
5	Misc. Appurtenances	LS	1	$3,600	$3,600

Project Subtotal	***$25,920***
Contingency	***$3,890***
Engineering	***$5,180***
Legal Admin.	***$780***
Permitting	***$4,000***
Project Total	***$39,770***

BASIN 24

No projects are recommended for this basin.

BASIN 25

No projects are recommended for this basin.

BASIN 26

Capital improvement Project No. 26-1 and 26-2 are recommended for this area. Project 26-1 involves replacing the culvert at Thompson Road and the Pony Creek Hospital Branch crossing, both to increase capacity and to address the deteriorated condition of the culvert. This involves removing the existing deformed section of 36-inch CMP through trench excavation and installation of 95 feet of new 36-inch PVC. This project is recommended as a Priority 3 project. The cost estimate for this measure is presented in Table 7.1.31.

TABLE 7.1.31
PROJECT 26-1 COST ESTIMATE

Item	Description	Units	No. Units	Unit Cost	Subtotal
1	Const. Fac. & Temp. Controls	LS	1	$3,480	$3,480
2	Demolition and Site Preparation	LS	1	$2,090	$2,090
3	36" Storm Drain Piping-Class C Backfill	LF	95	$130	$12,350
4	Manhole- 36"	EA	1	$8,000	$8,000
5	AC R&R	LF	95	$30	$2,850
6	Misc. Appurtenances	LS	1	$4,640	$4,640

Project Subtotal	***$33,410***
Contingency	***$5,010***
Engineering	***$6,680***
Legal Admin.	***$1,000***
Permitting	***$4,000***
Project Total	***$50,100***

Project 26-2 consists of replacing approximately 1,300 feet of the existing 18-inch and 21-inch storm lines on Thompson Road from Pony Creek to Bay Area Hospital with 18-inch and 24-inch PVC to improve capacity for current and future flows. This project is recommended as a Priority 3 project. The cost estimate for this measure is presented in Table 7.1.32.

TABLE 7.1.32
PROJECT 26-2 COST ESTIMATE

Item	Description	Units	No. Units	Unit Cost	Subtotal
1	Const. Fac. & Temp. Controls	LS	1	$23,250	$23,250
2	Demolition and Site Preparation	LS	1	$13,950	$13,950
3	18" Storm Drain Piping-Class C Backfill	LF	300	$50	$15,000
4	24" Storm Drain Piping-Class C Backfill	LF	1000	$90	$90,000
5	Manhole-Standard	EA	6	$4,000	$24,000
6	AC R&R	LF	1300	$20	$26,000
7	Misc. Appurtenances	LS	1	$31,000	$31,000

Project Subtotal	***$223,200***
Contingency	***$33,480***
Engineering	***$44,640***
Legal Admin.	***$6,700***
Permitting	***$4,000***
Project Total	***$312,020***

BASIN 27

Capital improvement Project No. 27-1 is recommended for this area. This project consists of replacing approximately 600 feet of the existing 12-inch storm drain line on Thompson Road between Koosbay Boulevard and the ESD baseball field with 18-inch PVC to improve capacity for current and future flows. This project is recommended as a Priority 3 project. The cost estimate for this measure is presented in Table 7.1.33.

TABLE 7.1.33
PROJECT 27-1 COST ESTIMATE

Item	Description	Units	No. Units	Unit Cost	Subtotal
1	Const. Fac. & Temp. Controls	LS	1	$6,900	$6,900
2	Demolition and Site Preparation	LS	1	$4,140	$4,140
3	18" Storm Drain Piping-Class C Backfill	LF	600	$50	$30,000
4	Manhole-Standard	EA	1	$4,000	$4,000
5	AC R&R	LF	600	$20	$12,000
6	Misc. Appurtenances	LS	1	$9,200	$9,200

Project Subtotal	***$66,240***
Contingency	***$9,940***
Engineering	***$13,250***
Legal Admin.	***$1,990***
Permitting	***$4,000***
Project Total	***$95,420***

7.2 Basis of Cost Estimates

The magnitude cost estimates in the plan have for components: construction costs, engineering costs, legal and administrative costs, and property acquisition costs. The cost estimates are preliminary in nature and are based on large scale planning detail. As projects enter the individual planning stage, that is, closer to being realized, more information will be gathered and the cost estimates will be refined. Actual costs will differ from what is shown here.

Construction Cost

The magnitude construction costs in this capital improvement plan are based on actual bidding results from similar work, published cost guides, and construction cost experience. Future changes in the cost of labor, equipment, and materials may be needed as the work is realized. For this reason, common engineering practices usually tie the cost estimates to a particular index that varies with changes in the national economy. The Engineering News Record (ENR) construction cost index is most commonly used. This index is based on the value of 100 for the year 1913. The ENR index for May 2004 was 7,064. Future yearly ENR indices can be used to calculate the cost of projects for their construction year based on the annual growth in the ENR index.

A contingency factor of 15 percent of the construction cost was added to the construction total. Because the cost estimates presented are based on low precision mapping and conceptual layouts, allowances must be made for variations in final quantities, bidding market conditions, adverse construction conditions, and other difficulties which were not included but may occur.

Engineering Cost

The cost of engineering services for projects typically include special investigations, a pre-design report, surveying, geotechnical exploration, preparation of contract drawings and specifications, bidding services, construction management, inspection, construction staking, start-up services, and the preparation of operation and maintenance manuals. Depending on the size and type of project, engineering costs may range from 15 to 25 percent of the contract cost when all of the above services are provided. The lower percentage applies to large projects without complicated mechanical systems. The higher percentage applies to small, complicated projects. The engineering costs for design and construction used in this study average 20 percent of the construction cost.

Environmental Review and Permits

A number of the recommended projects involve replacing piping that crosses Highway 101 and the Central Oregon Pacific Railroad (CORP) tracks and then empties into the Bay. ODOT requires a permit for each crossing of Highway 101, as does CORP for each crossing of the train tracks. The US Army Corps of Engineers requires a permit for any work below the ordinary high tide line in the Bay. The Department of State Lands requires a permit for any project in a wetlands or body of water that involves more than 50 cubic yards of fill or removal.

Legal and Administrative Cost

An allowance of three percent of construction cost was added for legal and administrative services. This allowance is intended to include internal project planning and budgeting.

Property Acquisition Cost

Costs for property acquisition and easements were not included in the cost estimate. At the beginning of each project, an evaluation of existing easements, both recorded and prescriptive should be made. It may be necessary to purchase easements or properties for routing storm drainage.

7.3 Cost Estimates

Magnitude cost estimates were developed for each recommended project. The detailed estimates are in Section 7.1 and Appendix E and the maps showing the projects may be found in Appendix A. The summary of costs in the table below is the cost of the total project, that is, the price of a fully urbanized basin that will successfully drain during significant storms. Included in this cost is the price to relieve present day problems.

TABLE 7.3.1
TOTAL PROJECT COSTS

Project Number	Description	Cost (Dollars)	Priority
9-1	Alder Outfall	$97,080	1
10A-1	Pump Station 11 Upgrade	$172,910	1
11-1	Egyptian Interceptor	$73,550	1
12C-2	Blossom Pump Station	$2,662,770	1
12-4	Manhole to Mill Slough Box	$13,210	1
14-1	Golden Pump Station	$1,380,810	1
14-2	Golden Interceptors	$394,980	1
17-1	Lockhart Interceptor	$262,500	1
17-2	DMV Interceptor	$601,350	1
17-3	Lockhart Pump Station	$1,402,740	1
19-1	Dakota Tidegate	$129,690	1
19-2	Englewood Pump Station	$1,160,250	1
Subtotal Priority 1		**$8,351,840**	

TABLE 7.3.1
TOTAL PROJECT COSTS (CONT.)

Project Number	Description	Cost (Dollars)	Priority
4-1	Separate WWTP Outfall	$306,420	2
5-1	Ivy Outfall	$118,840	2
6-1	Hemlock Outfall	$75,910	2
7-1	Lumbermen's Outfall	$99,440	2
8-2	Birch Outfall/Interceptor	$131,440	2
12C-1	Slough Box Widening	$209,800	2
20-1	Washington Outfall	$47,320	2
Subtotal Priority 2		**$989,170**	
1-1	Teakwood Outfall	$70,610	3
2-1	Pine Outfall	$101,300	3
3-1	Myrtle Tidegate	$76,700	3
5-2	Ivy Interceptor	$106,140	3
7-2	Timber Inn Interceptors	$92,530	3
8-1	Date Outfall/Tidegate	$49,180	3
11-2	Central Outfall	$58,810	3
12A-1	Mingus Pond Interceptor	$763,730	3
18-1	11th Street Outfall	$55,270	3
22-1	Middle Creek Tidegate	$43,740	3
23-1	Pennsylvania Interceptor	$39,770	3
26-1	Pony Creek Culvert	$50,100	3
26-2	West Thompson Interceptor	$312,020	3
27-1	East Thompson Interceptor	$95,420	3
Subtotal Priority 3		**$1,915,320**	
12C-3	Fire Station Line Cleaning	$1,000	N/A
14-3	Post Office Line Cleaning	$1,000	N/A
15-1	Pump Station 15 Vault	$5,000	N/A
16-1	Sediment Basin Cleaning	$2,000	N/A
Subtotal Not Prioritized		**$9,000**	
Total		**$11,265,330**	

7.4 Division of Responsibilities

The storm water master plan suggests projects, which either alleviate present day problems or prepare the system for future use. Each project in the plan contains these two parts.

While present day problems may be the result of past development, it is difficult to recuperate the price of patching the problem from the perceived source of the problem. These costs become the city's burden.

This may not be the case with projects that prepare the storm drain system for future use. With proper financial structures in place, for example, systems development charges, the city can recover the costs of the future system from those who benefit from the utility.

The purpose of the table below is to separate these costs. Only projects that are located in basins containing projected development and that are SDC eligible are included in the table. Projects not located in the following table are not SDC eligible due to no development speculated for the basin area. The individual project cost estimates are contained in Appendix E.

TABLE 7.4.1
DIVISION OF TOTAL PROJECT COST

Project Number	Total Project Cost	Development Portion Cost To INCREASE CAPACITY	City Portion Cost To Relieve PRESENT DAY PROBLEM
12C-1	$209,800	$0	$209,800
12C-2	$2,662,770	$718,948	$1,943,822
14-1	$1,380,810	$138,081	$1,242,729
14-2	$394,980	$39,498	$355,482
14-3	$1,000	$0	$1,000
17-1	$262,500	$0	$262,500
17-2	$601,350	$312,702	$288,648
17-3	$1,402,740	$729,425	$673,315
18-1	$55,270	$55,270	$0
26-1	$50,100	$10,000	$40,100
26-2	$312,020	$93,606	$218,414
TOTAL	**$2,810,000**	**$2,097,530**	**$712,470**
PERCENT OF TOTAL	**100%**	**75%**	**25%**

Financing

Section

8

Section

8

Financing

8.1 General

In general, cities have difficulty implementing storm drainage improvements. City services, such as, water, sanitary sewer, and streets usually have higher priority and use the available funds. Storm water issues become secondary and only immediate problems are corrected. Systematically programmed projects, which would be more effective in the long term, simply are not done.

As urbanization of the drainage area continues over time, storm drain issues present with more urgency. Reserve capacity in the existing system diminishes and postponed projects have increased in cost. With growth and without funding or commitment to make improvements, drainage problems increase.

The City could include the recommended projects in the annual budget, but, like most cities, budgets are limited and other important projects, such as, streets would be postponed.

Although grants are generally not offered to assist with storm drain projects, the city does have financing options available to them, some of which are listed below:

1. Issue a bond for storm water improvements as part of the city sewer system improvements.
2. Contact residents in each basin and form local improvement districts to fund the projects respective to each neighborhood.
3. Form a storm water utility and charge each user for storm water as a city service.
4. Construct improvements related to future development through system development charges.

8.2 General Obligation Bonds

General obligation bonds are often used to finance major utility improvements that benefit the entire community. Bonds are structured around the community's taxing authority and are retired through property taxes, or user fees, according to an equitable distribution of the bonded indebtedness across the community's assessed valuation.

8.3 Revenue Bonds

Revenue bonds are similar to general obligation bonds except that retirement of bonded indebtedness is from revenue generated from the sales of the utility. Unlike general obligation bonds, revenue bonds are more easily accessed because they do not always require a vote of the utility's populous. However, the security of a revenue bond is lower than a general obligation bond and this generally results in higher interest rates. Currently, the city does not have a storm water utility; consequently revenue for loan repayment would have to be generated through sewer user and SDC fees.

8.4 Local Improvement District

A local improvement district (LID) may be formed by local residents who are responsible for securing and repaying the debt incurred through a project. LID formation requires public hearings and agreement of the local residents of the affected area. A successful LID area results in liens against the LID properties at the end of the project.

An LID could be formed for each basin identified in the study. Equitable distribution of costs would be based on a defined equivalent dwelling unit (EDU) and users in the basin contribute their share of the cost for the recommended improvement.

However, certain areas of the city would not contribute to projects, since not all sections of the city require improvements. Areas of the city with high improvement costs may not approve LID formation, consequently, improvements in these basins could not be constructed with LID funds.

A local improvement district is allowed to include affected properties that are not within the city limits. Addressing deficiencies in the dikes would involve improvements outside of the City that benefit both city and unincorporated areas and should be considered for an LID.

8.5 Rural Development Grant/Loans

The United States Department of Agriculture, Rural Development (RD) makes loans and grants tocities and towns with a population of less than 10,000 and to public bodies and non-profit corporations in rural areas to construct or improve essential community facilities, including storm water systems. While the City may not be eligible directly for funding, entities such as Coos County or special drainage districts would be eligible and could partner with the City on projects that affect both entities, such as the Blossom Gulch pump station. Grants may also be available to applicants who meet the median household income (MHI) requirements. However, RD grant funding for storm water improvements would probably have a low priority.

Rural Development is a reasonable and practical loan source for storm water improvements. Loan funds acquired through RD would be re-paid through monthly user fees (revenue bonds) which are either added to the City's current sewer user fees or though a storm water utility.

Access to the loan will require the city to secure bonding authority through the formation of the SWM utility (or sewer fees). As a borrower, the city must meet the following stipulations;

1. Be unable to obtain needed funds from other sources at reasonable rates and terms,

2. Have legal capacity to borrow and repay loans, to pledge security for loans and to operate and maintain the facilities or services,
3. Be financially sound and able to manage the facility effectively, and
4. Have a financially sound facility based on taxes, assessments, revenues, fees or other satisfactory sources of income to pay all facility costs, including operation and maintenance, and to retire the indebtedness and maintain a reserve.

If acquired, loan and grant funds may be used for the following;

1. Construct, repair, improve, expand or otherwise modify storm drainage facilities,
2. Legal and engineering costs connected with the development of facilities, and
3. Other costs related to development of the facility including the acquisition of right-of-way and easements and the relocation of roads and other utilities.

The maximum term on Rural Development loans is 40 years. However, no repayment period will exceed any statutory limitation on the organization's borrowing authority nor the useful life of the improvement or facility to be financed. Interest rates are set periodically and are based on current market yields for municipal obligations. The following rates apply for the Rural Development program for the quarter ending June, 2003.

Market Rate
The market rate is paid by those applicants whose median household income (MHI) of the service area is more than the $34,608 (Oregon non-metropolitan MHI). The market rate is currently 4.625 percent.

Intermediate Rate
The intermediate rate is paid by those applicants whose MHI of the service area is less than $34,608. The intermediate rate is currently 4.50 percent (as of January 2004).

Poverty Line Rate
The lowest rate is paid by those applicants whose MHI of the service area is below $27,686 (80 percent of the non-metropolitan MHI). The poverty line rate is currently 4.50 percent.

The MHI for the City of Coos Bay, based on census data for the year 2000, is $31,212. The City would qualify for the intermediate rate for any project approved for financing by Rural Development.

8.6 Department of Environmental Quality Clean Water State Revolving Fund (SRF)

The SRF Program is administered by the DEQ and was developed to replace the EPA Construction Grants Program. The SRF is a loan program that provides low interest rate loans, instead of grants, for the planning, design, and construction of water pollution control facilities.

Interest rates on all design and/or construction loans are two-thirds of the current municipal bond rate during the quarter that the loan agreement is signed. Estimated loan rates are currently 3.1 percent. In addition, an annual servicing fee (0.5 percent of the outstanding balance) is also assessed to cover program administration by DEQ. Loans can be in the form of general obligation bonds or other rated debt obligations, revenue secured loan, or a discretionary loan.

SRF funds are allocated based on a prioritization process. Based on the preliminary applications, projects are assigned points and ranked in priority order based on 1) severity of water quality/health hazard problem; 2) receiving water body sensitivity; and 3) population served by the project.

The Intended Use Plan is one part of Oregon's annual SRF capitalization grant application. This plan includes lists of eligible projects ranked in priority order. Projects allocated funds are placed on the Funded List. Unfunded projects are on the Planning List to receive funds if any of the Funded List projects do not complete the loan process. Projects identified on the Funded List from prior years, which have not been initiated, are placed on a Supplemental List.

Obtaining SRF funding requires the submission of an environmental assessment of the project, a land use compatibility statement from the county planning official, and a department approved user charge system.

For additional information on this and other DEQ programs, call 1-800-452-4011 or visit the DEQ website at http://waterquality.deq.state.or.us.

8.7 Special Assessment/Utility Charges

A special assessment or utility charge would allow the city to charge residents a fee for storm water services. The collected revenue would be dedicated to constructing and maintaining the recommended projects. The term for the special assessment could be set over a limited time period, e.g., ten to 20 years. As funds accumulate, the city allocates them to complete each element of the long-term plan. Through this process, the city does not assume additional long-term debt, or minimizes debt by implementing certain improvements in each year. Special assessments could be collected on a monthly basis using the same methods currently used for collection of existing sewer and water fees, or through the formation of a storm water utility.

8.8 Storm Water Management Charges

Storm water management (SWM) utilities are becoming more common as communities search for methods to fund public works projects that involve storm drainage systems. Similar to a sewer and water system, the SWM utility considers the storm drainage system as a public facility that provides a service. One of the first SWM utilities developed in Oregon was in Washington County by the Unified Sewerage Agency (USA). The program was developed to address water pollution concerns in the Tualatin River and assist local communities to fund needed projects.

The formation of the SWM utility allows a city to collect revenue from rate payers and assess new developments. Unlike sewer and water, the rate is not based on use. Instead of consumption, the SWM assesses rates on the basis of runoff generation through impervious areas.

Runoff generation is based on the equivalent dwelling unit (EDU) methodology. One EDU is the impervious area of a typical of residential property, that is, a house with driveway, yard, and storage sheds. Each residential EDU is charged at flat rate for monthly service, while industry, commercial establishments, and institutional facilities are charged in terms of equivalent dwelling units.

Typically, this calculation involves determination of impervious area by aerial photography. If, for example, a shopping center and its parking lot have five times more impervious area than a typical house, then the center would be charged five times the EDU rate.

Once established, a SWM rate system is easily updated since changes to a community's EDU count only occur when a new development is constructed or an old building is destroyed.

There are advantages of a storm water management utility are as follows:

1. The SWM can enforce development standards, set minimum storm drainage requirements for new developments, address litter or storm water pollution, and maintain storm water facilities.
2. Once formed, the SWM utility collects revenue from customers based on the impervious surface EDU methodology.
3. The steady revenue allows the city to acquire loans for large scale improvements using revenue bonds issued by the SWM or by raising rates in preparation of future projects without having to seek loans.
4. New developments impacting the existing drainage system are also addressed by the SWM through system development charges based on an equitable share of costs and services.

Disadvantages of the storm water management utility are:
1. The additional bookkeeping and fund transfers required to keep the SWM independent from other city services.
2. Since the storm drainage system is addressed as an independent service, funds cannot be used for other city services.
3. Rate payers might also view the SWM as another level of government bureaucracy and taxation.

8.9 Systems Development Charges

In accordance with Oregon Revised Statutes (ORS) 223.97 through 223.314, system development charges (SDC) can be assessed for improvements directly relating to a development. The new user is considered to be, in effect, "buying in" to the existing system. Oregon Administrative Rules require that the money collected for an SDC be spent on increasing capacity in the system.

8.10 Federal Emergency Management Agency (FEMA) Grants

Flood Mitigation Assistance (FMA) Program

FMA provides funding to assist States and communities in implementing measures to reduce or eliminate the long-term risk of flood damage to buildings, manufactured homes, and other structures insurable under the National Flood Insurance Program (NFIP). There are three types of grants available under FMA: Planning, Project, and Technical Assistance Grants. FMA Planning Grants are available to States and communities to prepare Flood Mitigation Plans. NFIP-participating communities with approved Flood Mitigation Plans can apply for FMA Project Grants. FMA Project Grants are available to States and NFIP participating communities to implement measures to reduce flood losses. Ten percent of the Project Grant is made available to States as a Technical Assistance Grant. These funds may be used by the State to help administer the program. Communities receiving FMA Planning and Project Grants must be participating in the NFIP. A few examples of eligible FMA projects include: the elevation, acquisition, and relocation of NFIP-insured structures. Funding for the program is provided through the National Flood Insurance Fund, and FMA is funded at $20 million nationally.

States are encouraged to prioritize FMA project grant applications that include repetitive loss properties. The FY 2001 FMA emphasis encourages States and communities to address target repetitive loss properties identified in the Agency's Repetitive Loss Strategy. These include structures with four or more losses, and structures with 2 or more losses where cumulative payments have exceeded the property value. State and communities are also encouraged to develop Plans that address the mitigation of these target repetitive loss properties.

Pre-Disaster Mitigation Program

The Pre-Disaster Mitigation (PDM) program provides technical and financial assistance to States and local governments for cost-effective pre-disaster hazard mitigation activities that complement a comprehensive mitigation program, and reduce injuries, loss of life, and damage and destruction of property. FEMA provides grants to States and Federally recognized Indian tribal governments that, in turn, provide sub-grants to local governments (to include Indian Tribal governments) for mitigation activities such as planning and the implementation of projects identified through the evaluation of natural hazards.

After November 1, 2003, local governments and Indian Tribal governments applying for PDM funds through the States will have to have an approved local mitigation plan prior to the approval of local mitigation project grants. States will also be required to have an approved Standard State mitigation plan in order to receive PDM funds for State or local mitigation projects after November 1, 2004. Therefore, the development of State and local multi-hazard mitigation plans is key to maintaining eligibility for future PDM funding. Coos County is currently completing a local mitigation plan in cooperation with Coos Bay that will make the City eligible for this program.

Dennis Sigrist of the Oregon Office of Emergency Management (503-378-2911 x247) is the local contact for applying for FEMA grants.

8.11 Equivalent Dwelling Unit Generation

The total number of EDU's can be used to estimate future demands based on the average household size and the future population. In the example provided above, if the average household consisted of three persons and in twenty years there are 100 households and one restaurant in the community, then the equivalent population of the community would be 315 (300 people for the 100 houses + 15 equivalent people for the restaurant).

Unlike the example above, storm drainage use is not measured by consumption. Rather, an indirect method is employed. Since runoff is a consequence of the surface material and surface area, storm drain usage may be derived from the amount of impervious surface on a tax lot. The impervious surface methodology is used.

Impervious Surface Methodology

The impervious surface methodology for calculating storm water system EDU'S is based on the impervious surface area for each property. This method is based on the assumption that each residential unit consists of a lot divided into impervious area (roof tops, driveways, sheds, etc.) and non-impervious area (lawns, gardens, etc.). The typical lot size and the amount of impervious surface area are based on the average for the entire community. Determination of the typical residential lot size and impervious surface area can be calculated from a random survey of aerial photography and does not necessarily have to be based on the entire community.

Once established, the base impervious area for residential units is used to rate each commercial and industrial unit according to the amount of impervious area relative to the typical residential unit. As new development occurs, it is assumed that each new residential, commercial, or industrial unit increases storm water runoff proportional to the amount of impervious surface area developed with the respective property. Future residential units are rated as 1 EDU while commercial, multi-family, and industrial developments are rated according to the amount of impervious surface as measured in the field or as shown in the engineering plans. Using this method, future demands for storm system services and future SDC's can be based on estimated population growth rates for residential development with proportional growth in the commercial and industrial sectors.

Since industrial and commercial establishments generally develop larger areas of impervious surface, for example, parking lots and buildings, than residential developments, these sectors place a larger burden on the storm system. Consequently, this method allows for an equitable distribution of costs when evaluating how to finance storm water improvements and system development charges relative to the amount of benefit provided by the service. An example of the impervious surface EDU methodology for storm water system is provided below in Table 8.11.1.

TABLE 8.11.1
TYPICAL EDU's BASED ON IMPERVIOUS SURFACE METHODOLOGY

TYPE OF DEVELOPMENT	TYPICAL LOT SIZE, (SQUARE FEET)	IMPERVIOUS AREA, (SQUARE FEET)	NUMBER OF EDU'S*
Residential	10,000	5,000	1
Commercial w/ parking	10,000	9,000	2
Industrial w/ parking lot	20,000	15,000	3

*Rounded to the nearest whole unit.

Several storm water utilities have been established in Oregon based on this methodology. The utility provides a service with benefits based on a fair and equitable accounting method. Since the service received by the customer is directly proportional to the amount of impervious surface area, customers can be charged for the service accordingly.

EDU and impervious surface methodologies are used as an accounting procedure for properties that contribute storm water runoff to a drainage system. The same procedure can be used for developing SDC costs and assessing storm water utility fees.

8.12 Recommended Financing

The recommended financing would consist of a combination of loans and FEMA grants, with the loans repaid through storm water utility fees and system development charges.

The following recommendations affect project funding:

- The City should enter the FEMA National Flood Insurance Program to become eligible for federal grants.
- The City and Coos County should form a Blossom Gulch Drainage District to jointly administer development requirements and projects for flood prevention along the Blossom Gulch Creek floodplain and drainage basin. This district would act as a vehicle for making decisions to most efficiently direct the combined efforts of the City and County to reduce flood damage.

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