ORDINANCE NO. 911

AN ORDINANCE AMENDING THE STAYTON COMPREHENSIVE PLAN TO ADOPT THE 2009 STORM WATER MASTER PLAN AND INCORPORATE THE 2006 WATER MASTER PLAN AND 2006 WASTEWATER MASTER PLAN

WHEREAS, Oregon Revised Statutes, Chapter 197 requires municipalities to adopt and implement a comprehensive land use planning program in accordance with statewide planning goals established by the Legislature and the Oregon Land Conservation and Development Commission;

WHEREAS, the 1980 Master Utility Plan is the last time the City of Stayton has adopted a master plan for storm water management;

WHEREAS, starting in 2004 the City of Stayton started a comprehensive study of its storm water management needs;

WHEREAS, that study has documented current deficiencies in the City's storm water collection system, and needs for improvements to avoid flooding and other problems;

WHEREAS, the City of Stayton must, under state regulations, control the amount of mercury and bacteria and the temperature of stormwater discharges;

WHEREAS, pursuant to state regulations as a part of the comprehensive study of the City's storm water management needs, the City has submitted to the Oregon Department of Environmental Quality (DEQ) a plan for the management of mercury and bacteria in storm water discharges and the temperature of those discharges that meets the State's Total Maximum Daily Load requirements and that plan has been approved by the DEQ;

WHEREAS, once the City's population exceeds 10,000, storm water discharges will be regulated under Phase II of the Storm Water Program of the federal Clean Water Act;

WHEREAS, the Stayton City Council recognized the need for improvements in the City's storm water management system to comply with these state and federal regulations;

WHEREAS, the Stayton City Council has held workshop sessions on the draft Storm Water Master Plan in April 2007, January 2008, June 2008, and April 2009;

WHEREAS, following a public hearing on the proposed Storm Water Master Plan, the Stayton Planning Commission has recommended it be adopted by the Stayton City Council;

WHEREAS, the 2006 Water Master Plan and 2006 Wastewater Master Plan were adopted by the City Council by resolution and should be incorporated as a part of this Ordinance; and

WHEREAS, following a public hearing, the Stayton City Council finds that adoption of the 2009 Storm Water Master Plan will bring the City into compliance with the statewide planning goals.

NOW, THEREFORE, the Stayton City Council does ordain as follows:

SECTION 1. The Stayton City Council makes findings of fact and conclusions as contained in Exhibit A attached hereto and incorporated herein.

SECTION 2. The Stayton Comprehensive Plan, Chapter 4, is hereby amended as shown on Exhibit B attached hereto and incorporated herein.

SECTION 3. The April 6, 2009 Stayton Storm Water Master Plan, attached hereto as Exhibit C and incorporated herein, is hereby adopted as an addendum to the Stayton Comprehensive Plan.

SECTION 4. The Water Master Plan and Wastewater Master Plan as adopted by Resolution 768 on April 17, 2006, are hereby adopted as addenda to the Stayton Comprehensive Plan.

SECTION 5. Upon adoption by the Stayton City Council and Mayor's signing, this Ordinance shall become effective 30 days after the date of signing.

SECTION 6. A copy of this Ordinance shall be furnished to the State of Oregon, Department of Land Conservation and Development forthwith.

ADOPTED BY THE STAYTON CITY COUNCIL this 18th day of May, 2009.

CITY OF STAYTON

Signed: MAY 19, 2009 BY: ______________________

Gerry Aboud, Mayor

Signed: 5-19, 2009 ATTEST: ______________________

Don Eubank, City Administrator

APPROVED AS TO FORM:

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David A. Rhoten, City Attorney

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Exhibit A. Findings of Fact and Conclusions

Findings

After review of the record and the testimony presented at its public hearing, the Stayton City Council makes the following general findings of fact.

1. The City of Stayton adopted a Mater Utilities Plan in 1981 that addressed water, wastewater and storm water facilities. In 2006, the City Council adopted updated master plans for the City's water and wastewater systems.
2. In 2004, the City engaged Keller Associates to begin the process of updating the storm water master plan.
3. On June 8, 2005, Public Works Department personnel, the consulting City Engineer, representatives of Keller Associates and their subcontractor met to discuss the progress and procedures for developing the Master Plan. The Santiam Water Control District was represented at that meeting, mentioning the need for an agreement between the District and the City for an agreement on discharging storm water into their canals and their overall desire to see the discharge eventually removed.
4. Throughout the remainder of 2005 and 2006 Keller Associates worked with Public Works Department personnel to compile data on the existing storm water collection system and complete a draft of the Master Plan. During that time documentation of the storm water collection system was developed and Keller Associates created a computer model of the system to determine current and future inadequacies.
5. The study area for the Master Plan includes the entire Stayton Urban Growth Boundary as well as a portion of the Mill Creek watershed on the north side of State Route 22. Studies completed for the development of the master planned examined the existing conditions, the soils, natural resource features, and projected land use development in the study area.
6. A draft Master Plan was presented to the City Council at an April 23, 2007 work session. Keller Associates and their subcontractors explained the computer model, the alternatives analysis and the recommendations for storm water collection and treatment to the Council. The recommendations for new regulations to address storm water detention and improvements in storm water quality were also explained.
7. The Master Plan contains following components:
   a. A description of the study area, including land use, population projections, socio-economics and the storm water drainage sheds.
   b. Criteria for the design of storm water systems.
   c. Development and calibration of the computer model for the storm water collection system.
   d. A general description and a drainage basin assessment of existing conditions.
   e. Summaries of alternative improvements for each drainage basin.
   f. Discussion of water quality concerns, including the state federal regulatory programs, proposed storm water drainage standards and the results of water quality testing conducted by the City.
   g. Discussion of the operational maintenance and replacement needs of the stormwater collection system.

h. A capital improvements plan.

i. Recommendations for funding the capital improvements and operation of a storm water utility.

8. The City Council held work sessions in January and June 2008 to further discuss the Master Plan, with the focus of the discussion on financing the improvements necessary.

9. A majority of the city drains towards the Salem Ditch and the Stayton Power Canal. These man-made water conveyances were constructed in the mid-1800s as to provide water power for mills in Salem and downtown Stayton. They are now owned by the Santiam Water Control District and used for supply of municipal drinking water to the City of Stayton, hydroelectric generation, and supply of irrigation water to agricultural users.

10. On April 14, 2008, the City Notified the Department of Land Conservation and Development of the first evidentiary hearing on the proposed Storm Water Master Plan before the Stayton Planning Commission. Copies of the draft plan were sent to the Department. Notices of the public hearing were also published in the Stayton Mail, posted at City Hall, Stayton Library, Stayton Community Center and the City's web site, and sent to the Santiam Water Control District, and Marion County Planning Division.

11. On May 27, 2008, the Stayton Planning Commission held a public hearing on the Master Plan. The only testimony provided to the Planning Commission other than from staff and the City's consultants was from the Santiam Water Control District. The District testified that the City has no agreement to discharge drainage into the District's facilities, that there have instances of flooding and surface water contamination, and that the District fears it may lose its agricultural exemption from the requirements of the federal Clean Water Act because of urban storm water being discharged into its canals. As a result of the District's testimony the hearing was continued until June 30, 2008.

12. Following additional testimony from Staff and the Water Control District, the Planning Commission concluded its public hearing. As result of the testimony from the Santiam Water Control District, the Planning Commission made changes to the Master Plan that recognize the need for the City and District to work together to control runoff and come to an agreement regarding the management of the District facilities.

13. During the period July through October 2008, City staff met with the manager of the Water Control District to discuss a proposed Interim Agreement. After several meetings, discussion ended when the parties could not come to an agreement on issues of liability and payment of a fee.

14. The City Council held a final work session on the proposed Master Plan on April 13, 2009.

15. During the development of the Master Plan, the City came under the requirements of the Oregon Department of Environmental Quality's (DEQ) Total Daily Maximum Daily Load (TMDL) requirements for the Willamette River Basin. The City developed a TMDL plan for the control of mercury, bacteria and temperature that was submitted to the DEQ in November 2008 and approved on January 28, 2009. The approved TMDL Plan is included in the Master Plan as an appendix.

16. The City will come under the requirements of the Storm Water National Pollution Discharge Elimination System Phase II Program when its population exceeds 10,000 at a decennial census. The Master Plan projects this will occur following the 2020 Census and establishes a framework for the City to comply with the water quality standards of the Phase II Program.

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17. Stayton Council Resolution 768, adopted on April 17, 2006, adopted updates of the City's Water Master Plan and Wastewater Master Plan. OAR 660-011-0045 requires public facility plans to be adopted as part of the City's Comprehensive Plan.
18. Significant portions of the text of Chapter 4. Public Facilities of the Stayton Comprehensive Plan regarding water, wastewater, and storm water have not been updated in over twenty years and are no longer factually correct.

Criteria of approval

Stayton Municipal Code (SMC), Title 17, Land Use and Development, Section 17.12.170, Comprehensive Plan and Zone Map Amendments, Section 17.12.170.6, contains the Criteria for Approval for Comprehensive Plan amendments.

a. The proposed amendment is compatible with the existing provisions of the Comprehensive Plan as measured by:

   1) If a map amendment:

      a) The land area affected by change.

      b) Current use(s) in that area.

      c) The proposed use(s).

   Finding: There is no map amendment proposed.

   2) Impact of the proposed amendment on land use and development patterns within the City as measured by:

      a) Traffic generation and circulation patterns

      Finding: The proposal addresses storm water management within the city and the urban growth boundary. Construction of the proposed regional storm water detention facilities will result in small areas throughout the City not being available for residential or commercial development, therefore decreasing traffic generation. Aside from the small areas that will be removed from development potential by the construction of stormwater management facilities, the adoption of the updated Storm Water Management Plan will generally have a neutral impact on traffic generation and circulation patterns. Storm water facilities themselves are to be designed to improve and enhance development by providing planning tools for the appropriate disposal of storm water from new developments, including parking lots and streets.

      b) Population concentrations

      Finding: The proposal addresses storm water management within the city. Construction of the proposed regional storm water detention facilities will result in small areas throughout the City not being available for residential development, but will not affect overall population concentrations within the urban growth boundary.

      c) Demand for public facilities and services

      Finding: Adoption of the Storm Water Master Plan does not create any additional demand for public facilities or services. The proposal addresses the demand for storm water management facilities, and ensures that adequate storm water facilities will be developed to serve the City.

d) Level of park and recreation facilities

Finding: Adoption of this Storm Water Master Plan does not create any additional demand for park or recreation facilities. Storm water facilities to be constructed pursuant to this plan, such as detention basins may be able to provide open space and park type usage when they are not functioning for detention, which is a common use for such storm water facilities.

e) Economic activities

Finding: The proposal addresses future needs for storm water management within the urban growth boundary. Implementation of the plan will allow future commercial and industrial development to occur within an overall planned framework and assure that this development does not have detrimental impacts on water resources.

f) Protection and use of natural resources

Finding: The proposal will increase the level of protection of natural resources in the urban growth boundary by minimizing flooding in manmade and natural water bodies, by decreasing contamination levels in urban runoff, and by utilizing wetland areas as storm water detention basins.

g) Natural hazards and constraints

Finding: Adoption of this Storm Water Master Plan does not create any situation that would adversely impact or affect existing natural hazards or constraints in the City. Storm water management policies contained in the plan account for wetlands, floodplains, landslide hazards and other natural features present in the City.

h) Compliance of the proposal with existing adopted special purpose plans or programs such as public facilities improvement programs.

Finding: The City currently has in place master plans for water, sewer, and transportation. This Storm Water Master Plan was created in coordination with the goals and policies of those other master plans, and is designed to supplement and implement storm water management activities that are in compliance, to the extent applicable, those other City master plans.

b. A demonstrated need exists for the amendment based on the lack of available land in the districts where the proposed use(s) is allowed.

Finding: The proposed amendments to do not address the locations within the City where specific land uses are permitted.

c. The proposed amendment complies with all applicable Statewide Planning Goals and Oregon Administrative Rule (OAR) requirements, including compliance with Goal 14 and the Urban Growth Policies of the City of Stayton (Section 17.08.030) if a change in the urban growth boundary is requested.

Finding: No change to the location of the Urban Growth Boundary is proposed in this case, therefore compliance with Goal 14 and the Urban Growth Policies of the City is not necessary or relevant here.

The relevant and applicable Goals in this case are 1, 2, 5, 6 and 11. Goal 1 is complied with based on the process used for consideration of this case. This matter was initiated by the City Council and referred to the Planning Commission who conducted extensive inquiry and public hearing process. The City Council then held a work session on the Planning Commission's recommendation, and held its own public hearing process after due notice and opportunity to be heard was provided.

Goal 2 involves coordination with other relevant governments and agencies. In this case Marion County and the Santiam Water Control District were included in the consideration process and were notified of work sessions and public hearings at all relevant times. The Santiam Water Control District was an active participant with staff, at the Planning Commission and before the City Council.

Goal 5 involves open space and natural resources. As noted above, open space and natural resources have been considered in the new storm water master plan.

Goal 6 is intended to make sure changes to the comprehensive plan take into account air, water and land resource quality. The new Storm Water Master Plan takes into consideration specifically issues related to water quality, by addressing the need for improved and enhanced storm water management to ensure water quality in the storm water system.

Goal 11 relates to the provisions for public facilities and services by the City. Storm water management is a responsibility of the City. The current storm water plan is out of date, inaccurate, and not in compliance with current regulations. The Storm Water Master Plan provides updated and accurate quality testing and monitoring, a plan for future treatment, and plans and policies that conform to current law, specifically including the Total Daily Maximum Load regulations.

d. The proposed amendment is possible within the existing framework of the Comprehensive Plan (e.g., no new land use designation categories, policy categories, or plan elements are necessary to accommodate the amendment).

Finding: The framework of the Stayton Comprehensive Plan includes a series of public infrastructure master plans addressing detailed needs, goals and policies regarding specific areas of need that is provided by the City, including sewer, water, transportation and storm water. These master plans are a guide for the City for future planning and management of all aspects of the city, including growth, land use management and public facilities budgeting. It is important the City have updated and accurate master plans for its public facilities. This case addressed the need for updating the storm water master plan, bringing the text of the plan relative to Public Facilities up to date and does not involve any new land use designations.

e. The amendment is appropriate as measured by at least one of the following criteria:

1) It corrects identified error(s) in the provisions of the Plan.

Finding: The proposal corrects errors in out-dated information regarding some of the City's public facilities and by incorporating the 2006 Water and Wastewater Master Plans that were adopted only by resolution.

2) It represents a logical implementation of the Plan.

Finding: The proposed amendments continue the City's commitment to maintaining adequate facilities and services and to protecting natural resources.

3) It is mandated by changes in federal, state, or local law.

Finding: Portions of the proposal are required under the State's Total Maximum Daily Load regulations and the proposal is drafted to establish a framework for compliance with the federal storm water regulations when those regulations apply to the City of Stayton.

4) It is otherwise deemed by the City Council to be desirable, appropriate, and proper.

Finding: The City Council initiated the planning process in 2004 recognizing the need for improvements to the existing storm water collection and treatment system in the City and also recognizing that in the future the City of Stayton will need to comply with increasing state and federal regulations.

Conclusions

Based on the facts above, the Stayton City Council concludes that:

1. The proposed amendments to the Stayton Comprehensive Plan and the April 9, 2009 Stayton Storm Water Master Plan conform to the statewide planning goals and guidelines, more specifically,

   a. Statewide Planning Goal 1: Citizen Participation. The City Council concludes that he city has satisfied the requirements for citizen participation through the involvement of the Council and Planning Commission in the process of developing the Storm Water Master Plan, through the public workshops that were held on the drafts of the Master Plan as it was written and through the public hearings held by both the Planning Commission and the City Council.

   b. Statewide Planning Goal 2: Land Use Planning. The City Council concludes that the City has satisfied its obligations to coordinate its planning efforts with other levels of government and other quasi-governmental organizations through notification of these other entities of the planning process; by review of the testimony of the Santiam Water Control District by the Stayton Planning Commission; by the amendments to the draft Plan made by the Planning Commission in direct response to the testimony of the Santiam Water Control District; by the efforts of the City Staff to negotiate an Interim Agreement with the Santiam Water Control District.

   c. Statewide Planning Goal 5: Natural Resources, Scenic and Historic Areas, and Open Spaces. The City Council concludes that open space and natural resources have been considered in the new storm water master plan, and the Storm Water Master Plan complies with Goal 5 and with the requirements of OAR 066-016 and OAR 066-023.

   d. Statewide Planning Goal 6: Air, Water and Land Resources Quality. The City Council concludes that the Storm Water Master Plan has been written to provide the framework for compliance with the Phase II Storm Water Program of the federal Clean Water Act and with the State's Total Daily Maximum Load requirements for the Willamette River Basin. The City Council further concludes that implementation of the Master Plan will result in decreased storm water flow, decreased peak storm water discharge rates, and improved storm water quality.

   e. Statewide Planning Goal 11: Public Facilities and Services. The City Council concludes that the Storm Water Master Plan will help assure that urban development in the Stayton urban growth boundaries will be guided and supported by types and levels of urban facilities and services appropriate for the needs and requirements of the urban area to be serviced, and that those facilities and services are provided in a timely, orderly and efficient arrangement, and that the Master Plan has been written to meet the requirements of OAR 660-011.

2. The proposed amendments to the Stayton Comprehensive Plan and the April 9, 2009 Stayton Storm Water Master Plan meet the requirements of Stayton Municipal Code, Title 17, Land Use and Development, Section 17.12.170, Comprehensive Plan and Zone Map Amendments, Section 17.12.170.6, Criteria for Approval, more specifically,

    a. The proposed amendments are compatible with the existing provisions of the Comprehensive Plan as measured by the impact of the proposed amendments on land use and development patterns within the City as measured by:

        i. Traffic generation and circulation patterns

        ii. Population concentrations

        iii. Demand for public facilities and services

        iv. Level of park and recreation facilities

        v. Economic activities

        vi. Protection and use of natural resources

        vii. Natural hazards and constraints

        viii. Compliance of the proposal with existing adopted special purpose plans or programs such as public facilities improvement programs.

    b. The proposed amendments comply with all applicable Statewide Planning Goals and Oregon Administrative Rule requirements.

    c. The proposed amendments are possible within the existing framework of the Comprehensive Plan in that do not create any new land use designation categories, policy categories, or plan elements are necessary to accommodate the amendment.

        i. The amendments are appropriate as they correct identified errors in provisions of the Comprehensive Plan.

        ii. The amendments represent a logical implementation of the existing policies in the Comprehensive Plan.

        iii. The amendments are mandated by changes in the applicability of federal and state water quality laws.

        iv. The amendments are deemed by the City Council to be desirable, appropriate, and proper for the future improvements and expansion of the City's storm water collection and management system, for reducing the City's impacts on downstream flooding, and for improving water quality.

Chapter 4 Public Facilities and Services

The Public Facilities element of the Stayton Comprehensive Plan describes water, sanitary sewers, ~~and~~ storm ~~sewer~~water, and parks systems ~~based upon the City of Stayton's master utilities plan as required by ORS 660, Division 11~~. Other public facilities and services are either provided by the city, by other levels of government, or ~~need to be considered as new developments are proposed~~by independent districts.

This Chapter provides an overview of the public facilities and services in the City. For those provided by the City itself, there are more specific Master Plans that are updated and adopted by the City Council. These Master Plans are written with consideration of the City's goals and policies contained in the Comprehensive Plan but contain more specific details for improvements to the systems than is appropriate to include in the Comprehensive Plan. They are adopted as addenda to the Comprehensive Plan.

~~Master Utilities~~

~~The City of Stayton developed a master utilities plan in December 1980 after the adoption and acknowledgment of the Stayton Comprehensive Plan in April 1980. The master utilities plan evaluates the city's water system, sanitary sewer system, and storm sewer system. Since 1981, the city has utilized the computer programs developed for the master utilities plan to refine the service needs for new industry and other development. The master utilities plan includes chapters on financing methods and phased implementations.~~

~~The City of Stayton is preparing a Capital Improvements Program (CIP) based on the master utilities plan. A few projects noted in the master utilities plan have been completed; however, many projects remain to be completed. Most of the projects are needed to support the development of a city with a population of 11,500, although many projects are needed to better serve the current population.~~

Municipal Water System

The City of Stayton owns and operates a municipal water system serving most of the area within the present city limits.

~~The major water system facilities and the service areas are shown on the Public Facilities Map. The city built a new water treatment plant in 1971 with a supply capacity of 8.5 million gallons per day.~~ The major source of drinking water is the North Santiam River, with an intake from the Reid Power Canal. The C~~c~~ity also owns and maintains three infiltration wells ~~which~~ that draw water from the gravel strata adjacent to the river. Altogether, the wells would produce approximately two million additional gallons per day. Only one of these wells is used on a regular basis, but all three wells can be used if needed.

The majority of Stayton's water is ~~provided through a contract with~~delivered through the Santiam Water Control District's canal. The D~~d~~istrict agrees to provide continuous 24-hour a day service of up to 40 cubic feet per second (approximately 18,000 gallons per minute). For greater fire flows and better system reliability, the city also maintains a connection with the City of Salem's main transmission line. ~~This connection and related facilities, known as Schedule M, consists of a 1 million gallon reservoir and booster pump facilities.~~

The city built its water treatment plant in 1971 and the plant currently has a treatment capacity of 6.8 million gallons per day. Treatment processes include filtration, chlorination, and the addition of soda ash for pH stabilization. A 0.5 million gallon clearwell provides necessary chlorine contact time as well as some storage volume for the water system.

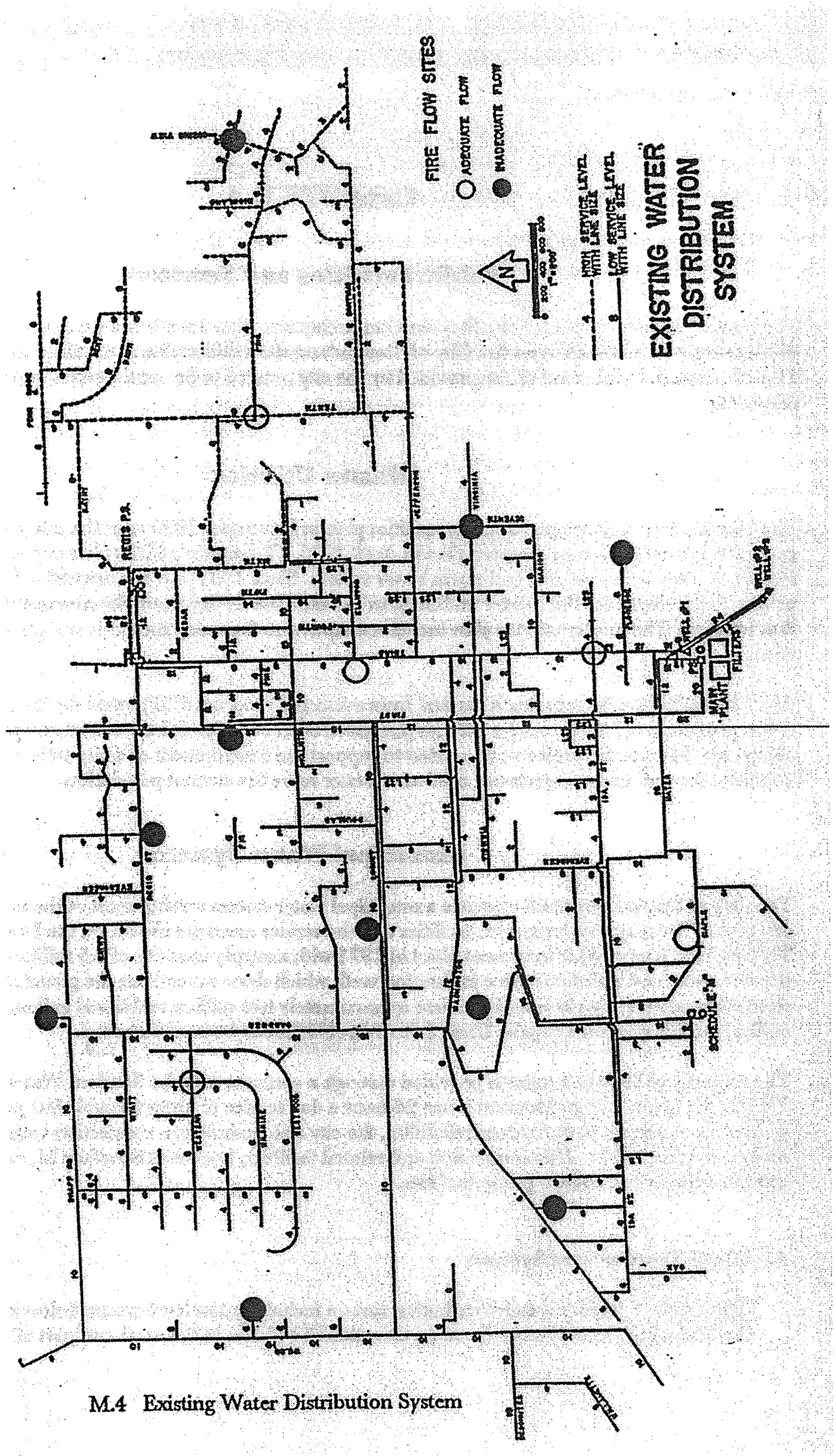
~~A. Water Distribution System~~

The City of Stayton's water distribution system consists of approximately 44 miles of pipe and covers two pressure zones. The two zones are intertied through pressure reducing valves thus providing system redundancy for emergency events.

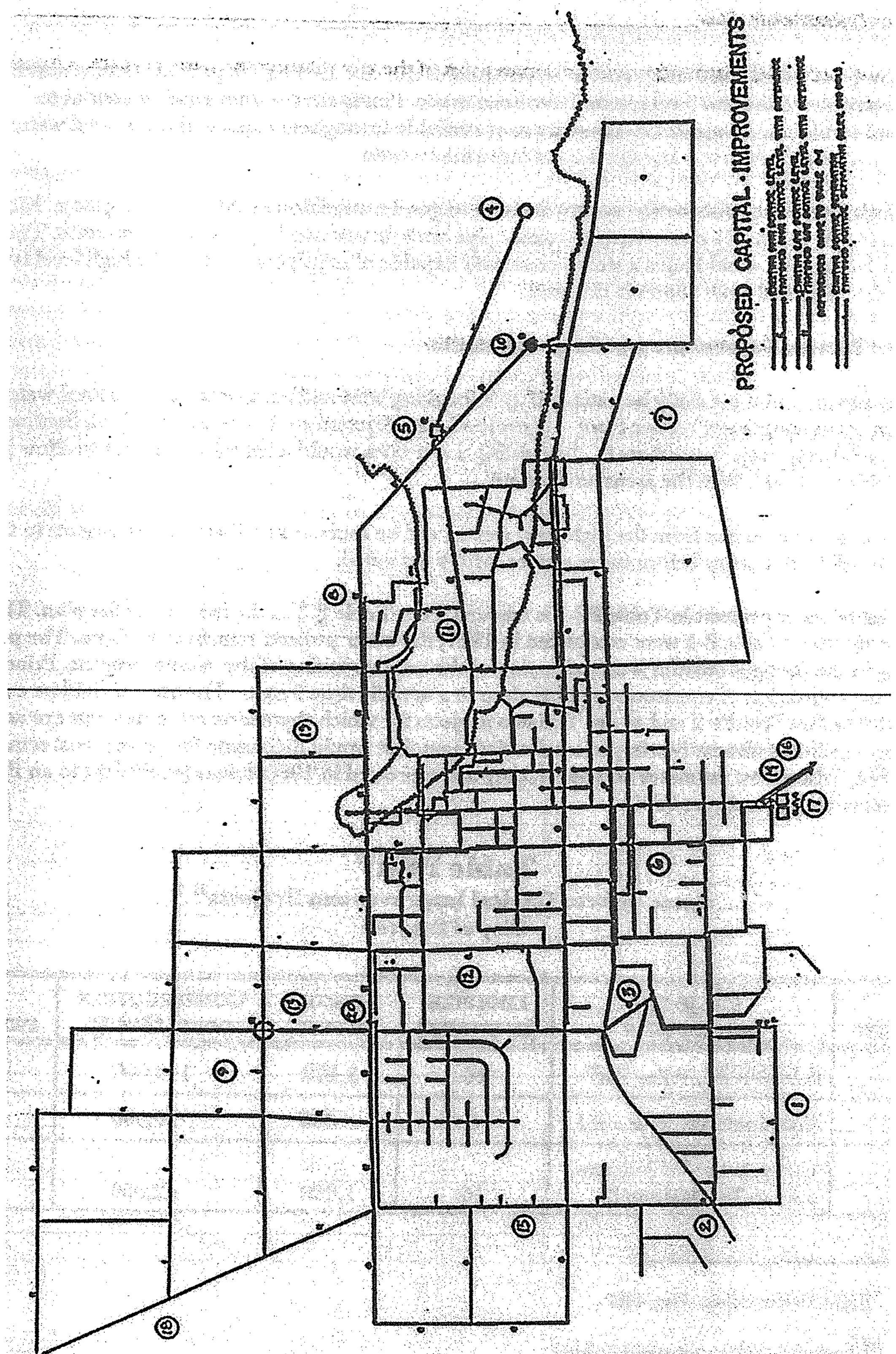
~~The City of Stayton's water distribution system includes a low level system below an elevation of 465 feet and a high level system above an elevation of 465 feet in the northeast part of the city.~~

Several capacity and operational improvements for all components of the water system have been identified in the City's Water Master Plan along with cost estimates and demand projections.~~The low level water distribution system serves most of the city. During the past 15 years, a number of improvements to the low level system have been made. Piping ranges from good to poor as to size and condition. Adequate fire flows are now available throughout some of the low level water system. Low level reservoir storage is considered inadequate.~~

~~The high level water distribution system is not in as good a condition as the low level system. Most of the piping is reasonably competent, but many pipe sizes do not handle peak water demands. The high level water system should have a storage reservoir capable of supplying water to the high level system to meet fire flows and peak domestic demand.~~



M.4 Existing Water Distribution System



M.5 Proposed Capital Improvements

~~B. Water Service Extensions and Improvements~~

~~Water service can most easily be extended by lines going west and north from the low level water system. Extending water service from the low level water system south toward the North Santiam River is also relatively easy. In most areas, the existing water lines would need reinforcement to allow pipeline extensions outward from the areas now served.~~

~~Extending water service from the high level system will be more costly. Basic improvements to that system will be necessary before water service is fully extended.~~

~~The list of water projects in Table PF-1 is adapted from Table 8-1 in the master utilities plan. The first two projects on Table 8-1 were completed in 1981; the other projects remain to be done. The priority listing in the far right column is an estimation of the relative timing of the various projects. Priorities refer to progression of construction rather than to a specific time frame—Priority 1 should be constructed before Priority 2 and so on. The two projects for which there is no estimated cost are cases where significant alternatives in project development that would determine the project cost remain to be decided. Where cost estimates do appear, they are expressed in 1980 dollars (equivalent to an ENR construction cost index at 3200).~~

~~Table PF-1[1], Water System Capital Improvement Projects[2]-[3], City of Stayton~~

~~Project~~	~~Project Description~~	~~Line Size (in inches)~~	~~Length (in feet)~~	~~Construction Costs (in 1980$)~~	~~Priority~~
~~1.~~	~~Schedule M, Wilco Rd~~	~~16~~	~~3,400~~	~~143,000~~	~~1~~
~~2.~~	~~Washington to Wilco Rd~~	~~6~~	~~800~~	~~20,000~~	~~1~~
~~3.~~	~~Connect 16" behind cannery to Washington St~~	~~16~~	~~1,000~~	~~42,000~~	~~2~~
~~4.~~	~~5 mg Reservoir~~	~~—~~	~~—~~	~~1,000,000~~	~~1~~
~~5.~~	~~High Lvl Pump Station~~	~~—~~	~~—~~	~~130,000~~	~~1~~
~~6.~~	~~Transmission Line 1, First Ave to Reservoir~~	~~20~~	~~9,000~~	~~468,000~~	~~1~~
~~7.~~	~~Grid Network, SE area~~	~~8~~	~~22,000~~	~~462,000~~	~~2~~
~~8.~~	~~Transmission Line 2, Reservoir to Wilco~~	~~24~~	~~17,000~~	~~1,071,000~~	~~2~~
~~9.~~	~~Grid Network, north area~~	~~8~~	~~40,000~~	~~840,000~~	~~3~~
~~10.~~	~~.75 mg Elevated Reservoir~~	~~—~~	~~—~~	[4]	~~3~~
~~11.~~	~~Transmission Line 3, High Service Zone~~	~~14~~	~~8,000~~	~~288,000~~	~~2~~
~~12.~~	~~Line from Shaff Rd to High School~~	~~12~~	~~2,400~~	~~74,400~~	~~2~~
~~13.~~	~~2 mg Ground Level Reservoir, Pump Station~~	~~—~~	~~—~~	~~500,000~~	4
~~14.~~	~~Treatment Plnt Expand~~	~~—~~	~~—~~	[5]	4

[1] ~~JMM Master Utilities Plan, 1980~~

[2] ~~Does not include maintenance projects~~

[3] ~~Priority 1 means should be constructed before Priority 2, and so on over the 20 years 1985 to 2005. Priorities are subject to change through revision of the Capitol Improvement Program and more detailed public facility planning.~~

[4] ~~No estimate at this time~~

~~15.~~	~~Line paralleling Wilco~~	~~10-12~~	~~7,000~~	~~217,000~~	~~4~~
~~16.~~	~~System Control, Tele-metering~~	~~-----~~	~~-----~~	~~40,000~~	~~2~~
~~17.~~	~~Pumping Plant Pumping Improvements~~	~~-----~~	~~-----~~	~~25,000~~	~~1~~
~~18.~~	~~Line from Shaff to Santiam Golf Course~~	~~12-14~~	~~8,000~~	~~288,000~~	~~3~~
~~19.~~	~~Grid Network, High Level Pump Station~~	~~8~~	~~12,000~~	~~252,000~~	~~3~~
~~20~~	~~Connect Shaff to First~~	~~12~~	~~1,200~~	~~37,200~~	~~2~~
~~TOTAL~~				~~$6,005,000~~	

Stayton ~~Santiam~~ Sanitary Sewer System

The City's wastewater collection system consists of approximately 33 miles of pipelines and five lift stations. Additional flow is conveyed to Stayton's collection system through a small private lift station and a municipal lift station bringing in wastewater from the neighboring City of Sublimity.~~In 1963, the City of Stayton developed a sanitary sewage collection and treatment system that provided service to the City of Stayton. The City of Sublimity was included in the system in 1975. Both systems are working well and are currently below capacity. The Stayton population projection to the year 2005 is 11,500. Sublimity's projection to the year 2005 is 2,900. The combined total of 14,400 will require major changes and additions to the treatment system prior to the year 2005. More trunk lines and lift stations are needed to serve all of the urban growth area.~~

~~A.Stayton-Sublimity Sewer Agreement~~

~~A June 1973 agreement between Stayton and Sublimity provided for a regionalized sanitary sewer facility. The agreement includes connection cost sharing and flow restrictions. General provisions were the adoption and enforcement of rules and regulations concerning the collection and disposal of sanitary waste.~~

~~These regulations meet current standards and practices laid out by the U.S. Environmental Protection Agency and the Oregon Department of Environmental Quality (DEQ).~~

~~B.Treatment System~~

The City ~~of Stayton~~ operates ~~maintains~~ a wastewater ~~sewage~~ treatment plant located along the Santiam River ~~at~~ the southwest corner of the urban growth boundary. The Treatment process includes headworks with screening, two sequencing batch reactors for biological treatment, and UV disinfection. Solids handing processes include aeration, dewatering, and lime stabilization. The treated biosolids are stored and land applied.~~This plant is a tertiary facility designed to handle an average flow of 1.35 million gallons per day (MGD). As of May, 1989, the average daily flow was .876 mgd. The plant has peak flow capacity equal to 4.05 million gallons per day. Effluent from the treatment plant is discharged to the North Santiam River and meets current DEQ effluent requirements.~~

~~C.Sewage Collection System~~

The City's original ~~Stayton~~ sewage collection system was built in 1963 and has a fairly significant infiltration/inflow problem. Organized efforts to correct this have made some progress in reducing the wet weather flows.

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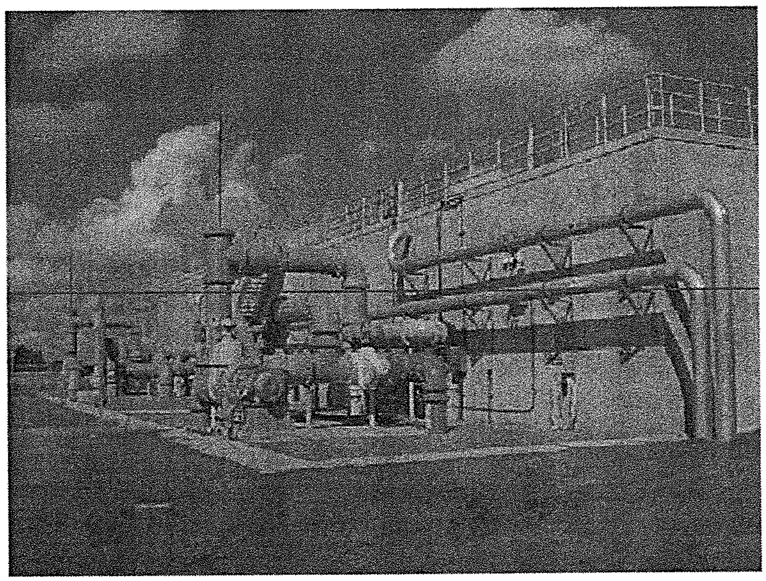
[5] ~~*Ibid*~~

The Sublimity sewage collection system was installed in 1975, and most homes in Sublimity were connected to the system by mid-summer 1976. All of the Sublimity sewage is pumped into the Stayton system for treatment. The Stayton sewage system was designed to expand to serve adjacent areas. The success of the infiltration/inflow reduction program will, however, determine how much additional service can ultimately be provided by the existing sewage treatment system.

Capacity and operational improvements for all components of the wastewater system have been identified in the City's Wastewater Master Plan.



For Illustrative Purposes Only

~~Sewer Service Areas~~

~~A.Pumping Facilities~~

~~The Public Facilities Map shows the City of Stayton and the urban growth area. Within the existing Stayton sewer service area, lift stations serve areas that could not be served by gravity.~~

~~Lift Station No. 1, located on Gardner Avenue, serves the east portion of Westown and West Regis and a portion of West Shaff Road. Lift Station No. 2 is located on Fern Ridge Road just east of Tenth Avenue. This lift station has the capacity to serve approximately 100 homes. If relocated, this lift station could serve much of the area on the north side of Fern Ridge in the eastern part of the city. Lift Station No. 3 is the Wilco Road lift station. It serves the immediate area with additional allowances for the sewage anticipated to be pumped from a future lift station located adjacent to Mill Creek near the Santiam Golf Course. Lift Station No. 4 is on Deschutes Avenue and serves the Stayton Industrial Park.~~

~~A fifth lift station pumps the sewage flows from Sublimity to Shaff Road. The sewage then flows by gravity to the Wilco Road lift station.~~

~~B.Gravity Sewers~~

~~The rest of the city is presently served by gravity sewers. Future development will generally require a combination of gravity sewers within drainage basins and lift stations to pump sewage out of the basins to the treatment plant.~~

~~The existing gravity sewer system could easily be expanded eastward within the urban growth boundary. The area along the south boundary of the city, however, will be difficult to serve. Much of this area lies in the floodplain of the Santiam River, and virtually all service would need to be provided by pumping facilities. Likewise there is another small area between the existing service and the urban growth boundary on the very west end of Shaff Road which will be difficult to serve by gravity from any of the existing or planned systems.~~

~~Much of the potential growth area for Stayton lies north of Shaff Road and in the westerly portion of the urban growth boundary. There are several options for expanded sewer service in the Mill Creek drainage north of the present sewer service area. There will probably be a need for a sewer lift station adjacent to Mill Creek near the Santiam Golf Course. Eventually gravity sewer service to that lift station might be extended all the way up Mill Creek, thereby providing sewer service to the Stayton urban growth boundary area north of the present sewer service area.~~

~~C.Sewer Extensions and Improvements~~

~~The first priority for assuring that capacity for expanded sewer service will be continued efforts to reduce infiltration and inflow into the present system. These flows of extraneous water greatly reduce the residual capacity for sewer service to new areas adjacent to the existing service areas. The flow reduction efforts should be seen as a continued maintenance effort. It should be pursued in an organized manner with some money budgeted each year for reduction.~~

~~Expanded sewer service at this time can most easily be provided in the area that would be served by gravity on the east side of the city, on the west side of the city, and within the Wilco Road service area. In each of these areas, land could be developed and served by simply extending existing sewers. The feasibility of serving the area in the east with sewers is offset, however, by the relatively greater costs of providing water service in that area.~~

~~The Lift Station No. 2 service area could allow extension of sewers where a considerable interest exists in more residential development. Extended service into the Mill Creek drainage area, with the exception of the area that can be served by the Wilco Road system, is a little more difficult. West of the Sublimity lift station the area would need to be served by a new lift station and force main. That, of course, would necessitate a considerable investment. The area east of the Sublimity lift station could be served to that lift station if arrangements with the City of Sublimity can be made.~~

~~Projects identified under "Model 1" in the Master Utilities Plan are listed in Table PF-2.~~

~~Table PF-26, Santiam Sewer System Capital Improvement Projects7~~

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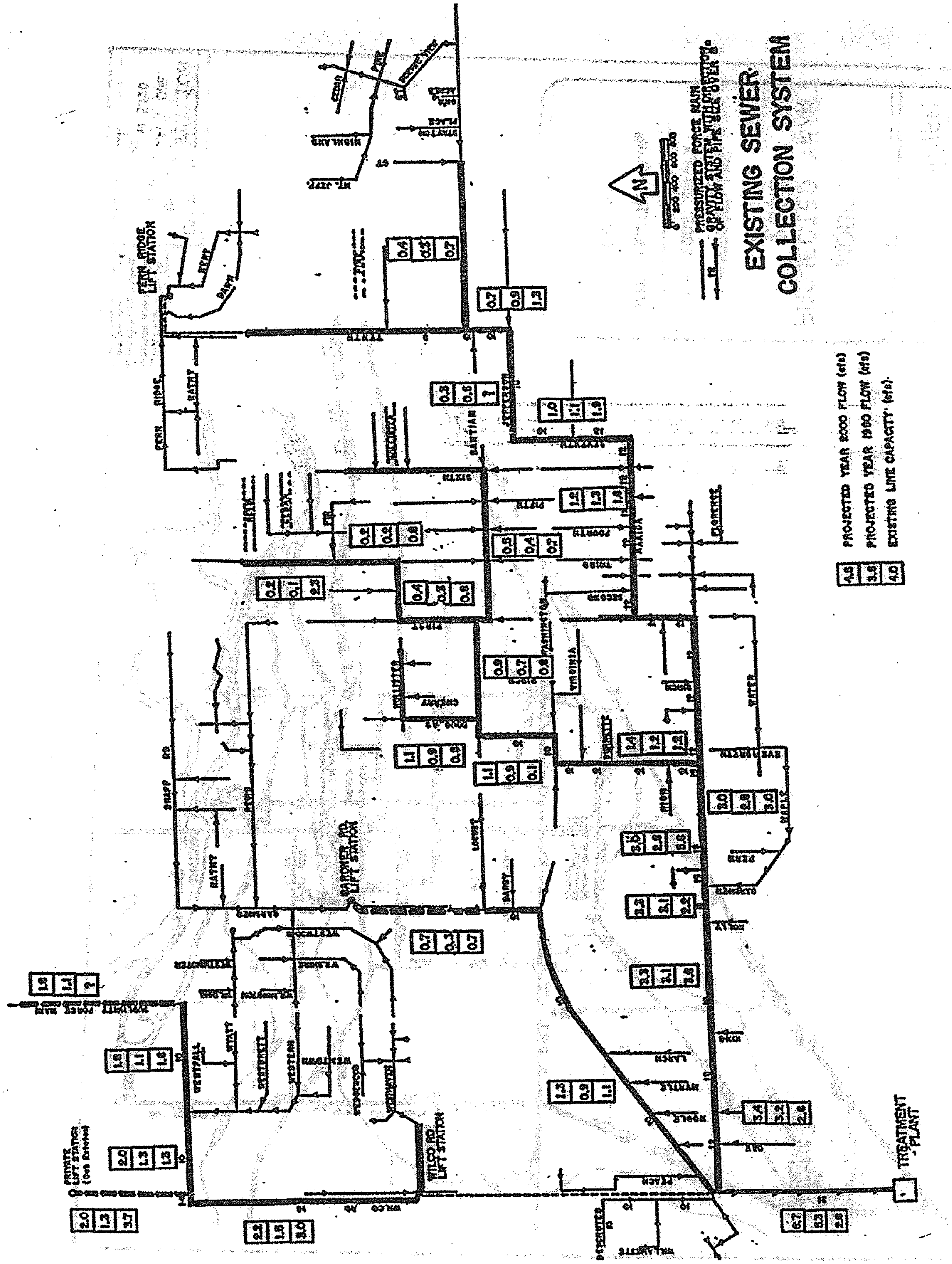
[6] ~~JMM Master Utilities Plan, 1980~~

[7] ~~Does not include maintenance projects~~

~~Project Description~~	~~Length (inches)~~	~~Size~~	~~Cost (1980 $)~~	~~Priority~~[8]
~~Lift Stations~~		~~(mgd)~~		
~~Golf Club Road (new)~~		~~3.0~~	~~75,000~~	~~2~~
~~Wilco Rd Station Remodel (existing)~~		~~4.2~~	~~55,000~~	~~3~~
~~First Ave Lift Station (temp.)~~		~~0.75~~	~~35,000~~	~~2~~
~~Summary of Needed Interceptors by Size~~	~~5,200~~ ~~7,200~~ ~~4,200~~ ~~13,800~~ ~~3,500~~ ~~3,100~~ ~~2,700~~ ~~2,500~~	~~8~~ ~~10~~ ~~12~~ ~~15~~ ~~18~~ ~~21~~ ~~24~~ ~~30~~	~~114,400~~ ~~180,000~~ ~~126,000~~ ~~483,000~~ ~~136,500~~ ~~136,400~~ ~~129,600~~ ~~145,000~~	~~1 to 4~~
~~Laterals~~	~~74,000~~	~~8~~	~~1,480,000~~	~~1 to 4~~
~~Force Mains~~	~~5,200~~ ~~3,500~~ ~~1,900~~	~~14~~ ~~16~~ ~~6~~	~~156,000~~ ~~122,500~~ ~~25,000~~	~~1 to 4~~
~~TOTAL COST~~			~~$3,399,400~~	

[8] ~~Priority 1 means should be constructed before Priority 2, and so on over the 20 years 1985 to 2005. Priorities are subject to change through revision of the Capitol Improvement Program and more detailed public facility planning.~~



M.6 Existing Sewer Collection System

22

~~[Map M.4, Sanitary Sewer Model 1]~~

~~[MAP M.5, EXISTING STORM SEWER COLLECTION SYSTEM]~~

~~[Map M.6, Storm Sewer Proposed Improvements]~~

Storm Sewer System

The City's storm water system consists of approximately 15 miles of pipe, 8 miles of open channels, 650 catch basins, 20 detention facilities, and 38 major outfalls all within six major drainage basins. The majority of the City's outfalls are along the Salem Ditch, which ultimately carries flow to Mill Creek.

The major trunk line through the City runs north on 1st Avenue from Hollister, and West on Shaff Road with 48" outfall to an open channel draining to Salem Ditch.

Runoff from the City is partially treated through biofiltration swales, catch basins, and detention facilities and is considered to be generally of good quality. Storm water within the city will be primarily managed through the BMPs identified in the City's TMDL Implementation Plan and Storm Water Master Plan.

The Storm Water Master Plan identifies specific improvements for the storm water system along with costs and concepts to accommodate runoff from future development.

~~The Master Utilities Plan also evaluated design criteria, quantity of storm runoff, and hydraulic considerations for new storm drains. New facilities were then proposed based upon 10-year storm events. New facilities would be either in the eastern part of the urban growth boundary or in the northern area drained by Mill Creek. The city completed a study of Mill Creek floodplain to plan the location of dikes, drains, and detention basins in 1982. The rough cost estimate for the last item in Table PF-3 is derived from the Mill Creek study. The Mill Creek study has not been adopted by the city council.~~

~~Table PF-39, Storm Sewer System Capital Improvement Projects10~~

~~Code~~[11]	~~Project~~	~~Line Size (inches)~~	~~Length (feet)~~	~~Construction (1980 $)~~	~~Priority~~[12]
~~Existing~~					
~~A,B~~	~~Drainage Basins 3, 4, 5, 6, 9~~	~~52~~	~~8,000~~	~~800,000~~	~~1~~
~~C~~	~~Drainage Basin 2~~	~~48~~	~~1,600~~	~~144,000~~	~~1~~
~~D~~	~~Existing Trouble Spots~~			~~100,000~~	~~1~~
~~New Eastern~~					
~~E~~	~~Trunks~~	~~48~~	~~9,000~~	~~810,000~~	~~4~~
~~F~~	~~Laterals~~	~~15~~	~~6,000~~	~~204,000~~	~~4~~
~~New Northern~~					
~~G~~	~~Open Channel~~			~~50,000~~	~~3~~
~~H~~	~~Trunks~~		~~5,000~~	~~256,000~~	~~2~~
~~I~~	~~Trunks~~	~~42~~	~~3,200~~	~~230,000~~	~~2~~
~~J~~	~~Trunks~~	~~24~~	~~4,800~~	~~98,000~~	~~2~~
~~K~~	~~Laterals~~	~~12~~	~~3,500~~	~~204,000~~	~~2~~
~~L~~	~~Laterals~~	~~15~~	~~6,000~~	~~66,000~~	~~2~~
~~M~~	~~Modify South Mill Creek~~	~~8~~	~~3,000~~	~~75,000~~	~~3~~
~~N~~	~~Rechannel Mill Creek~~			~~750,000~~	

[9] ~~Master Utilities Plan, 1980; Mill Creek Flood Plain Study~~

[10] ~~Does not include maintenance projects~~

[11] ~~Codes refer to Figure 14-1 in Master Utilities Plan~~

[12] ~~Priority 1 means should be constructed before Priority 2, and so on over the 20 years 1985 to 2005. Priorities are subject to change through revision of the Capitol Improvement Program and more detailed public facility planning.~~

~~TOTAL~~ ~~$3,780,000~~

Fire Service

The Stayton Rural Fire Protection District is a volunteer department, with a full time paid chief, which serves both the city and adjacent rural areas due to the 1985 annexation of the city into the rural district. The new fire station opened in 1988 and is located on West Ida Street near Wilco Road. Information on equipment, insurance rating, and fire incidents and service calls is included in the State Fire Marshal's annual report.

Expansion of the city will necessitate at least one additional fire station. The fire chief has recommended the area of Tenth Avenue and Santiam Street as a possible east side location.

In addition to fire fighting functions, the fire station provides first aid, communications, and public education on fire safety.

Police Service

Police services are provided by a professional force on a 24-hour per day basis. The police department occupies the old city hall building and was remodeled in 1988 and is located on Third Avenue.

Support services are provided the department by a complement of police reserves (adults) and cadets (ages 15 to 21), who provide support services and perform traffic and crowd control at special events. A comprehensive training program is required of all personnel.

The department maintains lock-up facilities for detention of arrestees. Currently two holding cells are provided in this facility.

Stayton police will need increased staffing in order to maintain current service levels as the city grows. Guidelines to meet growth needs include: 1) One patrol person for each 500 additional people; 2) One new vehicle for each four to five new patrol persons is a minimal standard; 3) Standard support equipment for each new patrol person; and 4) Modification and/or replacement of communications equipment for a five-year basis.

Schools

Stayton has a complementary group of schools that is unique among Oregon small towns. Both public and private schools enroll a significant number of children from grades kindergarten through twelfth grade.

School District 77J is a public elementary district that primarily serves Stayton and the surrounding area. The district includes Stayton Grade School and a small rural school at Mehama. Stayton Grade School had a 1989-1990 enrollment of 479 in grades kindergarten through fourth. Kindergarten was added in the 1984-1985 school year. The grade school has a student capacity of 550.

The Stayton Middle School had a 1989-1990 enrollment of 407 students in grades fifth through eighth. Its capacity is 400 students. The middle school occupies a 68½ acre site; however, some of it is not developable.

Stayton Private School had an enrollment of 93 in 1989-1990 in grades kindergarten through seventh. Santiam Montessori School had a kindergarten enrollment of 21 for 1989-1990. St. Mary's School had an enrollment of 292 in 1989-1990 in grades first through eighth. The facilities and its seven acre site are adequate for current and anticipated enrollment.

Regis High School had an enrollment of 206 in 1989-1990 in grades ninth through twelfth. The building has a capacity of 250 with room for expansion on a 30-acre site.

The Stayton Union High School district includes Stayton and Sublimity areas. The enrollment at Stayton Union High School reached a peak at 620 in 1979. In the early 1980s, enrollment declined somewhat to a range of 500 to 560. The 1989-1990 enrollment was 536. The school facilities and the 38-acre site are adequate for the foreseeable future.

The primary land use need of the schools in Stayton is for elementary school sites. One site is needed to permit the relocation of the Stayton grade school from its present downtown site. A second elementary school may be needed to accommodate the planned growth of the city to a population of 11,500 by 2005. A desirable site for a new elementary school would be next to the middle school.

Solid Waste

Currently solid waste in Stayton is collected by the Stayton Sanitary Service. The solid waste collected at Fern Ridge Transfer Station is located east of Stayton. Waste collected here is transferred to the Marion County Solid Waste Energy facility in Brooks.

Stayton is within the area covered by the Chemeketa Region Solid Waste Management Plan. Marion County is the primary local agency responsible for implementing the solid waste management plan. The Oregon DEQ is responsible for enforcing state and federal law related to solid waste. A recent state law, ORS 340.60, adopted in December 1984, requires curbside pickup of recyclable materials must be available at least monthly in cities of 4,000 or more and within the urban growth boundaries as of July 1, 1986. The City of Stayton, in its role as franchiser, is working in cooperation with the Marion County Solid Waste Division to implement this recycling bill.

Park and Facility Needs

(Ord. 875, March 2005)

There were a number of deficiencies identified in the Stayton Park and Recreation Master Plan. Some of these include a shortage of community and neighborhood parks, the absence of a comprehensive open space and off-street trail system and youth facilities like a skate park. The following is a summary of park and facility needs outlined in the Park and Recreation Master Plan:

1. Based on a one-mile service area, two additional community parks are needed to serve the entire planning area. See City of Stayton Park and Recreation Master Plan.
2. Based on a half mile service area, three additional neighborhood parks are needed to serve the entire planning area. One of these, Santiam Park, has been acquired, but not yet developed.
3. Linear Parks are needed to provide trail corridors along several ditches in the Stayton area.
4. Open space areas are needed to preserve environmentally sensitive areas, creek corridors and especially the Santiam River.
5. Special use areas, such as a skate park, would add to the diversity of park and recreation facilities and also serve as targeted population group.

6. There is considerable interest in trail facilities. The need for trails can be met by adding paved and unpaved trails through newly acquired open space areas, and urban stream corridors.

Parks and Recreation

The City of Stayton has four developed park facilities: Northslope Park, Pioneer Park, Westown Park, and the Community Center Park. Pioneer Park contains a tennis court, swings, slide, and picnicking facilities. Northslope and Westown parks are one-acre parks containing swings, slides, and other playground equipment. The Community Center Park area is located on First Avenue and contains tennis courts, swimming pool, and play equipment as well as the community center and public library.

Through the cooperation of the Regional Park and Recreation Agency and Marion County, a 55-acre site immediately east of Pioneer Park is available to Stayton residents as a wilderness and natural trails area.

In addition to publicly owned parks, there is the Santiam Golf Club's 18-hole golf course located at Golf Club Road and Highway 22 which is open to the public. Additional neighborhood parks and recreation facilities are needed. Those present and future needs are in the process of being addresses by the Stayton Parks and Recreation Board.

The existing school sites provide play fields and playground equipment for the present population. However, funding for additional facilities is limited. The subdivision section of the development ordinance requires a 5 percent land set-aside, or a contribution in lieu of a land set-aside, for parks and open space purposes. Assistance from the state and federal governments may be needed for the development of some new parks.

Several opportunities exist in the Stayton area to improve parks and meet recreation needs. The Salem Ditch, which travels through the heart of the city, provides an opportunity to develop a scenic waterway and bicycle and jogging paths to link existing park areas with the central shopping area and the North Santiam River. The Santiam and Mill Creek flood plains are also areas where recreational uses could be developed. The restrictions on development in the floodplain prevent many other uses. The flood plains are well suited to open spaces, parks, bicycle and foot paths, and limited facilities. A bicycle/foot path system could ultimately be developed that would provide a complete loop system among Stayton's parks and schools as well as the existing link to Sublimity.

Library

The Stayton Public Library is supported by city funds, membership dues, book fines, and private donations. The library operates with a full time librarian, part time staff, and volunteer aides from a citizen group, "Friends of the Library." The new library on First Avenue was recently constructed through city and volunteer assistance. It opened in December, 1989.

The Stayton library is a member of the Chemeketa Cooperative Regional Library Service (CCRLS), which allows access to materials from all participating libraries and the state library. As the population increases, expanded library services will be needed.

Hospital

Santiam Memorial Hospital, located on Tenth Avenue, is a 40-bed short-stay facility. Three medical clinics are located nearby. Santiam Memorial Hospital is a community controlled, self-supporting facility that provides medical services to an area with approximately 15,000 people.

The hospital maintains a helicopter pad for emergencies and leases an ambulance to the fire district for emergency services.

The Western Oregon Health Systems Agency lists Santiam Memorial in a group of small community hospitals in Oregon that have an overall high priority for renovation. As Stayton grows, the hospital will need to expand on its present site.

Public Facility Policies

PF-1 The City ~~of Stayton~~ shall be the ~~ultimate~~ provider of the following urban services within the Stayton urban growth boundary: 1) municipal water supply; 2) sanitary sewage collection and treatment; 3) storm sewers; 4) police protection; 5) parks and recreational facilities; and 6) library services.

PF-2 The City ~~of Stayton~~ shall use its Master ~~Utilities~~ Plans and associated Capital Improvement Programs to direct the provision of public facilities within the urban growth boundary.

PF-3 Utility Master Plans should be updated every five years.

PF-~~3~~4 The City ~~of Stayton~~ shall require adequate provision for utility easements through its development ordinance. This includes water, sewer, and storm drainage as well as energy and community utilities.

PF-~~4~~5 The Stayton Fire District shall be the provider of fire service in the ~~City of Stayton and~~ Stayton urban growth area.

PF-~~5~~6 In order to facilitate open and direct communication between schools and the City ~~of Stayton~~, the City Administrator shall appoint a member of his staff as a liaison officer to coordinate and communicate City plans with the schools. In addition, the schools shall be asked to appoint a liaison officer to coordinate with the City.

PF-~~6~~7 The City ~~of Stayton~~ shall maintain regular contact with the Marion County Solid Waste Division and Oregon DEQ to ensure that solid waste planning and implementation is coordinated. (Ord. 875, March 2005)

PF-~~7~~8 Standards and guidelines shall be adopted for the development and use of the recreational facilities in Stayton. The Regional Park and Recreation Agency standards shall be the minimum standards until city standards are developed. (Ord. 875, March 2005)

PF-~~8~~9 Areas along the waterways should be preserved for the passive enjoyment of the scenic and natural sites. The fish ladder near the City of Salem water works and on the power canal should have controlled public access. (Ord. 875, March 2005)

PF-~~9~~10 Addition to local recreation resources shall be required as a condition of approval of subdivision developments. Either land dedication or payment to a development fund shall be a requirement in the development ordinances. (Ord. 875, March 2005)

PF-~~10~~11 Need to provide parks and facilities as outlined in the Stayton Parks and Recreation Master Plan. (Ord. 875, March 2005)

PF-~~11~~12 Provide a broader range of park types in the community including natural open space, active use parks. (Ord. 875, March 2005)

PF-~~12~~13 Provide a broader range of recreation facilities within the parks. (Ord. 875, March 2005

PF-14 Implement a storm water management system that minimizes flooding on the natural bodies of water and man-made canals.

PF-15 Include water quality improvements within the storm water management system and development regulations.

Storm Water Master Plan

For

City of Stayton

September 24, 2007

2nd DRAFT

KELLER
ASSOCIATES

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Section 8 Operation, Maintenance, and Replacement

Section 9 Capital Improvement Plan

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SECTION 1 – EXECUTIVE SUMMARY

1.0 STUDY OBJECTIVES

Effective management of storm water runoff has become an issue of increasing concern and focus in recent years. Recognizing the existing challenges and emerging issues, the City of Stayton commissioned this storm water master plan to identify the key issues and to develop innovative solutions. The primary objectives of this Storm Water Master Plan are:

- Establish storm system design and planning criteria.
- Evaluate the existing storm system using computer hydraulic modeling.
- Summarize existing system deficiencies and propose improvements to enhance system serviceability.
- Recommend improvements needed to service future growth.
- Develop a Capital Improvement Plan and an appropriate System Implementation Strategy.

1.1 STUDY AREA

The City of Stayton is located in Marion County, Oregon approximately 12 miles southeast of Salem.

The city consists of approximately 2.7 square miles of land, of which roughly 1.47% is covered in water. The study area includes additional land outside of Stayton's urban growth boundary which contributes to storm runoff flows to the city's storm water system. The study area, the city limits, and Stayton's urban growth boundary are illustrated in Figure 1 in Appendix A.

The city's current population is estimated to be over 7,700 people, and the build-out population is projected at 19,200.

The climate of the study area is characterized by mild wet winters and warm, dry summers. According to the Western Regional Climate Center, Stayton sees an average annual rainfall of 53 inches and average temperatures ranging from 65 °F to 41 °F during the summer and winter months respectively.

The predominant soil types within the study area play an important role in watershed characterization and storm water runoff. The soil types in Stayton are classified as having moderate to slow infiltration rates and moderate to high runoff potential. Figure 2 in Appendix A displays the predominant hydrologic soil types based on Natural Resources Conservation Service (NRCS) Soil Survey data.

Another important watershed characteristic is the land use because it affects the quality, quantity, and timing of the runoff from rainfall events over the drainage basin. Figure 4 in Appendix A illustrates the land use designations as established by Stayton's comprehensive plan.

1.2 DESIGN CRITERIA

A Technical Review Committee (TRC) was established early on in the process for the purpose of developing and approving the design criteria for the master plan and public works storm water design standards. The TRC is comprised of representatives from Keller Associates, Tetra-Tech KCM, and Stayton Public Works including the consulting city engineer, Ed Sigurdson. Additionally, the Santiam Control District provided valuable input.

Several assumptions were made based on the design criteria in the creation of the storm water model which was used to evaluate the city's storm water system. The basic assumptions are:

- Catch basins capture all storm water.
- Pipes, ditches, and catch basins are clean.
- Detention facility discharges are clear of debris.
- Future development follows existing land use plan.

1.3 COMPUTER MODEL

The storm water modeling software XP-SWMM v10.5 was used to project storm water runoff from the study area using the USDA's TR55 Urban Hydrology Method. Additionally, XP-SWMM was used to dynamically route the hydrologic model runoff through a hydraulic model representing the existing storm water network. Hydrologic and hydraulic model parameters and calibration are further discussed in Section 4.

1.4 EXISTING STORM DRAINAGE SYSTEM CONDITION AND EVALUATION

Stayton's existing storm drain system is illustrated in Figure 5 in Appendix A. The existing system is composed of roughly 15 miles of pipe, 8 miles of open channel excluding the Salem Ditch, Power Canal, and Mill Creek. There are also about 650 catch basins, 20 detention facilities, and 38 major outfalls to receiving water bodies.

The storm drain system was delineated into six major drainage basins as shown in Figure 6. These six major basins were further divided into sub-basins which are shown in Figure 7 in Appendix A. The current storm water problem areas for each of the six major drainage basins are summarized in Figure 10.

1.5 WATER QUALITY CONDITION AND EVALUATION

Storm water management has historically emphasized flood control. However, in recent years the focus has shifted to include water quality management. Three of the regulatory programs applicable to Stayton's storm water include the Underground Injection Control (UIC) program, the National Pollutant Discharge Elimination System (NPDES) program, and the Willamette Basin Total Maximum Daily Load (TMDL).

The UIC program relies on voluntary reporting and registration. The City of Stayton is currently in the process of registering the two known storm water underground injection systems. The NPDES Phase II regulations on storm water do not apply to Stayton because the population is less than 10,000. However, the city has expressed the desire to be in a position to meet those requirements. Stayton has been listed as a Designated Management Agency (DMA) in the Willamette Basin TMDL and is therefore required to submit a TMDL implementation plan by March 2008.

Initial testing of Stayton's storm water quality indicates the discharge from the city's system is relatively clean. Details of the storm water quality analysis are included in Appendix D.

1.6 RECOMMENDED IMPROVEMENTS AND CAPITAL IMPROVEMENT PROGRAM

The capital improvement plan was developed and prioritized based on factors such as flooding frequency, potential or recurring damage to property, and time sensitive opportunities. There are currently not any regulatory demands for these improvements to be made - however, the nature of the improvements, their related costs, and Stayton's continued development make it a prudent decision to begin implementing the master plan now. Figure 11 illustrates all recommended improvements, and Figure 12 separates these recommendations into prioritized improvements. These improvements are summarized in Table 1.1 followed by a brief description of the proposed improvements. Further detail regarding the capital improvement plan is provided in Section 9.

Table 1.1
Capital Improvement Plan Summary

Prioritization	Cost*
Priority 1A Improvements	$4,699,800
Priority 1B Improvements	$5,943,600
Priority 2 Improvements	$5,918,000
Priority 3 Improvements	$1,644,300
Priority 4 Improvements	$1,245,300
Future Improvements**	$9,831,500
Total	$29,282,500

* All costs in 2007 Dollars and include engineering and contingencies.

** Timing depends on when growth occurs.

Priority 1A Improvements:

- *Wetland Preservation:* Purchase 25-acre wetlands west of Cascade Highway and preserve for treatment and detention.
- *Shaff Road Detention Basin:* Drains the largest portion of the city. Provide detention prior to discharge to reduce discharge rates and improve water quality. Time sensitive opportunity.
- *10th Ave Detention Basin:* Provide detention prior to discharge to reduce discharge rates and improve water quality. Time sensitive opportunity.

Priority 1B Improvements:

- *Industrial Detention Site Improvements:* Resolve problem with detention flooding into the neighboring farm.
- *Shaff Road Basin Pipeline Improvements:* Upsize conveyance to eliminate flooding in downtown area.
- *10th Avenue Pipeline Improvements:* Upsize conveyance to eliminate flooding along 10th Avenue.
- *Norpac NE Detention Site:* Provide intermediate detention to reduce discharge rates and improve water quality.

Priority 2 Improvements:

- *Fir to Regis through Regis HS Parking Lot:* Upsize conveyance to eliminate flooding near high school.
- *Evergreen Ave to Norpac SW Detention Site:* Purchase detention site for future interceptor south of Salem Ditch.
- *3rd and Jefferson to Library Detention Site:* Construct interceptor north of Salem Ditch to combine existing outfalls into one. Provide detention to reduce discharge rates and improve water quality.

- *Millstream Woods to Norpac SW Detention Site:* Intercept existing outfalls south of Salem Ditch and combine to one.

Priority 3 Improvements:

- *Sylvan Meadows Subdivision :* Upsize conveyance to eliminate flooding in Sylvan Meadows.
- *Gardner Road-Regis High School:* Potential improvements pending.
- *Wedgewood Place:* Upsize conveyance to eliminate flooding.
- *Western Avenue:* Upsize conveyance to eliminate flooding

Priority 4 Improvements:

- *Library Improvements:* Combine outfalls, and route through detention site.
- *Pacific Court:* Combine outfalls and route through detention site.
- *Water Street:* Upsize conveyance to eliminate flooding
- *Washington Street Area:* Provide detention to reduce discharge rates and improve water quality.
- *North Peach Street:* Upsize conveyance to eliminate flooding.

Future Improvements:

- *Fern Ridge Street Area:* Upsize conveyance and provide detention.
- *Dozler Property Area:* Upsize conveyance and provide detention for both existing and future development.
- *Phillips Property Area:* Provide drainage and detention for property and neighboring areas.
- *Detention Facilities & Pipelines:* Provide adequate conveyance, treatment, and detention for all future development. Coordinate regional detention sites or provide on-site detention per master plan.

1.7 STORM WATER FUNDING

In addition to capital improvements, a storm water assets replacement program is recommended. This consists of a plan to regularly replace all deteriorated components of the storm water system. Because this is such a large undertaking, it is recommended that this program and the priority improvements be phased into over time as resources are built up through both the SDC and the storm water utility.

The annual costs for the priority improvements, system replacement program, and O&M are detailed in Section 10, and summarized in Table 1.2

Table 1.2
Summary of Annual Costs

Item	Amount	Comment
System Replacement Program	$164,000	Includes pipelines and catch basins
O & M (Cleaning & T.V.)	$14,500	Values assumed based on contracted cleaning and TV work
City Staff Budget	$84,000	Assumes 1.2 people staff support @ $70,000 salary per year
Total	$262,500	

In addition to these recurring annual costs, Section 9 of this report has identified necessary capital improvements to the storm water system which total $29.3 million 2007 dollars. Approximately $8.3 million of this total cost will benefit future development and will likely be funded from a system development charge (SDC). The SDC will provide a means for each future development to pay its proportionate share of the capital improvement costs. The remaining $21.0 million will have to be paid by all of the City's residents and businesses through a storm water utility fee.

1.7.1 System Development Charge

TBD by EFA

1.7.2 Storm Water Utility

TBD by EFA

SECTION 2 – STUDY AREA

2.0 GENERAL

This section discusses the study area and its physical characteristics. Also discussed are pertinent land uses and planning criteria, as well as population and demographics.

2.1 STUDY AREA

The 2005 city limits of the City of Stayton encompass an area of approximately 1,768 acres between Highway 22, also known as Santiam Highway, and the North Santiam River. The study area roughly corresponds to the urban growth boundary (UGB) which includes an additional 1,440 acres of land, for a total of 3,208 acres. The UGB represents the expected areas of growth and development. Figure 1 in Appendix A illustrates the city limits, the study area, and the UGB.

2.2 LAND USE

The City of Stayton includes lands designated as commercial general, commercial retail, industrial, industrial agriculture, industrial commercial, light industrial, interchange development, low, medium and high density residential, and public/semi-public zoning inside the city limits. Figure 4 in Appendix A graphically reflects the land use distribution adopted by the city. Table 2.1 summarizes the breakdown in acreage for each land use type.

Table 2.1
Existing Land Use Inside Stayton City Limits (2005)

Stayton		
Land Use	**Acres**	**% of Total**
Commercial General	104	6%
Commercial Retail	47	3%
Industrial Agriculture	60	3%
Industrial Commercial	17	1%
Light Industrial	320	18%
Low Density Res.	709	40%
Medium-High Density Res.	273	16%
Public and Semi-Public	238	13%
Total Acreage	**1,768**	

A Land Use Compatibility Statement (LUCS) is the process used by DEQ to verify that permits and other approvals that affect land use are in agreement with local comprehensive land use plans. Oregon state law requires a LUCS for nearly all DEQ permits, some general permits, and other approvals that affect land use. A LUCS was completed in 2004 as part of the Mill Creek sewer project.

2.2.1 Future Land Use

Keller Associates worked with the TRC and Stayton planning personnel in developing future land use outside the existing city limits, but within the urban growth boundary (UGB). Future land uses assumed for this study are illustrated in Figure 4 in the Appendix A.

A corridor of light industrial use is expected along the west urban growth boundary of Stayton. Most of the remaining growth area is designated as low density residential with medium-high density residential areas scattered throughout. Some of the public lands correspond to potential areas identified by the city and school district as future school sites and parks.

The development densities for residential areas illustrated in Table 2.2 were developed as targets for future residential development based on consultation with city planners.

Table 2.2
Average Household Residential Densities

Low Density Residential (ERUs/ac)	Med-High Density Residential (ERUs/ac)	Household Size (people/ERU)
3.5	6	2.7

*ERU refers to the Equivalent Residential Unit

2.3 POPULATION

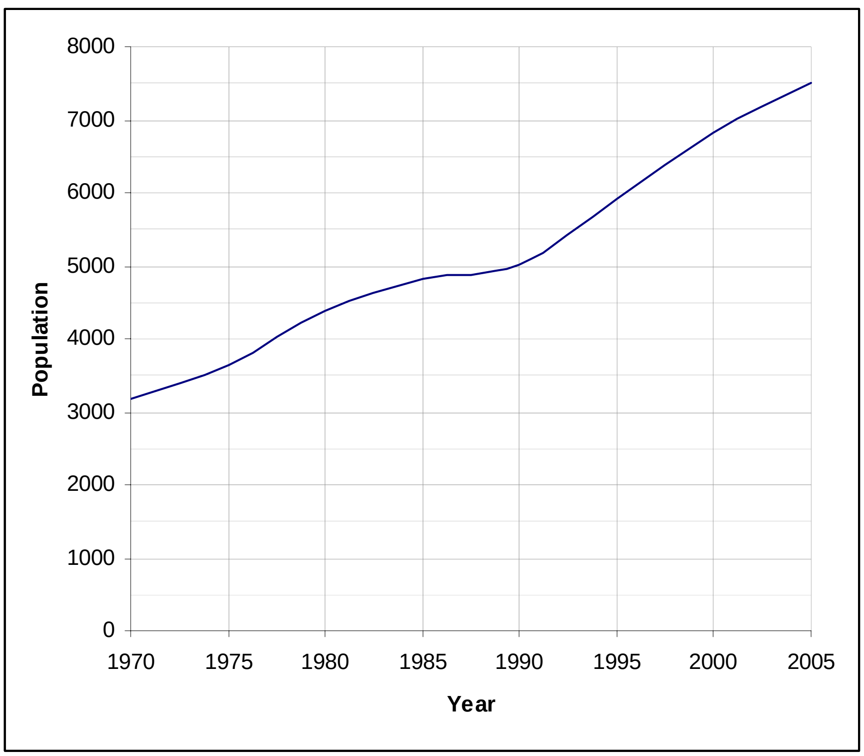
The estimated July 2006 population for the City of Stayton, as reported by the Portland State Population Research Center, is approximately 7,700. Historical population in the City of Stayton and in Marion County retrieved from census data is shown in the following Table 2.3.

Table 2.3
Stayton and Marion County Historical Population

Year	Office of Economic Analysis, State of Oregon and US Census—Marion Co.	Stayton Population Census Data	Marion County Growth Rate	Stayton % of Marion County	Stayton Annual Growth Rate
1970	151,309	3,170		2.10%	
1975	171,700	3,650	2.56%	2.13%	**2.86%**
1980	204,692	4,396	3.58%	2.15%	**3.79%**
1985	213,019	4,815	0.80%	2.26%	**1.84%**
1990	228,483	5,011	1.41%	2.19%	**0.80%**
1995	260,600	5,907	2.67%	2.27%	**3.34%**
2000	284,834	6,816	1.79%	2.39%	**2.90%**
2005	302,135	7,505	1.19%	2.48%	**1.94%**

As can be seen from the preceding table, the annual growth rate in Stayton declined between 1980 and 1990 and then rose sharply after 1990. The average annual growth rate for Stayton was 2.9% between 1995 and 2000, and 1.94% from 2000 to 2005. The growth rate in Stayton has generally been higher than Marion County. Chart 3.1 illustrates historical population trends.

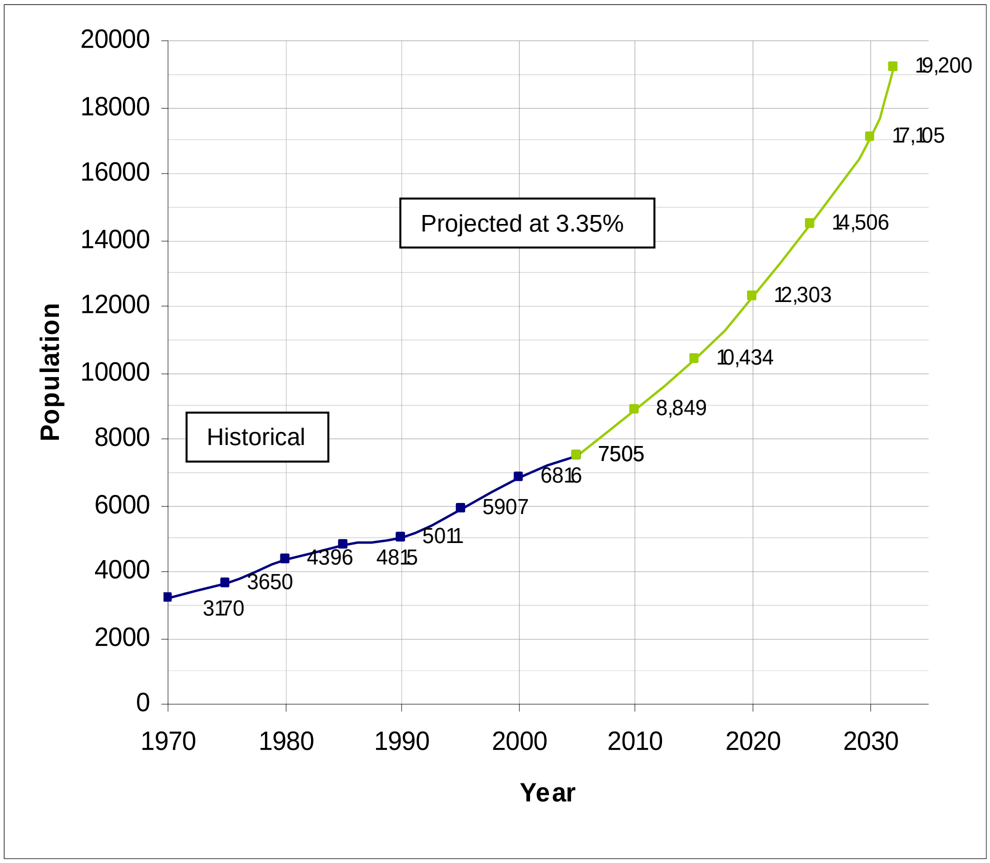
Chart 2.1
City of Stayton Historical Population



2.3.1 Population Projection

Growth projections are based on a continued growth of 3.35%. Build-out of the UGB using a growth rate of 3.35% will occur sometime around 2032. These growth projections are consistent with those used in the Water and Waste Water master plans previously completed.

Chart 2.2
City of Stayton Population Projections



2.4 PHYSICAL ENVIRONMENT

This section provides a review of the physical environment of the study area including climate, soils, geology, water resources, vegetation, etc., and its impact on project development.

2.4.1 Climate

Stayton lies within the Willamette Valley which has a relatively mild climate throughout the year, characterized by cool wet winters and warm dry summers. A summary of climate data for Stayton is shown in Table 2.4.

Table 2.4
Climatological Data (1971-2000) - Stayton, Oregon

	Jan	Feb	Mar	Apr	May	June	July
Precipitation (in)	7.17	6.46	5.37	4.26	3.31	2.42	0.87
Mean Temp. (°F)	40.3	43.0	46.5	50.0	55.6	61.2	66.8
Snowfall (in)	0.8	0.9	0	0	0	0	0
	Aug	**Sep**	**Oct**	**Nov**	**Dec**	**Average**	
Precipitation (in)	1.15	2.18	4.03	8.16	8.00	4.45	
Mean Temp. (°F)	67.0	62.2	52.9	45.2	40.2	52.6	
Snowfall (in)	0	0	0	0	0.6	0.19	

2.4.2 Soils

In general, soils within the Stayton area are either a silty clay loam or silt loam. Slopes vary from 0 to 30 percent. Soils data from the area was obtained from the NRCS website. A soils map and listing of soils within the Stayton area can be found in Figure 2 in Appendix A. The specific soil types and their descriptions found in Stayton are included in Appendix B.

2.4.3 Geologic Hazards

Potential geologic hazards in the Stayton area would be either landslides or earthquakes. There are no volcanoes near enough to cause any volcanic hazard. According to GIS data supplied by Marion County there is a low hazard of landslides in this area. Also, the return time of earthquakes within a 50km distance is approximately 1,000 years. Hazard maps for landslides and seismic activity can be seen in Appendix B.

2.4.4 Public Health Hazards

Keller Associates is not aware of any existing public health hazards in the Stayton area.

2.4.5 Energy Production and Consumption

The U.S. Army Corps of Engineers has predicted that demand for electric power in the Pacific Northwest will grow an average of 4.5 percent per year for the next ten years. Projections from the Oregon Department of Energy indicate that total energy usage will increase approximately 2.9 percent per year over the next 20 years.

2.4.6 Water Resources

Water resources in the area include the North Santiam River, Stayton Ditch, Salem Ditch, Mill Creek, Valentine Creek, Lucas Ditch and the Main Canal. The Santiam River is part of the Willamette River Basin structure draining approximately 790 square miles of the western slope of the Eastern Cascade Mountains.

The City of Stayton draws its raw water for the potable water system from two sources: the North Santiam River, via the Power Canal; and two shallow collector wells. The Water Treatment Plant utilizes the Power Canal river intake for all but a few days a year. The city's ability to utilize the Santiam River for potable water supply the majority of the year is a direct indication of the river's high quality even during periods of high precipitation and spring snowmelt, which could produce higher turbidities. When the Santiam River becomes turbid due to heavy precipitation or some other disturbance of the watershed, the city utilizes two shallow collector wells.

2.4.7 Flora and Fauna

A list of threatened or endangered plant and animal species that may occur within the state of Oregon has been provided in Appendix B. The most likely specie to be encountered within the Stayton/Sublimity area would be the Chinook salmon in the N. Santiam River.

2.4.8 Air Quality and Noise

Stayton lies within the Willamette Valley air shed. This valley is bordered on the east by the Cascade Mountain Range and on the west by the Coast Range. The valley is closed off on the north and south as the two ranges come together. The prevailing wind direction is from the southwest in the winter and from the north in the summer. Due to these geologic features, pollution generated in the valley becomes trapped. Pollution comes from industry, automobile emissions, field burning, slash burning, and other agricultural practices. Air quality data monitored by the EPA is shown in Table 2.5.

Table 2.5
Air Quality Report 2006 - Stayton, Oregon

CO (ppm)		O_3 (ppm)		
2^{nd} Max 1-hr	2^{nd} Max 8-hr	2^{nd} Max 1-hr	2^{nd} Max 8-hr	EPA Region
4.5	3.2	0.095	0.075	10

DEQ sound controls and Marion County policy will ensure that indoor and outdoor noise levels are within acceptable limits. The county will consider noise impacts when developments are proposed near a noise source, such as the Santiam Highway. The city of Stayton addresses sound pollution through the plan review process.

2.4.9 Topography

Ground elevations in the study area range from a low of approximately 405 feet above mean sea level near the northwest boundary, to approximately 665 feet above mean sea level (Mean Sea Level) near the city's eastern boundary. A bench that varies from 100-200 feet tall exists generally parallel and south of the Santiam Highway. Areas of the city located along and on the bench have slopes as steep as 25+%. The topography of the remainder of the city is flatter (0.35-0.45% slopes) and generally slopes from east to west. The area topography is shown in Figure 3 in Appendix A .

2.5 SOCIO-ECONOMIC ENVIRONMENT

2.5.1 Economic Conditions and Trends

According to 2000 Census data the median income for a household in the city was approximately $34,004 and the median income for a family was $41,389. According to the Marion County Comprehensive Plan, the labor force participation rates will increase by between 47 and 54 percent caused largely by increasing female entry into the labor force. The largest source of growth in employment is likely to be those in retail trade and services. Employment will shift towards white collar occupations as demand for workers declines in manufacturing and construction.

2.6 STORM WATER DRAINAGE SHEDS

Storm water from the study area generally drains into three different receiving streams: Power Canal, Salem Ditch, and Mill Creek. The areas that drain to each of these receiving streams is delineated in Figure 6 in Appendix A and summarized in Table 2.6.

Table 2.6
Percent of City Draining to Receiving Streams

Salem Ditch	Power Canal	Mill Creek / Lucas Ditch	Other
64%	16%	14%	6%

The Power Canal is an irrigation canal that is diverted from the North Santiam River southeast of the downtown Stayton area. The Power Canal generally flows from east to west along the southern portion of the city and ultimately discharges back into the North Santiam River. In addition to receiving some storm water from the southern part of the City of Stayton, it also delivers water to agricultural areas west of the city.

The Salem Ditch is also an irrigation canal that is diverted from the North Santiam River southeast of the downtown Stayton area. The Salem Ditch also generally flows from east to west along the southern portion of the city just north of the Power Canal. Towards the west edge of the city, the Salem Ditch alignment shifts to the northwest and flows towards the Mill Creek into which it discharges northwest of Stayton. The reported capacity of the Salem Ditch from the Santiam Control District is 120 cubic feet per second (cfs). In addition to receiving some storm water from the southern part of the City of Stayton, it also delivers water to agricultural areas west of the city. The Salem Ditch receives storm water runoff from a majority of the City of Stayton or approximately 64%.

Mill Creek is a natural water body that collects groundwater, irrigation wastewater and storm water from the area including portions of the city of Stayton. A majority of the storm water that discharges into Mill Creek from Stayton comes from the Lucas Ditch which discharges into Mill Creek northwest of the intersection of Cascade Highway and Shaff Road. Mill Creek generally meanders along the north boundary of the city near the Santiam Highway. Mill Creek has a mapped 100-year floodplain as illustrated in Figure 8.

The North Santiam River receives runoff storm water from a small area located in the east part of town. A small irrigation ditch receives runoff storm water from the Industrial Park on the far west part of town as shown on Figure 8. Both of these areas combined only account for approximately 6% of the city area.

SECTION 3 – STORM WATER SYSTEM DESIGN CRITERIA

3.0 GENERAL

Storm water system design criteria encompass the fundamental principles applied in evaluating the existing system and planning for future expansion of the system. The design criteria applied in this study come from sources such as neighboring communities, industry standards, and state and federal storm water regulations.

The aim of the design criteria is to accurately define the system demands in order to mitigate existing deficiencies and prevent future problems. Design criteria address design storm events, hydrologic methods, and hydraulic calculation methods. Storm water quality standards are addressed in Section 7 of this report.

As part of this master plan, the city's Storm Water Design Standards manual was reviewed and several changes have been recommended. These changes were accepted by the TRC and updated as part of this master plan. The details of the specific design criteria and BMPs for storm water system components are included in Appendix F.

3.1 DESIGN STORM

The design storm is the storm event for which the storm water facilities are designed. It essentially becomes the standard used to measure the functionality of the storm drain system. The design storm is a theoretical storm event with typical characteristics for storms in a given region.

One parameter of the design storm is the total depth of rainfall expected to occur over a given time period. Another parameter is the recurrence interval, or the average interval between successive events. For example, a 100 yr storm has occurred an average of once every 100 years. The Nation Oceanic and Atmospheric Administration (NOAA) has published isopluvial charts showing rainfall depths for a range of recurrence intervals over geographic areas. Table 3.1 contains the values for the City of Stayton as obtained from the NOAA isopluvial charts for the sate of Oregon.

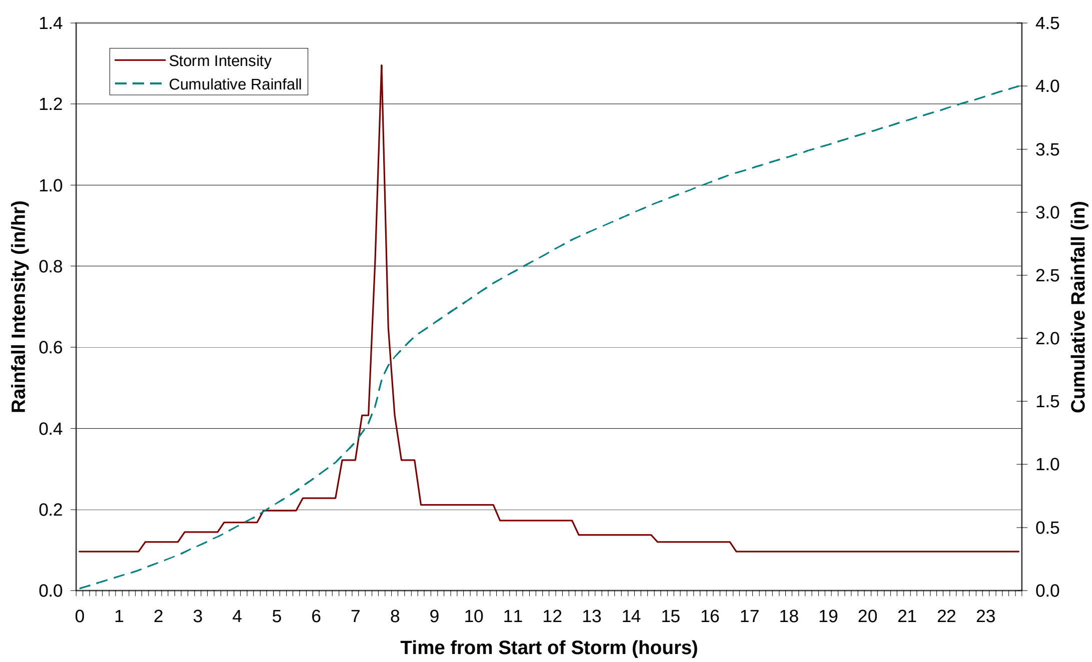
Table 3.1
24-Hour Storm Depths

Storm Event	Precipitation (in)*
2 year	2.5
5 year	3.0
10 year	3.5
25 year	4.0
50 year	4.5
100 year	4.6

*NOAA Atlas 2, Volume X

Another parameter of a design storm is how the given amount of precipitation is distributed over the duration of the storm (temporal distribution). A hyetograph illustrates the typical temporal distribution of a storm. The hyetograph shape is theoretical and is based on historical data collection and extrapolation. The National Resources Conservation Service (NRCS) has developed region-specific hyetographs for the state of Oregon. For Stayton, the NRCS recommends the use of a Type 1A distribution. The 25-year storm hyetograph is illustrated in Chart 3.1.

Chart 3.1
Stayton 25-year Storm Hyetograph



Selection of a design storm is a matter that balances level of service with economic feasibility. Through a series of meetings, the TRC establish the 25-yr storm event as the design storm for conveyance (pipes) and up to the 50-yr storm event as the design storm for detention facilities.

More specifically, the storm water lines should be capable of carrying the runoff from the contributing area for the 25-yr storm event without flooding. The existing system was evaluated by this standard and areas which showed flooding under the 25-yr event were marked as areas in need of improvement.

For detention facilities, the post-development runoff from the 50-yr storm cannot exceed the pre-development runoff from the 50-yr storm. In addition to the 50-yr storm, the detention facility should serve the same function for smaller storm events such as the 25-yr event, and the 2-yr event.

3.2 Hydrologic Methodology

Hydrologic methodology refers to the method applied to define how an area will react to the design storm. Some items of particular concern are how much of the rainfall over the area will be converted to runoff, where that runoff will go, and how quickly it will get there.

There are several acceptable methods for defining basin characteristics. According to the recently published Central Oregon Storm Water Manual, the following methods are deemed acceptable:

- The NRCS Urban Hydrograph Method
- The Santa Barbara Urban Hydrograph Method
- The Level Pool Routing Method
- The Rational Method
- The Modified Rational Method (Bowstring Method)

For this master plan, the NRCS Urban Hydrograph Method was employed. The specifics of this method and its parameters are covered in Section 4, Model Development.

3.3 STANDARDS COMPARISONS

Practical and useful information can be found in the experiences of Stayton's neighboring communities and their standards. In an effort to glean some of this information, a storm water policy survey was conducted for this master plan. As a result of the survey, the city has updated its policies to be consistent with neighboring communities, industry standards, and state and federal storm water regulations. The results of this survey have been recorded and are summarized in Table 3.2.

Table 3.2
Storm Drainage Design Criteria Comparison

Item	Stayton (Recommended)	Marion County	ODOT	Salem	Albany	Portland
Storm Distribution	NRCS 1A	NRCS 1A	NRCS 1A	As approved by Director	NRCS 1A	NRCS 1A
24 hr Storm Precipitation	NOAA	NOAA	NOAA	As approved	OCS	NOAA
Model Approach	NRCS- TR55	NRCS- TR55	SBUH	As approved	NRCS- TR55	Various
Minimum Tc	10 min	10 min	5 min	None Specified	None Specified	5 min
PVC “n” value	0.013	0.013	0.013	0.009 -0.013	0.013	0.013
Min. Pipe Diameter	12"	12"	12"	12"	12"	12"
Design Storm: For Conveyance	25 yr	10 yr	50 yr	25 yr	25 yr	25 yr
Design Standards: For Detention Facilities on new Developments	50 yr	100 yr	10 yr vol with 100 yr emergency overflow	50 year vol with overflow to appvd discharge point	Detain 25 yr post dev vol, 100 yr emergency overflow	Maximum Practicable
Detention facilities allowed inside floodway/flood plains?	Floodway: No Floodplain: with approval	As approved	Floodway: No Floodplain: yes	As approved	Floodway: No Floodplain: with approval	Floodway: No Floodplain: No
Infiltration policy	Not allowed	Not allowed	Not allowed	As approved	Not allowed	Allowable
Roof Drains to gutter or yard?	yard	gutter	gutter	yard	gutter	gutter

NRCS = Natural Resource Conservation Service
NOAA = National Oceanic & Atmospheric Adm.
SBUH = Santa Barbara Unit Hydrograph

Tc = Time of Concentration
n value = Manning’s roughness coefficient

SECTION 4 – MODEL DEVELOPMENT

4.0 GENERAL

An accurate computer model of the storm water system serves as planning tool and provides the basis for a solid storm water master plan. The model also provides insight into potential improvements to address existing deficiencies, and can be used to effectively plan for future development within the study area.

A storm water model correlates interactions of natural events and natural systems, (hydrologic parameters) with manmade systems (hydraulic parameters). Because there are countless variables with broad ranges of values in each system, a well coordinated and strategic data collection effort is required, along with practical assumptions and good judgment for data that cannot be feasibly obtained. This section outlines the model construction and calibration process beginning with data collection on the existing systems, and how key assumptions were incorporated to construct the final calibrated model of Stayton's storm water system.

4.1 EXISTING SYSTEM OVERVIEW

Prior to this study much of the storm water system was unmapped. Because an accurate base map is necessary to evaluate the existing system and create a master plan, a significant effort was put into mapping the existing storm water system. Data on the existing system was obtained from a combination of record drawings, survey data, GPS data, site visits, and field testing. The resulting storm water system base map is illustrated in Figure 5 in Appendix A. The following sub-sections briefly describe the existing system components and their general conditions.

4.1.1 Storm Water Inlets

The location and approximate elevation of catch basins and other storm water inlets was gathered with the aid of GPS units. Data on approximately 540 storm water inlets or catch basins was gathered through this survey. Other catch basins and storm water inlets have been added from successive field surveys and other sources of base map data.

From general observation and reporting from city staff it has been found that many of the catch basins are undersized, sparsely spaced, aged, and filled with sediment and debris.

4.1.2 Open Drainage Channels

Both natural and manmade open drainage ways are an integral part of the city's storm water system. The majority of the city's runoff is carried to the Salem Ditch, which in turn converges with Mill Creek in the northwest corner of the city's urban growth boundary. A large portion of the remaining runoff enters Mill Creek directly through a variety of pathways. A small portion of runoff drains to the North Santiam River, the Power Canal, and an irrigation ditch west of the urban growth boundary.

Portions of the constructed storm drain system run through stretches of biofiltration swales prior to re-entering the piped storm water system or discharging to a receiving body of water. Known bio filtration swales have been identified on the storm water base map.

Visual inspection of most of the open drainage ways shows high vegetation, and minimal meandering.

4.1.3 Storm Water Lines

There are roughly 15 miles of pipe in the city's storm drain system. The condition, age, and material of the lines vary considerably. Although the age of the lines is largely unknown, most lines are assumed to be 30 or more years old. A survey crew has collected storm water manhole rim elevations, invert elevations, and diameters on the major trunk lines included in the model.

Line sizes, layouts, and slopes for smaller lines shown on the base map come from the city's library of record drawings, and site visits. The focus of this study was on the main lines and key connectors. Much of the data for the smaller lines shown on the base map is from record drawings which have been found to be inaccurate in several cases.

4.1.4 Storm Water Detention Facilities

Detention facilities are designed to collect runoff from a designated area and control the discharge into the regional storm drain system. Detention facilities include a storage facility and usually include flow control structures such as weirs and orifices. These facilities both delay and attenuate the peak runoff events from their respective drainage area. Detention facilities may also be designed to improve water quality by acting as settling basins or be equipped with cleanouts and other water quality features.

The existing detention facilities in the study area are shown on Figure 5 in Appendix A. There are approximately 20 detention facilities currently in the system. The larger detention facilities that have a significant bearing on the upstream and downstream sections of the system have been modeled and evaluated for effectiveness under the 50 year storm event.

The modeling results evaluation is presented in Section 5, and recommendations from these evaluations are covered in Section 9.

4.1.5 Underground Injection Control Systems

According to DEQ, systems regulated by the underground injection control program are defined as any man-made design, structure or activity which discharges below the ground or subsurface. These are commonly referred to as UICs. A few specific examples of such systems pertinent to storm water are drywells, trench drains, sumps, perforated piping, floor drains, and drill holes. Due to the drainage conditions in the city, Stayton does not generally utilize subsurface drainage and no UICs were included in the model or future planning.

4.1.6 Storm Water Outfalls

Storm water outfalls are points at which the storm water system discharges into a receiving body of water. If an outfall is submerged or otherwise restricted, it affects the upstream hydraulics. Survey crew collected water surface elevation data for the large outfalls modeled in this study. This data was used to model submerged discharge outfalls where water levels exceeded outfall inverts.

There are numerous small outfalls and roof drains throughout the system, but these outfalls affect smaller, individual sites and were therefore not inventoried. However, larger diameter outfalls in the city's system were inventoried, mapped, and modeled. In summary, there are approximately 24 major outfalls to the Salem Ditch, 6 to the Power Canal, 7 to the Lucas Ditch, and 1 to an irrigation ditch west of the urban growth boundary.

4.2 MODEL PARAMETERS

The storm water model consists of two parts, a hydrologic model and a hydraulic model. The hydrologic model consists solely of drainage basins, or geographic areas that drain to a specific point. Each drainage basin is characterized by various input parameters. These input parameters essentially define the basin in terms of how much rainfall is converted to runoff and when the runoff reaches the outlet point. The hydraulic model then routes the runoff through the storm drain network of open channels, detention ponds, and pipelines.

Each of the two parts of the storm water model requires a number of input parameters to sufficiently simulate the actual rainfall events and the resulting effects on storm water sewers. The parameters and input assumptions are explained and summarized in this section.

The area within the Stayton's urban growth boundary was delineated into six major drainage basins as shown in Figure 6. These six major basins were further divided into minor basins which are shown in Figure 7 in Appendix A. The basin parameters for each of the minor basins are summarized in Table 4.1, followed by descriptions of each parameter and how it is calculated.

Table 4.1
Drainage Basin Parameters

Basin	Area (acre)	Avg. Slope (ft/ft)	CCN	Tc (min)
1	53.8	0.0051	73	133
2	53.7	0.0046	76	44
3	45.5	0.0047	81	89
4	30.9	0.0042	88	107
5	63.9	0.0077	73	158
6	35.5	0.0038	80	133
7	56.4	0.0038	84	177
8	43.1	0.0044	71	164
9	26.7	0.0036	83	33
10	53.0	0.0050	79	121
11	48.9	0.0040	88	113
12	40.5	0.0050	75	108
13	20.8	0.0022	81	26
14	19.7	0.0025	83	27
15A	28.1	0.0052	77	152
15B	25.9	0.0069	66	175
15C	17.4	0.0059	88	118
16	51.9	0.0031	74	107
17	54.4	0.0244	60	78
18	42.3	0.0065	61	37
19	62.4	0.0008	86	199
20	33.1	0.0057	89	27
21	29.7	0.0049	89	90
22	30.4	0.0452	81	5
23	35.8	0.0239	83	4
24	9.7	0.0194	83	47
25	12.3	0.0156	90	32
26	16.6	0.0344	77	33
27	59.1	0.0471	76	50
28	148.0	0.0277	77	90
29	72.0	0.0051	81	146
30	11.6	0.0074	93	17
31A	38.3	0.0047	90	17
31B	14.1	0.0081	89	11
31C	17.4	0.0032	89	94
31D	17.3	0.0063	82	75
32	7.1	0.0029	92	56
33	15.8	0.0048	90	62
34	13.2	0.0052	93	10
35	4.0	0.0067	90	30
36	19.3	0.0036	90	30
37	7.7	0.0027	92	14

Basin	Area (acre)	Avg. Slope (ft/ft)	CCN	Tc (min)
50	38.5	0.0064	78	125
51	15.8	0.0039	90	15
52	13.9	0.0054	87	77
54	31.6	0.0089	75	62
55	3.2	0.0045	72	97
56	7.3	0.0329	75	25
57	15.2	0.0220	76	25
58	25.4	0.0038	81	75
59	18.8	0.0050	73	133
60	18.5	0.0056	73	146
61	7.2	0.0113	73	126
62	9.4	0.0063	73	142
63	23.1	0.0078	61	118
64	6.9	0.0147	73	45
65	4.0	0.0036	77	55
66	18.7	0.0074	72	49
67	17.3	0.0107	72	33
68	34.9	0.0345	82	15
69	35.6	0.0301	92	20
70	12.2	0.0046	85	15
71	13.2	0.0040	91	92
72	3.8	0.0047	92	4
73	4.8	0.0032	92	9
74	24.9	0.0465	72	34
75	25.2	0.0467	78	20
76	17.9	0.0026	85	25
77	24.9	0.0069	92	70
78	5.1	0.0172	88	20
79	4.7	0.0114	65	21
80	5.9	0.0070	92	7
81	5.8	0.0025	92	15
82	9.8	0.0059	84	63
83	28.8	0.0521	79	35
84	9.5	0.0575	82	20
85	11.8	0.0166	75	44
86	17.7	0.0398	63	73
87	9.4	0.0371	92	35
88	28.5	0.0093	60	85
89	104.4	0.0296	88	40
90	16.3	0.0660	81	50
91	20.2	0.0529	70	41
92	12.0	0.0494	75	92

38B	1.5	0.0041	92	8	94	11.2	0.0031	75	60
39	15.0	0.0044	92	11	95	7.8	0.0041	74	63
40	40.7	0.0035	74	84	96	13.3	0.0109	72	38
41	11.2	0.0018	82	70	97A	23.3	0.0359	70	18
42	40.5	0.0017	75	100	97B	8.8	0.0686	72	79
43	47.1	0.0040	75	62	98	12.1	0.0050	73	79
44	11.7	0.0082	75	55	99	12.3	0.0086	70	90
45	3.0	0.0036	87	16	100	9.5	0.0076	72	59
46	8.4	0.0085	72	34	101	10.3	0.0032	70	137
47	14.7	0.0086	85	27	102	10.2	0.0354	70	19
48	11.1	0.0078	72	46	103	15.3	0.0169	74	46
49	15.5	0.0017	86	60	104	34.0	0.0711	73	33
					105	20.3	0.0117	75	67

Tc = Time of Concentration
CCn = Composite Curve Number

4.2.1 Area

The basin area is all of the area that collects and contributes runoff to the basin's outlet point. The basins areas were delineated with the use of two foot contours as shown in Figure 3 in Appendix A. Other physical boundaries such as roads and storm lines were also considered during the basin delineation process. After the basins were delineated, the areas for each of the basins were calculated with the use of a scaled drawing of the city.

4.2.2 Slope

The slope is the average slope along the time of concentration flow path. The slope is computed by dividing the difference between the beginning and ending elevation, by the flow path length. This parameter is given in feet per feet.

4.2.3 Time of Concentration

The time of concentration can be defined as the time at which outflow from a basin is equal to inflow. This state of equilibrium occurs because the drainage basin is assumed to be saturated at the time of concentration and all of the precipitation is going straight to runoff.

The time of concentration is calculated as the sum of the times of travel within the basin. Travel times represent various forms of flow within the basin. The following equations were used to calculate the times of travel for each of the flow types.

- Sheet flow (flow path less than 300 feet): $\mathbf{Ts=0.007*(nL)^{0.8}/(P_2)^{0.5}s^{0.4}}$
  Where: Ts=travel time for sheet flow (hr)
  n=Manning's roughness coefficient (Table 4.2)
  L=flow length (ft)

P_2=2-year, 24-hour rainfall (in)
s=slope of a hydraulic grade line (ft/ft)

- Shallow Concentrated Flow (flow path greater than 300 feet):

  - Slopes greater than 0.005: **Tsc=L/V**
    Where: Tsc=travel time for shallow concentrated flow with slopes less than 0.005 (sec)
    L=flow length (ft)
    V=flow velocity (ft/sec) determined from Marion County Chart included in Appendix C.

  - Slopes less than 0.005: **Tss=L/20.3282s$^{0.5}$**
    Where: Tss=travel time for shallow concentrated flow with slopes less than 0.005 (seconds)
    L=flow length (ft)
    s=slope of a hydraulic grade line (ft/ft)

- Pipe Flow: **Tp=L/2.0**
  Where: Tp=travel time for pipe flow (seconds)
  L=flow length (ft)
  Assumed: Pipe flow velocity = 2.0 ft/sec

- Total Time of Concentration**: Tc=Ts+Tsc+Tss+Tp**

As can be seen in the preceding equations, several parameters affect the time of concentration. One of the more significant parameters in the time of concentration calculations is the roughness value commonly referred to as Manning's n. The n values listed in the Table 4.2 were utilized in calculating the times of concentration for the various basins.

Table 4.2
Roughness Coefficients
(Manning's n) for Sheet Flow

Surface Description	Manning's n[1]
Smooth surfaces (concrete, asphalt, gravel or bare soil)	0.011
Fallow (no residue)	0.05
Cultivated Soils:	
Residue cover ≤ 20%	0.06
Residue cover > 20%	0.17
Grass:	
Short grass prairie	0.15
Dense grasses[2]	0.24
Bermuda grass	0.41
Range (natural)	0.13
Woods:[3]	
Light underbrush	0.40
Dense underbrush	0.80

Notes:
1) The n values are a composite of information compiled by Engman (1986).
2) Includes species such as weeping lovegrass, bluegrass, buffalo grass, blue grama grass, and native grass mixtures.
3) When selecting n, consider cover to a height of about 0.1 feet. This is the only part of the plant cover that will obstruct sheet flow.

4.2.4 Composite Curve Number

There are several acceptable and well established methods to define a drainage basin's hydrologic character. Use of a curve number implies the application of the principles from the TR-55 Method. The USDA's "Urban Hydrology for Small Watersheds Technical Release 55" (TR-55) outlines the process for computing the NRCS Curve Number (CN) for minor basins. The CN is used as an index of the potential runoff from a storm event over a given basin. The general relationship between the CN and predicted runoff is the higher the CN, the greater the runoff.

The curve number is based on the hydrologic soil group, ground cover, percent impervious and land use. Table 4.3 from TR-55 shows average CN for a variety of land uses, hydrologic soil groups and ground cover.

In order to accurately assign a CN, it is necessary to determine the percentage of the minor basin area that is impervious or pervious. Pervious surfaces are those which are covered primarily with vegetation and permit the infiltration of water. Impervious areas are those which inhibit infiltration of water, such as pavement, roadways, sidewalks, and roofs. An aerial image of the city was used to directly measure the percent impervious area for typical land use designations such as low density residential, commercial, and industrial areas.

The percent impervious is a key parameter used to determine a composite CN and Tc. Generally, as the percent impervious increases the infiltration decreases, resulting in more rapid runoff, shorter Tc, and greater CN. All of these factors combined lead to higher peak runoff rates.

In addition to land use designations, the permeability of each of the basins is also a function of soil types.

The predominant soil types within each of the minor basins were obtained from the USDA's soil survey data base. Figure 2 in Appendix A depicts a soils map of the City of Stayton. There are four general hydrologic soil groups. Group A soils are defined as soils having high infiltration rates and low runoff rates. Group B soils have moderate infiltration rates. Group C soils have slow infiltration rates. Group D soils have very slow infiltration rates and therefore higher runoff values.

Table 4.3 displays the effects of various land use types and soils groups on curve number values. Modified curve number values specifically calculated for Stayton were used in creating the model, but the values shown in Table 4.3 served as a starting point in assigning curve numbers to the various drainage basins.

Table 4.3
RUNNOFF CURVE NUMBERS FOR URBAN AREAS

Land Use	Cover Description		CN for Hydrologic Soil Group			
	Cover Type and Hydrologic Condition	Average % Imp.	A	B	C	D
	Fully developed urban areas (vegetation established)					
Public/ Semi - Public	Open Space (Lawn, Parks, Golf Courses, Cemeteries, Etc.)[3]					
	Poor Condition (grass cover <50%)		68	79	86	89
	Fair Condition (grass cover 50% to 75%)		49	69	79	84
	Good Condition (grass cover >75%)		39	61	74	80
	Impervious Areas:					
	Paved Parking Lots, Roofs, Driveways, etc. (excluding right-of-way)		98	98	98	98
	Streets and Roads: Paved; Curbs and Storm Sewers (including right-of-way)		98	98	98	98
	Paved; open ditches (including right-of-way)		83	89	92	93
	Gravel (including right-of-way)		76	85	89	91
	Dirt (including right-of-way)		72	82	87	89
	Western Desert Urban Areas:					
	Natural Desert Landscaping (pervious areas only)[4]		63	77	85	88
	Artificial Desert Landscaping (impervious weed barrier, desert shrub with 1- to 2-inch sand or gravel mulch and basin borders)		96	96	96	96
Industrial/ Commercial	Urban Districts:					
	Commercial and Business	85	89	92	94	95
	Industrial	72	81	88	91	93
Residential	Residential District by Average Lot Size:					
	1/8 acre or less (town houses)	65	77	85	90	92
	¼ Acre	38	61	75	83	87
	1/3 acre	30	57	72	81	86
	½ Acre	25	54	70	80	85
	1 Acre	20	51	68	79	84
	2 Acres	12	46	65	77	82
	Developing Urban Areas					
	Newly Graded Areas (pervious area only, no vegetation)[5]		77	86	91	94

4.2.5 Hydraulic Parameters

The hydraulic parameters for the model are the parameters relating to how the runoff from the drainage basin is routed through the network of storm water lines, open channels, and detention facilities. These parameters are calculated from input data on pipe diameter, length, roughness, slope, outfall conditions, and depth below surface. Survey data and record drawings provided most of the necessary input data, and a roughness value of 0.014 was assumed. For unknown pipe inputs, values such as length and slopes were interpolated using know upstream, downstream, and ground elevation data.

The storm water modeling focused on the major storm water lines in the system and other portions of the system which were considered to play an important role in system functionality. The modeled storm water lines are illustrated in Figure 9 in Appendix A.

4.3 MODEL CALIBRATION

This section covers the measures taken to calibrate the storm water model. Typically, calibration for a storm drain model involves more unknowns than for a water or wastewater model. There are a number of reasons for this.

First, the quantity of fluid going into a water or wastewater system is relatively well-defined with meters at pump stations, lift stations, and treatment plants. In contrast, influent into a storm system can be only generally related to precipitation and groundwater and spring water discharge. Many soil, vegetation, climatic, and topographical factors control the relationship between these elements and inflow into a storm drain system.

Second, the quantity of fluid exiting a water and wastewater system is also relatively well-defined with meters on residential and commercial services for water systems and meters at wastewater treatment plants. In contrast, very few storm systems have flow locations that are measured on a regular basis.

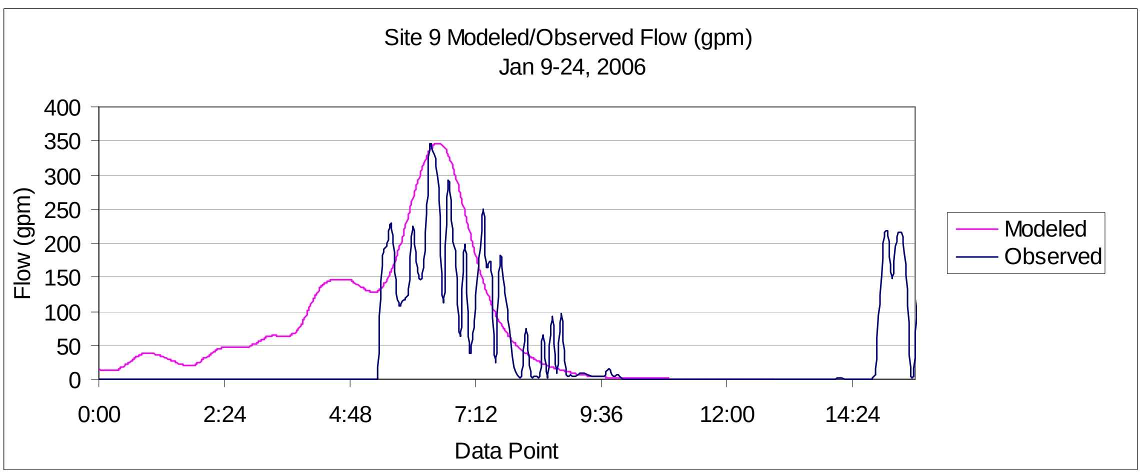
Thirdly, water and wastewater flows are much more regular and predictable. Storm drain flows are dependent on the weather which is much less predictable. Given these considerations, methods that would provide a reasonable assurance that the model accurately reflects field conditions were implemented.

The first method used to calibrate the model involved extensive storm water flow monitoring at ten sites throughout the storm water system. The monitoring was performed during winter months to ensure larger storm events. The rainfall during these events was also recorded in 15-minute increments. Portions of the data collected for both rainfall and flow appeared to be flawed due to instrument malfunctions or other problems. In all cases, the flawed data sets were either thrown out or recollected. The data collected for both pipe flow and rainfall was carefully reviewed for reliability and only reliable data for each of the sites was used.

The same amount and temporal distribution of rainfall for the recorded events was simulated over the applicable basins in the storm water model. The adjustable parameters such as the CN and Tc were used to calibrate the model to actual observed events. Although these parameters are adjustable, they were kept with the bounds of reasonability. Increasing the CN to an unlikely value to match an observed peak flow ignores other potential factors which leads an inaccurate model. To avoid this kind of error, the adjustable parameters were bound within reasonable ranges.

The initial calibration resulted in a very good correlation between modeled and observed flows as shown in Chart 4.1 Calibration Results. The calibration results for the other sites along with a site map have been included in Appendix C.

Chart 4.1
Sample Calibration Results



Following initial model calibration against observed results at known sites, typical storm events were imposed on the model. The modeled storm events resulted in flooding in specific areas throughout the city. The observed flooding points were reviewed by city staff to provide a reality check. City staff indicated whether or not flooding would actually be observed during storm events in those areas predicted by the model. For areas inconsistent with what the staff had observed, field and survey data were collected in order to validate the model or correct inaccuracies. This process was repeated several times, including gathering input from city council members and the Santiam Water Control District, in order to achieve the desired level of calibration. By design, the flow predictions err on the conservative side of higher peaks and higher volumes.

The final product of the calibration process is shown in Figure 10, Problem Areas. This figure illustrates areas of concern for the storm water system based on model results for the 25 year storm event. The details of the issues surrounding these areas are covered in the Section 5.

SECTION 5 – EXISTING SYSTEM CONDITIONS

5.0 GENERAL

The City of Stayton storm drainage system generally consists of surface flow to catch basins, a subsurface network of pipes, detention facilities, and open channels. Frequent rains combined with the natural drainage characteristics of Stayton result in high runoff volumes which tax the existing system beyond capacity. As a result, flooding and puddling are common occurrences. The majority of the runoff conveyed by the system ultimately drains to Mill Creek through various routes. The evaluation of the storm water system was conducted based upon the design criteria and model parameters established in previous sections.

5.1 DRAINAGE BASIN ASSESSMENTS

This section discusses the general conditions of the storm water system in the city's six major drainage basins. These assessments are based on computer modeling results of the design storm and input from city staff. Figure 6 outlines the major drainage basins discussed in this section, Figure 7 outlines the minor drainage basins, and Figure 10 illustrates some of the problem areas.

As a general note, the city has begun a prioritized television inspection program targeting key segments of the storm water system to verify connectivity and to assess the condition of the lines. The results of the TV inspection will aid the city in further assessing the condition of the existing system.

5.1.1 Mill Creek Basin

The Mill Creek basin occupies the northwestern portion of the urban growth boundary and is largely undeveloped. The hydrologic characteristics of this basin include a high groundwater table, poorly drained soils, relatively open flat lands, and groundcover consisting mostly of natural grasses and agricultural crops.

The combination of these basin characteristics results in high runoff volumes. The runoff generally drains to the Mill Creek through open ditches and sheet flow. The creek runs northwest through the basin. In winter months, areas near the creek's floodplain are saturated. The flat slopes and high ground water in the area present a challenge to installing a traditional subsurface storm drain and detention system. Development in this basin will require a significant amount of attention to the storm water system.

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5.1.2 Shaff Road Basin

The Shaff Road basin contains the majority of the existing storm water system and drains approximately 550 acres, which is the largest portion of the developed area within the urban growth boundary. The drainage basin is nearly all developed and has large areas of commercial and light industrial development. The basin's 48-inch diameter outfall at Shaff Road also carries the largest discharge of all other outfalls in system.

The backbone to the existing storm water network runs northwest through the basin and discharges directly to the Salem Ditch without prior detention or treatment. A few of the drainage problems in this basin include flooding at the intersection of 6th Ave & E. Pine, along Hollister, along 1st Avenue, at the Regis High School gymnasium, at St. Mary's School, and in the Quail Run subdivision as illustrated in Figure 10.

Most of the flooding is caused by inadequate conveyance capacity, but in some cases results from maintenance issues such as catch basins or pipelines being clogged. There is also limited access to maintain the storm lines due to a lack of manholes and catch basins. The existing system is riddled with segments of shallow to adverse slope and minimal ground cover. There are a handful of onsite detention facilities which reduce small portions of the discharge rate, but the runoff is generally undetained and untreated.

5.1.3 Industrial Basin

The Industrial drainage basin is well developed and consists of nearly all industrial land use with the exception of a small high density residential section in the southeast corner. Most of the 220-acre basin drains to the Salem Ditch, except for the northwest corner which drains to an irrigation ditch that runs northeast to an area outside of the urban growth boundary. This basin has high runoff volumes due to the amount of impervious area.

One of the problems in this basin is that the detention basin in the northwest corner of the basin has an eroded berm. This allows runoff from the neighboring farm to flow into the detention basin, and also allows runoff out of the detention pond into the farm. This can be problematic for both parties because the farm runoff is likely high in nutrients which leads to water quality problems, and it uses up capacity needed for runoff from the industrial area. Additionally, the runoff detention from the industrial area could because damage to the agricultural land and its crops if not properly detained. The other detention ponds in the basin appear to be functioning well.

There are some potential flooding locations under the 25-yr event due to inadequate conveyance, and there are several direct outfalls to the Salem Ditch which have no treatment or detention.

5.1.4 Downtown Basin

The Downtown drainage basin makes up the south central area of the urban growth boundary and covers about 400 acres. The basin consists of medium to high density residential housing and contains the majority of commercial land use in the city. There is very little undeveloped area and the basin is largely covered by impervious surfaces.

The storm water runoff is collected and discharged to the Salem Ditch through one of the several outfalls located in this basin. There is also a small area in the southern portion of the basin which discharges to the Power Canal.

Problems in this basin included undersized conveyance, multiple outfalls, little or no detention, and flooding as shown in Figure 10.

5.1.1 East Stayton Basin

The East Stayton basin is about 540 acres of mostly undeveloped land. The majority of the developed portion of the basin is low to medium density residential housing. The undeveloped area is mostly agricultural land. The future zoning designation for this area is public lands and low density residential housing.

The runoff from the developed portion of the basin drains southwest to the Salem Ditch, and the undeveloped portion drains south to the North Santiam River. The conveyance on 10th Avenue is undersized for the amount of runoff received and flooding is observed at the intersection of 10th Ave and Santiam Street. There is one detention facility at the upstream end of the basin, but no detention on the southern half. The area on the southeast side of the hospital does not appear to have a piped drainage system after the outfall near Robidoux Street where flooding has been reported. The line depths near the south end of the basin on 10th Avenue are as deep as 10 feet in some areas. A segment of the swale constructed behind the lots on Virginia Street is filled in and overgrown.

5.1.1 Lucas Ditch Basin

The Lucas Ditch basin occupies 690 acres in the northeast corner of the urban growth boundary. This basin is mostly undeveloped and collects drainage from rural areas beyond the urban growth boundary. The typical ground cover is natural grass or agricultural crop. The southeast portion has fairly steep slopes, but flattens out to the northwest. The largest detention facility connected to the system is in this basin on the upstream end.

The majority of the runoff discharges to the Lucas Ditch. The Sylvan Springs and Sylvan Meadows developments have wetlands and biofiltration swales which improve the quality of the storm water runoff. There is an onsite detention facility in Sylvan Meadows, but it is undersized for the 50-yr event. The conveyance in the basin is mostly adequate, but there is some flooding expected on Fern Ridge Road and in Sylvan Meadows under the 25-yr event. The Lucas Ditch basin benefits from detention, treatment, and overflow capacity provided by the existing wetland on the west side of Cascade Highway.

SECTION 6 – SUMMARY OF ALTERNATIVE IMPROVEMENTS

6.0 GENERAL

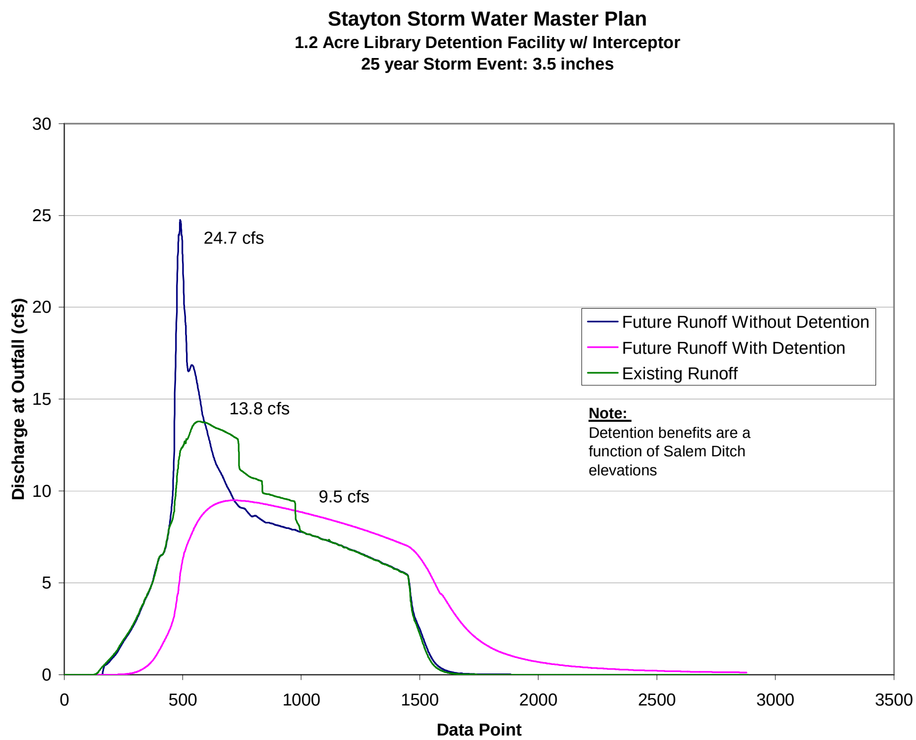
Problem areas or challenges discussed in Section 5 are summarized in Figure 10 in Appendix A. This section summarizes improvement alternatives and their respective costs. These alternatives are organized by drainage basin. The costs for improvements required to eliminate flooding for the 25-year storm are presented.

6.1 NORTH DOWNTOWN DRAINAGE BASIN

As shown in Figure 13, storm water from most of the downtown area from Cascade Highway to 7th Street and Washington Street to Florence Street is discharged directly into the Salem Ditch without either water quality mitigation or detention. During a 25-year storm event, it is estimated that a peak of flow approximately 14 cfs of storm water discharges into the Salem Ditch. Under these conditions, the conveyance pipe network in this area is undersized and flooding occurs in the area. However, if the conveyance pipe network is expanded to eliminate flooding, the storm water flows into Salem Ditch will be larger and more extreme.

Outlined below are two alternatives that were considered to address the storm water flooding in the downtown area. Chart 6.1 shows the effects of detention after improvements are implemented.

Chart 6.1
North Downtown Drainage Alternatives



The **first alternative** is to upsize the existing lines or add parallel pipes to provide adequate conveyance capacity in order to eliminate flooding. Additionally, each discharge into the Salem Ditch would be equipped with water quality mitigation measures. A hydraulic model was constructed to simulate this alternative, and the model predicted that the peak storm water runoff into the Salem Ditch would increase from 14 cfs to approximately 25 cfs. Since the reported capacity of the Salem Ditch is only 120 cfs, this alternative was not considered acceptable and was not pursued further.

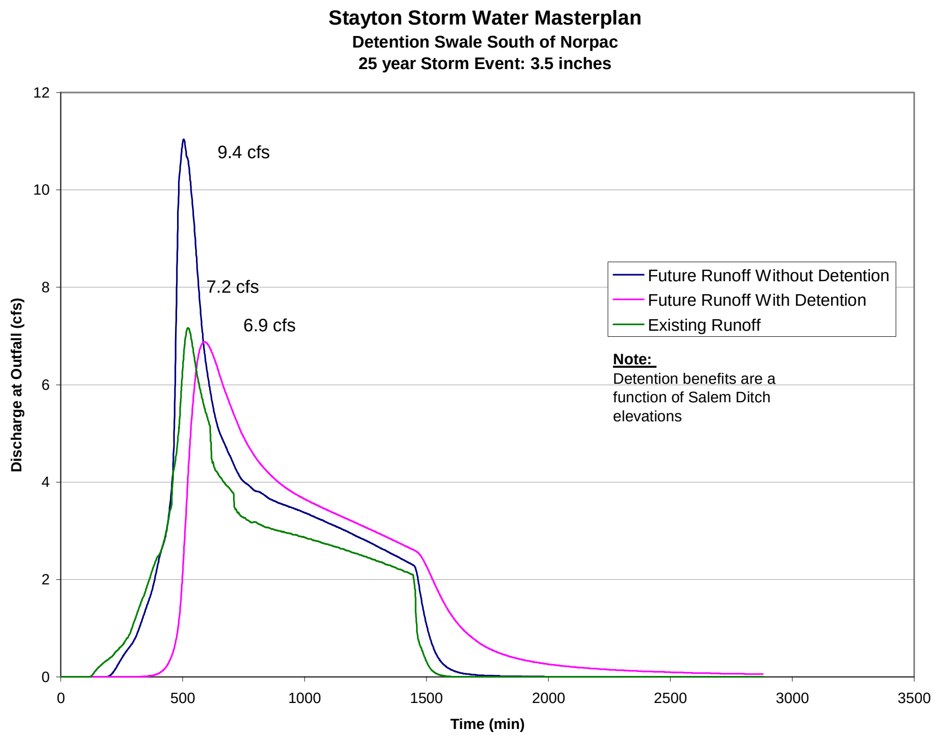
The **second alternative** is to construct a new storm water pipeline that would interceptor the storm water lines that have historically discharged into the Salem Ditch as shown on Figure 13. The new storm water pipeline would discharge into a new regional detention pond located on the Library property that contains approximately 3 ac-ft of storage volume. The detention pond should be designed in such a manner as to provide both water quality and water quantity treatment. Other improvements required include re-sloping the existing storm water pipelines between Salem Ditch and Marion Street to flow north to the new storm water line instead of into Salem Ditch. With the pipeline upgrades shown on Figure 13, the peak flow into the Salem Ditch during a 25-year storm event would be reduced from 25 cfs to 10 cfs because of the proposed detention facility near the Library. The estimated cost for this alternative is $2,468,300.

Recommendation: Based on the information presented above, Keller Associates recommends that the city adopt the **second alternative** as the best solution to the drainage problems in this area. While the first alternative is less expensive, the quantity of storm water inflow into the Salem Ditch exceeds the capacity allotment. Consequently, the first alternative is not feasible. Groundwater modeling at the proposed detention site should be conducted now to provide groundwater trend information during the pre-design phase of the detention facility at the Library.

6.2 SOUTH DOWNTOWN DRAINAGE BASIN

Currently, storm water from most of the downtown area from Cascade Highway to 4^{th} Street and Salem Ditch to Water Street is discharged directly into the Salem Ditch without either water quality mitigation or detention. During a 25-year event, a peak flow approximately 7 cfs of storm water discharges into the Salem Ditch. Under these conditions, the conveyance pipe network in this area is undersized and flooding occurs in the area. Consequently, if the conveyance pipe network is expanded to eliminate flooding, the storm water flows into Salem Ditch will be larger and more extreme. Outlined below are two alternatives that were considered to address the storm water flooding in the downtown area. Chart 6.2 shows the peak reductions expected from the detention facility.

Chart 6.2
South Downtown Drainage Alternatives



The **first alternative** is to upsize the existing lines or add parallel pipes to provide adequate conveyance capacity in order to eliminate flooding. Additionally, each discharge into the Salem Ditch would be equipped with water quality mitigation measures. A hydraulic model was constructed to simulate this alternative, and the model predicted that the peak storm water runoff into the Salem Ditch would increase from 7 cfs to approximately 9 cfs. Since the reported capacity of the Salem Ditch is only 120 cfs, this alternative was not considered acceptable and was not pursued further.

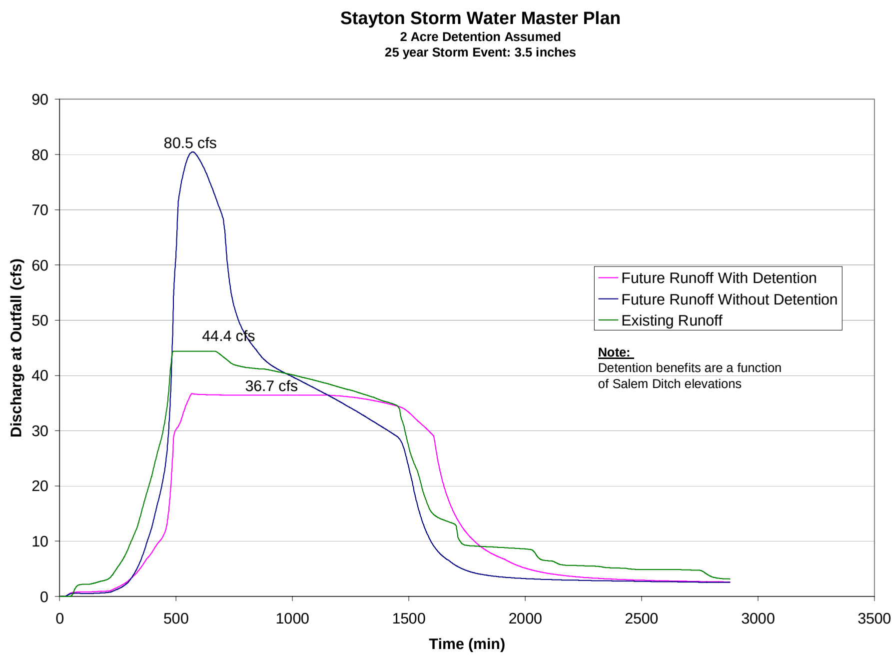
The **second alternative** is to construct a new storm water pipeline that would interceptor the storm water lines that have historically discharged into the Salem Ditch as shown on Figure 13. The new storm water pipeline would discharge into a new regional detention pond that contains approximately 2 ac-ft of storage volume located on property currently owned by Norpac Foods. The detention pond should be designed in such a manner as to provide both water quality and water quantity treatment. Other improvements required include re-sloping the existing storm water pipelines between Ida Street and the Salem Ditch to flow south to the new storm water line instead of into Salem Ditch. With the pipeline upgrades shown on Figure 13 and under a 25-year storm event, the peak flow into the Salem Ditch would be reduced from 9 cfs to 7 cfs because of the proposed detention facility on the Norpac Food site. The estimated cost for this alternative is $2,467,000.

Recommendation: Based on the information presented above, Keller Associates recommends that the city adopt the **second alternative** as the best solution to the drainage problems in this area. While the first alternative is less expensive, the quantity of storm water inflow into the Salem Ditch exceeds the capacity allotment. Consequently, the first alternative is not feasible. However, due to the cost of this improvement in comparison to the benefit, this improvement has been assigned a lower priority. Groundwater modeling at the proposed detention site should be conducted now to provide groundwater trend information during the pre-design phase of the detention facility at the Norpac Foods site. The city should also begin negotiations with property owners to secure property and/or easements for the detention facility site.

6.3 SHAFF ROAD DRAINAGE BASIN

The Shaff Road drainage basin collects storm water from nearly 50% of the city and is a critical component of the storm water conveyance system. This drainage basin discharges into the Salem Ditch at the intersection of the Salem Ditch and Shaff Road. Most of the area in the drainage basin is already developed. Much of the conveyance system in this drainage basin is currently undersized as illustrated in Figure 11. Consequently, if the conveyance pipe network is expanded to eliminate flooding, the storm water flows into Salem Ditch will be larger and more extreme. In order to ensure the flows discharged into Salem Ditch do not exceed the available capacity, detention measures are necessary. Outlined below are two alternative locations considered for the detention facility to address the storm water flooding in the Shaff Road drainage area. Chart 6.3 shows the peak reductions expected from the detention facility.

Chart 6.3
Shaff Road Basin Drainage Alternatives



The **first alternative** location for the detention facility was an area located on the west edge of the Regis High School property near the intersection of the Regis Street and Cascade Highway. At this location there is an existing large depression area in the grassy area north of the baseball fields. Under large storm events, this area would provide temporary storage volume until the large storm event passes and then water in this area would flow back into the conveyance system and on to the Salem Ditch. It was hoped that this interim detention facility would provide enough reduction of the peak flows in the conveyance downstream to eliminate the need to upsize the conveyance system downstream. While this would provide interim detention, this detention facility would not eliminate the need for end-of-the-line detention. The hydraulic model was used to simulate this alternative. Based on the model results, the existing area did not provide nearly enough detention to eliminate flooding in the conveyance system downstream. Consequently, this alternative was not considered acceptable and was not pursued further.

The **second alternative** is to upsize the entire conveyance system with either larger pipes or parallel pipes to convey the peak 25-year storm event through the conveyance system. After upsize the conveyance system, the peak storm flows at Salem Ditch increase from 44 cfs to 81 cfs. Consequently, a detention facility with a storage volume of 10.4 ac-feet near Salem Ditch is required. The proposed location of this facility is shown on Figure 11. The detention pond should be designed in such a manner as to provide both water quality and water quantity treatment. With the detention facility and under a 25-year storm event, the peak flow into the Salem Ditch would be reduced from 81 cfs to 37 cfs. The estimated cost for this alternative is $6,731,000.

Recommendation: Based on the information presented above, Keller Associates recommends that the city adopt the **second alternative** as the best solution to the drainage problems in this area. While the first alternative is less expensive, the quantity of storm water detention at the Regis High School site is not adequate to eliminate the need to upsize the conveyance pipelines downstream. Consequently, the first alternative is not cost effective. Groundwater modeling at the proposed detention site should be conducted now to provide groundwater trend information during the design phase of the detention facility near Salem Ditch. Furthermore, property and/or easements should be pursued for the detention facility site.

6.4 GENERAL DETENTION ALTERNATIVES

Three general types of detention alternatives are regional detention, local detention, and onsite detention. A regional detention facility would detain runoff from several minor basins, while a local detention facility detains runoff from one minor basin, and onsite detention would be designed to detain runoff from a single development within a minor basin. These three types can be effective individually, or in a variety of combinations depending on the major and minor basin characteristics. Each of the major and minor drainage basins was evaluated for which type of detention facility would best suit the specific area both on the local level and the regional level. Figure 11 in Appendix A summarizes the master plan recommendations for which type of detention facility works best for each area in the system.

For minor basins 12, 13, and 15A, show in Figure 7, a regional detention site was recommended because these basins would not otherwise drain effectively given their proximity to the Mill Creek, the relatively flat slopes, and high water table. Minor basins 6, 7, and 8A were also best suited to a regional site because their runoff is naturally routed to the same outfall point on Mill Creek, and the land at that point is available for a regional site. A few of the other basins with regional detention include the northern section of the Shaff Road basin, the southern section of the Shaff Road basin, and the southeast portion of the Lucas Ditch basin.

Minor basin 11 is the bordered by Mill Creek on the north and it does not have enough cover above the water table to feasibly collect runoff from other upstream basins, therefore local detention was the best option for this minor basin. The same is true for minor basins15C, 15B, and 19.

The city currently has a policy of requiring onsite detention for redevelopment and commercial developments, which is recommended as a continued practice. The runoff from these developments could either discharge directly to the receiving waters or continue through the storm system to a local or regional detention facility. This policy assists in reducing pollutants through the use of BMPs and further mitigates flooding impacts.

SECTION 7 – WATER QUALITY

7.0 GENERAL

Storm water management has historically emphasized flood control. However, in recent years the focus has shifted to include water quality management. Storm water quality in Oregon is regulated by three main programs. This section summarizes these programs and Stayton's current position with regard to each of them. This storm water master plan provides the framework for the city to be prepared to meet all regulatory requirements.

7.1 REGULATORY PROGRAMS

7.1.1 UIC Program

The Underground Injection Control (UIC) Program was enacted in 1974 for management of fluid injection underground, in order to protect groundwater aquifers from contamination. The primary goal of the UIC Program is to preserve groundwater for beneficial uses such as drinking water. The Oregon Department of Environmental Quality (DEQ) has been delegated primacy to administer the UIC program for Oregon.

The DEQ administers the UIC program under Oregon Administrative Rule (OAR) 340-044. According to this rule, underground injection activities must be authorized through DEQ, either by registering the injection system and meeting general regulatory requirements ("rule authorized") or by obtaining a permit.

A strict definition of a UIC is "any system, structure, or activity that is created to emplace fluid directly into the subsurface." A few examples of storm water UICs are drywells, trench drains, sumps, perforated piping, floor drains, and drill holes. Single residential roof or footing drains that receive only storm water are exempt from UIC requirements.

The DEQ has developed guidance documents and forms to facilitate compliance with the UIC program. A document titled *UIC Program Information* has been prepared as part of this master plan to provide guidance for the city relating to underground injection systems and it can be found in Appendix D.

There is one known underground injection system in Stayton, and one currently being designed. Both systems are in the registration process. Given the general ground water and soil characteristics in Stayton, it is recommended that underground injection be used only if all other storm water discharge options have been ruled out.

7.1.2 NPDES Program- Phase II

Point source discharges to waters of the U.S., including storm water, are regulated through NPDES permits issued by the U.S. Environmental Protection Agency (EPA) or by authorized states. In Oregon, NPDES permits are issued and implemented by the DEQ. The Water Pollution Control Act (Oregon Revised Statute 468B) is the primary Oregon State law protecting water quality.

DEQ combines the federal NPDES regulations with pertinent state regulations and issues combined permits that regulate discharges to waters of the U.S. and waters of the state. These permits are designed to meet NPDES permit requirements and state law under the Water Pollution Control Act. Waters of the state include lakes, bays, ponds, impounding reservoirs, springs, wells, rivers, streams, creeks, estuaries, marshes, inlets, canals, and the Pacific Ocean within the territorial limits of the State of Oregon. In general, the waters of state include all bodies of surface or underground waters, natural or artificial, inland or coastal, fresh or salt, public or private (except private waters which do not combine with surface or underground waters), which are wholly or partially within or bordering the state or within its jurisdiction.

The storm water portion of the federal NPDES regulations has been implemented in two phases. Phase I addressed storm water discharges by large and medium municipal separate storm sewer systems (MS4s) and certain industrial activities, including construction sites disturbing more than 5 acres (The term "separate" means that wastewater such as sewage is not combined with storm water runoff). The Phase I storm water regulations were published in 1990. Phase II addressed MS4s in smaller municipalities and construction sites disturbing between 1 and 5 acres; those regulations were adopted in 1999. Municipalities with a population of 10,000 or more are candidate Phase II communities. Stayton is not currently designated as a Phase II community.

DEQ requires Phase II municipalities to adopt ordinances and implement minimum measures and BMPs equivalent to those in the federal guidance and in DEQ's Internal Management Directive—Phase II MS4 General Permit: Storm Water Management Program Plan Framework (June 2003). Under the Phase II rules, municipalities may be subject not only to the requirements of MS4 owners and operators, but also to two other components of the federal NPDES storm water program, also delegated to DEQ for implementation:

- The Industrial Storm Water General Permit as an operator of regulated industrial activity

- The Construction Storm Water General Permit as an operator of regulated construction activity disturbing more than 1 acre of land disturbed.

Each of the three components of the NPDES storm water program (municipal, industrial and construction) has its own requirements and permits.

Although Stayton is currently not required to meet NPDES Phase II requirements, the city has expressed the desire to be in a position on to meet these requirements. A separate document titled *Stormwater NPDES Phase II Program Plan* was prepared by Tetra Tech KCM as part of this master plan to provide the framework necessary for the city to meet Phase II requirements. This document can be found in Appendix D. In addition the preparing the city to meet phase II requirements, the program's approach will serve as a springboard to meet the requirements of the Willamette River TMDL program.

7.1.3 Total Maximum Daily Load Program

The Federal Clean Water Act requires that Total Maximum Daily Loads (TMDLs) be established when a water body does not meet water quality standards. The majority of Stayton's runoff eventually discharges to the Mill Creek which has been listed as water quality impaired under the Willamette Basin TMDL. The DEQ adopted a TMDL for the Willamette Basin in September 2006, and Stayton was identified as a "designated management agency" (DMA) in the Willamette River TMDL. A designated management agency is held responsible to mange water quality within their jurisdiction. As such, Stayton is required to develop a TMDL Implementation Plan to address TMDL allocations within their jurisdiction. TMDL Implementation Plans are due within 18 months from the date of the Notification Letters that DEQ sends to DMAs, permitees, and other affected parties. The Notification Letters were sent out by DEQ within 20 days of the TMDL being issued as an Order by DEQ. For Stayton, the final implementation plan must be submitted to the DEQ by March 2008.

The pollutants of concern in the Willamette Basin TMDL are temperature, bacteria, and mercury. The required elements for TMDL implementation plans are defined in OAR 340-042-0080(3). In summary, the requirements are:

- Develop and implement best management practices (BMPs) or other management strategies to achieve TMDL load allocations.
- Develop a timeline for implementation and a schedule for completing measurable milestones
- Develop a monitoring plan to determine whether:

    - BMPs are being implemented
    - Individual BMPs are effective
    - TMDL load allocations are being met
    - Water quality criteria are being met.
- Evidence of compliance with applicable statewide land use requirements
- DMAs also will have to include a storm water management component in their TMDL Implementation Plans.
- DMAs with a population between 10,000 and 50,000 will have to address the six minimum control measures identified in the NPDES Phase II program
- DMAs with a population less than 10,000 are expected to give considerations to any of the measures that are relevant.

To assist the city in getting started on the TMDL program, a document titled *Strategies for Reducing Pollutants in Surface Waters* was prepared by Tetra Tech KCM as part of this master plan. This document identifies the pollutants of concern and lists several BMPs which could be applied. This document can be found in Appendix D.

7.2 STORM WATER DRAINAGE STANDARDS

The storm water drainage standards for the city are contained in a separate document which provides guidance to developers building within Stayton's urban growth boundary. The standards touch on all aspects of water quantity and water quality management including conveyance, detention, and minimum BMP requirements. As Stayton continues to grow, this document serves as the rule by which the future storm drainage system will be constructed. It is, therefore, imperative for this document to be consistent with the city's goals for effective storm water management.

In connection with this master plan, Stayton's storm water drainage standards were found lacking in light of the city's storm water needs. The standards were carefully reviewed by Tetra Tech KCM and several improvements were recommended to the Technical Review Committee. These improvements were approved by the committee and incorporated into the draft set of standards. One of the most notable changes to the standards is the expansion of the water quality practices, and BMPs listed in the appendices of the draft standards. The draft revisions to the Storm Water Drainage Standards have been included in Appendix F.

The recommended revisions to the design standards have been developed to meet the city's goal of being prepared to meet future storm water regulatory requirements and target the specific needs of the city based in its geographic location and hydrologic conditions. Additionally, the recommendations are consistent with industry standards, neighboring communities, and regional practices.

The recommended revisions were specifically compared with the standards in the recently published *Central Oregon Stormwater Manual* (COSM). This manual was developed through a coordinated effort of cities and counties in Central Oregon and provides storm water guidance in such a way that a managing agency could wholly adopt the manual as their storm water design standards. However, the standards contained in COSM are geared to the climatic and hydro-geologic conditions of central Oregon rather than those found in Stayton. Therefore, not all of the recommendations in COSM should be directly applied to Stayton's storm water standards. Nevertheless, the principal methods and BMPs that can be applied in either region are consistent with the recommended improvements in the Draft Stayton Storm Water Drainage Standards.

7.3 INITIAL WATER QUALITY TESTING

In March of 2007, four storm water samples were collected from two inlet and outlet points to the storm water system. The points were chosen on the basis of their ability to provide a "before and after" picture of the storm water as it passes through the city's system. The samples were tested for Biochemical Oxygen Demand, Chemical Oxygen Demand (COD), Orthophosphate-phosphorus, Specific Conductivity, Total Solids, Total Suspended Solids (TSS), Turbidity, Hardness, pH, Phosphorus, and Ecoli.

The laboratory report has been included in Appendix D, but the sample results show that the water quality appears generally quite good with very little if any degradation. The COD, solids and phosphorus concentrations all decreased from inlet upstream of Stayton to outlet downstream of Stayton.

More testing over an extended period will be required before any firm conclusions can be drawn on the storm water quality, but initial testing appears promising. There are currently not any regulatory mandates for the city to perform storm water quality testing. However, if testing is continued, the Willamette Basin TMDL parameters of temperature, bacteria, and mercury should be given first priority for monitoring and in defining BMP implementations. Other pollutants which are often a concern with storm water include zinc, copper & lead, COD, and TSS, so if expanded testing is to be done these pollutants may be considered as second priority.

SECTION 8 – OPERATION, MAINTENANCE, AND REPLACEMENT

8.0 GENERAL

Proper maintenance enables the storm water system to function as designed, however, it requires that a significant amount of resources be dedicated to the storm water system. This section covers recommendations for the operation, maintenance, and replacement programs for the storm water system. The costs associated with these programs are also evaluated and summarized. The specifics of financing and total system costs are covered more completely in Section 10.

8.1 O&M TASKS

The City of Stayton's storm water conveyance system consists of approximately 20 detention facilities and an estimated 15 miles of pipe ranging from 6 to 48 inches in diameter. The system also includes roughly 650 catch basins and several small to medium sized biofiltration swales and open channels summing to nearly 8 miles in length excluding the Power Canal, Salem Ditch, and Mill Creek.

Operation and maintenance of the city's storm water system includes, but is not limited to:

- Daily implementation and tracking of Best Management Practices as outlined in the forthcoming TMDL implementation plan.
- Regular water quality samples. (not required by regulating agencies, but recommended)
- Annual TMDL Implementation Plan reporting.
- Annual review and revision of storm water master plan and implementation plan and enforcement through development construction plan review.
- Preparing budgets and implementing improvements.
- Public outreach and education.
- Code enforcement and construction storm water prevention plan monitoring.
- Annual catch basin cleaning.
- Annual TV inspection and cleaning of storm lines.
- Equipment Maintenance and coordination.
- Routine open channel maintenance.
- Routine detention basin maintenance.

A detailed discussion of these tasks and the accompanying replacement programs is covered in the following subsections.

8.2 DAILY BEST MANAGEMENT PRACTICES (BMPS)

The forthcoming TMDL Implementation Plan will outline the specific BMPs the city will follow. While the majority of these BMPs will be targeted at reducing the TMDL pollutants, they will also address storm water in general aimed at ensuring the storm water system functions properly.

Each of the BMPs listed in the TMDL Implementation Plan will have a benchmark associated with it, and a means for tracking the effectiveness of the particular BMP. If, for example, street sweeping is a BMP, the amount of sediment picked up would be tracked and recorded to compare it's effectiveness to other BMPs. The tracking and implementation would need to be summarized and reported annually to DEQ.

There will need to be coordination, planning, and enforcement behind the BMPs to ensure they are implemented correctly and that they are an effective use of the city's resources. The cost associated with these tasks will be the additional staffing required.

8.3 SYSTEM MAINTENANCE

The storm water conveyance system requires maintenance to ensure that pipelines, catch basins, and detention sites facilitate flows during the design storm event. Different maintenance tasks and programs for the conveyance system are outlined below.

8.3.1 Overview of Cleaning Program

Pipelines: It is necessary to provide regular TV inspection to determine pipeline conditions and then clean the pipelines as needed. Sediment build-up in the pipelines reduces the capacity of the pipelines and increases the severity of flooding. It also results in higher discharge of pollutants when flushed out by large storm events. Other problems that could reduce the conveyance capacity of the storm water lines are broken or cracked pipelines, offset joints, root intrusion, and other blockage. A regular cleaning and TV program for the storm water pipelines will enable the city to identify and prioritize the pipelines that need maintenance.

Records and notes of conditions and corrective actions should be kept. It is recommended that all the storm water pipelines be cleaned every 3 years or more regularly if TV records justify a higher cleaning frequency. Annual cleaning is recommended for lines with significant root intrusion. A record should be kept of the amount of sediment accumulated. The cleaning and TV inspection work has been subcontracted out in the past. The cost of pipeline cleaning and inspection depends on if the work is contracted out or performed by city staff. Subsection 8.3.4 reviews these costs.

Catch Basins & Sand/Grease Traps: Some of the catch basins, particularly in the older parts of town, are damaged and need replacement. New catch basins may also need to be added where drainage and slopes are not adequate. At a minimum, catch basins need to be cleaned when sediment or debris blocks more than 1/3 of the pipe. Sand/grease traps need to be cleaned when 1 inch of sediment has accumulated in the sand trap, or when 1 inch of oil/grease has accumulated in the grease trap.

Records and notes of conditions and corrective actions should be kept. According to a study titled *Evaluation of Catch Basin Performance for Urban Stormwater Pollution Control* (Aronson et al, 1983. EPA-600/2-83-043), it is recommended that all catch basins be cleaned at least annually. A catch basin's effectiveness increases with more frequent cleanings.

Catch basin cleaning can be coordinated with line cleaning and TV inspection. If lines are cleaned and inspected every three years, approximately 1/3 of the lines and catch basins will be cleaned yearly. This leaves 2/3 of the catch basins to be cleaned independently of the storm lines.

According to the contractor currently cleaning catch basins for the city, the cost for catch cleaning varies depending on unit size and conditions, but on average the cost is about $25.00 per catch basin. With an estimated 650 catch basins, the annual contracted cost is about $16,500. The current contractor uses a one man crew for catch basin cleaning.

Detention Facilities and Open Channels: Many of Stayton's detention facilities have grates on both the inlet and outlet pipes. Grates should be cleaned regularly and the control structures should be inspected and cleaned. The areas around the detention facilities should be sprayed for weeds. The spray used for this should be such that it does not impair water quality. Open detention facilities should be cleared of any trash or debris on a regular basis.

If detention facilities have a vegetative cover, mowing and other maintenance will be required during growing seasons. The base of the detention facilities are generally designed to be 6" below the outlet. If sediment accrual causes the base elevation to be level with or exceed the outfall elevation the detention facility will no longer function properly. When this occurs, the facility should be dredged. Similar maintenance should be performed on and around biofiltration swales and open channels.

The mowing and weed spraying is currently budgeted through other departments, but all aspects of the storm system maintenance should be paid for through the storm utility fees. For equipment used in multiple departments, the cost should be allocated to each department according to usage.

Maintenance of the swales and detention facilities should be preformed regularly for all facilities during the growing season. Keller Associates estimates that it will require an estimated 26 man-days/year for mowing and general cleaning and 21 man-days/year for spraying. Assuming the sediment removal from the detention facilities is contracted out at an average annual cost of $2,500 and the remainder of the work is performed by a full-time employee (FTE) on city staff at a rate of $270/working day, the annual cost will be around $23,300. In addition to the staffing cost, there are the equipment and supplies costs which have been summarized in Table 8.1.

Table 8.1. Detention Basin and Open Channel Maintenance

Equipment and Supplies	Rounded Annual Cost
Tractor ($23K/15yrs)	$1,600
Flail Mower ($10K/5yrs)	$2,000
Chemical Sprays	$2,500
Equipment fuel	$1,000
Equipment maintenance	$1,000
Labor Cost (at $270/day)	
Mowing and Cleaning	$7,000
Spraying	$5,700
Dredging	$2,500
Total	**$23,300**

Street Sweeping: In Stayton, the street sweeping is handled by the streets department. While staff support and equipment costs have not included for street sweeping in this report, street sweeping is an important part of the storm water operation and maintenance procedures in pollution prevention and control. Records of the quantity of debris removed (tons/year) with the street sweeping equipment should be kept and reviewed to identify higher maintenance areas that may require more frequent cleaning or erosion control measures.

8.3.2 Overview of Flow Monitoring Program

Flow and water quality monitoring at strategic locations will enable the city to document both water quality and water quantity impacts to the receiving streams including the Power Canal, Salem Ditch, Mill Creek, and the North Santiam River.

Keller Associates recommends that periodic flow and water quality monitoring programs be initiated and continued indefinitely. To be successful, the city will need city staff. Water quality monitoring equipment has been recommended as part of the capital improvement plan. Keller Associates recommends pulling samples at least on a quarterly basis. For planning purposes, a quarterly sample routine was assumed for 15 locations testing mercury and bacteria. Based on these assumptions, the annual cost for water quality monitoring is $6,000. Testing for additional parameters can increase the cost significantly.

8.3.3 Ownership versus Contracting Out T.V. Inspection

According the contractor currently performing the storm line cleaning for the city, a two-man crew can clean and TV storm lines at the rate of 3,000 feet per day for regularly maintained lines. For poorly maintained lines, which is the current state of the city's system, the pace slows to 400 feet per day. In addition to sediment build-up, another factor affecting the cost of cleaning the storm lines is root intrusion. Hollister, between 6th and 1st, and Gardner between Regis and Shaff, are two examples of storm lines severely impacted by tree roots. Root cutting is an additional maintenance item with rates ranging from 1,000 ft per day to 3,000 ft per day.

The initial time required for cleaning, TV inspecting, and root cutting the system may be extremely high based on cleaning cutting already performed by the current contractor. However, once the system is under control and annual maintenance is performed, the time and effort required will drop considerably. For planning purposes, a cleaning and TV rate of 3,000 ft/day will be used.

The city currently has its own cleaning rig, but it is reportedly too old to be used or feasibly repaired. According to a recent survey of suppliers, fully equipped rigs to TV inspect collection lines cost approximately $150,000. Annualized capital cost of the TV equipment would be $14,400 per year based on a 15 year equipment life and 5% interest rate.

A 3-year cleaning and TV cycle requires 5 miles of the total 15 to be cleaned annually which, based on a 3,000 ft/day estimate, amounts to approximately 20 man-days per year (based on 2-man crew at 10 days). The estimated cost of about $270 per working day per FTE yields the annual cost of $5,400 per year to clean and TV the lines. Therefore, total annual labor and equipment cost for cleaning and TV inspection for the city to do the work would be approximately $19,800 per year.

Current subcontracted cleaning and TV costs are about $0.43/ft assuming the lines are regularly maintained. Poorly maintained lines can cost up to $5/ft. Based on a 3-year cleaning and TV inspection cycle it would cost the city approximately $11,500 per year to subcontract these services and an additional $3,500 per year for root cutting or additional cleaning costs for high maintenance lines. The total estimated contracted cost is $15,000.

Therefore, at this time it appears the cost effective option is to hire the work out than to purchase equipment and set aside personnel dedicated to the storm water system. However, if the equipment were used for the storm water system and the wastewater collection system, the cost for the city to purchase the equipment and perform its own cleaning and TV inspection would drop considerably.

One additional reason why the city should consider purchasing their own equipment in the more immediate future, would be to give the city the flexibility to clean and TV monitor without scheduling it with a third party. City staff could respond more quickly to debris blockages that may cause flooding or ponding during storm events.

The city's current plan is to purchase TV equipment as part of the waste water capital improvement plan. In light of the additional benefit from using the TV equipment for the storm water system, the city could justify making the purchase of the equipment a higher priority. Keller Associates recommends the city assume the cleaning in 2010 and hire additional staffing with the acquisition of the new equipment.

8.3.4 Storm Water System Replacement Program

As broken or offset pipe sections are identified through TV monitoring and flow monitoring, Keller Associates recommends that these areas be documented and included in a replacement program. Pipeline and manhole replacement and rehabilitation needs will only increase as the storm water conveyance system ages.

The replacement program is based on the total amount of pipe not included in the priority improvements and its estimated useful life. There are approximately 13 miles of storm lines not already included in the capital improvement plan that were considered for the replacement program. Assuming an average of a 40-year remaining useful life, the pipe replacement program should target approximately 1,716 feet per year. Assuming 563 of the total 650 catch basins distributed along the 13 miles of storm lines not included in the capital improvements, and a manhole every 300 ft, the catch basin replacement program should target approximately 14 catch basins per year and the manhole replacement program should target about 6 manholes per year. Assuming an average pipe replacement cost of $85/ft, a catch basin cost of $1,600 each, and a manhole cost of $3,500 each, the city would need an annual replacement budget of $182,300. The estimated total replacement value of the existing system is $6.55 million. Table 8.2 summarizes the annual replacement program targets and the associated costs.

Table 8.2
Summary of Annual Replacement Costs

Facilities	Units	Unit Cost	Total Cost
Lineal Feet of Storm Lines	1,716	$85/ft	$145,900
Number of Catch Basins	14	$1,100 EA	$15,400
Number of Manholes	6	$3,500 EA	$21,000
Total Annual Replacement Cost @ 40 yrs			**$182,300**

8.3.5 System Replacement and Management

As the system is replaced, maintained, and updated, there are several issues to consider. Among these are coordination with other utility and roadway improvements, replacement methods, low maintenance systems, continuous updates to the storm system base map, and system inventory measures.

Rehabilitation Techniques: Rehabilitation techniques may include a combination of traditional and emerging trenchless techniques.

- Open cut replacements are recommended when pipeline grade corrections are needed, when spot repairs are needed, or when previously planned surface restoration / disturbance make it cost effective.

- Trenchless technologies include pipe lining and pipe bursting. Pipe lining may include slip lining with a smaller pipe, instituform, fold-in-form, and similar technologies. These approaches are cost effective where an open cut approach results in extensive surface repairs or high excavation and backfill costs. Trenchless technologies are typically faster and require less surface disturbance than traditional open cut approaches and are sometimes used when minimizing traffic disruptions is critical to the project.

- Pipe bursting entails pulling a continuous HDPE pipe through an existing sewer pipe using a bursting tool. Bursting is especially cost effective for pipelines 12-inch and smaller and may result in a 20% construction savings. Pipe bursting can also be used for pipeline upsizing (typically, upsize is limited to 1 larger nominal pipe diameter).

- Manhole and catch basin rehabilitation techniques include special liners, special grouting, and replacement.

- It should be noted that there are many locations inside the storm water service area where there is inadequate access to the storm water conveyance system. This condition is particularly true in the downtown area. Consequently, it is recommended that during rehabilitation projects, catch basins and storm water manholes be added as needed to provide more access for cleaning and video equipment.

- As storm lines are replaced, it is recommended that root intrusion technologies be considered where roots are an existing problem or are likely to become a problem in the future. These technologies often include either a polymer plate or plastic sheeting as a liner in the trench.

Keller Associates has had success on rehabilitation projects by allowing open cut and trenchless technologies to be competitively bid against each other.

Base Map Management: As portions of the system is replaced, abandoned, altered, or discovered the storm water base map created as part of this master plan should updated on a monthly basis. Accurate base maps will serve as a powerful tool for effective system maintenance and operation.

System Inventory: Keller Associates recommends that the city track system conditions and problems via a GIS or maintenance management software such as Oasis, Hansen, or custom program using the city's existing GIS. Logging conditions over time will help prioritize replacement projects and project replacement needs.

Low Maintenance Systems: New storm water system products become available almost continuously. Time spent in even minor evaluations of new equipment that may reduce maintenance costs may yield significant cost benefits in the long run.

Improvement Coordination: Estimated costs for improving the storm water system can be reduced considerably through coordinating multiple improvements at one time such as streets and other utilities.

8.3.6 Annual System Cost Summary

The costs presented in previous subsections are summarized in Table 8.3. The costs are largely based on quantities and will therefore need to be updated as the system grows and as unit costs change. Budgeting updates should be performed at least annually to ensure the storm water master plan implementation is on track.

Table 8.3. Annual System Costs Summary.

Catch basin cleaning	$15,400	per year (contracted price)
Detention Sites and Swales	$23,300	per year
Water Quality Sampling	$6,000	per year (contracted price)
Storm line cleaning and TV	$15,000	per year (contracted price)
System Replacement Program	$182,300	per year
Total	**$242,000**	**per year**

The costs shown in Table 8.3 do not include the annual costs associated with the capital improvement plan which specifically targets priority improvements intended to bring the storm water system to the standards established by the TRC. The capital improvement plan is presented in Section 9.

8.4 STAFFING

The equivalent of approximately 0.5-man year is required for system operation management, including testing and reporting. Another 1.0 man-year would be required for line and catch basin cleaning and TV inspection if those duties are undertaken by the city. Table 8.4 summarizes the current staffing recommendations, and Table 8.5 summarizes the future staffing recommendations when the city will undertake more the storm water maintenance tasks.

Table 8.4. Current Staffing Recommendations.

0.5 FTE	storm system management: BMP implementation/enforcement, contracting coordination, compliance reports, sampling, budgeting.
0.5 FTE	**total until 2010**

Table 8.5. Future Staffing Recommendations.

1 FTE	storm cleaning and maintenance (part of a 2 man crew spending 50/50 time on each system)
1 FTE	storm system management
2 FTE	**total after 2010**

SECTION 9 – CAPITAL IMPROVEMENT PLAN

9.0 GENERAL

This section summarizes the recommended capital improvements and their associated costs. Recommended improvements are illustrated in Figure 12 in Appendix A.

9.1 CAPITAL IMPROVEMENT PLAN

The capital improvement plan costs were prioritized based on their urgency to mitigate existing deficiencies and for servicing anticipated growth. Figure 10 in Appendix A illustrates the problem areas for the 2-year, 5-year, and 10-year storm events. *Probable cost estimates are in 2007 dollars for improvements necessary to correct flooding for the 25-year storm event have been summarized below.* Details of the costs estimates presented below for each project can be found in Appendix E.

9.1.1 Priority 1

Priority 1A improvements were considered most urgent and include improvements that will improve both water quantity and water quality discharges into various receiving streams. Priority 1B improvements correct flooding problems that pose substantial and immediate threat to property for the largest portions of the city. The total estimated project cost for all the Priority 1 Improvements is $8,185,100. All of the improvements are illustrated in Figure 12 and are color-coded by priority.

1A Improvements:

- Establish a wetland preserve area just south of the Cascade Highway Interchange on Hwy 22. This wetland preserve will provide a plant and wildlife refuge as well as water quality benefits for runoff routed through the area prior to discharging to Mill Creek. This improvement includes the purchase of approximately 25 acres. Estimated Project Cost = $695,800

- Construct a regional detention facility near the intersection of Shaff Road and the Salem Ditch. This detention facility should provide a minimum of 10.4 ac-ft of storage volume and be designed to also provide water quality treatment. This facility will provide detention for storm water collected from the largest drainage basin and reduce peak storm water runoff into the Salem Ditch from 25 cfs to 10 cfs. The detention facility could also be designed to double as a recreation area during dry periods. Estimated Project Cost = $1,753,600

- Construct a regional detention facility in the existing City Park area off Marion Street. This detention facility should provide a minimum of 8 ac-ft of storage volume and be designed to provide water quality treatment also. This facility will provide detention for storm water collected from a majority of the southeast portion of the city and reduce peak storm water runoffs from 28 cfs to 15 cfs into the Salem Ditch. The detention facility could be designed to double as a recreation area also during dry periods. Estimated Project Cost = $658,700

1B Improvements:

- Divert runoff from the agricultural field directly west of the industrial detention facility by constructing a berm and conveying agricultural runoff to an existing drain. The existing detention facility is not sized to handle agricultural runoff. Estimated Project Cost = $95,000

- Increase the conveyance capacity of the Shaff Road Basin conveyance system by upsizing sections of pipe and installing parallel pipes as illustrated in Figure 12. The detention facility off Shaff Road outlined in the section 1A Improvements is necessary prior to this improvement. Estimated Project Cost = $3,551,200

- Increase the conveyance capacity of the 10th Avenue Basin conveyance system by upsizing sections of pipe and installing parallel pipes as illustrated in Figure 12. The detention facility in the City Park area outlined in the section 1A Improvements is necessary prior to this improvement. Estimated Project Cost = $810,000

- Construct a regional detention facility on property currently owned by Norpac located near the intersection of Evergreen Street and Washington Street. This detention facility should provide a minimum of 3 ac-ft of storage volume and be designed to also provide water quality treatment. The detention facility could also be designed to double as a recreation area during dry periods. Estimated Project Cost = $620,800

9.1.2 Priority 2 Improvements

Priority 2 improvements correct problems that pose a smaller and less immediate threat to human health and property. Priority 2 improvements predominantly correct flooding and capacity problems in the downtown area and are estimated to cost $4,900,800.

- Construct a parallel 36-inch storm pipe from Fir to Regis Street through the Regis High School parking lot. This improvement is necessary to eliminate flooding in the school parking lot. Estimated Project Cost = $357,000

- Increase the conveyance capacity of the conveyance system that will discharge into the proposed Priority 1B regional lift station near the intersection of Evergreen and Washington streets by constructing parallel 12-inch pipes. The regional detention facility outlined in the section 1B Improvements is necessary prior to this improvement. Estimated Project Cost = $568,900

- Implement the best apparent alternative improvements outlined in Section 6 for the North Downtown Drainage Basin by constructing a regional detention facility near the library and rerouting all the storm water lines that discharge directly into Salem Ditch with a new large storm line along Marion Street. This detention facility should provide a minimum of 3.6 ac-ft of storage volume and be designed to provide water quality treatment also. This facility will reduce peak storm water runoffs from 25 cfs to 10 cfs into the Salem Ditch. The detention facility could be designed to double as a recreation area also during dry periods. Estimated Project Cost = $1,922,400

- Implement the best apparent alternative improvements outlined in Chapter 6 for the South Downtown Drainage Basin by constructing a regional detention facility on property owned by Norpac north of Holly Avenue and rerouting all the storm water lines that discharge directly into Salem Ditch with a new large storm line along Ida Street. This detention facility should provide a minimum of 2 ac-ft of storage volume and be designed to also provide water quality treatment. This facility will reduce peak storm water runoff into the Salem Ditch from 9 cfs to 7 cfs. The detention facility could also be designed to double as a recreation area during dry periods. Due to the large project cost in comparison to the relatively small benefit, this improvement would have a lower priority than other Priority 2 improvements. Estimated Project Cost = $1,955,800

- Install 5 storm water quality monitoring manholes at strategic points throughout the system. The water quality manholes include the cost of installing a new manhole and the cost of automated, refrigerated sampling equipment withy the accompanying operational software. The samples pulled at these manholes can be an effective way to track the bottom-line benefits from the implementation of various BMPs and provide the city with solid data supporting their efforts to reach TMDL load allocations. The capital improvement plan already accounts for storm water quality monitoring manholes at discharge points downstream of future and existing detention facilities. The intent of these additional manholes is to provide the city some flexibility should the need arise to monitor water quality at points in the system other than those already designated. Estimated Project Cost = $1,955,800

9.1.3 Priority 3 Improvements

Priority 3 improvements correct problems that pose less immediate threat to health or property. Priority 3 improvements predominantly correct flooding and capacity problems under the 25-year storm event in the northwest part of town and are estimated to cost $1,527,200.

- Construct a parallel 10-inch storm pipe in the Sylvan Meadows subdivision to adequately convey storm water to detention swale. Estimated Project Cost = $60,500

- Increase the conveyance capacity of the conveyance system along Locust Street and Gardner Road by TBD. These improvements are necessary to protect the Stayton High School from flooding and ponding. Estimated Project Cost = $TBD

- Construct a parallel 24 to 30-inch storm pipe starting in Wilshire Drive to just west of Wilco Road. Sections of this alignment are in the back of residential lots. Estimated Project Cost = $735,800

- Construct a parallel storm pipes in portions of the Westtown Park Subdivision. Sections of this alignment are in the back of residential lots. Estimated Project Cost = $730,800

9.1.4 Priority 4 Improvements

Priority 4 improvements predominantly correct flooding and capacity problems under the 25-year storm event in the south part of town and are estimated to cost $911,300.

- Construct a new 15-inch storm pipe in the area west of the Library property to intercept multiple direct discharges into Salem Ditch and redirect this runoff into the proposed detention basin on the site. This improvement will provide water quantity and quality mitigation. The detention basin in Priority 2 improvements is a prerequisite to this improvement. Estimated Project Cost = $49,500

- Upsize the storm water pipe along Pacific Court with a new 30-inch storm pipe. Estimated Project Cost = $440,900

- Upsize the existing storm water pipe along 1st Avenue from Florence to the discharge into the Power Canal with a new 15-inch storm pipe. Estimated Project Cost = $122,300

- Construct a regional detention facility on the site on the southeast corner of the intersection of Washington Street and the Salem Ditch that will mitigate water quality and water quantity challenges for storm water runoff. This detention facility should provide a minimum of 1.5 ac-ft of storage volume and be designed to provide water quality treatment. Existing storm water piping should be modified to redirect storm water into the proposed detention facility and then discharged into Salem Ditch through the existing discharge pipe. The detention facility could also be designed to double as a recreation area during dry periods. Negotiations for easements or land acquisition for the site should be initiated now. Estimated Project Cost = $216,600

- Upsize the existing storm water pipe along the undeveloped portion of North Peach Street to the discharge into the Salem Ditch with a new 18-inch storm pipe. Estimated Project Cost = $82,000

9.1.5 Future Improvements

Future improvements are necessary to expand the storm water utility to the undeveloped property inside the urban growth boundary. The future improvements summarized below are estimated to cost $9,395,300. Because these improvements are largely development driven they should be development financed.

- Improvements to expand the city's storm water facilities along Fern Ridge Road to accommodate undeveloped lands in the area include parallel pipes and regional detention facilities as shown in Figure 12. The location, sizing, and alignment of these facilities should be coordinated and verified during the development review process. Estimated Project Cost = $1,700,100

- Improvements to expand the city's storm water facilities to the Dozler property include conveyance pipelines and a regional detention facility with a detention volume of approximately 5 acre-feet. The location, sizing, and alignment of these facilities should be coordinated and verified during the development review process. Estimated Project Cost = $740,800

- Improvements to expand the city's storm water facilities to the Phillips property include conveyance pipelines and a regional detention swale as shown on Figure 12. The location, sizing, and alignment of these facilities should be coordinated and verified during the development review process. These facilities should be sized to accommodate existing runoff from the Quail Run Subdivision area. Estimated Project Cost = $1,991,900

- Upsize the existing storm water pipe along the north portion of Larch Avenue that discharges into the Salem Ditch with a new 15-inch storm pipe. Estimated Project Cost = $129,700

- Improvements necessary to expand the city's storm water facilities to other undeveloped lands in the urban growth boundary include conveyance storm water pipelines and regional detention facilities as shown in Figure 12. The location, sizing, and alignment of these facilities should be coordinated and verified during the development review process. Estimated Project Cost = $3,402,000

- Establish a fund for upsize costs. As new developments are constructed, there will be areas where the storm water master plan requires a large conveyance line or a regional detention facility to accommodate runoff from areas outside of the development. With this fund, the city could reimburse the developer for costs incurred over and above that which is required for the development alone. As other developments come on line that benefit from the larger conveyance or regional detention they will pay a later comer fee.

9.1.6 Future Improvements

A summary of the recommended improvements organized by priority is presented below. A graphical illustration of each improvement is provided on Figure 12, and each improvement has been labeled with the priority number presented in Table 9.1.

Table 9.1
Capital Improvement Plan

Priority Improvements					
Item (2007 Project Costs*)	**Priority 1**	**Priority 2**	**Priority 3**	**Priority 4**	**Future**
Priority 1 (2008)					
1A					
Wetland Preservation	$695,800				
Shaff Road Detention Basin and piping	$1,753,600				
10th Ave Detention Basin and piping	$658,700				
PRIORITY 1A SUBTOTAL	$3,108,100				
1B					
Industrial Detention Site Improvements	$95,000				
Shaff Road Basin Pipeline Improvements	$3,551,200				
10th Avenue Pipeline Improvements	$810,000				
Norpac NE Detention Site	$620,800				
PRIORITY 1B SUBTOTAL	$5,077,000				
Total Priority 1	***$8,185,100***				
Priority 2 (2010)					
Fir to Regis through Regis HS Parking Lot		$357,000			
Evergreen Ave to Norpac Dtn Site		$568,900			
3rd and Jefferson to Library Dtn Site		$1,922,400			
Millstream Woods to Norpac SW Dtn Site		$1,955,800			
5 Additional Manhole Monitoring Equipement		$96,700			
Total Priority 2		***$4,900,800***			
Priority 3 (2015)					
Sylvan Meadows Subdivision			$60,500		
Gardner Road-Regis High School-Unverified			TBD		
Wedgewood Place			$735,800		
Western Avenue			$730,800		
Total Priority 3			***$1,527,100***		
Priority 4 (2020)					
Library Improvements				$49,500	
Pacific Court				$440,900	
1st Avenue				$122,300	
Washington Street Area				$216,600	
North Peach Street				$82,000	
Total Priority 4				***$911,300***	
Future*					
Fern Ridge Street Area					$1,700,100
Dozler Property Area					$740,800
Phillips Property Area					$1,991,900
Larch Avenue					$129,700
Detention Facilities					$3,402,000
Pipeline Upsize Costs (over 18")					$1,430,800
Total Future					***$9,395,300***
TOTAL (rounded)	**$8,185,100**	**$4,900,800**	**$1,527,100**	**$911,300**	**$9,395,300**

* All costs in 2007 Dollars. Costs include engineering and contingencies.
** Timing depends on when growth occurs. Development participation anticipated.

SECTION 10 – STORM WATER SYSTEM FUNDING

10.0 GENERAL

Stayton's existing storm water system is in need of several improvements which require a substantial amount of funding. In addition to the previously identified improvements, the storm water system requires regular maintenance and replacement. The City of Stayton currently pays for storm water operations and maintenance from a combination of general funds, wastewater funds, water funds, park funds, street funds, and contributions from private developers.

Keller Associates' subconsultant Economic & Financial Analysis (EFA) has reviewed the city's current financing practices and has recommended several changes which are summarized in this section along with an evaluation of potential funding sources. The details of the financial analysis have been included in Appendix G.

10.1 CURRENT STORM WATER FINANCING

Because Stayton has not tracked storm water expenditures as a separate utility, EFA has compiled the available financial information to obtain the most probable estimate of current and historic funding procedures.

Table 10.1 recapitulates the historic storm water utility cash flows and identifies missing information. For operating expenses, the city transfers money from the General Fund, which is typically backed by the state-shared gas-tax revenues. The storm water system expenses are also subsidized by the city's sewer and water rates. Storm water does not have independent operating receipts like the water and waste water utilities, nor does it specifically identify labor expenses.

For capital and capital related activities, the city undertakes storm drainage projects as cash is made available from other funds. With these funds, the city has completed miscellaneous storm system repairs, installed new facilities in Shaff Road in 2005-06 ($8,522) and in 2006-2007 ($184,000), and paid for the storm water master plan, ($34,650) in 2006-2007.

Because the storm water utility does not exist as a financial entity, it does not accumulate cash savings or earn interest on investments. The storm water utility existed in the General Fund until fiscal year 2006-07, when it was transferred to the sewer fund, as part of the sanitary sewer utility. Under these current financial conditions, necessary repairs and maintenance of the system tend to compete with other capital projects such as street repairs.

Table 10.1
Storm Water Utility Cash Flow History

	Audit		Estimate	Budget
	2004 2005	2005 2006	2006 2007	2007 2008
CASH FLOWS FROM OPERATING ACTIVITIES:				
Operating Receipts				
Transfers from the Street Fund	2,319	11,781	25,860	18,025
Total Operating Receipts	2,319	11,781	25,860	18,025
Operating Expenditures				
Personal services				
Materials and services	2,319	11,781	25,860	18,025
Total Operating Expenditures	2,319	11,781	25,860	18,025
Net Cash Provided by Operating Activities	-	-	-	-
CASH FLOWS FROM CAPITAL AND RELATED FINANCING ACTIVITIES				
System development charges				
Capital expenditures	(7,413)	(28,127)	(253,300)	(30,000)
Bond/Loan Proceeds				
Grants				
Bond/Loan Closing Expense				
Transfers from other City funds	7,413	28,127	253,300	30,000
Net Cash Provided by (Used in) Capital and Related Financing Activities	-	-	-	-
CASH FLOWS FROM INVESTING ACTIVITIES:				
Interest income on investments				
Net Increase (Decrease) in Cash & Cash Equivalents	-	-	-	-
CASH AND CASH EQUIVALENTS - July 1	-	-	-	-
CASH AND CASH EQUIVALENTS - June 30	-	-	-	-

10.2 RECOMMENDED ANNUAL BUDGET CONSIDERATIONS

The annual storm water budget should cover the phased costs for funding the replacement program, capital improvements, and O&M. The capital improvement costs are covered in Section 9, the replacement costs along with the operation and maintenance costs are covered in Section 8. Recommended staffing is also covered in Section 8. Table 10.2 summarizes the total annual costs for all of these items.

Table 10.2
Summary of Total Annual Storm Water Costs

Item	Amount	Comment
System Replacement Program	$182,300	Includes pipelines and catch basins
O & M Equipment,Supplies, Contracted work	$21,600	Values assumed based on contracted cleaning, dredging, and TV work
City Staff Budget	$105,000	Assumes 1.5 FTE @ $70,000 annual salary
Rounded Total	**$309,000**	

In addition to these recurring annual costs, the necessary capital improvements to the storm water system total $24.9 million dollars. Approximately $7.5 million of this total cost will benefit future development and will likely be funded from a system development charge (SDC). The SDC will ensure each future development pays its proportionate share of the capital improvement costs. The remaining $17.4 million not covered by the SDC will have to be paid by all of the city's residents and businesses through a storm water utility fee.

10.3 STORM WATER FINANCING PLAN

EFA has developed a storm water financing plan through the establishment of an SDC and a storm water utility. The supporting details for this financial plan have been included in Appendix G.

10.3.1 System Development Charge (SDC) Impacts

To be provided by EFA

10.3.2 Storm Water Utility User Rate Impacts

To be provided by EFA

10.4 POTENTIAL STORM WATER FUNDING SOURCES

Outside of funds gathered by the city through the recommended SDCs and storm water utility fees, there are other sources of funding from private and government programs which may be available for the city to aid in the implementation of this master plan.

With the aid of the Boise State University Environmental Finance Center, twenty-five sources of potential funding have been identified as having specific application to Stayton's storm water system financing. It is recommended that the city review the application requirements for each of these sources and apply for as many as possible. These potential sources are listed in Appendix G.

Appendix A
Figures

KELLER ASSOCIATES

W:\Work\104037 (moved to V)\StormWaterBaseMapping\ReportFigures\FIG-1.dwg

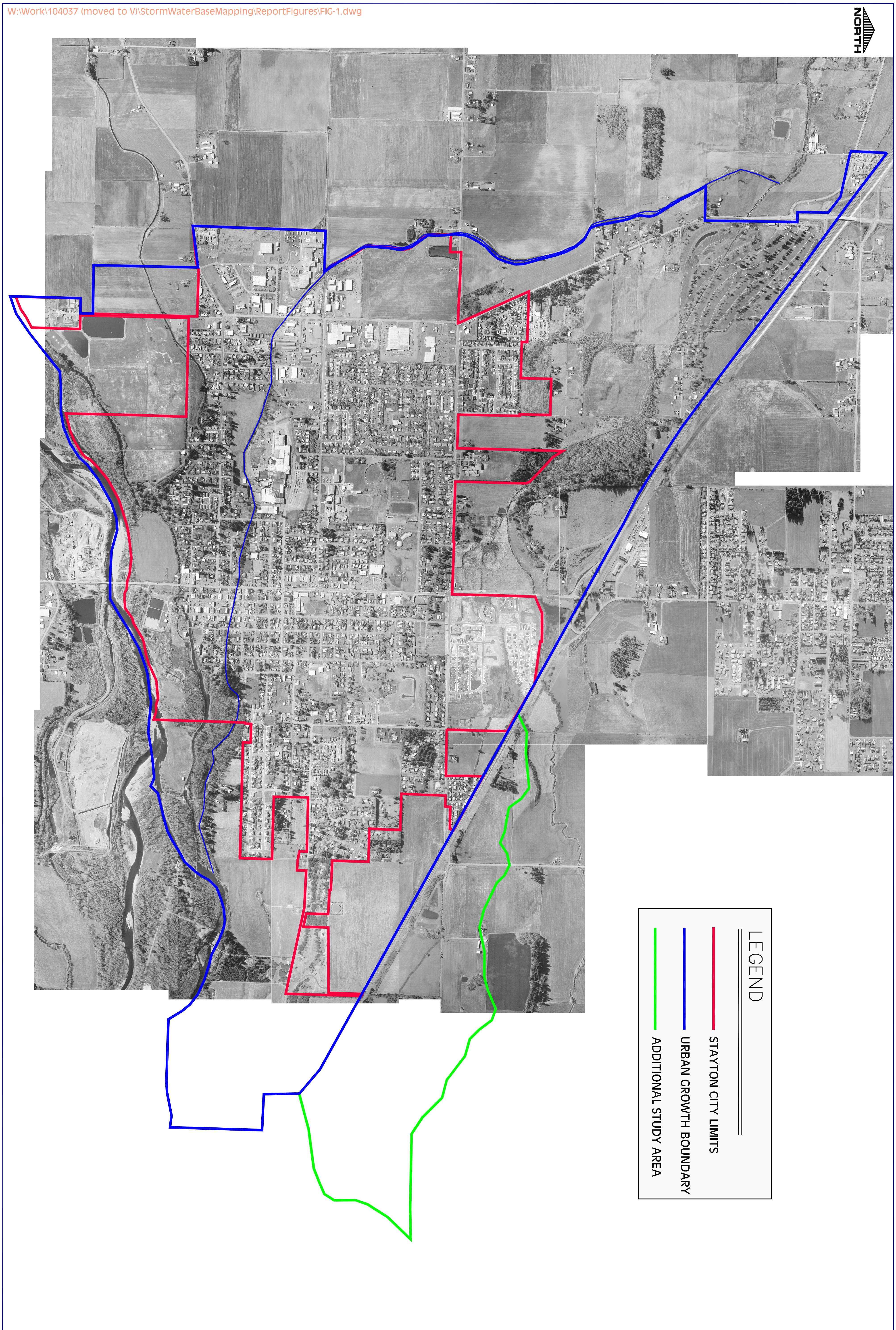


FIGURE 1

Study Area

Storm Water Master Plan
Stayton, OR

KELLER ASSOCIATES

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FIG-1.dwg

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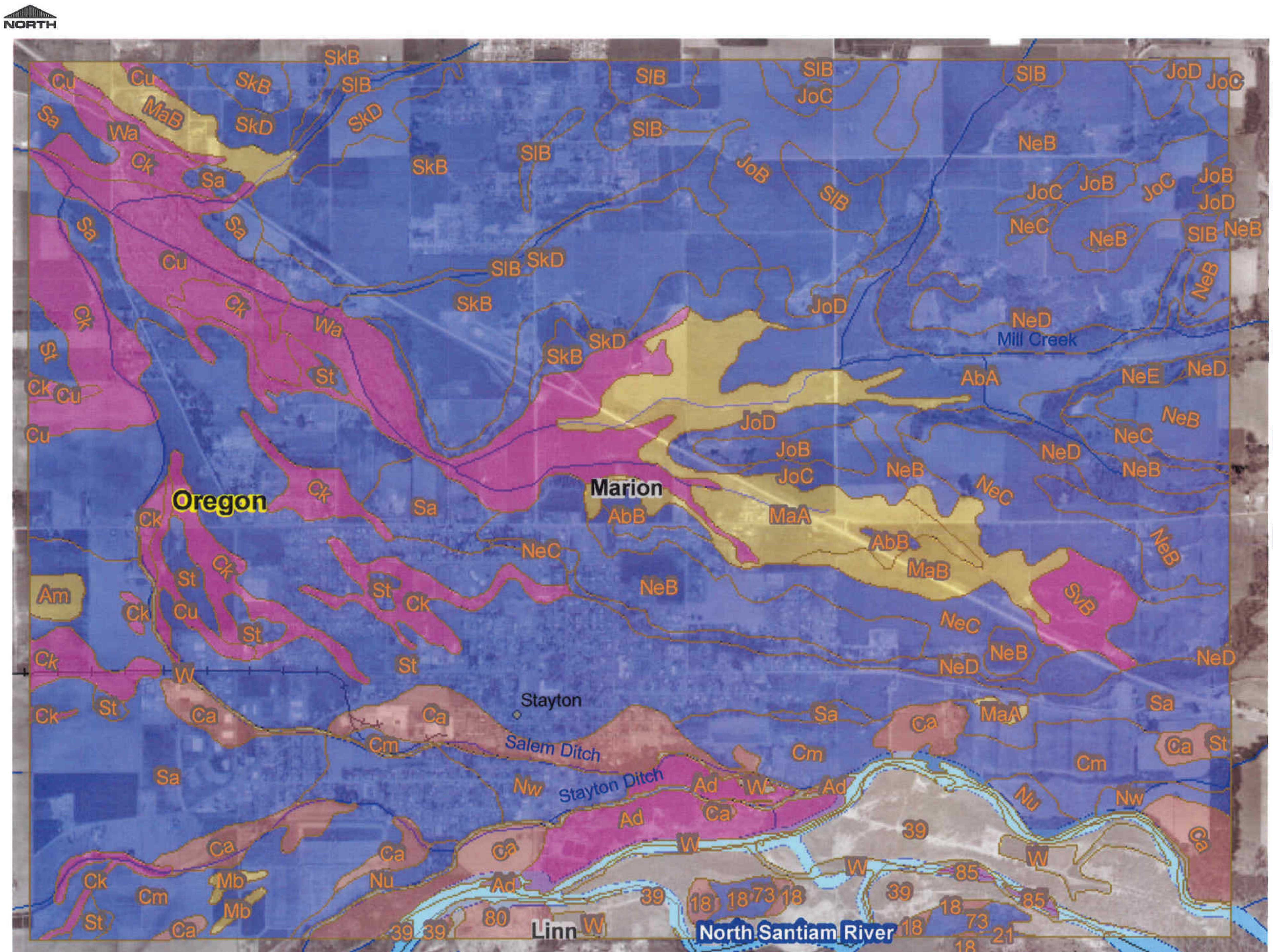

LEGEND

A
INCLUDES SOIL TYPES: Ca

B
INCLUDES SOIL TYPES: AbA, AbB, Cm, JoB, JoC, JoD, NeB, NeC, NeD, NeE, Nu, Nw, Sa, SkB, SkD, SlB, St

C
INCLUDES SOIL TYPES: Am, MaA, MaB, Mb

D
INCLUDES SOIL TYPES: Ad, Ck, Cu, SvB, Wa

NR/NA

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FIG-2.dwg

KELLER ASSOCIATES

Storm Water Master Plan
Stayton, OR

Soil Types

FIGURE 2

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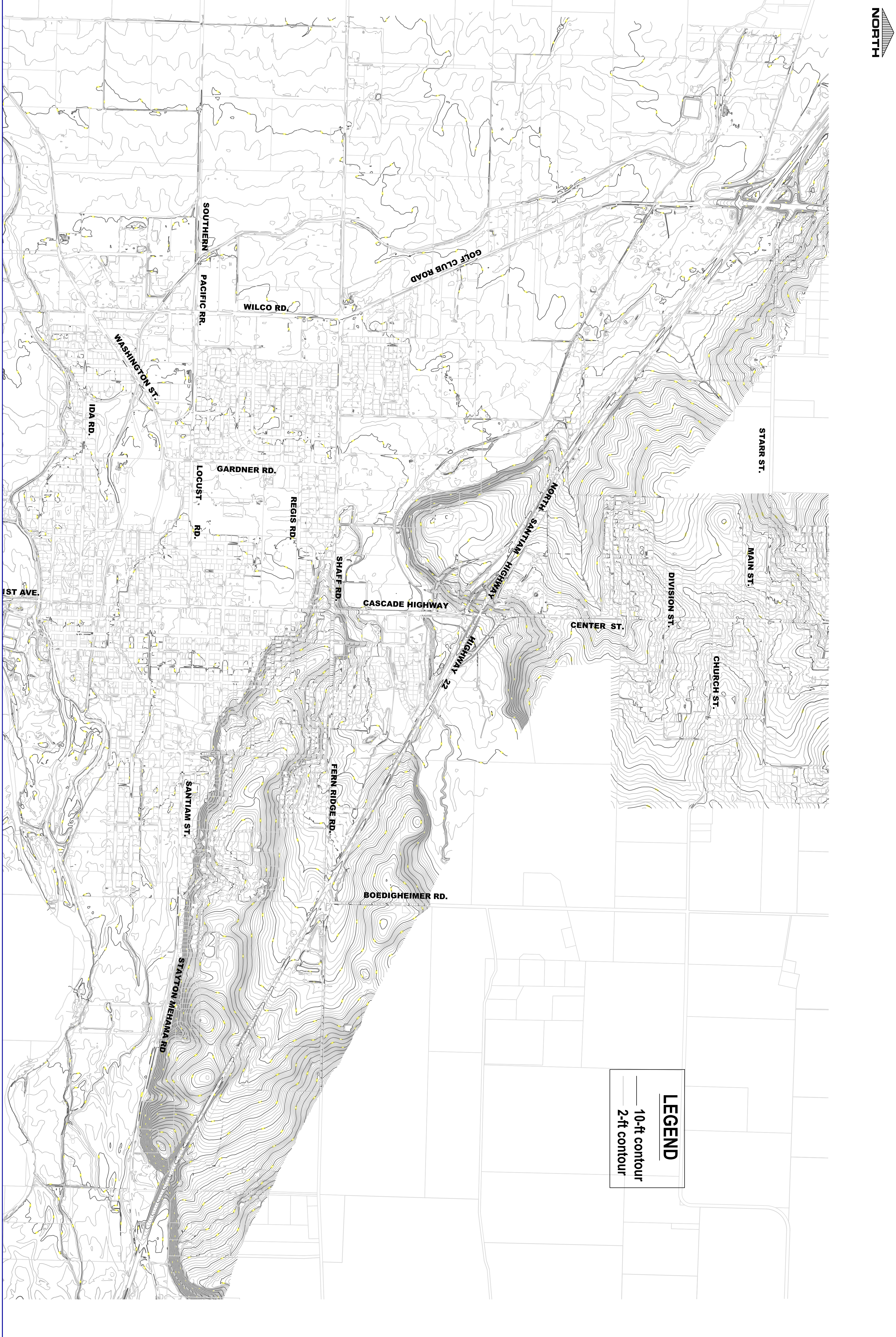

FIGURE 3

TOPOGRAPHY

Storm Water Master Plan

Stayton, OR

CITY OF STAYTON

KELLER ASSOCIATES

KA:104037

FIG-3.dwg

W:\Work\104037 (moved to V)\StormWaterBaseMapping\ReportFigures\FIG-4.dwg

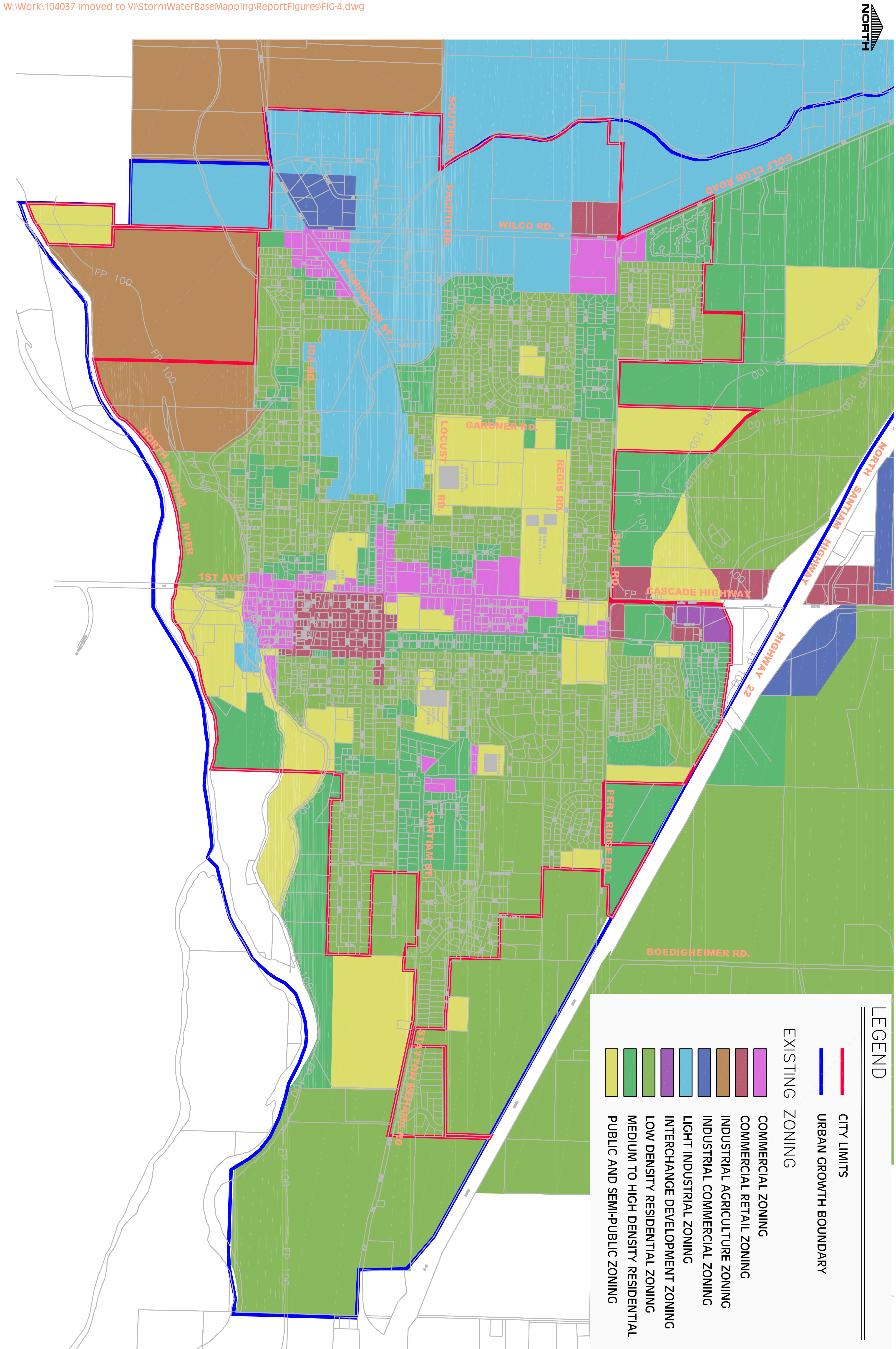

FIGURE 4

Land Use

Storm Water Master Plan
Stayton, OR

KELLER ASSOCIATES

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FIG-4.dwg

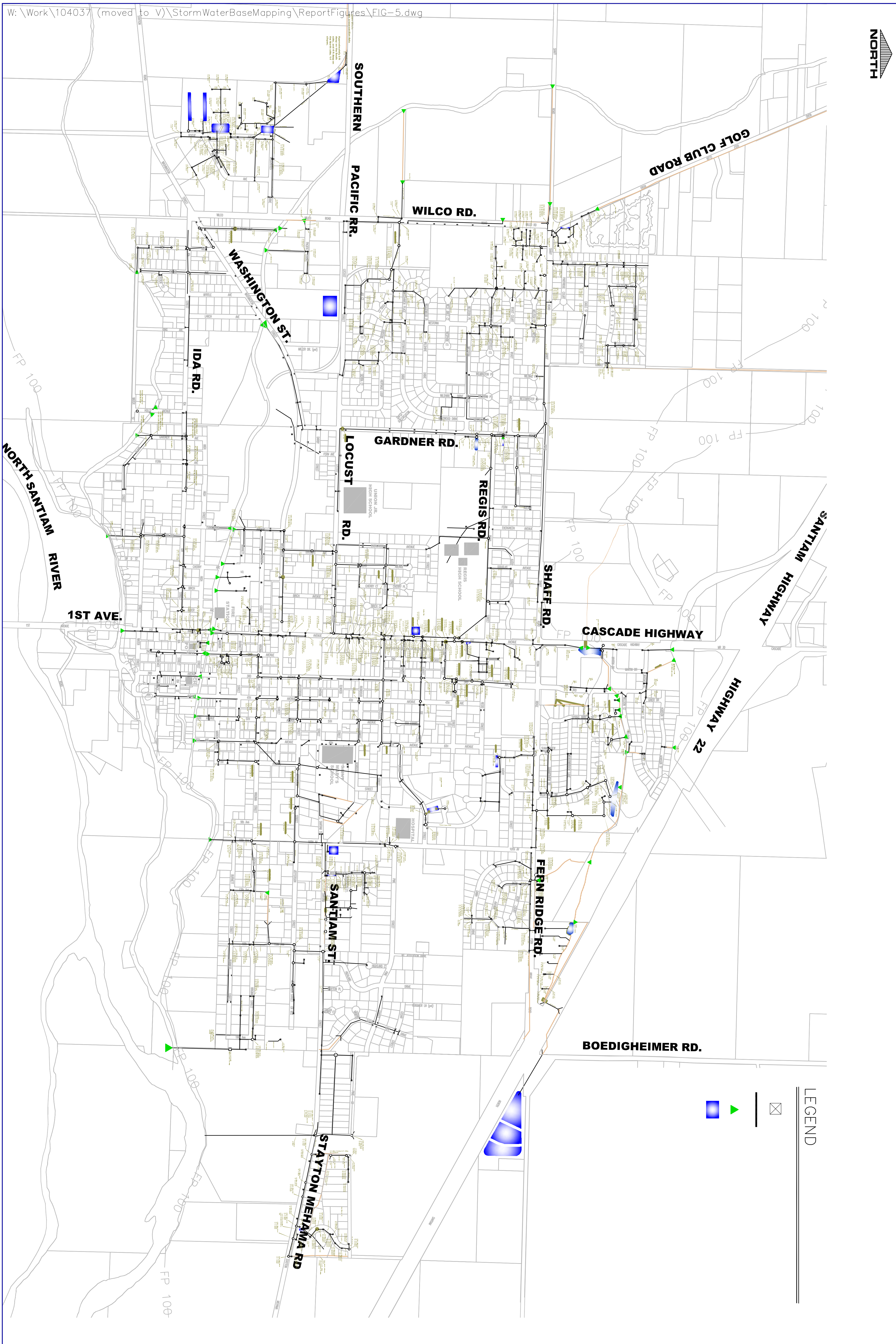

FIGURE 5

Existing Storm System

Storm Water Master Plan
Stayton, OR

KELLER ASSOCIATES

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FIG-5.dwg

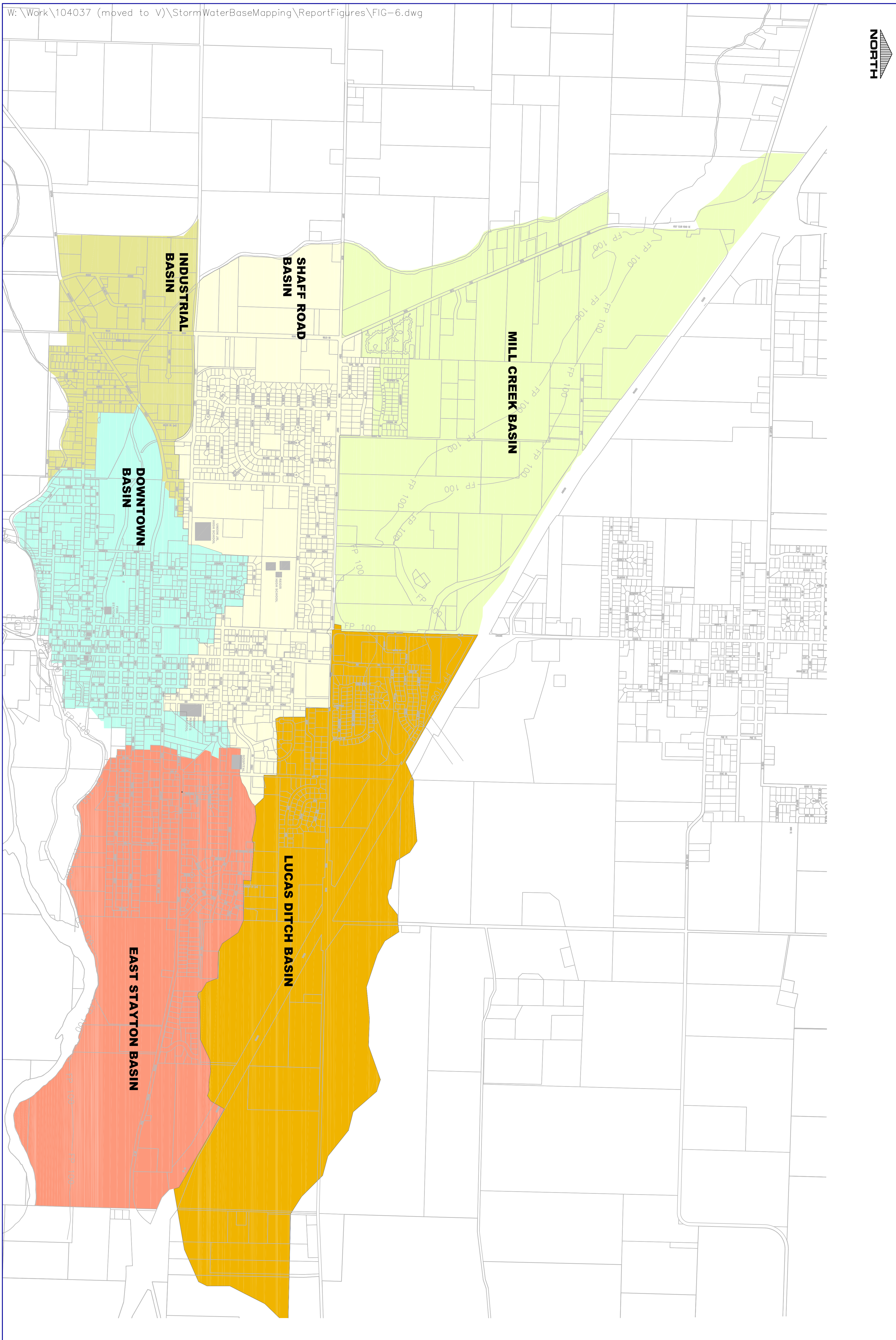

FIGURE 6

Major Drainage Basins

Storm Water Master Plan
Stayton, OR

CITY OF STAYTON

KELLER ASSOCIATES

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FIG-6.dwg

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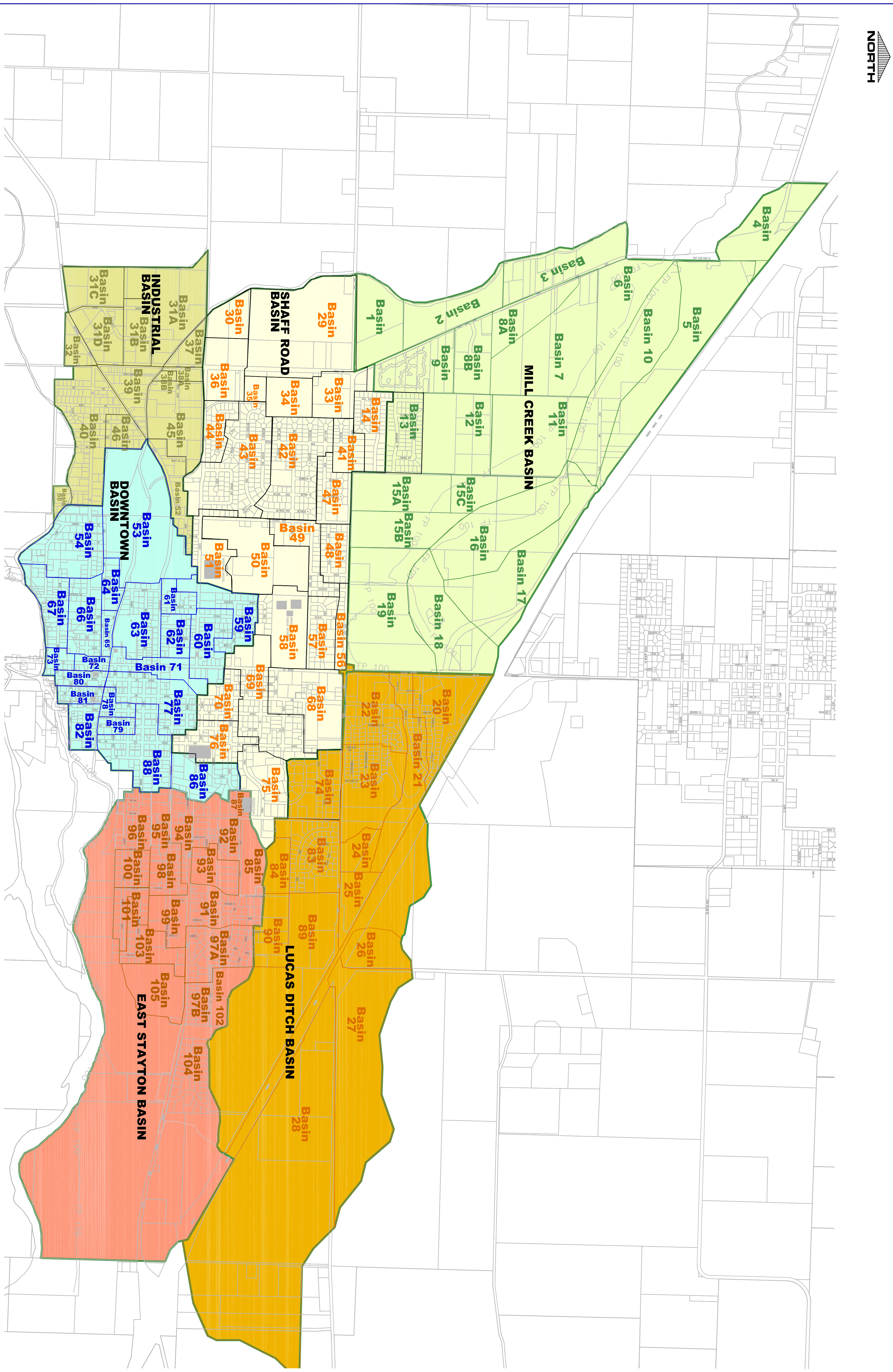

FIGURE 7

Minor Drainage Basins

Storm Water Master Plan
Stayton, OR

KELLER ASSOCIATES

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FIG-7.dwg

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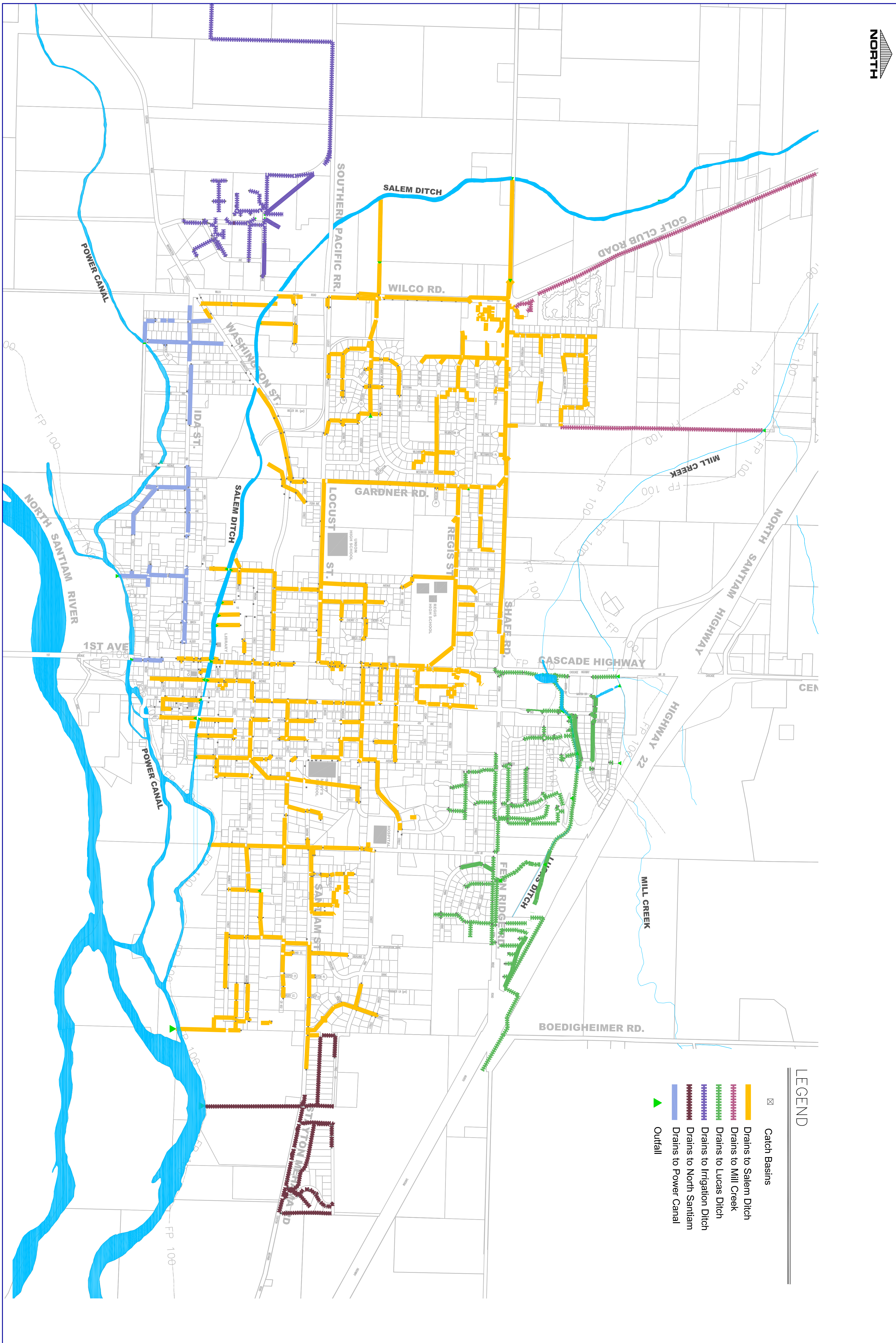

FIGURE 8

Discharge Locations

Storm Water Master Plan
Stayton, OR

KELLER ASSOCIATES

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FIG-8.dwg

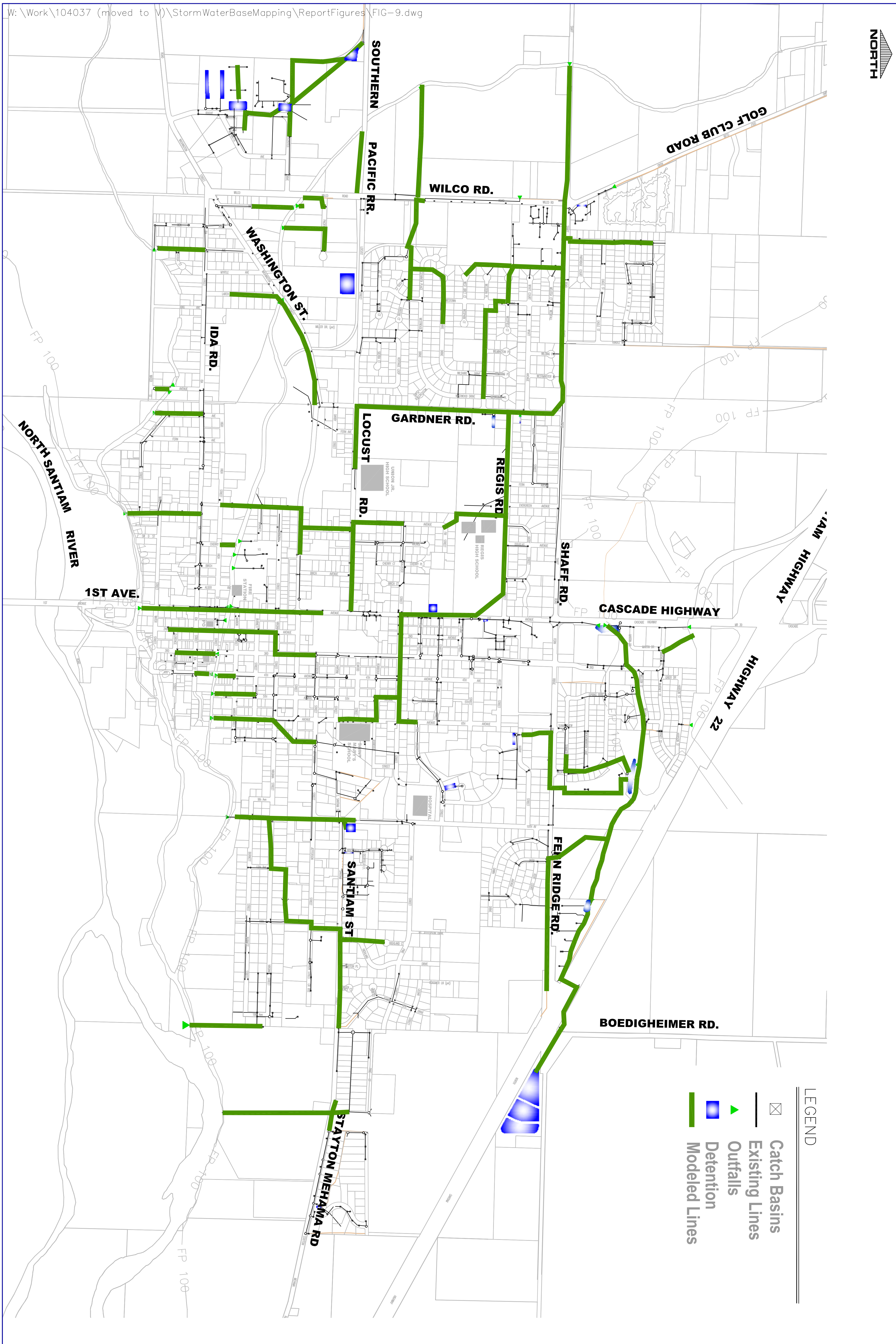

FIGURE 9

Modeled Lines

Storm Water Master Plan
Stayton, OR

CITY OF STAYTON

KELLER ASSOCIATES

KA:104037
FIG-9.dwg

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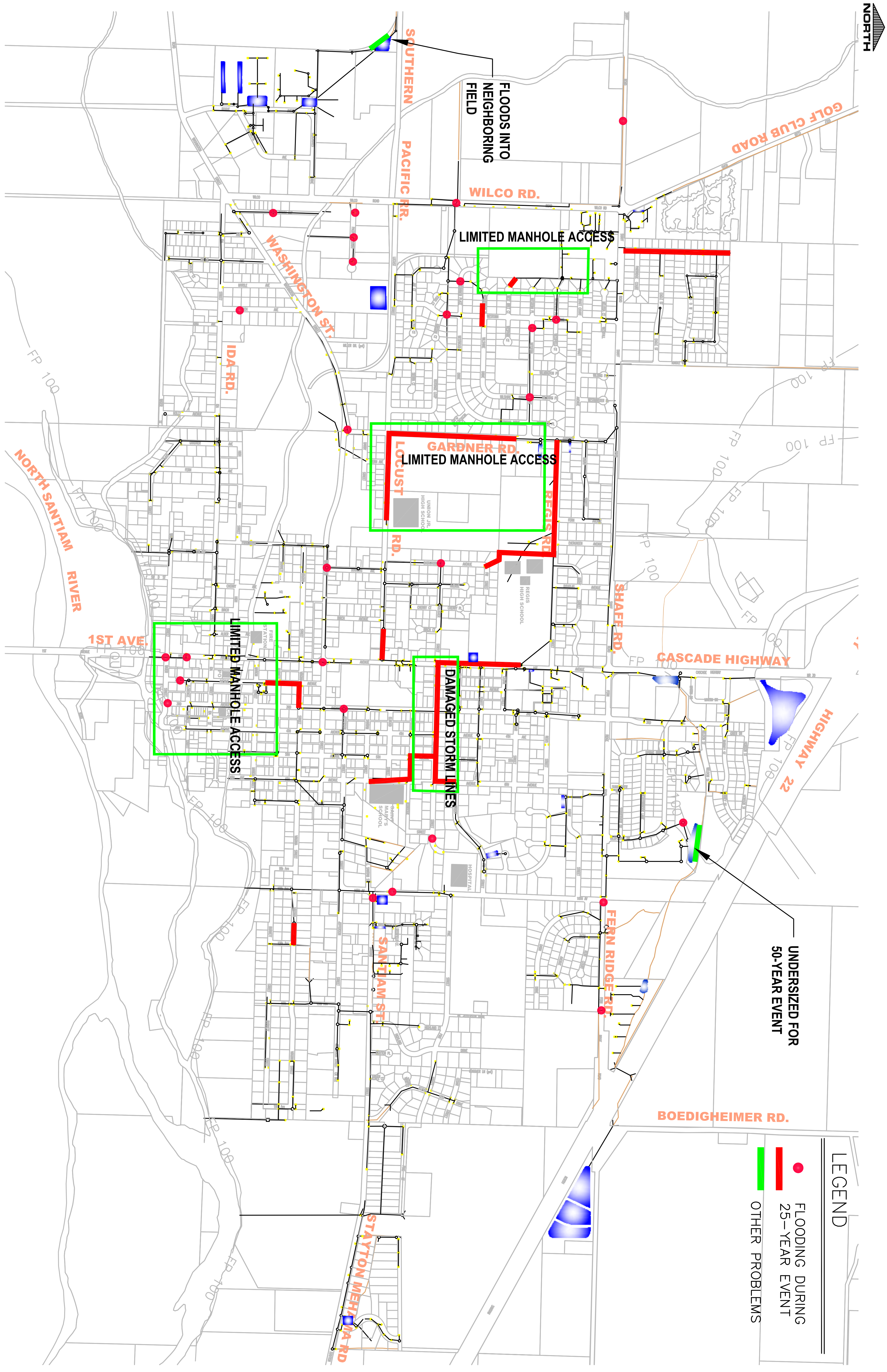

FIGURE 10

Problem Areas

Storm Water Master Plan
Stayton, OR

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FIG-10.dwg

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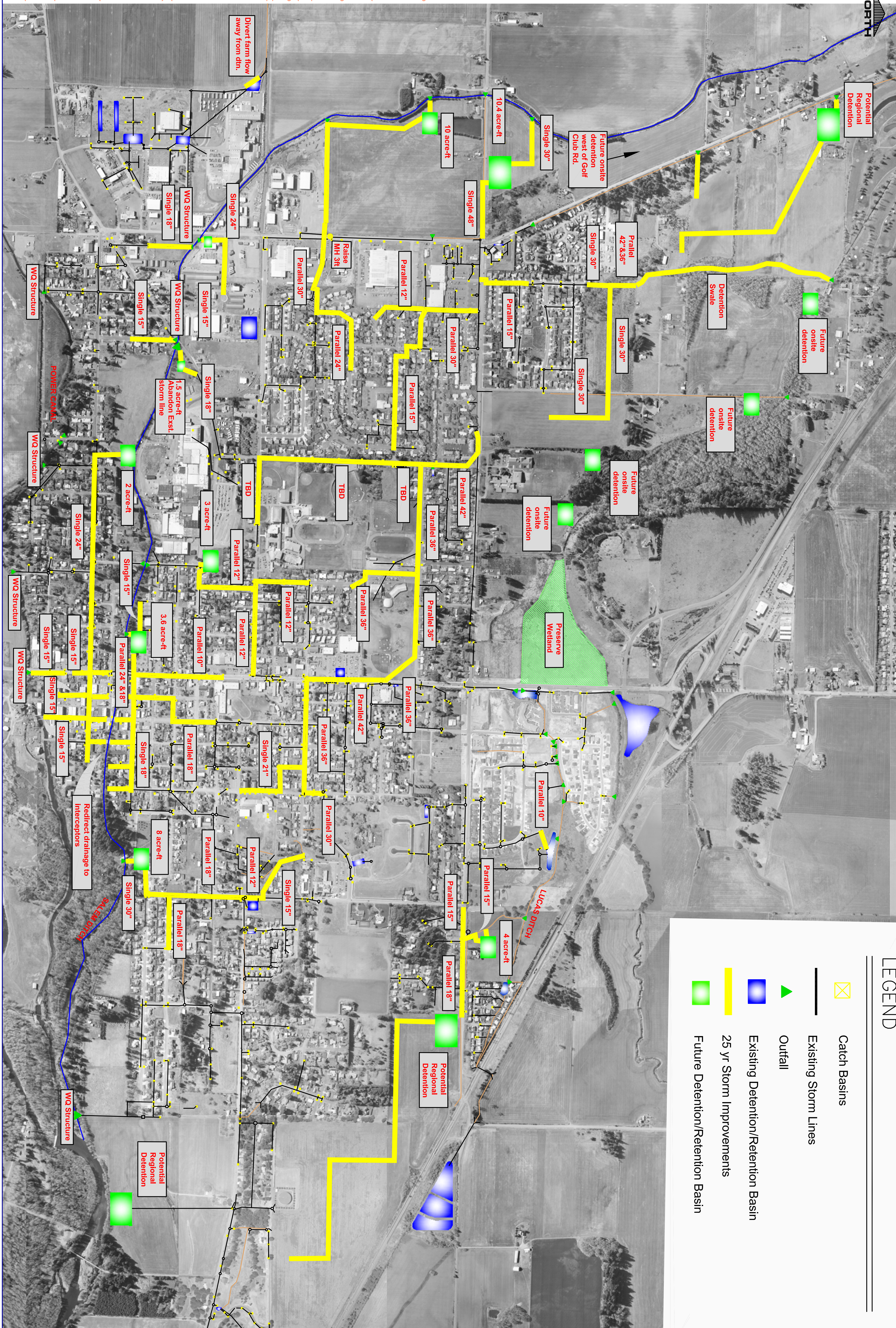

FIGURE 11

Recommended Improvements

Storm Water Master Plan
Stayton, OR

KELLER ASSOCIATES

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FIG-11.dwg

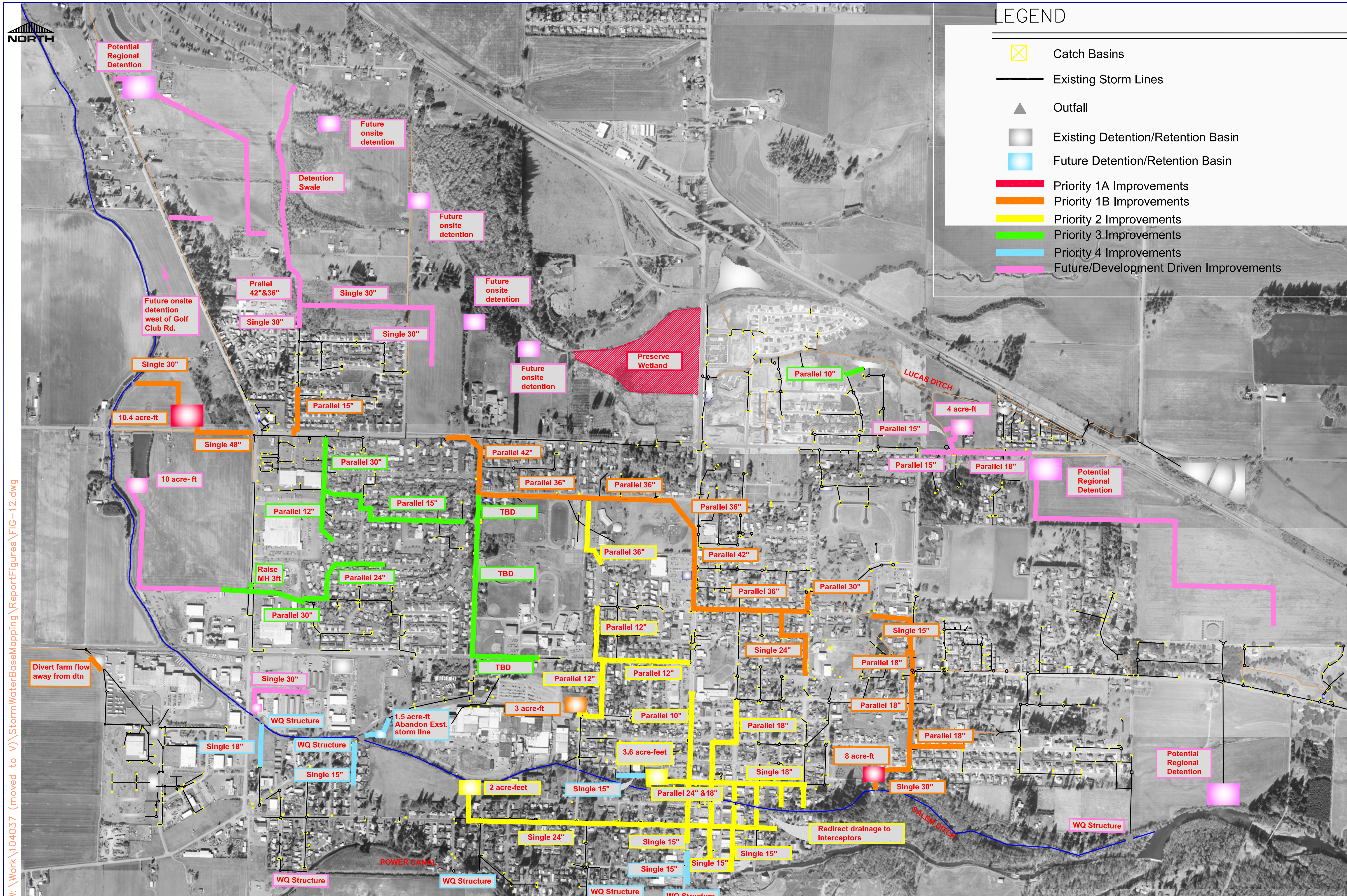

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FIG-12.dwg

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Storm Water Master Plan

Stayton, OR

Prioritized Improvements

FIGURE 12

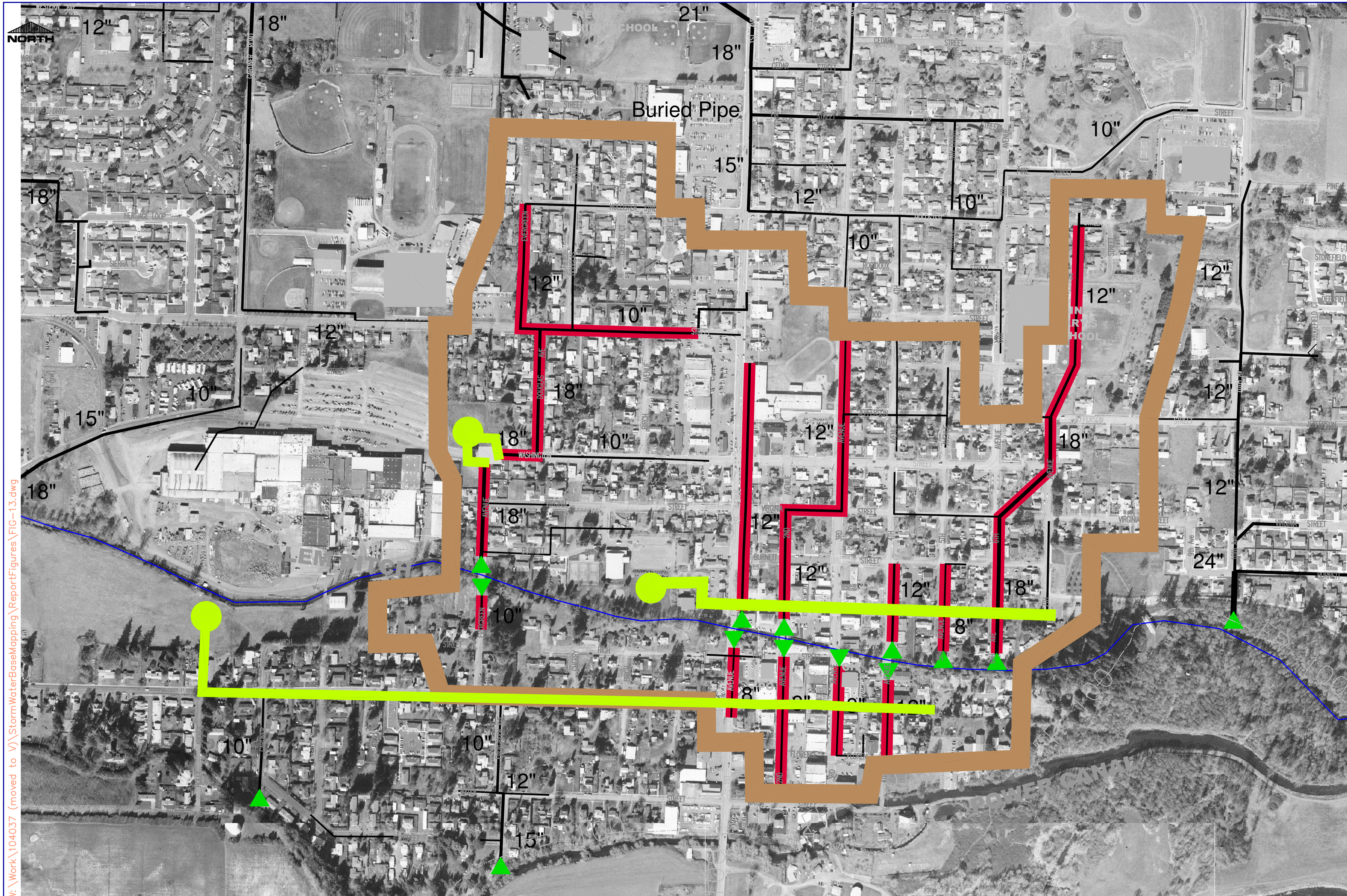

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FIG-13.dwg

KELLER ASSOCIATES

Storm Water Master Plan
Stayton, OR

Downtown Interceptors

FIGURE 13

Appendix B
Study Area Data

KELLER
ASSOCIATES

B.1 Land Use Compatibility Statement

COPY

DEQ
State of Oregon
Department of Environmental Quality

Department of Environmental Quality
LAND USE COMPATIBILITY STATEMENT (LUCS)

WHAT IS A LUCS? The Land Use Compatibility Statement is the process used by the DEQ to determine whether DEQ permits and other approvals affecting land use are consistent with local government comprehensive plans.

WHY IS A LUCS REQUIRED? Oregon law requires state agency activities that impact land use be consistent with local comprehensive plans. DEQ Division 18 administrative rules identify agency activities or programs that significantly affect land use. These programs must have a process for determining local plan consistency.

WHEN IS A LUCS REQUIRED? A LUCS is required for nearly all DEQ permits, some general permits, and certain approvals of plans or related activities that affect land use. These activities are listed in this form. A single LUCS can be used if more than one DEQ permit/approval is being applied for concurrently.

A permit modification requires a LUCS when any of the following applies:

1. physical expansion on the property or proposed use of additional land;
2. a significant increase in discharges to water;
3. a relocation of an outfall outside of the source property; or
4. any physical change or change of operation of an air pollutant source that results in a net significant emission rate increase as defined in OAR 340-200-0020.

A permit renewal requires a LUCS if one has not previously been submitted, or if any of the above four permit modification factors apply.

HOW TO COMPLETE A LUCS:

Step	Who Does It	What Happens
1	Applicant	Completes Section 1 of the LUCS and submits it to the appropriate city or county planning office.
2	City or County Planning Office	Determines if the business or facility meets all local planning requirements, and returns to the applicant the signed and dated LUCS form **with findings of fact for any local reviews or necessary planning approvals.**
3	Applicant	Includes the completed LUCS with **findings of fact** with the DEQ permit or approval submittal application to the DEQ.

WHERE TO GET HELP: Questions about the LUCS process can be directed to the region staff responsible for processing the permit or approval. Headquarters and regional offices may also be reached using DEQ's toll-free telephone number 1-800-452-4011.

SECTION 1 - TO BE FILLED OUT BY APPLICANT *(may be filled in electronically using Tab key to move to each field)*

1. **Applicant Name:** City of Stayton — **Contact Person:** Mike Faught
   Location Address: 362 N. Third Ave — **Mailing Address:** 362 N. Third Ave
   City, State Zip: Stayton, OR 97383 — **City, State Zip:** Stayton, OR 97383
   Telephone: 503-769-2919 — **Tax Account No:** Various — **Tax Lot No:** See attached map
   Township: ______ **Range:** ______ **Section:** ______
   Latitude: ______ **Longitude:** ______

   *Use the **DEQ Location Finder** (http://deq12.deq.state.or.us/website/findloc) to determine latitude/longitude.*

2. **Describe the type of business or facility and services or products provided:**
   Sanitary sewer pipelines and lift station.

3. **Check the type of DEQ permit(s) or approval(s) being applied for at this time.**

☐ Air Notice of Construction	☐ Pollution Control Bond Request	☑ Clean Water State Revolving Fund Loan Request
☐ Air Discharge Permit *(excludes portable facility permits)*	☐ Solid Waste Compost Registration - Permit	☐ Water Quality NPDES/WPCF *Permit (for onsite construction-installation permits use DEQ's Onsite LUCS form)*
☐ Title V Air Permit	☐ Solid Waste Letter Authorization Permit	☑ Wastewater/Sewer Construction Plan/Specifications *(includes review of plan changes that require use of new land)*
☐ Parking/Traffic Circulation Plan	☐ Solid Waste Material Recovery Facility Permit	☐ Water Quality Storm Water General Permit
☐ Air Indirect Source Permit	☐ Solid Waste Transfer Station Permit	☐ Other Water Quality General Permit *(Generals: 600 (if mobile), 700, 1200CA, 1500, 1700 (if mobile) are exempted))*
☐ Solid Waste Disposal Permit	☐ Solid Waste - Waste Tire Storage Permit	
☐ Solid Waste Treatment Permit	☐ Hazardous Waste/PCB Storage/ Treatment/Discharge Permit	☐ Federal Permit - Water Quality 401 Certification

4. **This application is for:** ☐ permit renewal ☑ new permit ☐ permit modification ☐ other ____________

SECTION 2 - TO BE FILLED OUT BY CITY OR COUNTY PLANNING OFFICIAL

5. **The facility proposal is located:** ☒ inside city limits ☒ inside UGB ☐ outside UGB

6. **Name of the city or county that has land use jurisdiction** *(the legal entity responsible for land use decisions for the subject property or land use)*: City of Stayton/Marion County

7. **Does the business or facility comply with all applicable local land use requirements?**

☒ **YES**; attach findings to support the affirmative compliance decision *(as required by Oregon Administrative Rules (OAR) 660, Division 31)*. See attached sheet.

☐ **NO**; attach findings for noncompliance, and identify requirements the applicant must comply with before LUCS compatibility can be determined.

8. **Planning Official Signature:** [signature] **Title:** CITY PLANNER
Print Name: Steve Goeckritz **Telephone No.:** 503-769-2998 **Date:** 27 SEPT 04

***Planning Official Signature:** ____________ **Title:** ____________
Print Name: ____________ **Telephone No.:** ____________ **Date:** ____________

*(*If necessary, depending upon city/county agreement on jurisdiction outside city limits but within UGB.)*

Please Note: A LUCS approval cannot be accepted by DEQ until all local requirements have been met. Written findings of fact for all local decisions addressed under Item No. 7 above **must be attached to the LUCS**.

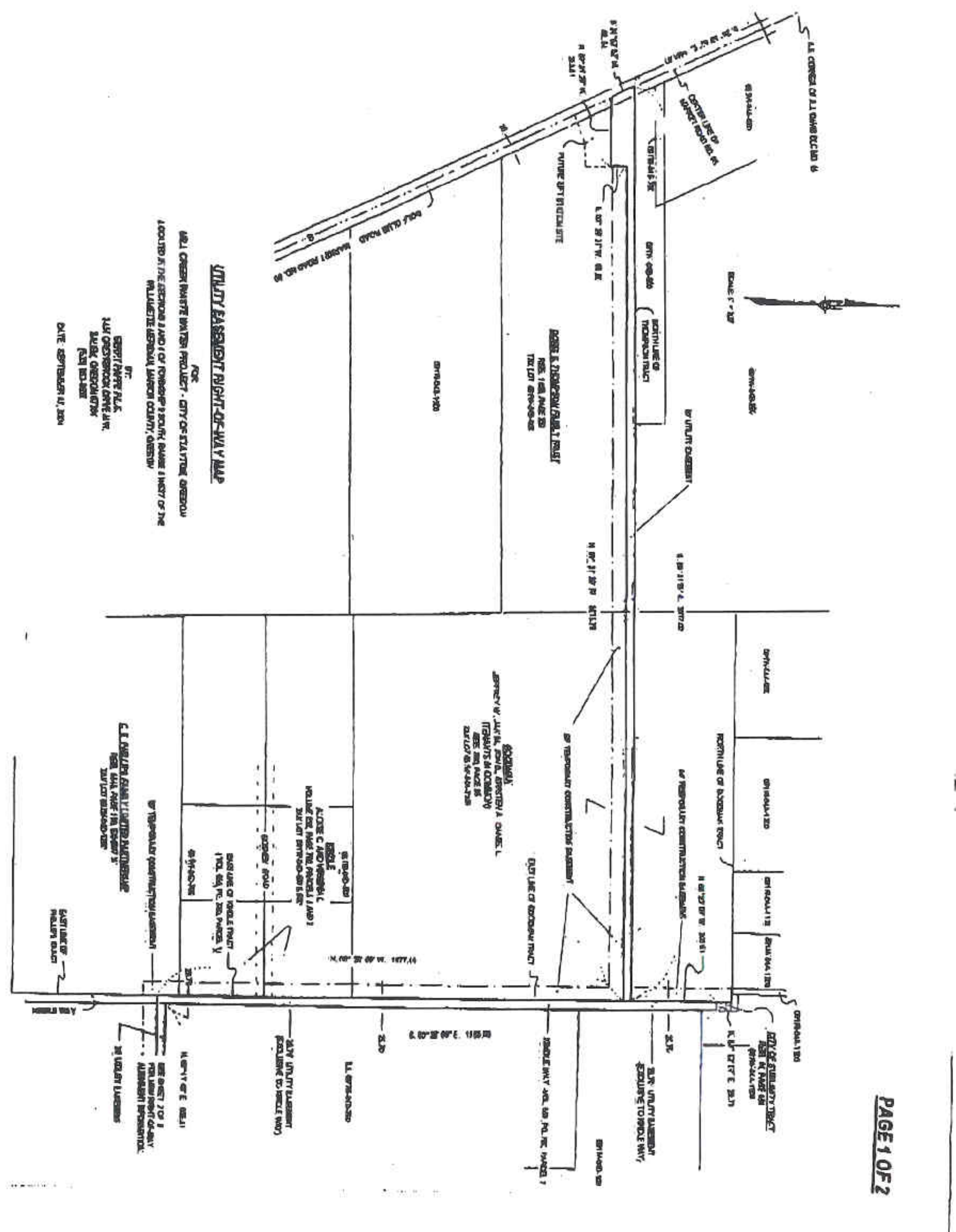
CULTURAL RESOURCES PROTECTION LAWS: *Applicants involved in ground-disturbing activities should be aware of federal and state cultural resources protection laws. ORS 358.920 prohibits the excavation, injury, destruction, or alteration of an archeological site or object, or removal of archeological objects from public and private lands without an archeological permit issued by the State Historic Preservation Office. 16 USC 470, Section 106, National Historic Preservation Act of 1966 requires a federal agency, prior to any undertaking, to take into account the effect of the undertaking that is included on or eligible for inclusion in the National Register. For further information, contact the State Historic Preservation Office at 503-378-4168, extension 232.*

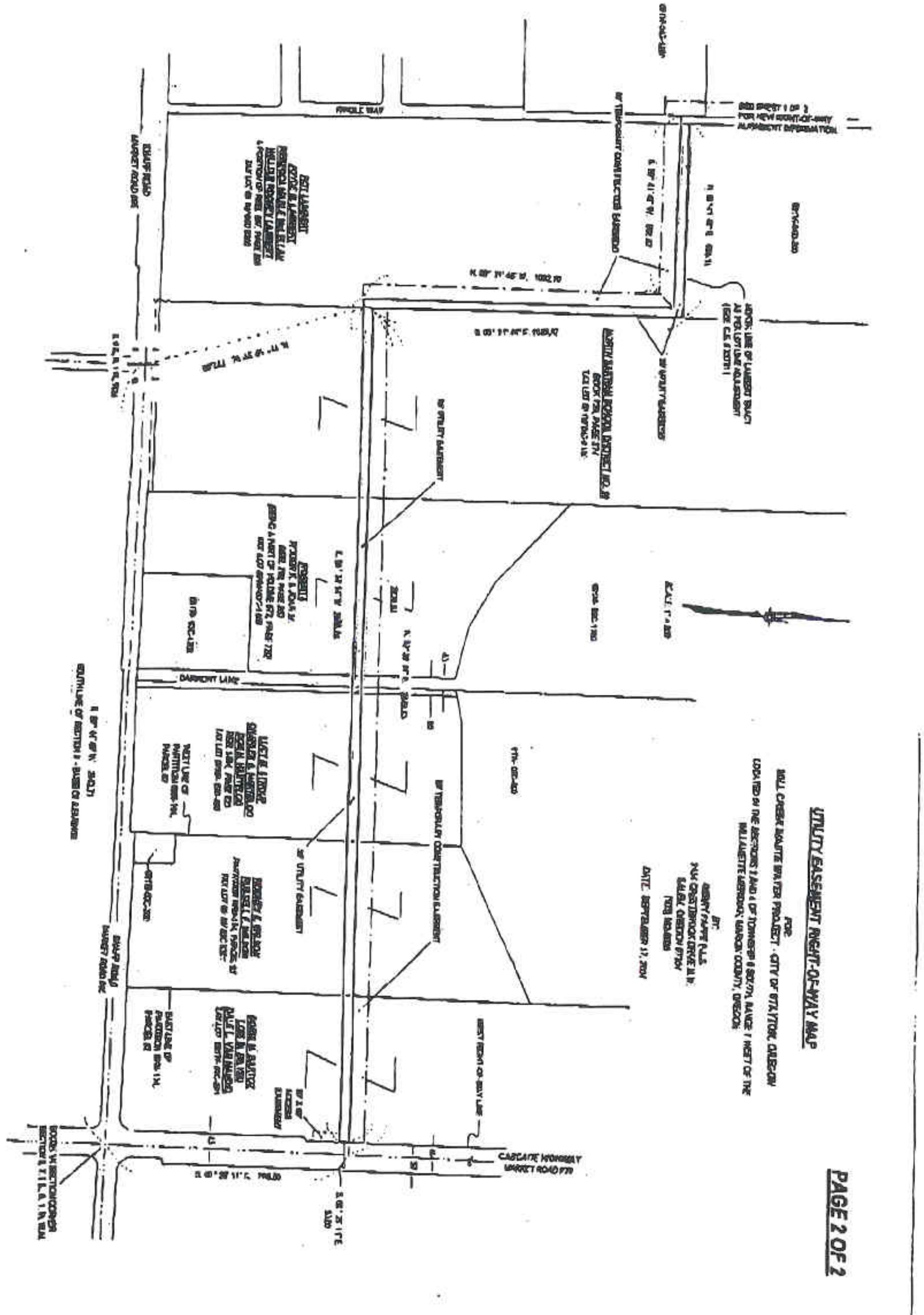
The proposal meets the following City of Stayton Comprehensive Plan Goals and Policies:

PF-1 The City of Stayton shall be the ultimate provider of the following urban services within the Stayton urban growth boundary: 1) municipal water supply; 2) sanitary sewage collection and treatment; 3) storm sewers; 4) police protection; 5) parks and recreational facilities; and 6) library services.

PF-2 The City of Stayton shall use its Master Utilities Plan and Capital Improvement Program to direct the provision of public facilities within the urban growth boundary.

Encourage urban development in areas with existing services and in those areas where future extensions of those services can be provided in the most feasible, efficient, and economical manner.


PAGE 1 OF 2
UTILITY EASEMENT RIGHT-OF-WAY MAP


UTILITY EASEMENT RIGHT-OF-WAY MAP
PAGE 2 OF 2
CASCADE HIGHWAY

B.2 Soil Types and Description

Map Unit Symbol	Map Unit Name
91D	Alspaugh clay loam, 15 to 30 percent slopes
92E	Andic Cryaquepts, moderately steep
92F	Andic Cryaquepts, steep
93F	Aschoff-Brightwood complex, 60 to 90 percent slopes
94E	Fernwood very gravelly loam, 30 to 60 percent slopes
95C	Hardscrabble silt loam, 7 to 20 percent slopes
96E	Highcamp very gravelly loam, 30 to 60 percent slopes
97F	Highcamp-Rock outcrop complex, 50 to 90 percent slopes
98D	Highcamp-Soosap complex, 5 to 30 percent slopes
99D	Kinzel-Divers complex, 5 to 30 percent slopes
99E	Kinzel-Divers complex, 30 to 60 percent slopes
100E	Springwater loam, 30 to 60 percent slopes
101D	Wilhoit-Zygore gravelly loams, 5 to 30 percent slopes
102F	Xerochrepts and Haploxerolls, very steep
103E	Zygore-Wilhoit gravelly loams, 30 to 60 percent slopes
AbA	Abiqua silty clay loam, 0 to 3 percent slopes
AbB	Abiqua silty clay loam, 3 to 5 percent slopes
Ad	Alluvial land
Am	Amity silt loam
Ba	Bashaw clay
Ca	Camas gravelly sandy loam
CeC	Chehalem silt loam, 2 to 12 percent slopes
Ch	Chehalis silty clay loam
Ck	Clackamas gravelly loam
CLD	Cumley silty clay loam, 2 to 20 percent slopes
Cm	Cloquato silt loam
Co	Concord silt loam
Cu	Courtney gravelly silty clay loam
Da	Dayton silt loam
HaB	Hazelair silt loam, 2 to 6 percent slopes
HaD	Hazelair silt loam, 6 to 20 percent slopes
HcD2	Hazelair silty clay loam, 2 to 15 percent slopes, eroded
HEE	Henline very stony sandy loam, 6 to 30 percent slopes
HEF	Henline very stony sandy loam, 30 to 55 percent slopes
HEG	Henline very stony sandy loam, 55 to 80 percent slopes
Ho	Holcomb silt loam
HRD	Horeb loam, 2 to 20 percent slopes
HSC	Horeb gravelly silt loam, gravelly substratum, 0 to 15 percent slopes
HSE	Horeb gravelly silt loam, gravelly substratum, 15 to 35 percent slopes
HTD	Hullt clay loam, 2 to 20 percent slopes
HTE	Hullt clay loam, 20 to 30 percent slopes
HTF	Hullt clay loam, 30 to 60 percent slopes
HuB	Hullt clay loam, 2 to 7 percent slopes
HuD	Hullt clay loam, 7 to 20 percent slopes
JoB	Jory silty clay loam, 2 to 7 percent slopes
JoC	Jory silty clay loam, 7 to 12 percent slopes
JoD	Jory silty clay loam, 12 to 20 percent slopes
JoE	Jory silty clay loam, 20 to 30 percent slopes
KCD	Kinney cobbly loam, 2 to 20 percent slopes

KCF	Kinney cobbly loam, 20 to 50 percent slopes
KCG	Kinney cobbly loam, 50 to 70 percent slopes
La	Labish silty clay loam
MaA	McAlpin silty clay loam, 0 to 3 percent slopes
MaB	McAlpin silty clay loam, 3 to 6 percent slopes
Mb	McBee silty clay loam
McB	McCully clay loam, 2 to 7 percent slopes
McC	McCully clay loam, 7 to 12 percent slopes
McD	McCully clay loam, 12 to 20 percent slopes
McE	McCully clay loam, 20 to 30 percent slopes
MID	McCully stony clay loam, 2 to 20 percent slopes
MmE	McCully very stony clay loam, 2 to 30 percent slopes
MUE	McCully clay loam, 2 to 30 percent slopes
MUF	McCully clay loam, 30 to 50 percent slopes
MUG	McCully clay loam, 50 to 70 percent slopes
MYB	Minniece silty clay loam, 0 to 8 percent slopes
NeB	Nekia silty clay loam, 2 to 7 percent slopes
NeC	Nekia silty clay loam, 7 to 12 percent slopes
NeD	Nekia silty clay loam, 12 to 20 percent slopes
NeE	Nekia silty clay loam, 20 to 30 percent slopes
NeF	Nekia silty clay loam, 30 to 50 percent slopes
NkC	Nekia stony silty clay loam, 2 to 12 percent slopes
NsE	Nekia very stony silty clay loam, 2 to 30 percent slopes
NsF	Nekia very stony silty clay loam, 30 to 50 percent slopes
Nu	Newberg fine sandy loam
Nw	Newberg silt loam
PITS	Pits
Sa	Salem gravelly silt loam
SCE	Steiwer and Chehulpum silt loams, 3 to 40 percent slopes
SkB	Salkum silty clay loam, 2 to 6 percent slopes
SkD	Salkum silty clay loam, 6 to 20 percent slopes
SIB	Salkum silty clay loam, basin, 0 to 6 percent slopes
SnA	Santiam silt loam, 0 to 3 percent slopes
SnB	Santiam silt loam, 3 to 6 percent slopes
SnC	Santiam silt loam, 6 to 15 percent slopes
So	Semiahmoo muck
St	Sifton gravelly loam
SuC	Silverton silt loam, 2 to 12 percent slopes
SuD	Silverton silt loam, 12 to 20 percent slopes
SvB	Stayton silt loam, 0 to 7 percent slopes
SwB	Steiwer silt loam, 3 to 6 percent slopes
SwD	Steiwer silt loam, 6 to 20 percent slopes
Sy	Stony rock land
Te	Terrace escarpments
W	Water
Wa	Waldo silty clay loam
Wc	Wapato silty clay loam
WHE	Whetstone stony loam, 3 to 25 percent slopes
WHF	Whetstone stony loam, 25 to 55 percent slopes
WHG	Whetstone stony loam, 55 to 75 percent slopes

WlA	Willamette silt loam, 0 to 3 percent slopes
WlC	Willamette silt loam, 3 to 12 percent slopes
WtE	Witzel very stony silt loam, 3 to 40 percent slopes
WuA	Woodburn silt loam, 0 to 3 percent slopes
WuC	Woodburn silt loam, 3 to 12 percent slopes
WuD	Woodburn silt loam, 12 to 20 percent slopes

are defined in the Glossary. The acreage and proportionate extent of the mapping units are shown in table 7. The location of the soils in the Marion County Area is shown on the detailed soil map at the back of this survey.

Abiqua Series

The Abiqua series consists of well-drained soils that have formed in alluvium. These soils have slopes of 0 to 5 percent. They occur on low foothills, along small streams and in drainageways, at elevations of 250 to 1,000 feet.. The average annual precipitation is 40 to 60 inches, the average annual air temperature is 52° to 54° F., and the length of the frost-free season is 190 to 210 days. In areas that are not cultivated, the vegetation is mainly Douglas-fir, native grasses, and shrubs. Abiqua soils are associated with McAlpin and Waldo soils.

In a typical profile, the surface layer is very dark brown silty clay loam about 6 inches thick. The subsurface layer is also very dark brown silty clay loam and is about 15 inches thick. The upper part of the subsoil is dark reddish-brown silty clay that extends to a depth of about 54 inches. The lower part of the subsoil is dark-brown silty clay loam that extends to a depth of 72 inches or more.

The Abiqua soils are used mainly for small grains, grass grown for seed, orchards, and pastures. When irrigated, they are used for other crops.

Abiqua silty clay loam, 0 to 3 percent slopes (AbA).This soil is along streams and in drainageways of the Salem and Waldo Hills. The areas are small.

Representative profile 85 feet east and 60 feet south of road intersection (in the corner of SW1/48W1/4NE1/4 sec. 2, T. 9 S., R. 1 W.)

Ap-0 to 6 inches, very dark brown (10YR 2/2) silty clay loam, dark brown (7.5YR 3/2) when dry; moderate, very fine, granular structure; friable, hard, slightly plastic and slightly sticky; many roots; many interstitial pores; medium ,acid (pH 5.8) ; abrupt, smooth boundary. (5 to 7 inches thick.)

A3-6 to 21 inches, very dark brown (10YR 2/2) silty clay loam, dark brown (7.5YR 3/2) when dry; moderate, fine and very fine, subangular blocky structure; firm, hard, plastic and sticky; many roots; many, fine, tubular pores; thin, patchy, darker colored coatings on ped surfaces; medium acid (pH 5.6); clear, smooth boundary. (13 to 17 inches thick.)

B21-21 to 36 inches, dark reddish-brown (5YR 2/2) silty clay, dark reddish brown (5YR 3/4) when dry; weak, prismatic structure breaking to moderate, medium, subangular blocky structure; firm, very hard, very plastic and very sticky; common roots; many, fine and very fine, tubular pores; thin, continuous, slightly darker colored coatings on ped surfaces; strongly acid (pH 5.4); diffuse, smooth boundary. (10 to 20 inches thick.)

B22-36 to 54 inches, dark reddish-brown (5YR 3/2) silty clay, reddish brown (5YR 4/4) when dry; very weak, prismatic structure breaking to moderate, medium, subangular blocky structure; firm, very hard, very plastic and very sticky; few roots; many, fine and very fine, tubular pores; thin, continuous, dark reddish-brown (5YR 3/4) coatings on ped surfaces when dry; common, fine and very fine fragments of weathered rock; strongly acid (pH 5.3); diffuse, smooth boundary. (13 to 23 inches thick.)

B3-54 to 72 inches, dark-brown (7.5YR 3/2) silty clay loam, reddish brown (5YR 4/3) when dry; moderate, medium, subangular blocky structure; firm, hard, plastic and sticky; very few roots; many, fine and very fine, tubular pores; many fine and very fine fragments of weathered rock; strongly acid (pH 5.3).

Color of the A horizon is dark brown or very dark brown, and texture of that horizon ranges from silt loam to silty clay loam. Color of the B horizon ranges from dark brown to dark reddish brown. Texture of the B horizon ranges from silty clay to clay, except that the B3 horizon is silty clay loam in many places. In some areas a few angular pebbles are scattered throughout the profile.

Included with this soil in mapping were small areas that contain a layer of gravel below a depth of 40 inches. Also included were small areas of McAlpin and Waldo soils.

The available water capacity is 10 to 11 inches, permeability is moderately slow, and fertility is moderate. Runoff is slow, and the hazard of erosion is only slight. Where additions of organic matter are regularly supplied, workability of this soil is good. Depth to which roots can penetrate is not restricted.

This soil is used mainly for small grains, grass grown for seed, orchards, and pasture, but small areas are still in Douglas-fir. When this soil is irrigated, it is used for most of the crops commonly grown in the survey area. It is well suited to most crops, but it is not well suited to potatoes and carrots. (Capability unit I-1; not placed in a woodland suitability group)

Abiqua silty clay loam, 3 to 5 percent slopes (AbB).This soil has a profile similar to the one described for Abiqua silty clay loam, 0 to 3 percent slopes, except that material washed from higher slopes has been deposited on the surface in a few places. Runoff is medium, and the hazard of erosion is slight.

This soil is used for about the same crops as Abiqua silty clay loam, 0 to 3 percent slopes. (Capability unit IIe-2; not placed in a woodland suitability group)

Alluvial Land

Alluvial land (Ad) occurs mostly along the Santiam, North Santiam, and Willamette Rivers, on or near the bed of the main stream, in overflow channels, and on islands or bars. It consists mostly of loose sand, gravel, and cobblestones, but it includes some small areas of silt loam. This material is frequently shifted by floodwaters, for this land type is subject to overflow in winter and spring.

In places this land type supports a good stand of cottonwoods, but use of these trees for timber is restricted by the very severe hazard of erosion if the trees are cut. Other areas have a cover of Douglas-fir. Still other small areas are bare, except for scattered willows. (Capability unit VIIw-1; not placed in a woodland suitability group)

Amity Series

The Amity series consists of somewhat poorly drained soils that have formed in mixed alluvial silts. These soils have slopes of 0 to 2 percent. They occur on broad valley terraces at elevations of 150 to 350 feet. The average annual precipitation is between 40 and 45 inches. The average annual air temperature is 52° to 54° F., and the length of the frost-free season is 190 to 210 days. In areas that are not cultivated, the vegetation is mainly grasses, shrubs, hardwoods, :and scattered, Douglas-firs. Amity soils are associated with Dayton and Concord soils.

In a typical profile, the surface layer is very dark grayish-brown silt loam that is mottled in the lower part and is about 17 inches thick. The subsurface layer is mottled dark-gray silt loam about 7 inches thick. The subsoil is mottled grayish-brown silty clay loam about 13 inches thick. A substratum of mottled olive-brown silt loam underlies the subsoil.

The Amity soils are used mainly for cereal grains, grass grown for seed, and pasture. When irrigated, areas that are drained can be used for all the crops commonly grown in the survey area.

Amity silt loam (Am).-This is the only soil of the Amity series mapped in the survey area. It occupies slightly convex or nearly level areas on terraces consisting of Willamette silts.

Representative profile 30 feet east of a paved road (SW1/2SE1/4 sec. 10, T. 5 S., R. 2 W.)

Ap-0 to 7 inches, very dark grayish-brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) when dry; moderate, fine, subangular blocky structure; friable, slightly hard, slightly sticky and slightly plastic; abundant fine roots; many interstitial pores; medium acid (pH 6.0); clear, smooth boundary. (5 to 8 inches thick.)

A1-7 to 17 inches, very dark grayish-brown (10YR 3/2) silt loam grayish brown (10YR 5/2) when dry; common, fine, faint, reddish-brown mottles; moderate, medium, subangular blocky structure; friable, hard, slightly sticky and slightly plastic; abundant fine roots; common interstitial pores and few, fine and medium, tubular pores; common, fine and medium, reddish-brown concretions; medium acid (pH 6.0); clear, smooth boundary. (5 to 10 inches thick.)

A2-17 to 24 inches, dark-gray (10YR 4/1) silt loam, gray (10YR 6/1) when dry; common, fine, faint, reddish-brown mottles; weak, medium, subangular blocky structure; friable, slightly hard, slightly sticky and slightly plastic; common fine roots; common interstitial pores and common, fine and medium, tubular pores; common, fine and medium, brown concretions; medium acid (pH 6.0); clear, wavy boundary. (4 to 8 inches thick.)

B21t-24 to 29 inches, grayish-brown (2.5Y 5/2) silty clay loam, light brownish gray (10YR 6/2) when dry; common, fine, distinct, reddish-brown mottles; weak, medium, prismatic structure breaking to moderate, coarse, subangular blocky structure; friable, hard, sticky and plastic; few fine roots; common, medium, tubular pores; thin, patchy clay films in pores, on vertical surfaces of peds, and on some horizontal surfaces of peds; common, fine, red and black concretions; slightly acid (pH 6.2); gradual, wavy boundary. (4 to 9 inches thick.)

B22t-29 to 37 inches, grayish-brown (2.5Y 5/2) silty clay loam, light brownish gray (2.5Y 6/2) when dry; common, fine, distinct, light yellowish-brown and black mottles; weak, medium, prismatic structure breaking to moderate, coarse, subangular blocky structure; friable, hard sticky and plastic; few fine roots; few, medium and fine, tubular pores; thin, patchy clay films in pores and on vertical and horizontal surfaces of peds; many, fine, reddish-brown and few, fine, black concretions; slightly acid (pH 6.2); diffuse boundary. (5 to 14 inches -thick.)

C-37 to 60 inches, olive-brown (2.5Y 4/4) silt loam, light yellowish brown (2.5Y 6/4) when dry; common, fine, faint, brown mottles; massive; friable, hard, slightly sticky and slightly plastic; few fine roots; few fine and medium pores; thick clay films in pores; slightly acid (pH 6.4).

When the soil is moist, color of the A horizon ranges from dark brown to very dark grayish brown. Texture of the B horizon is heavy silt loam in some areas, and the structural grade of that horizon; is moderate in places. In some places the lower part of the B horizon is weakly to moderately brittle. Bedrock is at a depth of more than 60 inches.

Included with this soil is mapping were small areas of soils that are in drainageways and depressions and that have slopes of 2 to 5 percent. Also included were small areas of Woodburn and Concord soils.

The available water capacity ranges from 9 to 12 inches. Permeability is moderately slow, and fertility is moderate. Runoff is slow, and erosion is not a hazard or is only a slight hazard. The depth to which roots can penetrate is moderately restricted by wetness, partly caused by a high water table that is near the surface during winter and spring. Workability is good, but this soil compacts easily if it is cultivated when wet.

Undrained areas of this soil are used for small grains, pasture, and grasses grown for seed, but drainage is needed for berries, vegetables, and specialty crops. If this soil is drained and irrigated, it can be used for all the crops commonly grown in the survey area. Evan after drainage is installed, however, there are slightly restrictions to use of this soil for deep-rooted crops that cannot tolerate excessive moisture. Nevertheless, response to drainage and fertilizer is generally good. (Capability unit IIw-2; not placed in a woodland suitability group)

Bashaw Series

The Bashaw series consists of poorly drained and very poorly drained soils that have formed in alluvium. These soils are in backwater areas of the flood plains and in drainage channels of silty alluvial terraces. They have slopes of 0 to 1 percent. Elevations range from 100 to 400 feet. The average annual precipitation is between 40 and 45 inches, the average annual air temperature is 52° to 54° F., and the length of the frost-free season is 200 to 210 days. In areas that are not cultivated, the vegetation is mainly annual and perennial grasses, wild blackberries, sedges, rushes, willows, and a few ash and oak trees. Bashaw soils are associated with Wapato soils.

In a typical profile, the surface layer is about 31 inches thick and consists of mottled very dark gray clay in the uppermost 3 inches and of mottled black clay below. The upper part of the substratum, just beneath the surface layer, is very dark gray clay that extends to a depth of 48 inches. The lower part of the substratum is dark grayish-brown clay or sandy clay that extends to a depth of 60 inches or more. The substratum is mottled throughout.

The Bashaw soils are used mainly for pasture.

Bashaw clay (Ba).-This is the only soil of the Bashaw series mapped in the survey area. It occupies concave backwater areas adjacent to silty alluvial terraces, and it is also in drainage channels on the terraces. The areas are small.

Representative profile (NW1/4SW1/4NE1/4 sec. 9, T. 6 S., R.1 W.)

A11--0 to 3 inches, very dark gray (10YR 3/1) clay, dark gray (10YR 4/1) when dry; many, fine, distinct, yellowish-red (5YR 4/6) mottles; moderate, medium and fine, subangular blocky structure; firm, very hard, very sticky and very plastic; common roots; many very fine pores; medium acid (pH 5.8); abrupt, smooth boundary. (0 to 4 inches thick.)

A12g-3 to 14 inches, black (N 2/0) clay, very dark gray (N 3/0) when dry; few, fine, distinct, yellowish-red (5YR 5/6) mottles; massive when wet; weak, coarse, prismatic structure breaking to weak, coarse, angular blocky structure when moist or dry; very firm, very hard, very sticky and very plastic; common very fine roots; many very fine pores; common, fine, red and black concretions; few small slickensides; medium acid (pH 6.0); clear, smooth boundary. (6 to 15 inches thick.)

A13g-14 to 31 inches, black (N 2/0) clay, very dark gray (N 3/0) when dry; few, fine, distinct, yellowish-red (5YR 4/6) mottles; massive; very firm, very hard, very plastic and very sticky; few slickensides; few very fine roots; few very fine pores; common, fine, red and black concretions; neutral (pH 6.6); gradual, smooth boundary. (14 to 20 inches thick.)

C1g-31 to 48 inches, very dark gray (N 3/0) clay, dark gray (N 4/0) when dry; common, medium, faint, light olive-brown (2.5Y 5/6) mottles; massive; very firm, very hard, very sticky and very plastic; common large slickensides; common, fine, light-colored fragments; few roots; few very fine pores; neutral (pH 7.0); abrupt, smooth boundary. (10 to 20 inches thick.)

C2g-48 to 60 inches, dark grayish-brown (2.5Y 4/2). clay or sandy clay, light brownish gray (2.5Y 6/2) when dry; many, medium, distinct, dark-brown (7.5YR 3/2) and dark reddish-brown (5YR 3/2) mottles and few, medium, faint, dark-gray (N 4/0) mottles; massive; firm, very hard, sticky and plastic; no roots; common very fine pores; neutral (pH 7.0).

When this soil is moist, the A12g and A13g horizons are generally black, but their color ranges to very dark gray in some areas. In the uppermost 3 to 4 inches of the soil profile, the structure is weak to strong granular or very fine subangular blocky. Texture in the uppermost 3 to 8 inches of the profile ranges from clay to silty clay or silty clay loam. The soil material between depths of 8 and 40 inches is more than 60 percent clay. Reaction ranges from neutral to medium acid in the uppermost 10 to 15 inches of the profile, and it is slightly acid to neutral below.

Included with this soil in mapping were small areas of moderately fine textured soils that have a very dark grayish-brown surface layer. Also included were areas of clayey soils that have a thin, black surface layer.

The available water capacity ranges from 8 to 10 inches. Permeability is very slow, and fertility is moderate. Runoff is very slow to ponded, and the hazard of erosion is slight. Some material is deposited on the surface each year in areas not protected and not drained. Workability is poor. Because of the annual high water table and the very fine texture of the soil material, only a few roots penetrate to depths greater than 31 inches, but roots can penetrate to a depth of about 48 inches.

This soil is used mainly for pasture, but it can be used for spring barley, wheat, improved pasture, and hay if surface drainage is provided. Although drainage is needed, outlets are generally inadequate for surface drainage, and this soil is unsuitable for tile drains, because of its fine texture and very slow permeability. For only short periods is it dry enough to cultivate. (Capability unit IVw-2; not placed in a woodland suitability group)

Camas Series

The Camas series consists of excessively drained soils that formed in recent alluvium derived mainly from basic igneous and sedimentary rocks. These soils have slopes of 0 to 3 percent. They occur on bottom lands of the large streams. Elevations range from 125 to 500 feet. The average annual precipitation is between 40 and 45 inches, the average annual air temperature is 52° to 54° F., and the length of the frost-free season is 200 to 210 days. In areas that are not cultivated, the vegetation is mainly ash, oak, alder, rose, blackberry, annual weeds, and grasses. Camas soils are associated with Newberg and Cloquato soils.

In a typical profile, the surface layer is dark-brown gravelly sandy loam about 9 inches thick. The substratum, just beneath the surface layer, is dark yellowish-brown very gravelly sand that extends to a depth of 60 inches or more.

The Camas soils are used mainly for small grains, for pasture, or as woodland. When irrigated, they are used for all the crops commonly grown in the survey area.

Camas gravelly sandy loam (Ca).-This soil occupies small areas along Butte Creek and the Willamette, North Santiam, and Santiam Rivers. It is the only soil of the Camas series mapped in the survey area.

Representative profile (SW1/4SE1/4 sec. 11, T. 9 S., R. 1W.)

A1-0 to 9 inches, dark-brown (10YR 3/3) gravelly sandy loam, brown (10YR 5/3) when dry; weak, medium, subangular blocky structure; friable, slightly hard, nonsticky and nonplastic; many roots; many, fine, interstitial pores; slightly acid (pH 6.1); gradual, smooth boundary. (7 to 11 inches thick.)

C-9 to 60 inches, dark yellowish-brown (10YR 4/4) very gravelly sand, light yellowish brown (10YR 6/4) when dry; single grain; loose, nonsticky and nonplastic; common roots; many interstitial pores; medium acid (pH 6.0).

When the soil is moist, color of the A horizon ranges from very dark grayish brown to dark brown. Texture of the A horizon ranges from silt loam to loamy sand, and texture of the C horizon ranges from very gravelly loamy sand to very gravelly sand or cobbly sand. More than 50 percent of the C horizon, by volume, is coarse fragments. Reaction of the A horizon ranges from neutral to medium acid. Reaction of the C horizon ranges from medium acid to slightly acid.

Included with this soil in mapping were small cobbly areas and other small areas that have a surface layer of silt loam.

The very gravelly or cobbly substratum near the surface restricts the available water capacity, which is 3 inches or less. It also restricts the depth to which roots can penetrate. Permeability is very rapid, and fertility is low. Runoff is very slow, and erosion is generally only a slight hazard. Areas adjacent to streams are moderately susceptible to erosion because they are usually flooded at least once each year. Workability is poor.

This soil is used mainly for small grains, for pasture, or as woodland. When irrigated, it is used for all the crops commonly grown in the survey area, although it is poorly suited to root crops and to many other crops. (Capability unit IVw-3; not placed in a woodland suitability group

Chehalem Series

The Chehalem series consists of somewhat poorly drained soils that have formed in alluvium. These soils have slopes of 2 to 12 percent. They occur on alluvial fans at elevations of 150 to 300 feet. The average annual precipitation is 40 to 45 inches, the average annual air temperature is 52° to 54° F., and the length of the frost-free season is 200 to 210 days. In noncultlvated areas the vegetation is mainly ash, cottonwood, willow, oak, sedges, reeds, and grasses. Chehalem soils are associated with Woodburn soils.

In a typical profile, the surface layer is very dark brown silt loam about 16 inches thick. The subsoil is mottled silty clay about 44 inches thick. The upper part of the subsoil is very dark grayish brown, the middle part is dark grayish brown, and the lower part is olive brown. The Chehalem soils are used mainly for small grains, pasture, hay, and native hardwoods. Mainly irrigated, a small acreage is used for vegetables, improved pasture, and caneberries.

Chehalem silt loam, 2 to 12 percent slopes (CeC).This is the only soil of the Chehalem series mapped in the survey area. It occupies small areas on foot slopes of the Salem and Waldo Hills.

Representative profile (SE1/4SW1/4 sec. 23, T. 9 S., R. 3 W.).

Ap-0 to 8 inches, very dark brown (10YR 2/2) heavy silt loam, very dark grayish brown (10YR 3/2) when dry; moderate, coarse, subangular blocky structure; friable, hard, sticky and plastic; common roots; many, fine, tubular pores; medium acid (pH 5.8); clear, smooth boundary. (6 to 8 inches thick.)

A1-8 to 16 inches, very dark brown (10YR 2/2) heavy silt loam, very dark grayish brown (10YR 3/2) when dry; moderate, coarse, subangular blocky structure breaking to fine, subangular blocky structure; friable, hard, sticky and plastic; common roots; many, fine, tubular pores; medium acid (pH 5.6); abrupt, smooth boundary. (4 to 8 inches thick.)

B21-16 to 31 inches, very dark grayish-brown (10YR 3/2) silty clay, dark grayish brown (10YR 4/2) when dry; common, fine, distinct, yellowish-brown (10YR 5/6) mottles; moderate, medium and coarse, subangular blocky structure; firm, very hard, very sticky and very plastic; few roots; many, very fine, tubular pores; medium acid (pH 5.6); gradual, smooth boundary. (6 to 15 inches thick.)

B22-31 to 42 inches, dark grayish-brown (2.5Y 4/2) silty clay, light yellowish brown (2.5Y 6/4) when dry; many, fine, distinct, yellowish-brown (10YR 5/6) mottles; moderate, medium, prismatic structure; very firm, extremely hard, very sticky and very plastic; few roots; common, fine, tubular pores; many particles the size of fine shot; medium acid (pH 5.8); gradual, smooth boundary. (8 to 15 inches thick.)

IIB3-42 to 60 inches, olive-brown (2.5Y 4/4) silty clay, light olive brown (2.5Y 5/4) when dry; few, fine, distinct, yellowish-brown (10YR 5/6) mottles; moderate, coarse, prismatic and weak, coarse, angular blocky structure; very firm, extremely hard, sticky and plastic; few roots; common, fine, tubular pores; many manganese stains; many sand-size fragments of rock; medium acid (pH 6.0).

Texture of the A horizon ranges from silt loam to clay loam or silty clay loam. In places the A horizon is dark brown. Color of the B2 horizons ranges from very dark brown to dark grayish brown or very dark grayish brown, and mottling in those horizons ranges from faint to distinct. Weathered coarse fragments of sedimentary rock are common throughout the profile. They make up as much as 40 percent of the lower B horizons. In places the profile also contains fragments of basalt.

Included with this soil in mapping were small areas of a soil along Butte Creek that has a lighter colored surface layer and a more permeable subsoil than this soil. The subsoil of the included soil is silty clay loam.

The available water capacity is 10 to 11 inches. Permeability is slow, and fertility is moderate. Runoff is medium, and the hazard of erosion is slight. This soil is subject to seepage and runoff from higher areas. The depth to which roots can penetrate is restricted by wetness during winter and spring. Workability is fair.

This soil is used mainly for small grains, pasture, hay, and native hardwoods. When irrigated, a small acreage is used for vegetables, improved pasture, and caneberries. (Capability unit IIIe-5; not placed in a woodland suitability group)

Chehalis Series

The Chehalis series consists of well-drained soils that have formed in alluvium. These soils are nearly level or gently undulating, and they occur on bottom lands that are traversed by old overflow channels and sloughs. Elevations range from 100 to 650 feet. The average annual precipitation is 40 to 45 inches, the average annual air temperature is about 52° to 54° F., and the length of the frost-free season is 200 to 210 days. In areas that are not cultivated, the vegetation is mainly alder, ash bigleaf maple, oak, and an understory of vine maple, wild blackberry, vines, and shrubs. Chehalis soils are associated with Cloquato and Newberg soils.

In a typical profile, the surface layer is dark-brown silty clay loam about 9 inches thick. The subsoil is also dark-brown silty clay loam and is about 28 inches thick. The substratum is silty clay loam that is dark brown in the upper part and dark yellowish brown in the lower part. It extends to a depth of 80 inches or more.

The Chehalis soils are used mainly for pasture, hay, cereal grains, grass grown for seed, and orchards. When irrigated, they are used extensively for vegetables and berries.

Chehalis silty clay loam (Ch).-This is the only soil of the Chehalis series mapped in the survey area. It occupies the higher parts of bottom lands along the larger streams. Overflow occurs only about once in 50 years.

Representative profile (W1/2SE1/4NE1/4 sec. 20, T. 6 S., R. 1 W.)

Ap-0 to 9 inches, dark-brown (10YR 3/3) silty clay loam, dark brown (10YR 4/3) when dry; weak, fine, subangular blocky structure; friable, slightly hard, sticky and plastic; many roots; many fine pores; slightly acid (pH 6.6); abrupt, smooth boundary. (6 to 10 inches thick.)

B2-9 to 37 inches, dark-brown (10YR 3/3) silty clay loam, brown (10YR 5/3) when dry; weak, medium, subangular blocky structure; friable, slightly hard, sticky and plastic; many roots; many very fine and fine pores; slightly acid (pH 6.4); gradual, smooth boundary. (22 to 40 inches thick.)

C1-37 to 63 inches, dark-brown (10YR 3/3) silty clay loam, dark grayish brown (10YR 4/2) when dry; weak, medium, subangular blocky structure; friable, slightly hard, sticky and plastic; few roots; many very fine and fine pores; slightly acid (pH 6.4); gradual, smooth boundary.

C2-63 to 80 inches, dark yellowish-brown (10YR 3/4) silty clay loam, dark grayish brown (10YR 4/2) when dry; massive; friable, slightly hard, sticky and plastic; many fine pores; slightly acid (pH 6.4).

Texture of the Ap horizon is dominantly silty clay loam, but it ranges to heavy silt loam.

Included with this soil in mapping were small areas of Cloquato, Newberg, and Camas soils, and small areas of a steep soil on breaks.

The available water capacity is 11 to 12 inches. Permeability is moderate, and fertility is high. Runoff is slow, and the hazard of erosion is slight. Depth to which roots can penetrate is not restricted. This soil is generally in good tilth if regular additions of organic matter are provided.

This soil is used mainly for pasture, hay, cereal grains, grass grown for seed, and orchards. When irrigated, it is used extensively for vegetables and berries, but it is also used for all the crops commonly grown in the survey area, except potatoes and carrots. (Capability unit I-1; not placed in a woodland suitability group)

Chehulpum Series

The Chehulpum series consists of well-drained soils formed in mixed material that contains loess and is underlain by sandstone or shale. Bedrock is within 20 inches of the surface. These soils have slopes of 3 to 40 percent. They occur on foot slopes and on low foothills at elevations of 300 to 650 feet. The average annual precipitation is 40 to 60 inches, the average annual air temperature is 52° to 54° F., and the length of the frost-free season is 190 to 210 days. The vegetation is mainly oak, poison-oak, wild rose, and grasses. Chehulpum soils are associated with Steiwer soils.

In a typical profile, the surface layer is very dark brown silt loam about 12 inches thick. This is covered with a thin layer of decomposing grass and leaves. The underlying bedrock, at a depth of about 12 inches, is horizontally bedded, fine-grained sandstone.

The Chehulpum soils are used mostly for pasture. In this survey area, the Chehulpum soils were mapped only in an undifferentiated unit with Steiwer soils. A detailed technical profile of a Chehulpum soil is described in the Steiwer series under Steiwer and Chehulpum silt loams, 3 to 40 percent slopes.

Clackamas Series

The Clackamas series consists of somewhat poorly drained soils that have formed in gravelly mixed alluvium. These soils have slopes of 0 to 3 percent. They occur on terraces at elevations of 175 to 650 feet. The average annual precipitation is between 40 and 45 inches, the average annual air temperature is 52° to 54° F., and the length of the frost-free season is 200 to 210 days. In areas that are not cultivated, the vegetation is mainly Douglas-fir, hazel, brackenfern, wild rose, and grasses. Clackamas soils are associated with Sifton and Salem soils.

In a typical profile, the surface layer is very dark grayish-brown gravelly loam about 6 inches thick. The subsurface layer is also very dark grayish-brown gravelly loam, and it is about 9 inches thick. The subsoil is mottled very dark gray and dark reddish-brown gravelly clay loam about 9 inches thick. The substratum is mottled. It consists of dark-brown and strong-brown very gravelly clay loam that extends to a depth of 60 inches or more.

Clackamas soils that are neither drained nor irrigated are used mainly as woodland and for pasture, hay, and cereal grains. When irrigated, the drained areas are used for pole beans, bush beans, sweet corn, berries, squash, and cucumbers.

Clackamas gravelly loam (Ck).-This is the only soil of the Clackamas series mapped in the survey area. It is on terraces between Stayton, Jefferson, and Salem, and along Abiqua Creek, northeast of Silverton. The areas are of medium size.

Representative profile 50 feet east of a paved road (NE1/4SE1/4 sec. 1, T. 8 S., R. 3 W.)

Ap-0 to 6 inches, very dark grayish-brown (10YR 3/2) gravelly loam, dark grayish brown (10YR 4/2) when dry; moderate, medium and fine, subangular blocky structure; friable, slightly hard, slightly sticky and slightly plastic; many roots; many very fine and fine pores medium acid (pH -5.6); abrupt, smooth boundary. (5 to 7 inches thick.)

A3-6 to 15 inches, very dark grayish-brown (10YR 3/2) gravelly loam, dark grayish brown (10YR 4/2) and brown (10YR 4/3) when dry; common, fine and medium, black and reddish-brown mottles; moderate, medium, subangular blocky structure; friable, hard, slightly sticky and slightly plastic; many roots; many, very fine and fine, tubular pores; common, fine (1 millimeter in diameter), light-colored fragments; medium acid (pH 5.8); clear, smooth boundary. (7 to 11 inches thick.)

B2tg-15 to 24 inches, mottled very dark gray (10YR 3/1) and dark reddish-brown (2.5YR 3/4) gravelly clay loam, grayish brown (10YR 5/2) and yellowish red (5YR 5/6) when dry; moderate, medium, subangular blocky structure; friable, hard, sticky and plastic; many roots; many fine and medium pores; common moderately thick clay films in pores and on the surfaces of pebbles, and a few on the surfaces of peds; medium acid (pH 5.6); abrupt, smooth boundary. (8 to 10 inches thick.)

IICg-24 to 60 inches, mottled dark-brown (10YR 3/3) and mottled strong-brown (7.5YR 5/6) very gravelly clay loam, light brownish gray (10YR 6/2), pale brown (10YR 6/3), and light yellowish brown (10YR 6/4) when dry; massive; firm, very hard, slightly sticky and slightly plastic; few pores; 80 to 90 percent gravel and cobblestones; strongly acid (pH 5.4).

Color of the A horizon ranges from black to very dark grayish brown. Color of the B horizon is highly variegated. In places texture in the lower part of the B horizon ranges to very gravelly light silty clay. Depth to the gravelly lower part of the B horizon or to the very gravelly C horizon ranges from 20 to 36 inches.

Included with this soil in mapping were small areas of Courtney soils and small areas that have a surface layer of clay loam. These included areas make up as much as 15percent of the acreage in the mapping unit.

The available water capacity is 4 to 5 inches. Permeability is moderately slow, and fertility is moderate. Runoff is slow, and the hazard of erosion is only slight. This soil has a seasonal high water table. In some irrigated areas, there is a permanent high water table as the result of overirrigation and seepage from irrigation ditches. Depth to which roots can penetrate is restricted to about 24 inches by the compact, very gravelly substratum. Workability is poor.

Areas of this soil that are neither drained nor irrigated are used for pasture, hay, and cereal grains, and they are also used as woodland. Areas that are drained are used for pole beans, bush beans, sweet corn, berries, squash, and cucumbers when they are irrigated. If this soil is irrigated and properly fertilized, it is well suited to all the commonly grown crops. (Capability unit IIIw-1; not placed in a woodland suitability group)

Cloquato Series

The Cloquato series consists of well-drained soils that have formed in alluvium. These soils are nearly level and gently undulating, and they are on flood plains of the major streams. The areas are traversed by overflow channels and sloughs. Elevations range from 100 to 650 feet. The average annual precipitation is 40 to 45 inches, the average annual air temperature is fir, cottonwood, bigleaf maple, Oregon white oak, ash, and an understory of vine maple, wild blackberry, vines, shrubs, and grasses. Cloquato soils are associated with Chehalis and Newberg soils.

In a typical profile, the surface layer is dark-brown silt loam about 9 inches thick. The subsoil, which is also dark brown silt loam, is about 56 inches thick. The substratum is dark-brown fine sandy loam that extends to a depth of 83 inches or more.

Cloquato soils that are not irrigated are used mainly for small grains, orchards, pasture, hay, and grass grown for seed. When irrigated, these soils are used for all the crops commonly grown in the survey area.

Cloquato silt loam (Cm).-This is the only Cloquato soil mapped in the survey area. It occupies large areas along the Willamette, Pudding, and Santiam Rivers and along Butte Creek.1 Representative profile (E1/2SE1/4 sec. 20, T. 6 S., R.

Ap-0 to 9 inches, dark-brown (10YR 3/3) silt loam, brown (10YR 5/3) when dry; weak, medium and coarse, subangular blocky structure; friable, slightly hard, slightly sticky and slightly plastic; many roots; many, fine and very fine, tubular pores; medium acid (pH 6.0); clear, smooth boundary. (6 to 10 inches thick.)

B2-9 to 41 inches, dark-brown (10YR 3/3) silt loam, brown (10YR 5/3) when dry; weak, medium, subangular blocky structure; friable, slightly hard, slightly sticky and slightly plastic; common roots; many, very fine, tubular pores; slightly acid (pH 6.2); gradual, smooth boundary. (15 to 35 inches thick.)

B3-41 to 65 inches, dark-brown (10YR 4/3) silt loam, pale brown (10YR 6/3) when dry; very weak, coarse, subangular blocky structure; very friable, slightly hard. slightly sticky and nonplastic; few roots; many, fine, tubular pores; slightly acid (pH 6.4); clear, smooth boundary. (0 to 25 inches thick.)

C-65 to 83 inches, dark-brown (10YR 4/3) fine sandy loam, pale brown (10YR 6/3) when dry; massive; very friable, soft, nonsticky and nonplastic; no roots; many fine pores; slightly acid (pH 6.4).

Texture of the B2 horizon is dominantly silt loam, but this horizon contains thin layers of sandy material in places. This sandy material is generally below a depth of 30 inches.

Included with this soil in mapping were small areas of Chehalis, Newberg, and Camas soils, and small areas in which the substratum is gravelly. Also included were areas of steeper soils that have short slopes and that are adjacent to sloughs and old stream channels. The included areas make up from 10 to 15 percent of the acreage in this mapping unit.

The available water capacity is 12 to 14 inches. Permeability is moderate, and fertility is high. Runoff is slow, but the hazard of erosion is slight to moderate as the result of periodic overflow. Overflow generally occurs about once in 3 or 4 years, but it occurs two or more times in some years. Roots can penetrate to a depth of 5 feet or more. Workability is very good.

This soil is used mainly for small grains, orchards, pasture, hay, and grass grown for seed. When irrigated, it is used for all the crops commonly grown in the survey area.

This soil is well suited to all the commonly grown crops. Floodwaters leave debris, and they can erode deep holes in orchards and in areas occupied by other permanent crops. (Capability unit IIw-3; not placed in a woodland suitability group).

Concord Series

The Concord series consists of poorly drained soils that have formed in alluvium of mixed mineralogy. These soils are on broad valley terraces, in slightly concave depressions and in drainageways. They have slopes of 0 to 2 percent. Elevations range from 125 to 350 feet. The average annual precipitation is 40 to 45 inches, the average annual air temperature is 52° to 54° F., and the length of the frost-free season is 200 to 210 days. In areas that are not cultivated, the vegetation is mainly rushes, sedges, wild blackberry, hazel, annual grasses, and ash trees. Concord soils are associated with Amity and Dayton soils.

In a typical profile, the surface layer is very dark grayish-brown silt loam about 6 inches thick. The subsurface layer is mottled dark-gray silt loam about 9 inches thick. Just below the subsurface layer is a layer of mottled gray and dark-gray silty clay about 4 inches thick. The subsoil is about 10 inches thick. It consists of mottled grayish-brown silty clay in the upper part and of mottled dark grayish-brown silty clay in the lower part. The substratum of mottled dark grayish-brown silt loam extends to a depth of 60 inches or more.

Concord soils that are neither drained nor irrigated are used mainly for cereal grains, pasture, hay, and grass grown for seed. When irrigated, the drained areas are used mainly for berries and vegetables.

Concord silt loam (Co).-This is the only soil of the Concord series mapped in the survey area. It occupies narrow strips along and at the heads of drainageways, and it is also in depressions on terraces. In most places the slope is less than 2 percent.

Representative profile at the eastern edge of the Baldock Freeway, 200 feet north of the overpass (NE1/4NE1/4NW1/4 sec. 33, T. 5 S., R. 2 W.)

Ap--0 to 6 inches, very dark grayish-brown (10YR 3/2) silt loam, light brownish gray (10YR 6/2) when dry; moderate, fine, subangular blocky structure breaking to moderate, fine, granular structure; friable, hard, sticky and plastic; abundant fine roots; many interstitial pores and wormholes; common, fine, brown concretions; medium acid (pH 6.0); abrupt, smooth boundary. (5 to 7 inches thick.)

A21-6 to 9 inches, dark-gray (10YR 4/1) silt loam, gray (10YR 6/1) when dry; common, fine, distinct, dark brown (7.5YR 4/2) mottles; moderate, medium, subangular blocky structure; friable, hard, sticky and plastic; abundant fine roots; many, very fine and few, fine, tubular pores; common, fine, very dark brown concretions; medium acid (pH 5.8); clear, smooth boundary. (1 to 6 inches thick.)

A22-9 to 15 inches, dark-gray (10YR 4/1) heavy silt loam, light gray (10YR 7/1) when dry; common, fine, distinct, dark-brown (7.5YR 4/4) mottles; weak, medium, prismatic structure breaking to moderate, medium, subangular blocky structure; friable, hard, sticky and plastic; few fine roots; many, very fine and common, fine, tubular pores; common, fine, very dark brown concretions; medium acid (pH 6.0); clear, smooth boundary. (4 to 9 inches thick.)

A&B-15 to 19 inches, gray (10YR 5/1) and dark-gray (10YR 4/1) light silty clay, light gray (10YR 7/1 and 10YR 6/1) when dry; darker colors in ped interiors; common, fine, distinct, dark-brown (7.5YR 4/4) mottles; weak, medium, prismatic structure breaking to moderate, medium, subangular blocky structure; friable, hard, sticky and plastic; few fine roots; many, very fine, tubular pores; many, fine, very dark brown concretions; slightly acid (pH 6.2); clear, smooth boundary. (2 to 7 inches thick.)

IIB2t-19 to 24 inches, grayish-brown (2.5Y 5/2) heavy silty clay, light brownish gray (2.5Y 6/2) when dry; common, fine, distinct, yellowish-brown (10YR 5/6) mottles; strong, fine, prismatic structure breaking to strong, medium and fine, angular blocky structure; firm, extremely hard, very sticky and very plastic; very few roots; many, very fine and few, fine and medium, tubular pores; few thin and moderately thick clay films on ped surfaces and in pores; many, fine, very dark brown and few black concretions; slightly acid (pH 6.4); clear, wavy boundary. (4 to 12 inches thick.)

IIB3t 24 to 29 inches, dark grayish-brown (2.5Y 4/2) silty clay, light brownish gray (2.5Y 6/2) when dry; many, fine, distinct, dark yellowish-brown (10YR 4/4) mottles; massive: firm, very hard, sticky and plastic; few fine roots; common fine pores; common moderately thick clay films along lines of weakness, and few clay films in pores; few, fine, dark-brown and black concretions; neutral (pH 6.6); gradual, smooth boundary. (3 to 9 inches thick.)

IIIC-29 to 60 inches, dark grayish-brown (2.5Y 4/2) silt loam, light gray (2.5Y 7/2) when dry; many, medium, distinct, dark yellowish-brown (10YR 4/4) mottles; friable, hard, sticky and plastic; massive; common, very fine, tubular pores; few black stains; neutral (pH 6.6).

The Ap horizon is dominantly silt loam, but the texture ranges to silty clay loam. In places texture of the IIB2t horizon is clay. Soil reaction ranges from medium acid in the A horizon to slightly acid and neutral in the B and C horizons.

Included with this soil in mapping were small areas of Dayton soils. These included soils make up from 5 to 10 percent of the acreage in the mapping unit.

The available water capacity ranges from 9 to 12 inches. Permeability is slow, and fertility is low. Runoff is slow, and ponding occurs in some areas, especially in depressions. The hazard of erosion is slight. Depth to which roots can penetrate is restricted by the silty clay in the subsoil. It is also restricted by wetness, caused by the poor drainage and by the seasonal high water table. This soil is easily worked, but it tends to compact if it is cultivated when too moist.

Areas of this soil that are neither drained nor irrigated are used for spring small grains, pasture, hay, and grass grown for seed. When irrigated, drained areas are used for berries and vegetables. This soil is well suited to vegetables, small grains, pasture, and hay. (Capability unit IIIw-2; not placed in a woodland suitability group)

Courtney Series

The Courtney series consists of poorly drained soils that have formed in alluvial deposits of different ages. These soils are on gravelly alluvial terraces, where they occur in shallow depressions and in drainageways. Slopes range from 0 to 2 percent, and elevations range from 175 to 650 feet. The average annual precipitation is 40 to 45 inches, the average annual air temperature is 52° to 54° F., and the length of the frost-free season is 190 to 210 days. In areas that are not cultivated, the vegetation is mainly ash, vine maple, hazel, wild rose, blackberry, rushes, sedges, and annual and perennial grasses. Courtney soils are associated with Salem and Clackamas soils.

In a typical profile, the surface layer is about 12 inches thick, and it consists of mottled, black gravelly silty clay loam in the upper part and of mottled, very dark gray gravelly silty clay loam in the lower part. The subsoil is mottled dark-gray gravelly clay about 12 inches thick. The substratum consists of a layer of dark grayish-brown very gravelly clay loam, about 25 inches thick, that grades to mottled, dark-brown very gravelly sand, which extends to a depth of 57 inches or more.

Undrained areas of Courtney soils are used mainly for pasture, hay, and grass grown for seed. The drained areas are used for these crops and also for small grains.

Courtney gravelly silty clay loam (Cu).-This soil is on terraces between Stayton and Salem. It is in depressions and in narrow drainageways. This is the only soil of the Courtney series mapped in the survey area.

Representative profile (NW1/4SE1/4 sec. 6, T. 8 S., R. 2 W.).

A11-0 to 4 inches, black (10YR 2/1) gravelly silty clay loam, dark gray (10YR. 4/1) when dry; few, fine, distinct, dark-brown (7.5YR 4/4) mottles; strong, medium and fine, subangular blocky structure; friable, hard, sticky and plastic; many roots; many, very fine and fine, interstitial pores; iron stains in root channels; 20 to 25 percent coarse pebbles; strongly acid (pH 5.4); clear, smooth boundary. (2 to 6 inches thick.)

A12-4 to 12 inches, very dark gray (7.5YR 3/0) gravelly silty clay loam, very dark gray (10YR 3/1) when crushed and dark gray (10YR 4/1) when dry; common, medium, distinct, strong-brown (7.5YR 4/4) mottles; strong, medium and fine, subangular blocky structure; friable, hard, sticky and plastic; many roots; many, very fine, tubular pores; iron stains in root channels; 30 percent pebbles; medium acid (pH 5.8); abrupt, smooth boundary. (7 to 10 inches thick.)

IIB2t-12 to 24 inches, dark-gray (10YR 4/1) gravelly clay, gray (10YR 5/1) when dry; few, fine, distinct mottles; weak, coarse, prismatic structure; firm, very hard, very sticky and very plastic; few roots; 30 percent pebbles and a few cobblestones; slightly acid (pH 6.4); clear, smooth boundary, (10 to 20 inches thick.)

IIIC1-24 to 49 inches, dark grayish-brown (10YR 4/2) very gravelly clay loam, gray (10YR 5/1) when dry; massive; firm, hard, sticky and plastic; iron stains; 85 percent pebbles; few cobblestones; slightly acid (pH 6.2); abrupt, smooth boundary. (24 to 48 inches thick.)

IVC2-49 to 57 inches, mottled dark-brown (7.5YR 3/2) very gravelly sand, strong brown (7.5YR 5/6) when moist; massive; friable, soft, nonsticky and nonplastic; many, medium, interstitial pores; neutral (pH 6.7).

Color of the A horizon ranges from black or very dark brown to very dark gray, and texture of that horizon ranges from silty clay loam or clay loam to silty clay. In some places the B horizon is very dark gray, and it is gravelly silty clay in some areas. The amount of gravel in the B horizon ranges from 20 to 30 percent. Depth to the very gravelly C horizon ranges from 24 to 36 inches. The C horizon is stratified. Both the thickness of the different layers in the C horizon and the amount of gravel and cobblestones in that horizon are highly variable.

Included with this soil in mapping were small areas that have a surface layer of very dark gray silt loam.

Above the clay subsoil, the available water capacity is less than 3 inches. Permeability is very slow, and fertility is moderate. Runoff is ponded or very slow, and the hazard of erosion is slight. The depth to which roots can penetrate is restricted by the claypan in the subsoil, but it ranges from 12 to 16 inches. Workability is fair.

Undrained areas of this soil are used for pasture, hay, and grass grown for seed. The drained areas are used for these crops and also for spring small grains and winter wheat. When irrigated, the drained areas are used for sweet corn, berries, and beans. This soil is used for these irrigated crops because it occupies only small areas and extends through and is managed like the adjacent Sifton, Salem, and Clackamas soils. Courtney soils are poorly suited to row crops and root crops. (Capability unit IVw-1; not placed in a woodland suitability group)

Cumley Series

The Cumley series consists of moderately well drained soils that have formed in glacial till and colluvium. These soils are on mountain foot slopes, and they have slopes of 2 to 20 percent. Elevations range from 800 to 2,000 feet. The average annual precipitation is between 55 and 75 inches, the average annual air temperature is 48° to 51° F., and the length of the frost-free season is 165 to 190 days. The vegetation is mainly Douglas-fir, maple, alder, brackenfern, and grasses. Cumley soils are associated with McCully, Kinney, and Minniece soils.

In a typical profile, the surface layer is dark-brown silty clay loam about 9 inches thick. This is covered with a thin layer of decomposing leaves, stems, and twigs. The subsoil is about 37 inches thick and is dark reddish-brown silty clay in the upper part, dark-brown heavy silty clay in the middle part, and mottled brown clay in the lower part. The substratum is mottled, olive-brown clay. Bedrock is at a depth of more than 5 feet.

The Cumley soils are used mainly for timber and for watershed.

Cumley silty clay loam, 2 to 20 percent slopes (CLD) -This is the only soil of the Cumley series mapped in the survey area. It occurs in small areas on foot slopes and within slump areas of McCully soils.

Representative profile 25 feet northwest of a logging road (NE1/4NE1/4 sec. 25, T. 9 S., R. 2 E.)

01 and 02-1 inch to 0, layer of duff consisting of partly decomposed leaves, stems. and twigs.

A11-0 to 4 inches, dark-brown (7.5YR 3/2) silty clay loam, dark brown (7.5YR 4/2) when dry; moderate, fine, granular structure; friable, hard, sticky and plastic; many, fine, interstitial pores; many roots; medium acid (pH 6.0); gradual, smooth boundary. (3 to 7 inches thick.)

A12-4 to 9 inches, dark-brown (7.5YR 3/2) silty clay loam, dark brown (7.5YR 4/2) when dry; moderate, fine and medium, subangular blocky structure; friable, hard, sticky and plastic; many, fine and very fine, tubular pores; many roots; slightly acid; clear, smooth boundary. (4 to 8 inches thick.)

B1-9 to 15 inches, dark reddish-brown (5YR 3/4) silty clay, dark brown (7.5YR 4/3) when dry; moderate, medium, subangular blocky structure; firm, very hard, sticky and plastic; common, very fine and fine, tubular pores; many roots; medium acid (pH 5.8); clear, smooth boundary. (4 to 9 inches thick.)

B21t-15 to 25 inches, dark-brown (7.5YR 3/4) heavy silty clay, dark brown (7.5YR 4/4) when dry; moderate, coarse, subangular blocky structure; firm, very hard, very sticky and very plastic; common, very fine and fine, tubular pores; many roots; common thin and moderately thick clay films; common, fine, brown and black concretions; medium acid (pH 5.6). (8 to 14 inches thick.)

B22t-25 to 46 inches, brown (7.5YR 4/4) clay, brown (7.5YR 5/4) when dry; many, coarse, prominent, grayish brown (2.5Y 5/2) mottles; moderate, coarse, subangular blocky structure; very firm, very hard, very sticky and very plastic; common, very fine and fine, tubular pores; common roots; nearly continuous, thin and moderately thick clay films; few coarse fragments of basalt; strongly acid; clear, smooth boundary. (17 to 25 inches thick.)

C-46 to 60 inches, olive-brown (2.5Y 4/4) clay, grayish brown (2.5Y 5/2) when dry; many, coarse, strong-brown (7.5YR 4/4) mottles; massive; firm, very hard, very sticky and very plastic; few roots; few coarse fragments of basalt; common, very fine and fine, tubular pores; strongly acid.

Texture of the A horizon ranges from silty clay loam to silty clay. In places the A horizon is very dark brown. Mottling in the B22t horizon is distinct in some places. In some areas the entire profile contains a few pebbles, cobblestones, and other stones.

Included with this soil in mapping were small areas of Minniece soils and stony soils.

The available water capacity ranges from 9 to 12 inches. Permeability is moderately slow, and fertility is low. Runoff is medium, and the hazard of erosion is slight. The depth to which roots can penetrate is restricted by wetness and by the layer of clay at a depth of 46 inches.

This soil is used mainly for growing Douglas-fir to which it is moderately well suited. Where cleared, it can be used for small grains, pasture, hay, and grass grown for seed. If this soil is drained and irrigated, it is suitable for some vegetable and berry crops. (Capability unit IIIe-2; woodland suitability group 3c4)

Dayton Series

The Dayton series consists of soils that are poorly drained. These soils have formed mainly in old mixed alluvium, but their upper layers may have been influenced, to some extent, by loess. The soils are on broad valley terraces, and they occur in drainageways and in shallow depressions. Slopes range from 0 to 2 percent, and elevations range from 125 to 350 feet. The average annual precipitation is 40 to 45 inches, the average annual air temperature is 52° to 54° F., and the length of the frost-free season is 190 to 210 days. In areas that are not cultivated, the vegetation is mainly annual and perennial grasses, wild rose, and scattered ash trees. Dayton soils are associated with Amity and Concord soils.

In a typical profile, the surface layer is very dark grayish-brown silt loam about 7 inches thick. The subsurface layer is mottled dark-gray silt loam about 6 inches thick. The subsoil is mottled and consists of a layer of clay about 33 inches thick. It is dark gray in the upper part and is grayish brown in the lower part. The substratum is mottled grayish-brown silty clay loam that extends to a depth of 60 inches or more.

The Dayton soils are used mainly for small grains, pasture, hay, and grass grown for seed.

Dayton silt loam (Da).-This soil is on terraces, where it occupies small areas in drainageways and depressions. It is the only soil of the Dayton series mapped in the survey area.

Representative profile (SW1/4NE1/4 sec. 16, T. 6 S., R. 2 W.).

Ap-0 to 7 inches, very dark grayish-brown (10YR 3/2) silt loam, light brownish gray (10YR 6/2) when dry; few, fine, faint, yellowish-brown (10YR 5/6) mottles; moderate, fine, subangular blocky and granular structure; friable, hard, slightly sticky and slightly plastic; many roots; many, fine, interstitial pores; few, medium, black and red concretions; medium acid (pH 5.6); clear, smooth boundary. (5 to 9 inches thick.)

A2-7 to 13 inches, dark-gray (10YR 4/1) silt loam, gray (10YR 6/1) when dry; common, fine, faint, brownish-yellow (10YR 6/6) mottles; moderate, medium, subangular blocky structure; friable, slightly hard, slightly sticky and slightly plastic; many roots; common, very fine, tabular pores; few black and red concretions; medium acid (pH 5.8); abrupt, smooth boundary. (4 to 15 inches thick.)

IIB21t-13 to 25 inches, dark-gray (10YR 4/1) clay, gray (10YR 5/1) when dry; moderate, medium, prismatic structure breaking to coarse and medium, subangular blocky structure; very firm, very hard, very sticky and very plastic; few roots; few, fine, tubular pores; thick, continuous clay films; few black and red concretions; slightly acid (pH 6.4); gradual, smooth boundary. (10 to 24 inches thick.) .

IIB22t-25 to 46 inches, grayish-brown (10YR 5/2) clay, light brownish gray (10YR 6/2) when dry; few, fine, faint, yellowish-brown (10YR 5/6) mottles; massive; firm, very hard, very plastic and very sticky ; few roots; few, fine, tubular pores; slightly acid (pH 6.4); gradual, smooth boundary.

IIIC-46 to 60 inches, grayish-brown (2.5Y 5/2) silty clay loam, light brownish gray (2.5Y 6/2) when dry; common, medium, faint, light olive-brown (2.5Y 5/6) mottles; massive; friable, hard, sticky and plastic; few, fine, tubular pores; slightly acid (pH 6.2).

Color of the Ap horizon ranges from dark gray to very dark grayish brown when the soil is moist, and from light gray to light brownish gray when the soil is dry. Texture of the Ap horizon ranges from silt loam to silty clay loam.

Included with this soil in mapping were small areas of a Concord soil. The included areas make up as much as 5 percent of the acreage in the mapping unit.

The available water capacity above the clay subsoil is 3 to 6 inches. Permeability is very slow, and fertility is low. Runoff is very slow to ponded, and the hazard of erosion is slight. Roots can penetrate to the claypan, which is at a depth of only 12 to 24 inches. Workability is good, but this soil tends to puddle and compact if it is cultivated when too moist.

Undrained areas of this soil are used for small grains, pasture, hay, and grass grown for seed, and the drained areas are used for corn and for winter and spring small grains. When irrigated, this soil is used for sweet corn and bush beans. Even where it is drained, it is not suited to deep-rooted crops, many perennial crops, and crops that cannot tolerate excessive moisture. (Capability unit IVw1; not placed in a woodland suitability group)

Hazelair Series

The Hazelair series consists of moderately well drained soils that formed in material weathered from sandstone and shale. These soils have slopes of 2 to 20 percent. They are on foot slopes adjacent to the valley floor, at elevations of 250 to 650 feet. The average annual precipitation is 40 to 60 inches, the average annual air temperature is 52° to 54° F., and the length of the frost-free season is 190 to 210 days. In areas that have not been cultivated, the vegetation is mainly Oregon white oak, poison-oak, rose, annual weeds and grasses, and a few Douglas-firs. Hazelair soils are associated with Steiwer soils.

In a typical profile, the surface layer is very dark brown silt loam about 12 inches thick. The subsoil is very dark grayish-brown silty clay loam about 6 inches thick. The substratum, about 20 inches thick, is mottled and is dark grayish brown throughout. It is silty clay in the upper part and clay in the lower part. Sandstone bedrock is at a depth of about 38 inches.

The Hazelair soils are used as woodland and for small grains, pasture, hay, and grass grown for seed.

Hazelair silt loam, 2 to 6 percent slopes (HaB).This soil occupies small areas on the foot slopes of red foothills south of Salem. It also occurs near Scotts Mills.

Representative profile 40 feet south of a gravel road (NE1/4NE1/4 sec. 25, T. 9 S., R. 3 W)

Ap-0 to 6 inches, very dark brown (10YR 2/2) silt loam, grayish brown (10YR 5/2) when dry; weak, medium and fine, granular structure; friable, slightly hard, slightly sticky and slightly plastic; few roots; common, very fine and fine, tubular and interstitial pores; common, fine, rounded concretions or fragments of rock; medium acid (pH 5.8); abrupt, smooth boundary. (6 to 10 inches thick.)

A1-6 to 12 inches, very dark brown (10YR 2/2) silt loam, grayish brown (10YR 5/2) when dry; moderate, medium, subangular blocky structure breaking to strong, very fine, subangular blocky structure; friable, slightly hard, slightly sticky and slightly plastic; few roots; many, very fine and fine, tubular pores; common gray silt coatings on ped surfaces; medium acid (pH 5.6); clear, smooth boundary. (3 to 6 inches thick.)

B2-12 to 18 inches, very dark grayish-brown (10YR 3/2) silty clay loam, grayish brown (10YR 5/2) when dry; weak, medium, prismatic structure breaking to strong, fine and very fine, subangular blocky structure; firm, hard, plastic and sticky; few roots; many, very fine and fine, tubular pores; slightly acid (pH 6.2); clear, smooth boundary. (3 to 10 inches thick.)

IIC1-18 to 28 inches, dark grayish-brown (2.5Y 4/2) silty clay, grayish brown (2.5Y 5/2) when dry; few, faint, dark yellowish-brown (10YR 4/4) and few, distinct, light brownish-gray (10YR 6/2) mottles; strong, medium, angular blocky structure; firm very hard, very sticky and very plastic; few fine roots; common, very fine, tubular pores; many slickensides; many, fine and very fine, black concretions; slightly acid (pH 6.2); gradual, wavy boundary. (5 to 10 inches thick.)

IIC2-28 to 36 inches, dark grayish-brown (2.5y 4/2) clay, grayish brown (2.5Y 5/2) when dry; many, medium and fine, distinct, dark yellowish-brown (10YR 4/4) and few, distinct, light brownish-gray (10YR 6/2) mottles; moderate, very coarse and coarse, angular blocky structure; firm, very hard, very sticky and very plastic; no roots; few, very fine, tubular pores; common slickensides; few fine fragments of weathered sandstone; slightly acid (pH 6.4 gradual, wavy boundary. (5 to 8 inches thick.)

IIC3-36 to 38 inches, dark grayish-brown (2.5Y 4/2) clay, grayish brown (2.5Y 5/2) when dry; many, medium and fine, distinct, yellowish-brown (10YR 4/4) mottles; weak to moderate, coarse, angular blocky structure; firm, very hard, very sticky and very plastic; few, very fine, tubular pores; common slickensides; common, fine, black concretions; many fine and medium fragments of weathered sandstone; slightly acid (pH 6.4) abrupt, slightly wavy boundary. (0 to 4 inches thick.)

IIIR-38 inches, dark yellowish-brown (10YR 4/4), hard, fractured, fine-grained sandstone that is horizontally bedded.

Texture of the A horizon ranges from silt loam to silty clay loam. Mottles that are faint or distinct are within 20 inches of the surface. Depth to the C horizon ranges from 12 to 24 inches.

Included with this soil in mapping were small stony areas, and other areas where bedrock is at a depth of 4 to 5 feet.

The available water capacity is 4 to 7 inches. Permeability is slow, and fertility is low. Runoff is slow, and the hazard of erosion is slight. The depth to which roots and water can penetrate is restricted by the layer of dense clay at some depth below 12 to 24 inches. Workability is fair. If this soil is cultivated when too moist, however, it tends to puddle and a tillage pan forms readily.

This soil is used mainly for small grains, pasture, hay, and grass grown for seed. It is not suitable for fruit trees and deep-rooted crops, unless it is irrigated. When this soil is irrigated, small areas are used for pole beans, sweet corn, strawberries, and caneberries. (Capability unit IIIe-3 ; not placed in a woodland suitability group)

Hazelair silt loam, 6 to 20 percent slopes (HaD).-This soil has slopes of 6 to 12 percent in as much as 85 percent of the acreage. Runoff is medium, and erosion is a moderate hazard. Small grains, pasture plants, hay, and grass grown for seed are the main crops. (Capability unit IVe-2; not placed in a woodland suitability group)

Hazelair silty clay loam, 2 to 15 percent slopes, eroded (HcD2).-This soil has a profile similar to the one described for Hazelair silt loam, 2 to 6 percent slopes. It has lost as much as three-fourths of the original surface layer through erosion, however, and the present surface layer is very dark grayish-brown, slightly acid silty clay loam. Sheet erosion has caused most of the soil losses, but gully erosion has caused formation of a few shallow gullies. Runoff is medium, and further erosion is a moderate hazard. The available water capacity is only 2 to 3 inches.

Included with this soil in mapping were small areas in which slopes are steeper than 15 percent.

Areas of this Hazelair soil that have not been cleared are used mainly as woodland or for woodland pasture. The small areas that have been cleared are used for improved pasture. Because this soil is droughty, the amount of forage produced is small. (Capability unit VIe-1; not placed in a woodland suitability group)

Henline Series

The Henline series consists of well-drained very stony soils that have formed in colluvium from basalt or agglomerate. These soils have slopes of 6 to 80 percent. They occur on mountainous uplands at elevations of 3,000 to 5,000 feet. The average annual precipitation is 70 to 90 inches, the average annual air temperature is 41° to 45° F., and the length of the frost-free season is 90 to 110 days. The vegetation is mainly noble fir, hemlock, Douglas-fir, and an understory of blue huckleberry, Oregongrape, pathfinder, and beargrass.

In a typical profile, the surface layer is very dark brown very stony sandy loam about 10 inches thick. This is covered with a thin layer of decomposing plant remains. The substratum, just beneath the surface layer, is dark-brown very stony sandy loam. Bedrock of fractured basalt is at a depth of about 30 inches.

The Henline soils are used mainly for producing timber, and for watershed and wildlife habitat.

Henline very stony sandy loam, 6 to 30 percent slopes (HEE).-This soil is on foot slopes of the Cascade Mountains.

Representative profile 100 feet north of a logging road (SE1/4NE1/4 sec. 21, T. 9 S., R. 4 E.)

O1-1/2 inch to 0, patchy, partly decomposed plant and animal matter.

Al-0 to 10 inches, very dark brown (10YR 2/2) very stony sandy loam, dark grayish brown (10YR 4/2) when dry; very weak, coarse, subangular blocky structure; very friable, loose, nonsticky and nonplastic; many roots; many very fine pores; 60 to 70 percent coarse fragments; slightly acid (pH 6.4); diffuse, smooth boundary. (5 to 15 inches thick.)

C-10 to 30 inches, dark-brown (10YR 3/3) very stony sandy loam, brown (10YR 5/3) when dry; massive, readily breaking to single grain; very friable, loose, nonsticky and nonplastic; many roots; many interstitial pores; 60 to 70 percent coarse fragments; slightly acid (pH 6.4); clear, wavy boundary. (15 to 30 inches thick.)

IIR-30 inches, fractured basalt.

The content of coarse rock fragments in the soil profile ranges from 50 to 80 percent. In places part of the A horizon has granular structure. Depth to bedrock ranges from 20 to 40 inches.

Included with this soil in mapping were a few rock outcrops and small areas of Whetstone and Kinney soils. These included areas make up as much as 10 percent of the acreage in this mapping unit.

The available water capacity is 3 inches or less. Permeability is moderately rapid, and fertility is low. Runoff is medium, and the hazard of erosion is moderate. Roots can penetrate only to the basalt or agglomerate, at a depth of 20 to 40 inches.

This soil is well suited to forest trees, and it is used mainly for producing timber. It is too stony to be suitable for cultivated crops. (Capability unit VIs-1; woodland suitability group 3o2)

Henline very stony sandy loam, 30 to 55 percent slopes (HEF).-Steep slopes and rapid runoff make this soil highly susceptible to erosion. Rock outcrops are common, and there are a few escarpments.

This soil is used mainly for producing timber. It is more difficult to manage, however, than Henline very stony sandy loam, 6 to 30 percent slopes. Roads are hard to build and are difficult to maintain. (Capability unit VIs-1; woodland suitability group 3r3)

Henline very stony sandy loam, 55 to 80 percent slopes (HEG).-This soil is highly susceptible to erosion because of its very steep slopes and the very rapid runoff. Rock outcrops are numerous, and escarpments are common.

This soil is used mainly for producing timber, but management is extremely difficult. Roads are difficult to build and to maintain. (Capability unit VIIs-1; woodland suitability group 3r4)

Holcomb Series

The Holcomb series consists of somewhat poorly drained soils that are nearly level. These soils have formed mainly in mixed alluvial silts and clays, but they have some loess in the upper layers. They are on terraces. Elevations range from 125 to 350 feet. The average annual precipitation is 40 to 45 inches, the average annual air temperature is 52° to 54° F., and the length of the frost-free season is 200 to 210 days. In areas that are not cultivated, the vegetation is mainly grasses, wild blackberry, rose, and oak. Holcomb soils are associated with Amity and Dayton soils.

In a typical profile, the surface layer is silt loam about 18 inches thick. It is very dark brown in the upper part and is very dark grayish brown in the lower part. The subsurface layer is mottled, dark-brown light silty clay loam about 6 inches thick. The subsoil, about 18 inches thick, is mottled, dark grayish-brown clay in the upper part and is dark grayish-brown silty clay in the lower part.

The Holcomb soils are used mainly for small grains, pasture, hay, and grass grown for seed.

Holcomb silt loam (Ho).-This silty soil occupies small areas adjacent to drainageways on old alluvial terraces. It is the only soil of the Holcomb series mapped in the survey area.

Representative profile (SW1/4SW1/4SE1/4 sec. 4, T. 9 S., R. 2 W.).

Ap-0 to 6 inches, very dark brown (10YR 2/2) silt loam, grayish brown (10YR 5/2) when dry; moderate, coarse, subangular blocky structure breaking to moderate, fine, granular structure; friable, slightly hard, slightly sticky and slightly plastic; many roots; many very fine pores; medium acid (pH 5.6); gradual, smooth boundary. (3 to 9 inches thick.)

A1-6 to 18 inches, very dark grayish-brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) when dry; moderate, coarse, subangular blocky structure breaking to fine subangular blocky structure; friable, slightly hard, sticky and slightly plastic; many roots; many very fine pores; medium acid (pH 5.8); clear, smooth boundary. (9 to 15 inches thick.)

A2-18 to 24 inches, dark-brown (10YR 3/3) light silty clay loam, light brownish gray (10YR 6/2) when dry; common, fine, distinct, yellowish-brown (10YR 5/6) mottles; moderate, fine subangular blocky structure; firm, hard, sticky and plastic; common roots; common fine pores; common grains of clean silt and sand on ped surfaces; slightly acid (pH 6.2); abrupt, smooth boundary. (2 to 7 inches thick.)

IIB2tg-24 to 34 inches, dark grayish-brown (10YR 4/2) clay, grayish brown (2.5Y 5/2) when dry; common, fine, distinct, yellowish-brown (10YR 5/6) mottles; weak, coarse, angular blocky structure breaking to strong, fine, angular blocky structure; very firm, very hard, very sticky and very plastic; few roots; few very fine pores; common thin clay films on ped surfaces; neutral (pH 6.6); clear, smooth boundary. (8 to 12 inches thick.)

IIB3tg-34 to 42 inches, dark grayish-brown (10YR 4/2) silty clay, grayish brown (10YR 5/2) when dry; weak, fine, angular blocky structure; firm, very hard, very sticky and very plastic; no roots; common very fine pores; common thin clay films on ped surfaces; common, medium, black concretions; neutral (pH 6.6).

When the soil is moist, color of the A1 horizon ranges from very dark brown to very dark grayish brown. Depth to the upper part of the B horizon ranges from 20 to 30 inches. In places the lower part of the B horizon is gravelly. In most places a gravelly substratum is within 5 feet of the surface.

Included with this soil in mapping were areas in which the surface layer is dark brown.

Within the root zone, the available water capacity is 4 to 6 inches. Permeability of the subsoil is very slow, and fertility is moderate. Runoff is slow, and erosion is only a slight hazard. Workability is good, but a tillage pan develops if this soil is cultivated when too moist. Roots can penetrate to depths of 20 to 30 inches.

This soil is well suited to small grains, pasture plants, hay, and grass grown for seed, and it is used mainly for those crops. Small areas are drained. When irrigated, these drained areas are used for pole beans, corn, and blackberries. (Capability unit IIIw-1; not placed in a woodland suitability group)

Horeb Series

The Horeb series consists of moderately well drained and well drained soils that have formed in glacial till and colluvium. These soils have slopes of 0 to 35 percent. They occur on terraces and on mountain foot slopes at elevations of 1,600 to 3,500 feet. The average annual precipitation is 70 to 90 inches, the average annual air temperature is 46° to 50° F., and the length of the frost-free season is 120 to 165 days. The vegetation is mainly Douglas-fir, vine maple, brackenfern, swordfern, huckleberry, and sedges. Horeb soils are associated with Kinney soils.

In a typical profile, the surface layer is loam that is very dark brown in the upper part and is very dark grayish brown in the lower part. This is covered with a thin layer of decomposing leaves, needles, and twigs. The subsoil is about 17 inches thick, and it consists of gravelly loam that is dark brown in the upper part and dark yellowish brown in the lower part. The upper part of the substratum is mottled, light olive-brown gravelly loam about 5 inches thick. The lower part of the substratum is mottled, dark grayish-brown cobbly loam that extends to a depth of 60 inches or more.

The Horeb soils are used mainly for growing timber, for watershed, and as habitat for wildlife.

Horeb loam, 2 to 20 percent slopes (HRD).-Some areas of this soil are on foot slopes of the Cascade Mountains. Others occupy old slide or slip, areas in these mountains.

Representative profile (NE1/4NW1/4 sec. 15, T. 9 S., R. 3 E.).

O1-2 inches to 0, organic litter consisting of needles, fern leaves, twigs, and other residue from plants.

A11-0 to 9 inches, very dark brown (10YR 2/2) loam, dark gray (10YR 4/1) when dry; moderate, fine, granular structure; very friable, slightly hard, nonsticky and nonplastic; many, fine and very fine, interstitial pores; many roots; 5 percent fine and medium pebbles; strongly acid (pH 5.2); gradual, wavy boundary. (6 to 12 inches thick.)

A12-9 to 14 inches, very dark grayish-brown (10YR 3/2) loam, brown (10YR 5/3) when dry; moderate, fine, subangular blocky structure; friable, slightly hard, slightly sticky and slightly plastic; many, fine and very fine, interstitial pores; many roots; 10 percent fine and medium pebbles; strongly acid (pH 5.4); clear, wavy boundary. (4 to 7 inches thick.)

B21-14 to 24 inches, dark-brown (10YR 4/3) gravelly loam, light yellowish brown (10YR 6/4) when dry; moderate, fine subangular blocky structure; friable, hard, slightly sticky and slightly plastic; common roots; common very fine pores; 20 percent pebbles; very strongly acid (pH 4.8); clear, wavy boundary. (8 to 14 inches thick.)

B22-24 to 31 inches, dark yellowish-brown (10YR 4/4) gravelly loam, light yellowish brown (10YR 6/4) when dry; weak, medium, subangular blocky structure; friable, slightly hard, slightly sticky and slightly plastic; few roots; many very fine pores; 25 percent pebbles; very strongly acid (pH 4.8); clear, wavy boundary. (5 to 10 inches thick.)

C1-31 to 36 inches, light olive-brown (2.5Y 5/4) gravelly loam that contains common, medium, distinct, yellowish-brown (10YR 5/6) mottles; pale yellow (2.5Y 8/4) when dry; weak, coarse, subangular blocky structure or massive; friable, slightly hard, slightly sticky and slightly plastic; few roots; common very fine pores; 25 percent pebbles; very strongly acid (pH 4.8); clear, wavy boundary. (4 to 8 inches thick.)

C2-36 to 60 inches, dark grayish-brown (2.5Y 4/2) cobbly loam that contains common, medium, distinct, yellowish-brown (10YR 5/6) mottles; pale yellow (2.5Y 8/4) when dry; massive; firm, hard, sticky and plastic; few roots; many very fine and few medium pores; 15 percent pebbles, and 20 percent cobblestones; very strongly acid (pH 4.8).

Texture of the A horizon ranges to silt loam in some places. Color of the B horizon ranges from dark brown to dark yellowish brown. In some areas as much as 15 percent of the solum consists of fragments coarser than 3 inches in diameter. Thick ness of the solum ranges from 24 to 40 inches. Below a depth of 40 inches, the soil material is cobbly loam to very gravelly sand and the content of coarse fragments ranges from 25 to 85 percent.

Included with this soil in mapping were small areas of a steep Kinney soil, and areas that lack a cobbly or gravelly substratum.

The available water capacity is 5 to 7 inches. Permeability is moderate, and fertility is low. Runoff is medium, and the hazard of erosion is slight to moderate. This soil receives extra water that seeps from higher areas. Depth to which roots can penetrate is restricted by wetness caused by seepage and by the cobblestones and gravel in the substratum. Workability is good.

This soil is fairly well suited to use as woodland, and it is especially well suited to Douglas-fir. It is also suited to cultivated crops. (Capability unit IIIe-2; woodland suitability group 1o1)

Horeb gravelly silt loam, gravelly substratum, 0 to 15 percent slopes (HSC).-This is a well-drained soil on terraces. The depth to which roots can penetrate is restricted to about 40 inches by the very gravelly sand in the substratum. Runoff is slow, and the hazard of erosion is slight. Workability is fair.

Included with this soil in mapping were small areas where material from adjacent higher areas has been deposited on the surface of this soil. These included areas have a reddish color.

This Horeb soil is well suited to forest trees. It is used mainly for growing Douglas-fir, but small areas have been cleared and are used for pasture. Small grains, hay, berries, and vegetables could be grown. (Capability unit IIIe-4; woodland suitability group 2c1)

Horeb gravelly silt loam, gravelly substratum, 15 to 35 percent (HSE).-This soil is on abrupt breaks of terrace fronts. Runoff is rapid, and the hazard of erosion is moderate to severe. Included in mapping in some places were a few, small, very gravel-, and cobbly areas.

This Horeb soil is used mainly for growing Douglas-fir. It is poorly suited to many of the commonly grown cultivated crops, but it can be used for small grains and pasture. (Capability unit IVe-1; woodland suitability group 2c1)

Hullt Series

The Hullt series consists of well-drained soils that have formed in colluvium derived from sandstone. These soils have slopes of 2 to 60 percent. They occur on the margins of mountainous foot slopes at elevations of 800 to 1,200 feet. The average annual precipitation is 55 to 75 inches, the average annual air temperature is 49° to 51° F., and the length of the frost-free season is 165 to 190 days. In areas that are not cultivated, the vegetation is mainly Douglas-fir, hemlock, maple, brackenfern, salal, ocean-spray, hazel, snowberry, thimbleberry, strawberry, and trailing blackberry. Hullt soils are associated with Nekia and McCully soils.

In a typical profile, the surface layer is very dark brown clay loam about 9 inches thick. The subsurface layer is variegated dark-brown clay loam about. 6 inches thick. The subsoil is about 40 inches thick and is silty clay loam throughout. The upper part of the subsoil consists of a layer that is dark reddish brown and that is underlain by a layer that is reddish brown; the middle part of the subsoil is yellowish red; and the lower part is dark brown The substratum is variegated strong-brown to yellowish red, strongly weathered sandstone.

The Hullt soils are used mainly for small grains, pasture, hay, grass grown for seed, trees that grow in wooded areas, acid watershed.

Hullt clay loam, 2 to 7 percent slopes (HuB).-This soil is on the lower foot slopes of the Cascade Mountains.

Representative profile (SW1/4NE1/4 sec. 26, T. 6 S., R. 1 E.).

Ap-0 to 9 inches, very dark brown (7.5YR 2/2) clay loam, dark brown (7.5YR 4/4) when dry; weak, coarse and medium, subangular blocky structure breaking to weak, very fine, subangular (blocky structure; friable, hard, sticky and plastic; many roots; many very fine pores; few, very fine, black and reddish-colored concretions; medium acid (pH 5.8); abrupt, wavy boundary. (8 to 10 inches thick.)

A3-9 to 15 inches, variegated dark-brown (7.5YR 3/2 and 3/4) clay loam, brown (7.5YR 4/4) when dry; weak, coarse, prismatic structure breaking to weak, fine and very fine, subangular blocky structure; friable, hard, sticky and plastic; many roots; many, fine and very fine, tubular pores; common worm casts; strongly acid (pH 5.4); clear, smooth boundary. (0 to 8 inches thick.)

B1-15 to 22 inches, dark reddish-brown (5YR 3/4) silty clay loam, reddish brown (5YR 4/4) when dry; weak, coarse and medium, subangular blocky structure; friable, hard, sticky and very plastic; common roots; many, very fine and few, fine, tubular pores; strongly acid (pH 5.4); clear, smooth boundary. (5 to 9 inches thick.)

B21-22 to 33 inches, reddish-brown (5YR 4/4) silty clay loam, reddish brown (5YR 5/4) when dry; weak, medium, subangular blocky structure; friable, hard, sticky and very plastic; common roots; common fine and very fine pores; very strongly acid (pH 5.0); clear, smooth boundary. (9 to 13 inches thick.)

B22-33 to 46 inches, yellowish-red (5YR 4/6) silty clay loam, yellowish red (5YR 5/6) when dry; weak, medium and fine, subangular blocky structure; firm, very hard, sticky and very plastic; few roots; common, fine and very fine, tubular pores; very strongly acid (pH 5.0); gradual, smooth boundary. (10 to 16 inches thick.)

B3--46 to 55 inches, dark-brown (7.5YR 4/4) silty clay loam, strong brown (7.5YR 5/6) when dry; common, faint, medium and coarse, reddish-brown (5YR 4/4) mottles; weak, coarse, subangular blocky structure; firm, hard, sticky and very plastic; few roots; common, fine and very fine, tubular pores; few, black, medium stains; very strongly acid (pH 5.0); clear, wavy boundary. (6 to 20 inches thick.)

C-55 inches, variegated strong-brown (7.5YR 5/6 and 5/8), pinkish-gray (7.5YR 6/2), and yellowish-red (5YR 4/6), strongly weathered sandstone; massive; clay films along fractures; very strongly acid (pH 4.8).

Color of the horizon ranges from very dark brown to dark reddish brown. In places the A horizon is silty clay loam. Depth to weathered sandstone ranges from 40 to 60 inches.

Included with this soil in mapping were small eroded areas, where weathered sandstone is less than 30 inches from the surface. These areas make up about 5 percent of the acreage in this mapping unit. Also included were small areas of Nekia and McCully soils that make up from 5 to 10 percent of the acreage in the mapping unit.

The available water capacity is 8 to 10 inches. Permeability is moderately slow, and fertility is low. Runoff is slow, and the hazard of erosion is slight. The depth to which roots can penetrate ranges from 40 to 60 inches. Workability is fair, but it becomes progressively poorer as the content of moisture drops below field capacity.

This soil is well suited to most of the crops commonly grown in the survey area. It is used mainly for small grains, pasture, hay, and grass grown for seed, and it is also used as woodland. In addition, a small acreage is used for pole beans, sweet corn, caneberries, strawberries, and specialty crops. Irrigation is needed if pole beans and sweet corn are to be grown commercially. (Capability unit IIe-3; woodland suitability group 2o1)

Hullt clay loam, 7 to 20 percent slopes (HuD).-In about 60 percent of the acreage, this soil has slopes steeper than 12 percent. Runoff is medium, and erosion is a moderate hazard.

This soil is used for about the same crops as Hullt clay loam, 2 to 7 percent slopes, except that sweet corn is not grown. Tilling of row crops is difficult, and using mechanical methods for harvesting berries and vegetables is not feasible. (Capability unit IIIe-2; woodland suitability group 2o1)

Hullt clay loam, 2 to 20 percent slopes (HTD).-Runoff from this soil is medium, and the hazard of erosion is moderate. Where cleared, this soil is suitable for cultivated crops. It is used mainly as woodland. (Capability unit. IIIe-2; woodland suitability group 2o1)

Hullt clay loam, 20 to 30 percent slopes (HTE).-Runoff from this soil is rapid, and the hazard of erosion is severe. This soil is used mainly as woodland and for small grains, pasture, hay, and grass grown for seed. Small areas are also used for strawberries and cherries. Cultivating and harvesting most crops is difficult. (Capability unit IVe-1; woodland suitability group 2o1)

Hullt clay loam, 30 to 60 percent slopes (HTF).-Runoff from this soil is rapid, and the hazard of erosion is severe. This soil is not suitable for cultivated crops. It is used mainly for pasture, as woodland, and for grass grown for seed. (Capability unit VIe-2; woodland suitability group 2c2)

Jory Series

The Jory series consists of well-drained soils that have formed in colluvium from tuffs and basalt. These soils are on low, red foothills that are deeply dissected by drainageways and streams. They have slopes of 2 to 30 percent. Elevations range from 300 to 1,000 feet. The average annual precipitation is 40 to 60 inches, the average annual air temperature is 52° to 54° F., and the length of the frost-free season is 190 to 210 days. In areas that are not cultivated, the vegetation is mainly Douglas-fir, scattered Oregon oaks, and an understory of poison-oak and rose bushes. Jory soils are associated with Nekia soils.

In a typical profile, the surface layer is dark reddish-brown silty clay loam about 8 inches thick. The subsurface layer is also dark reddish-brown silty clay loam and is about 7 inches thick. The upper part of the subsoil consists of a layer of dark reddish-brown silty clay about 21 inches thick. The lower part of the subsoil is dark reddish-brown clay. Basalt is at a depth of more than 5 feet.

The Jory soils are used for small grains, orchards, pasture, hay crops, and grass grown for seed, and they are also used as woodland, for watershed, for wildlife habitat, and as homesites. Some areas are irrigated and are used for truck crops and vegetables.

Jory silty clay loam, 2 to 7 percent slopes (JoB).-This soil is on low foothills south and east of Salem.

Representative profile west of the Salem bypass (U.S. No. 99) and south of the secondary road running east from Grabenhorst Corners (NW1/4NW1/4NE1/4 sec. 13, T. 8 S., R. 3 W.; profile No. 1 in table 9 in the section "Laboratory Data.")

Ap1-0 to 4 inches, dark reddish-brown (5YR 3/3) silty clay loam, reddish brown (5YR 4/3) when dry; strong, medium and fine, granular structure; very friable, slightly hard, plastic and sticky; common, soft, fine, spherical pellets (shot); common roots; many, fine and very fine, interstitial pores; medium acid (pH 5.9); clear, smooth boundary. (4 to 8 inches thick.)

Ap2-4 to 8 inches, dark reddish-brown (5YR 3/3) silty clay loam, color the same when dry; weak, fine and very fine, subangular blocky structure; friable, slightly hard, sticky and plastic; few, soft, fine, spherical pellets; common roots; many, fine and very fine, interstitial pores; strongly acid (pH 5.5); clear, smooth boundary. (4 to 12 inches thick.)

A3--8 to 15 inches, dark reddish-brown (5YR 3/3) silty clay loam, color the same when dry; moderate, fine and very fine, subangular blocky structure; friable, slightly hard, very sticky and very plastic; few, soft, fine, spherical pellets; common roots; many, fine and very fine, interstitial and tubular pores; strongly acid (pH 5.5); gradual, smooth boundary. (4 to 7 inches thick.)

B1t-15 to 20 inches, dark reddish-brown (5YR 3/4) silty clay, reddish brown (5YR 4/3) when dry; moderate, fine, angular blocky structure breaking to strong, very fine, angular blocky structure; friable, hard, very sticky and very plastic; thin, continuous clay films; common roots; many, very fine, tubular pores; strongly acid (pH 5.2); gradual, smooth boundary. (0 to 8 inches thick.)

B21t-20 to 28 inches, dark reddish-brown (5YR 3/4) silty clay, reddish brown (5YR 4/3) when dry; moderate, medium and fine, angular blocky structure; friable, hard, very sticky and very plastic; thin, continuous clay films; common roots; many, very fine, tubular pores; very strongly acid (pH 5.0); clear, smooth boundary. (6 to 15 inches thick.)

B22t-28 to 36 inches, dark reddish-brown (5YR 3/4) silty clay, reddish brown (5YR 4/3) when dry; moderate, medium and fine, angular blocky structure; friable, hard, very sticky and very plastic; thin, continuous clay films; few black splotches 1 to 3 millimeters in diameter; few roots; many, very fine, tubular pores; very strongly acid (pH 4.9); clear, smooth boundary. (8 to 20 inches thick.)

B23t-36 to 50 inches, dark reddish-brown (2.5YR 3/4) clay, reddish brown (2.5YR 4/4) when dry; strong, fine and very fine, angular blocky structure; very firm, very hard, plastic and sticky; common black splotches and concretions 3 to 8 millimeters in diameter; thin, continuous clay films; very few roots; many, very fine, tubular pores; very strongly acid (pH 4.9) ; gradual, smooth boundary. (10 to 20 inches thick.)

B24t-50 to 63 inches, dark reddish-brown (2.5YR 3/4) clay, reddish brown (2.5YR 4/4) when dry; moderate, fine. angular blocky structure; firm, hard, plastic and sticky; few black splotches 3 to 8 millimeters in diameter; thin, continuous clay films; very few roots; many, very fine, tubular pores; very strongly acid (pH 4.9).

Thickness of the A horizon ranges from 12 to 20 inches. Color of the B horizon ranges from dark reddish brown to dark red. The content of clay in the B horizon ranges from about 40 to 60 percent, but the soil material has a coarser feel when rubbed between the fingers. In some places these soils contain a discontinuous stone line at a depth of 2 to 12 feet. In places a few basalt boulders are in all parts of the profile.

Included with this soil in mapping were small areas of a Nekia soil.

The available water capacity is 7 to 10 inches. Permeability is moderately slow, and fertility is moderate. Runoff is slow, and erosion is only a slight hazard. Roots can penetrate to a depth of 5 feet or more. Workability is fair, but it becomes progressively poorer when the content of moisture drops below field capacity.

This soil is used mainly for small grains, orchards (fig. 7), pasture, hay, and grass grown for seed, but a small acreage is used for strawberries, pole beans, sweet corn, caneberries, and specialty crops. When irrigated, this soil is used for most of the crops commonly grown in the survey area. Water for irrigation is obtained from reservoirs and ponds. (Capability unit IIe-3; woodland suitability group 3c1)

Jory silty clay loam, 7 to 12 percent slopes (JoC).-In most places this soil has slopes steeper than 9 percent. Runoff is medium, and the hazard of erosion is moderate. This soil is used for about the same crops as Jory silty clay loam, 2 to 7 percent slopes. (Capability unit IIIe-6; woodland suitability group 3c1)

Jory silty clay loam, 12 to 20 percent slopes (JoD).Runoff from this soil is medium, and erosion is a moderate hazard. This soil is used for about the same crops as Jory silty clay loam, 2 to 7 percent slopes. Sweet corn is not grown, however, because of the difficulty of using machinery for harvesting the crop. (Capability unit IIIe-2; woodland suitability group 3c1)

Jory silty clay loam, 20 to 30 percent slopes (JoE).Runoff from this soil is rapid. The hazard of erosion is severe. This soil is used mainly for small grains, pasture, hay, and grass grown for seed, but a small acreage is used for strawberries, for cherries, and as woodland. (Capability unit IVe-1; woodland suitability group 3cl)

Kinney Series

The Kinney series consists of well-drained soils that have formed in glacial till over basic igneous tuffaceous agglomerate. These soils have slopes of 2 to 70 percent. They occur on mountain foot slopes at elevations of 1,000 to 3,500 feet. The average annual precipitation is 60 to 90 inches, the average annual air temperature is 46° to 50° F., and the length of the frost-free season is 120 to 165 days. The vegetation is mainly Douglas-fir, hemlock, alder, Oregongrape, salal, vine maple, and rhododendron. Kinney soils are associated with Horeb, McCully, and Henline soils.

In a typical profile, the surface layer is very dark brown cobbly loam about 10 inches thick. This is covered by a thin layer of partly decomposed ferns, fir needles, leaves, and twigs, and by a thin layer of well-decomposed, black organic matter. The subsoil is about 30 inches thick. It consists of dark-brown cobbly clay loam in the upper part and of dark yellowish-brown cobbly clay loam in the lower part. The substratum is dark yellowish-brown cobbly loam about 13 inches thick. It is underlain by variegated light olive-brown to dark-red, weathered, basic igneous agglomerate.

The Kinney soils are used mainly for growing timber and for watershed.

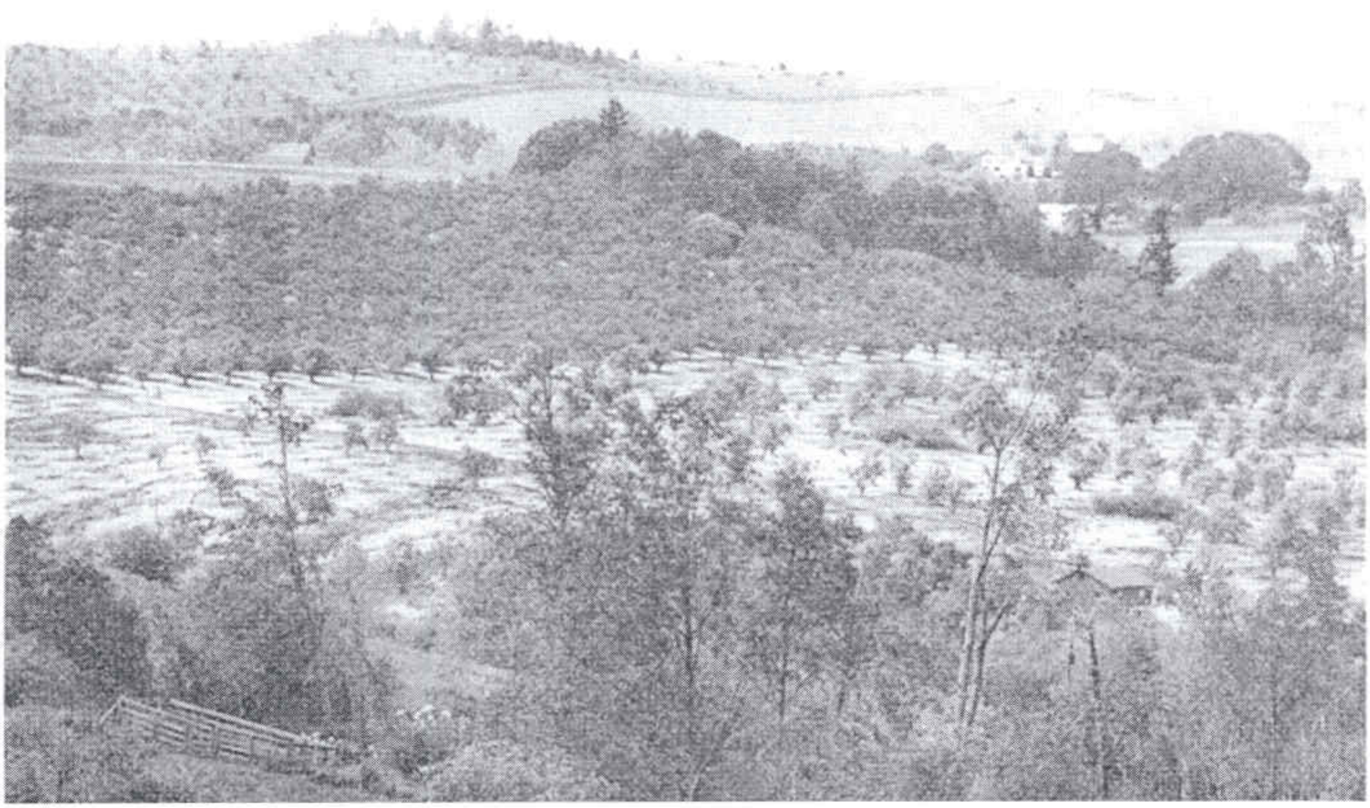


Figure 7.-Orchard on Jory silty clay loam , 2 to 7 percent slopes, in the Salem Hills.

Kinney cobbly loam, 2 to 20 percent slopes (KCD).This soil occupies broad ridges on foot slopes of the Cascade Mountains.

Representative profile about 3 miles southeast of South Burn Guard Station; 60 feet north of South Burn Road (NW1/4NE1/4SE1/4 sec. 31, T. 8 S., R. 2 E.)

O1-2 inches to 1 inch, partly decomposed fern leaves, fir needles, other leaves, and twigs.

O2-1 inch to 0, well-decomposed, black, friable organic matter.

A11-0 to 4 inches, very dark brown (10YR 2/2) cobbly loam, dark brown (10YR 4/3) when dry; moderate, fine, granular structure; friable, slightly hard, slightly sticky and slightly plastic; many fine and medium roots; many, fine, interstitial pores; many medium and fine particles of shot; 25 percent pebbles and angular cobble-size fragments; strongly acid (pH 5.3); clear, smooth boundary. (4 to 6 inches thick.)

A12-4 to 10 inches, very dark brown (10YR 2/2) cobbly loam, dark brown (10YR 4/3) when dry; moderate, medium and fine, granular structure; friable, slightly hard, slightly sticky and slightly plastic; many fine roots; many, fine, interstitial pores; many medium and fine particles of shot; 25 percent pebbles and angular cobble-size fragments; Strongly acid (pH 5.1); abrupt, wavy boundary. (4 to 6 inches thick.)

B1-10 to 15 inches, dark-brown (10YR 3/3) cobbly clay loam, dark brown (10YR 4/3) when dry; weak, fine, subangular blocky structure; friable, slightly hard, slightly sticky and slightly plastic; many medium roots; many, very fine, tubular pores; thin, patchy cutans; many medium and fine particles of shot; 30 percent coarse fragments; strongly acid (pH 5.5); clear, wavy boundary. (2 to 6 inches thick.)

B21-15 to 20 inches, dark-brown (7.5YR 3/4) cobbly clay loam, brown (7.5YR 5/4) when dry; weak, medium, subangular blocky structure; friable, slightly hard, sticky and plastic; common roots; many, very fine, tubular pores; thin, continuous cutans on peds, and thin, continuous clay films in root channels and in the larger pores; many, coarse, sand-size particles of material that resembles quartz; 30 percent pebbles and angular cobblestones; very strongly acid (pH 4.6); gradual, smooth boundary. (4 to 20 inches thick.)

B22-20 to 40 inches, dark yellowish-brown (10YR 4/4) cobbly clay loam, yellowish brown (10YR 5/4) when dry; weak, coarse and medium, subangular blocky structure; friable, slightly hard, slightly sticky and slightly plastic; common roots; many, very fine, tubular pores; moderately thick clay films in some of the larger pores; common, coarse, sand-size particles of material that resembles quartz; 35 percent pebbles and angular, cobble-size fragments of rock; very strongly acid (pH 4.6); clear, wavy boundary. (10 to 25 inches thick.)

C-40 to 53 inches, dark yellowish-brown (10YR 4/4) cobbly loam, light yellowish brown (10YR 6/4) when dry; massive or very weak, medium, subangular blocky structure; friable, slightly hard, slightly sticky and slightly plastic; few roots; many very fine pores; many, coarse, sand-size particles of material that resembles quartz; 35 percent pebbles and angular, cobble-size fragments of rock; very strongly acid (pH 4.8); abrupt, irregular boundary. (0 to 13 inches thick.)

IIR-54 inches, variegated light olive-brown (2.5Y 5/4), pale yellow (2.5Y 7/4), yellow (2.5Y 7/6), and dark-red (2.5YR 3/6), highly weathered, basic igneous agglomerate; very strongly acid (pH 4.8).

The A horizon is dark brown in some places. The predominant color of the B2 horizon is dark yellowish brown, but the color ranges to strong brown or slightly redder in some areas. Thickness of the solum ranges from 40 to 60 inches, but it is generally between 40 and 48 inches. In places pebbles, cobblestones, and other stones constitute as much as 25 to 50 percent of the solum. The upper part of the profile contains pumice in some areas. Weathered basic igneous agglomerate is at a depth of only 40 to 60 inches in many places, but it is at a much greater depth in some places where the layer of till is many feet thick. Rock crops out in some areas.

Included with this soil in mapping were small areas of McCully and Horeb soils. These included areas make up less than 5 percent of the acreage in the mapping unit.

The available water capacity is 5 to 9 inches. Permeability and fertility are both moderate. Runoff is medium, and erosion is only a slight hazard. Depth to which roots can penetrate ranges from 40 to 60 inches.

This soil is used mainly for growing Douglas-fir to which it is well suited. It is not suited to field crops. (Capability unit VIe-2; woodland suitability group 3o1)

Kinney cobbly loam, 20 to 50 percent slopes (KCF).This soil contains more rock outcrops than Kinney cobbly loam, 2 to 20 percent slopes. Bedrock commonly crops out along slope breaks between the two soils. Runoff is rapid, and the hazard of erosion is moderate to severe.

This soil is used and is managed about the same as Kinney cobbly loam, 2 to 20 percent slopes. (Capability unit VIe-2; woodland suitability group 3r1)

Kinney cobbly loam, 50 to 70 percent slopes (KCG).Runoff from this soil is very rapid. The hazard of erosion is very severe.

This soil is used in about the same way as Kinney cobbly loam, 2 to 20 percent slopes. It is not managed, except to harvest the natural stands of timber. Constructing logging roads and performing logging operations are difficult. (Capability unit VIIe-1; woodland suitability group 3r2)

Labish Series

The Labish series consists of poorly drained soils that have formed in mixed mineral and organic material. These soils have slopes of 0 to 1 percent. They occur on the bottoms of former shallow lakes at elevations of 150 to 175 feet. The average annual precipitation is between 40 and 45 inches, the average annual air temperature is 53° F., and the length of the frost-free season is 200 to 210 days. In areas that are not cultivated, the vegetation is mainly sedges, tussocks, and . willows. Labish soils are associated with Semiahmoo soils.

In a typical profile the surface layer is black and is about 7 inches tick. It consists of silty clay loam in the upper part and of silty clay in the lower part. The next layer is very dark brown silty clay about 9 inches thick. Below this is very dark gray clay that extends to a depth of 60 inches or more.

The Labish soils are used mainly for onions, small grains, pasture, and hay.

Labish silty clay loam (La).-This is the only soil of the Labish series mapped in the survey area. Nearly all of the acreage is in Lake Labish Bottom and in intermittent drainageways that have their outlets in Lake Labish Bottom.

Representative profile (NE1/4SW1/4 sec. 14, T. 6 S., R. 2 W.)

Ap1-0 to 3 inches, black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) when dry; strong, fine, granular structure; friable, very hard, sticky and plastic; many roots; many, fine, interstitial pores; slightly acid (pH 6.4); abrupt, smooth boundary. (3 to 6 Inches thick.)

Ap2-3 to 7 inches, black (10YR 2/1) silty clay, very dark gray (10YR 3/1) when dry; weak, coarse, subangular blocky structure; firm, very hard, sticky and plastic; common roots; many, fine and medium, tubular pores; medium acid (pH 5.6); abrupt, smooth boundary. (3 to 5 inches thick.)

AC1g-7 to 16 inches, very dark brown (10YR 2/2) silty clay, very dark gray (10YR 3/1) when dry; moderate, coarse, prismatic structure; firm, very hard, very sticky and very plastic; few roots; common, very fine, tubular pores; very strongly acid (pH 4.8); clear, smooth boundary. (7 to 11 inches thick.)

AC2g-16 to 30 inches, very dark gray (N 3/0) clay, very dark gray (N 3/0) when dry; weak, coarse, prismatic structure, massive when wet; very firm, extremely hard, very sticky and very plastic; few very fine pores; common fibrous roots; very strongly acid (pH 4.6); gradual, smooth boundary. (11 to 17 inches thick.)

C1g-30 to 48 inches, very dark gray (N 3/0) clay, very dark gray (N 3/0) when dry; massive; very firm, extremely hard, very sticky and very plastic; few very fine pores; common, medium-sized, light-colored, porous, soft fragments; very strongly acid (pH 4.6); abrupt, smooth boundary. (5 to 25 inches thick.)

C2g-48 to 60 inches, very dark gray (5Y 3/1) clay, dark gray (5Y 4/1) when dry; massive; very firm, extremely hard, very sticky and very plastic; few very fine pores; neutral (pH 7.0).

In most places the content of organic matter in the A horizon is between 10 and 25 percent. The content of organic matter is so high in some places, however, that the A horizon is almost muck. In a few places, thin layers of peat are within 5 feet of the surface.

Included with this soil in mapping were small areas of Wapato and Semiahmoo soils.

The available water capacity is 12 to 15 inches. Permeability is slow, and fertility is high. Workability is only fair. Runoff is very slow to ponded, and erosion is not a hazard or is only a slight hazard. Depth to which roots can penetrate is limited by the high water table. Annual flooding is a hazard to crops.

This soil is used mainly for onions, small grains, pasture, and hay. When irrigated, drained areas are used for vegetables and specialty crops. (Capability unit IIIw-2; not placed in a woodland suitability group)

McAlpin Series

The McAlpin series consists of moderately well drained and somewhat poorly drained soils that have formed in mixed alluvium. These soils are on alluvial fans and alluvial bottoms of small streams and in drainageways that traverse the low foothills. They have slopes of 0 to 6 percent. Elevations range from 250 .to 1,000 feet. The average annual precipitation is between 40 and 60 inches, the average annual air temperature is 52° to 54° F., and the length of the frost-free season is 190 to 210 days. In areas that are not cultivated, the vegetation is mainly Douglas-fir, with some ash, rosebush, and grasses. McAlpin soils are associated with Abiqua and Waldo soils.

In a typical profile, the surface layer is dark-brown silty clay loam about 8 inches thick. The subsurface layer is dark reddish-brown silty clay loam about 6 inches thick. The subsoil is dark reddish-brown silty clay loam in the upper part; mottled, dark reddish-brown silty clay in the middle part; and mottled, dark-brown silty clay in the lower part. It extends to a depth of 65 inches or more.

The McAlpin soils are used mainly for small grains, hay, pasture, and grass grown for seed.

McAlpin silty clay loam, 0 to 3 percent slopes (MaA).This soil is along streams and intermittent drainageways of the Salem, Waldo, and Silverton Hills. The areas are small.

Representative profile 425 feet east and 270 feet north of a road intersection (SE1/4NW1/4SE1/4 sec. 17, T. 9 S., R. 2 W.) .

Ap1-0 to 5 inches, dark-brown (7.5YR 3/2) silty clay loam, brown (7.5YR 4/2) when dry; moderate, fine and very fine, granular structure; friable, slightly hard, slightly plastic and slightly sticky; many roots; many interstitial pores, few, medium and fine, reddish-brown concretions; strongly acid (pH 5.5); abrupt, smooth boundary. (4 to 8 inches thick.)

Ap2-5 to 8 inches, dark-brown (7.5Y 3/2) silty clay loam, brown (7.5YR 4/4) when dry; massive; very firm, hard, slightly plastic and slightly sticky; common roots; few very fine pores; few, medium and fine, reddish-brown concretions; medium acid (pH 5.6); clear, smooth boundary. (0 to 4 inches thick.)

A3-8 to 14 inches, dark reddish-brown (5YR 3/3) silty clay loam, reddish brown (5YR 4/3) when dry; weak, coarse, prismatic structure breaking to moderate, coarse and fine, granular structure; friable, slightly hard, slightly plastic and slightly sticky; few roots; many, very fine, tubular pores; common, medium and fine, reddish-brown concretions; medium acid (pH 5.7); gradual, smooth boundary. (3 to 9 inches thick.)

B1-14 to 23 inches, dark reddish-brown (5YR 3/3) silty clay loam, reddish brown (5YR 4/4) when dry; weak, coarse, prismatic structure breaking to moderate, medium and fine, subangular blocky structure; friable, hard, plastic and sticky; few roots; many, very fine, tubular pores; thin, very dark brown coatings on ped surfaces; common, medium and fine, reddish-brown concretions; medium acid (pH 5.8); gradual, smooth boundary. (6 to 12 inches thick.)

B21-23 to 37 inches, dark reddish-brown (5YR 3/4) silty clay, reddish brown (5YR 4/4) when dry; common, fine, faint mottles; weak, coarse, prismatic structure breaking to moderate, medium and fine, subangular blocky structure; firm, hard, plastic and sticky; few roots; many, very fine, tubular pores; thin, very dark brown coatings on ped surfaces and in pores; common, fine and medium, black and reddish-brown concretions; medium acid (pH 5.9); gradual, smooth boundary. (9 to 15 inches thick.)

B22-37 to 51 inches, dark-brown (7.5YR 3/2) silty clay, brown (7.5YR 5/2) when dry; common, medium and fine, faint, brown (10YR 5/3 and 7.5YR 5/2) and gray (10YR 5/1) mottles when moist; moderate, fine, subangular blocky structure; firm, hard, very plastic and very sticky; few roots; many, fine and very fine, tubular pores; thick, dark coatings in root channels and in wormholes; common, fine and medium, black and reddish-brown concretions; medium acid (pH 5.9); clear, smooth boundary. (12 to 16 inches thick.)

B3-51 to 65 inches, dark-brown (7.5YR 4/2) silty clay, brown (7.5YR 5/4) when dry; many, coarse and medium, distinct mottles of light yellowish brown (10YR 6/4), brown (10YR 5/3), and strong brown (7.5YR 5/8) when moist; moderate, fine subangular blocky structure; firm, hard, very plastic and very sticky; many, very fine and fine, tubular pores; many, fine and medium, black and reddish-brown concretions; medium acid (pH 5.9).

Color of the A horizon ranges from dark brown or very dark brown to dark reddish brown. Color of the B horizon ranges from dark reddish brown. In places the B horizon contains faint mottles below a depth of 20 inches and distinct mottles below a depth of 30 inches. In some areas a few pebbles are scattered throughout the solum.

Included with this soil in mapping were small areas of Abiqua and Waldo soils. These included soils make up less than 5 percent of the acreage in the mapping unit.

The available water capacity is 9 to 11 inches. Permeability is moderately slow, and fertility is moderate. Runoff is slow, and erosion is not a hazard or is only a slight hazard. Depth to which roots can penetrate is restricted by a seasonal high water table. Workability is fair.

When not irrigated, this soil is used for small grains, hay, pasture, and grass grown for seed. When irrigated, it is used for all the crops commonly grown in the survey area, except potatoes and carrots. This soil is well suited to most of the commonly grown crops, but drainage is needed for deep-rooted crops. Outlets for drainage are adequate in most places, and this soil can be readily drained. (Capability unit IIw-1; not placed in a woodland suitability group)

McAlpin silty clay loam, 3 to 6 percent slopes (MaB).This soil receives runoff from higher areas, and as a result, additional soil material is deposited on its surface. Runoff is medium, and the hazard of erosion is moderate.

About the same kinds of crops are grown on this soil as are grown on McAlpin silty clay loam, 0 to 3 percent slopes: (Capability unit IIe-1; not placed in a woodland suitability group)

McBee Series

The McBee series consists of moderately well drained, undulating soils that formed in mixed alluvium. These soils have slopes of 0 to 3 percent. They occur on flood plains that are traversed by sloughs and old overflow channels. Elevations range from 100 to 650 feet. The average annual precipitation is 40 to 45 inches, the average annual air temperature is 52° to 54° F., and the length of the frost-free season is 200 to 210 days. In areas that are not cultivated, the vegetation is mainly Douglas-fir, alder, ash, big-leaf maple, oak, and an understory of vine maple, blackberry, shrubs, and grasses. McBee soils are associated with Wapato and Chehalis soils.

In a typical profile, the surface layer is very dark brown silty clay loam about 10 inches thick. The subsoil is about 32 inches thick and is mottled throughout. It is very dark brown silty clay loam in the upper part; dark brown, very dark brown, and very dark grayish-brown silty clay loam in the middle part; and dark grayish-brown clay loam in the lower part. The substratum is mottled, dark gray clay loam that extends to a depth of 65 inches or more.

McBee soils that are not irrigated are used mainly for small grains, orchards, pasture, hay, and grass grown for seed. They are used mostly for row crops when irrigated.

McBee silty clay loam (Mb).-This is the only soil of the McBee series mapped in the survey area. It occurs along Butte Creek and along the Willamette, Pudding, and Santiam Rivers, and it is subject to frequent overflow.

Representative profile (SE1/4SE1/4 sec. 6, T. 6 S., R. 1 E.) .

Ap-0 to 7 inches, very dark brown (10YR 2/2) silty clay loam, dark grayish brown (10YR 4/2) when dry; moderate, coarse, medium and fine, granular structure; friable, slightly hard, plastic and sticky; many, medium, fine and very fine, interstitial pores; common very fine roots; medium acid (pH 6.0); abrupt, smooth boundary. (6 to 8 inches thick.)

A1-7 to 10 inches, very dark brown (10YR 2/2) silty clay loam, dark grayish brown (10YR 4/2) when dry; few, faint, dark-brown mottles; weak, coarse and medium prismatic structure breaking to moderate, medium and fine, subangular blocky structure; friable, slightly hard, plastic and sticky; common very fine roots; many, very fine, tubular pores; slightly acid (pH 6.2)m ; clear, smooth boundary. (2 to 5 inches thick.)

B1-10 to 22 inches, very dark brown (10YR 2/2) silty clay loam, dark grayish brown (10YR 4/2) when dry; common, fine, faint mottles of dark brown; moderate, medium, prismatic structure breaking to strong, fine and very fine, subangular blocky structure; friable, slightly hard, plastic and sticky; many, very fine, tubular pores; few roots; many worm casts; slightly acid (pH 6.2); gradual, smooth boundary. (9 to 15 inches thick.)

B2-22 to 35 inches, faintly mottled, dark-brown (10YR 3/3) , very dark brown (10YR 2/2) , and very dark grayish-brown (10YR 3/2) silty clay loam, grayish brown (10YR 4/2) and brown (10YR 4/3) when dry; weak, medium, prismatic structure breaking to moderate, coarse and medium, subangular blocky structure; friable, slightly hard, plastic and sticky; many, very fine and few, fine, tubular pores; few very fine roots; slightly acid (pH 6.4); gradual, smooth boundary. (10 to 16 inches thick.)

B3-35 to 42 inches, dark grayish-brown (10YR 4/2) clay loam, grayish brown (10YR 5/2) when dry; many, fine and medium, very dark brown (10YR 2/2), brown (10YR 3/3), and dark yellowish-brown (10YR 4/4) mottles and common, fine, strong-brown mottles; medium and fine, subangular blocky structure; friable, slightly hard, plastic and sticky; very few roots; many, very fine and few, fine, tubular pores; slightly acid (pH 6.4); gradual, smooth boundary. (5 to 11 inches thick.)

Cg-42 to 65 inches, dark-gray (10YR 4/1) clay loam; many, medium and fine, distinct, very dark brown (10YR 2/2) and dark-brown (10YR 3/3) mottles; massive; no roots; many very fine and few fine pores; slightly acid (pH 6.4).

Texture of the A horizon ranges from heavy silt loam to silty clay loam. Depth to mottling ranges from 6 to 24 inches, but mottles are at a depth of 18 inches in many places. Mottles in the A1 and Bl horizons appear to be relic. Coarse fragments are commonly absent to a depth of 40 inches. In some places, however, the content of coarse fragments is as high as 20 percent at depths below 35 inches and it is as high as 50 percent at depths below 40 inches.

Included with this soil in mapping were small areas of a soil that has a layer of gravelly material below a depth of 3 feet. Also included were small areas of Wapato and Chehalis soils.

The available water capacity is 12 to 14 inches or more. In many places the drainage has been improved by lowering the water table and by improving outlets. Depth to which roots can penetrate is still restricted, however, by a seasonal high water table. Permeability and fertility are both moderate, and runoff is slow. Because of the frequent overflow, erosion is a moderate hazard. Workability is good, but regular additions of organic matter are needed to keep the soil structure from deteriorating and to keep tillage from becoming more difficult.

When not irrigated, this soil is used mainly for small grains, orchards, pasture, hay, and grass grown for seed. When irrigated, it is used for caneberries, sweet corn, beans, and hops. Drainage is not necessary for many crops, but it is needed if maximum use is to be made of this soil and if best returns are to be realized. Where this soil is drained, it is suited to all the crops commonly grown in the survey area. (Capability unit IIw-5; not placed in a woodland suitability group)

McCully Series

The McCully series consists of well-drained soils that have formed in till or colluvium underlain by basic igneous tuffaceous agglomerate. These soils have slopes of 2 to

70 percent. They occur on the margins of mountainous foot slopes at elevations of 800 to 2,000 feet. The average annual precipitation is 55 to 75 inches, the average annual air temperature is 48° to 51° F., and the length of the frost-free season is 165 to 190 days. In areas that are not cultivated, the vegetation is mainly Douglas-fir, hemlock, vine maple, salal, brackenfern, snowberry, trailing blackberry, and wild strawberry. McCully soils are associated with Jory, Hullt, and Kinney soils.

In a typical profile, the surface layer is dark reddish-brown clay loam about 6 inches thick. This is covered with a thin layer of decomposing fern leaves, fir needles, other -leaves, and twigs. The subsurface layer is dark reddish-brown clay loam about 4 inches thick. The subsoil is dark reddish-brown clay about 47 inches thick. A substratum of variegated dark-brown, dark yellowish-brown, and very dark grayish-brown gravelly loam that is mostly weathered agglomerate extends to a depth of 108 inches or more.

The McCully soils are used mainly for timber, watershed, pasture, hay, orchards, small grains, and grass grown for seed. When irrigated, they are used mainly for row crops.

McCully clay loam, 2 to 7 percent slopes (McB).-This soil occurs along the margins of the lower foot slopes of the Cascade Mountains.

Representative profile 0.2 mile southeast of the South Burn guard station, 100 feet east of South Burn Road (SW1/4SE1/4SW1/4 sec. 26, T. 8 S., R.1 E.)

O1&O2-1 inch to 0, partly decomposed fern leaves, fir needles, other leaves, and twigs.

Al-0 to 6 inches, dark reddish-brown (5YR 3/2) clay loam, dark brown (7.5YR 4/4) when dry; strong, medium and fine, granular structure; friable to firm, slightly hard, slightly sticky and slightly plastic; many roots; many, fine, interstitial pores; many medium concretions; many, coarse, sand-size fragments of rock ; strongly acid (pH 5.4); abrupt, smooth boundary. (6 to 8 inches thick.)

A3-6 to 10 inches, dark reddish-brown (5YR 3/2) clay loam, dark brown (7.5YR 4/4) when dry; strong, medium and fine, granular structure; friable, slightly hard, sticky and plastic; many roots; many, fine, interstitial pores; few thin cutans ; common, medium, reddish concretions; common, coarse, sand-size, light-colored fragments of rock; strongly acid (pH 5.2); clear, wavy boundary. (4 to 6 inches thick.)

B21-10 to 24 inches, dark reddish-brown (5YR 3/4) clay, yellowish red (5YR 4/6) when dry; weak, medium, subangular blocky structure; friable, hard, sticky and plastic; many roots; many, very fine, tubular pores; few thin cutans ; few small concretions; few, coarse, sand-size fragments of light-colored rock; very strongly acid (pH 4.6); clear, smooth boundary. (9 to 15 inches thick.)

B22-24 to 49 inches, dark reddish-brown (5YR 3/4) clay, yellowish red (5YR 4/6) when dry; weak, coarse and medium, subangular blocky structure; firm, hard, sticky and plastic; common roots; many, very fine, tubular pores; continuous, thin cutans ; few concretions; very strongly acid (pH 4.6); gradual, smooth boundary. (14 to 30 inches thick.)

B3-49 to 57 inches, dark reddish-brown (5YR 3/4) clay, reddish brown (5YR 4/4) when dry; weak, medium and fine, subangular blocky structure; friable, hard, sticky and plastic; few roots; many, very fine, tubular pores; few thin cutans; few small concretions; very strongly acid (pH 4.6); clear, wavy boundary. (7 to 10 inches thick.)

IIC-57 to 108 inches, variegated dark-brown (10YR 4/3), dark yellowish-brown (10YR 4/4), dark-brown (7.5YR 4/4), and very dark grayish-.brown (2.5Y 3/2) gravelly loam that is mostly weathered rock; massive; very strongly acid (pH 4.6); many feet thick.

In some places the A horizon is stony. Rock outcrops are absent from some areas and are common in others. In places a few large boulders are on the surface and angular fragments of rock the size of cobblestones make up from 5 to 15 percent of the A and B horizons. The solum is predominantly dark reddish brown, but the color ranges from dark brown in the A horizon to dark red in the B horizon. In places the B2 horizon is silty clay. The solum ranges from 40 to 60 inches in thickness, but it is commonly 40 to 48 inches thick. Depth to weathered agglomerate ranges from 40 inches to 12 feet. The entire profile is strongly acid or very strongly acid.

Included with this soil in mapping were small areas of Kinney and Cumley soils.

The available water capacity is 8 to 10 inches. Permeability is moderately slow, and fertility is low. Runoff is slow, and the hazard of erosion is slight. The depth to which roots can penetrate is 40 to 60 inches or more. Workability is fair, but it becomes progressively poorer as the content of moisture decreases to below field capacity.

This soil is well suited to pasture plants, hay, orchards, small grains, and grass grown for seed, and it is used mainly for those crops. Much of the acreage has been cleared and is used extensively for crops that require cultivation. A small acreage is used for strawberries, and other small acreages are used for pole beans, sweet corn, berries, and specialty crops. A limited supply of water for irrigation is available from reservoirs and ponds. (Capability unit IIe-3; woodland suitability group 2o1)

McCully clay loam, 7 to 12 percent slopes (McC).-This soil has slopes of more than 9 percent in most places. Runoff is medium, and the hazard of erosion is moderate. Bedrock crops out in a few places.

This soil is used for about the same crops as McCully clay loam, 2 to 7 percent slopes. More careful management is needed, however, to control erosion. (Capability unit IIIe-6; woodland suitability group 2o1)

McCully clay loam, 12 to 20 percent slopes (McD).-This soil contains a few stony areas. Runoff is medium, and erosion is a moderate hazard.

In general, this soil is used for about the same crops as McCully clay loam, 2 to 7 percent slopes. Sweet corn is not grown, however, because of the difficulty of harvesting the crop. Tilling and irrigating row crops so that soil losses will not be excessive is difficult. Mechanical harvesting of vegetables and berry crops is not feasible. (Capability unit IIIe-2; woodland suitability group 2o1)

McCully clay loam, 20 to 30 percent slopes (McE).-In a few places, this soil contains rock outcrops. Runoff is rapid, and the hazard of erosion is severe.

This soil is used mainly as woodland and for small grains, pasture, hay, and grass grown for seed. A small acreage is used for strawberries and cherries. Crops are difficult to cultivate and harvest. For row crops, practices that help to prevent excessive soil losses are necessary, but those practices are difficult to apply without damaging the crop. (Capability unit IVe-1; woodland suitability group 2o1)

McCully clay loam, 2 to 30 percent slopes (MUE).-In a few places, bedrock crops out in areas of this soil. Runoff is medium, and the hazard of erosion is moderate.

This soil is used mainly for growing Douglas-fir. Where cleared, it is suitable for cultivated crops. Logging is best done in summer, when this soil is drier than at other times. (Capability unit IVe-1; woodland suitability group 2o1)

McCully clay loam, 30 to 50 percent slopes (MUF).-In this soil, bedrock crops out in a few places. Runoff is rapid. The hazard of erosion is severe.

This soil is not suitable for crops that require cultivation, and nearly all of the acreage is in Douglas-fir, Small areas are used for improved pasture and for grass grown for seed, although this soil is poorly suited to these uses. (Capability unit VIe-2; woodland suitability group 2c2)

McCully clay loam, 50 to 70 percent slopes (MUG).-Runoff from this soil is very rapid, and the hazard of erosion is very severe. In places small areas that have a stony surface layer were included in mapping.

This McCully soil is used mainly for growing Douglas-fir. Except for harvesting the timber, management is not feasible. Logging is best done in summer, when this soil is drier than at other times. (Capability unit VIIe-1; woodland suitability group 2c3)

McCully stony clay loam, 2 to 20 percent slopes (MID).-Angular pebbles, one-half inch to 3 inches in diameter, make up from 20 to 30 percent, by volume, of the surface layer of this soil. Rock outcrops are common, and small areas of this soil are shallow over bedrock. Runoff is medium, and erosion is a moderate hazard. The available water capacity is moderate.

This soil is used mainly for pasture and for grass grown for seed, but some areas are used for cultivated crops. Tillage is more difficult than for less sloping, less stony McCully soils. In areas to be tilled, the larger stones are usually removed by hand. (Capability unit IIIe-4; woodland suitability group 2o1)

McCully very stony clay loam, 2 to 30 percent slopes (MmE).-From 45 to 55 percent of this soil, by volume, consists of angular fragments of rock. The fragments range from 1 to 9 inches in diameter. Rock outcrops are common. The available water capacity is low.

Because of the stones in the surface layer, this soil is not suitable for crops that require cultivation, and it is used mainly for growing Douglas-fir. Logging is best done in summer, when the soil is drier than at other times. (Capability unit VIs-1; woodland suitability group 3c2)

Minniece Series

The Minniece series consists of deep, somewhat poorly drained and poorly drained soils that have formed in colluvium and alluvium from basic igneous tuffs or agglomerate. These soils have slopes of 0 to 8 percent. They occur in seepage areas and in drainage channels at elevations ranging from 800 to 3,000 feet. The average annual precipitation is 60 to 90 inches, the average annual air temperature is 47° to 50° F., and the length of the frost-free season is 145 to 190 days. The vegetation is mainly alder, maple, swordfern, skunkcabbage, and sedges. Minniece soils are associated with McCully, Horeb, and Kinney soils.

In a typical profile, the surface layer is very dark grayish-brown silty clay loam about 10 inches thick. The subsoil is mottled throughout and is about 22 inches thick. It is dark grayish-brown silty clay loam in the upper part, dark grayish-brown silty clay in the middle part, and gray clay in the lower part. The substratum is gray clay that extends to a depth of 60 inches or more. The substratum, like the subsoil, is mottled.

The Minniece soils are used mainly for producing timber and for watershed.

Minniece silty clay loam, 0 to 8 percent slopes (MYB).-This soil occupies small seep areas and small areas in drainageways on the lower slopes of the Cascade Mountains. It is the only soil of the Minniece series mapped in the survey area.

Representative profile 50 feet west of logging road (SW1/4NE1/4 sec. 22, T. 9 S., R. 3 E.)

A1-0 to 5 inches, very dark grayish-brown (10YR 3/2) silty clay loam, grayish brown (10YR 5/2) when dry; moderate, fine, granular structure; friable, hard, slightly sticky and plastic; many roots; many, fine, interstitial pores; medium acid (pH 5.8); clear, smooth boundary. (3 to 7 inches thick.)

A3-5 to 10 inches, very dark grayish-brown (10YR 3/2) silty clay loam, grayish brown (10YR 5/2) when dry; moderate, medium, subangular blocky structure; firm, hard, sticky and plastic many roots; common, very fine and few, medium, tubular pores; medium acid (pH 5.8); clear, smooth boundary, (3 to 7 inches thick.)

B1-10 to 15 inches, dark grayish-brown (10YR 4/2) heavy silty clay loam, grayish brown (10YR 5/2) and light brownish gray (10YR 6/2) when dry; common, distinct, strong-brown (7.5YR 5/6) mottles; moderate, medium, subangular blocky structure; firm, hard, sticky and plastic; common roots; common, very fine, tubular pores; few thin clay films; medium acid (pH 5.8); clear, smooth boundary. (3 to 7 inches thick.)

IIB21tg-15 to 19 inches, dark grayish-brown (10YR 4/2) silty clay, light gray (10YR 7/2) when dry; many, medium, distinct, strong-brown (7.5YR 5/6) mottles; moderate, medium, prismatic structure breaking to strong, medium, subangular blocky structure; firm, very hard, sticky and plastic; common roots; common, very fine and few, fine, tubular pores; few thin clay films; ped surfaces coated with white (10YR 8/1) particles of silt medium acid (pH 5.8); clear, smooth boundary. (2 to 6 inches thick.)

IIB22tg-19 to 32 inches, gray (10YR 5/1) clay, light gray (10YR 6/1) when dry; many, medium, distinct, strong-brown (7.5YR 5/6) mottles; moderate, coarse, prismatic structure breaking to weak, medium, subangular blocky structure; very firm, extremely hard, very sticky and very plastic; few roots; few, very fine and fine, tubular pores; common thin clay films medium acid (pH 5.8); clear, smooth boundary. (14 to 16 inches thick.)

IICg-32 to 60 inches, gray (10YR 5/1) clay, light gray (10YR 6/1) when dry; common, medium, distinct, strong-brown (7.5YR 5/6) mottles-, massive; very firm, extremely hard, very sticky and very plastic; few roots; few, very fine, tubular pores; medium acid (pH 5.8); few black stains.

Color of the A horizon ranges from very dark brown to very dark grayish brown. Color of the B horizon ranges from dark grayish brown to gray. In some places the entire solum contains mottles. A few stones are scattered throughout the solum in some areas.

Included with this soil in mapping were small stony areas.

The available water capacity ranges from 6 to 8 inches. Permeability is very slow, and fertility is low. Runoff is slow to medium, and the hazard of erosion is slight. Depth to which roots can penetrate varies because of differences in the height of the water table, but the root depth is generally shallow. This soil receives additional water as the result of seepage from higher areas. Therefore, it is wet during most of the year.

This soil is used mainly for growing alder and maple to which it is moderately well suited. Small areas have been cleared and are used for pasture. The difficulties of building roads and of conducting logging operations are limitations to use of this soil for producing timber. Because the areas are small, however, roads can generally be built around them. Drainage is needed in areas used for pasture, and response is generally good where drainage has been established. Under the present management, draining areas of this soil to be used for timber is not economically feasible. (Capability unit VIw-1; not placed in a woodland suitability group)

Nekia Series

The Nekia series consists of well-drained soils that have formed in material weathered from tuffs and basalt. These soils are on low, red foothills that are dissected by drainage channels and streams. They have slopes of 2 to 50 percent. Elevations range from 300 to 1,000 feet. The normal annual precipitation is 40 to 60 inches, the normal annual air temperature is 52° to 54° F., and the length of the frost-free season is 190 to 210 days. In areas that are not cultivated, the vegetation is mainly Douglas-fir, but it includes a few scattered oaks and an understory of poison-oak, rose, and brackenfern. Nekia soils are associated with Jory soils.

In a typical profile, the surface layer is dark reddish-brown silty clay loam about 9 inches thick. The subsoil is dark reddish-brown clay about 27 inches thick. Basalt bedrock underlies the subsoil at a depth of about 36 inches.

The Nekia soils are used mainly as woodland and for small grains, orchards, pasture, hay, and grass grown for seed. Some areas are irrigated.

Nekia silty clay loam, 2 to 7 percent slopes (NeB).-This soil is in the Salem, Waldo, and Silverton Hills.

Representative profile 150 feet south of a paved road (NW1/4SW1/4NW1/4 sec. 17, T. 8 S., R. 1 W.)

Ap-0 to 9 inches, dark reddish-brown (5YR 2/2) silty clay loam, reddish brown (5YR 4/3) when dry; moderate, medium and fine, granular structure; friable, slightly hard, plastic and sticky; many roots; many, fine, interstitial pores; medium acid (pH 5.6); abrupt, wavy boundary. (5 to 10 inches thick.)

B1-9 to 18 inches, dark reddish-brown (5YR 3/3) clay, reddish brown (5YR 4/4) when dry; weak, medium, prismatic structure breaking to weak, very fine, granular structure; friable, slightly hard, plastic and sticky; common roots; many, very fine, tubular pores; strongly acid (pH 5.5); clear, smooth boundary. (3 to 12 inches thick.)

B21t-18 to 24 inches, dark reddish-brown (5YR 3/3) clay, reddish brown (5YR 4/4) when dry; weak, very coarse, prismatic structure breaking to moderate, fine and very fine, subangular blocky structure; friable, hard, plastic and sticky; common roots; many, very fine, tubular pores; few thin clay films on ped surfaces and in pores; strongly acid (pH 5.4) ; clear, smooth boundary. (4 to 18 inches thick.)

B22t-24 to 36 inches, dark reddish-brown (5YR 3/4) clay, yellowish red (5YR 4/6) when dry; very weak, coarse, prismatic structure breaking to moderate fine and very fine, subangular blocky structure; firm, hard, very plastic and very sticky; few roots; many, very fine, tubular pores; many moderately thick clay films on ped surfaces and in pores; very few, faint, black coatings on ped surfaces; very few, fine, black concretions; many, coarse, sand-size fragments; strongly acid (pH 5.3); clear, wavy boundary. (8 to 18 inches thick.)

R1-36 to 45 inches, fractured bedrock, the fractures filled with reddish-brown (5YR 4/4) clay, reddish brown (5YR 5/3) when dry; weak, fine and very fine, subangular blocky structure; firm, hard, very plastic and very sticky; few large roots; many, very fine, tubular pores; few thick clay films on stone surfaces and in pores; variegations in color caused by weathering of the fragments of rock; many, medium, black coatings on stone surfaces; few, medium, black concretions; 90 percent of horizon is fractured, hard rock; strongly acid (pH 5.3); clear, wavy boundary.

R2-45 inches, basalt bedrock.

Color of the A horizon ranges from dark brown to dark reddish brown. Color of the B2 horizon ranges from dark reddish brown to yellowish red, but it is dominantly dark reddish brown. In places the B2 horizon is silty clay. The content of coarse fragments of hard basalt in the A horizon ranges from 0 to 15 percent, but the content of coarse fragments in the B22t horizon is as high as 50 percent. Depth to bedrock ranges from 20 to 40 inches. Bedrock is at a depth of more than 30 inches in most places.

Included with this soil in mapping were small areas of Jory and McCully soils. These included soils make up from 10 to 15 percent of the acreage in the mapping unit.

The available water capacity is 4 to 7 inches. Permeability is moderately slow, and fertility is moderate. Runoff is slow, and erosion is only a slight hazard. The depth to which roots can penetrate ranges from 20 to 40 inches, but it is more than 30 inches in most places. Workability is only fair, and it becomes progressively poorer as the content of moisture drops below field capacity.

This Nekia soil is well suited to the commonly grown crops. Nonirrigated areas are used mainly for small grains, orchards, pasture, hay, and grass grown for seed, but small acreages are used for strawberries, field corn, caneberries, and specialty crops. When irrigated, this soil is used for pole beans and sweet corn (fig. 8). Irrigation water is obtained from reservoirs and ponds. (Capability unit IIe-3; woodland suitability group 3c1)

Nekia silty clay loam, 7 to 12 percent slopes (NeC).- This soil has slopes that are mainly steeper than 9 percent. Bedrock crops out in a few places. Runoff is medium, and erosion is a moderate hazard.

Included with this soil in mapping were areas of Jory, McCully, and Witzel soils. These included soils make up from 5 to 10 percent of the acreage in this mapping unit.

This Nekia soil is used for about the same crops as Nekia silty clay loam, 2 to 7 percent slopes, but irrigation and tillage of row crops are more difficult. Mechanical harvesting of vegetables and berries is not feasible. (Capability unit IIIe-6; woodland suitability group 3c1)

Nekia silty clay loam, 12 to 20 percent slopes (NeD).-This soil contains a few stony areas and areas of rock outcrop. Runoff is medium. The hazard of erosion is moderate.

Included with this soil in mapping were areas of Jory, McCully, and Witzel soils. These included soils make up from 5 to 10 percent of the acreage in this mapping unit.

This Nekia soil is used for about the same crops as Nekia silty clay loam, 2 to 7 percent slopes, except that sweet corn is not grown. Row crops are grown on a small acreage but it is difficult to till and irrigate them. Mechanical harvesting of vegetables and berries is not feasible. (Capability unit IIIe-2; woodland suitability group 3c1)

Nekia silty clay loam, 20 to 30 percent slopes (NeE).-On steep breaks a few small areas of this soil are stony and rock crops out in places. Runoff is rapid, and the hazard of erosion is severe.

Included with this soil in mapping were areas of Witzel soils. These included areas make up about 5 percent of the acreage in the mapping unit.

This Nekia soil is used mainly for small grains, pasture, hay, and grass grown for seed, but a small acreage is used for strawberries, for cherries, or as woodland. The crops

Figure 8.-Irrigated sweet corn on Nekia silty clay loam, 2 to 7 percent slopes, near Stayton.

are difficult to cultivate and to harvest. If row crops are grown, practices required to prevent excessive soil losses are difficult to apply without damaging the crop. (Capability unit IVe-1; woodland suitability group 3c1)

Nekia silty clay loam, 30 to 50 percent slopes (NeF).-In a few places, this soil contains small stony areas that lie below tile few areas of rock outcrop. Runoff is rapid or very rapid, and the hazard of erosion is severe.

Included with this soil in mapping were areas of Witzel soils. These included areas make up less than 5 percent of the acreage in the snapping unit.

This Nekia soil is used mainly for pasture or as woodland. (Capability unit VIe-2,; woodland suitability group 3c3)

Nekia stony silty clay loam, 2 to 12 percent slopes (NkC).-This soil has a profile similar to the one described for Nekia silty clay loam, 2 to 7 percent slopes, except that the surface layer is stony and bedrock crops out in a few places. The stones hinder tillage and make this soil slightly droughty. The available water capacity is 2 1/2 to 7 inches. Runoff is medium, and erosion is a moderate hazard.

Included with this soil in mapping were areas of Witzel soils. These included areas make up from 5 to 10 percent of the acreage in this mapping unit.

This Nekia soil is used for about the same crops as Nekia silty clay loam, 2 to 7 percent slopes, but irrigation and tillage of row crops are more difficult. Mechanical harvesting of vegetables and berries is feasible where the slopes are less than 5 percent. (Capability unit IIIe-4; woodland suitability group 3c1)

Nekia very stony silty clay loam, 2 to 30 percent slopes (NsE).-This soil has a profile similar to the one described for Nekia silty clay loam, 2 to 7 percent slopes, except that the surface layer is very stony and rock outcrops are common. The available water capacity is 2 1/2 to 5 1/2, inches. Runoff is medium, and the hazard of erosion is slight to moderate.

Included with this soil in mapping were areas of Witzel soils. These included areas make up from 10 to 15 percent of the acreage in this mapping unit.

This Nekia soil is not suited to cultivated crops, and it is used mainly for woodland-grass pasture and as woodland. The wooded areas are within or adjacent to fields where grass is grown for seed. When these fields are burned over each year, extreme care is necessary to protect the wooded areas from fire. (Capability unit VIs-1 ; woodland suitability group 3c2)

Nekia very stony silty clay loam, 30 to 50 percent slopes (NsF).-This soil has a profile similar to the one; described for Nekia silty clay loam, 2 to 7 percent slopes, except that the surface layer is very stony and rock outcrops are common. Runoff is rapid, and the hazard of erosion is severe.

Included with this soil in mapping were areas of Witzel soils. These included areas make up from 5 to 10 percent of the acreage in this mapping unit.

This Nekia soil is not suited to cultivated crops, and it is used mainly as woodland and for woodland-grass pasture. The wooded areas are within or adjacent to fields where grass is grown for seed. When these fields are burned over each year, extreme care is necessary to protect the wooded areas from fire. (Capability unit VIs-1; woodland suitability group 3c3)

Newberg Series

The Newberg series consists of somewhat excessively drained soils that have formed in mixed alluvium over sandy or gravelly material. These soils are on flood plains that are traversed by old, meandering overflow channels and sloughs, and they are subject to frequent overflow. Slopes range from 0 to 3 percent, and elevations range from 100 to 650 feet. The average annual precipitation is between 40 and 45 inches, the average annual air temperature is 52° to 54° F., and the length of the frost-free season is 200 to 210 days. In areas that are not cultivated, the vegetation is mainly ash, oak, Douglas-fir willow, rose, blackberry, annual grasses, and weeds. Newberg soils are associated with Cloquato, Chehalis, and Camas soils.

In a typical profile, the surface layer is very dark grayish-brown fine sandy loam about 10 inches thick. The substratum, just beneath the surface layer, is dark yellowish-brown sandy loam that extends to a depth of 60 inches or more.

The Newberg soils are used mainly for small grains, orchards, pasture, row crops, and grass grown for seed.

Newberg fine sandy loam (Nu).-This soil is along the channels of Butte Creek and the Willamette, Pudding, and Santiam Rivers.

Representative profile (NE1/4SE1/4 sec. 24, T. 9 S., R. 2 W.).

Ap-0 to 10 inches, very dark grayish-brown (10YR 3/2) fine sandy loam, grayish brown (10YR 5/2) when dry; weak, medium and fine, subangular blocky structure; very friable, soft, nonsticky and nonplastic; many, fine and very fine, tubular pores; many roots; medium acid (pH 6.0); clear, smooth boundary. (7 to 12 inches thick.)

C-10 to 60 inches, dark yellowish-brown (10YR 3/4) sandy loam, grayish brown (10YR 5/2) when dry; massive; very friable, soft, nonsticky and nonplastic; many roots; many, fine, interstitial pores; neutral (pH 6.6).

Texture of the A horizon ranges from fine sandy loam to silt loam. When the soil is moist, the color of the A horizon is as dark or darker than dark brown. Color of the C horizon ranges from dark grayish brown to dark yellowish brown. In some places the C horizon is structureless, and in others it has weak, subangular blocky structure. Depth to sand and gravel is more than 40 inches. In some areas as much as 15 percent of the material between depths of 10 and 40 inches is coarse fragments.

Included with this soil in mapping were small areas that have a few pebbles in the surface layer and that have a gravelly subsoil. Also included were small areas of Camas, Cloquato, and Chehalis soils.

The available water capacity is 5 to 7 inches. Permeability is moderately rapid, and fertility is moderate. Roots can penetrate to a depth of 5 feet or more. Runoff is slow, and the hazard of erosion is moderate. Even where management is poor, workability of this soil is excellent, for the texture and structure of the soil material are difficult to change.

This soil is well suited to small grains, orchards, pasture, and grass grown for seed, and it is used mainly for those crops. When irrigated, it is used for all the crops commonly grown in the survey area. (Capability unit IIw-4; not placed in a woodland suitability group)

Newberg silt loam (Nw).-This soil has a profile similar to the one described for Newberg fine sandy loam, except that the surface layer is finer textured and is dark brown. Because of this finer texture of the surface layer, the range of moisture content within which this soil can be satisfactorily worked is narrower than for Newberg fine sandy loam. Also, the infiltration rate is reduced, and movement of water is slower through the surface layer to the coarser textured material below. The available water capacity is 6 to 7 inches.

This soil is used for about the same crops as Newberg fine sandy loam, except that it is not used for crops that are harvested late in fall. Irrigation is difficult because areas of this soil are small and are within larger areas of Cloquato and Chehalis soils. (Capability unit IIw-6; not placed in a woodland suitability group)

Salem Series

The Salem series consists of well-drained soils that are nearly level. These soils have formed in gravelly alluvium that is of mixed mineralogy and contains a large amount of basaltic pebbles. They occur on terraces at elevations of 100 to 600 feet. The average annual precipitation is 40 to 45 inches, the average annual air temperature is 52° to 54° F., and the length of the frost-free season is 200 to 210 days. In areas that are not cultivated, the vegetation is mainly Douglas-fir, oak, maple, wild rose, and grasses. Salem soils are associated with Sifton and Clackamas soils.

In a typical profile, the surface layer is very dark brown gravelly silt loam about 9 inches thick. The subsoil is about 21 inches thick and is very dark brown gravelly silty clay loam in the upper part and is dark-brown gravelly clay loam in the lower part. The substratum is grayish-brown very gravelly sand that extends to a depth of 60 inches or more.

The Salem soils are used mainly for small grains, pasture, vegetables, orchards, and berries.

Salem gravelly silt loam (Sa).-This is the only soil of the Salem series mapped in the survey area. It is along the margins of gravelly terraces, adjacent to the alluvial bottoms of the North Santiam and Santiam Rivers.

Representative profile 100 feet south of the Marion to West Stayton highway (SE1/4NW1/4SW1/4 sec. 14, T. 9 S., R. 2 W.) .

Ap-0 to 9 inches, very dark brown (10YR 2/2) gravelly silty loam, dark grayish brown (10YR 4/2) when dry; cloddy and has weak, medium and fine, subangular blocky structure; friable, slightly hard, slightly sticky and slightly plastic; many roots; many, very fine, tubular pores; 15 percent pebbles; slightly acid (pH 6.2); gradual, smooth boundary. (6 to 12 inches thick.)

B2t-9 to 18 inches, very dark brown (10YR 2/2) gravelly silty clay loam, brown (10YR 4/3) when dry; moderate, medium, subangular blocky structure; friable, hard, sticky and plastic; many roots; many, fine and very fine, tubular pores; 15 percent pebbles; few thin and moderately thick clay films; slightly acid (pH 6.4); abrupt, smooth boundary. (8 to 20 inches thick.)

B3t-18 to 30 inches, dark-brown (10YR 3/3) gravelly clay loam; brown (10YR 5/3) when dry; massive; firm, hard, slightly sticky and plastic; common roots; common, fine and very fine, tubular pores; thin clay coatings on sand grains; 45 percent pebbles; neutral (pH 6.6) ; clear, smooth boundary. (0 to 14 inches thick.)

IIC-30 to 60 inches, grayish-brown (10YR 5/2) very gravelly sand, pale brown (10YR 6/3) when dry; single grain; very friable, loose, nonsticky and nonplastic; few roots; many, medium, interstitial pores; 60 percent pebbles; slightly acid (pH 6.2) ; many feet thick.

Texture of the A horizon ranges from gravelly silt loam to gravelly loam. Texture of the B horizon ranges from gravelly clay loam to gravelly silty clay loam. The content of pebbles and cobblestones in the A and B horizons ranges from 10 to 50 percent, but it is less than 35 percent in most places. In the C horizon, the content of coarse fragments, mostly pebbles, ranges from 35 to 80 percent. Depth to the very gravelly sand of the C horizon ranges from 20 to 40 inches.

Included with this soil in mapping were small areas in which the content of pebbles in the surface layer is less than 15 percent. Also included were areas of a soil that is shallow over very gravelly sand and has a surface layer of dark-brown loam.

The available water capacity is 5 to 6 inches. Permeability and fertility are both moderate. Runoff is slow, and erosion is not a hazard. Depth to which roots can penetrate is restricted by the gravelly substratum. Workability is generally good, but some small areas that have a gravelly surface layer are hard to cultivate.

This soil is used mainly for cereal grains, pasture, caneberries, strawberries, vegetables, and orchards. Irrigation is necessary if vegetables and berries are to be grown commercially. (Capability unit IIs-1; not placed in a woodland suitability group)

Salkum Series

The Salkum series consists of well-drained soils that have formed in weathered gravelly alluvium. These soils have slopes of 0 to 20 percent. They occur on remnants of old, high terraces at elevations of 300 to 1,000 feet. The average annual precipitation is 40 to 60 inches, the average annual air temperature is 52° to 54° F., and the length of the frost-free season is 190 to 200 days. In areas that are not cultivated, the vegetation is mainly Douglas-fir, poison-oak, and rose. Salkum soils are associated with Nekia and Jory soils.

In a typical profile, the surface layer is very dark brown silty clay loam about 14 inches thick. The subsoil is dark brown and is about 26 inches thick. The upper part of the subsoil is silty clay loam, and the lower part is mottled silty clay. The upper part of the substratum is variegated light-gray, yellowish-red, brown, and strong-brown silty clay loam to a depth of about 48 inches. The lower part of the substratum is mottled, variegated strong-brown and dark-brown gravelly and cobbly clay loam or silty clay loam that extends to a depth of 65 inches or more.

The Salkum soils are used mainly for small grains, orchards, pasture, hay, and grass grown for seed.

Salkum silty clay loam, 2 to 6 percent slopes (SkB).This soil is on high terraces north of Mill Creek. The areas are between Sublimity and Aumsville.

Representative profile along the Stayton-Sublimity Highway and 35 feet east of the center of the highway (SW1/4NE1/4 sec. 3, T. 9 S., R. 1 W.)

Ap-0 to 5 inches, very dark brown (7.5YR 2/2) silty clay loam, dark brown (10YR 4/3) when dry; weak, very coarse, prismatic structure breaking to moderate, fine and very fine, granular; friable, slightly hard, plastic and sticky; abundant roots; many, fine and. very fine, interstitial pores; strongly acid (pH 5.2); abrupt, smooth boundary. (5 to 9 inches thick.)

A1-5 to 14 inches, very dark brown (7.5YR 2/2) silty clay loam, dark brown (7.5YR 4/4) when dry; weak, very coarse, prismatic structure breaking to weak, medium and coarse, subangular blocky structure that breaks, in turn, to moderate, fine and very fine, granular structure; friable, slightly hard, plastic and sticky; many roots; few thin clay films; common, very fine and fine, tubular pores; very strongly acid (pH 5.0); clear, smooth boundary. (0 to 9 inches thick.)

B1t-14 to 20 inches, dark-brown (7.5YR 4/4) heavy silty clay loam, brown (7.5YR 5/4) when dry; weak, very coarse, prismatic structure breaking to moderate, coarse and medium, subangular blocky structure; firm; slightly hard, very plastic and sticky; thin, nearly continuous clay films; common worm casts; very strongly acid (pH 5.0); clear, smooth boundary. (6 to 12 inches thick.)

B2t-20 to 29 inches, dark-brown (7.5YR 4/4) silty clay, brown (7.5YR 5/4) when dry; moderate, coarse and medium, subangular blocky structure; firm, hard, very plastic and sticky; moderately thick, continuous clay films; few, coarse, and common, fine and very fine, tubular pores; few roots; very strongly acid (pH 5.0); clear, smooth boundary. (6 to 15 inches thick.)

B3t-29 to 40 inches, dark-brown (7.5YR 4/4) silty clay, strong brown (7.5YR 5/6) when dry; few to common, fine, light-gray mottles and few, fine, strong-brown specks; weak, coarse, subangular blocky structure; firm, hard, very plastic and sticky; many thin clay films; few roots; few, fine and very fine, tubular pores; strongly acid (pH 5.2); clear, smooth boundary. (0 to 12 inches thick.)

C1-40 to 48 Inches, variegated light-gray (7.5YR 7/1), yellowish-red (5YR 4/6), brown (7.5YR 5/2), and strong brown (7.5YR 5/8) silty clay loam, reddish yellow (7.5YR 6/6) when dry; firm, very hard, plastic and sticky; thin, patchy clay films; few, fine and very fine, tubular pores; no roots; very strongly acid (pH 5.0); gradual, smooth boundary. (0 to 15 inches thick.)

IIC2-48 to 65 inches, finely variegated strong-brown (7.5YR 5/8) and dark-brown (7.5YR 3/2 and 4/4) gravelly and cobbly clay loam or silty clay loam, very pale brown (10YR 7/4) when dry; few, fine, reddish-brown mottles; massive; firm, extremely hard, plastic and sticky; no roots; very few, fine and very fine, tubular pores; thin, patchy clay films; very strongly acid (pH 5.0); the cobblestones and pebbles are so strongly weathered that they can be broken easily in the hand.

The solum ranges from 24 to 50 inches in thickness over weathered gravel, but it is more than 30 inches thick in most places. In places the A horizon is dark brown. The IIC2 horizon contains weathered pebbles of basalt and a few pebbles of hard quartzite as much as 1 inch in diameter.

Included with this soil in mapping were small areas of Nekia and Jory soils.

The available water capacity ranges from 9 to 12 inches. Permeability is slow, and fertility is low. Runoff is slow, and the hazard of erosion is slight. Roots can penetrate to a depth of 4 to 5 feet. Workability is fair, but it becomes progressively poorer as the content of moisture drops below field capacity.

This soil is used mainly for cereal grains, orchards, pasture, hay, and grass grown for seed, but a small acreage is used for strawberries, field corn, caneberries, and specialty crops. When irrigated, this soil is used for pole beans and sweet corn. (Capability unit IIe-3; woodland suitability group 3c1)

Salkum silty clay loam, 6 to 20 percent slopes (SkD).In nearly 70 percent of the acreage, this soil has slopes of less than 12 percent. Runoff is medium, and erosion is a moderate hazard. Mapped with this soil were a few areas in which the surface layer is gravelly.

This Salkum soil is used for about the same crops as Salkum silty clay loam, 2 to 6 percent slopes, but tilling the small acreage of row crops so that excessive losses of soil are prevented is more difficult on this soil. Mechanical harvesting of vegetables and berries is not feasible. (Capability unit IIIe-2; woodland suitability group 3c1)

Salkum silty clay loam, basin, 0 to 6 percent slopes (SIB).-This soil is on foot slopes and in drainageways of old, high terraces. In winter it sometimes receives additional soil material washed from higher lying soils that are not protected by a cover crop. This material is deposited in a thin layer on the surface of this soil. Fertility is moderate, and this soil is well drained. In winter and spring, however, the additional water received from higher areas causes the water table to rise to the lower part of the subsoil. In some places small areas of McAlpin, Waldo, or Stayton soils block runoff from this soil. As a result, the water table is high for short periods during storms of high intensity. Nevertheless, water moves rapidly through this soil, and wetness is not a serious hazard to crops. Included with this soil in mapping were small areas of McAlpin, Waldo, and Stayton soils.

This Salkum soil is used for about the same crops as Salkum silty clay loam, 2 to 6 percent slopes. To make this soil more suitable for strawberries, and to make farming easier, the runoff from higher areas should be intercepted and safely diverted to other areas before it reaches this soil. (Capability unit IIe-1; woodland suitability group 3c1)

Santiam Series

The Santiam series consists of moderately well drained soils that formed in silty material over weathered gravelly alluvium or weathered basalt. These soils occur on remnants of old, high terraces along the foot slopes of low, red foothills. They have slopes of 0 to 15 percent. Elevations range from 300 to 375 feet. The average annual precipitation is 40 to 45 inches, the average annual air temperature is 53° F., and the length of the frost-free season is 200 to 210 days. In areas that are not cultivated, the vegetation is mainly Douglas-fir, vine maple, poison-oak, hazel, ocean-spray, trailing blackberry, wild strawberry, thimbleberry, brackenfern, and grass. Santiam soils are associated with Silverton soils.

In a typical profile, the surface layer is dark-brown silt loam about 6 inches thick. The subsurface layer is mottled, dark-brown silt loam about 7 inches thick. The subsoil is mottled, dark yellowish-brown silty clay loam about 17 inches thick. The substratum is mottled, dark grayish-brown and brown silty clay or clay that extends to a depth of 60 inches or more.

The Santiam soils are used for small grains, orchards, pasture, vegetables, berries, and grass grown for seed. They are also used as woodland.

Santiam silt loam, 0 to 3 percent slopes (SnA).-This soil occupies terrace remnants along the foot slopes of the Salem, Waldo, and Silverton Hills. It is adjacent to the valley floor.

Representative profile 15 feet south of the center of a gravel road and 475 feet east of the corner of the road (NW1/4SE1/4 sec. 1, T. 10 S., R. 3 W.)

Ap-0 to 6 inches, dark-brown (10YR 3/3) silt loam, pale brown (10YR 6/3) when dry; moderate, medium and fine, granular structure; friable, slightly hard, plastic and sticky; many roots; many, very fine and fine, interstitial pores; medium acid (pH 5.6); abrupt, smooth boundary. (4 to 7 inches thick.)

A3-6 to 13 inches, dark-brown (10YR 3/3) silt loam, pale brown (10YR 6/3) when dry; contains common, fine and very fine, faint, very dark grayish-brown (10YR 3/2) mottles when moist; weak, very coarse, prismatic structure breaking to moderate, medium and fine, subangular blocky structure; friable, slightly hard, plastic and sticky; many roots; many, fine and very fine, tubular pores; few pebbles; medium acid (pH 5.6) ; abrupt, smooth boundary. (6 to 10 inches thick.)

B21t-13 to 22 inches, dark yellowish-brown (10YR 4/4) silty clay loam, pale brown (10YR 6/3) when dry; contains many, medium and fine, faint, dark grayish-brown mottles; common, fine, black stains and concretions; weak, very coarse, prismatic structure breaking to moderate, medium and fine, subangular blocky structure; friable, hard, plastic and sticky; common roots; many, fine and very fine, tubular pores; few pebbles; few thin clay films; peds thinly coated with gray silt and very fine sand; strongly acid (pH 5.4) ; gradual, wavy boundary. (6 to 10 inches thick.)

B22t-22 to 30 inches, dark yellowish-brown (10YR 4/4) heavy silty clay loam, light yellowish brown (10YR 6/4) when dry; contains common, fine and medium, faint, dark-brown (10YR 3/3) mottles and common black mottles; thick, grayish-brown (10YR 5/2), silty coatings on ped surfaces, light gray (10YR 7/2) when dry; weak, fine, prismatic structure breaking to moderate, fine and medium, subangular and angular blocky structure; firm, very hard, plastic and sticky; few roots; many, medium, fine and very fine, tubular pores; few pebbles; common, moderately thick clay films; strongly acid (pH 5.2) ; clear, smooth boundary. (8 to 14 inches thick.)

IIC-30 to 60 inches, dark grayish brown (10YR 4/2) and brown (10YR 4/3) silty clay or clay, pale brown (10YR 6/3) and light gray (10YR 7/1) when dry; few, fine, distinct, yellowish-brown (10YR 5/8) mottles; massive; firm, very hard, very plastic and very sticky; few roots; common, fine and very fine, tubular pores; medium and coarse, light-colored sand grains and few medium-sized pebbles that increase in number with depth; strongly acid (pH 5.2).

The A horizon ranges from dark brown to brown in color. The B horizon is dark brown to dark yellowish brown, and it contains mottles that range from faint to distinct in contrast. In places the color of the A and B horizons is slightly redder than shown in the typical profile. Texture of the B horizon ranges from silty clay loam to light silty clay or clay, with a weighted average of 35 to 42 percent clay. In places strongly weathered and unweathered pebbles make up as much as 15 percent, by volume, of the lower part of the B horizon. Depth to the C horizon ranges from 24 to 40 inches, and depth to bedrock is more than 40 inches. In places the C horizon consists of highly weathered basalt tuffs, or of gravelly material that has a matrix of clay.

Included with this soil in mapping were small areas that have a strong-brown surface layer, and small areas of a well-drained soil.

The available water capacity ranges from 8 to 11 inches. Permeability is moderately slow in the B horizon and slow in the C horizon. Fertility is moderate. This soil receives extra water as the result of seepage from higher areas, and it contains a perched water table in winter and spring. Runoff is slow, and erosion is not apparent. Below 22 to 30 inches, the depth to which roots can penetrate is restricted by excess moisture and by the clayey texture of the soil material. Workability is good.

When not irrigated, this soil is used mainly for small grains, orchards, pasture, and grass grown for seed, and it is also used as woodland. It is used for pole beans, sweet corn, caneberries, and strawberries when irrigated. Because of the extra moisture received as the result of seepage, this soil is not well suited to deep-rooted crops and to crops that cannot tolerate excessive moisture. (Capability unit IIw-1; not placed in a woodland suitability group)

Santiam silt loam, 3 to 6 percent slopes (SnB).-This soil has slightly better drainage than Santiam silt loam, 0 to 3 percent slopes, but it is used for about the same crops. Runoff is slow, and the hazard of erosion is slight. Drainage is needed for deep-rooted crops and for crops that cannot tolerate excessive moisture. (Capability unit IIe-1; not placed in a woodland suitability group)

Santiam silt loam, 6 to 15 percent slopes (SnC).-This soil has better drainage than Santiam silt loam, 0 to 3 percent slopes. Runoff is medium, and erosion is a moderate hazard.

This soil is used mainly for small grains, pasture, hay, and grass grown for seed, but a small acreage is used as woodland or for orchards, vegetables, and berries. Growing row crops or tilling so that excessive soil losses are prevented is difficult, and mechanical harvesting of vegetables and berries is not feasible. Drainage is needed for deep-rooted crops and for crops that cannot tolerate excessive moisture. (Capability unit IIIe-1; not placed in a woodland suitability group)

Semiahmoo Series

The Semiahmoo series consists of poorly drained organic soils that formed in partly decomposed organic material. These soils occur on the bottoms of former shallow lakes at elevations of 130 to 150 feet. The average annual precipitation is 40 to 45 inches, the average annual air temperature is 53° F., and the length of the frost-free season is 200 to 210 days. In areas that are not cultivated, the vegetation is mainly sedges, tussocks, and willows. Semiahmoo soils are associated with Labish soils.

In a typical profile, the surface layer is black muck about 9 inches thick. The next layer consists of very dark brown peaty muck about 21 inches thick. Below this is a layer of peat that extends to a depth of 60 inches or more.

The Semiahmoo soils are used mostly for growing vegetables.

Semiahmoo muck (So).-This soil is on the Labish Bottom. It is the only soil of the Semiahmoo series mapped in the survey area.

Representative profile one-fourth mile north of Labish Center, 100 feet east of road, and 200 feet south of Labish Ditch (NW1/4SW1/4 sec. 22, T. 6 S., R. 2 W.)

1-0 to 2 inches, black (10YR 2/1) muck, very dark gray (10YR 3/1) when dry; weak, very fine, granular structure; very friable, loose, nonsticky and nonplastic; many roots; many, fine, interstitial pores; medium acid (pH 6.0); abrupt, smooth boundary. (0 to 4 inches thick,)

2--2 to 9 inches, black (10YR 2/1) muck, very dark gray (10YR 3/1) when dry; weak, medium, subangular blocky structure; very friable, loose, nonsticky and nonplastic; many roots; many fine pores; medium acid (pH 6.0); clear, smooth boundary. (6 to 10 inches thick.)

3-9 to 30 inches, very dark brown (10YR 2/2) peaty muck; massive; very friable, soft, nonsticky and nonplastic; many pores; slightly acid (pH 6.2); gradual, smooth boundary. (10 to 30 inches thick.)

4-30 to 60 inches, variegated peat; massive; very friable, slightly hard, nonsticky and nonplastic; slightly acid (pH 6.4); many feet thick.

Included with this soil in mapping were small areas that have a surface layer of peaty muck; areas in which a layer of clay is at a depth of 14 to 15 inches; and areas along the boundary between the soil and mineral soils where the depth to mineral material in the substratum is less than 5 feet.

The available water capacity ranges from 13 to 30 inches. Permeability is moderate, acid fertility is high. Runoff is slow, and the hazard of erosion is moderate. The depth to which roots can penetrate is limited by the high water table. This is subject to annual flooding. Workability is excellent.

This soil is well suited to onions and to other shallow-rooted crops, and it is used mainly for growing onions. A minor acreage is used for pole beans, sweet corn, mint, pasture, hay, and blackberries. Drainage is needed to keep the water table below the root zone. (Capability unit IIIw-3; not placed in a woodland suitability group

Sifton Series

The Sifton series consists of excessively drained soils that are underlain by gravelly sand. These soils are nearly level. They occur on alluvial terraces at elevations of 100 to 600 feet. The average annual precipitation is 40 to 45 inches, the average annual air temperature is 52° to 54° F., and the length of the frost-free season is 200 to 210 days. In areas that are not cultivated, the vegetation is mainly Douglas-fir, vine maple, hazel, ocean-spray, poison-oak, blackberry, and brackenfern. Sifton soils are associated with Clackamas and Salem soils.

In a typical profile, the surface layer is black gravelly loam about 17 inches thick. The subsoil is dark-brown gravelly loam about 7 inches thick. The substratum is dark-brown very gravelly and cobbly sand that extends to a depth of 60 inches or more.

The Sifton soils are used for small grains, pasture, vegetables, and caneberries, and they are also used as woodland.

Sifton gravelly loam (St).-This is the only soil of the Sifton series map in the survey area. It is on terraces along the North Santiam River and Mill Creek.

Representative profile beside old farm buildings (SE1/4SW1/4 sec. 6, T. 9 S., R. 1 W.)

Ap-0 to 7 inches, black (10YR 2/1) gravelly loam, dark grayish brown (10YR 4/2) when dry; moderate, fine, granular structure-, friable, soft, slightly plastic and very slightly sticky; many roots: very many, fine and very fine, interstitial pores; high content of organic matter; neutral (pH 6.9); abrupt, smooth boundary. (4 to 8 inches thick.)

A1-7 to 17 inches, black (10YR 2/1) gravelly loam, dark grayish brown (10YR 4/2) when dry; coarse and very coarse, subangular blocky structure; friable, soft, slightly plastic and slightly sticky; common, fine, tubular pores; few roots; common worm casts; high in content of organic matter; neutral (pH 6.9); clear, wavy boundary. (4 to 12 inches thick.)

B2-17 to 24 inches, dark-brown (10YR 3/3) gravelly loam, dark brown (10YR 4/3) when dry; weak, coarse, subangular blocky structure breaking to moderate.

fine, subangular blocky structure; friable, soft, plastic and slightly sticky; many, medium, fine and very fine, tubular pores; few roots; slightly acid (pH 6.2); gradual, wavy boundary. (7 to 10 inches thick.)

IIC-24 to 60 inches, dark-brown (10YR 4/3) very gravelly and cobbly sand that is mostly of basaltic origin, brown (10Y R 5/3) when dry; massive; loose, nonsticky and nonplastic; medium acid; most of the soil material and fragments of basalt are at least moderately magnetic.

Color of the A horizon ranges from black to very dark brown. In places the A horizon is gravelly silt loam, and in some places the B horizon is gravelly very fine sandy loam. Pebbles and cobblestones in the solum constitute from 25 to 40 percent of the soil mass in some areas. Depth to the very gravelly material in the substratum ranges from 20 to 30 inches.

Included with this soil in mapping were small areas of Clackamas soils and small areas of cobbly, brown soils.

The available water capacity is 4 to 5 inches. Permeability is moderately rapid in the solum and very rapid in the substratum. Fertility is low. Runoff is very slow, and erosion is not a hazard. Roots can penetrate to depths of only 20 to 30 inches. Workability is only fair because of the gravel in the surface layer. Even though this soil is intensively used, it does not become compacted and the rate of infiltration remains high.

This soil is used mainly as woodland and for cereal grains, pasture, pole beans, bush beans, sweet corn, and caneberries. When irrigated, it is well suited to forage crops and other crops that require little cultivation. This soil is poorly suited to root crops, and it is unsuitable for mechanical harvesting of root crops. Tillage is hindered by the gravel in the surface layer. Irrigation is needed for adequate growth of most crops. It is essential for growing vegetables and berries, and for extending the use of pastures during the dry, warm summers. (Capability unit IIIs-1; not placed in a woodland suitability group)

Silverton Series

The Silverton series consists of well-drained soils that have formed in silty material over fine-textured material that contains gravel. These soils are on dissected terraces or on the foot slopes of low foothills. They have slopes of 2 to 20 percent. Elevations range. from 225 to 300 feet. The average annual precipitation is 40 to 45 inches, the average annual air temperature is 52° to 54° F., and the length of the frost-free season is 200 to 210 days. In areas that are not cultivated, the vegetation is mainly Douglas-fir, vine maple, hazel, poison-oak, ocean-spray, thimbleberry, blackberry, strawberry, pathfinder, brackenfern, and bentgrass. Silverton soils are associated with Santiam and Nekia soils.

In a typical profile, the surface layer is dark-brown silt loam about 7 inches thick. The subsurface layer is dark-brown heavy silt loam about 9 inches thick: The upper part of the subsoil consists of a layer of dark-brown silty clay loam about 9 inches thick. The lower part of the subsoil is dark-brown gravelly silty clay about 12 inches thick. The substratum is fractured and partly weathered, consolidated basalt bedrock.

The Silverton soils are used mainly as woodland and for pasture, hay, orchards, caneberries, and grass grown for seed.

Silverton silt loam, 2 to 12 percent slopes (SuC).-This soil occupies remnants of old, high terraces along the foot slopes of low foothills. It is in areas adjacent to the terraces of Willamette silts.

Representative profile 2,640 feet south of the city limits of Silverton and 65 feet west of the highway that leads from Silverton to Stayton (in northeast corner of SW1/4NW1/4 sec. 3, T. 7 S., R.1 W.)

Ap-0 to 7 inches, dark-brown (10YR 3/3) silt loam, yellowish brown (10YR 5/4) when dry; moderate, medium, subangular blocky structure breaking to moderate, very fine, granular structure; friable, slightly hard, slightly plastic and slightly sticky; many roots; many interstitial pores; few, medium and fine, distinct, black concretions; medium acid (pH 5.8) ; clear, smooth boundary. (6 to 8 inches thick.)

A3-7 to 16 inches, dark-brown (7.5YR 3/3) heavy silt loam, brown (7.5YR 5/4) when dry; weak, medium, subangular blocky structure breaking to moderate, fine and very fine, subangular blocky structure; friable, slightly hard, slightly plastic and slightly sticky; many roots; many interstitial pores, and many, very fine, tubular pores; common gray coatings of silt on some vertical surfaces of peds; few, medium and fine, dark-colored concretions; common, medium, black sand grains; 3 percent, by volume, fine pebbles; medium acid (pH 6.0) ; clear, smooth boundary. (4 to 10 inches thick.)

B21t-16 to 25 inches, dark-brown (7.5YR 3/3) silty clay grains; 3 percent, by volume, fine pebbles; medium loam, brown (7.5YR 5/4) when dry; moderate, fine and very fine, subangular blocky structure; firm, hard, plastic and sticky; many roots; few coatings of silt on the surfaces of peds; many, fine and very fine, tubular pores; few thin clay films in pores; common, medium and fine, dark-colored concretions; common, medium, black sand grains; 3 percent, by volume, fine pebbles and cobblestones; medium acid (pH 5.9); clear, wavy boundary. (5 to 12 inches thick.)

IIB22t-25 to 37 inches, dark-brown (7.5YR 4/3) gravelly silty clay, light brown (7.5YR 6/4) when dry; moderate, medium, subangular blocky structure breaking to strong, very fine, subangular blocky structure; firm, very hard, plastic and sticky; few roots; many, fine and very fine, tubular pores; thin, nearly continuous clay films; common coarse and medium sand grains; 20 percent, by volume, pebbles and partly weathered cobblestones; medium acid (pH 5.8); abrupt, wavy boundary. (5 to 15 inches thick.)

IIIR-37 inches, fractured and partly weathered, consolidated basalt bedrock.

Depth to the nonconforming IIB22t horizon ranges from 15 to 30 inches. As much as 50 percent of this horizon is coarse fragments that are mostly strongly weathered. Depth to weathered basalt ranges from 20 to 40 inches, but it is more than 30 inches in most places.

Included with this soil in mapping were small areas of Jory and Nekia soils.

The available water capacity is 5 to 7 inches. Permeability is moderately slow, and fertility is moderate. Runoff is slow, and the hazard of erosion is slight. Roots can penetrate to depths of 20 to 40 inches. Workability is generally good, but it is variable where this soil is near areas of Jory and Nekia soils.

This soil is used mainly as woodland and for pasture, orchards, caneberries, and grass grown for seed. When irrigated, a small acreage is used for strawberries, sweet corn, and pole beans. (Capability unit IIe-3; woodland suitability group 3c1)

Silverton silt loam, 12 to 20 percent slopes (SuD).Runoff from this soil is medium, and erosion is a moderate hazard. Included in mapping were small areas of Witzel soils.

This Silverton soil is used mainly for small grains, pasture, hay, and grass grown for seed, but a small acreage is used for strawberries, for cherries, or as woodland. Crops are difficult to cultivate and harvest. Cultivation and harvesting of row crops require practices that are difficult to apply without causing excessive soil losses and damage to the crops. The strong slopes and the water received from higher areas intensify the hazard of erosion. (Capability unit IIIe-2; woodland suitability group 3c1)

Stayton Series

The Stayton series consists of well-drained soils that have formed in alluvium underlain by basalt. These soils are on foot slopes and in drainageways of the red foothills. They have slopes of 0 to 7 percent. Elevations range from 250 to 1,200 feet. The average annual precipitation is 40 to 60 inches, the average annual air temperature is 50° to 53° F., and the length of the frost-free season is 190 to 210 days. In areas that are not cultivated, the vegetation is mainly oak, vine maple, sedges, and grass. Stayton soils are associated with Nekia and Jory soils.

In a typical profile, the surface layer is black silt loam about 17 inches thick. Just below the surface layer is a layer of dark reddish-brown silt loam about 3 inches thick. Hard basalt bedrock is at a depth of about 20 inches.

The Stayton soils are used mainly for pasture, for grass grown for seed, and as woodland.

Stayton silt loam, 0 to 7 percent slopes (SvB).-This soil is in drainageways and on foot slopes of the red foothills. It is the only soil of the Stayton series mapped in the survey area.

Representative profile 150 to 200 yards north of Drift Creek where that creek flows under Drift Creek Road; about 1 1/2 miles south of Drift Creek Falls (NW1/4SW1/4 see. 17, T. 8 S., R.1 E.)

A11-0 to 12 inches, black (5YR 2/1) silt loam, dark reddish brown (5YR 3/3) when dry; moderate, very fine, granular structure; very friable, slightly hard, slightly sticky and slightly plastic; plentiful roots; many, very fine, interstitial pores; medium acid (pH 5.6); gradual wavy boundary. (7 to 14 inches thick.)

A12-12 to 17 inches, black (5YR 2/1) silt loam, dark reddish brown (5YR 3/3) when dry; weak, very fine and fine, subangular blocky structure; friable, slightly hard, slightly sticky and slightly plastic; plentiful roots; few fine pores and common very fine pores; medium acid (pH 5.8); clear, wavy boundary. (3 to 8 inches thick.)

AC-17 to 20 inches, dark reddish-brown (5YR 3/2) silt loam, reddish brown (5YR 4/4) when dry; weak, medium, subangular blocky structure; friable, slightly hard, slightly sticky and slightly plastic; common fine roots; few medium pores and common very fine pores; medium acid (pH 5.8); abrupt, wavy boundary. (0 to 6 inches thick.)

IIR-20 inches, hard basalt bedrock.

Color of the A horizon ranges from black to very dark brown. Depth to bedrock ranges from 15 to 20 inches. Where the solum is shallowest over bedrock, the AC horizon is thin or absent. Where the profile lacks an AC horizon, the A horizon rests directly on bedrock. In places bedrock crops out at the surface. A few fragments of rock the size of pebbles are scattered throughout the solum.

The available water capacity ranges from 2 to 4 inches. Permeability and fertility are both moderate. Runoff is medium, and erosion is a moderate hazard. Roots can penetrate to a depth of only 15 to 20 inches.

This soil is used for pasture, for grass grown for seed, and as woodland. It is well suited to forage plants grown for pasture and to early maturing grasses grown for seed. This soil is droughty, however, and forage plants grow well only in spring. (Capability unit VIe-1; not placed in a woodland suitability group)

Steiwer Series

The Steiwer series consists of well-drained soils on foot slopes and on low foothills. These soils have formed in a thin mantle of material consisting partly of silty alluvium and colluvium and partly of sedimentary material derived from the underlying bedrock. They have slopes of 3 to 40 percent. Elevations range from 250 to 650 feet. The average annual precipitation is between 40 and 60 inches, the average annual air temperature is 52° to 54° F., and the length of the frost-free season is 190 to 210 days. In areas that are not cultivated, the vegetation is mainly oak, wild rose, poison-oak, annual bromegrass, and velvetgrass. Steiwer soils are associated with Chehulpum and Hazelair soils.

In a typical profile, the surface layer is about 17 inches thick and consists of very dark brown silt loam in the upper part and of very dark grayish-brown silt loam in the lower part. A subsurface layer of dark-brown silt loam, about 4 inches thick, is just beneath the surface layer. The subsoil is dark yellowish-brown silty clay loam about 11 inches thick. Fine-grained sandstone is at a depth of about 32 inches.

Steiwer soils are used mainly as woodland and for small grains, pasture, hay, and grass grown for seed.

Steiwer silt loam, 3 to 6 percent slopes (SwB).-This soil is on low foothills and on foot slopes of the Salem and Waldo Hills.

Representative profile in a field just south of a barn, about 30 feet south of the center of a road (NW1/4NE1/4 sec. 25, T. 9 S., R. 3 W.)

Ap1-0 to 5 inches, very dark brown (10YR 2/2) silt loam, grayish brown (10YR 5/2) when dry; cloddy, breaking to very weak, coarse, granular structure; friable, hard, slightly plastic and slightly sticky; common roots; many interstitial pores; many wormholes and worm casts; common, very fine, black concretions; common very fine fragments of weathered rock; medium acid (pH 5.6); abrupt, smooth boundary. (4 to 8 inches thick.)

Ap2--5 to 8 inches, very dark brown (10YR 2/2) silt loam, grayish brown (10YR 5/2) when dry; massive, breaking to very weak, coarse, subangular blocky structure; friable, hard, slightly plastic and slightly sticky; few, very fine and fine, tubular pores; common, very fine, black concretions; common fine fragments of weathered rock; medium acid (pH 5.9); clear, smooth boundary. (0 to 4 inches thick.)

A1-8 to 17 inches, very dark grayish-brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) when dry; weak, medium, prismatic structure and moderate to strong, coarse and medium, subangular blocky structure; very friable, slightly hard, slightly plastic and slightly sticky; few roots; common, very fine and fine, tubular pores; very few, fine, black concretions; medium acid (pH 5.9); clear, smooth boundary. (0 to 10 inches thick.)

A3--17 to 21 inches, dark-brown (10YR 3/3) silt loam; pale brown (10YR 6/3) when dry; weak, coarse, prismatic structure and moderate, medium, subangular blocky structure; very friable, slightly hard, slightly plastic and slightly sticky; few roots; common, very fine and fine, tubular pores; medium acid (pH 5.8); clear, smooth boundary. (0 to 8 inches thick.)

B21-21 to 29 inches, dark yellowish-brown (10YR 4/4) silty clay loam, light yellowish brown (10YR 6/4) when dry; weak, coarse, prismatic structure breaking to moderate, coarse and medium, subangular blocky structure; firm, hard, plastic and sticky; few roots; many, very fine and fine, tubular pores; dark grayish-brown (10YR 4/2) coatings on ped surfaces; few, fine, black concretions; common medium and fine fragments of sandstone; medium acid (pH 5.9); clear, smooth boundary. (6 to 15 inches thick.)

B22-29 to 32 inches, dark yellowish-brown (10YR 4/4) silty clay loam, light yellowish brown (10YR 6/4) when dry; weak, medium, prismatic structure breaking to moderate, medium, subangular blocky structure; firm, hard, plastic and sticky; few roots; many, very fine and fine, tubular pores; dark grayish-brown (10YR 4/2) coatings on ped surfaces; few very fine concretions; many, coarse, medium and fine fragments of sandstone; slightly acid (pH 6.2); abrupt, wavy boundary. (3 to 12 inches thick.)

R-32 inches, dark yellowish-brown (10YR 4/4), hard, fractured, fine-grained sandstone that is horizontally bedded.

When the soil is moist, color of the A horizon ranges from very dark grayish brown to very dark brown or dark brown, and color of the B horizon ranges from dark brown to dark yellowish brown. Texture of the A horizon ranges from silt loam to silty clay loam, and texture of the B horizon ranges from clay loam to heavy silty clay loam. The number of fragments of siltstone, sandstone, and shale ranges from few in the upper part of the solum to many (as much as 30 percent) in the lower part of the B horizon. Depth to sedimentary bedrock ranges from 20 to 40 inches, but the depth is generally between 24 and 32 inches. Where bedrock is at the greatest depth, these soils contain a clayey horizon, as much as 4 inches thick, that lies just above the bedrock.

Included with this soil in mapping were small areas of Hazelair soils.

The available water capacity ranges from 4 to 8 inches. Permeability is moderately slow, and fertility is moderate. Runoff is slow, and the hazard of erosion is slight. Roots can penetrate to a depth of 20 to 40 inches.

This soil is well suited to winter cereal grains, forage crops, and early maturing grasses grown for seed. It is used mainly for those crops and for improved or woodland-grass pasture. The small irrigated acreage is used to grow pole beans, sweet corn, blackberries, and strawberries. (Capability unit IIIe-3; not placed in a woodland suitability group)

Steiwer silt loam, 6 to 20 percent slopes (SwD).-This soil has slopes that are mainly steeper than 12 percent. Runoff is medium, and the hazard of erosion is moderate. Included in mapping were some areas of sandstone outcrops, and small areas of Chehulpum soils.

This Steiwer soil is used mainly for small grains, grass grown for seed, cleared pasture, hay, and woodland pasture. (Capability unit IVe-2; not placed in a woodland suitability group)

Steiwer and Chehulpum silt loams, 3 to 40 percent slopes (SCE).-This undifferentiated unit consists of gently sloping to steep Steiwer and Chehulpum soils that are moderately deep and shallow over bedrock. Some areas consist wholly of Steiwer soils, others consist wholly of Chehulpum soils, and still others consist of both soils. The soils are on foot slopes and foothills. In areas that are not cultivated, the vegetation is mainly velvetgrass, annual bromegrass, poison-oak, rose, and oak trees.

The profile of the Steiwer soil is similar to the one described as typical for Steiwer silt loam, 3 to 6 percent slopes, except that bedrock is at a depth of only 20 to 24 inches. A representative profile of the Chehulpum soil follows

Representative profile 25 feet south of county road NE1/4NE1/4NE1/4 sec. 25, T. 9 S., R,. 2 W.)

01&02-1/2 inch to 0, grass and leaves in varying degrees of decomposition.

A11-0 to 4 inches, very dark brown (10YR 2/2) silt loam, dark grayish brown (10YR 4/2) when dry; moderate, medium, subangular blocky and moderate, fine, granular structure; friable, slightly hard, sticky and plastic; many roots; many, very fine, interstitial and tubular pores; medium acid (pH 5.9) ; clear, smooth boundary. (2 to 6 inches thick.)

A12-4 to 12 inches, very dark brown (10YR 2/2) silt loam, dark grayish brown (10YR 4/2) when dry; moderate, medium and fine, subangular blocky structure; friable, hard, sticky and plastic; many roots; many, very fine and fine, tubular pores; common fine fragments of sandstone; medium acid (pH 5.9); abrupt, smooth boundary. (6 to 14 inches thick.)

IIR-12 inches, horizontally bedded, fine-grained sandstone.

Texture throughout the profile ranges from silt loam to loam., In places the A horizon is dark brown. Depth to bedrock ranges from 10 to 20 inches.

Included with these soils in mapping were small areas of Hazelair, Witzel, and Nekia soils, and many areas of rock outcrops.

The available water capacity of the Steiwer soil of this undifferentiated unit is 4 to 5 inches, and that of the Chehulpum soil is 2 to 4 inches. Permeability of the Steiwer soil is moderately slow, and that of the Chehulpum soil is moderate. Runoff is medium to rapid, and the hazard of erosion is severe. Roots can penetrate to a depth of 20 to 24 inches in the Steiwer soil, but to a depth of only 10 to 20 inches in the Chehulpum soil.

This undifferentiated unit is mainly in native pasture (fig. 9) and in wooded areas. Most of the forage is produced in spring, for the forage plants make little growth in summer and fall. These soils are not suited to Douglas-fir. Douglas-fir grows only where additional soil material has been deposited on the surface of these soils, or it grows on deeper included soils. (Capability unit VIe-1; not placed in a woodland suitability group)

Stony Rock Land

Stony rock land (Sy) is a miscellaneous land type in which 25 percent or more of the acreage is nearly bare and very stony or consists of outcrops of basalt. This land type is nearly level to very steep. Except where some areas have a sparse cover of forage plants or of stunted trees that grow where there are small pockets of soil material, the land has no value for farming. (Capability unit VIIIs-1; not placed in a woodland suitability group)

Terrace Escarpments

Terrace escarpments (Te) consists of gravelly and silty alluvium that is too variable in characteristics to be classified as soil. It is moderately steep or steep and occurs along the sidewalls of the major streams, on terrace scarps, and on the side slopes bordering channels of intermittent streams. The vegetation is mainly Douglas-fir, maple, hazel, swordfern, brackenfern, poison-oak, tussock, sedges, and grasses.

This land type is suitable for pasture and for use as woodland. The short, steep slopes make tillage impracticable. (Capability unit VIe-2; not placed in a woodland suitability group

Waldo Series

The Waldo series consists of poorly drained soils that have formed in alluvium. These soils are nearly level. They are on bottom lands along small streams and in drainageways that dissect low foothills. Elevations range from 250 to 1,000 feet. The average annual precipitation is 40 to 60 inches, the average annual air temperature is 52° to 54° F., and the length of the frost-free season is 190 to 210 days. In areas that are not cultivated, the vegetation is mainly sedges, grasses, willow, cottonwood, ash, and oak. Waldo soils are associated with Abiqua and McAlpin soils.

In a typical profile, the surface layer is very dark grayish-brown silty clay loam that is mottled in the lower part and is about 10 inches thick. The subsoil is mottled throughout and is about 36 inches thick. It is very dark grayish-brown clay in the upper part, dark-gray clay in the middle part, and gray silty clay in the lower part. The substratum is mottled gray silty clay that extends to a depth of 60 inches or more.

The Waldo soils are used mainly for small grains, pasture, and grass grown for seed.

Waldo silty clay loam (Wa).-This is the only soil of the Waldo series mapped in the survey area. It occupies narrow strips along small streams and in drainageways of the Salem, Waldo, and Silverton Hills.

Representative profile 475 feet west and 175 feet south of the center of a gravel road that crosses over Beaver Creek (SE1/4NE1/4 sec. 29, T. 8 S., R. 1 W.)

Ap1-0 to 2 inches, very dark grayish-brown (10YR 3/2) silty clay loam, grayish brown (10YR 4/2) when dry; moderate, very fine, granular structure; friable, slightly hard, plastic and sticky; many interstitial pores; many, fine, reddish-brown and black concretions; medium acid (pH 5.6); abrupt, smooth boundary. (0 to 3 inches thick.)

Ap2-2 to 7 inches, very dark grayish-brown (10YR 3/2) silty clay loam, grayish brown (10YR 4/2) when dry; cloddy, breaking to very weak, fine, granular structure; very firm, very hard, plastic and sticky; few roots; few interstitial and very fine, tubular pores; many, fine, reddish-brown and black concretions ; medium acid (pH 5.7) ; abrupt, smooth boundary. (4 to 7 inches thick.)

A1-7 to 10 inches, very dark grayish-brown (10YR, 3/2) silty clay loam, dark grayish brown (10YR 4/2) when dry; common, medium, distinct, dark gray (10YR 4/1), very dark gray (10YR 3/1), and red (2.5YR 4/8) mottles; strong, medium and fine, granular structure; friable, hard, plastic and sticky; common roots; many interstitial pores; many, coarse, medium and fine, reddish-brown and black concretions; medium acid (pH 5.8); abrupt, wavy boundary. (2 to 4 inches thick.)

B1-10 to 15 inches, very dark grayish-brown (10YR 3/2) clay, gray (10YR 5/1) when dry; common, medium, distinct, very dark gray (10YR 3/1) and yellowish-red (5YR 5/8) mottles; strong, coarse, subangular blocky structure breaking to strong, very fine, subangular blocky structure; firm, very hard, very plastic and very sticky; common roots; many, very fine and fine, tubular pores; ; thin coatings of silt on the surfaces of peds ; many, fine and very fine, reddish-brown and black concretions; slightly acid (pH 6.1); clear, wavy boundary. (3 to 8 inches thick.)

B21g-15 to 23 inches, dark-gray (N 4/0) clay, gray (N 5/0) when dry; common, medium, distinct, strong-brown (7.5YR 5/8) mottles; strong prismatic structure breaking to strong, coarse, subangular blocky structure; very firm, very hard, very plastic and very sticky; common roots; many, very fine and fine. tubular pores; thin coatings of silt on the surfaces of peds; many, fine, reddish-brown and black concretions; medium acid (pH 5.9); clear, smooth boundary. (6 to 10 inches thick.)

B22g-23 to 37 inches, dark-gray (N 4/0) clay, gray (N 5/0) when dry; many, medium, prominent, strong-brown (7.5YR 5/8) mottles; strong prismatic structure breaking to moderate coarse, subangular blocky structure; firm, very hard, very plastic and very sticky; common roots; many, very fine and fine, tubular pores; few, fine, reddish-brown and black concretions; medium acid (pH 5.8) gradual, smooth boundary.

B3g-37 to 146 inches, gray (N 5/0) silty clay, gray (N 6/0) when dry; many, prominent, strong-brown (7.5YR 5/8) and yellowish-red (5YR 4/8) mottles; weak, coarse, subangular blocky structure; firm, very hard, very plastic and very sticky; few roots; few, very fine, tubular pores; few, moderately thick, gray clay films in the larger pores; few, fine, reddish-brown and black concretions; medium acid (pH 5.7); gradual, smooth boundary. (6 to 12 inches thick.)

Cg-46 to 60 inches, gray (N 5/0) silty clay, gray (N 6/0) when dry; many, medium, prominent, strong-brown (7.5YR 5/8) mottles; massive; friable, very hard, very plastic and very sticky; very few roots; common, very fine, and very few, medium, tubular pores; thick, continuous clay films in cracks, pores, and root channels; few, medium, black concretions; medium acid (pH 5.7).

In the A horizon and the upper part of the B horizon, thickness of the soil material that is as dark as very dark grayish brown is less than 24 inches. Color of the B horizon ranges from very dark grayish brown to gray. Structure in the B1 and B2 horizons ranges from moderate to strong prismatic and subangular blocky or blocky. Depth to the clay or silty clay of the B horizon is less than 25 inches. In some places mottling is near the surface. In others it is at a depth of as much as 15 inches.

Included with this soil in mapping were small areas of McAplin soils and small areas of very poorly drained soils.

The available water capacity is 9 to 11 inches. Permeability is slow, and fertility is moderate. Runoff is slow, and erosion is not a hazard. Depth to which roots can penetrate is limited by a seasonal high water table. Workability is fair, but it becomes progressively poorer as the content of moisture drops below field capacity.

This soil is used mainly for small grains, pasture, and grass grown for seed. When irrigated, areas that are drained are used for pole beans and sweet corn. Surface drainage and subsurface drainage are both needed, but establishing outlets is necessary in most places. Even after adequate surface drainage has been installed, subsurface drainage it still difficult. (Capability unit IIIw-2; not placed in a woodland suitability group)

Wapato Series

The Wapato series consists of poorly drained soils that have formed in mixed alluvium. These soils are nearly level. They occur in depressions and overflow channels on flood plains at elevations of 100 to 650 feet. The average annual precipitation is 40 to 45 inches, the average annual air temperature is about 53° F., and the length of the

Figure 9.-Clearing an area for pasture on Steiwer and Chehulpum silt loams, 3 to 40 percent slopes. Typical vegetation on these soils is oak trees and annual grasses.

frost-free season is 200 to 210 days. In areas that are not cultivated, the vegetation is mainly willow, ash, tussocks, sedges, and grasses. Wapato soils are associated with McBee and Bashaw soils.

In a typical profile, the surface layer is mottled very dark brown silty clay loam about 16 inches thick. The subsoil is mottled very dark grayish-brown silty clay loam about 20 inches thick. The substratum is mottled dark-brown silty clay loam that extends to a depth of 60 inches or more.

The Wapato soils are used mainly for pasture, hay, small grains, vegetables, and caneberries.

Wapato silty clay loam (Wc).-This is the only soil of the Wapato series mapped in the survey area. It occurs in backwater areas of the flood plains, in most places adjacent to the terraces.

Representatives profile (SE1/4NE1/4 sec. 15, T. 6 S., R. 1 W.).

Ap-0 to 6 inches, very dark brown (10YR 2/2) silty clay loam, very dark grayish brown (10YR 3/2) when dry; few, fine, faint, yellowish-brown (10YR 5/4) mottles; cloddy; moderate, fine, subangular blocky structure; friable, hard, sticky and plastic; many roots; common, fine, tubular pores; few reddish-brown and black concretions; slightly acid (pH 6.2); clear, smooth boundary. (6 to 9 inches thick.)

A1-6 to 16 inches, very dark brown (10YR 2/2) silty clay loam, dark grayish brown (10YR 4/2) when dry; common, fine, distinct, dark reddish-brown (5YR 3/4) mottles; moderate, medium, subangular blocky structure; firm, hard, sticky and plastic; many roots; many, fine, tubular pores; many reddish-brown concretions; slightly acid (pH 6.4); gradual, smooth boundary. (6 to 10 inches thick.)

B2-16 to 36 inches, very dark grayish-brown (10YR 3/2) silty clay loam, dark grayish brown (10YR 5/2) when dry; few, fine, faint, dark-gray (10YR 5/1) mottles; weak, coarse, subangular blocky structure; firm, hard, sticky and plastic; common roots; many, fine, tubular pores; few, fine, reddish-brown and black concretions; slightly acid (pH 6.2); clear, smooth boundary. (14 to 20 inches thick.)

C-36 to 60 inches, dark-brown (7.5YR 4/4) silty clay loam, brown (7.5YR 5/4) when dry; many, medium, prominent, grayish-brown (2.5Y 5/2) mottles; massive; friable, hard, sticky and plastic; many, fine, tubular pores; common black concretions and stains; slightly acid (pH 6.2).

Color of the A horizon ranges from very dark brown to very dark grayish brown. In places the B horizon is dark grayish brown. Texture of the B horizon ranges from silty clay loam to light silty clay. Texture of the C horizon ranges from clay loam or silty clay loam to light silty clay. In some places this soils is mottled at or near the surface. In others mottling is at depths of as much as 12 inches.

Included with this soil in mapping were small areas of better drained soils, and small areas of a soil that has a surface layer of silt loam.

The available water capacity is 10 to 12 inches. Permeability is moderately slow, and fertility is moderate. Runoff is slow and erosion is not a hazard or is only a slight hazard. The depth to which roots can penetrate is restricted by a high water table during winter and spring. Workability is good where the content of organic matter is adequate. Overflow occurs during winter and early in spring.

Undrained areas of this soil are used for pasture and hay. Drained areas are used for small grains, sweet corn, pole beans, hops, and blackberries. Irrigation is needed for vegetables to be grown commercially. It is also needed to make this soil better suited to forage plants and to extend the period during with these plants produce forage. Drainage is needed for most crops. Adequate outlets for surface runoff are needed. Subsurface tile drainage is needed to lower the water table for deep-rooted crops and to make tillage possible early in spring. Providing drain age for deep-rooted crops is of questionable value in most areas, however, for adequate drainage generally cannot be maintained during winter and spring. (Capability unit IIIw-2; not placed in a woodland suitability group)

Whetstone Series

The Whetstone series consists of well-drained soils that have formed in till -and colluvium from basalt and tuffs. These soils are on mountainous uplands. They are underlain by basalt and have slopes of 3 to 75 percent. Elevations range from 3,000 to 4,000 feet. The average annual precipitation is 70 to 90 inches, the average annual air temperature is 41° to 45° F., and the length of the frost-free season is 90 to 110 days. The vegetation is mainly noble fir, silver fir, hemlock, Douglas-fir, blue huckleberry, rhododendron, fireweed, and beargrass. Whetstone soils are associated with Henline, Kinney, and Horeb soils.

In a typical profile, the surface layer is dark-gray stony sandy loam that is only about 1 inch thick. This is covered with a thin layer of undecomposed and partly decomposed tree limbs, twigs, leaves, needles, and grass. The subsoil is about 18 inches thick, and it consists of dark reddish-brown stony loam in the upper part and of dark-brown stony loam in the lower part. The substratum is dark yellowish-brown stony loam. It is underlain by basalt bedrock at a depth of about 38 inches.

Whetstone stony loam, 3 to 25 percent slopes (WHE).-This soil occupies large areas on the middle slopes of the slopes of the Cascade Mountains. Some of the areas are steep.

Representative profile 50 feet north of a steel gate at junction of roads (NE1/4NE1/4 sec. 9, T. 8 S., R. 3 E.)

O1-4 to 2 inches, undecomposed limbs, twigs, leaves, needles, and grass.

O2-2 inches to 0, partly decomposed plant and animal matter.

A2-0 to 1 inch, dark-gray (5YR 4/1) stony sandy loam, gray (5YR 5/1) when dry; single grain; friable, soft, nonsticky and nonplastic; many, fine, interstitial pores; many roots; extremely acid (pH 4.0); abrupt, wavy boundary. (1/2 to 1 1/2 inches thick.)

B21ir-1 to 5 inches, dark reddish-brown (5YR 3/3) stony loam, reddish brown (5YR 4/4) when dry; massive; weakly cemented; firm, hard, slightly sticky and nonplastic; common roots; 20 percent, by volume, cobblestones, other stones, and pebbles; common fine and very fine pores dark coatings of iron on incipient surfaces of peds; dark reddish-brown (2.5YR 2/4) stains of organic matter; extremely acid (pH 4.2); abrupt, wavy boundary. (3 to 8 inches thick.)

B22ir-5 to 19 inches dark-brown (7.5YR 3/2) stony loam, brown (7.5YR 5/4) when dry; massive; friable, hard, slightly sticky and nonplastic; common roots; common fine and very fine pores; 30 percent, by volume, cobblestones, other stones, and pebbles; bands of iron accumulation 1 to 2 inches thick along planes of weakness of incipient surfaces of peds; many, dark reddish-brown, firm nodules 5 to 25 millimeters in diameter; very strongly acid (pH 4.6); clear, wavy boundary. (12 to 16 inches thick.)

C-19 to 38 inches, dark yellowish-brown (10YR 4/4) stony loam, brown (10YR 5/3) when dry; massive; friable, slightly hard, slightly sticky and nonplastic; few roots; common fine and very fine pores; 40 percent, by volume, cobblestones, other stones, and pebbles; very strongly acid (pH 4.6).

R-38 inches, basalt bedrock.

The A2 horizon appears to be intermittent because it has been destroyed by burning or logging in many places. It is present wherever the original surface layer is present. The B horizon ranges from dark reddish brown to dark brown in color, and it has firm or friable consistence. Thickness of the B horizon ranges from 15 to 24 inches. The content of cobblestones, other stones, and pebbles in that horizon is less than 50 percent. Depth to bedrock ranges from 20 to more than 40 inches.

Included with this soil in mapping were areas that are deeper over bedrock than typical and that have only a trace of the dark-gray surface layer remaining. Also included were areas where the dark-gray surface layer is missing. Other inclusions consist of a few rock outcrops.

The available water capacity is 3 to 6 inches. Permeability is moderate, and fertility is low. Runoff is medium, and the hazard of erosion is moderate. Roots can penetrate to a depth of 20 to 40 inches.

This soil is well suited to forest trees, and it is used mainly for growing timber. It is not suited to cultivated crops. Snow usually covers the surface in winter and early in spring. (Capability unit VIe-2; woodland suitability group 3o2)

Whetstone stony loam, 25 to 55 percent slopes (WHF).-Runoff from this soil is rapid, and the hazard of erosion is severe. Rock outcrops are common.

Included with this soil in mapping were areas of Henline soils. The included areas make up from 5 to 10 percent of the acreage in this mapping unit.

This Whetstone soil is used mainly for growing timber. (Capability unit VIe-2; woodland suitability group 3r3)

Whetstone stony loam, 55 to 75 percent slopes (WHG).-Runoff from this soil is very rapid, and the hazard of erosion is very severe. Rock outcrops are numerous, and rock escarpments are common.

Included with this soil in mapping were areas of Henline soils. The included areas make up from 10 to 15 percent of the acreage in this mapping unit.

This Whetstone soil is used mainly for growing timber. (Capability unit VIIe-1; woodland suitability group 3r4)

Willamette Series

The Willamette series consists of deep, well-drained soils that have formed in silty alluvium. These soils are on low, broad valley terraces. They have slopes of 0 to 12 percent. Elevations range from 150 to 350 feet. The average annual precipitation is 40 to 45 inches, the average annual air temperature is 50° to 54° F., and the length of the frost-free season is 200 to 210 days. In areas that are not cultivated, the vegetation is mainly oatgrass and other native grasses, hazel, blackberry, Oregon white oak, and Douglas-fir. Willamette soils are associated with Woodburn soils.

In a typical profile, the surface layer is very dark grayish-brown silt loam about 12 inches thick. A subsurface layer that also consists of very dark grayish-brown silt loam and that is about 5 inches thick is just beneath the surface layer. The upper part of the subsoil is dark-brown silt loam about 7 inches thick; the middle part of the subsoil is dark-brown silty clay loam about 14 inches thick; and the lower part is dark-brown silt loam about 16 inches thick. A substratum of dark yellowish-brown silt loam underlies the subsoil, and it extends to a depth of 65 inches or more.

The Willamette soils are used mainly for small grains, pasture, hay, orchards, berries, and vegetables.

Willamette silt loam, 0 to 3 percent slopes (WIA).-This soil is on broad valley terraces that lie between the flood plains of the North Santiam, Santiam, and Willamette Rivers and the red foothills. The areas are between Marion and Aurora.

Representative profile (NW1/4NE1/4SE1/4 sec. 22, T. 5S.,R.1W.):

Ap-0 to 6 inches, very dark grayish-brown (10YR 3/2) silt loam, dark grayish brown (10YR 4/2) when dry; moderate, medium, subangular blocky structure; friable, slightly hard, slightly sticky and slightly plastic; many roots; many, fine, tubular pores; few reddish-brown and black concretions; slightly acid (pH 6.1); clear, smooth boundary. (5 to 7 inches thick.)

A1-6 to 12 inches, very dark grayish-brown (10YR 3/2) silt loam, dark grayish brown (10YR 4/2) when dry; moderate, coarse and medium, subangular blocky structure; friable, slightly hard, slightly sticky and slightly plastic; many roots; common, very fine and fine, tubular pores; iron stains along root channels; common, fine, reddish-brown and black concretions; slightly acid (pH 6.1); clear, smooth boundary. (4 to 8 inches thick.)

A3-12 to 17 inches, very dark grayish-brown (10YR 3/2) silt loam, dark grayish brown (10YR 4/2) when dry; moderate, medium, subangular blocky structure; friable, hard, slightly sticky and slightly plastic; common roots; common, very fine and fine, tubular pores; common, medium and fine, reddish-brown and black concretions; slightly acid (pH 6.2); clear, smooth boundary. (3 to 12 inches thick.)

B1t-17 to 24 inches, dark-brown (10YR 3/3) silt loam, dark brown (10YR 4/3) when dry; moderate, medium, subangular blocky structure; friable, hard, sticky and slightly plastic; common roots; common, very fine and fine, tubular pores; few thin clay films; common, medium and fine, reddish-brown and black concretions; strong-brown (7.5YR 3/2) coatings on ped surfaces; few black stains; slightly acid (pH 6.2) ; gradual, smooth boundary. (7 to 11 inches thick.)

B2t-24 to 38 inches, dark-brown (10YR 3/3) silty clay loam, dark yellowish brown (10YR 4/4) when dry; moderate, coarse, subangular blocky structure; friable, hard, sticky and plastic; common roots; common, very fine, tubular pores; medium, continuous clay films; dark-brown (10YR 4/3) mottles and common gray coatings of silt on ped surfaces (10YR 5/1); few reddish-brown and black concretions; slightly acid (pH 6.2); gradual, smooth boundary. (10 to 14 inches thick.)

B3t-38 to 54 inches, dark-brown (10YR 3/3) silt loam, dark yellowish brown (10YR 4/4) when dry; moderate, coarse, subangular blocky structure; friable, hard, slightly sticky and slightly plastic; few roots; common, very fine, tubular pores; medium, patchy clay films; few reddish-brown and black concretions; slightly acid (pH 6.4); gradual, smooth boundary. (6 to 18 inches thick.)

C-54 to 65 inches, dark yellowish-brown (10YR 4/4) silt loam, brown (10YR 5/3) when dry; massive; friable. hard, slightly sticky and slightly plastic; common, very fine, tubular pores; slightly acid (pH 6.5).

The A horizon ranges from 15 to 25 inches in thickness and from very dark brown or dark brown to very dark grayish brown in color. The B horizon ranges from silty clay loam to silt loam in texture and from moderate or weak, medium, prismatic to moderate subangular blocky in structure. In places the B horizon contains faint mottles in the lower part, and distinct mottles below a depth of 40 inches. The C horizon is mainly silt loam or silty clay loam that is massive, but in places it contains thin layers that have other texture or structure.

Included with this soil in mapping were areas of Amity and Woodburn soils. The areas of Amity soils make up less than 2 percent of the total acreage in the mapping unit. Those of Woodburn soils make up as much as 15 percent.

The available water capacity is 12 to 14 inches. Permeability is moderate, and fertility is high. Runoff is slow, and no apparent erosion has taken place. Internal drainage is medium. Roots can penetrate to a depth of 5 feet or more.

This soil is used mainly for small grains, field corn, orchards, pasture, hay, caneberries, strawberries, and vegetables, but it is suited to all the crops commonly grown in the survey area. Irrigation makes this soil even better suited to crops, and it improves the quality of most crops. (Capability unit I-1; not placed in a woodland suitability group)

Willamette silt loam, 3 to 12 percent slopes (WIC).-This soil has slopes of 3 to 7 percent in about 70 percent of the acreage; Runoff is slow to medium, and the hazard of erosion is slight to moderate.

Included with this soil in mapping were small areas of Woodburn soils, and small areas in which slopes are as steep as 20 percent.

This Willamette soil is used mainly for small grains, pasture, hay, and orchards, but a moderate acreage is used for vegetables and berries. This soil is less suitable for vegetables and berries than Willamette silt loam, 0 to 3 percent slopes. Mechanical harvesting of crops is difficult on slopes steeper than 5 percent. (Capability unit IIe-2; not placed in a woodland suitability group)

Witzel Series

The Witzel series consists of well-drained, very stony soils on breaks in red foothills. These soils have formed partly in loess but mainly in colluvium from basic igneous rock. They have slopes of 3 to 40 percent. Elevations range from 300 to 1,000 feet. The average annual precipitation is 40 to 60 inches, the average annual air temperature is 52°

to 54° F., and the length of the frost-free season is 190 to 200 days. The vegetation is mainly grass, poison-oak, rose, oak, and scattered Douglas-firs. Witzel soils are associated with Nekia and Jory soils.

In a typical profile, the surface layer is dark-brown very stony silt loam about 4 inches thick. The subsoil is about 15 inches thick, and it consists of dark-brown very stony silty clay loam in the upper part and of dark reddish-brown very stony silty clay loam in the lower part. Partly fractured basalt bedrock is at a depth of about 19 inches.

The Witzel soils are used mainly for pasture and as woodland.

Witzel very stony silt loam, 3 to 40 percent slopes (ME).-This is the only soil of the Witzel series mapped in the survey area. It is on slope breaks and in red foothills. The dominant slopes are less than 12 percent.

Representative profile (NE1/4SE1/4 sec. 8, T. 8 S., R. 2W.):

A1--0 to 4 inches, dark-brown (7.5YR 3/2) very stony silt loam, brown (7.5YR 5/4) when dry; moderate, fine, granular structure; friable, hard, slightly sticky and slightly plastic; 60 percent roots; many, very fine and fine, interstitial pores; many coarse fragments; medium acid (pH 6.0); clear, smooth boundary. (2 to 6 inches thick.)

B21-4 to 9 inches, dark-brown (7.5YR 3/2) very stony silty clay loam, brown (7.5YR 5/4) when dry; moderate, fine, subangular blocky structure; firm, hard, sticky and plastic; many roots; common, very fine, tubular pores; 60 percent coarse fragments; medium acid (pH 6.0); gradual, wavy boundary. (3 to 10 inches thick.)

B22-9 to 19 inches, dark reddish-brown (5YR 3/4) very stony silty clay loam, reddish brown (5YR 5/4) when dry; weak, medium, subangular blocky structure; friable, hard, sticky and plastic; many roots; common, very fine, tubular pores; 60 percent coarse fragments; medium acid (pH 6.0); clear, smooth boundary, (2 to 6 inches thick.)

IIR-19 inches, partly fractured basalt bedrock.

The A horizon ranges from silt loam to silty clay loam or clay loam in texture, and in places the B horizon is clay loam. Color of the B horizon ranges from dark brown to dark reddish brown. Thickness of the solum over basalt bedrock ranges from 12 to 20 inches. The content of coarse fragments of rock in the soil mass ranges from 50 to 75 percent.

Included with this soil in mapping were some areas in which bedrock is as deep as 30 inches.

The available water capacity is 1 to 3 inches. Permeability is moderately slow, and fertility is low. Roots can penetrate to a depth of 12 to 20 inches. Runoff is medium to rapid, and the hazard of erosion is moderate to high.

This soil is not used for cultivated crops, but it is used mainly for native pasture and as woodland. The high content of stones, low available water capacity, and hazard of erosion make this soil poorly suited to use for pasture. (Capability unit VIs-1; not placed in a woodland suitability group)

Woodburn Series

The Woodburn series consists of moderately well drained soils that have formed in silty alluvium and loess of mixed mineralogy. These soils are on broad valley terraces. They have slopes of 0 to 20 percent. Elevations range from 150 to 350 feet. The average annual precipitation is 40 to 45 inches, the average annual air temperature is 52° to 54° F., and the length of the frost-free season is 200 to 210 days. In areas that are not cultivated, the vegetation is mainly grass and Douglas-fir. Woodburn soils are associated with Willamette soils.

In a typical profile, the surface layer is about 17 inches thick and is very dark brown silt loam in the upper part and dark-brown silt loam in the lower part. The subsoil is about 37 inches thick. It is dark yellowish-brown silty clay loam in the upper part; mottled dark-brown silty clay loam in the middle part; and mottled, dark-brown silt loam in the lower part. The substratum is dark-brown silt loam that extends to a depth of 68 inches or more.

The Woodburn soils are used mainly for small grains, pasture, hay, orchards, berries, and vegetables.

Woodburn silt loam, 0 to 3 percent slopes (WuA).-This soil is on broad terraces of Willamette silts.

Representative profile about 200 feet west of the paved road to Champoeg (SW1/4SE1/4SE1/4 sec. 2, T. 4 S., R. 2 W.; profile No. 5 in table 9 in the section "Laboratory Data.") .

Ap-0 to 9 inches, very dark brown (10YR 2/2) silt loam, brown (10YR 5/3) when dry; cloddy and has very weak, subangular blocky structure; friable, slightly hard, slightly sticky and slightly plastic; many roots; many, fine and very fine, tubular pores; few, fine, interstitial pores; common, medium and fine, reddish-brown and black concretions; medium acid (pH 5.9); abrupt, smooth boundary. (6 to 10 inches thick.)

A1-9 to 17 inches, dark-brown (10YR 3/3) silt loam, brown (10YR 5/3) when dry; moderate, medium, subangular blocky structure; friable, hard, slightly sticky and slightly plastic; common clean silt and sand grains on ped surfaces; many roots; many, very fine, tubular pores; few, thin, darker (10YR 2/2) coatings on ped surfaces; few reddish-brown and black concretions; slightly acid (pH 6.2), smooth boundary. (3 to 8 inches thick.)

B21t-17 to 25 inches, dark yellowish-brown (10YR 3/4) silty clay loam, brown (7.5YR 5/4) when dry; moderate, coarse and medium, subangular blocky structure; friable, hard, sticky and plastic; common roots; many, very fine, tubular pores; few thin clay films on peds; few reddish-brown and black concretions; few black stains on ped surfaces; medium acid (pH 6.0); clear, smooth boundary. (7 to 9 inches thick.)

B22t-25 to 32 inches, dark-brown silty clay loam, brown (10YR 5/3) when dry; few, fine and medium, distinct, dark-gray (10YR 4/1) mottles, light brownish gray (10YR 6/2) when dry; moderate, medium and coarse, subangular blocky structure; friable, hard, brittle, sticky and plastic; common roots; many, very fine, tubular pores; continuous, moderately thick clay films on ped surfaces and in pores; few, fine, black concretions and stains on ped surfaces; medium acid (pH 5.8); abrupt, smooth boundary. (6 to 10 inches thick.)

B31t-32 to 39 inches, dark-brown (10YR 4/3) silt loam, brown (10YR 5/3) when dry; distinct, dark grayish-brown (10YR 4/2) mottles in a few root channels; thin, dark grayish-brown (10YR 4/2) coatings on plane surfaces, light gray (10YR 7/2) when dry; nearly massive; some planes of weakness that are indistinct; vertical planes are more distinct than horizontal planes; very firm, very hard, brittle, slightly sticky and slightly plastic; few roots; many, fine and very fine, tubular pores; continuous, moderately thick clay films on plane surfaces and in some root channels and pores; few, fine and medium, black concretions and few, black coatings on plane surfaces; medium acid (pH 5.7); gradual, smooth boundary. (7 to 10 inches thick.)

B32t-39 to 54 inches, dark-brown (10YR 4/3) silt loam, pale brown (10YR 6/3) when dry; nearly massive, and has some indistinct vertical planes of weakness; very firm, very hard, brittle, slightly sticky and slightly plastic;

no roots; many, fine and very fine, and few, medium, tubular pores; continuous, thin clay films in pores and in old root channels; few black concretions, and some patchy, black coatings on plane surfaces; medium acid (pH 5.9); gradual, wavy boundary. (11 to 17 inches thick.)

C-54 to 68 inches, dark-brown (10YR 4/3) silt loam, pale brown (10YR 6/3) when dry; massive; very firm, very hard, brittle, slightly sticky and slightly plastic; no roots; many, very fine, tubular pores; common moderately thick clay films in larger pores and in old root channels or worm channels; few black coatings in pores and in channels; medium acid (pH 5.9); gradual, wavy boundary. (14 to 16 inches thick.)

When the soil is moist, color of the A horizon ranges from dark grayish brown to very dark brown or dark brown, and color of the B2 horizon ranges from very dark grayish brown or dark brown to dark yellowish brown or strong brown. In all areas the A horizon is thicker than 10 inches. The B2 horizon ranges from heavy silt loam to silty clay loam in texture. Structure of the B2 horizon ranges from weak to moderate, medium or coarse, prismatic to moderate, fine to coarse, subangular blocky. Distinct mottling occurs at a depth above 30 inches. In some places the B3 horizon has weak to moderate subangular blocky or prismatic structure. In others it is massive and has vertical planes of weakness. Consistence of the B3 horizon is firm or very firm when the soil is moist. The substratum is stratified. It ranges from silty clay loam or silt loam to very fine sandy loam or fine sandy loam in texture.

Included with this soil in mapping were small areas of Amity and Willamette soils, and small areas of a somewhat poorly drained soil. The areas of Amity soils occupy less than 5 percent of the acreage in this mapping unit. The areas of Willamette soils occupy as much as 10 percent.

The available water capacity is 11 to 13 inches. Permeability is moderate in the upper part of the subsoil, and it is slow in the lower part. Fertility is high. Depth to which roots can penetrate is restricted by a seasonal perched water table and as the result of the type of structure. Runoff is slow, and no apparent erosion has taken place.

This soil is used mainly for small grains, field corn, orchards, pasture, hay, caneberries, and vegetables. Areas that are drained are used for all the crops commonly grown in the survey area. Because of the perched water table, drainage is needed for crops that cannot tolerate excessive moisture. (Capability unit IIw-1; not placed in a woodland suitability group)

Woodburn silt loam, 3 to 12 percent slopes (WuC).-This soil has slopes of 3 to 5 percent in about 60 percent of the acreage. Runoff is slow to medium, and the hazard of erosion is slight to moderate.

Included with this soil in mapping were small areas that have a thin surface layer and that have distinct mottling within 12 inches of the surface.

This Woodburn soil is used for about the same crops as Woodburn silt loam, 0 to 3 percent slopes. It is less suitable for vegetables and berries, however, because of the difficulty of cultivating those crops so that erosion is controlled without damaging the crop. Mechanical harvesting of vegetables and berries is difficult where slopes are steeper than 5 percent. (Capability unit IIe-1; not placed in a woodland suitability group)

Woodburn silt loam, 12 to 20 percent slopes (WuD).-Where this soil occurs along creeks, intermittent drainageways, and terrace fronts, its slopes are short and abrupt. Runoff is rapid, and the hazard of erosion is moderate.

Included with this soil in mapping were small areas that hve a thin surface layer and that have distinct mottling within 12 inches of the surface.

This Woodburn soil is used mainly for pasture, hay, and small grains, although some small areas are used for row crops and orchards. This soil is poorly suited to row crops; for the slopes are too short and steep for mechanical harvesting of vegetables, berries, and other row crops to be feasible. Tilling row crops so that excessive soil losses are avoided is also difficult. (Capability unit IIIe-1; not placed in a woodland suitability group)

Formation and Classification of Soils

Soils of the Marion County Area differ in fertility, in physical and chemical properties, and in productivity. These differences are the result of differences in parent material and of local differences in the environment under which the soils have formed. This section describes some factors in the environment, and major processes that have affected the formation of soils of the Marion County Area. It also defines the current system, for classifying soils and shows the classification of the soils by series and by higher categories.

Formation of Soils

Soil is a natural body on the surface of the earth. It consists of mixtures of rocks and minerals that have been subjected to various degrees of weathering and that contain greatly varying amounts of organic matter, water, and air. Soils have more or less distinct horizons that have developed under the influence of local factors in the environment. The soil-forming processes that produce different kinds of soils are parent material, which affects the physical and chemical composition of the soils; climate, principally precipitation and temperature; biological forces., or the plant and animal life in and on the soil; relief, or topography; and the time in which the soil-forming processes have acted on the parent material. These five factors, in many different combinations and intensities, produce soils that differ from place to place. The influence of each soil-forming factor on the soils of the Marion County Area is described in the following paragraphs.

Parent material

Soils in the survey area have formed in eight major kinds of parent material. These are (1) recent alluvium, (2) gravelly alluvium, (3) young, silty terrace alluvium, (4) weakly consolidated, old gravelly alluvium, (5) basic colluvium from basalt and massive tuffs, (6) sedimentary alluvium and colluvium derived from tuffaceous sandstone and shale, (7) glacial till, and (8) deposits of organic material. The soils in about 80 percent of the survey area have formed in recent alluvium (Willamette silts); in basic igneous material (basic colluvium derived from basalt and massive tuffs); or in glacial till. Figure 10 shows the approximate distribution of the different kinds of parent materials in the survey area. This figure is based only partly on the results of geologic studies, and therefore it cannot be called a geologic map. The distribution shown is the result of combining information obtained

B.3 Environmental Characteristics

Water Quality

Search

About DEQ Regulations News & Info Programs Contact Us

Home > Water Quality > 303(d) List Home > Search Choices Page > List of Waterbodies

Water Quality Limited Streams Database

The following records match your search criteria. Select a **Record ID** to view details of the waterbody:

Record ID	Waterbody Name	Sub-Basin	River Mile	Parameter	Season	List Date	Listing Status
8854	North Santiam River	NORTH SANTIAM	0 to 10	Temperature	Summer	2002	303(d) List
8856	North Santiam River	NORTH SANTIAM	0 to 10	Temperature	September 1 - June 30	2002	303(d) List
8857	North Santiam River	NORTH SANTIAM	10 to 26.5	Temperature	September 15 - June 30	2002	303(d) List

There are 3 records in the table.

Download CSV file: Client630.csv

For additional information, please contact Karla Urbanowicz at (503) 229-6099.

Table 4. Listed, Candidate, and Species of Concern and the Determination of Effect from the Biological Assessment for Expansion, Operation and Maintenance of the Geren Island WTF

Common name	Scientific name	Federal status[1]	Jurisdiction
Oregon chub	*Oregonichthys crameri*	Endangered	USFWS
Winter steelhead	*Oncorhynchus mykiss*	Threatened	NOAA[2]
Spring chinook salmon	*Oncorhynchus tshawytscha*	Threatened	NOAA[2]
Bald eagle	*Haliaeetus leucocephalus*	Threatened	USFWS
Fender's blue butterfly	*Icaricia icarioides fenderi*	Endangered	USFWS[3]
Golden Indian paintbrush	*Castilleja laevisecta*	Threatened	USFWS[2]
Willamette daisy	*Erigeron decumbens* var. *decumbens*	Endangered	USFWS[2]
Howellia	*Howellia aquatilis*	Threatened	USFWS
Bradshaw's lomatium	*Lomatium bradshawii*	Endangered	USFWS
Kincaid's lupine	*Lupinus sulphureus* var. *kincaidii*	Threatened	USFWS[2]
Nelson's checker-mallow	*Sidalcea nelsoniana*	Threatened	USFWS
Candidate Species			
Yellow-billed cuckoo	*Coccyzus americanus*	Candidate	USFWS[3]
Oregon spotted frog	*Rana pretiosa*	Candidate	USFWS[2]
Taylor's checkerspot	*Euphydras editha taylori*	Candidate	USFWS[3]
Streaked horned lark	*Eremophila alpestris strigata*	Candidate	USFWS[3]
Pacific lamprey	*Lampetra tridentata*	Sp. of Concern	USFWS
Northern red-legged frog	*Rana aurora aurora*	Sp. of Concern	USFWS
Foothill yellow-legged frog	*Rana boylii*	Sp. of Concern	USFWS
Northwestern pond turtle	*Clemmys marmorata marmorata*	Sp. of Concern	USFWS
Little willow flycatcher	*Empidonax traillii brewsteri*	Sp. of Concern	USFWS
Band-tailed pigeon	*Columba fasciata*	Sp. of Concern	USFWS[3]
Olive-sided flycatcher	*Contopus cooperi (=borealis)*	Sp. of Concern	USFWS[3]
Yellow-breasted chat	*Icteria virens*	Sp. of Concern	USFWS[3]
Acorn woodpecker	*Melanerpes formicivarus*	Sp. of Concern	USFWS[3]
Oregon vesper sparrow	*Pooecetes gramineus affinis*	Sp. of Concern	USFWS[3]
Purple martin	*Progne subis*	Sp. of Concern	USFWS[3]
Silver-haired bat	*Lasionycteris noctivagans*	Sp. of Concern	USFWS[3]
Long-eared myotis	*Myotis evotis*	Sp. Of Concern	USFWS
Fringed myotis	*Myotis thysanodes*	Sp. Of Concern	USFWS
Long-legged myotis	*Myotis volans*	Sp. Of Concern	USFWS
Yuma myotis	*Myotis yumanensis*	Sp. Of Concern	USFWS
Pacific western big-eared bat	*Plecotus townsendii townsendii*	Sp. Of Concern	USFWS
Camas pocket gopher	*Thomomys bulbivorus*	Sp. of Concern	USFWS[3]
Oregon giant earthworm	*Megascolides macelfreshi*	Sp. of Concern	USFWS
White top aster	*Aster curtus*	Sp. of Concern	USFWS
Peacock larkspur	*Delphinium pavonaceum*	Sp. of Concern	USFWS

[1] Federal Status

Endangered: Species that are in danger of becoming extinct within the foreseeable future throughout all or a significant portion of their range.

Threatened: Species that are likely to become endangered within the foreseeable future.

Candidate: Species considered for threatened or endangered listing, but not yet the subject of a proposed rule

Species of Concern: Species that are currently under review for listing.

Shaggy horkelia	*Horkelia congesta* spp. *Congesta*	Sp. of Concern	USFWS
Thin-leaved peavine	*Lathyrus holochlorus*	Sp. of Concern	USFWS[3]

[1] Federal Status

Endangered: Species that are in danger of becoming extinct within the foreseeable future throughout all or a significant portion of their range.

Threatened: Species that are likely to become endangered within the foreseeable future.

Candidate: Species considered for threatened or endangered listing, but not yet the subject of a proposed rule

Species of Concern: Species that are currently under review for listing.

[2] Status changed since preparation of the Biological Assessment
Source: AAI and SPCA 1996

[3] Status change since 1996 Source: USFWS, October 2003

ENCLOSURE A

FEDERALLY LISTED AND PROPOSED ENDANGERED AND THREATENED SPECIES, CANDIDATE SPECIES AND SPECIES OF CONCERN THAT MAY OCCUR WITHIN THE AREA OF THE CITY OF SALEM WATER MANAGEMENT PLAN PROJECT
1-7-03-SP-0684

LISTED SPECIES[1/]

Birds		
Bald eagle[2/]	*Haliaeetus leucocephalus*	T
Fish		
Steelhead (Upper Willamette River)[3/]	*Oncorhynchus mykiss*	**T
Chinook salmon (Upper Willamette River)[4/]	*Oncorhynchus tshawytscha*	**T
Oregon chub	*Oregonichthys crameri*	E
Invertebrates		
Fender's blue butterfly[5/]	*Icaricia icarioides fenderi*	E
Plants		
Golden Indian paintbrush[6/]	*Castilleja levisecta*	T
Willamette daisy[5/]	*Erigeron decumbens var. decumbens*	E
Howellia	*Howellia aquatilis*	T
Bradshaw's lomatium	*Lomatium bradshawii*	E
Kincaid's lupine[5/]	*Lupinus sulphureus var. kincaidii*	T
Nelson's checker-mallow	*Sidalcea nelsoniana*	T

PROPOSED SPECIES

None

CANDIDATE SPECIES[7/]

Birds	
Yellow-billed cuckoo[8/]	*Coccyzus americanus*
Streaked horned lark	*Eremophila alpestris strigata*
Amphibians and Reptiles	
Oregon spotted frog	*Rana pretiosa*
Invertebrates	
Taylor's checkerspot	*Euphydryas editha taylori*

SPECIES OF CONCERN

Mammals	
Pacific western big-eared bat	*Corynorhinus (=Plecotus) townsendii townsendii*
Silver-haired bat	*Lasionycteris noctivagans*
Long-eared myotis (bat)	*Myotis evotis*
Fringed myotis (bat)	*Myotis thysanodes*

Long-legged myotis (bat)	*Myotis volans*
Yuma myotis (bat)	*Myotis yumanensis*
Camas pocket gopher	*Thomomys bulbivorus*
<u>Birds</u>	
Band-tailed pigeon	*Columba fasciata*
Olive-sided flycatcher	*Contopus cooperi (=borealis)*
Yellow-breasted chat	*Icteria virens*
Acorn woodpecker	*Melanerpes formicivorus*
Oregon vesper sparrow	*Pooecetes gramineus affinis*
Purple martin	*Progne subis*
<u>Amphibians and Reptiles</u>	
Northwestern pond turtle	*Emys (=Clemmys) marmorata marmorata*
Northern red-legged frog	*Rana aurora aurora*
Foothill yellow-legged frog	*Rana boylii*
<u>Fish</u>	
Pacific lamprey	*Lampetra tridentata*
Coastal cutthroat trout (Upper Willamette)	*Oncorhynchus clarki clarki*
<u>Invertebrates</u>	
Oregon giant earthworm	*Driloleirus (=Megascolides) macelfreshi*
<u>Plants</u>	
White top aster	*Aster curtus*
Peacock larkspur	*Delphinium pavonaceum*
Shaggy horkelia	*Horkelia congesta* ssp. *congesta*
Thin-leaved peavine	*Lathyrus holochlorus*

(E) - Listed Endangered *(T) - Listed Threatened* *(CH) - Critical Habitat has been designated for this species*
(PE) - Proposed Endangered *(PT) - Proposed Threatened* *(PCH) - Critical Habitat has been proposed for this species*
(S) - Suspected *(D) - Documented*

Species of Concern - Taxa whose conservation status is of concern to the Service (many previously known as Category 2 candidates), but for which further information is still needed.

(CF) - Candidate: National Marine Fisheries Service designation for any species being considered by the Secretary for listing for endangered or threatened species, but not yet the subject of a proposed rule.

*** Consultation with National Marine Fisheries Service may be required.*

1/ *U. S. Department of Interior, Fish and Wildlife Service. October 31, 2000, <u>Endangered and Threatened Wildlife and Plants</u>, 50 CFR 17.11 and 17.12*

2/ *Federal Register Vol. 60, No. 133, July 12, 1995 - Final Rule - Bald Eagle*

3/ *Federal Register Vol. 64, No. 57, March 25, 1999, Final Rule - Middle Columbia and Upper Willamette River Steelhead*

4/ *Federal Register Vol. 64, No. 56, March 24, 1999, Final Rule - West Coast Chinook Salmon*

5/ *Federal Register Vol. 65, No. 16, January 25, 2000, Final Rule-Erigeron decumbens var. decumbens, Lupinus sulphureus ssp. kincaidii and Fender's blue butterfly*

6/ *Federal Register Vol. 62, No. 112, June 11, 1997, Final Rule-Castilleja levisecta*

7/ *Federal Register Vol. 67, No. 114, June 13, 2002, Notice of Review - Candidate or Proposed Animals and Plants*

8/ *Federal Register Vol. 66, No. 143, July 25, 2001, 12-Month Finding for a Petition To List the Yellow-billed Cuckoo*

B.4 Oregon Natural Heritage Information

OREGON NATURAL HERITAGE INFORMATION CENTER

Institute for Natural Resources

OREGON STATE UNIVERSITY
1322 SE Morrison Street
Portland, Oregon 97214-2423

August 25, 2004

Justin R. Walker
Keller Associates, Inc.
131 SW 5th Avenue, Suite A
Meridian, ID 83642

Dear Mr. Walker:

Thank you for requesting information from the Oregon Natural Heritage Information Center (ORNHIC). We have conducted a data system search for rare, threatened and endangered plant and animal records for your Stayton Water Management and Conservation Plan Project in Township 9 South, Range 1 West, Sections 11 and 13, W.M.

Twenty-five (25) records were noted within a two-mile radius of your project and are included on the enclosed computer printout. A key to the fields is also included.

Please remember that the lack of rare element information from a given area does not mean that there are no significant elements there, only that there is no information known to us from the site. To assure that there are no important elements present, you should inventory the site, at the appropriate season.

This data is confidential and for the specific purposes of your project and is **not to be distributed**.

If you need additional information or have any questions, please do not hesitate to contact me.

Sincerely,

Cliff Alton
Conservation Information Assistant

encl.: invoice (H-082404-CWA4)
computer printout and data key

OREGON NATURAL HERITAGE INFORMATION CENTER

Institute for Natural Resources

OREGON STATE UNIVERSITY
1322 SE Morrison Street
Portland, Oregon 97214-2423

Invoice Number: H-082404-CWA4
Index: RNR105

INVOICE

TO: Keller Associates, Inc.
131 SW 5th Avenue, Suite A
Meridian, ID 83642

ATTN: Accounts Payable

DATE: August 25, 2004

RE: Data system search for rare, threatened and endangered plants and animals in the vicinity of Township 9 South, Range 1 West, Sections 11 and 13, W.M. Requested by Justin R. Walker for the Stayton Water Management and Conservation Plan Project.

For services and products:

Computer records (25 @ $0.50/record)	$ 12.50
Computer fee (flat rate)	$ 20.00
Staff time (0.75 hours @ $50.00/hour)	$ 37.50
TOTAL DUE:	**$ 70.00**

Please make checks payable to: **Oregon Natural Heritage Information Center**

Please include invoice number at top of page with payment.

Terms: **Net 30**

Scientific Name: ***Rana aurora aurora***
Common Name: **Northern red-legged frog**
Federal Status: SOC GRANK: G4T4 NHP List: 4 Category: Vertebrate Animal
State Status: SV/SU SRANK: S3S4 HP Track: N ELCODE: AAABH01021
EO ID: 19241 First Obs: 1996-04-07 Last Obs: 1996-04-07 Confirmed:
Directions: GEREN ISLAND (STAYTON ISLAND). POND EXCAVATED IN 1979 TO OBSERVE GROUND WATER LEVELS. EAST OF SLOW SAND FILTERS IN AREA TO BE EXCAVATED FOR MORE SAND FILTERS. ALSO SMALL FORESTED WETLAND JUST EAST OF THE SLOW SAND FILTER COMPLEX.

County Name	Ecoregion	Source Feature [Uncertainty Type (Distance)]
Marion	WV	Polygon [Areal - Delimited (8 m)]

Town-Range	Sec	Note	QuadCode	QuadName	Watershed
009S001W	13		44122-G7	Stayton	1709000506 - NORTH SANTIAM RIVER, LOWER

Owner Name/Type	Owner Comments	Managed Area Name
CITY; COUNTY	CITY OF SALEM, MARION COUNTY	

EO Type: Minimum Elev.(m): 143 Annual Observations
EO Data: 1996: POND - 2 EGG MASSES HATCHING WITH SEVERAL ADULTS. FORESTED WETLAND SITE - 1 ADULT ONLY, NO EGGS.
EO Comments: ARTIFICIAL POND AND SMALL FORESTED WETLAND. ROUGH SKINNED NEWT, NORTHWESTERN SALAMANDER EGGS AND GARTER SNAKE IN POND.
Protection:
Management: LOTS OF BULLFROGS AT POND AND WETLAND.
General: OBSERVER: PRISCILLA STANFORD

Scientific Name: ***Rana pretiosa***
Common Name: **Oregon spotted frog**
Federal Status: C GRANK: G2 NHP List: 1 Category: Vertebrate Animal
State Status: SC SRANK: S2 HP Track: Y ELCODE: AAABH01180
EO ID: 5019 First Obs: 1937-10-13 Last Obs: 1937-10-13 Confirmed:
Directions: AUMSVILLE, ALONG MILL CREEK

County Name	Ecoregion	Source Feature [Uncertainty Type (Distance)]
Marion	WV	Point [Areal - Estimated (8050 m)]

Town-Range	Sec	Note	QuadCode	QuadName	Watershed
008S002W	36		44122-G7	Stayton	1709000506 - NORTH SANTIAM RIVER, LOWER 1709000701 - MILL CREEK 1709000907 - SILVER CREEK

Owner Name/Type	Owner Comments	Managed Area Name

EO Type: Minimum Elev.(m): 107 Annual Observations
EO Data: 1937: ONE ADULT FEMALE COLLECTED
EO Comments: LOW, EMERGENT MARSH
Protection:
Management:
General: COLLECTOR: H.S. FITCH MVZ#25288

Scientific Name: ***Haliaeetus leucocephalus***
Common Name: **Bald eagle**
Federal Status: LT GRANK: G4 NHP List: 4 Category: Vertebrate Animal
State Status: LT SRANK: S4B,S4N HP Track: Y ELCODE: ABNKC10010
EO ID: 26095 First Obs: 2003 Last Obs: 2003 Confirmed:
Directions: S. of Stayton, along the North Santiam River.

County Name	Ecoregion	Source Feature [Uncertainty Type (Distance)]
Marion	WV	Point [Areal - Estimated (50 m)]

Town-Range	Sec	Note	QuadCode	QuadName	Watershed
009S001W	16		44122-G7	Stayton	1709000506 - NORTH SANTIAM RIVER, LOWER

Owner Name/Type	Owner Comments	Managed Area Name

EO Type: Minimum Elev.(m): Annual Observations
EO Data: See annual observations. * 2003 - 1 downy nestling

EO Comments:
Protection:
Management:
General: Isaacs and Anthony nest 1128.

Scientific Name: ***Eremophila alpestris strigata***
Common Name: **Streaked horned lark**
Federal Status: C | GRANK: G5T2 | NHP List: 1 | Category: Vertebrate Animal
State Status: SC | SRANK: S2B | HP Track: Y | ELCODE: ABPAT0201L
EO ID: 1181 | First Obs: 1999-05-19 | Last Obs: 1999-05-19 | Confirmed:
Directions: APPROX. 1.5 MI SE OF KINGSTON.

County Name	Ecoregion	Source Feature [Uncertainty Type (Distance)]
Linn	WV	Point [Areal - Estimated (200 m)]

Town-Range	Sec	Note	QuadCode	QuadName	Watershed
009S001W	26		44122-G7	Stayton	1709000506 - NORTH SANTIAM RIVER, LOWER

Owner Name/Type	Owner Comments	Managed Area Name
PRIVATE		

EO Type: Minimum Elev.(m): 183 Annual Observations
EO Data: 1999: 1 BIRD OBSERVED.
EO Comments:
Protection:
Management:
General:

Scientific Name: ***Progne subis***
Common Name: **Purple martin**
Federal Status: SOC | GRANK: G5 | NHP List: 2 | Category: Vertebrate Animal
State Status: SC | SRANK: S2B | HP Track: Y | ELCODE: ABPAU01010
EO ID: 20254 | First Obs: 1998-07-23 | Last Obs: 1998-07-23 | Confirmed:
Directions: FROM STAYTON TAKE KINGSTON-JORDAN RD. CROSS THE RIVER AND RAILROAD TRACKS. TURN LEFT ON KINGSTON-LYONS RD, AND GO 1.5 MI. TURN LEFT AT THE SIGN "BIRDHAVEN", GO UP THE GREAVEL LANE. THE NESTBOXES ARE NEAR THE GARDENS AND DOWN BELOW THE HOUSE IN THE MOWN F

County Name	Ecoregion	Source Feature [Uncertainty Type (Distance)]
Linn	WV	Point [Areal - Estimated (50 m)]

Town-Range	Sec	Note	QuadCode	QuadName	Watershed
009S001E	18		44122-G6	Stout Mountain	1709000506 - NORTH SANTIAM RIVER, LOWER

Owner Name/Type	Owner Comments	Managed Area Name
PRIVATE	FARM	

EO Type: Minimum Elev.(m): 226 Annual Observations
EO Data: 1998: 15 PAIRS NESTING IN BOXES.
EO Comments:
Protection:
Management:
General:

Scientific Name: ***Pooecetes gramineus affinis***
Common Name: **Oregon vesper sparrow**
Federal Status: SOC | GRANK: G5T3 | NHP List: 2 | Category: Vertebrate Animal
State Status: SC | SRANK: S2B,S2N | HP Track: Y | ELCODE: ABPBX95011
EO ID: 13494 | First Obs: 1999-05-26 | Last Obs: 1999-05-26 | Confirmed:
Directions: SW of Wisner Cemetery.

County Name	Ecoregion	Source Feature [Uncertainty Type (Distance)]
Linn	WV	Point [Areal - Estimated (50 m)]

Town-Range	Sec	Note	QuadCode	QuadName	Watershed
009S001W	26		44122-G7	Stayton	1709000506 - NORTH SANTIAM RIVER, LOWER

Owner Name/Type	Owner Comments	Managed Area Name
PRIVATE		

EO Type: Minimum Elev.(m): 168 Annual Observations
EO Data: 1999: 1 bird observed.

EO Comments:
Protection:
Management:
General:

Scientific Name: ***Pooecetes gramineus affinis***
Common Name: **Oregon vesper sparrow**
Federal Status: SOC GRANK: G5T3 NHP List: 2 Category: Vertebrate Animal
State Status: SC SRANK: S2B,S2N HP Track: Y ELCODE: ABPBX95011
EO ID: 26250 First Obs: 1999-07-02 Last Obs: 1999-07-02 Confirmed:
Directions: Approx. 1mi SE of Kingston.

County Name	Ecoregion	Source Feature [Uncertainty Type (Distance)]
Linn	WV	Point [Areal - Estimated (50 m)]

Town-Range	Sec	Note	QuadCode	QuadName	Watershed
009S001W	24		44122-G7	Stayton	1709000506 - NORTH SANTIAM RIVER, LOWER

Owner Name/Type	Owner Comments	Managed Area Name
Private		

EO Type: Minimum Elev.(m): 198 Annual Observations
EO Data: 1999: 1 male singing.
EO Comments:
Protection:
Management:
General:

Scientific Name: ***Ammodramus savannarum***
Common Name: **Grasshopper sparrow**
Federal Status: GRANK: G5 NHP List: 2 Category: Vertebrate Animal
State Status: SV/SP SRANK: S2B HP Track: Y ELCODE: ABPBXA0020
EO ID: 12542 First Obs: 1999-06-09 Last Obs: 1999-06-23 Confirmed:
Directions: APPROX. 1 MI SE OF STAYTON ISLAND.

County Name	Ecoregion	Source Feature [Uncertainty Type (Distance)]
Linn	WV	Point [Areal - Estimated (50 m)]

Town-Range	Sec	Note	QuadCode	QuadName	Watershed
009S001W	24		44122-G6	Stout Mountain	1709000506 - NORTH SANTIAM RIVER, LOWER

Owner Name/Type	Owner Comments	Managed Area Name
PRIVATE		

EO Type: Minimum Elev.(m): 213 Annual Observations
EO Data: 1999: 1 MALE SINGING.
EO Comments:
Protection:
Management:
General:

Scientific Name: ***Oncorhynchus tshawytscha pop. 23***
Common Name: **Chinook salmon (Upper Willamette River ESU, spring run)**
Federal Status: LT GRANK: G5T2Q NHP List: 1 Category: Vertebrate Animal
State Status: SRANK: S2 HP Track: Y ELCODE: AFCHA02052
EO ID: 94 First Obs: Last Obs: 1999-PRE Confirmed:
Directions: MILL CREEK & TRIBUTARIES

County Name	Ecoregion	Source Feature [Uncertainty Type (Distance)]
Marion		Data currently not available.

Town-Range	Sec	Note	QuadCode	QuadName	Watershed
			44122-G7	Stayton	17090007 - Middle Willamette
			44122-G8	Turner	
			44122-H8	Salem East	
			44123-H1	Salem West	

Owner Name/Type	Owner Comments	Managed Area Name

EO Type: REARING & MIGRATION - fish Minimum Elev.(m): Annual Observations
EO Data: SPRING RUN; ODFW DISTRIBUTION MAPS USED TO CREATE THE 1:24,000 COVERAGE.
EO Comments:
Protection:
Management:
General: DISTRIBUTION INFORMATION USED IN THIS EOR WAS DERIVED FROM ODFW GEOGRAPHIC RESOURCES DATA PRODUCED AND DISTRIBUTED IN 2001. UNLESS SPECIFIC DATA EXISTS IN THE DATA FIELD, THE INFORMATION PRESENTED IN THIS EOR REPRESENTS THE "BEST PROFESSIONAL JUDGMENT" BY ODFWS DISTRICT FISHERIES BIOLOGIST; THE PRESENCE OF CHINOOK IN DESCRIBED AREAS SHOULD BE CONSIDERED UNDOCUMENTED BUT AS HAVING A POTENTIAL OF BEING PRESENT.

Scientific Name: ***Oncorhynchus tshawytscha pop. 23***
Common Name: **Chinook salmon (Upper Willamette River ESU, spring run)**
Federal Status: LT GRANK: G5T2Q NHP List: 1 Category: Vertebrate Animal
State Status: SRANK: S2 HP Track: Y ELCODE: AFCHA02052
EO ID: 5008 First Obs: Last Obs: 1999-PRE Confirmed:
Directions: VALENTINE CREEK

County Name: Marion
Ecoregion:
Source Feature [Uncertainty Type (Distance)]: Data currently not available.

Town-Range Sec Note:
QuadCode QuadName: 44122-G6 Stout Mountain
Watershed: 1709000506 - NORTH SANTIAM RIVER, LOWER

Owner Name/Type:
Owner Comments:
Managed Area Name:

EO Type: REARING & MIGRATION - fish Minimum Elev.(m): Annual Observations
EO Data: SPRING RUN; ODFW DISTRIBUTION MAPS USED TO CREATE THE 1:24,000 COVERAGE.
EO Comments:
Protection:
Management:
General: DISTRIBUTION INFORMATION USED IN THIS EOR WAS DERIVED FROM ODFW GEOGRAPHIC RESOURCES DATA PRODUCED AND DISTRIBUTED IN 2001. UNLESS SPECIFIC DATA EXISTS IN THE DATA FIELD, THE INFORMATION PRESENTED IN THIS EOR REPRESENTS THE "BEST PROFESSIONAL JUDGMENT" BY ODFWS DISTRICT FISHERIES BIOLOGIST; THE PRESENCE OF CHINOOK IN DESCRIBED AREAS SHOULD BE CONSIDERED UNDOCUMENTED BUT AS HAVING A POTENTIAL OF BEING PRESENT.

Scientific Name: ***Oncorhynchus tshawytscha pop. 23***
Common Name: **Chinook salmon (Upper Willamette River ESU, spring run)**
Federal Status: LT GRANK: G5T2Q NHP List: 1 Category: Vertebrate Animal
State Status: SRANK: S2 HP Track: Y ELCODE: AFCHA02052
EO ID: 18370 First Obs: Last Obs: 1999-PRE Confirmed:
Directions: SANTIAM RIVER & TRIBUTARIES

County Name: Linn, Marion
Ecoregion:
Source Feature [Uncertainty Type (Distance)]: Data currently not available.

Town-Range Sec Note:

QuadCode	QuadName
44122-F3	Lawhead Creek
44122-F4	Mill City South
44122-F8	Crabtree
44122-G3	Elkhorn
44122-G4	Mill City North
44122-G5	Lyons
44122-G6	Stout Mountain
44122-G7	Stayton
44122-G8	Turner
44123-F1	Albany

Watershed: 17090005 - North Santiam

Owner Name/Type:
Owner Comments:
Managed Area Name:

EO Type: SPAWNING & REARING - fish Minimum Elev.(m): Annual Observations

EO Data: SPRING RUN. ODFW DISTRIBUTION MAPS USED TO CREATE THE 1:24,000 COVERAGE. ODFW SALMONID DISTRIBUTION DOCUMENTATION 1998: NORTH SANTIAM RIVER, LITTLE NORTH SANTIAM RIVER. 1997: NORTH SANTIAM RIVER. 1952: NORTH SANTIAM RIVER.

EO Comments:

Protection:

Management:

General: DOCUMENTATION INFORMATION USED IN THIS EOR WAS DERIVED FROM THE ODFW SALMONID DISTRIBUTION DOCUMENTATION DIGITAL DATABASE DISTRIBUTED IN 2001. DISTRIBUTION INFORMATION USED IN THIS EOR WAS DERIVED FROM ODFW GEOGRAPHIC RESOURCES DATA PRODUCED AND DISTRIBUTED IN 2001. UNLESS SPECIFIC DATA EXISTS IN THE DATA FIELD, THE INFORMATION PRESENTED IN THIS EOR REPRESENTS THE "BEST PROFESSIONAL JUDGMENT" BY ODFW'S DISTRICT FISHERIES BIOLOGIST; THE PRESENCE OF CHINOOK IN DESCRIBED AREAS SHOULD BE CONSIDERED UNDOCUMENTED BUT AS HAVING A POTENTIAL OF BEING PRESENT.

Scientific Name: ***Oncorhynchus mykiss pop. 33***

Common Name: **Steelhead (Upper Willamette River ESU, winter run)**

Federal Status: LT	GRANK: G5T2Q	NHP List: 1	Category: Vertebrate Animal
State Status: SC	SRANK: S2	HP Track: Y	ELCODE: AFCHA02138
EO ID: 1134	First Obs:	Last Obs: 1999-PRE	Confirmed:

Directions: NORTH SANTIAM RIVER & TRIBUTARIES

County Name	Ecoregion	Source Feature [Uncertainty Type (Distance)]
Linn		Data currently not available.
Marion		

Town-Range Sec Note	QuadCode	QuadName	Watershed
	44122-F3	Lawhead Creek	17090005 - North Santiam
	44122-F4	Mill City South	
	44122-F8	Crabtree	
	44122-G2	Battle Ax	
	44122-G3	Elkhorn	
	44122-G4	Mill City North	
	44122-G5	Lyons	
	44122-G6	Stout Mountain	
	44122-G7	Stayton	
	44122-G8	Turner	
	44123-F1	Albany	

Owner Name/Type	Owner Comments	Managed Area Name

EO Type: SPAWNING & REARING - fish Minimum Elev.(m): Annual Observations

EO Data: WINTER RUN; ODFW DISTRIBUTION MAPS USED TO CREATE THE 1:24,000 COVERAGE.

EO Comments:

Protection:

Management:

General: DISTRIBUTION INFORMATION USED IN THIS EOR WAS DERIVED FROM ODFW GEOGRAPHIC RESOURCES DATA PRODUCED AND DISTRIBUTED IN 2001. UNLESS SPECIFIC DATA EXISTS IN THE DATA FIELD, THE INFORMATION PRESENTED IN THIS EOR REPRESENTS THE "BEST PROFESSIONAL JUDGMENT" BY ODFW'S DISTRICT FISHERIES BIOLOGIST; THE PRESENCE OF STEELHEAD IN DESCRIBED AREAS SHOULD BE CONSIDERED UNDOCUMENTED BUT AS HAVING A POTENTIAL OF BEING PRESENT.

Scientific Name: ***Oncorhynchus mykiss pop. 33***

Common Name: **Steelhead (Upper Willamette River ESU, winter run)**

Federal Status: LT	GRANK: G5T2Q	NHP List: 1	Category: Vertebrate Animal
State Status: SC	SRANK: S2	HP Track: Y	ELCODE: AFCHA02138
EO ID: 4118	First Obs:	Last Obs: 1999-PRE	Confirmed:

Directions: ALDER CREEK

County Name	Ecoregion	Source Feature [Uncertainty Type (Distance)]
Marion		Data currently not available.

Town-Range Sec Note	QuadCode	QuadName	Watershed
	44122-G6	Stout Mountain	1709000506 - NORTH SANTIAM RIVER, LOWER

Owner Name/Type | Owner Comments | Managed Area Name

EO Type: MIGRATION - fish | Minimum Elev.(m): | Annual Observations

EO Data: WINTER RUN; ODFW DISTRIBUTION MAPS USED TO CREATE THE 1:24,000 COVERAGE.

EO Comments:

Protection:

Management:

General: DISTRIBUTION INFORMATION USED IN THIS EOR WAS DERIVED FROM ODFW GEOGRAPHIC RESOURCES DATA PRODUCED AND DISTRIBUTED IN 2001. UNLESS SPECIFIC DATA EXISTS IN THE DATA FIELD, THE INFORMATION PRESENTED IN THIS EOR REPRESENTS THE "BEST PROFESSIONAL JUDGMENT" BY ODFWS DISTRICT FISHERIES BIOLOGIST; THE PRESENCE OF STEELHEAD IN DESCRIBED AREAS SHOULD BE CONSIDERED UNDOCUMENTED BUT AS HAVING A POTENTIAL OF BEING PRESENT.

Scientific Name: ***Oncorhynchus mykiss pop. 33***

Common Name: **Steelhead (Upper Willamette River ESU, winter run)**

Federal Status: LT | GRANK: G5T2Q | NHP List: 1 | Category: Vertebrate Animal

State Status: SC | SRANK: S2 | HP Track: Y | ELCODE: AFCHA02138

EO ID: 9461 | First Obs: | Last Obs: 1999-PRE | Confirmed:

Directions: ALDER CREEK

County Name: Marion

Ecoregion

Source Feature [Uncertainty Type (Distance)]: Data currently not available.

Town-Range Sec Note

QuadCode QuadName: 44122-G6 Stout Mountain

Watershed: 1709000506 - NORTH SANTIAM RIVER, LOWER

Owner Name/Type | Owner Comments | Managed Area Name

EO Type: REARING & MIGRATION - fish | Minimum Elev.(m): | Annual Observations

EO Data: WINTER RUN; ODFW DISTRIBUTION MAPS USED TO CREATE THE 1:24,000 COVERAGE.

EO Comments:

Protection:

Management:

General: DISTRIBUTION INFORMATION USED IN THIS EOR WAS DERIVED FROM ODFW GEOGRAPHIC RESOURCES DATA PRODUCED AND DISTRIBUTED IN 2001. UNLESS SPECIFIC DATA EXISTS IN THE DATA FIELD, THE INFORMATION PRESENTED IN THIS EOR REPRESENTS THE "BEST PROFESSIONAL JUDGMENT" BY ODFWS DISTRICT FISHERIES BIOLOGIST; THE PRESENCE OF STEELHEAD IN DESCRIBED AREAS SHOULD BE CONSIDERED UNDOCUMENTED BUT AS HAVING A POTENTIAL OF BEING PRESENT.

Scientific Name: ***Oncorhynchus mykiss pop. 33***

Common Name: **Steelhead (Upper Willamette River ESU, winter run)**

Federal Status: LT | GRANK: G5T2Q | NHP List: 1 | Category: Vertebrate Animal

State Status: SC | SRANK: S2 | HP Track: Y | ELCODE: AFCHA02138

EO ID: 16605 | First Obs: | Last Obs: 1999-PRE | Confirmed:

Directions: VALENTINE CREEK

County Name: Marion

Ecoregion

Source Feature [Uncertainty Type (Distance)]: Data currently not available.

Town-Range Sec Note

QuadCode QuadName: 44122-G6 Stout Mountain; 44122-G7 Stayton

Watershed: 1709000506 - NORTH SANTIAM RIVER, LOWER

Owner Name/Type | Owner Comments | Managed Area Name

EO Type: REARING & MIGRATION - fish | Minimum Elev.(m): | Annual Observations

EO Data: WINTER RUN; ODFW DISTRIBUTION MAPS USED TO CREATE THE 1:24,000 COVERAGE.

EO Comments:

Protection:

Management:

General: DISTRIBUTION INFORMATION USED IN THIS EOR WAS DERIVED FROM ODFW GEOGRAPHIC RESOURCES DATA PRODUCED AND DISTRIBUTED IN 2001. UNLESS SPECIFIC DATA EXISTS IN THE DATA FIELD, THE INFORMATION PRESENTED IN THIS EOR REPRESENTS THE "BEST PROFESSIONAL JUDGMENT" BY ODFWS DISTRICT FISHERIES BIOLOGIST; THE PRESENCE OF STEELHEAD IN DESCRIBED AREAS SHOULD BE CONSIDERED UNDOCUMENTED BUT AS HAVING A POTENTIAL OF BEING PRESENT.

Scientific Name: ***Oncorhynchus mykiss pop. 33***
Common Name: **Steelhead (Upper Willamette River ESU, winter run)**

Federal Status: LT	GRANK: G5T2Q	NHP List: 1	Category: Vertebrate Animal
State Status: SC	SRANK: S2	HP Track: Y	ELCODE: AFCHA02138
EO ID: 19279	First Obs:	Last Obs: 1999-PRE	Confirmed:

Directions: MILL CREEK & TRIBUTARIES

County Name	Ecoregion	Source Feature [Uncertainty Type (Distance)]
Marion		Data currently not available.

Town-Range Sec Note	QuadCode QuadName	Watershed
	44122-G7 Stayton	17090007 - Middle Willamette
	44122-G8 Turner	
	44122-H8 Salem East	
	44123-H1 Salem West	

Owner Name/Type	Owner Comments	Managed Area Name

EO Type: SPAWNING & REARING - fish   Minimum Elev.(m):   Annual Observations

EO Data: WINTER RUN; ODFW DISTRIBUTION MAPS USED TO CREATE THE 1:24,000 COVERAGE.

EO Comments:

Protection:

Management:

General: DISTRIBUTION INFORMATION USED IN THIS EOR WAS DERIVED FROM ODFW GEOGRAPHIC RESOURCES DATA PRODUCED AND DISTRIBUTED IN 2001. UNLESS SPECIFIC DATA EXISTS IN THE DATA FIELD, THE INFORMATION PRESENTED IN THIS EOR REPRESENTS THE "BEST PROFESSIONAL JUDGMENT" BY ODFWS DISTRICT FISHERIES BIOLOGIST; THE PRESENCE OF STEELHEAD IN DESCRIBED AREAS SHOULD BE CONSIDERED UNDOCUMENTED BUT AS HAVING A POTENTIAL OF BEING PRESENT.

Scientific Name: ***Oregonichthys crameri***
Common Name: **Oregon chub**

Federal Status: LE	GRANK: G2	NHP List: 1	Category: Vertebrate Animal
State Status: SC	SRANK: S2	HP Track: Y	ELCODE: AFCJB56010
EO ID: 18585	First Obs: 1996-05-20	Last Obs: 2003-07-31	Confirmed:

Directions: Sensitive Data - contact ORNHIC for more information

County Name	Ecoregion	Source Feature [Uncertainty Type (Distance)]
Marion	WV	Point [Areal - Estimated (100 m)]
		Point [Areal - Estimated (100 m)]
		Polygon [Negligible (8 m)]

Town-Range	Sec	Note	QuadCode	QuadName	Watershed
009S001W	15		44122-G6	Stout Mountain	1709000506 - NORTH SANTIAM RIVER, LOWER
009S001W	10		44122-G7	Stayton	
009S001W	11				
009S001W	13				

Owner Name/Type	Owner Comments	Managed Area Name
CITY	CITY OF SALEM OWNS MOST OF THE ISLAND ALTHOUGH A FEW PRIVATE INHOLDINGS EXIST.	

EO Type: YEAR-ROUND - fish   Minimum Elev.(m):

EO Data: See annual observations.

Annual Observations
- 2003 - 1845 chub captured/estimated
- 2002 - 747 chub captured/estimated
- 2001 - 782 chub captured/estimated
- 2000 - 359 chub captured/estimated
- 1999 - 894 chub captured/estimated
- 1998 - 1836 chub captured/estimated
- 1997 - 9737 chub captured/estimated
- 1996 - 12792 chub captured/estimated

EO Comments: Red-legged frog adults and eggs observed at site. Also tadpole, juvenile and adult bullfrogs and largemouth bass found.
Protection:
Management:
General: GEREN ISLAND IS THE SITE OF SALEM'S WATER SUPPLY AND FILTRATION PLANT. CHUBS WERE COLLECTED FROM A NUMBER OF SITES WITHIN A NETWORK OF CANALS, SLOUGHS AND PONDS CONNECTED WITH THE WATER TREATMENT PLANT. THE CITY HAS REQUESTED AN EXPANSION OF THE PLANT AND THE PROJECT IS CURRENTLY GOING THROUGH A BIOLOGICAL ASSESSMENT TO DETERMINE POTENTIAL IMPACTS TO CHUBS AND WETLANDS. PRELIMINARY DISCUSSIONS INDICATE THAT AN EASEMENT WILL BE GRANTED AND A RESERVE SET UP FOR THE LARGEST POND ON THE ISLAND (NORTH POND). Scheerer site #441, 442, 443, 444, 446, 447, 449, 574 and 612.

Scientific Name: ***Emys marmorata marmorata***
Common Name: **Northwestern pond turtle**
Federal Status: SOC GRANK: G3G4T3T4 NHP List: 2 Category: Vertebrate Animal
State Status: SC SRANK: S2 HP Track: Y ELCODE: ARAAD02031
EO ID: 2418 First Obs: 1997-06-09 Last Obs: 1999 Confirmed:
Directions: PIONEER PARK SLOUGH; OFF OF THE NORTH SANTIAM RIVER SOUTH OF STAYTON, NEAR THE STAYTON PARK TRAIL.

County Name	Ecoregion	Source Feature [Uncertainty Type (Distance)]
Marion	WV	Polygon [Negligible (8 m)]

Town-Range	Sec	Note	QuadCode	QuadName	Watershed
009S001W	11		44122-G7	Stayton	1709000506 - NORTH SANTIAM RIVER, LOWER
009S001W	10				

Owner Name/Type	Owner Comments	Managed Area Name

EO Type: Minimum Elev.(m): 140 Annual Observations
EO Data: 1999: 6 adults observed basking. 1997: 1 turtle.
EO Comments:
Protection:
Management:
General: REPORTED BY PAUL SCHEERER, ODFW.

Scientific Name: ***Emys marmorata marmorata***
Common Name: **Northwestern pond turtle**
Federal Status: SOC GRANK: G3G4T3T4 NHP List: 2 Category: Vertebrate Animal
State Status: SC SRANK: S2 HP Track: Y ELCODE: ARAAD02031
EO ID: 25544 First Obs: Last Obs: 1999 Confirmed:
Directions: Valentine Cr. @ 16253 Old Mehama Road SE; E. of Stayton

County Name	Ecoregion	Source Feature [Uncertainty Type (Distance)]
Marion	WV	Point [Areal - Estimated (50 m)]

Town-Range	Sec	Note	QuadCode	QuadName	Watershed
009S001E	08		44122-G6	Stout Mountain	1709000506 - NORTH SANTIAM RIVER, LOWER

Owner Name/Type	Owner Comments	Managed Area Name

EO Type: Minimum Elev.(m): 162 Annual Observations
EO Data: 1999: exact date not specified, 1 adult turtle observed basking.
EO Comments:
Protection:
Management:
General:

Scientific Name: ***Lomatium bradshawii***
Common Name: **Bradshaw's lomatium**
Federal Status: LE GRANK: G2 NHP List: 1 Category: Vascular Plant
State Status: LE SRANK: S2 HP Track: Y ELCODE: PDAPI1B030
EO ID: 22909 First Obs: 1988 Last Obs: 1988-07-26 Confirmed:
Directions: BETWEEN KINGSTON & LYONS. TAKE KINGSTON-LYONS RD. TOWARDS LYONS, FOR 1.6 MI. TO SHARP RIGHT TURN. SIGHT IS STRAIGHT AHEAD. PLANTS ARE IN SEASONAL CREEK BED.

County Name	Ecoregion	Source Feature [Uncertainty Type (Distance)]
Linn	WV	Polygon [Areal - Delimited (8 m)]

Town-Range	Sec	Note	QuadCode	QuadName	Watershed
009S001E	19		44122-G6	Stout Mountain	1709000506 - NORTH SANTIAM RIVER, LOWER

Owner Name/Type	Owner Comments	Managed Area Name
PRIVATE		KINGSTON PRAIRIE PRESERVE

EO Type: Minimum Elev.(m): 229

Annual Observations
* 1988 - 1000

EO Data: ABOUT 1000 PLANTS CONCENTRATED IN A 3-4 ACRE PATCH ALONG THE SEASONAL CREEK DRAINAGE. POPULATION FRUITING & FLOWERING WELL, IN SPITE OF VERY LIMITED HABITAT.

EO Comments: SHALLOW SOILED, BASALT CREEK BED & VERNAL POOLS. DOMINATED BY MIMGUT, DESCAE, ALOGEN, CAREX, JUNCUS & ELEOCHARIS, ALLIUM SP., POASCR & DANCAL. SURROUNDED BY FESRUB PRAIRIE.

Protection: NEEDS TNC PROTECTION ASAP!

Management:

General: GRAZING IS AN IMMEDIATE THREAT, AS IS FARMING. AREA WILL BE DEVELOPED SHORTLY (RECENTLY SUBDIVIDED)

Scientific Name: ***Erigeron decumbens var. decumbens***
Common Name: **Willamette Valley daisy**

Federal Status: LE	GRANK: G4T1	NHP List: 1	Category: Vascular Plant
State Status: LE	SRANK: S1	HP Track: Y	ELCODE: PDAST3M133
EO ID: 11171	First Obs: 1988	Last Obs: 1988-07-26	Confirmed:

Directions: BETWEEN KINGSTON & LYONS. TAKE KINGSTON-LYONS ROAD TOWARDS LYONS FOR 1.6 MILES TO SHARP RIGHT HAND TURN. SITE IS STRAIGHT AHEAD: PLANTS ARE ALSO ON E SIDE OF RD, 0.1 MI. FURTHER.

County Name	Ecoregion	Source Feature [Uncertainty Type (Distance)]
Linn	WV	Polygon [Areal - Delimited (8 m)] Polygon [Areal - Delimited (8 m)] Polygon [Areal - Delimited (8 m)]

Town-Range	Sec	Note	QuadCode	QuadName	Watershed
009S001E	19		44122-G6	Stout Mountain	1709000506 - NORTH SANTIAM RIVER, LOWER
009S001E	24				

Owner Name/Type	Owner Comments	Managed Area Name
PRIVATE		KINGSTON PRAIRIE PRESERVE

EO Type: Minimum Elev.(m): 229

Annual Observations
* 1988 - 200 PLANTS

EO Data: ABOUT 200 PLANTS, 150 ON E. SIDE OF ROAD AND 50 ON W. SIDE OF RD. (AT THE SOUTH END OF SITE). PLANTS SCATTERED IN DRIER AREAS OF SITE. LARGE & ROBUST.

EO Comments: RED FESCUE PRAIRIE DOMINATED BY FESRUB, AGREXA, AGRTEN & PANCAL WITH AGRDAS, FESIDA, FESARU, ANTODA AND MANY NATIVE FORBS. ALLUVIAL SILTY SOIL, SHALLOW IN SPOTS.

Protection: NEEDS TNC ACQUISITION TO PREVENT DEVELOPMENT.

Management:

General: ALVERSON COLLECTION, OSC. 1988.

Scientific Name: ***Aster curtus***
Common Name: **White-topped aster**

Federal Status: SOC	GRANK: G3	NHP List: 1	Category: Vascular Plant
State Status: LT	SRANK: S2	HP Track: Y	ELCODE: PDASTEF010
EO ID: 7265	First Obs: 1990	Last Obs: 1990-07-22	Confirmed:

Directions: KINGSTON PRAIRIE, ALONG N. FENCELINE OF FRICHTL PROPERTY DUE EAST OF 90 DEGREE CURVE, 4 PATCHES SCATTERED AT EDGE OF PARCEL AND IN THE RIGHT-OF-WAY ACROSS THE FENCE

County Name	Ecoregion	Source Feature [Uncertainty Type (Distance)]
Linn	WV	Point [Areal - Estimated (50 m)]

Town-Range	Sec	Note	QuadCode	QuadName	Watershed
009S001E	19		44122-G6	Stout Mountain	1709000506 - NORTH SANTIAM RIVER, LOWER

Owner Name/Type	Owner Comments	Managed Area Name
PRIVATE	RUBY FRICHTL	KINGSTON PRAIRIE PRESERVE

EO Type: Minimum Elev.(m): 229
EO Data: AN ESTIMATED 75 RAMETS WERE OBSERVED IN 4 DIFFERENT PATCHES; ADDITIONAL COLONIES MAY OCCUR IN THE AREA. IN <1 ACRE

Annual Observations
* 1990 - 75 RAMETS

EO Comments: REMNANT OF FESTUCA RUBRA/IDAHOENSIS PRAIRIE, WITH POTENTILLA GRACILIS, SIDALCEA CAMPESTRIS, ASTER HALLII, SOLIDAGO CANADENSIS. FENCE ROW AND R.O.W. MAY HAVE PROVIDED PROTECTION FROM GRAZING.
Protection:
Management: CYTISUS SCOPARIUS IS COLONIZING THE SITE
General:

Scientific Name: ***Lathyrus holochlorus***
Common Name: **Thin-leaved peavine**
Federal Status: SOC GRANK: G2 NHP List: 1 Category: Vascular Plant
State Status: SRANK: S2 HP Track: Y ELCODE: PDFAB250B0
EO ID: 5269 First Obs: 1988-05-15 Last Obs: 1988-05-15 Confirmed:
Directions: WISNER CEMETERY. I MI S OF KINGSTON. POP ACROSS RD FROM CEMETARY.

County Name	Ecoregion	Source Feature [Uncertainty Type (Distance)]
Linn	WV	Point [Areal - Estimated (50 m)]
Town-Range Sec Note	**QuadCode QuadName**	**Watershed**
009S001W 23	44122-G7 Stayton	1709000506 - NORTH SANTIAM RIVER, LOWER
Owner Name/Type	**Owner Comments**	**Managed Area Name**

EO Type: Minimum Elev.(m): 177 Annual Observations
EO Data: [NO EODATA GIVEN]
EO Comments: NEKIA SILTY CLAY LOAM (CLASS III).
Protection:
Management:
General: 1990 REPORT FOR LOCATING NATIVE GRASSLAND REMNANTS IN THE MID-WILLAMETTE VALLEY BY EDWARD ALVERSON.

Scientific Name: ***Cimicifuga elata***
Common Name: **Tall bugbane**
Federal Status: GRANK: G3 NHP List: 1 Category: Vascular Plant
State Status: C SRANK: S3 HP Track: Y ELCODE: PDRAN07030
EO ID: 2751 First Obs: 1998-06-30 Last Obs: 1998-06-30 Confirmed:
Directions: S OF BEAR BRANCH.

County Name	Ecoregion	Source Feature [Uncertainty Type (Distance)]
Linn	WV	Point [Areal - Estimated (50 m)]
Town-Range Sec Note	**QuadCode QuadName**	**Watershed**
009S001W 25	44122-G7 Stayton	1709000506 - NORTH SANTIAM RIVER, LOWER
Owner Name/Type	**Owner Comments**	**Managed Area Name**
COUNTY	LINN COUNTY RIGHT OF WAY	

EO Type: Minimum Elev.(m): 244
EO Data: ONE PLANT; IN BUD.

Annual Observations
* 1998 - 1 PLANT

EO Comments: PLANT GROWING IN A BRUSHY R/W AREA ALONG COUNTY RD, KINGSTON JORDAN RD; PSME OVERSTORY; MID SLOPE; FILTERED LIGHT; MOIST; ASSOC SPECIES: PSME, POMU.
Protection:
Management:
General: 1998 BLM PLANT SIGHTING REPORT; TERRY FENNELL REPORTER.

Scientific Name: ***Delphinium oreganum***
Common Name: **Willamette Valley larkspur**
Federal Status: SOC GRANK: G1Q NHP List: 1 Category: Vascular Plant
State Status: C SRANK: S1 HP Track: Y ELCODE: PDRAN0B220
EO ID: 16633 First Obs: 1989 Last Obs: 2000-06-28 Confirmed:
Directions: KINGSTON PRAIRIE. FROM STAYTON DRIVE S ON FIRST STREET WHICH CROSSES THE N SANTIAM RIVER AND BECOMES STAYTON-SCIO ROAD. ~1/4 MI AFTER CROSSING THE RIVER, TURN LEFT (E) ON KINGSTON-JORDAN DR. GO ~1 MI, JUST PAST A RAILROAD CROSSING, TURN LEFT ON LINGSTON-

County Name	Ecoregion	Source Feature [Uncertainty Type (Distance)]
Linn	WV	Polygon [Areal - Delimited (8 m)]
Town-Range Sec Note	**QuadCode QuadName**	**Watershed**
009S001E 19	44122-G6 Stout Mountain	1709000506 - NORTH SANTIAM RIVER, LOWER
Owner Name/Type	**Owner Comments**	**Managed Area Name**
PRIVATE	THE NATURE CONSERVANCY, OREGON FIELD OFFICE. THIS TRACT HAS BEEN IN TNC OWNERSHIP SINCE 1996.	KINGSTON PRAIRIE PRESERVE

EO Type: Minimum Elev.(m): 229 Annual Observations

EO Data: ~1280 FLOWERING PLANTS, IN 12 SEPARATE PATCHES OVER AN AREA OF ~20 ACRES.

EO Comments: MODERATE QUALITY UPLAND PRAIRIE THAT ALSO SUPPORTS A GOOD POP OF ERDED. ASSOC WITH: FESTUCA ROEMERI, FESTUCA RUBRA, AGROSTIS CAPILLARIS, FESTUCA ARUNDINACEA, ERIOPHYLLUM LANATUM, SIDALCEA CAMPESTRIS, BRODIAEA HYACINTHINA, ACHILLEA MILLEFOLIUM, ASTER HALLII, PRUNELLA VULGARIS VAR LANCEOLATA.

Protection: POP EXTENDS TO THE N OFF NATURE CONSERVANCY LAND ONTO THE ROW OF A PRIVATE DRIVE.

Management: SCOTS BROOM PATCHES WERE REMOVED IN 1997/1998 WITH ANNUAL FOLLOW-UP SINCE THEN.

General: 2000 PLANT SIGHTING REPORT, ED ALVERSON REPORTER. MAY BE ONE OF THE BEST PROTECTED SITES FOR THIS SPECIES. TENDS TO OCCUR IN AREAS OF DEEPER SOILS. NEED TO SURVEY OTHER TNC TRACTS FOR THIS SPECIES.

25 records total

Key to Oregon Natural Heritage Information Center Data

Field Name	Description
Scientific Name	The scientific name of the species.
Common Name	The common name of the species.
Category	Value that indicates the broad biological category for each species.
ELCODE	Unique Heritage Program code for identifying this element. 1st and 2nd byte (PD=Plant dict, PM=Plant monocot, PG=Plant gymnosperm, PP=Plant pteridophyte, AA=amphibian, AB=bird, AF=fish, AM=mammal, AR=reptile, I=invertebrate. 3rd-5th byte (family abbreviation). 6th-7th (genus code). 8th-9th (species). 10th (tie breaker).
Federal Status	US Fish and Wildlife Service or National Marine Fisheries Service status. **LE**=listed endangered, **LT**=listed threatened, **PE** or **PT**=proposed endangered or threatened, **C**=candidate for listing with enough information available for listing, **SOC**=species of concern, **-PD**=proposed delisting, **-NL**=not listed (in part of the range).
State Status	For animals, Oregon Department of Fish and Wildlife status; **LE**=listed endangered, **PE**=proposed endangered, **PT**=proposed threatened, **SC** or **C**=sensitive-critical, **SV** or **V**=sensitive-vulnerable, **SP** or **P**=sensitive-peripheral, **SU** or **U**=sensitive-undetermined status. For plants, Oregon Department of Agriculture status; **LE**=listed endangered, **LT**=listed threatened, **C**=candidate.
GRANK/SRANK	ORNHIC participates in an international system for ranking rare, threatened and endangered species throughout the world. The system was developed by The Nature Conservancy and is now maintained by NatureServe in cooperation with Heritage Programs or Conservation Data Centers (CDCs) in all 50 states, in 4 Canadian provinces, and in 13 Latin American countries. The ranking is a 1-5 scale, primarily based on the number of known occurrences, but also including threats, sensitivity, area occupied, and other biological factors. In this book, the ranks occupy two lines. The top line is the Global Rank and begins with a "G". If the taxon has a trinomial (a subspecies, variety or recognized race), this is followed by a "T" rank indicator. A "Q" at the end of this line indicates the taxon has taxonomic questions. The second line is the State Rank and begins with the letter "S". The ranks are summarized as follows: **1** = Critically imperiled because of extreme rarity or because it is somehow especially vulnerable to extinction or extirpation, typically with 5 or fewer occurrences; **2** = Imperiled because of rarity or because other factors demonstrably make it very vulnerable to extinction (extirpation), typically with 6-20 occurrences; **3** = Rare, uncommon or threatened, but not immediately imperiled, typically with 21-100 occurrences; **4** = Not rare and apparently secure, but with cause for long-term concern, usually with more than 100 occurrences; **5** = Demonstrably widespread, abundant, and secure; **H** = Historical Occurrence, formerly part of the native biota with the implied expectation that it may be rediscovered; **X** = Presumed extirpated or extinct; **U** = Unknown rank; **?** = Not yet ranked, or assigned rank is uncertain.
NHP list	All rare species in Oregon are assigned a list number of 1, 2, 3 or 4, where **1**=threatened or endangered throughout range, **2**=threatened or endangered in Oregon but more common elsewhere, **3**=Review List (more information is needed), **4**=Watch List (currently stable). A null value indicates the species is not currently on our rare species list.
HP Track	We currently obtain and computerize locational information for only those elements marked with **Y**(es). Those species marked with **N**(o) or **W**(atch) have incomplete data because we do not actively track them at this time.
EO ID	Unique identifier for the Element Occurrence (EO).
First_obs	First reported sighting date for this occurrence in the form YYYY-MM-DD.
Last_obs	Last reported sighting date, usually in the form YYYY-MM-DD.
Confirmed	Indication of whether taxonomic identification of the Element represented by this occurrence has been confirmed by a reliable individual. Blank=unknown, assumed to be correctly identified. Y=Yes, confident identification. ?=identification questions.
Directions	Site name and/or directions to site.
County	County name(s) in which EO is mapped.
Ecoregion	Physiographic Province in which EO is mapped: **CR**=Coast Range, **WV**=Willamette Valley, **KM**=Klamath Mountains, **WC**=West slope and crest of the Cascades, **EC**=East slope of the Cascades, **BM**=Ochoco, Blue and Wallowa Mts., **BR**=Basin and Range, **CB**=Columbia Basin, **SP**=Snake River Plains.

Key to Oregon Natural Heritage Information Center Data

Field Name	Description
Source Feature	A Source Feature is the initial translation of a discrete unit of observation data as a spatial feature. Creation of a Source Feature requires an interpretive process. The likely location and extent of an observation is determined through consideration of the amount and direction of any variability between the recorded and actual locations of the observation data. In most cases, the Source Feature is delineated to encompass locational uncertainty. A Source Feature can be a point, line, or polygon. The type of Source Feature developed depends on both the preceding conceptual feature type and the locational uncertainty associated with the feature.
Uncertainty Type (Distance)	The recorded location of an observation of an Element may vary from its true location due to many factors, including the level of expertise of the data collector, differences in survey techniques and equipment used, and the amount and type of information obtained. This inaccuracy is characterized as locational uncertainty, and is assessed for Source Feature(s) based on the uncertainty associated with the underlying information on the location of the observation. Four categories of locational uncertainty have been identified, as follows: <u>Negligible</u> uncertainty is less than or equal to 6.25 meters in any dimension. Source Features with negligible uncertainty are based on a comprehensive field survey with high quality mapping and a high degree of certainty. <u>Linear</u> uncertainty is greater than 6.25 meters, and varies along an axis (e.g., a path, stream, ridgeline). The true location of an observation with linear uncertainty may be visualized as effectively sliding along a line that delineates the uncertainty. <u>Areal delimited</u> uncertainty is greater than 6.25 meters, and varies in more than one dimension. The true location of an observation can be visualized as floating within an area with a boundary that can be specifically delimited. Boundaries can be defined using roads, bodies of water, etc. <u>Areal estimated</u> uncertainty is greater than 6.25 meters, and varies in more than one dimension. A boundary cannot be specifically delimited based on the observation information, i.e., the actual extent is unknown. The true location of the observation can be visualized as floating within an area for which boundaries cannot be specifically delimited. Source Features with areal estimated uncertainty require that the user specify an estimated uncertainty distance to be used for buffering the feature to incorporate the locational uncertainty.
Town-Range, Sec, and Note	United States rectangular land survey (also known as the Public Land Survey System) legal township, range, and section descriptions that best define the location of the Element Occurrence. Township first (4 bytes), range second (4 bytes). For example: 004S029E = Township 4S, Range 29E. All locations are with reference to the Willamette Meridian. Fractional ranges or townships are indicated in the Note field.
Quadcode	USGS code for the USGS topographic quadrangle map(s) where the record is mapped.
Quadname	Name of the USGS topographic quadrangle map(s) where the record is mapped.
Watershed	Watershed(s), identified according to the U.S. Geological Survey (USGS) Hydrologic Unit Map 10-digit code, within which the Element Occurrence is located.
Owner Name/Type and Comments	Federal, State, Private, etc.
Managed Area Name	BLM District, USFS Forest, Private Preserve
EO Type	For animals, type of occurrence, eg. roost, nest, spawning, etc.
EO Data	Species and population biology - numbers, age, nesting success, vigor, phenology, disease, pollinators, etc.
EO Comments	Habitat information, e.g. aspect, slope, soils, associated species, community type, etc.
Minimum Elevation	Minimum elevation of the area covered by the range of the taxon, in meters. -339 or blank=not determined.
Annual Observation	Summary of yearly observation.
Protection	Comments on protectibility and threats.
Management	Comments on how the site is managed.
General	Miscellaneous comments.

B.5 Marion County Standards

FLOODPLAIN/GREENWAY APPLICATIONS

inside 100 yr - floodplain

PURPOSE OF THE FLOODPLAIN OVERLAY ZONE:

(a) Restrict or prohibit uses which are dangerous to health, safety and property due to water or erosion hazards or which result in damaging increases in erosion or in flood heights or velocities.

(b) Minimize expenditure of public money for flood control projects and rescue and relief efforts in areas subject to flooding.

(c) Minimize flood damage to new construction by elevating or flood proofing all structures.

(d) Control the alteration of natural floodplains, stream channels, and natural protective barriers which hold, accommodate, or channel flood waters.

(e) Control filling, grading, dredging, and other development which may be subject to, or increase, flood damage.

(f) Prevent or regulate the construction of flood barriers which may increase flood hazards in other areas.

(g) Comply with the requirements of the Federal Insurance Administration to qualify Marion County for participation in the National Flood Insurance Program.

(h) Minimize flood insurance premiums paid by the citizens of Marion County by reducing potential hazards due to flood damage.

(i) Implement the floodplain/greenway policies in the Marion County Comprehensive Plan.

GENERAL PROVISIONS: The following regulations apply to all lands in identified floodplains as shown graphically on the zoning maps. The floodplain is the area of special flood hazard identified by the Federal Insurance Administration in a scientific and engineering report entitled "The Flood Insurance Study for Marion County, Oregon, Unincorporated Areas", dated August 15, 1979, with accompanying Flood Insurance Rate Maps and amendments taking effect as of August 19, 1987. When base flood elevation data has not been provided, the Planning Division shall have the authority to determine the location of the boundaries of the floodplain where there appears to be a conflict between a mapped boundary and the actual field conditions, provided a record is maintained of any such determination.

(a) Duties of the Planning Division shall include, but not be limited to:

  (1) Review all development permits to determine that the permit requirements of the Floodplain/Greenway Ordinances have been satisfied.

  (2) Review all development permits to determine that all necessary permits have been obtained from those Federal, State, or local governmental agencies from which prior approval is required.

  (3) Review development permits to determine if the proposed development is located in the floodway. If located in the floodway, assure that the encroachment provisions of Section 178.060 (j) are met.

In order to determine whether or not a particular Floodplain/Greenway Permit will be approved, the Planning Division will require evidence from the applicant which addresses the criteria for development in the Floodplain/Greenway. This information should be included in the "Applicant's Statement". Failure to address the criteria may result in denial of your request or a delay in processing. A copy of the entire Floodplain or Greenway Ordinance is available from the Planning Division.

PROCEDURE:

A. Once a complete application is received, the Planning Division will request comments from other County departments and affected agencies and special districts.

B. After receiving a response from these entities, the Planning Division will check the application for compliance with: a) the County Comprehensive Plan, b) the County Zoning Ordinance, c) the Oregon Statewide Planning Goals, and d) other applicable ordinances and regulations. The Planning Division will approve or conditionally approve the application if it clearly complies with all land use laws.

C. Notice of the decision, including findings, is sent to the applicant and, if approved, notice is also sent to property owners within the notification area. There is a 12 day appeal period. The appeal process and, if approved, any conditions attached are explained on the Notice of Decision.

APPLICATION REQUIREMENTS: A complete floodplain/greenway application consists of the following:

A. The attached application form filled out completely in ink.

B. Copy of the officially recorded title transfer instrument (deed, warranty deed, or contract) that shows the legal description for the parent parcel. Title reports are not acceptable. Available at the Clerk's Office, 1st floor of the County Courthouse, 100 High St. NE.

C. Plot Plan (see example) on a separate sheet of paper 8 1/2" X 11", drawn in ink, showing the location of the proposed use and its distance from other structures, property lines, roads and other features. The Plot Plan must be reviewed and initiated as approved by a Plans Examiner from the Building Inspection Division.

D. A written statement which explains how the proposal meets each applicable criteria contained in the County's Floodplain and/or Greenway Ordinances, whichever applies. Additional information may be submitted that can assist the Planning Division in determining whether the proposed new use meets the applicable criteria. Such information could include floodproofing and anchoring proposals, certification by a registered professional engineer or architect demonstrating that any proposed encroachments into the floodway will not result in any increase in flood levels during major floods, identification of unusual terrain features, and statements or drawings or photos of the proposed external appearance of the proposed activity as viewed from the river (if within the greenway).

E. Filing fee (make check payable to Marion County).

TO ENSURE YOU HAVE ALL NECESSARY ITEMS USE LIST ABOVE AS CHECK-OFF

NOTE: If all required information is not presented at the time you submit the application, it will be returned. Until a Planner has certified that the application is complete, no file will be set up and no processing will occur. If the application is withdrawn after the application has been certified complete and the file set up or fee deposited, the entire fee cannot be refunded. Partial refunds are at the discretion of the Planning Division based on the amount of staff work undertaken.

MARION COUNTY FLOODPLAIN/GREENWAY DEVELOPMENT APPLICATION

Effective 08/01/02

Applicant: Please check one or both of the following:

FLOODPLAIN DEVELOPMENT PERMIT ( )
fee: $910.00

GREENWAY DEVELOPMENT PERMIT ( )
fee: $910.00

APPLICATIONS RETURNED BY MAIL WILL NOT BE ACCEPTED

If the Planning Division has questions about this application, who should be contacted?

____
Name

____
Address

____
Daytime phone (8:00 a.m.- 4:30 p.m.)

1. Property owners — Address and zip code

____________________________ ____________________________

____________________________ ____________________________

2. Contract and/or mortgage holders (if any) — Address and zip code

____________________________ ____________________________

3. The owners of record of the subject property do hereby request permission to (describe the request and list each item separately):

____

FOR OFFICE USE ONLY

Section ______ Township______ Range______

Tax lot number(s) ____________________
Zone ____________________________

Zone map number____________________
Name of watercourse and river mile location:

____

Type of case ________________________
urban or rural

Application elements submitted:

__(a) Title transfer instrument
__(b) Plot plan
__(c) Applicant's statement
__(d) Filing fee
__(e) GeoHazard Peer Review (if applicable)

____
Date app. determined complete

____
Application accepted by

4. Location of the property (street address, or if not addressed, state the nearest intersecting street or known landmark. Also, please give the name of the river mile location of the proposed floodplain and/or greenway development).

____

____

5. If the proposed use or development is within the floodplain as identified on the official zoning maps of Marion County, please fill in the following:

Zone AE: FEMA Base Flood Elevation from FIRM map or stream study ____________

Zone A, AO: Highest land elevation within 5 (five) feet of the development site ________ (USGS mean feet above sea level).

All Zones: The elevation above sea level of: 1) the lowest floor (including basements) of the proposed structure or development, 2) the lowest floor of any existing structures and other developments, and 3) the top of any proposed fill.

(1) ____
proposed use (USGS mean feet above sea level)

(2) ____
existing use(s) elevation

(3) ____
proposed fill or grade elevation and/or elevation of any altered topography

6. THE APPLICANT(S) SHALL CERTIFY THAT:

(a) If the application is granted, the applicant(s) will exercise the rights granted in accordance with the terms and subject to all the conditions and limitations of the approval.

(b) I/We hereby declare under penalties of false swearing (ORS 162.075 and 162.085) that all of the above information and statements and the statements in the plot plan, attachments and exhibits transmitted herewith are true; and the applicants so acknowledge that any permit issued on the basis of this application may be revoked if it is found that any such statements are false.

(c) The applicants have read the entire contents of the application, including the policies and criteria, and understand the requirements for approving or denying the application.

(d) I/We hereby grant permission for and consent to Marion County, its officers, agents, and employees coming upon the above-described property to gather information and inspect the property whenever it is reasonably necessary for the purpose of processing this application.

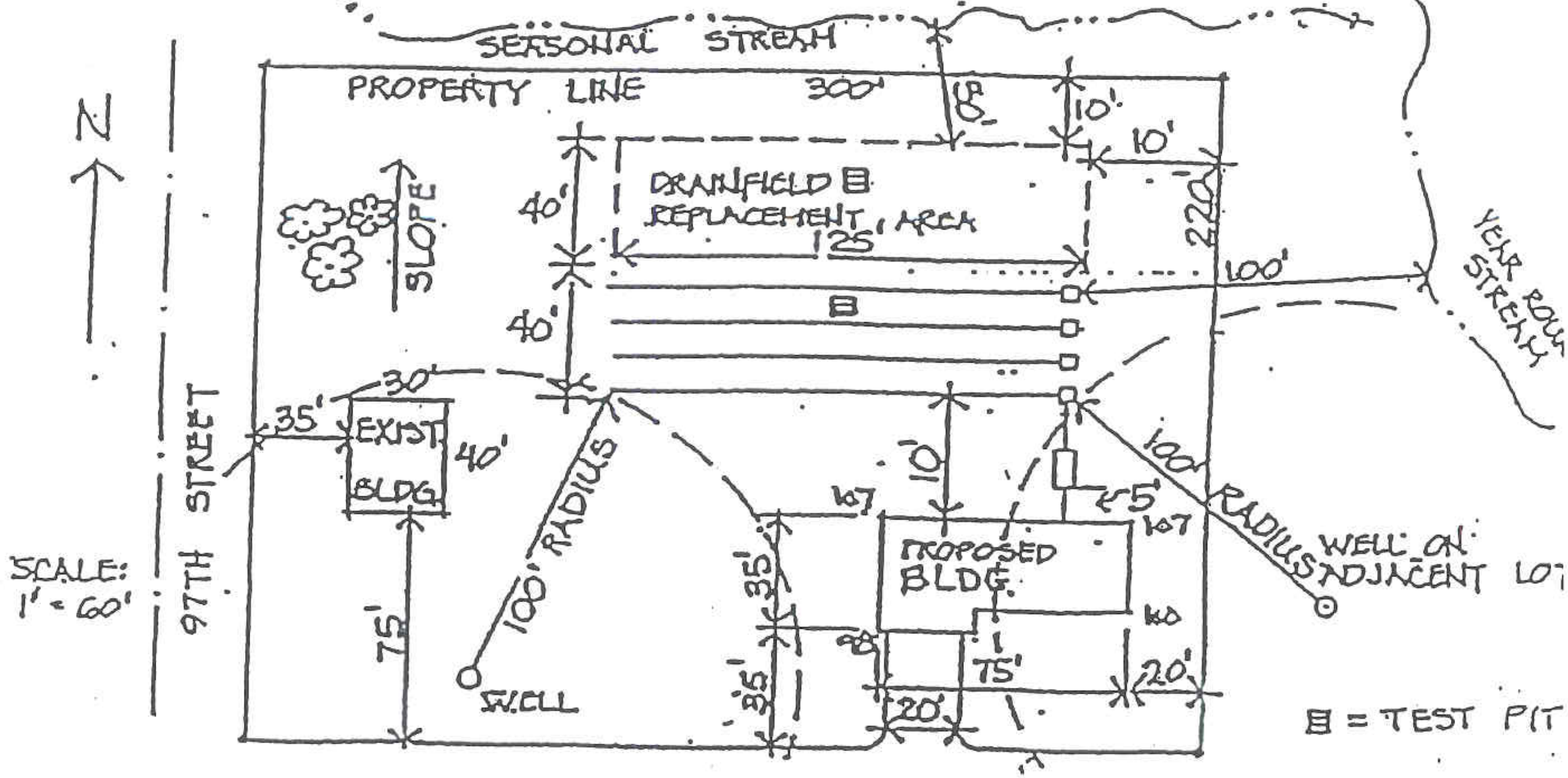
DATED this ________ day of ________________________ 20________

SIGNATURES of each owner of the subject property:

____________________________ ____________________________

____________________________ ____________________________

SAMPLE ONLY



SEASONAL STREAM
PROPERTY LINE
300'
18'
10'
10'
220'
100'
YEAR ROUND STREAM
N
SLOPE
DRAINFIELD
REPLACEMENT AREA
125'
40'
40'
30'
35'
EXIST BLDG
40'
75'
97TH STREET
SCALE: 1' = 60'
100' RADIUS
WELL
10'
5'
PROPOSED BLDG
35'
35'
75'
20'
20'
100' RADIUS
WELL ON ADJACENT LOT
= TEST PIT

INSTRUCTIONS FOR PREPARING A RESIDENTIAL SITE PLAN

Site plan must be current, drawn to scale on 8 ½ x 11 paper, and show all property lines. If unable to draw to scale, property lines must still be shown noting actual dimensions or total acreage.

Failure to include all of the items listed below may delay the review necessary to obtain a permit

ITEMS THAT MUST BE SHOWN ON YOUR SITE PLAN:

1. **NORTH ARROW.**
2. **SCALE OF DRAWING.**
3. **STREET NAME** accessing the parcel.
4. **ALL PROPERTY LINES AND DIMENSIONS** – existing and proposed.
5. **DRIVEWAYS AND ROADS** – existing and proposed.
6. **EXISTING AND PROPOSED STRUCTURES** - label as *"Proposed"* and *"Existing"*. Include dimensions and distance to all property lines and other structures.
7. **UTILITY LINES AND EASEMENTS.**
8. **GEOGRAPHIC FEATURES** – ground slope and direction of slope, escarpments, streams, ponds, or other drainage ways.
9. **WELLS** – existing and proposed on this parcel and adjacent parcels within 100 feet.
10. **FENCES, RETAINING WALLS** – location of existing and/or proposed.
11. **PARTITIONING** (if applicable) – shown by dotted lines, with parcels labeled as *"Parcel 1", "Parcel 2"*, etc.
12. **SEPTIC SYSTEM** and **REPLACEMENT AREA** – existing and proposed. Show existing septic tank, drainfield lines and distance from structure(s).
13. **CUTS/FILLS** – show existing and proposed.
14. **ELEVATIONS** – at lot corners or construction area and at corners of building site.

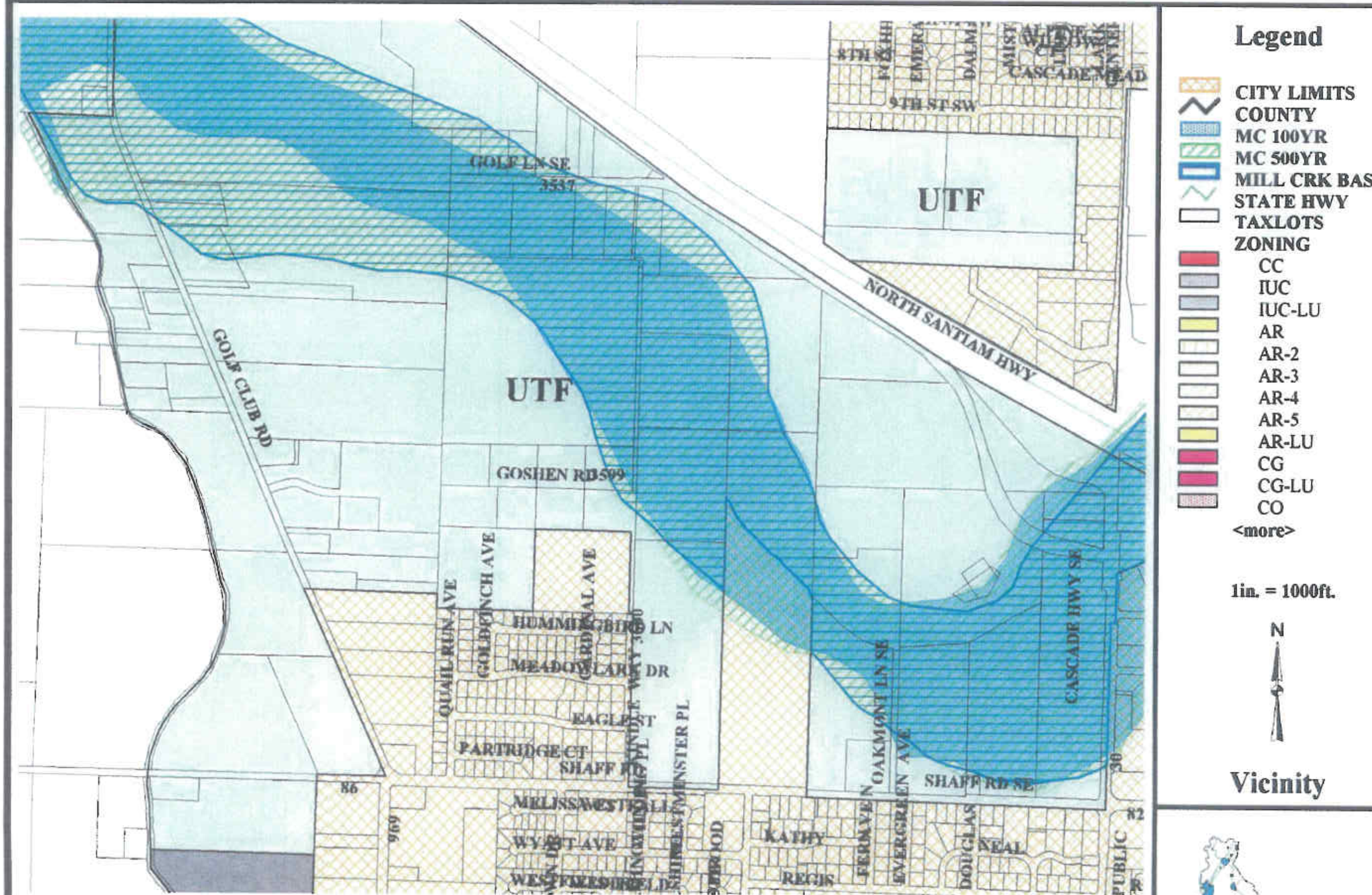
If sanitary sewer service is not available, a septic system must be installed. Include the following additional items on the site plan:

TEST HOLES – show distances between holes and property lines. One test hole should be located in the center of the initial system installation site, the other in the center of the replacement area. Accuracy of location is very important.

Additional information, such as patio slabs, walkways, roof overhangs, etc., may be required for the issuance of your permit.

USE THE REVERSE SIDE OF THIS FORM TO DRAW YOUR SITE PLAN

Marion County Map



This map was produced using the Marion County GIS data. The GIS data is maintained by the county to support its governmental activities. The County is not reponsible for map errors, ommisions, misuse or misinterpretation.

03/11/2004

B.6 Threatened and Endangered Species Summary

Threatened and Endangered Species System (TESS)

Listings by State and Territory as of 03/09/2004

Oregon

Notes:

- *Displays one record per species or population.*
- *This list does not include experimental populations and similarity of appearance listings.*
- *The range of a listed population does not extend beyond the states in which that population is defined.*
- *This list does not include non-nesting sea turtles and whales in State/Territory coastal waters.*
- *Includes species or populations under the sole jurisdiction of the National Marine Fisheries Service.*

Go to the Threatened and Endangered Wildlife and Plants Page
Go to the TESS Home Page

View All Listed Species in State

Return to US Map

- *Click on the highlighted scientific names below to view a Species Profile for each listing.*

Oregon -- 50 listings

Animals -- 32

Status	Listing
E	Albatross, short-tailed (*Phoebastria (=Diomedea) albatrus*)
E	Butterfly, Fender's blue (*Icaricia icarioides fenderi*)
T	Butterfly, Oregon silverspot (*Speyeria zerene hippolyta*)
E	Chub, Borax Lake (*Gila boraxobius*)
T	Chub, Hutton tui (Hutton) (*Gila bicolor ssp.*)
E	Chub, Oregon (*Oregonichthys crameri*)
T	Dace, Foskett speckled (Foskett) (*Rhinichthys osculus ssp.*)
E	Deer, Columbian white-tailed Columbia River DPS (*Odocoileus virginianus leucurus*)
T	Eagle, bald (lower 48 States) (*Haliaeetus leucocephalus*)
T	Fairy shrimp, vernal pool (*Branchinecta lynchi*)
T	Murrelet, marbled (CA, OR, WA) (*Brachyramphus marmoratus marmoratus*)
T	Owl, northern spotted (*Strix occidentalis caurina*)
E	Pelican, brown (except U.S. Atlantic coast, FL, AL) (*Pelecanus occidentalis*)
T	Plover, western snowy (Pacific coastal pop.) (*Charadrius alexandrinus nivosus*)
T	Salmon, chinook (fall Snake R.) (*Oncorhynchus (=Salmo) tshawytscha*)
T	Salmon, chinook (spring/summer Snake R.) (*Oncorhynchus (=Salmo) tshawytscha*)
T	Salmon, chinook (lower Columbia R.) (*Oncorhynchus (=Salmo) tshawytscha*)
T	Salmon, chinook (upper Willamette R.) (*Oncorhynchus (=Salmo) tshawytscha*)
T	Salmon, chum (Columbia R.) (*Oncorhynchus (=Salmo) keta*)
T	Salmon, coho (OR, CA pop.) (*Oncorhynchus (=Salmo) kisutch*)
E	Salmon, sockeye U.S.A. (Snake River, ID stock wherever found.) (*Oncorhynchus (=Salmo) nerka*)
T	Sea turtle, green (except where endangered) (*Chelonia mydas*)
E	Sea turtle, leatherback (*Dermochelys coriacea*)
T	Sea turtle, loggerhead (*Caretta caretta*)
T	Sea-lion, Steller (eastern pop.) (*Eumetopias jubatus*)
T	Steelhead (Snake R. Basin) (*Oncorhynchus (=Salmo) mykiss*)
T	Steelhead (lower Columbia R.) (*Oncorhynchus (=Salmo) mykiss*)
T	Steelhead (middle Columbia R.) (*Oncorhynchus (=Salmo) mykiss*)
T	Steelhead (upper Willamette R.) (*Oncorhynchus (=Salmo) mykiss*)
E	Sucker, Lost River (*Deltistes luxatus*)
E	Sucker, shortnose (*Chasmistes brevirostris*)
T	Sucker, Warner (*Catostomus warnerensis*)
T	Trout, bull (U.S.A., conterminous, lower 48 states) (*Salvelinus confluentus*)

T Trout, Lahontan cutthroat (*Oncorhynchus clarki henshawi*)
E Whale, humpback (*Megaptera novaeangliae*)
T Wolf, gray Western Distinct Population Segment (*Canis lupus*)

Plants -- 18

Status	*Listing*
E	Rock-cress, McDonald's (*Arabis mcdonaldiana*)
E	Sandwort, Marsh (*Arenaria paludicola*)
E	Milk-vetch, Applegate's (*Astragalus applegatei*)
T	Paintbrush, golden (*Castilleja levisecta*)
E	Daisy, Willamette (*Erigeron decumbens* var. *decumbens*)
E	Fritillary, Gentner's (*Fritillaria gentneri*)
T	Howellia, water (*Howellia aquatilis*)
E	Lily, Western (*Lilium occidentale*)
E	Meadowfoam, large-flowered wooly (*Limnanthes floccosa grandiflora*)
E	Desert-parsley, Bradshaw's (*Lomatium bradshawii*)
E	Lomatium, Cook's (*Lomatium cookii*)
T	Lupine, Kincaid's (*Lupinus sulphureus (=oreganus)* ssp. *kincaidii (=var. kincaidii)*)
T	Four-o'clock, MacFarlane's (*Mirabilis macfarlanei*)
E	Popcornflower, rough (*Plagiobothrys hirtus*)
T	Checker-mallow, Nelson's (*Sidalcea nelsoniana*)
T	Catchfly, Spalding's (*Silene spaldingii*)
E	Wire-lettuce, Malheur (*Stephanomeria malheurensis*)
T	Thelypody, Howell's spectacular (*Thelypodium howellii spectabilis*)

B.7 Cultural Resources Review

Oregon
Theodore R. Kulongoski, Governor

Parks and Recreation Department
State Historic Preservation Office
725 Summer St. NE, Suite C
Salem, OR 97301-1271
(503) 986-0707
FAX (503) 986-0793
www.hcd.state.or.us

March 22, 2004

Mr. Justin Walker
Keller Associates
131 SW 5th Ste A
Meridian, ID 83642

RE: SHPO Case No. 04-0498
Stayton Regional Wastewater Interceptor System
Construction of wastewater system
Keller Associates
8S 1W 33 and 9S 1W 3 and 4, Stayton, Marion County

Dear Mr. Walker:

Our office recently received a request to conduct a cultural resource review for the area of the project referenced above. In checking our statewide cultural resource database, I find that there have been no previous cultural surveys completed within your proposed project area but cultural sites are known to exist in the surrounding area. Your project area is located on a landform generally perceived to have a high probability for possessing archaeological sites and buried human remains.

While not having sufficient knowledge to pinpoint the exact location of cultural resources within your project area, two possibilities are open for determining the possibility of their presence. These possibilities include: 1) the completion of a cultural resource pedestrian survey of the area to identify any surface material, or 2) have an archaeological/tribal monitor on site for all surface disturbance activities. Due to the very high likelihood of significant sites being present, in this instance I suggest that your office contact an archaeologist to complete a cultural resource survey of the project area. A list of possible archaeological consultants can be found on our web page (www.hcd.state.or.us) by clicking on SHPO and highlighting the section marked Archaeological Permits.

ORS 358.905 and ORS 97.740 protect archaeological sites and objects and human remains on both state public and private lands in Oregon. I hope that by providing the above-suggested archaeological survey, damage to any archaeological sites in the area of your proposed project can be avoided.

If you have any questions about the above comments or would like additional information, please feel to contact me at your convenience.

Dennis Griffin

Dennis Griffin, Ph.D., RPA
SHPO Archaeologist
(503) 986-0674
dennis.griffin@state.or.us

MAR 2 4 2004

Index by State and City (Links) - NATIONAL REGISTER OF HISTORIC PLACES 03/15/2004 15:43:41

No filter Include filter in navigation

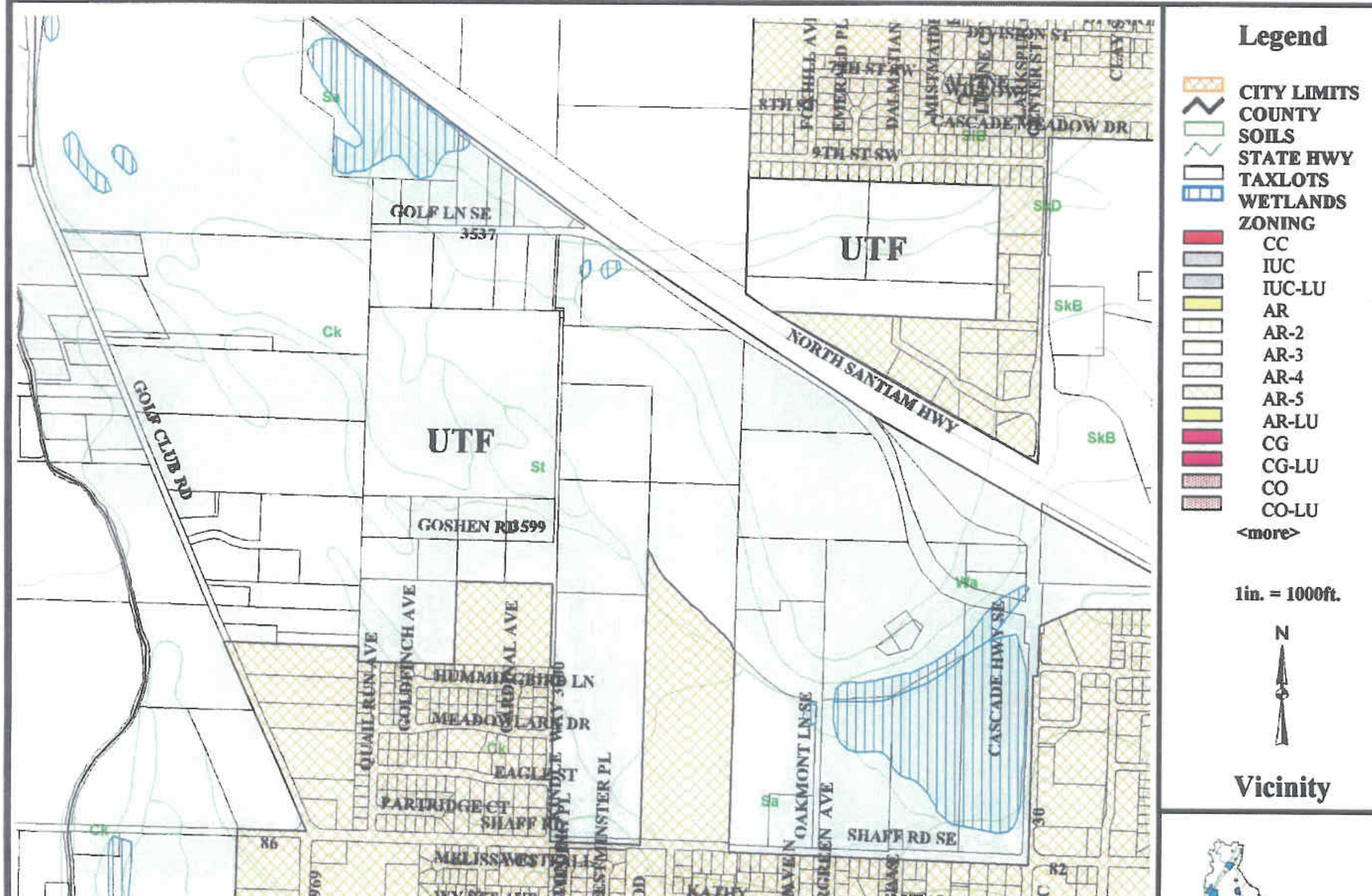
Row	STATE	COUNTY	RESOURCE NAME	ADDRESS	CITY	LISTED	MULTIPLE	WEB PAGE
1	OR	Linn	**Mt. Pleasant Presbyterian Church**	S of Stayton on Stayton-Jordan Rd.	Stayton	1974-01-24		NULL
2	OR	Marion	**Brown, Charles and Martha, House**	425 N. First Ave.	Stayton	2002-09-06		NULL
3	OR	Marion	**Paris Woolen Mill**	535 E. Florence St.	Stayton	1981-12-21		NULL

Page 1

First Page Next Page Refresh Export

Marion County Map

Wetlands and Land Use



This map was produced using the Marion County GIS data. The GIS data is maintained by the county to support its governmental activities. The County is not reponsible for map errors, ommisions, misuse or misinterpretation.

03/11/2004

Appendix C
Model Data

KELLER ASSOCIATES

STORM WATER MONITORING LOCATIONS

ID	SIZE	DESCRIPTION	TEST SEQUENCE*
1	24"	PLACE IN N. END OF VAULT (Deep)	1
2	30"	PLACE IN OUTFALL	2
3	19"	PLACE IN MANHOLE	1
4	12"	PLACE IN CB	3
5	18"	PLACE IN S. SIDE OF MANHOLE	2
6	18"	PLACE IN CB (LOCATED IN BLACKBERRY BUSHES)	3
7	48"	AT OUTFALL OR MANHOLE	4
8	24"	DOWNSTREAM SIDE OF MH	4
9	18"	PLACE IN DOWNSTREAM SIDE OF CB	5
10	24"?	ACCESS UNKNOWN	5

* ORDER OF TESTS (TWO FLOW METERS)

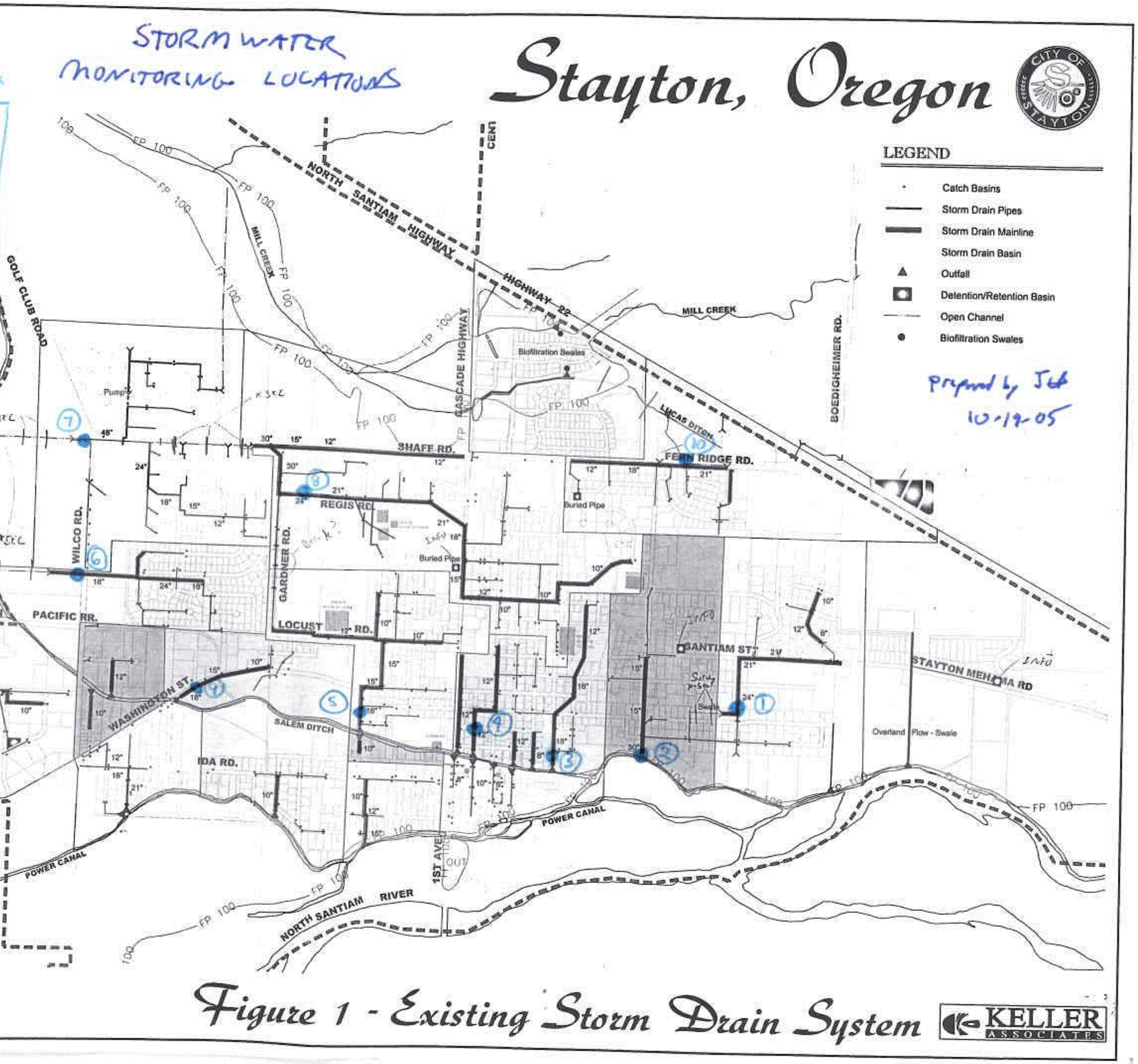
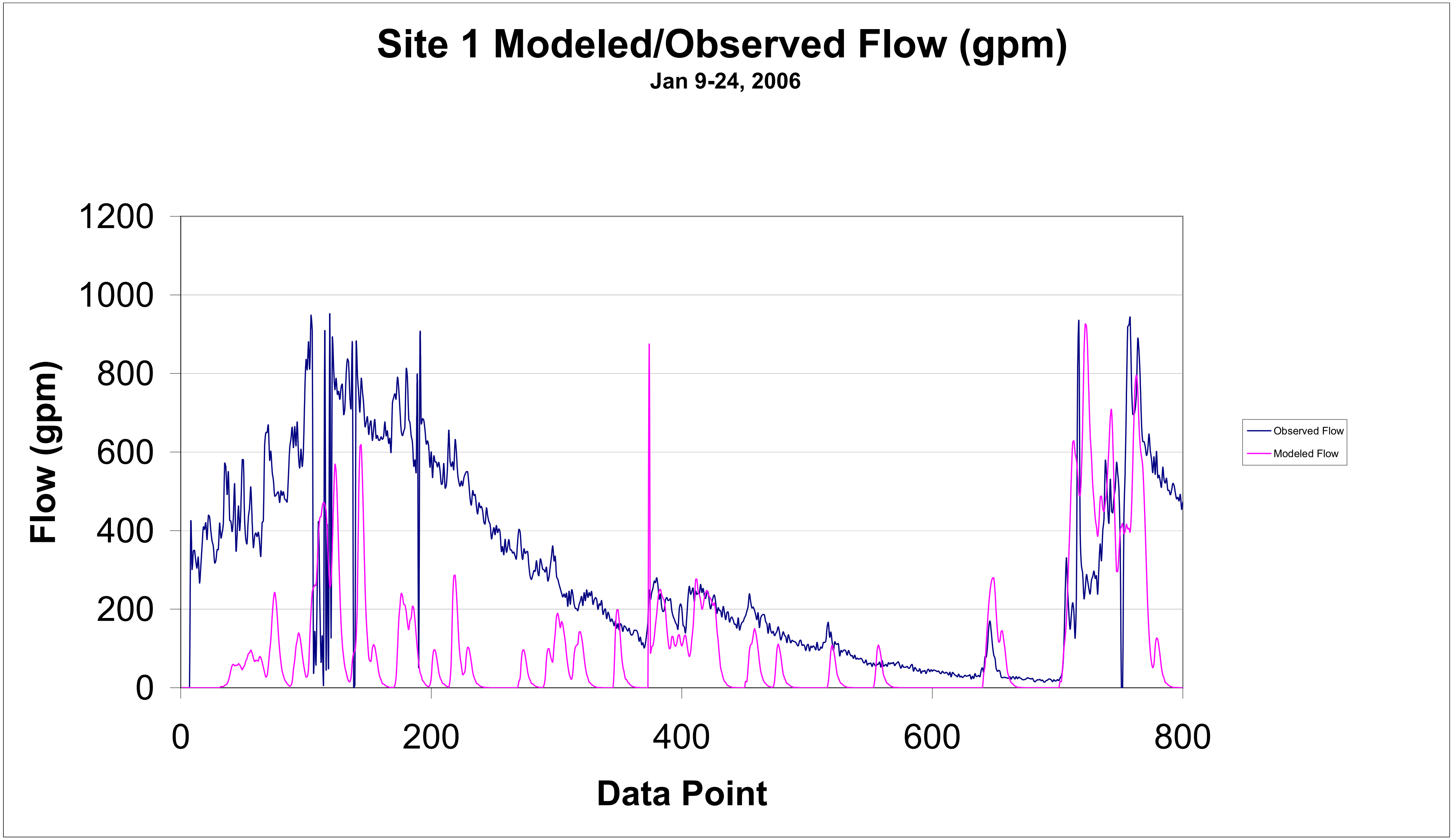


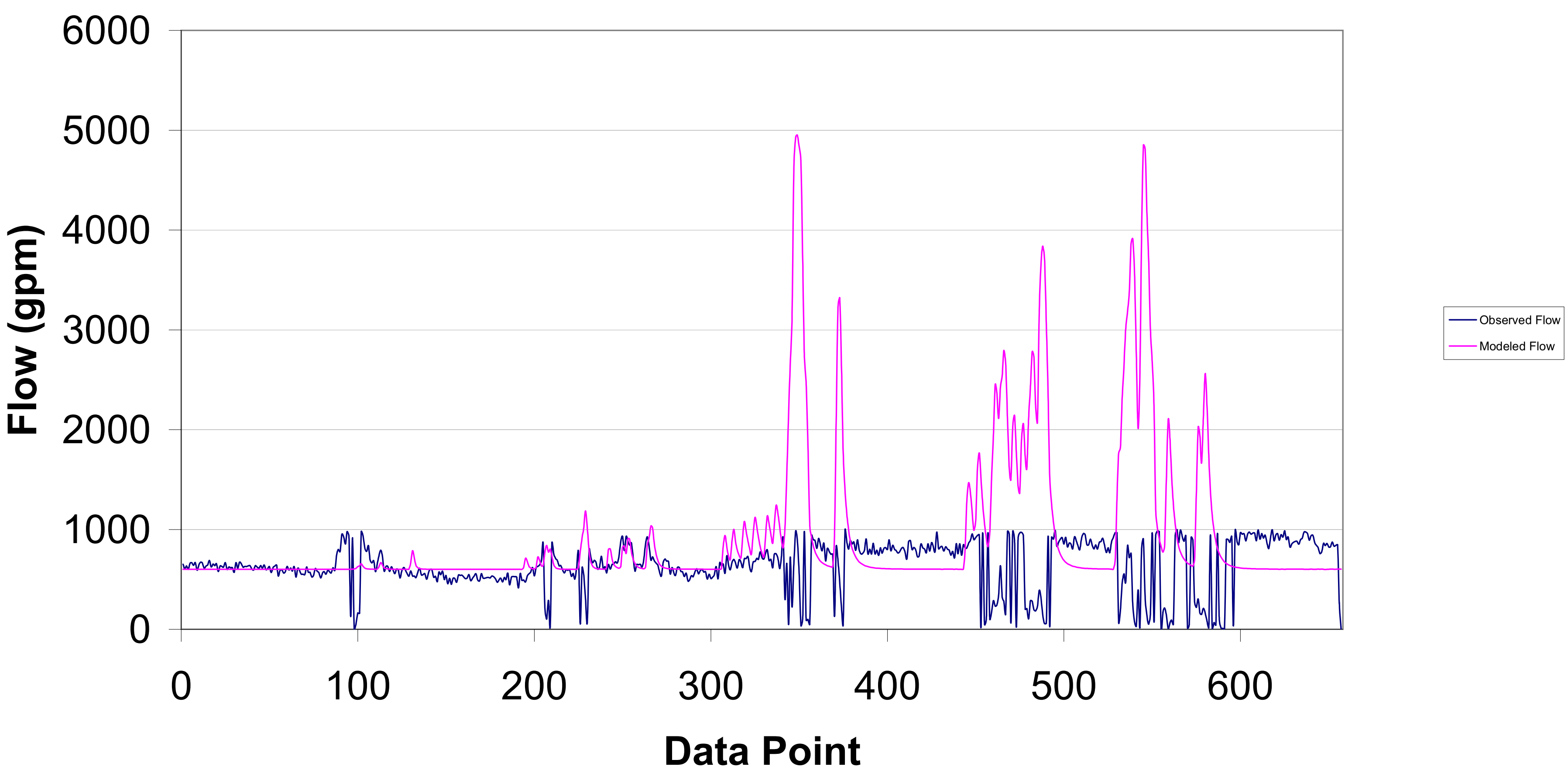
Figure 1 - Existing Storm Drain System

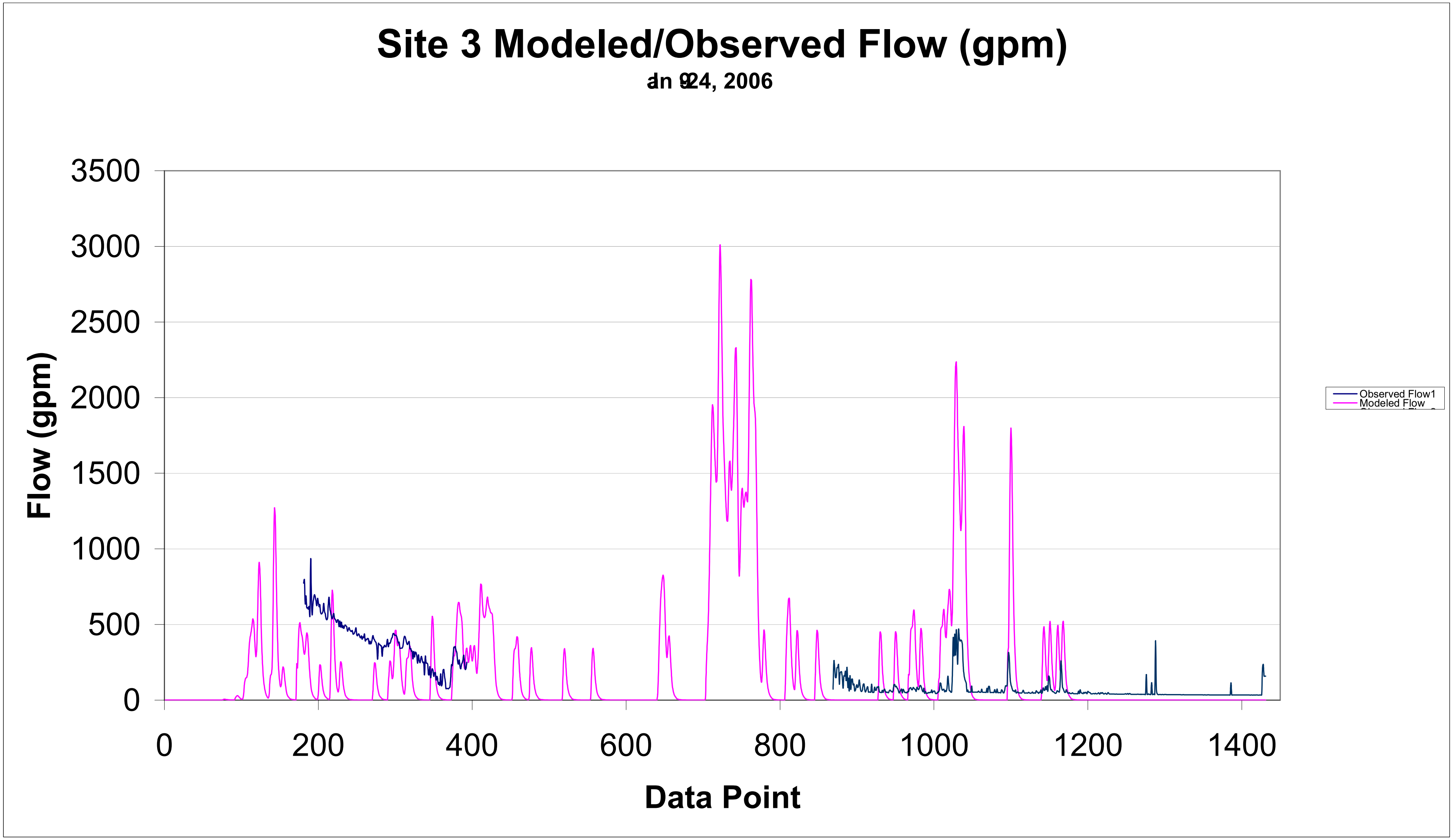
KELLER ASSOCIATES


Site 1 Modeled/Observed Flow (gpm)
Jan 9-24, 2006
Flow (gpm)
1200
1000
800
600
400
200
0
0
200
400
600
800
Data Point
Observed Flow
Modeled Flow

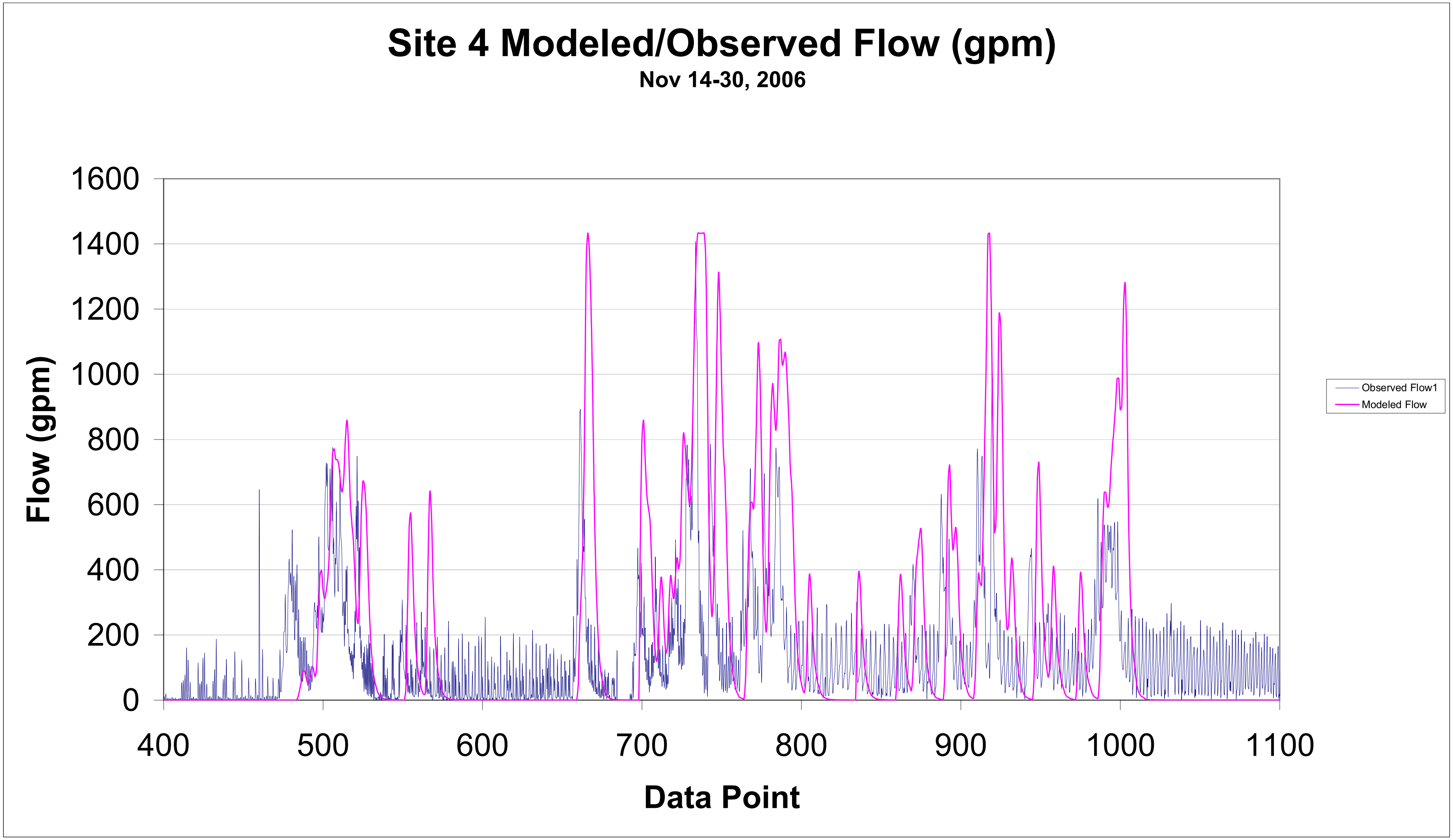
Site 2 Modeled/Observed Flow (gpm)

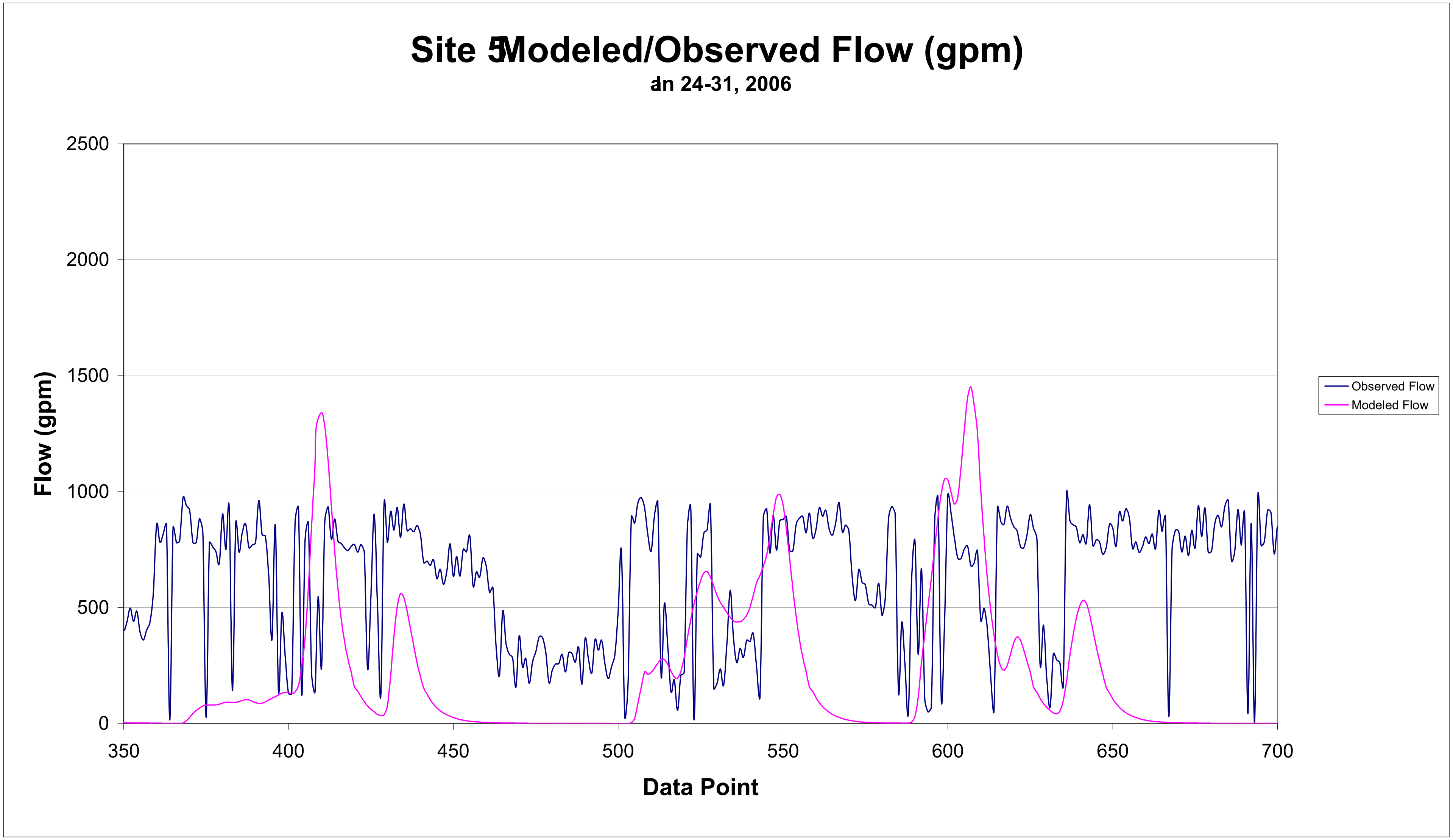
Jan 24-31, 2006





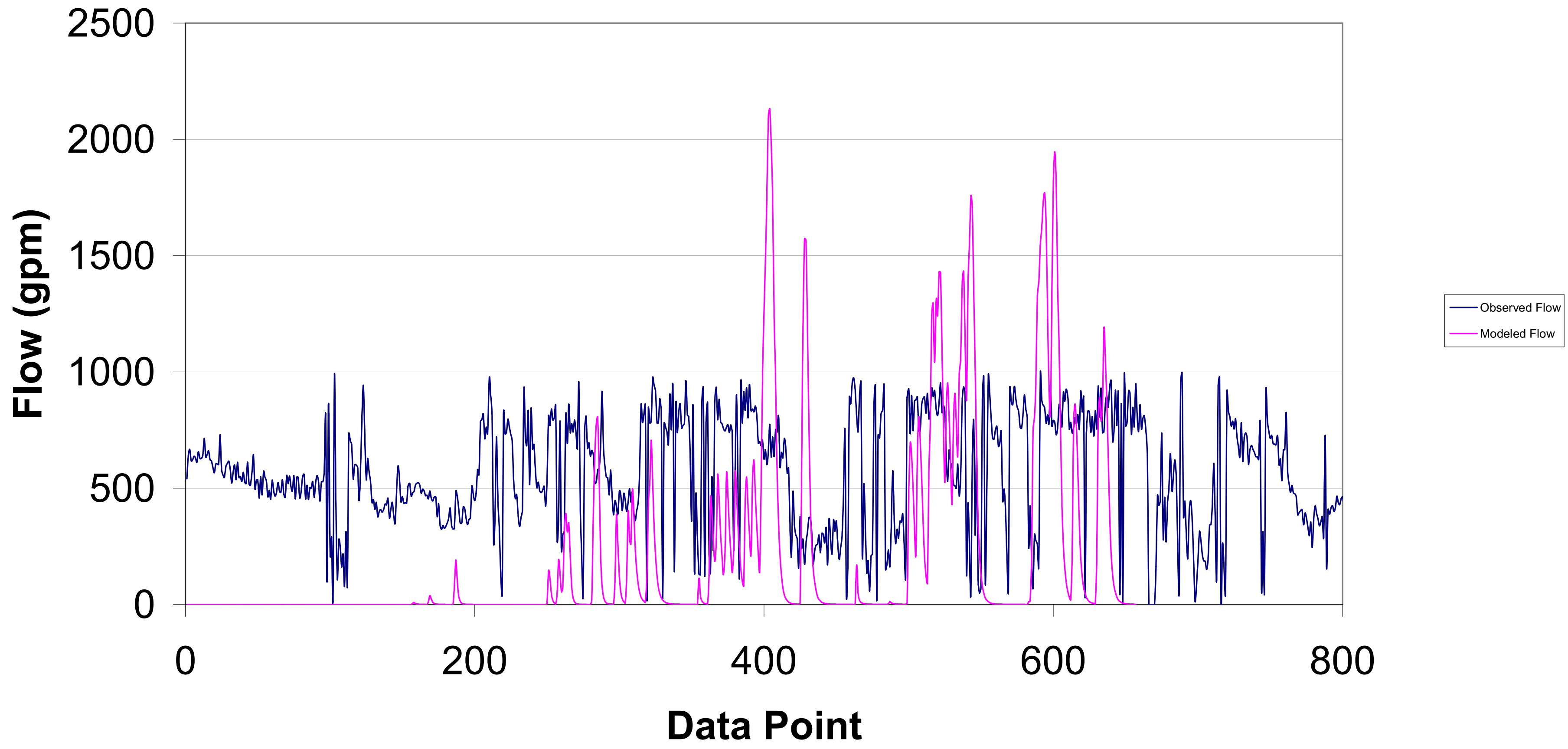
Site 3 Modeled/Observed Flow (gpm)
Flow (gpm)
3500
3000
2500
2000
1500
1000
500
0
0
200
400
600
800
1000
1200
1400
Data Point
Observed Flow1
Modeled Flow

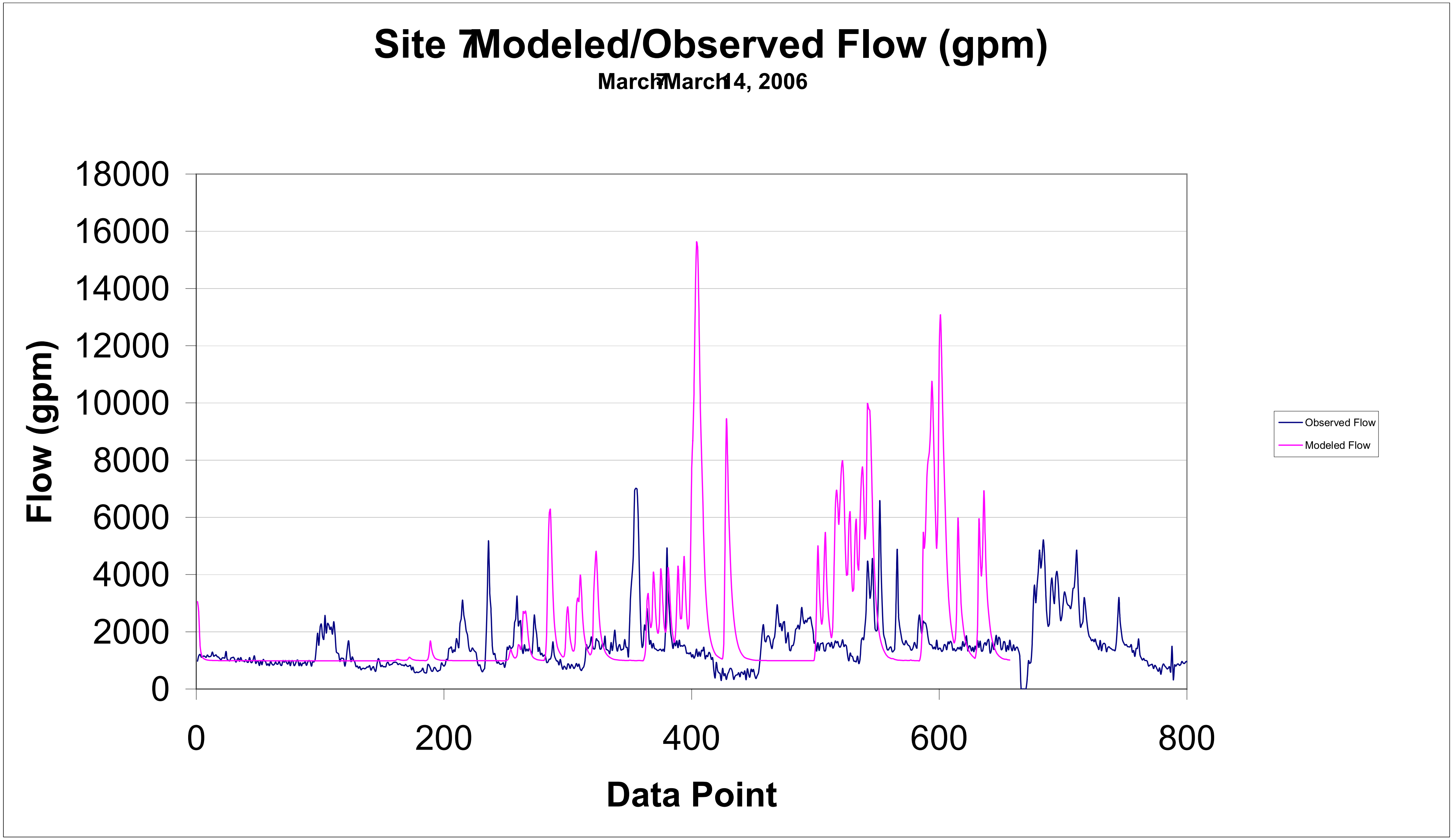

Site 4 Modeled/Observed Flow (gpm)
Nov 14-30, 2006
Flow (gpm)
1600
1400
1200
1000
800
600
400
200
0
400
500
600
700
800
900
1000
1100
Data Point
Observed Flow1
Modeled Flow


Site 5 Modeled/Observed Flow (gpm)
Jan 24-31, 2006
Flow (gpm)
2500
2000
1500
1000
500
0
350
400
450
500
550
600
650
700
Data Point
Observed Flow
Modeled Flow

Site 6 Modeled/Observed Flow (gpm)

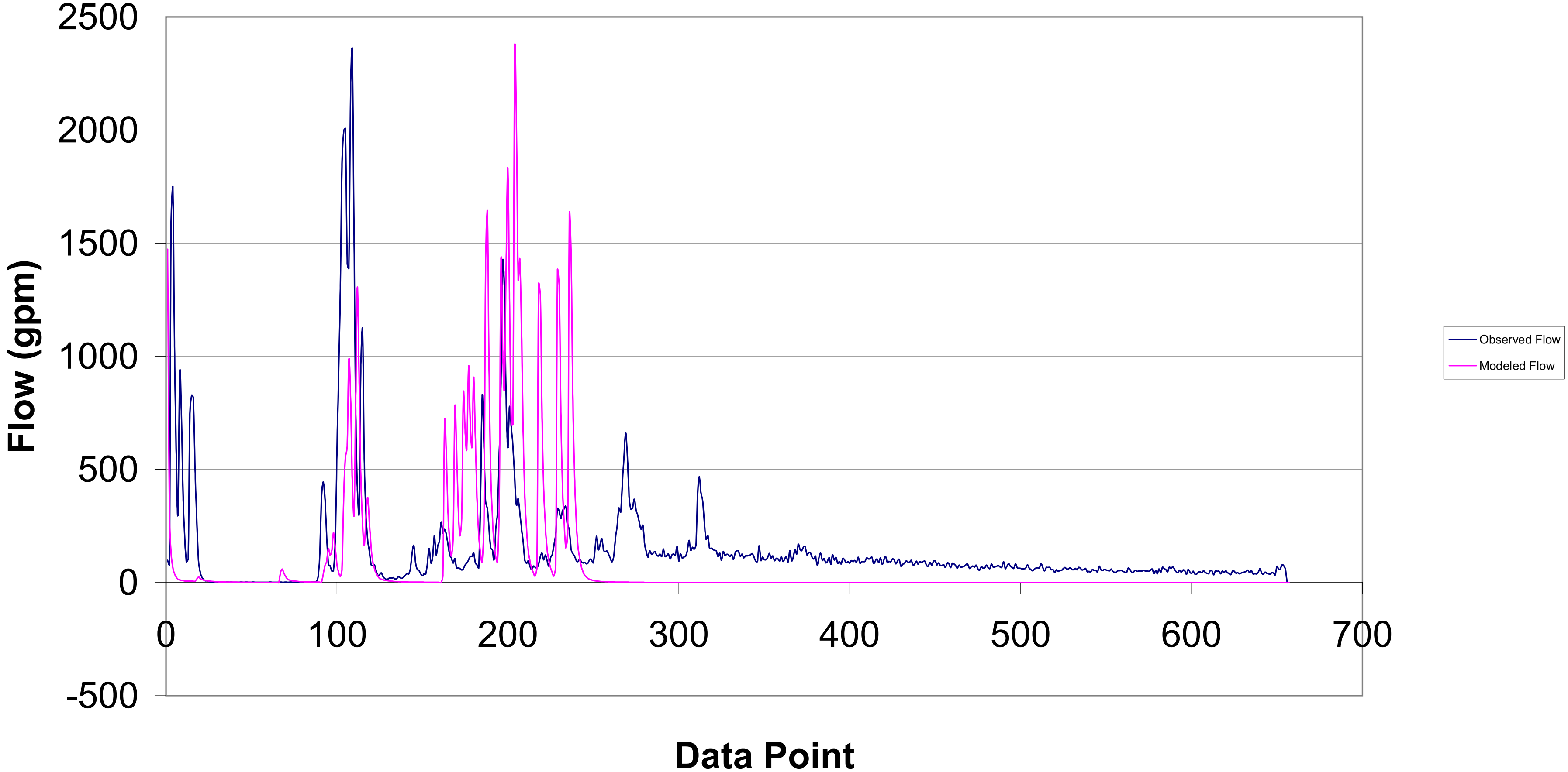
dn 24-Feb 92006

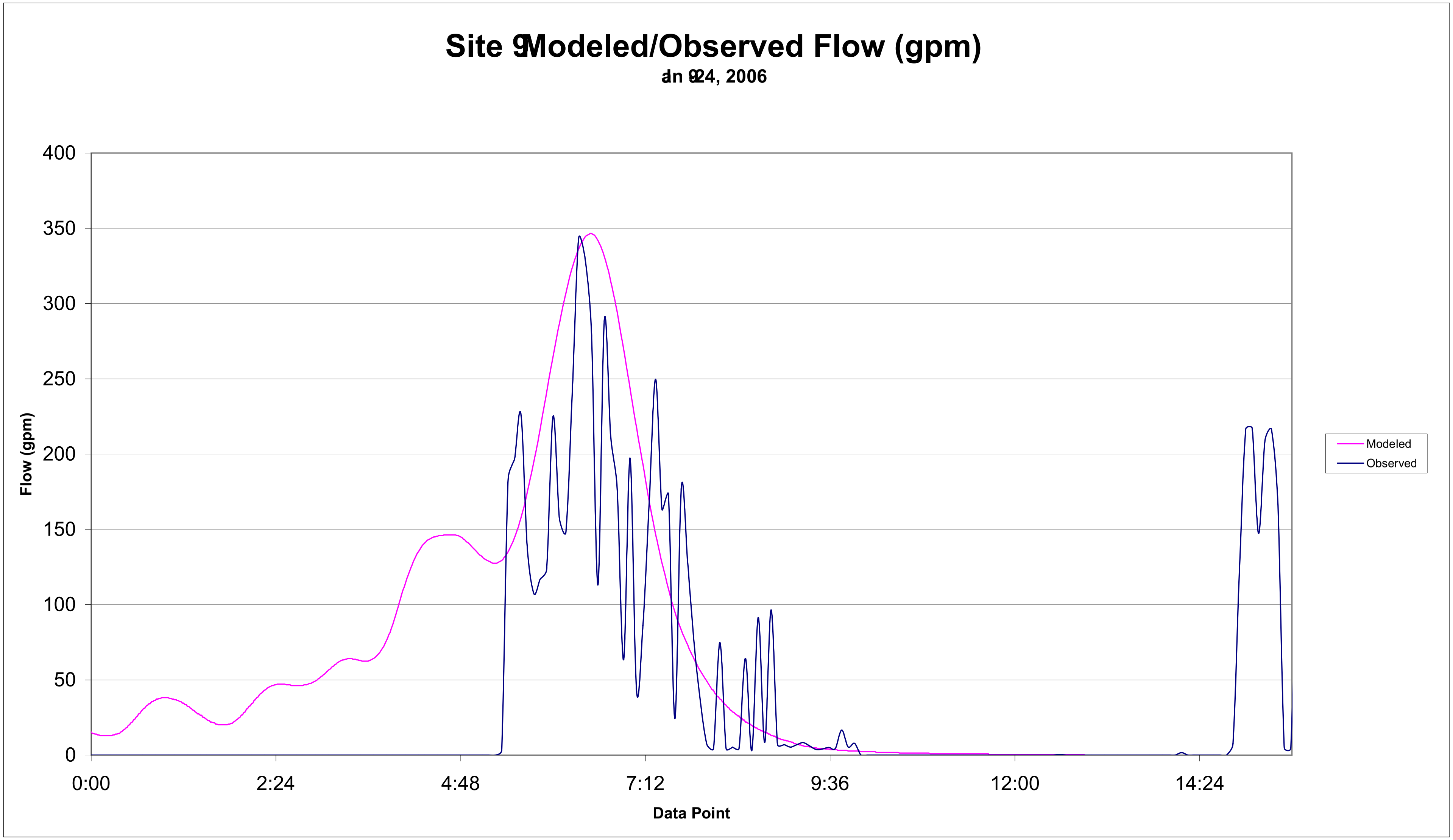



Site 7 Modeled/Observed Flow (gpm)
March 7 March 14, 2006
Flow (gpm)
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
0
200
400
600
800
Data Point
Observed Flow
Modeled Flow

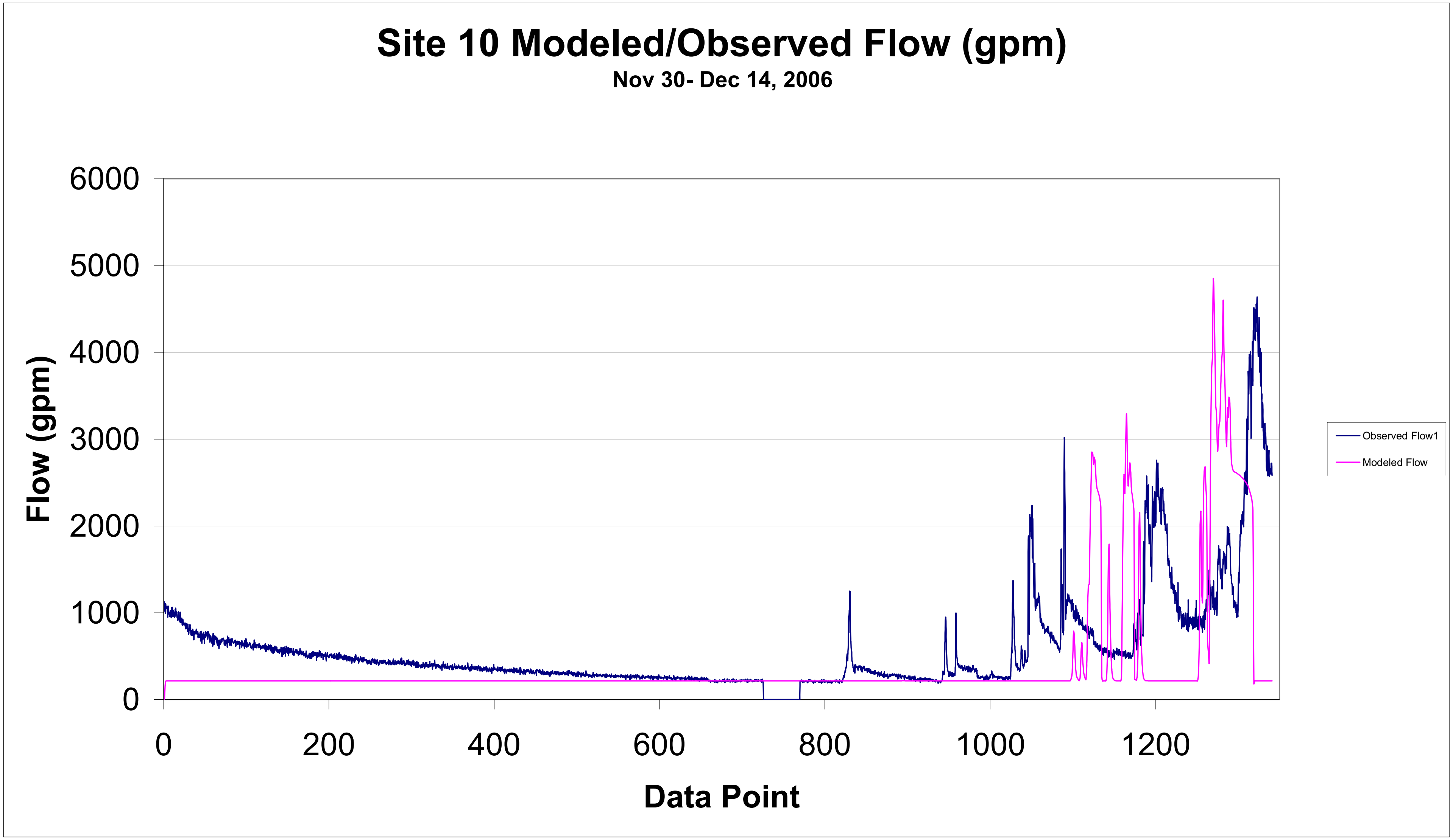
Site 8 Modeled/Observed Flow (gpm)

March 7 - March 14, 2006





Site 9 Modeled/Observed Flow (gpm)
Jun 24, 2006
Flow (gpm)
400
350
300
250
200
150
100
50
0
0:00
2:24
4:48
7:12
9:36
12:00
14:24
Data Point
Modeled
Observed


Site 10 Modeled/Observed Flow (gpm)
Nov 30- Dec 14, 2006
Flow (gpm)
6000
5000
4000
3000
2000
1000
0
0
200
400
600
800
1000
1200
Data Point
Observed Flow1
Modeled Flow

Appendix D
Water Quality Related Data

KELLER
ASSOCIATES

D.1 Storm Water Quality Lab Report

TestAmerica
ANALYTICAL TESTING CORPORATION

PORTLAND, OR 9405 S.W. NIMBUS AVENUE
BEAVERTON, OR 97008-7132
ph: (503) 906.9200 fax: (503) 906.9210

March 19, 2007

Brenda Kuiken
City of Stayton
362 N Third Avenue
Stayton, OR 97383

RE: Stormwater Testing

Enclosed are the results of analyses for samples received by the laboratory on 03/01/07 14:56.
The following list is a summary of the Work Orders contained in this report, generated on 03/19/07 17:28.

If you have any questions concerning this report, please feel free to contact me.

Work Order	Project	ProjectNumber
PQC0032	Stormwater Testing	Stormwater Testing

Brian Cone, Industrial Services Manager

TestAmerica
ANALYTICAL TESTING CORPORATION

PORTLAND, OR 9405 S.W. NIMBUS AVENUE
BEAVERTON, OR 97008-7132
ph: (503) 906.9200 fax: (503) 906.9210

City of Stayton	Project Name:	**Stormwater Testing**	
362 N Third Avenue	Project Number:	Stormwater Testing	Report Created:
Stayton, OR 97383	Project Manager:	Brenda Kuiken	03/19/07 17:28

ANALYTICAL REPORT FOR SAMPLES

Sample ID	Laboratory ID	Matrix	Date Sampled	Date Received
INLET	PQC0032-01	Water	03/01/07 10:20	03/01/07 14:56
6 AVE	PQC0032-02	Water	03/01/07 11:20	03/01/07 14:56
OUTLET	PQC0032-03	Water	03/01/07 12:00	03/01/07 14:56
CCH BSN	PQC0032-04	Water	03/01/07 12:50	03/01/07 14:56

TestAmerica - Portland, OR

Brian L Cone

Brian Cone, Industrial Services Manager

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report shall not be reproduced except in full, without the written approval of the laboratory.

TestAmerica
ANALYTICAL TESTING CORPORATION

PORTLAND, OR 9405 S.W. NIMBUS AVENUE
BEAVERTON, OR 97008-7132
ph: (503) 906.9200 fax: (503) 906.9210

City of Stayton
362 N Third Avenue
Stayton, OR 97383

Project Name: **Stormwater Testing**
Project Number: Stormwater Testing
Project Manager: Brenda Kuiken

Report Created:
03/19/07 17:28

Total Metals per EPA 200 Series Methods

TestAmerica - Portland, OR

Analyte	Method	Result	MDL*	MRL	Units	Dil	Batch	Prepared	Analyzed	Notes
PQC0032-01 (INLET)		**Water**			**Sampled: 03/01/07 10:20**					
Calcium	EPA 200.7	**3.57**	-----	0.100	mg/l	1x	7030531	03/14/07 11:27	03/16/07 20:21	
Copper	EPA 200.8	ND	-----	0.00200	"	"	7030485	03/13/07 14:22	03/15/07 01:05	
Lead	"	ND	-----	0.00100	"	"	"	"	"	
Magnesium	EPA 200.7	**1.09**	-----	0.100	"	"	7030531	03/14/07 11:27	03/16/07 20:21	
Zinc	EPA 200.8	ND	-----	0.00500	"	"	7030485	03/13/07 14:22	03/15/07 01:05	
PQC0032-02 (6 AVE)		**Water**			**Sampled: 03/01/07 11:20**					
Calcium	EPA 200.7	**11.9**	-----	0.100	mg/l	1x	7030531	03/14/07 11:27	03/16/07 20:40	
Copper	EPA 200.8	ND	-----	0.00200	"	"	7030485	03/13/07 14:22	03/15/07 01:12	
Lead	"	ND	-----	0.00100	"	"	"	"	"	
Magnesium	EPA 200.7	**2.60**	-----	0.100	"	"	7030531	03/14/07 11:27	03/16/07 20:40	
Zinc	EPA 200.8	ND	-----	0.00500	"	"	7030485	03/13/07 14:22	03/15/07 01:12	
PQC0032-03 (OUTLET)		**Water**			**Sampled: 03/01/07 12:00**					
Calcium	EPA 200.7	**4.24**	-----	0.100	mg/l	1x	7030531	03/14/07 11:27	03/16/07 20:46	
Copper	EPA 200.8	ND	-----	0.00200	"	"	7030485	03/13/07 14:22	03/15/07 01:20	
Lead	"	ND	-----	0.00100	"	"	"	"	"	
Magnesium	EPA 200.7	**1.16**	-----	0.100	"	"	7030531	03/14/07 11:27	03/16/07 20:46	
Zinc	EPA 200.8	ND	-----	0.00500	"	"	7030485	03/13/07 14:22	03/15/07 01:20	
PQC0032-04 (CCH BSN)		**Water**			**Sampled: 03/01/07 12:50**					
Calcium	EPA 200.7	**10.5**	-----	0.100	mg/l	1x	7030531	03/14/07 11:27	03/16/07 20:53	
Copper	EPA 200.8	ND	-----	0.00200	"	"	7030485	03/13/07 14:22	03/15/07 01:27	
Lead	"	ND	-----	0.00100	"	"	"	"	"	
Magnesium	EPA 200.7	**2.49**	-----	0.100	"	"	7030531	03/14/07 11:27	03/16/07 20:53	
Zinc	EPA 200.8	**0.0202**	-----	0.00500	"	"	7030485	03/13/07 14:22	03/15/07 01:27	

TestAmerica - Portland, OR

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report shall not be reproduced except in full, without the written approval of the laboratory.

Brian L Cone

Brian Cone, Industrial Services Manager

PORTLAND, OR 9405 S.W. NIMBUS AVENUE
BEAVERTON, OR 97008-7132
ph: (503) 906.9200 fax: (503) 906.9210

City of Stayton	Project Name:	Stormwater Testing	
362 N Third Avenue	Project Number:	Stormwater Testing	Report Created:
Stayton, OR 97383	Project Manager:	Brenda Kuiken	03/19/07 17:28

Dissolved Metals per EPA 200 Series Methods

TestAmerica - Portland, OR

Analyte	Method	Result	MDL*	MRL	Units	Dil	Batch	Prepared	Analyzed	Notes
PQC0032-01 (INLET)		**Water**			**Sampled: 03/01/07 10:20**					
Copper	EPA 200.8	ND	-----	0.00200	mg/l	1x	7030142	03/05/07 10:09	03/06/07 15:57	
PQC0032-02 (6 AVE)		**Water**			**Sampled: 03/01/07 11:20**					
Copper	EPA 200.8	ND	-----	0.00200	mg/l	1x	7030142	03/05/07 10:09	03/06/07 16:01	
PQC0032-03 (OUTLET)		**Water**			**Sampled: 03/01/07 12:00**					
Copper	EPA 200.8	ND	-----	0.00200	mg/l	1x	7030142	03/05/07 10:09	03/06/07 16:05	
PQC0032-04 (CCH BSN)		**Water**			**Sampled: 03/01/07 12:50**					
Copper	EPA 200.8	ND	-----	0.00200	mg/l	1x	7030142	03/05/07 10:09	03/06/07 16:09	

TestAmerica - Portland, OR

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report shall not be reproduced except in full, without the written approval of the laboratory.

Brian L Cone

Brian Cone, Industrial Services Manager

PORTLAND, OR 9405 S.W. NIMBUS AVENUE
BEAVERTON, OR 97008-7132
ph: (503) 906.9200 fax: (503) 906.9210

City of Stayton	Project Name:	Stormwater Testing	
362 N Third Avenue	Project Number:	Stormwater Testing	Report Created:
Stayton, OR 97383	Project Manager:	Brenda Kuiken	03/19/07 17:28

Total Mercury per EPA Method 245.1

TestAmerica - Portland, OR

Analyte	Method	Result	MDL*	MRL	Units	Dil	Batch	Prepared	Analyzed	Notes
PQC0032-01 (INLET)		**Water**			**Sampled: 03/01/07 10:20**					
Mercury	EPA 245.1	ND	-----	0.000200	mg/l	1x	7030245	03/07/07 12:11	03/07/07 17:59	
PQC0032-02 (6 AVE)		**Water**			**Sampled: 03/01/07 11:20**					
Mercury	EPA 245.1	ND	-----	0.000200	mg/l	1x	7030245	03/07/07 12:11	03/07/07 18:01	
PQC0032-03 (OUTLET)		**Water**			**Sampled: 03/01/07 12:00**					
Mercury	EPA 245.1	ND	-----	0.000200	mg/l	1x	7030245	03/07/07 12:11	03/07/07 18:03	
PQC0032-04 (CCH BSN)		**Water**			**Sampled: 03/01/07 12:50**					
Mercury	EPA 245.1	ND	-----	0.000200	mg/l	1x	7030245	03/07/07 12:11	03/07/07 18:06	

TestAmerica - Portland, OR

Brian L Cone

Brian Cone, Industrial Services Manager

PORTLAND, OR 9405 S.W. NIMBUS AVENUE
BEAVERTON, OR 97008-7132
ph: (503) 906.9200 fax: (503) 906.9210

City of Stayton	Project Name:	Stormwater Testing	
362 N Third Avenue	Project Number:	Stormwater Testing	Report Created:
Stayton, OR 97383	Project Manager:	Brenda Kuiken	03/19/07 17:28

Conventional Chemistry Parameters per APHA/EPA Methods

TestAmerica - Portland, OR

Analyte	Method	Result	MDL*	MRL	Units	Dil	Batch	Prepared	Analyzed	Notes
PQC0032-01 (INLET)		**Water**			**Sampled: 03/01/07 10:20**					
Biochemical Oxygen Demand	EPA 405.1	ND	-----	4.00	mg/l	1x	7030064	03/02/07 08:59	03/07/07 18:47	
Chemical Oxygen Demand	EPA 410.4	**5.12**	-----	5.00	"	"	7030506	03/14/07 08:51	03/14/07 14:50	
Orthophosphate-phosphorus	EPA 365.2	ND	-----	0.0100	"	"	7030058	03/02/07 07:52	03/02/07 10:40	
Specific Conductivity	120.1/ 9050	**37.3**	-----	10.0	uS/cm	"	7030149	03/05/07 11:05	03/05/07 12:19	
Total Solids	EPA 160.3	**62.0**	-----	10.0	mg/l	"	7030316	03/08/07 14:40	03/08/07 16:57	
Total Suspended Solids	EPA 160.2/SM 2540D	**20.0**	-----	10.0	"	"	7030241	03/07/07 10:43	03/07/07 15:47	
Turbidity	EPA 180.1	**3.22**	-----	0.200	NTU	"	7030051	03/02/07 07:11	03/02/07 09:10	
Hardness	SM2340B	**13.4**	-----	0.662	mg/l	"	[CALC]	03/14/07 11:27	03/16/07 20:21	
pH	EPA 150.1	**7.33**	-----		pH Units	"	7030050	03/02/07 07:10	03/02/07 08:30	
Phosphorus	EPA 365.1	**0.0498**	-----	0.0200	mg/l	"	7030280	03/08/07 09:45	03/09/07 15:00	
PQC0032-02 (6 AVE)		**Water**			**Sampled: 03/01/07 11:20**					
Biochemical Oxygen Demand	EPA 405.1	ND	-----	4.00	mg/l	1x	7030064	03/02/07 08:59	03/07/07 18:47	
Chemical Oxygen Demand	EPA 410.4	ND	-----	5.00	"	"	7030506	03/14/07 08:51	03/14/07 14:50	
Orthophosphate-phosphorus	EPA 365.2	ND	-----	0.0100	"	"	7030058	03/02/07 07:52	03/02/07 10:40	
Specific Conductivity	120.1/ 9050	**116**	-----	10.0	uS/cm	"	7030149	03/05/07 11:05	03/05/07 12:19	
Total Solids	EPA 160.3	**105**	-----	10.0	mg/l	"	7030316	03/08/07 14:40	03/08/07 16:57	
Total Suspended Solids	EPA 160.2/SM 2540D	ND	-----	10.0	"	"	7030241	03/07/07 10:43	03/07/07 15:47	
Turbidity	EPA 180.1	**2.57**	-----	0.200	NTU	"	7030051	03/02/07 07:11	03/02/07 09:10	
Hardness	SM2340B	**40.4**	-----	0.662	mg/l	"	[CALC]	03/14/07 11:27	03/16/07 20:40	
pH	EPA 150.1	**7.10**	-----		pH Units	"	7030050	03/02/07 07:10	03/02/07 08:30	
Phosphorus	EPA 365.1	**0.0274**	-----	0.0200	mg/l	"	7030280	03/08/07 09:45	03/09/07 15:00	
PQC0032-03 (OUTLET)		**Water**			**Sampled: 03/01/07 12:00**					
Biochemical Oxygen Demand	EPA 405.1	ND	-----	4.00	mg/l	1x	7030064	03/02/07 08:59	03/07/07 18:47	
Chemical Oxygen Demand	EPA 410.4	ND	-----	5.00	"	"	7030506	03/14/07 08:51	03/14/07 14:50	
Orthophosphate-phosphorus	EPA 365.2	ND	-----	0.0100	"	"	7030058	03/02/07 07:52	03/02/07 10:40	
Specific Conductivity	120.1/ 9050	**44.0**	-----	10.0	uS/cm	"	7030149	03/05/07 11:05	03/05/07 12:19	
Total Solids	EPA 160.3	**45.0**	-----	10.0	mg/l	"	7030316	03/08/07 14:40	03/08/07 16:57	
Total Suspended Solids	EPA 160.2/SM 2540D	ND	-----	10.0	"	"	7030241	03/07/07 10:43	03/07/07 15:47	
Turbidity	EPA 180.1	**2.13**	-----	0.200	NTU	"	7030051	03/02/07 07:11	03/02/07 09:10	
Hardness	SM2340B	**15.4**	-----	0.662	mg/l	"	[CALC]	03/14/07 11:27	03/16/07 20:46	
pH	EPA 150.1	**7.31**	-----		pH Units	"	7030050	03/02/07 07:10	03/02/07 08:30	
Phosphorus	EPA 365.1	**0.0225**	-----	0.0200	mg/l	"	7030280	03/08/07 09:45	03/09/07 15:00	

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City of Stayton	Project Name:	**Stormwater Testing**	
362 N Third Avenue	Project Number:	Stormwater Testing	Report Created:
Stayton, OR 97383	Project Manager:	Brenda Kuiken	03/19/07 17:28

Conventional Chemistry Parameters per APHA/EPA Methods

TestAmerica - Portland, OR

Analyte	Method	Result	MDL*	MRL	Units	Dil	Batch	Prepared	Analyzed	Notes
PQC0032-04 (CCH BSN)		**Water**			**Sampled: 03/01/07 12:50**					
Biochemical Oxygen Demand	EPA 405.1	ND	-----	4.00	mg/l	1x	7030064	03/02/07 08:59	03/07/07 18:47	
Chemical Oxygen Demand	EPA 410.4	**6.66**	-----	5.00	"	"	7030506	03/14/07 08:51	03/14/07 14:50	
Orthophosphate-phosphorus	EPA 365.2	ND	-----	0.0100	"	"	7030058	03/02/07 07:52	03/02/07 10:40	
Specific Conductivity	120.1/ 9050	**118**	-----	10.0	uS/cm	"	7030149	03/05/07 11:05	03/05/07 12:19	
Total Solids	EPA 160.3	**96.0**	-----	10.0	mg/l	"	7030316	03/08/07 14:40	03/08/07 16:57	
Total Suspended Solids	EPA 160.2/SM 2540D	ND	-----	10.0	"	"	7030241	03/07/07 10:43	03/07/07 15:47	
Turbidity	EPA 180.1	**3.18**	-----	0.200	NTU	"	7030051	03/02/07 07:11	03/02/07 09:10	
Hardness	SM2340B	**36.5**	-----	0.662	mg/l	"	[CALC]	03/14/07 11:27	03/16/07 20:53	
pH	EPA 150.1	**6.95**	-----		pH Units	"	7030050	03/02/07 07:10	03/02/07 08:30	
Phosphorus	EPA 365.1	**0.0204**	-----	0.0200	mg/l	"	7030280	03/08/07 09:45	03/09/07 15:00	

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City of Stayton	Project Name:	Stormwater Testing	
362 N Third Avenue	Project Number:	Stormwater Testing	Report Created:
Stayton, OR 97383	Project Manager:	Brenda Kuiken	03/19/07 17:28

Microbiological Parameters per APHA Standard Methods

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Analyte	Method	Result	MDL*	MRL	Units	Dil	Batch	Prepared	Analyzed	Notes
PQC0032-01 (INLET)		**Water**			**Sampled: 03/01/07 10:20**					
E. Coli	SM 9223B	**6.30**	-----	1.00	MPN/100 ml	1x	7030071	03/02/07 09:45	03/03/07 19:20	
PQC0032-02 (6 AVE)		**Water**			**Sampled: 03/01/07 11:20**					
E. Coli	SM 9223B	**7.20**	-----	1.00	MPN/100 ml	1x	7030071	03/02/07 09:45	03/03/07 19:20	
PQC0032-03 (OUTLET)		**Water**			**Sampled: 03/01/07 12:00**					
E. Coli	SM 9223B	**14.8**	-----	1.00	MPN/100 ml	1x	7030071	03/02/07 09:45	03/03/07 19:20	
PQC0032-04 (CCH BSN)		**Water**			**Sampled: 03/01/07 12:50**					
E. Coli	SM 9223B	**26.9**	-----	1.00	MPN/100 ml	1x	7030071	03/02/07 09:45	03/03/07 19:20	

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City of Stayton	Project Name:	Stormwater Testing	
362 N Third Avenue	Project Number:	Stormwater Testing	Report Created:
Stayton, OR 97383	Project Manager:	Brenda Kuiken	03/19/07 17:28

Total Metals per EPA 200 Series Methods - Laboratory Quality Control Results

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QC Batch: 7030485 **Water Preparation Method: EPA 200/3005**

Analyte	Method	Result	MDL*	MRL	Units	Dil	Source Result	Spike Amt	% REC	(Limits)	% RPD	(Limits)	Analyzed	Notes
Blank (7030485-BLK1)								**Extracted: 03/13/07 14:22**						
Copper	EPA 200.8	ND	---	0.00200	mg/l	1x	--	--	--	--	--	--	03/14/07 20:19	
Lead	"	ND	---	0.00100	"	"	--	--	--	--	--	--	"	
Zinc	"	ND	---	0.00500	"	"	--	--	--	--	--	--	03/15/07 13:37	
LCS (7030485-BS1)								**Extracted: 03/13/07 14:22**						
Copper	EPA 200.8	0.0861	---	0.00200	mg/l	1x	--	0.100	86.1%	(85-115)	--	--	03/14/07 20:26	
Lead	"	0.0896	---	0.00100	"	"	--	"	89.6%	"	--	--	"	
Zinc	"	0.0858	---	0.0100	"	2x	--	"	85.8%	"	--	--	03/15/07 13:44	
Duplicate (7030485-DUP1)				**QC Source: PQB0979-01**				**Extracted: 03/13/07 14:22**						
Copper	EPA 200.8	ND	---	0.00200	mg/l	1x	ND	--	--	--	3.71%	(20)	03/14/07 20:41	
Lead	"	ND	---	0.00100	"	"	ND	--	--	--	24.4%	"	"	R4
Zinc	"	0.0501	---	0.00500	"	"	0.0500	--	--	--	0.200%	"	03/15/07 13:59	
Matrix Spike (7030485-MS1)				**QC Source: PQC0019-29**				**Extracted: 03/13/07 14:22**						
Copper	EPA 200.8	0.115	---	0.00200	mg/l	1x	0.0350	0.100	80.0%	(75-125)	--	--	03/14/07 20:48	
Lead	"	0.0854	---	0.00100	"	"	0.000770	"	84.6%	"	--	--	"	
Zinc	"	0.180	---	0.00500	"	"	0.105	"	75.0%	(70-130)	--	--	03/15/07 14:06	
Matrix Spike (7030485-MS2)				**QC Source: PQB0979-01**				**Extracted: 03/13/07 14:22**						
Copper	EPA 200.8	0.0863	---	0.00200	mg/l	1x	0.00185	0.100	84.4%	(75-125)	--	--	03/14/07 21:10	
Lead	"	0.0882	---	0.00100	"	"	0.000230	"	88.0%	"	--	--	"	
Zinc	"	0.127	---	0.00500	"	"	0.0500	"	77.0%	(70-130)	--	--	03/15/07 14:21	

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362 N Third Avenue	Project Number:	Stormwater Testing	Report Created:
Stayton, OR 97383	Project Manager:	Brenda Kuiken	03/19/07 17:28

Total Metals per EPA 200 Series Methods - Laboratory Quality Control Results

TestAmerica - Portland, OR

QC Batch: 7030531 **Water Preparation Method: EPA 200/3005**

Analyte	Method	Result	MDL*	MRL	Units	Dil	Source Result	Spike Amt	% REC	(Limits)	% RPD	(Limits)	Analyzed	Notes
Blank (7030531-BLK1)								**Extracted: 03/14/07 11:27**						
Calcium	EPA 200.7	ND	---	0.100	mg/l	1x	--	--	--	--	--	--	03/15/07 12:43	
Magnesium	"	ND	---	0.100	"	"	--	--	--	--	--	--	"	
LCS (7030531-BS1)								**Extracted: 03/14/07 11:27**						
Calcium	EPA 200.7	9.26	---	0.100	mg/l	1x	--	10.0	92.6%	(85-115)	--	--	03/15/07 12:49	
Magnesium	"	9.49	---	0.100	"	"	--	"	94.9%	"	--	--	"	
Duplicate (7030531-DUP1)				**QC Source: PQC0025-01**				**Extracted: 03/14/07 11:27**						
Calcium	EPA 200.7	12.4	---	0.100	mg/l	1x	12.0	--	--	--	3.28%	(20)	03/16/07 20:33	
Magnesium	"	1.63	---	0.100	"	"	1.57	--	--	--	3.75%	"	"	
Matrix Spike (7030531-MS1)				**QC Source: PQC0025-02**				**Extracted: 03/14/07 11:27**						
Calcium	EPA 200.7	19.1	---	0.100	mg/l	1x	10.2	10.0	89.0%	(75-125)	--	--	03/16/07 20:08	
Magnesium	"	4.25	---	0.100	"	"	1.55	"	27.0%	"	--	--	03/15/07 13:18	M2
Matrix Spike (7030531-MS2)				**QC Source: PQC0032-01**				**Extracted: 03/14/07 11:27**						
Calcium	EPA 200.7	21.6	---	0.100	mg/l	1x	3.57	10.0	180%	(75-125)	--	--	03/16/07 20:27	M2
Magnesium	"	2.55	---	0.100	"	"	1.09	"	14.6%	"	--	--	03/15/07 13:31	M2

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City of Stayton	Project Name:	**Stormwater Testing**	
362 N Third Avenue	Project Number:	Stormwater Testing	Report Created:
Stayton, OR 97383	Project Manager:	Brenda Kuiken	03/19/07 17:28

Dissolved Metals per EPA 200 Series Methods - Laboratory Quality Control Results

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QC Batch: 7030142 **Water Preparation Method: EPA 200/3005 Diss**

Analyte	Method	Result	MDL*	MRL	Units	Dil	Source Result	Spike Amt	% REC	(Limits)	% RPD	(Limits)	Analyzed	Notes
Blank (7030142-BLK1)								**Extracted: 03/05/07 10:09**						
Copper	EPA 200.8	ND	---	0.00200	mg/l	1x	--	--	--	--	--	--	03/06/07 15:17	
LCS (7030142-BS1)								**Extracted: 03/05/07 10:09**						
Copper	EPA 200.8	0.104	---	0.00200	mg/l	1x	--	0.100	104%	(85-115)	--	--	03/06/07 15:21	
Duplicate (7030142-DUP1)				**QC Source: PQB0510-01**				**Extracted: 03/05/07 10:09**						
Copper	EPA 200.8	ND	---	0.00200	mg/l	1x	ND	--	--	--	15.6%	(20)	03/06/07 15:29	
Matrix Spike (7030142-MS1)				**QC Source: PQB0860-17**				**Extracted: 03/05/07 10:09**						
Copper	EPA 200.8	0.124	---	0.00200	mg/l	1x	0.0176	0.100	106%	(70-130)	--	--	03/06/07 15:45	

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Stayton, OR 97383	Project Manager:	Brenda Kuiken	03/19/07 17:28

Total Mercury per EPA Method 245.1 - Laboratory Quality Control Results

TestAmerica - Portland, OR

QC Batch: 7030245 **Water Preparation Method: EPA 245.1**

Analyte	Method	Result	MDL*	MRL	Units	Dil	Source Result	Spike Amt	% REC	(Limits)	% RPD	(Limits)	Analyzed	Notes
Blank (7030245-BLK1)										**Extracted: 03/07/07 12:11**				
Mercury	EPA 245.1	ND	---	0.000200	mg/l	1x	--	--	--	--	--	--	03/07/07 17:22	
LCS (7030245-BS1)										**Extracted: 03/07/07 12:11**				
Mercury	EPA 245.1	0.00508	---	0.000200	mg/l	1x	--	0.00500	102%	(85-115)	--	--	03/07/07 17:24	
LCS Dup (7030245-BSD1)										**Extracted: 03/07/07 12:11**				
Mercury	EPA 245.1	0.00527	---	0.000200	mg/l	1x	--	0.00500	105%	(85-115)	3.67%	(20)	03/07/07 17:29	
Duplicate (7030245-DUP1)				**QC Source: PQB0975-01**						**Extracted: 03/07/07 12:11**				
Mercury	EPA 245.1	ND	---	0.000200	mg/l	1x	ND	--	--	--	NR	(20)	03/07/07 17:33	
Matrix Spike (7030245-MS1)				**QC Source: PQB0975-01**						**Extracted: 03/07/07 12:11**				
Mercury	EPA 245.1	0.00499	---	0.000200	mg/l	1x	ND	0.00500	99.8%	(75-125)	--	--	03/07/07 17:35	
Matrix Spike (7030245-MS2)				**QC Source: PQC0061-05**						**Extracted: 03/07/07 12:11**				
Mercury	EPA 245.1	0.00545	---	0.000200	mg/l	1x	0.000149	0.00500	106%	(75-125)	--	--	03/07/07 17:42	
Matrix Spike Dup (7030245-MSD1)				**QC Source: PQB0975-01**						**Extracted: 03/07/07 12:11**				
Mercury	EPA 245.1	0.00497	---	0.000200	mg/l	1x	ND	0.00500	99.4%	(75-125)	0.402%	(20)	03/07/07 17:39	
Matrix Spike Dup (7030245-MSD2)				**QC Source: PQC0061-05**						**Extracted: 03/07/07 12:11**				
Mercury	EPA 245.1	0.00535	---	0.000200	mg/l	1x	0.000149	0.00500	104%	(75-125)	1.85%	(20)	03/07/07 17:46	

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362 N Third Avenue	Project Number: Stormwater Testing	Report Created:
Stayton, OR 97383	Project Manager: Brenda Kuiken	03/19/07 17:28

Conventional Chemistry Parameters per APHA/EPA Methods - Laboratory Quality Control Results

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QC Batch: 7030050 Water Preparation Method: General Preparation

Analyte	Method	Result	MDL*	MRL	Units	Dil	Source Result	Spike Amt	% REC	(Limits)	% RPD	(Limits)	Analyzed	Notes
Duplicate (7030050-DUP1)			QC Source: PQC0032-01					Extracted: 03/02/07 07:10						
pH	EPA 150.1	7.34	---		pH Units	1x	7.33	--	--	--	0.136%	(25)	03/02/07 08:30	

QC Batch: 7030051 Water Preparation Method: General Preparation

Analyte	Method	Result	MDL*	MRL	Units	Dil	Source Result	Spike Amt	% REC	(Limits)	% RPD	(Limits)	Analyzed	Notes
Blank (7030051-BLK1)								Extracted: 03/02/07 07:11						
Turbidity	EPA 180.1	ND	---	0.200	NTU	1x	--	--	--	--	--	--	03/02/07 09:10	
LCS (7030051-BS1)								Extracted: 03/02/07 07:11						
Turbidity	EPA 180.1	18.0	---	0.200	NTU	1x	--	20.0	90.0%	(85-115)	--	--	03/02/07 09:10	
Duplicate (7030051-DUP1)			QC Source: PQC0028-01					Extracted: 03/02/07 07:11						
Turbidity	EPA 180.1	ND	---	0.200	NTU	1x	ND	--	--	--	22.9%	(20)	03/02/07 09:10	R4

QC Batch: 7030058 Water Preparation Method: General Preparation

Analyte	Method	Result	MDL*	MRL	Units	Dil	Source Result	Spike Amt	% REC	(Limits)	% RPD	(Limits)	Analyzed	Notes
Blank (7030058-BLK1)								Extracted: 03/02/07 07:52						
Orthophosphate-phosphorus	EPA 365.2	ND	---	0.0100	mg/l	1x	--	--	--	--	--	--	03/02/07 10:40	
LCS (7030058-BS1)								Extracted: 03/02/07 07:52						
Orthophosphate-phosphorus	EPA 365.2	0.291	---	0.0100	mg/l	1x	--	0.300	97.0%	(85-115)	--	--	03/02/07 10:40	
Duplicate (7030058-DUP1)			QC Source: PQC0032-01					Extracted: 03/02/07 07:52						
Orthophosphate-phosphorus	EPA 365.2	ND	---	0.0100	mg/l	1x	ND	--	--	--	NR	(20)	03/02/07 10:40	
Matrix Spike (7030058-MS1)			QC Source: PQC0032-01					Extracted: 03/02/07 07:52						
Orthophosphate-phosphorus	EPA 365.2	0.0660	---	0.0100	mg/l	1x	ND	0.100	66.0%	(80-120)	--	--	03/02/07 10:40	M2

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City of Stayton	Project Name:	Stormwater Testing	
362 N Third Avenue	Project Number:	Stormwater Testing	Report Created:
Stayton, OR 97383	Project Manager:	Brenda Kuiken	03/19/07 17:28

Conventional Chemistry Parameters per APHA/EPA Methods - Laboratory Quality Control Results

TestAmerica - Portland, OR

QC Batch: 7030064 Water Preparation Method: General Preparation

Analyte	Method	Result	MDL*	MRL	Units	Dil	Source Result	Spike Amt	% REC	(Limits)	% RPD	(Limits)	Analyzed	Notes
Blank (7030064-BLK1)										**Extracted: 03/02/07 08:59**				
Biochemical Oxygen Demand	EPA 405.1	ND	---	4.00	mg/l	1x	--	--	--	--	--	--	03/07/07 18:47	K3
LCS (7030064-BS1)										**Extracted: 03/02/07 08:59**				
Biochemical Oxygen Demand	EPA 405.1	179	---	4.00	mg/l	1x	--	198	90.4%	(85-115)	--	--	03/07/07 18:47	
Duplicate (7030064-DUP1)				**QC Source: PQB0956-02**						**Extracted: 03/02/07 08:59**				
Biochemical Oxygen Demand	EPA 405.1	ND	---	4.00	mg/l	1x	ND	--	--	--	NR	(40)	03/07/07 18:47	

QC Batch: 7030149 Water Preparation Method: General Preparation

Analyte	Method	Result	MDL*	MRL	Units	Dil	Source Result	Spike Amt	% REC	(Limits)	% RPD	(Limits)	Analyzed	Notes
Blank (7030149-BLK1)										**Extracted: 03/05/07 11:05**				
Specific Conductivity	120.1/ 9050	ND	---	10.0	uS/cm	1x	--	--	--	--	--	--	03/05/07 12:19	
LCS (7030149-BS1)										**Extracted: 03/05/07 11:05**				
Specific Conductivity	120.1/ 9050	1390	---	10.0	uS/cm	1x	--	1410	98.6%	(85-115)	--	--	03/05/07 12:19	
Duplicate (7030149-DUP1)				**QC Source: PQB0836-01**						**Extracted: 03/05/07 11:05**				
Specific Conductivity	120.1/ 9050	2780	---	10.0	uS/cm	1x	2830	--	--	--	1.78%	(20)	03/05/07 12:19	

QC Batch: 7030241 Water Preparation Method: General Preparation

Analyte	Method	Result	MDL*	MRL	Units	Dil	Source Result	Spike Amt	% REC	(Limits)	% RPD	(Limits)	Analyzed	Notes
Blank (7030241-BLK1)										**Extracted: 03/07/07 10:43**				
Total Suspended Solids	EPA 160.2/SM 2540D	ND	---	10.0	mg/l	1x	--	--	--	--	--	--	03/07/07 15:47	
LCS (7030241-BS1)										**Extracted: 03/07/07 10:43**				
Total Suspended Solids	EPA 160.2/SM 2540D	48.0	---	10.0	mg/l	1x	--	50.0	96.0%	(80-120)	--	--	03/07/07 15:47	
Duplicate (7030241-DUP1)				**QC Source: PQB0968-01**						**Extracted: 03/07/07 10:43**				
Total Suspended Solids	EPA 160.2/SM 2540D	ND	---	10.0	mg/l	1x	ND	--	--	--	NR	(20)	03/07/07 15:47	

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City of Stayton	Project Name:	**Stormwater Testing**	
362 N Third Avenue	Project Number:	Stormwater Testing	Report Created:
Stayton, OR 97383	Project Manager:	Brenda Kuiken	03/19/07 17:28

Conventional Chemistry Parameters per APHA/EPA Methods - Laboratory Quality Control Results

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QC Batch: 7030280 Water Preparation Method: Wet Chem

Analyte	Method	Result	MDL*	MRL	Units	Dil	Source Result	Spike Amt	% REC	(Limits)	% RPD	(Limits)	Analyzed	Notes
Blank (7030280-BLK1)								**Extracted: 03/08/07 09:45**						
Phosphorus	EPA 365.1	ND	---	0.0200	mg/l	1x	--	--	--	--	--	--	03/09/07 15:00	
LCS (7030280-BS1)								**Extracted: 03/08/07 09:45**						
Phosphorus	EPA 365.1	0.420	---	0.0200	mg/l	1x	--	0.400	105%	(90-110)	--	--	03/09/07 15:00	
Duplicate (7030280-DUP1)				**QC Source: PQB0939-01**				**Extracted: 03/08/07 09:45**						
Phosphorus	EPA 365.1	0.607	---	0.100	mg/l	5x	0.452	--	--	--	29.3%	(20)	03/09/07 15:00	R2
Matrix Spike (7030280-MS1)				**QC Source: PQB0939-01**				**Extracted: 03/08/07 09:45**						
Phosphorus	EPA 365.1	0.776	---	0.100	mg/l	5x	0.452	0.400	81.0%	(90-110)	--	--	03/09/07 15:00	M1

QC Batch: 7030316 Water Preparation Method: General Preparation

Analyte	Method	Result	MDL*	MRL	Units	Dil	Source Result	Spike Amt	% REC	(Limits)	% RPD	(Limits)	Analyzed	Notes
Blank (7030316-BLK1)								**Extracted: 03/08/07 14:40**						
Total Solids	EPA 160.3	ND	---	10.0	mg/l	1x	--	--	--	--	--	--	03/08/07 16:57	
Blank (7030316-BLK2)								**Extracted: 03/08/07 14:40**						
Total Solids	EPA 160.3	ND	---	10.0	mg/l	1x	--	--	--	--	--	--	03/08/07 16:57	
LCS (7030316-BS1)								**Extracted: 03/08/07 14:40**						
Total Solids	EPA 160.3	49.0	---	10.0	mg/l	1x	--	50.0	98.0%	(80-120)	--	--	03/08/07 16:57	
LCS (7030316-BS2)								**Extracted: 03/08/07 14:40**						
Total Solids	EPA 160.3	52.0	---	10.0	mg/l	1x	--	50.0	104%	(80-120)	--	--	03/08/07 16:57	
Duplicate (7030316-DUP1)				**QC Source: PQC0032-03**				**Extracted: 03/08/07 14:40**						
Total Solids	EPA 160.3	47.0	---	10.0	mg/l	1x	45.0	--	--	--	4.35%	(20)	03/08/07 16:57	
Duplicate (7030316-DUP2)				**QC Source: PQC0032-04**				**Extracted: 03/08/07 14:40**						
Total Solids	EPA 160.3	96.0	---	10.0	mg/l	1x	96.0	--	--	--	0.00%	(20)	03/08/07 16:57	

TestAmerica - Portland, OR

Brian L Cone

Brian Cone, Industrial Services Manager

PORTLAND, OR 9405 S.W. NIMBUS AVENUE
BEAVERTON, OR 97008-7132
ph: (503) 906.9200 fax: (503) 906.9210

City of Stayton
362 N Third Avenue
Stayton, OR 97383

Project Name: **Stormwater Testing**
Project Number: Stormwater Testing
Project Manager: Brenda Kuiken

Report Created:
03/19/07 17:28

Conventional Chemistry Parameters per APHA/EPA Methods - Laboratory Quality Control Results

TestAmerica - Portland, OR

QC Batch: 7030506 **Water Preparation Method: General Preparation**

Analyte	Method	Result	MDL*	MRL	Units	Dil	Source Result	Spike Amt	% REC	(Limits)	% RPD	(Limits)	Analyzed	Notes
Blank (7030506-BLK1)								**Extracted: 03/14/07 08:51**						
Chemical Oxygen Demand	EPA 410.4	ND	---	5.00	mg/l	1x	--	--	--	--	--	--	03/14/07 14:50	
LCS (7030506-BS1)								**Extracted: 03/14/07 08:51**						
Chemical Oxygen Demand	EPA 410.4	50.9	---	5.00	mg/l	1x	--	50.0	102%	(90-110)	--	--	03/14/07 14:50	
Duplicate (7030506-DUP1)				**QC Source: PQC0032-01**				**Extracted: 03/14/07 08:51**						
Chemical Oxygen Demand	EPA 410.4	ND	---	5.00	mg/l	1x	5.12	--	--	--	--	(20)	03/14/07 14:50	

TestAmerica - Portland, OR

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report shall not be reproduced except in full, without the written approval of the laboratory.

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City of Stayton	Project Name:	**Stormwater Testing**	
362 N Third Avenue	Project Number:	Stormwater Testing	Report Created:
Stayton, OR 97383	Project Manager:	Brenda Kuiken	03/19/07 17:28

Notes and Definitions

Report Specific Notes:

K3	-	The dilution water D.O. depletion was > 0.2 mg/L.
M1	-	The MS and/or MSD were above the acceptance limits due to sample matrix interference. See Blank Spike (LCS).
M2	-	The MS and/or MSD were below the acceptance limits due to sample matrix interference. See Blank Spike (LCS).
R2	-	The RPD exceeded the acceptance limit.
R4	-	Due to the low levels of analyte in the sample, the duplicate RPD calculation does not provide useful information.

Laboratory Reporting Conventions:

DET	-	Analyte DETECTED at or above the Reporting Limit. Qualitative Analyses only.
ND	-	Analyte NOT DETECTED at or above the reporting limit (MDL or MRL, as appropriate).
NR/NA	-	Not Reported / Not Available
dry	-	Sample results reported on a Dry Weight Basis. Results and Reporting Limits have been corrected for Percent Dry Weight.
wet	-	Sample results and reporting limits reported on a Wet Weight Basis (as received). Results with neither 'wet' nor 'dry' are reported on a Wet Weight Basis.
RPD	-	RELATIVE PERCENT DIFFERENCE (RPDs calculated using Results, not Percent Recoveries).
MRL	-	METHOD REPORTING LIMIT. Reporting Level at, or above, the lowest level standard of the Calibration Table.
MDL*	-	METHOD DETECTION LIMIT. Reporting Level at, or above, the statistically derived limit based on 40CFR, Part 136, Appendix B. *MDLs are listed on the report only if the data has been evaluated below the MRL. Results between the MDL and MRL are reported as Estimated Results.
Dil	-	Dilutions are calculated based on deviations from the standard dilution performed for an analysis, and may not represent the dilution found on the analytical raw data.
Reporting Limits	-	Reporting limits (MDLs and MRLs) are adjusted based on variations in sample preparation amounts, analytical dilutions and percent solids, where applicable.
Electronic Signature	-	Electronic Signature added in accordance with TestAmerica's *Electronic Reporting and Electronic Signatures Policy.* Application of electronic signature indicates that the report has been reviewed and approved for release by the laboratory. Electronic signature is intended to be the legally binding equivalent of a traditionally handwritten signature.

TestAmerica - Portland, OR

Brian L Cone

Brian Cone, Industrial Services Manager

008

TestAmerica
ANALYTICAL TESTING CORPORATION

11720 North Creek Pkwy N Suite 400, Bothell, WA 98011-8244 425-420-9200 FAX 420-9210
11922 E. First Ave, Spokane, WA 99206-5302 509-924-9200 FAX 924-9290
9405 SW Nimbus Ave, Beaverton, OR 97008-7145 503-906-9200 FAX 906-9210
2000 W International Airport Rd Ste A10, Anchorage, AK 99502-1119 907-563-9200 FAX 563-9210

CHAIN OF CUSTODY REPORT

Work Order #: YQC0032

CLIENT: City of Stayton

REPORT TO: Brenda Kuiken
ADDRESS: 362 N 3rd Ave
Stayton, Oregon

PHONE: 503 769 2810 FAX:

INVOICE TO: City of Stayton
362 N 3rd Ave
Stayton, Oregon 97383

P.O. NUMBER: WWTF

PROJECT NAME: Stormwater Testing

PROJECT NUMBER:

SAMPLED BY: John L Sullivan Jr

TURNAROUND REQUEST in Business Days *

Organic & Inorganic Analyses: 10 (STD.) 7 5 4 3 2 1 <1

Petroleum Hydrocarbon Analyses: 5 (STD.) 4 3 2 1 <1

OTHER Specify:

* Turnaround Requests less than standard may incur Rush Charges.

PRESERVATIVE: — | HNO3 | HNO3 | HNO3 | H2SO4

REQUESTED ANALYSES

	CLIENT SAMPLE IDENTIFICATION	SAMPLING DATE/TIME	E. coli	Hg, Cu, Zn, Pb	Dis Cu	Hardness	COD O phos	BOD	T phos	TS	TSS	TURB	pH	Bior Duct		MATRIX (W, S, O)	# OF CONT.	LOCATION / COMMENTS	TA WO ID
1	INLET	3-1-07 1020	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		W	5		
2	GAVE	3-1-07 1120	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		W	5		
3	OUTLET	3-1-07 1200	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		W	5		
4	CCH BSN	3-1-07 1250	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓ ✓	✓		W	5		
5																			
6																			
7																			
8																			
9																			
10																			

RELEASED BY:
PRINT NAME: John L Sullivan Jr FIRM: City of Stayton DATE: 3-1-07 TIME:

RECEIVED BY: Camille Holladay
PRINT NAME: Camille Holladay FIRM: TAP DATE: 3/1/07 TIME: 1456

RELEASED BY:
PRINT NAME: FIRM: DATE: TIME:

RECEIVED BY:
PRINT NAME: FIRM: DATE: TIME:

ADDITIONAL REMARKS:

TEMP: 4.3

PAGE OF

COC REV 05/2006

Note: By relinquishing samples to TestAmerica, client agrees to pay for the services requested on this chain of custody form and for any additional analyses performed on this project. Payment for services is due within 30 days from the date of invoice unless otherwise contracted. Sample(s) will be disposed of after 30 days unless otherwise contracted.

TEST AMERICA SAMPLE RECEIPT CHECKLIST

Received By: (applies to temp at receipt)	Logged-in By:	Unpacked/Labeled By:	Cooler ID: ____ (____ of ____)
Date: 3/1/07	Date: 3/1/07	Date: 3/1/07	Work Order No. PQL0032
Time: 1458	Initials: CA	Initials: CA	Client: City of Staton
Initials: CA			Project: Stormwater

Container Type:
- ✓ Cooler
- ✓ Ship. Container
- ____ Box
- ____ On Bottles
- ____ None/Other ______

COC Seals:
- ✓ Sign By
- ____ Date
- ____ None

Packing Material
- ____ Bubble Bags
- ____ Styrofoam
- ____ Foam Packs
- ✓ None/Other Other ______

Refrigerant:
- ✓ Gel Ice Pack ______
- ____ None
- ____ Loose Ice
- ____ None/Other ______

Received Via: Bill# ______
- ____ Fed Ex
- ✓ Client
- ____ UPS
- ____ NCA Courier
- ____ DHL
- ____ Mid Valley
- ____ Senvoy
- ____ TDP
- ____ GS
- ____ Other ______

Cooler Temperature (*IR*): 4.3 °C Plastic Glass (circle one) (Frozen filters, Tedlars and aqueous Metals exempt)

Temperature Blank? ______ °C or NA   Trip Blank? Y or N or NA

Sample Containers:		ID			ID
Intact?	Y or N		Metals Preserved?	Y or N or NA	
Provided by NCA?	Y or N		Client QAPP Preserved?	Y or N or NA	
Correct Type?	Y or N		Adequate Volume? (for tests requested)	Y or N	
#Containers match COC?	Y or N		Water VOAs: Headspace?	Y or N or NA	
IDs/time/date match COC?	Y or N		Comments:		
Hold Times in hold?	Y or N				

PROJECT MANAGEMENT

Is the Chain of Custody complete? Y or N If N, circle the items that were incomplete

Comments,Problems ______________________________

Total access set up? Y or N

Has client been contacted regarding non-conformances? Y or N If Y ____/____ Date Time

PM Initials: ________ Date: ________ Time: ________

(rev 3, 09/12/05)

D.2 Management Strategies

TETRA TECH/KCM
7080 SW Fir Loop
Portland, Oregon 97223-8022

Technical Memorandum

City of Stayton STRATEGY FOR ADDRESSING STORMWATER MANAGEMENT

January 5, 2007

OVERVIEW

This technical memorandum presents a preliminary strategy for the City of Stayton to manage stormwater in a way that addresses existing and potential future regulatory requirements. The preliminary strategy is a starting point for developing a final long-term overall strategy. This memorandum describes current and potential future regulatory requirements, approaches to addressing the requirements, and how the approaches have worked for other communities. It describes how state and federal requirements can be met in a way that is most economical and beneficial to the citizens and environment of Stayton.

A stormwater management strategy must incorporate the goals of the community and input from City staff who will implement it. This memorandum was prepared to help elected officials, staff and citizens who must plan and implement programs to comply with regulations and protect local water quality.

The City of Stayton was not identified as a community included in the National Pollutant Discharge Elimination System (NPDES) Phase II program. However, the Oregon Department of Environmental Quality (DEQ) has developed the NPDES Phase II requirements into a program that could eventually merge with the requirements of the state’s Total Maximum Daily Load (TMDL) Program, and Stayton is in the Willamette Basin, which adopted a TMDL on September 21, 2006. Therefore Stayton has the potential of being required to meet the same conditions as an NPDES Phase II community.

Benefits of Implementing a Stormwater Management Program

A comprehensive municipal stormwater management program can provide a wide array of benefits for local jurisdictions and for the environment. A successful program offers benefits related to water quality, municipal operations, preservation of green space, and other aspects of a community’s quality of life. Ultimately, such benefits can translate into economic benefits through more efficient operating practices, increased property values, and increased revenues from recreation and tourism.

Poorly managed stormwater can contribute high levels of pollutants into receiving rivers, lakes, streams and groundwater. Stormwater management programs recognize the potential impacts of unchecked stormwater runoff: accelerated stream flows, destruction of aquatic habitat, modified natural hydrologic patterns, and elevated pollutant concentrations. A stormwater management program that promotes or requires advanced land use practices can minimize negative chemical, physical, and biological impacts and produce water quality improvements over time.

A stormwater management program that improves water quality can help to meet regulatory water quality standards, which are the yardstick for assessing the need for pollution controls such as TMDLs or other water cleanup plans. Avoiding the need for such additional pollution controls or for limits on development can translate into cost savings for communities. Stormwater management programs can also play an important role in reducing the number of impaired water bodies due to bacteria levels and reducing the need for additional expensive treatment technologies for drinking water supplies.

Stormwater management programs also can provide communities with a framework for efficient and cost-effective operational activities. Management practices that prevent pollutants from entering the storm sewer system reduce the need for costly system maintenance and repair activities. Through the reporting mechanisms required for stormwater management programs, communities establish the ability to track activities and expenditures related to stormwater management activities, thereby improving communication and coordination among responsible departments and with citizens.

Other benefits to consider include enhanced fishing and opportunities for recreation. Stormwater management helps to reduce pollutants that can harm important fish habitat and minimize the contaminants that make fish unsafe to eat—often the same pollutants that make swimming and boating unsafe. Stormwater quantity is often addressed through stormwater management techniques intended to improve water quality. Effective management techniques help to limit increases in impervious surface, thereby decreasing the quantity and velocity of stormwater runoff and minimizing flooding events. Stormwater management programs can help promote maintaining green spaces in the community, improve visual appearance of waterways, and promote cleaner, more attractive sites on land (e.g., better maintained parking lots, industrial sites, and municipal facilities).

REGULATORY FRAMEWORK

Background

The federal Clean Water Act is the primary federal law protecting water quality. The act requires that TMDLs be established when a water body does not meet water quality standards. The DEQ adopted a TMDL for the Willamette Basin in September 2006. The City of Stayton is within the Willamette Basin and has been identified as a "designated management agency" (DMA) in the Willamette River TMDL program. The TMDL includes limits for temperature, mercury, and bacteria.

The TMDL and Water Quality Management Plan (September 2006), states that DMAs are required to develop TMDL Implementation Plans to address TMDL allocations within their jurisdiction. TMDL Implementation Plans are due within 18 months from the date of the Notification Letters that ODEQ sends to DMAs, permitees, and other affected parties. The Notification Letters are to be sent out by ODEQ within 20 days of the TMDL being issued as an Order by ODEQ. The Implementation Plan due date is not dependent on USEPA's approval of the TMDL.

The required elements for TMDL implementation plans are defined in OAR 340-042-0080(3). required to fulfill the following objectives:

- Develop and implement best management practices (BMPs) or other management strategies to achieve TMDL load allocations.
- Develop a timeline for implementation and a schedule for completing measurable milestones.
- Develop a monitoring plan to determine whether:
  - BMPs are being implemented
  - Individual BMPs are effective
  - TMDL load allocations are being met

  - Water quality criteria are being met.
- Evidence of compliance with applicable statewide land use requirements.

DMAs also will have to include a stormwater management component in their TMDL Implementation Plans. DMAs with a population between 10,000 and 50,000 will have to address the six minimum control measures identified in the NPDES Phase II program; DMAs with a population less than 10,000 are expected to give considerations to any of the measures that are relevant. Therefore, Stayton has the potential of being required to meet the same conditions of a Phase II community.

Endangered Species Act

The Federal Endangered Species Act (ESA) was enacted in 1973 to protect threatened and endangered species. In 1987 the State of Oregon enacted the Oregon Endangered Species Act (ESA). The Willamette River provides habitat for steelhead and chinook salmon that are listed under both the Oregon and federal ESA. As the City's stormwater projects and policies have impacts on the Willamette River, the City should protect itself from potential legal action by working to ensure that its stormwater does not adversely affect the river's water quality. The City is directly regulated by the ESA through the review and permitting of in-stream construction project.

NPDES Permit Program

The federal Clean Water Act includes the NPDES permit program. Point source discharges to waters of the U.S., including stormwater and wastewater discharges, are regulated through NPDES permits issued by the U.S. Environmental Protection Agency (EPA) or by delegated states. In Oregon, NPDES permits are issued and implemented by the DEQ. The Water Pollution Control Act (Oregon Revised Statue (ORS) 468B) is the primary Oregon State law protecting water quality.

DEQ combines the federal NPDES regulations with pertinent state regulations and issues combined permits that regulate discharges to waters of the U.S. and waters of the state. These permits are designed to meet NPDES permit requirements and state law under the Water Pollution Control Act. "Waters of the state" include lakes, bays, ponds, impounding reservoirs, springs, wells, rivers, streams, creeks, estuaries, marshes, inlets, canals, the Pacific Ocean within the territorial limits of the State of Oregon and all other bodies of surface or underground waters, natural or artificial, inland or coastal, fresh or salt, public or private (except private waters which do not combine with natural surface or underground waters), which are wholly or partially within or bordering the state or within its jurisdiction.

The stormwater portion of the federal NPDES regulations has been implemented in two phases. Phase I addressed stormwater discharges by large and medium municipal separate storm sewer systems (MS4s) and certain industrial activities, including construction sites disturbing more than 5 acres. The term "separate" means that wastewater such as sewage is not combined with stormwater runoff. The Phase I stormwater regulations were published in 1990. Phase II addressed MS4s in smaller municipalities and construction sites disturbing between 1 and 5 acres; those regulations were adopted in 1999.

Phase I NPDES Permit Jurisdictions in Oregon

In Oregon, the DEQ has issued NPDES Phase I permits to regulate the discharges of stormwater from the MS4s operated by the following jurisdictions:

- Clean Water Services—Many jurisdictions in Washington County are covered by this permit
- City of Eugene

- City of Gresham—Including the City of Fairview and a portion of Multnomah County
- City of Portland—Including the Port of Portland and a portion of Multnomah County
- City of Salem
- Clackamas County SD No. 1—Including the following jurisdictions:
  - Clackamas County
  - City of Gladstone
  - City of Happy Valley
  - City of Johnson City
  - City of Lake Oswego
  - City of Milwaukie
  - City of Oregon City
  - City of River Grove
  - City of West Linn
  - City of Wilsonville
  - Oak Lodge Sanitary District

These Phase I jurisdictions were originally permitted in 1995, except for Salem, which was permitted in 1997. The Oregon Department of Transportation (ODOT) is also a Phase I municipal stormwater permittee for its stormwater discharges within the jurisdictions of the above cities and counties. Initially, ODOT was a co-permittee on all the Phase I permits, but DEQ issued ODOT a separate permit in 2000.

Phase II NPDES Permit

Affected Jurisdictions

Cities and counties in Oregon were required to apply for NPDES Phase II stormwater permit coverage if they meet all of the following conditions:

- Own and operate a municipal separate storm sewer system
- Discharge from the MS4 to surface waters
- Are within a census-defined urbanized area or are otherwise designated by DEQ.

The Phase II stormwater regulations apply only to discharges to surface waters. Communities that do not discharge to surface waters are not required to apply for NPDES stormwater permits.

The cities and counties listed below meet the three conditions above and are regulated under the NPDES Phase II program:

- City of Ashland
- City of Bend
- City of Central Point
- City of Philomath
- City of Phoenix
- City of Springfield
- City of Wood Village
- Benton County
- Jackson County

- City of Corvallis
- City of Keizer
- City of Medford
- City of Talent
- City of Troutdale
- City of Turner
- Lane County
- Marion County
- Polk County

General Requirements

The Phase II stormwater regulations address runoff from the urban areas of the cities and counties listed above. If runoff from agricultural land is discharging to a municipal storm drain system and contributing to a water quality problem, then the community should work to resolve those discharges.

DEQ requires Phase II municipalities to adopt ordinances and implement minimum measures and BMPs equivalent to those in the federal guidance and in DEQ's *Internal Management Directive—Phase II MS4 General Permit: Storm Water Management Program Plan Framework* (June 2003). Under the Phase II rules, municipalities may be subject not only to the requirements of MS4 owners and operators, but also to two other components of the federal NPDES stormwater program, also delegated to DEQ for implementation:

- The Industrial Stormwater General Permit as an operator of regulated industrial activity
- The Construction Stormwater General Permit as an operator of regulated construction activity disturbing more than 1 acre of land disturbed.

Each of the three components of the NPDES stormwater program (municipal, industrial and construction) has its own requirements and permits.

Industrial Stormwater General Permit (1200-Z; NPDES Permit for Stormwater Discharges Associated With Industrial Activities)

Businesses subject to the Industrial Stormwater General Permit have to prepare and implement a Stormwater Pollution Prevention Plan in accordance with the terms of that permit. The general permit (first issued in 1992, reissued in 1997 in the form of a 1200-Z permit, and again reissued in 2002) requires a description and implementation of operational source control BMPs and structural source control BMPs as applicable to their industrial activity. Erosion and sediment control (ESC) BMPs, flow control BMPs, and treatment BMPs are required if necessary to address an erosion, flow, or pollution problem.

Municipalities with industrial facilities and activities are also required to apply for the 1200-Z Industrial Permits. Under NPDES Phase II, a permitted small MS4 should probably apply for the 1200-Z permit, but its owner could designate those facilities to be covered under the "Municipal Operations" section of its plan with the DEQ's approval.

Construction Stormwater General Permit (1200-C; NPDES General Permit for Stormwater Discharges Associated With Construction Activity)

Operators of construction activities are required to seek coverage under the NPDES 1200-C general permit if the activity results in the disturbance (including clearing, grading, and excavation activities) of 1 acre or more, or if the activity is part of a "larger common plan of development or sale" with a planned disturbance of 1 acre or more and has a discharge of stormwater to a surface water and/or to a storm drain used to convey water to a stream, lake, or wetland. Construction projects that disturb 1 or more acres are subject to three major requirements:

- Submit an NPDES 1200-C permit application, along with a Land Use Compatibility Statement signed by the local land-use authority (county or city planning department) prior to the construction start.
- Develop, submit, and fully implement an erosion and sediment control plan that is approved by DEQ or DEQ agent prior to initiating any on-site activities. This plan specifies the measures that will be put in place to prevent and/or control erosion and sediment runoff.
- Submit a Notice of Termination when the following criteria have been met: final stabilization of the site has been achieved as defined in the permit, all temporary erosion and sediment controls have been removed, and no potential remains for construction-related sediment discharge to surface waters.

Jurisdictions can implement the state's 1200-C permit program locally, by Memorandum of Agreement, through coordination with the Oregon DEQ. DEQ completed a *Statewide Erosion Prevention and Sediment Control Manual* and related *Inspection Guidance Booklet* for use by the construction industry and state and local inspectors in April 2005.

Underground Injection Control Program

One of the provisions of the federal Safe Drinking Water Act is to protect underground sources of drinking water (USDW). The Underground Injection Control (UIC) Program was established to protect USDW by regulating the discharges of fluids into the subsurface by underground injection wells. The federal UIC program was enacted in 1974, and is administered under 40 Code of Federal Regulations (CFR) part 144. The DEQ was delegated by the EPA in 1984 to oversee this program in Oregon, and was re-authorized in 1991. The DEQ regulates this program under Oregon Administrative Rules (OAR) Chapter 340, Division 44. The intent of the UIC program is to protect groundwater aquifers, primarily used for drinking water, from contamination. All groundwater aquifers in Oregon are considered suitable as drinking water.

Subsurface infiltration systems, such as drywells, are classified as Class V injection wells in the EPA's federal UIC program. The two requirements of the UIC program are as follows:

- A non-endangerment performance standard must be met, prohibiting discharges that allow movement of fluids containing contaminants into potential underground sources of drinking water.
- All UIC facility owners/operators must provide inventory information by registering the facilities.

Under the federal UIC regulations, the definition of an underground injection well is a bored, drilled, or driven shaft whose depth is greater than the largest surface dimension; a dug hole whose depth is greater than the largest surface dimension; an improved sinkhole; or a subsurface fluid distribution system that includes an assemblage of perforated pipes, drain tiles, or other similar mechanisms intended to distribute fluids below the surface of the ground. Examples of a UIC well or a subsurface infiltration system are drywells, drain fields, pipe or French drains, and other similar devices that discharge to ground.

OTHER RELATED TOPICS FOR NPDES PHASE II

Common Terms

The following terms have specific definitions for use in discussions of NPDES Phase II permitting:

- A **Municipal Separate Storm Sewer System** (MS4) means a conveyance or system of conveyances, including roads with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, man-made channels, storm drain pipes, subsurface infiltration systems (drywells and infiltration trenches), detention systems, and stormwater quality facilities.
- An **operator** of an MS4 can be a town, city or county, the Oregon Department of Transportation, a tribe, or a special district (drainage improvement district, flood control district, etc.) and may include state-owned facilities (universities, prisons, hospitals, etc.).
- A **combined sewer** is a sewer system designed to convey commingled wastewater and stormwater runoff to a wastewater treatment plant. Where treatment plant or pipe capacity is inadequate during wet weather, the excess combined sewage discharges from the system at designated outfalls (termed combined sewer overflows).
- **Regulated small MS4s** are defined as all small MS4s located in “urbanized areas” as defined by the Bureau of the Census, and small MS4s located outside of a urbanized areas that are designated by NPDES permitting authorities. Only regulated small MS4s need to apply for a Phase II permit.

Urbanized Areas in Oregon and the Phase II NPDES Municipal Stormwater Permit

An urbanized area is a land area composed of one or more central places and the adjacent surrounding area (urban fringe) that together have a residential population of at least 50,000 and a density of at least 1,000 people per square mile. MS4s in other areas may be designated as needing a permit based on application of criteria to be developed by DEQ. The criteria must evaluate whether stormwater discharges result in or have the potential to result in exceedances of water quality standards, including impairment of designated uses, or other significant water quality impacts, including adverse habitat and biological impacts. In Oregon, there are six census-defined urbanized areas:

- Bend Urbanized Area
- Corvallis Urbanized Area
- Eugene Urbanized Area
- Medford Urbanized Area
- Portland Urbanized Area
- Salem Urbanized Area.

The federal Phase II stormwater regulations require the stormwater program to be implemented only within these urbanized areas. However, these urbanized areas do not generally follow city and county boundaries. Phase II communities, for ease of implementation, may want to implement the program jurisdiction-wide instead of only within the urbanized areas. For Phase II counties where only a small portion of the county is in the urbanized area, the county may want to implement the program within the urban growth boundary or other planning boundary or similar urban area. When identifying the area of implementation of their stormwater programs, communities may want to consider areas of significant development and industrial or commercial land uses that are outside of the urbanized area and discharge to their storm drain system.

DEQ, in coordination with local governments, considered the following when identifying the coverage area for the Phase II permit:

- **Where the urbanized area does not follow city/county boundaries**. The census defined urbanized area does not follow city and county boundaries.
- **Where the urbanized area includes a combined sewer area.** Some areas of Oregon contain combined sewer systems. Areas drained by combined sewers are not addressed in the Phase II regulations, but are instead addressed by the Combined Sewer Overflow Reduction Program. Cities and counties served by combined sewers should coordinate the development and implementation of these programs and practices jurisdiction-wide.
- **Where parts of the urbanized area discharge to ground through subsurface infiltration systems or do not drain to waters of the U.S.** NPDES municipal stormwater permits are not required in areas that do not drain to waters of the U.S. For cities or counties with numerous drywells and outfalls to surface waters, this could result in a patchwork program where Phase II requirements apply in some areas or to some stormwater discharges, but not others. The state's Water Pollution Control Act (ORS 468B) requires that discharges to all waters of the state be managed to protect water quality. The state's UIC rule will require cities and counties to manage stormwater discharges to UIC wells. Stormwater management programs are developed in compliance with the Phase II Municipal Stormwater Permit.
- **Where the urbanized area is only a small portion of a jurisdiction.** This especially applies to counties, where the urbanized areas are generally only a small portion of their jurisdictions.
- **Where the urban growth boundary is located with respect to the census-defined urbanized area.** DEQ is considering whether coverage under the Phase II municipal stormwater permit should be based on the Urban Growth Boundaries established by cities and counties under the state Growth Management Act. A coincident boundary may ease program implementation in the long run.
- **Where there are unincorporated islands within a city.** The Phase II stormwater regulations apply to all storm drain systems within urbanized areas. Where a city has an unincorporated island within the city boundary, this unincorporated island is subject to the permit, but responsibility for compliance falls to the county. These unincorporated islands present an excellent opportunity for city and county agencies to cooperate on developing a joint stormwater program.

Jurisdictions Not Covered by NPDES Phase II

In Oregon, 25 small MS4s within the census-defined urbanized areas designated by EPA in the 2000 Census were mandated to be evaluated for Phase II coverage. DEQ performed an analysis and designated 18 municipalities for coverage. From the initial list, DEQ determined that the following municipalities are exempt at this time:

- Adair Village
- Rainier

- Coburg
- Jacksonville
- Maywood Park
- Columbia County
- Deschutes County

Generally, these jurisdictions either have less than 1,000 people in the urbanized area served by MS4s, or they do not discharge to surface water.

The following jurisdictions outside of census-defined urbanized areas were considered for coverage by DEQ but were not designated at this time:

- Albany
- Canby
- Coos Bay
- Dallas
- Grants Pass
- Hermiston
- Klamath Falls
- La Grande
- Lebanon
- McMinnville
- Newberg
- Ontario
- Pendleton
- Redmond
- Roseburg
- St. Helens
- The Dalles
- Woodburn

Municipalities not subject to NPDES stormwater municipal permits are encouraged to adopt stormwater programs at least equivalent to the program components. Adoption of such a program is voluntary. Such municipalities would benefit by helping to protect local ground and surface water sources from stormwater pollution, reducing potential flooding concerns, and ensuring that their storm drain system is properly maintained. Such programs would include adoption of ordinances and implementation of minimum measures, including BMPs.

Any of the above listed jurisdictions can be designated by DEQ, should their status change. One of the most likely criteria for designation will result from a TMDL evaluation that indicates stormwater is a significant contributor to water quality pollution in a receiving water.

What Does Phase II Require

The Phase II stormwater regulations specify that an operator of an MS4 must implement a program of stormwater management activities to protect water quality. The program must at least address the following minimum requirements:

1. **Public education and outreach**—Develop and distribute educational materials and conduct public outreach aimed at informing citizens about the impacts of polluted stormwater as well as ways to minimize their contribution to pollution.
2. **Public involvement and participation**—Involve the public in stormwater management program development and implementation.
3. **Illicit discharge detection and elimination**—Develop and implement a program of detecting and eliminating illicit discharges to the storm drain system. This includes storm system mapping, dry weather sampling, and citizen information activities.
4. **Construction site stormwater runoff control**—Develop, implement, and enforce a program and standards to control or prevent erosion and sediment discharges from

construction sites that disturb 1 or more acres of land. This includes preparation of a construction site erosion and sediment control plan.

5. **Post-construction stormwater management**—Develop, implement, and enforce a program and standards to control or prevent discharge of polluted runoff from new development and redeveloped sites. This can include structural treatment and detention systems as well as resource protection measures (wetland protection, habitat protection, etc.) and pollution prevention planning.
6. **Pollution prevention, or "good housekeeping," for municipal operations**—Develop, implement, and enforce a program to control or prevent the discharge of polluted runoff from municipal operations (road maintenance, vegetation management, storm drain maintenance, etc.).
7. **Compliance with more stringent conditions**—Measures beyond the six above may be needed to achieve TMDLs or other cleanup plans to meet federal Clean Water Act requirements to restore beneficial uses of impaired water bodies.
8. **Evaluation and assessment**—Evaluate the program's compliance with permit conditions and the effectiveness and appropriateness of the identified BMPs. Keep records and report to DEQ any changes in activities resulting from program evaluation and assessment.

The federal regulations do not require Phase II jurisdictions to inspect industrial sites. DEQ is responsible for inspecting industrial sites to ensure compliance with the statewide Industrial Stormwater General Permits. Phase II communities will still be expected to investigate reports of illicit discharges to their storm drain systems at industrial sites, review erosion and sediment control plans for construction of new industrial sites, and implement other aspects of their stormwater management programs that are generally applicable jurisdiction-wide.

Development of a Phase II-compliant stormwater management program may necessitate additional staff, office space, equipment, and funding.

As a practical matter, implementing a stormwater management program to address the minimum requirements of a NPDES permit may require that operators of small MS4s do the following:

- Integrate a stormwater management program into their organizational structure.
- Hire additional staff to carry out the work (public involvement and education, plan review, inspection and enforcement, maintenance, planning, complaint response, management, etc.).
- Find additional office space for staff.
- Obtain additional office, field, and maintenance equipment.
- Develop and adopt ongoing funding methods.
- Develop and adopt various legal ordinances.
- Conduct ongoing stormwater and surface water planning efforts.

D.3 NPDES Plan

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Technical Memorandum

City of Stayton STORMWATER NPDES PHASE II PROGRAM PLAN

January 5, 2007

1.0 INTRODUCTION

This Stormwater NPDES Phase II Program Plan for the City of Stayton, Oregon, has been developed to address the Municipal Separate Storm Sewer System (MS4) permit requirements of the National Pollutant Discharge Elimination System (NPDES). The MS4 program for small jurisdictions is often called NPDES Phase II. The program described in this document is outlined for a 5-year period, since that is the standard length of a NPDES permit term. Although the City of Stayton is currently not required to meet NPDES Phase II requirements, the City is addressing several of these issues as part of the overall stormwater master plan effort. This program's approach will meet the requirements of the Willamette River TMDL program where the City is identified as a Designated Management Agency (DMA).

This Plan is arranged by the six minimum measures that were identified in the Federal Register. At the beginning of each section is a summary table listing each proposed activity (or BMP) associated with the measure addressed in that section. The five columns indicate which years (during the 5-year permit period) that the activity is anticipated to be performed by the City, working either jointly or independently, as applicable. The summary tables are followed by descriptions of schedules, measurable goals, responsible parties, and other implementation issues for each activity.

The measurable goals proposed for each activity were established through various means. Generally, they represent what seemed reasonable for each situation, based on past experience and common practices for stormwater management. Certain activities have precedent activities, so those are scheduled accordingly. From a practical sense, not all activities can be performed in Year 1, so a conscientious attempt was made to spread them out over a 5-year period.

A NPDES permit would require reporting of measurable goals and implementation schedule, which is also a requirement of the DMA's under the TMDL program.

2.0 STORMWATER PUBLIC EDUCATION PROGRAM

Stayton may wish to maximize the use of regional information and publications to the extent practical. This would include assisting with the circulation of literature developed by DEQ, EPA, the North Santiam Watershed Council, and others.

In addition to preparing the 5-year program, Stayton could implement a program to educate the public about possible regional coordination efforts and what the NPDES Phase II and the TMDL programs mean to the community. This work could include conducting open houses, preparing brochures, and making presentations to City Council. The following table describes efforts that could be undertaken and planned for the 5-year program.

TABLE 2-1
STORMWATER PUBLIC EDUCATION PROGRAM

BMP Activity / Description	Activity Year				
	1	2	3	4	5
Stormwater Education & Outreach Strategy	√	–	√	–	–
Stormwater Brochure for the General Public	–	–	√	–	–
Targeted Stormwater Brochures	–	√	–	√	–
Storm Drain Stenciling	√	√	√	√	√
Water Quality Education with Schools	–	√	–	√	–
Volunteer Groups on Stormwater Education	–	√	–	√	–
Stormwater Speakers Bureau	–	–	–	–	–
Stormwater Public Service Announcements	–	–	√	–	–
Stormwater Display	–	√	–	–	–
Stormwater Web Site	–	–	–	–	–

√	Activity scheduled for year	–	No activity scheduled for year

2.1 Develop a Stormwater Education and Outreach Strategy

Develop and implement a stormwater education and outreach strategy that examines target audiences. Include in the strategy information on the hazards associated with illicit discharges and improper disposal of waste.

Description: The stormwater outreach strategy is a required BMP under the NPDES Phase II permit. An effective education and outreach program begins with a comprehensive education and outreach strategy. The strategy focuses on identifying target audiences, including what they value and how they communicate. This information directly relates to determining the other education and outreach BMPs that are most appropriate for target audiences.

- Step 1. Characterize Target Audiences: Specific groups within the community may have the potential to contribute pollutants to stormwater. If so, document characteristics about these groups for use in developing and distributing educational materials.
- Step 2. Develop Education and Outreach Strategy: Using information about the storm drainage system and target audiences, develop an education and outreach strategy to help implement the overall program. The strategy identifies a variety of information, including the driving force (i.e., key problems caused by stormwater associated with the target audience); the key message(s); the objective (e.g., raise awareness, educate, or motivate action); the format for delivering the message; the distribution method; and the responsible parties and/or partners.

Action Plan and Schedule: The Action Plan for this activity is to meet with the North Santiam Watershed Council to discuss current public outreach activities and to identify potential audiences, methods to reach these audiences and a schedule to implement these activities.

Measurable Goal: Every six months City staff will meet with staff of the North Santiam Watershed Council to discuss Public Education and Outreach. This will determine the effectiveness of the existing programs and potential future endeavourers. If it is determined minor modifications to the program are required to reach a larger audience these will be outlined in the annual reporting.

2.2 Stormwater Brochure for the General Public

Develop and distribute a brochure or equivalent program to inform the general public about stormwater issues and of the hazards associated with illicit discharges and improper disposal of waste.

Description: Develop and distribute a general brochure on stormwater. The purpose of this brochure is to address how stormwater can impact water quality and the steps that people can take to reduce stormwater pollution (e.g., do not dump to storm drains). One element of the illicit discharge detection and elimination minimum measure is to "inform public employees, businesses, and the general public of hazards associated with illegal discharges and improper disposal of waste." This BMP fulfills this element.

There are many opportunities to "piggyback" the distribution of educational materials onto the distribution of others such as newspapers, newsletters, and community events. Take advantage of these existing communication channels for distributing materials and messages in an effective and cost-efficient manner.

Exposing target audiences to a message on a regular basis can raise awareness. A combination of formats and distribution channels to reach each target audience is beneficial. A feedback mechanism can be developed for evaluating the effectiveness of the materials and the changes in target audiences' level of awareness regarding stormwater.

Action Plan and Schedule: The plan is to send out one general stormwater brochure in the third year of the program.

Measurable Goal: The measurable goal of this activity is the number or percentage of residents and business contacted with the brochure.

2.3 Targeted Stormwater Brochures

Develop and distribute stormwater brochures that address a variety of different target audiences.

Description: Brochures targeted and written specifically for the audience are often more effective than general brochures. The stormwater education and outreach strategy will provide direction on target audiences and issues to consider when developing targeted brochures.

Target audiences include residents, businesses, industries, and developers. Consider addressing topics such as pet waste management, pollution prevention tips for landscaping, proper disposal of household hazardous waste, pesticide use, do-it-yourself auto maintenance, car washing, and/or pavement deicing.

Action Plan and Schedule: Within the second year Stayton will develop a targeted brochure for erosion control (see Section 5.6). The brochure will discuss the need for erosion control along within general prevention and where more information can be obtained. The brochure will be included in all building permit application packages.

Develop second brochure by the fourth year of the program. Other targeted brochures might include homeowners along creek corridors, or brochures describing new development requirements as part of this program. Targeted groups to be determined in year 1 as part of the Outreach Strategy.

Measurable Goal: Erosion Control targeted brochure included in all building permits by year 2.

2.4 Storm Drain Stenciling

Plan and conduct storm drain stenciling projects using "Do Not Dump – Drains to Stream" or an equivalent message on storm drain inlets draining to the system.

Description: Stenciling storm drains with messages such as "Do Not Dump – Drains to Stream" or "Do Not Dump – Drains to Ground Water" have proven very effective in many jurisdictions. Some residents still do not know that material placed in storm drains is not treated at a wastewater treatment plant before reaching a river or infiltrating into ground water. These permanent messages on storm drains serve as constant reminders and teaching tools for everyone who sees them.

There are several options to consider in terms of what type of stencils to use and how to get the job done. First is to consider enlisting the aid of volunteer organizations. Second is to decide on the method of applying the messages. To apply the "no dumping" messages, use either actual stencils that require paint or signs and emblems out of plastic and metal that permanently affix. Labor for stenciling can come from either municipal employees or volunteers. Set a goal to complete a certain amount of storm drain stenciling by the end of the first permit term. Using the storm sewer system map completed for the Illicit Discharge Detection and Elimination minimum measure (described in Section 4), prioritize storm drain inlets according to potential risk (e.g., inlets with a history of illegal dumping; inlets located near industries with outdoor, uncovered operations; and inlets located near areas with high rates of development) and begin stenciling projects in those areas.

Action Plan and Schedule: The City of Stayton currently stencils/does not stencil? storm drain inlets. The City will begin/continue? to stencil storm drains and catch basins which have not been stenciled or re-stencil inlets where the markings have worn off. City Staff will investigate the wear of the stenciling in year 3 and 5 to determine if the storm drains will need repainting. All storm drains of new development and road improvement projects will be painted following project completion.

Measurable Goal: Measurable goal will be to monitor stencils for wear and to include storm drain stenciling in the City final inspection for new development.

2.5 Promote Water Quality Education with School Districts

Contact school districts to discuss opportunities to integrate water quality educational materials into the classroom and provide educational materials when requested by schools. This effort might already be preformed by the North Santiam Watershed Council and therefore should be discussed at the strategy meeting.

Description: For this BMP, contact all schools districts within the storm drain system and offer to distribute appropriate water quality educational materials. If feasible, offer staff from a department involved in stormwater management to teach some of the material or organize alternative educational efforts such as tours of wastewater treatment plants or stream restoration visits.

The Oregon Department of Environmental Quality lists Classroom Curriculum Guides (K-12) that could be distributed to local schools. See the web site http://www.deq.state.or.us/programs/education.htm for more information. DEQ also holds workshops for teachers on Project WET, Water Education for Teachers. Additional information can be found on DEQ's web site.

Action Plan and Schedule: The City of Stayton may wish to coordinate and promote stormwater Education. This effort could be lead by the Watershed Council or the City and include meetings with educators to determine how City Staff can provide educational instruction and material to local educators. The coordination will include working with local organizations and school districts to develop a water quality education program. Specific guidelines can be obtained from other resources throughout the region. Details of how the effort can assist educators will be determined based on the initial meetings with the educators. The effort will start approaching school districts and educators in year 2 of the program to determine the best methods to coordinate efforts.

Measurable Goal: Contact the school district within the storm drain system boundary by the end of permit year 2. Measurable goals for the detailed education will be based on the approach chosen to assist educators. The goals and achievements will be presented in the annual reporting.

2.6 Work with Volunteer Groups on Stormwater Education Projects

Contact volunteer organizations to discuss opportunities to integrate stormwater into existing education projects. This should include the Watershed Council and other groups within the area.

Description: Many volunteer organizations within the storm drainage system may already conduct water quality related educational programs. Where these organizations exist, they may be willing to incorporate stormwater issues into their programs and activities to help meet this minimum measure.

Begin by researching the various volunteer programs and organizations that focus on the boundaries of the storm drainage system and/or the watershed and identify ways to integrate stormwater issues into these existing volunteer opportunities.

Action Plan and Schedule: Stayton will to work with local volunteer organizations to discuss opportunities to integrate stormwater/water quality information into existing education projects.

Adopt a Street Program?: This program allows businesses, service clubs, schools, and organizations to adopt an arterial or collector street. The groups is asked to adopt the street for at least 1 year and conduct litter clean ups at least every 3 months. Individual residents, neighborhoods, or families can also adopt streets in their neighborhood. They are asked to adopt the street for at least a 1 year period and clean it on an as needed basis.

Storm Drain Stenciling Program?: The City will supply all equipment for "adopt a street" program participants or other volunteers to stencil the words "Dump No Waste—Drains to Streams" on storm drains.

Measurable Goal: Assist any groups actively contacting the City. This should be an ongoing activity with groups that express interest. In years 2 and 4 actively contact at least 2 volunteer organizations per year to discuss and promote stormwater education.

2.7 Develop a Stormwater Speakers Bureau

Develop and promote a stormwater speakers bureau that gives presentations on stormwater issues throughout the community. The Watershed Council may already have qualified people to make these presentations.

Description: Recruiting a team of stormwater management advocates from target audiences is one way to educate stakeholders and to distribute stormwater educational messages at a low-cost. Speakers bureaus are an effective way to get out information on stormwater management and have the message come from a representative of each target audience. All that is needed to implement this BMP are presentation materials on stormwater management and a group of willing volunteers who like to speak in public.

Action Plan and Schedule: This activity should be discussed with the Watershed Council to determine the best qualified residents or staff to go to meetings to discuss Stormwater Quality programs and activities.

Measurable Goal: Keep records of any stormwater presentations and the number of attendees or number of times the program was repeated.

2.8 Create Stormwater Public Service Announcements

Broadcast stormwater public service announcements (PSAs) through newspapers, television, or radio and run the announcements at appropriate frequent intervals to ensure target audiences are exposed to the message.

Description: Most people within communities receive their information from mass media sources such as newspapers, television, and radio. While these forms of outreach tend to be more expensive than printed materials, they can reach a wide audience and have a stronger, more lasting impact.

Design public service announcements (PSAs) for mass media sources such as newspaper, television, or radio. To have an impact, audiences need exposure to PSAs over a long-period of time and at regular intervals. Many communities have already designed and used PSAs related to stormwater and make these PSAs available to other communities to use either for free or at a minimal cost.

Action Plan and Schedule: Working with the Watershed Council, DEQ or others a public announcement should be attempted in the third year of the program. This could be radio or news print and could use material developed by others.

Measurable Goal: The number of Public Service Announcements will be kept over the first five years.

2.9 Design a Stormwater Display

Display a stormwater exhibit at various community locations and events (e.g., county fairs, city events).

Description: Buildings and events that have regular traffic and/or attract a large number of people provide an opportunity for stormwater education. Free-standing educational displays are intended to communicate information in an easy-to-understand format using photographs, maps, and hands-on activities.

In order to design and develop an educational display on stormwater issues, include messages for members of each target audience, provide information on stormwater problems and solutions, and use a combination of images and text to convey information. In addition to developing the display, use the information contained in the education and outreach strategy (BMP 2A) to identify the most effective places and/or events to set-up the display.

Action Plan and Schedule: A stormwater display will be developed by the second year of the program to be shown on community events.

Measurable Goal: Track the number of events and attendance the display is shown.

2.10 Create a Stormwater Web Site

Create a stormwater website that contains educational information for a variety of target audiences.

Description: Design and develop a stormwater website that contains educational information on stormwater and information on the jurisdiction's stormwater program. Include the website address on other forms of outreach, such as brochures and displays, to ensure that the community knows where to find additional information about stormwater.

Action Plan and Schedule: Nothing is scheduled for this activity for the first 5 years of the program. This activity is listed as an alternate if others activities are not successful or not implemented.

Measurable Goal: A measurable goal for this activity would be the development of a web site or a section of the City's overall web site.

3.0 STORMWATER PUBLIC INVOLVEMENT AND PARTICIPATION PROGRAM

Stayton may wish to maximize the use of regional public involvement activities to the extent practical. This would include coordinating with activities performed by DEQ, EPA, the North Santiam Watershed Council, and others.

Stayton could implement a program to involve the public in local and regional coordination efforts. This work could include conducting public meetings, distributing news releases, and forming a stormwater group to advise staff and the City Council. The following table describes efforts that could be undertaken and planned for the 5-year program.

TABLE 3-1
STORMWATER PUBLIC INVOLVEMENT AND PARTICIPATION PROGRAM

BMP Activity / Description	Permit Year				
	1	2	3	4	5
Public Review/ Public Meetings	√	–	√	–	–
Distribute News Releases	√	–	–	–	–
Stormwater Advisory Group	√	√	√	√	√

√	Activity scheduled for year	–	No activity scheduled for year

3.1 Public Review/Public Meetings

Hold public meetings and solicit public review of the stormwater management plan.

Description: Follow all local and state public notice requirements to ensure that the public has an opportunity to participate in the program. Local public notice requirements vary, but will probably consist of public meetings and publishing notices in local newspapers.

Action Plan and Schedule: The City of Stayton will investigate methods to encourage the involvement of the public in stormwater activities. This effort will continue throughout the 5-year program. The program will be developed to allow public comment on stormwater programs and projects.

Once the stormwater management plan is completed, Stayton will hold public meetings to solicit public review of the plan.

The effort for public review and public meetings will continue throughout the 5-year program however attempts should be made to have a public meeting in the first and third year of the program.

Measurable Goal: Hold at least two public meeting and publish at least two public notices during the 5-year program.

3.2 Distribute News Releases

Develop a news release for local newspapers in order to solicit interest to cover the new stormwater program as a feature story.

Description: To help encourage additional local coverage on the development of the stormwater program, create and distribute a new release for use by local papers. Include in the news release an overview of the new stormwater program, activities that will be conducted, and how the public can obtain more information.

Action Plan and Schedule: The distribution of news releases will be provided when the local press is available and interested in stormwater topics. No schedule for this has been developed and opportunities will depend on the news agencies' interest in stormwater activities.

Measurable Goal: At least one news release story on the jurisdictions stormwater program over the first five year program.

3.3 Stakeholder Advisory Group

Hold meetings with a stakeholder advisory group for stormwater issues.

Description: An advisory group could be formed with representatives from several City departments and members of various organizations in the City and beyond. This group would address issues pertaining to the stormwater program and provide guidance for planning, engineering, construction and operation activities.

Action Plan and Schedule: The group should set a schedule for meeting and every six months or every year.

Measurable Goal: Dates and attendance will be kept for each meeting. A summary of topics discussed and key decisions will be kept and submitted as part of the annual report.

4.0 ILLICIT DISCHARGE DETECTION AND ELIMINATION PROGRAM

In order to meet regulations under 40CFR122.34(b)(3), an Illicit Discharge Detection and Elimination Program will be developed for the City of Stayton. The following table describes efforts that could be undertaken and planned for the 5-year program.

TABLE 4-1
ILLICIT DISCHARGE DETECTION AND ELIMINATION PROGRAM

BMP Activity / Description	Permit Year				
	1	**2**	**3**	**4**	**5**
Storm Sewer System Map	√	–	–	–	–
Ordinance to Prohibit Non-Stormwater Discharges	√	√	–	–	–
Detect and Address Non-Stormwater Discharges	–	–	√	–	√
Conduct Field Inspections	–	√	√	√	√
Spill Response Plan (create new plans or review and update existing plans)	–	√	–	–	–
Plan for Enforcement Actions	–	√	–	–	–
Train Municipal Staff on Spill and Illicit Discharge BMPs	–	√	–	–	√

√	Activity scheduled for year	–	No activity scheduled for year

In addition to the following required best management practices (BMPs), brochures, including information about illicit discharges will be created for the general public as a part of the Public Education requirements.

4.1 Storm Sewer System Map

Create a storm sewer system map showing all known storm drain outfalls to receiving waters.

Description: If one does not already exist, a storm sewer system map showing, at a minimum, locations of all outfalls and the names and locations of all waters that receive a discharge from those outfalls is needed. The mapping of storm sewer pipe or storm drain inlet locations is not required, although it is probably desirable for most cities in the long-term to assist with maintenance

Action Plan and Schedule: A storm sewer system map is being created as part of the Master Plan effort and therefore this effort is due to be completed in the first year of the plan.

The storm sewer system map will be updated as a part of the Illicit Discharge Detection and Elimination activities and the Post-Construction program activities. As new development is permitted the drainage system will be added to the base map.

Measurable Goal: The storm sewer system map will be updated annually.

4.2 Ordinance to Prohibit Non-Stormwater Discharges

Develop and enforce an ordinance prohibiting illicit discharges and illegal dumping, and authorizing enforcement actions, including on private property.

Description: First, assess whether the required legal authority to prohibit non-stormwater discharges to the storm drainage system currently exists. Look to existing ordinances or municipal codes to identify this legal authority. If adequate legal authority prohibiting illicit discharges does not exist, an ordinance can be drafted.

A model ordinance includes authority for all three of the ordinances required by EPA's Phase II regulations: ordinances to control illicit discharges, construction site runoff, and post-construction runoff. It may be easier to combine all three ordinances into a single ordinance if legal authority does not currently exist.

Action Plan and Schedule: Under Section _?_ of the City's current municipal code it is unlawful to deposit substances in the public drainage system that could cause damage to that system. Under Section _?_ of the City's current municipal code provides the City with penalties to enforce the municipal code.

Measurable Goal: The measurable goal is to have ordinances in place to make it (1) unlawful to discharge pollutants to the storm system, (2) allow the City to investigate private property for illegal discharges, (3) allow the City to force private properties to make changes if illegal discharges are detected, (4) make it illegal for new development to construct illegal discharge connections.

4.3 Detect and Address Non-Stormwater Discharges

Develop an illicit discharge detection plan that includes, at a minimum, the following components: (1) Identification of priority areas for assessment, (2) Field assessment activities, (3) Routine schedule for system inspection, (4) Characterization of any discharges found, (5) Procedures to trace an illicit discharge, and (6) Procedures to remove an illicit discharge.

Description: The primary component of this minimum measure is to develop an illicit discharge detection plan to find, identify, and eliminate unknown pollutant discharges to the storm drainage system. The purpose of this plan is to identify priority areas within the storm drainage system that are believed to be more susceptible to illicit discharges, describe field assessment activities, determine when a discharge is found whether it is illicit, and describe procedures to trace the discharge back to its source and eliminate the discharge.

Action Plan and Schedule: An Illicit Discharge Plan will be prepared by year 3 of the program. This will include a procedure for the inspection and detection of illicit discharges. The following components will be included in the plan:

1. Identification of priority areas for assessment
2. Field assessment activities
3. Routine schedule for system inspection
4. Characterization of any discharges found
5. Procedures to trace an illicit discharge
6. Procedures to remove an illicit discharge

The new stormwater ordinance discussed under Section 4.2 will provide the City with regulations to remove illicit discharges if detected.

After the program has been implemented for a year the overall plan will be reevaluated in year 5 to make minor modifications.

Measurable Goal: Develop plan by year 3 and evaluate plan in year 5.

4.4 Conduct Field Inspections

Visually inspect for illicit discharges during dry weather at all known outfalls that discharge to surface waters (in conjunction with the storm sewer system map).

Description: Using the plan and City maps, the City field staff will inspect outfalls for any signs of illicit discharges. Field inspection activities consist of visiting outfall locations using the system map and recording visual observations at each outfall within a priority area. For accessible outfalls, mark the outfall once it is located and complete a field inspection form. If an outfall is not accessible, field crews must use the system map and identify the nearest point to access the system. Locate the storm sewer manhole closest to the outfall and remove the cover to identify signs of dry-weather flow, such as odor or residue. City Staff will inspect outfalls and the drainage system to determine if they are functioning as designed.

Action Plan and Schedule: This activity is simply implementing the Illicit Discharge Plan developed under Section 4.3 of this section. The plan will develop a schedule and reporting procedures to be used when conducting these inspections. At a minimum, each outfall shall be inspected on a 3-year rotation. Appropriate actions will be taken to determine the source of any illicit discharges found during the inspections.

Measurable Goal: The measurable goals for this activity should be developed as part of the Illicit Discharge Plan. Methods for measurement might be inspection of a percentage of the system each year.

4.5 Spill Response Plan

Develop and implement a spill response plan.

Description: A written spill response plan is needed to identify appropriate actions when a spill occurs. Include in the plan, for different kinds of spills, who should be contacted and what the municipality will do in response. The plan also needs to include recordkeeping and reporting requirements so that each spill, the response, and its outcome are tracked.

Action Plan and Schedule: A Spill Response Plan shall be prepared in year 2 of the program.

Measurable Goal: Implement the program by the end of permit year 2.

4.6 Plan for Enforcement Actions

Develop and implement an enforcement plan to ensure compliance with local ordinances. This enforcement plan will be used for illicit discharges, construction site discharges, and post-construction discharges.

Description: The enforcement plan developed for this BMP addresses how to handle non-compliance with local ordinances and discharges from illicit sources, construction sites, and post-construction BMPs. Develop the plan so that it is specific enough to give inspectors guidance on the typical penalty for each situation.

Action Plan and Schedule: After discovering an Illicit Discharge, the City of Stayton will first attempt to work with the responsible party to eliminate the problem or to route the flow to the sanitary sewer, if allowable. Under Section _?_ of the municipal code, the City can fine a party $_____ per day for an infraction. The City can also work with the DEQ to eliminate spills and illicit discharges when discovered.

Measurable Goal: No measurable goal for this activity.

4.7 Train Municipal Staff on Spill and Illicit Discharge BMPs

Provide training or coordinate with existing training efforts to educate relevant staff on proper BMPs for spills and illicit discharges.

Description: Provide training to relevant municipal staff, such as field maintenance crews, illicit discharge inspectors, and other first responders, on the proper BMPs to use for spills and illicit discharges. Include in the training who to call for different types of spills.

This training could be combined with other training of municipal staff conducted in Section 7.

Action Plan and Schedule: Once the above items are completed, relevant municipal staff will be trained on the proper BMPs to use for spill response and illicit discharge detection and removal. The staff training will occur in combination with training for Pollution Prevention. "Refresher" training will update staff on changes to the procedures as needed.

The training of staff will begin in year 2 with refresher courses and courses for new staff conducted in year 5 of the program. Selected staff will go to regional or statewide training classes and develop a program to train all staff within the City crews.

Measurable Goal: The number of staff time spent in class along with class subjects will be documented and reported annually.

5.0 CONSTRUCTION SITE STORMWATER RUNOFF CONTROL PROGRAM

In order to meet regulations under 40 CFR 122.34(b)(4), the City of Stayton will need to develop, implement, and enforce a program to reduce pollutants in any stormwater runoff from construction activities. The regulations covering this activity will need to be part of the overall City stormwater ordinance. The size of the construction activity covered by the ordinance will be determined during the ordinance development. Meetings with City Council however, will cover, at a minimum, construction activity of 1-acre or larger. The following table describes efforts that could be undertaken and planned for the 5-year program.

TABLE 5-1
CONSTRUCTION SITE STORMWATER RUNOFF CONTROL PROGRAM

BMP Activity / Description	Permit Year				
	1	2	3	4	5
Modify Erosion and Sediment Control Ordinance	–	√	–	–	–
Develop Erosion Control Manual (or adopt state or other manual)	–	√	–	–	–
Train Plan Reviewers and Field Inspectors	–	√	–	–	–
Training for Contractors and Developers		√	–	–	–
Review Site Plans for Erosion and Sediment (E&S) Controls	–	–	√	√	√
Receive Information from the Public	–	–	√	√	√
Inspect Construction Sites	–	–	√	√	√
Information Brochures for Contractors	–	√	–	–	–
Provide Information on Training for Construction Operators	–	√	–	–	–

√	Activity scheduled for year	–	No activity scheduled for year

5.1 Modify Erosion and Sediment Control Ordinance

For permits or authorizations issued by the jurisdiction for construction operators disturbing at least 1 acre, require through an ordinance, erosion and sediment controls in compliance with an adopted stormwater management *Manual* or other guidance document. Jurisdictions may, at their discretion, require erosion and sediment controls for smaller sites based on local conditions and needs.

Description: The 1994 Storm Design Standards has a section describing erosion control requirements however this section is limited to areas within the banks of a waterway. This standard requires updating to include referencing the need for developing an ordinance to allow the collection of permit applications and the issuing of permits. This will allow the City to administer the DEQ program. This ordinance typically requires construction operators to follow a guidance manual. An effective ordinance also includes penalties to ensure compliance. At a minimum, this ordinance applies to all construction activity disturbing at least one (1) acre but can include single family construction. Incorporate these ordinance requirements into an existing grading permit process, requiring sites to submit erosion and sediment control plans and implement BMPs before a grading permit is issued.

Include in the local ordinance a requirement that construction sites comply with an adopted stormwater management *Manual*. Such a *Manual* could either be prepared locally, regionally, or statewide. Alternately, the Oregon DEQ has prepared a statewide *Erosion Prevention and Sediment Control Manual* for use by the construction industry and state and local inspectors. In any case, the details on the types of controls construction sites must implement should preferably be contained in the technical *Manual*, not in the ordinance. The State Building Code can also provide the legal authority, however, in most cases it is probably better to have the legal authority specified in the local municipal code.

Action Plan and Schedule: Stayton will adopt a stormwater ordinance that will include illicit discharges, construction site runoff, and post construction runoff by year 2 of the program.

Stayton currently has design guidelines that include requirements for erosion and sediment control, however these guidelines are very brief (about one page of text). An expanded program should be developed to address new requirements of stormwater NPDES Phase II, or the state's manual, once available, could be used.

Measurable Goal: Adopt updated Ordinance and Design *Manual* by the end of program year 2.

5.2 Train Plan Reviewers and Field Inspectors

Provide training or coordinate with existing training efforts to educate plan reviewers and field inspectors in erosion and sediment control BMPs and requirements.

Description: Sections 5.3 and 5.5 describe the process to review site plans for erosion and sediment controls and inspect construction sites for proper BMP installation and maintenance. To help implement these activities, provide training to plan reviewers and field inspectors in developing and implementing an effective erosion and sediment control plan. This training can be developed in-house, or a variety of organizations offer training courses on construction site sediment and erosion control.

Action Plan and Schedule: Once an ordinance is in place, Stayton will train city staff responsible for reviewing plans and inspecting construction sites to ensure that erosion and sediment control BMPs are properly installed and maintained. If possible, training will be coordinated with training on post-construction stormwater management. "Refresher" training will update staff on changes to the procedures as needed. Stayton may participate in a regional training program. This might include training programs by DEQ.

Train plan reviewers and field inspector by the end of program year 2.

Measurable Goal: The number of hours spent in class along with class subjects will be documented and reported annually.

5.3 Review Site Plans for Erosion and Sediment (E&S) Controls

Review stormwater site plans prior to construction to ensure that they include adequate E&S controls and post-construction controls. This review is conducted to determine compliance with local ordinances and the adopted stormwater management *Manual*. Federal rules require that all construction sites greater than one disturbed acre be subject to plan review. Jurisdictions may, at their discretion, require plan review for smaller sites based on local conditions and needs.

Description: To ensure that construction sites include the required stormwater controls, review pre-construction site plans to ensure that they include appropriate erosion and sediment controls and post-construction controls in compliance with the local ordinance and the adopted stormwater management *Manual*. Combine this pre-construction review of E&S controls with the review of post-construction controls to streamline the review time and conserve resources. EPA recommends that procedures for site plan review include the review of individual pre-construction site plans to ensure consistency with local sedimentation and erosion control requirements. At a minimum, include review of all plans for construction sites disturbing at least one acre in the site plan review process.

Action Plan and Schedule: Once a stormwater ordinance is updated/adopted for Stayton, construction site plans will be reviewed to ensure they are in compliance with local ordinances and stormwater management manuals. Plans will also be reviewed for appropriate use of erosion and sediment BMPs as well as post-construction controls.

Start reviewing site plans for erosion control beginning in year 2. This will allow development of the stormwater ordinance and training of staff. Until that time the 1200-C permit process administered by DEQ will be used to review and control construction runoff in Stayton.

Measurable Goal: Once this effort has started, City staff will monitor the number of permit reviews, the number of on-site inspections, and the number of on-site revisions required. If enforcement is required this will also be recorded. All records will be reported annually.

5.4 Receive Information from Public

Publish a phone number, or equivalent system, to receive information from the public on construction site runoff issues. Set up a process to pass this information off to field inspectors.

Description: To meet this requirement, list a phone number for “construction-related complaints” in the local government pages, published in brochures and listed on the jurisdictions web site, if available. Direct this phone number to the appropriate staff person, such as an administrative assistant or a construction inspector.

Keep written logs of all complaints that include the date and time of the call, location of the construction site, and the nature of the complaint. Provide information on these complaints to the local construction inspectors by the end of the day; the goal is to have inspectors follow-up on each complaint within three days.

Action Plan and Schedule: On brochures, permit applications, and other publications, the phone number of the City’s Stormwater Department will be given to allow the public to report complaints and/or comments from the general public regarding construction site runoff. These comments and follow-up activities will be monitored internally by City Staff. The City’s construction inspector will receive information on the complaint by the end of the day and will be responsible for following up on each complaint within 2 days.

Measurable Goal: Record the number of complaints received and handled, and submit with the annual report.

5.5 Inspect Construction Sites

Inspect all construction sites during the construction period that are regulated by the ordinance adopted in Section 5.1.

Description: Once site plans receive approval for E&S controls, it is extremely important to ensure that E&S controls are properly installed and maintained, and that the site plan reflects changes made on-site (e.g., different types of controls used and changed location of controls). Frequent and consistent inspections are the key to ensuring proper installation and maintenance of E&S controls. At a minimum, inspect all construction sites at least once during the project period.

Set inspection priorities based upon local goals, resources, and known problem areas. These priority sites can be based on particular areas or the priority sites can be based on specific operators with past problems or larger construction sites.

Action Plan and Schedule: All construction sites which are required to submit site plans for erosion and sediment control will be inspected to ensure that the selected BMPs are installed and maintained correctly. Site plans must also reflect changes made on-site after the plans were reviewed. The frequency of inspection will be determined based on the complexity of the project. Each construction site shall be inspected at least once.

Inspection will start in year 3 of the program.

Measurable Goal: Records of the inspections and any follow-up work will be kept and submitted annually.

5.6 Provide Information on Training for Construction Operators

Provide information on local training available to construction operators on how to install and maintain effective erosion and sediment control and how to comply with the requirements in the adopted stormwater management *Manual*.

Description: Local jurisdictions do not need to conduct this training for local construction operators, but should direct construction operators to available training resources if requested. This could be provided as a single page handout during the pre-construction meeting or as requested.

The training described in Section 5.2 also applies to local construction operators. In fact, many classes will include a mix of both municipal construction plan reviewers and inspectors, along with local construction operators.

Action Plan and Schedule: A brochure on construction site erosion control and post construction controls will be prepared and distributed (see Section 2.3). This will include brief descriptions of methods, sources of information for erosion control methods, including DEQ's manual and web sites.

The brochure will also include information on training available for local construction operators. If contractors require further training following the classes provided by DEQ.

Develop Erosion Control brochure by year 2.

Measurable Goal: Document the distribution of the erosion control brochure and the scheduled classes along with attendance, and submit with the annual report.

6.0 POST-CONSTRUCTION STORMWATER MANAGEMENT PROGRAM

In order to meet regulations under 40 CFR 122.34(b)(5), the City of Stayton will develop a program for post construction stormwater management. The following table describes efforts that could be undertaken and planned for the 5-year program.

TABLE 6-1
POST-CONSTRUCTION STORMWATER MANAGEMENT PROGRAM

BMP Activity / Description	Permit Year				
	1	2	3	4	5
Ordinance Requiring Post-Construction Controls	√	√	–	–	–
Develop a Plan to Address Post-Construction Run-off	√	–	–	–	–
Training for Plan Reviewers and Field Inspectors	√	–	–	–	–
Training for Local Engineers and Developers	√	–	–	–	–
Site Plan Review for Post-Construction BMPs	√	√	√	√	√
Inspections of Structural Post-Construction BMPs	√	√	√	√	√

√	Activity scheduled for year	–	No activity scheduled for year

6.1 Ordinance Requiring Post-Construction Control

For permits or authorizations issued by the jurisdiction for construction of private developments, require through an ordinance, the installation and proper maintenance of post-construction runoff controls in compliance with an adopted stormwater management *Manual/Standards* or other guidance document. The size of the development requiring post development stormwater controls will be laid out the management manual and is at the discretion of the City.

This ordinance might already be in place but should be reviewed. The ordinance will not contain the detailed design requirements but will only reference the Stormwater Manual/ Design Standards being developed as part of the master plan effort and discussed below in Section 6.2.

Description: Combine the post-construction ordinance with the illicit discharge and construction ordinance, described in Sections 4 and 5 respectively, into a single stormwater ordinance. This ordinance largely requires local construction sites to comply with a local stormwater manual. After the ordinance is adopted, plan on evaluating the effectiveness of this ordinance during subsequent years of the permit.

EPA only requires the ordinance to “address post-construction runoff from new development and redevelopment projects” but does not say specifically what the ordinance must include. The ordinance could be as simple as requiring post-construction runoff to be no greater than pre-construction runoff.

Ensure that the ordinance addresses post-construction runoff from new developments and redevelopment projects that disturb more than one acre. The term “redevelopment” should refer to alterations of a property that change the "footprint" of a site or building and is not intended to include such activities as exterior remodeling, which would not be expected to cause adverse stormwater quality impacts and offer no new opportunity for stormwater controls.

Action Plan and Schedule: Stayton will adopt a new stormwater ordinance that will include illicit discharges, construction site runoff, and post construction runoff. The stormwater ordinance is scheduled to be prepared and adopted in the first year of the 5-year program.

Measurable Goal: Adopt ordinance by the end of the first year of the program.

6.2 Develop a Plan to Address Post-Construction Runoff

Develop a plan to address post-construction stormwater runoff during the plan review, construction inspection, and post-construction maintenance inspection process.

Description: To develop a plan to address post-construction stormwater runoff, consider the key water quality and water quantity issues in the City and surrounding area. Incorporate findings from the stormwater master plan and existing flood management and stormwater planning strategies into the post-construction plan. Also, evaluate the existing plan review process to identify opportunities to integrate post-construction controls. For example, new developments under plan review provide an opportunity to reduce impervious surfaces or incorporate traditional or other BMPs.

Where water quality impairments have been identified by DEQ within the jurisdiction, include strategies or BMPs in the post-construction plan targeted to reducing those pollutants.

Action Plan and Schedule: Stayton currently has stormwater design standards which predominantly specify the "nuts and bolts" of planning, designing, and constructing the physical drainage system and its components. As part of the master plan process the design requirements for stormwater detention facilities and water quality treatment facilities will be developed and incorporated into the new stormwater design standards. A formal post-construction runoff program designed to meet NPDES requirements would involve the development of much more detailed specifications for such treatment facilities (often referred to as Best Management Practices, or BMPs).

The Stormwater Design Manual/Standards should be developed in the first year of the program.

6.3 Training for Plan Reviewers and Field Inspectors

Provide training or coordinate with existing training efforts to educate construction plan reviewers and field inspectors on post-construction design standards, runoff control BMPs and maintenance standards.

Description: Coordinate post-construction training for plan reviewers and field inspectors with training identified in section 5.2, training for erosion and sediment control.

Action Plan and Schedule: Once an ordinance is in place, Stayton will train City staff responsible for reviewing plans and inspecting construction sites to ensure that appropriate post-construction stormwater management is employed. If possible, training will be coordinated with training on erosion and sediment control BMPs. "Refresher" training will update staff on changes to the procedures as needed.

The training of staff will begin in the first year of the program.

Measurable Goal: The number of hours spent in training along with subjects will be documented and reported annually.

6.4 Site Plan Review for Post-Construction BMPs

In accordance with the plan developed in Section 6.2, review stormwater site plans prior to construction to ensure that they include post-construction controls in compliance with local ordinances and the adopted stormwater management *Manual*. Require submittal of information pertaining to the proper operation and maintenance of storm drain components and BMPs. This work should be coordinated with the review in Section 5.3.

Description: The site plan review process, for both erosion and sediment control practices and post-construction control practices, is described in Section 5.3. Conduct both of these reviews at the same time to ensure that plans include all the practices necessary to meet the requirements of the adopted stormwater management *Manual*.

Action Plan and Schedule: Once the stormwater ordinance is adopted and design criteria or a design manual is developed, the City staff will start reviewing permit drawings for compliance with local ordinances and stormwater management manuals. Plans will also be reviewed for appropriate post-construction controls as well as erosion and sediment BMPs.

Reviewing site plans for post construction BMPs should start as soon as the ordinance is in place in the first year of the program.

Measurable Goal: Once this effort has started City staff will monitor the number of plan reviews, the number of on-site inspections, and the number of on-site revisions required. If enforcement is required this will also be recorded. All records will be reported annually.

6.5 Inspections of Structural Post-Construction BMPs

In accordance with the plan developed in Section 6.2, inspect priority structural post-construction BMPs for compliance with operation and maintenance (O&M) standards.

Description: Develop a program to ensure the long-term O&M of structural stormwater BMPs. This requirement only applies to new BMPs installed as part of new construction; existing BMPs installed prior to the effective date of the Phase II permit are not specifically addressed.

The post-construction O&M program includes the following components:

- Requirements for private property owners to maintain facilities
- Database of structural BMPs
- Inspection procedures, including a schedule for conducting inspections, and
- Inspection form

Action Plan and Schedule: Stayton will develop an operations and maintenance program for public and private post-construction stormwater controls. The program will include requirements for private property owners to maintain facilities, a database of structural BMPs, inspection schedules and procedures, and an inspection form. This activity should start when the post-development BMP's are required.

Measurable Goal: Once this effort has started, City staff will keep records of the number of BMPs installed, inspection schedules, and procedures. The City will also maintain copies of the inspection reports for each facility. If enforcement is required, this will also be recorded.

7.0 POLLUTION PREVENTION IN MUNICIPAL OPERATIONS PROGRAM

In order to meet regulations under 40 CFR 122.34(b)(6), the City of Stayton will develop a formal operations and maintenance plan. The following presents the requirements for the plan, how they are being achieved and the implementation schedule.

Basically most City operations already meet the requirements for NPDES Phase II. These requirements are generally "good housekeeping" measures when servicing vehicles and maintaining City facilities. The Operation and Maintenance (O&M) Plan will be a documentation of existing activities together with suggested modifications to reduce pollutants. The following table describes efforts that could be undertaken and planned for the 5-year program.

TABLE 7-1
POLLUTION PREVENTION IN MUNICIPAL OPERATIONS PROGRAM

BMP Activity / Description	Permit Year				
	1	2	3	4	5
Operations and Maintenance (O&M) Plan	√	–	–	–	–
Park and Open Space Maintenance	√	–	–	–	–
Vehicle & Equipment Maintenance & Washing	–	–	√	–	–
New Construction and Land Disturbance	–	√	√	√	√
Dust Control Practices	–	√	√	√	√
Stormwater System Maintenance	–	√	–	√	–
Open Channels and Structural Stormwater Controls	–	√	–	√	–
Roads, Highways, and Parking Lot Maintenance	√	√	√	√	√
Flood Management Project Evaluations	√	–	–	–	–
Employee Training on O&M Plan Implementation	√	–	–	–	–
Stormwater Plans for Municipal Facilities	√	–	–	–	–

√	Activity scheduled for year	–	No activity scheduled for year

7.1 Operation and Maintenance (O&M) Plan

Develop and implement a municipal O&M Plan that considers, where appropriate all the BMPs within Section 7 of this documents.

Description: An O&M plan is essential to ensure that all municipal activities and programs impacting stormwater are implemented efficiently and effectively. The O&M plan is intended to reduce the amount of pollutants carried by stormwater runoff into the storm drainage system. Comprised of a description of procedures and associated schedules, the O&M plan serves as a tool for all municipal employees that are directly involved in stormwater management or administer programs that impact stormwater. It also serves as the basis for the employee training program described in Section 7.10.

An O&M Plan contains the following information:

- Description of the required maintenance activities and procedures as it relates to existing municipal operations and programs
- List of responsible departments and personnel for each activity, and
- Schedule of activities, including maintenance, inspections and reporting

Action Plan and Schedule: The City of Stayton will review existing municipal O&M activities and document the activities in an O&M Plan that will address municipal activities. The O&M Plan shall include the following:

- Descriptions of the required maintenance activities and procedures as it relates to existing municipal operations and programs
- A list of responsible department and personnel for each activity
- A schedule of activities, including maintenance, inspections & reports.
- Review the maintenance of Parks and open space.
- Review use of herbicides and pesticide and maintain records when applied.

The following sections discuss the particular maintenance activities to be addressed in further detail. The O&M Plan should be developed and implemented the first year of the program.

Measurable Goal: Plan preparation and records of all herbicide and pesticide use are the measurable goals for this activity.

7.2 Park and Open Space Maintenance

In accordance with the O&M plan developed, implement park and open space maintenance pollution prevention/good housekeeping practices.

Description: Municipal maintenance practices at parks and other open spaces (e.g., golf courses, picnic areas, recreational facilities, rights-of-way, landscaped areas in parking lots, plazas) can include fertilizer, herbicide, and pesticide application; vegetation maintenance and disposal; and trash management. To ensure these activities do not negatively impact stormwater runoff, incorporate these pollution prevention/good housekeeping procedures into existing municipal operations for maintaining parks and other open spaces.

Action Plan and Schedule: Stayton will implement park and open space maintenance pollution prevention/good housekeeping practices as developed in the O&M Plan. These practices include fertilizer, herbicide and pesticide application; vegetation maintenance and disposal; and trash management. Currently, any herbicide or pesticide application is performed by a licensed applicator. Records of all herbicide and pesticide use are kept.

Measurable Goal: Same as Section 7.1 above.

7.3 Vehicle and Equipment Maintenance and Washing

In accordance with the O&M plan developed, implement publicly-owned vehicle and equipment washing pollution prevention/good housekeeping practices.

Description: Wash water from vehicle/equipment cleaning can contain oil and grease, suspended solids, heavy metals, organics, and other pollutants from detergents. Whenever possible, conduct vehicle/equipment cleaning in a self-contained, covered building. If the enclosed facilities are not available for vehicle/equipment cleaning, conduct this activity in a designated uncovered wash area that meets specific requirements.

Action Plan and Schedule: If the City of Stayton already has a covered or self-contained location to wash and maintain vehicles the only action would be to require all vehicles to use the facility. If not the construction of such a facility is the action required. This involves a capital expenditure that should be work into the overall CIP program.

Measurable Goal: The measurable goals for this activity are the facility and the use of the facility.

7.4 New Construction and Land Disturbances

Description: This activity is simply requiring City construction projects following the same stormwater requirements as private developments.

Action Plan and Schedule: Once new stormwater design standards for erosion control, post-development BMPs and other construction related activities have been established they will be incorporated into the City's CIP project. Public construction projects will be required to follow the same requirements and procedures as private development. Construction will be required to follow local ordinances, and design standards.

Measurable Goal: Records of the BMPs for public construction projects shall be kept; inspection reports and any follow-up work will be kept.

7.5 Dust Control Practices

In accordance with the O&M plan developed in Section 7.1, implement dust control practices where necessary on public projects.

Description: Follow appropriate BMPs to minimize and control dust from public construction projects. Dust control BMPs could be described in the adopted stormwater master plan, or other appropriate document.

Action Plan and Schedule: Stayton will implement BMPs for dust control from public construction projects as developed in the O&M Plan. Public construction projects will be required to follow appropriate BMPs to minimize and control dust.

Measurable Goal: Implement dust control program upon completion of the O&M Plan.

7.6 Stormwater System Maintenance

In accordance with the O&M plan developed in Section 7.1, implement catch basin cleaning and stormwater system maintenance pollution prevention/good housekeeping practices.

Description: Several activities are suggested below; others can be added as needed.

- Catch Basin Inspections and Cleaning. Inspect catch basins and clean inlets at least once a year during the dry season. Based on inspection results, clean (i.e., remove debris from) catch basins as required to prevent water quality impacts. During or before the wet season, perform inspection, clearing, and cleaning in areas that generate large quantities of waste and debris during rainstorms and snowmelt events. Using adaptive management, optimize maintenance activities and frequencies.
- Proper Waste Disposal. Dewater wastes collected during storm drain cleaning and maintenance, if necessary, into the municipal sanitary sewer. Do not dewater near a storm drain or stream. Store solid waste and debris in appropriate containers or temporary storage sites in a manner that prevents discharge to the storm drain. Dispose of sediment waste appropriately, depending on the level of contaminants.
- Record keeping. Document the following information for inspections and cleaning of catch basins: 1) date, 2) location of catch basin, 3) activity performed (e.g., inspection or cleaning), and 4) description of condition or overall amount of material removed (estimated in either volume or dry weight).

Action Plan and Schedule: Stayton will implement stormwater system maintenance as developed in the O&M Plan. Catch basins and other stormwater facilities will be inspected and maintained regularly. Waste from the stormwater facilities will be disposed of properly, and records of cleaning and maintenance will be kept. Street sweeping will be conducted at a frequency established under Section 7.1.

Measurable Goal: Keep records of storm drain system cleaning and maintenance activities and submit in annual report. Waste disposal operations will be included in the records.

7.7 Open Channels and Structural Stormwater Controls

In accordance with the O&M plan developed in Section 7.1, implement structural stormwater control pollution prevention/good housekeeping practices.

Description: Several activities are suggested below; others can be added as needed.

- Open Channel and Structural Controls Inspections and Cleaning. Inspect open channels and structural controls (e.g., detention ponds, commercial stormwater technologies) for trash and debris, and clean, if necessary, at least once a year during dry season. Inspect and clean open channels and structural stormwater controls in areas that generate significant waste and debris during rainy season.
- Proper Waste Disposal. Dewater wastes collected during storm drain cleaning and maintenance, if necessary, into the municipal sanitary sewer. Do not dewater near a storm drain or stream. Store solid waste and debris in appropriate containers or temporary storage sites in a manner that prevents discharge to the storm drain. Sediment may contain elevated levels of lead, hydrocarbons, and oil and grease. If sediment contains elevated levels of these pollutants, dispose of as hazardous waste.
- Record keeping. Document the following information for inspections and cleaning of open channels and structural controls, including catch basins: 1) date, 2) location, 3) activity performed (e.g., inspection or cleaning), 4) description of condition or overall amount of material removed (estimated in either volume or dry weight).

Action Plan and Schedule: Stayton will implement open channel and structural stormwater control maintenance as developed in the O&M Plan. Open channel and structural stormwater controls will be inspected and maintained regularly. Waste from the stormwater controls will be disposed of properly, and records of cleaning and maintenance will be kept.

Measurable Goal: Maintain records of maintenance activities and submit in annual report.

7.8 Road, Highway, and Parking Lot Maintenance

In accordance with the O&M plan developed in Section 7.1, implement deicing and snow removal pollution prevention/good housekeeping practices for roads, highways, and parking lots.

Description: Maintaining roads, highways, and parking lots for public safety purposes can generate pollutants that will enter the storm drainage system. Include in the O&M plan pollution prevention procedures related to these maintenance activities. This could be adopting and following the ODOT "Routine Road Maintenance – Water Quality and Habitat Guide Best Management Practices" (ODOT, July 1999).

Action Plan and Schedule: The City of Stayton should adopt existing guideline or develop a set of guidelines for maintenance of roads as part of the O&M Plan developed in Section 7.1.

Measurable Goal: Maintain records of maintenance activities.

7.9 Flood Management Project Evaluations

In accordance with the O&M plan developed in Section 7.1, implement flood management project evaluation and review procedures.

Description: Flood control has been the traditional focus of stormwater management in many communities. Traditional approaches to flood management often include projects such as widening channels, dredging riverbeds, or creating dikes, levees or embankments. By incorporating water quality considerations into project review criteria, negative impacts to water quality from new flood management projects can be decreased. In designing and/or evaluating flood management projects, attempt to employ more natural solutions and use controls that preserve the hydrology of a site (e.g., swales and natural channels, riparian buffers) as a first-line of flood control. Evaluate existing flood management projects to determine whether or not additional water quality protection devices should be added.

Action Plan and Schedule: Stayton is in the process of developing and implementing a Stormwater Master Plan. This process will address increased runoff and flows, water quality and capital projects. All new flood management projects will include water quality considerations. Priority existing flood management projects will be identified and re-evaluated with water quality considerations.

This program will be developed in the first year of the program. Implementation will be scheduled based on priorities, funding and identifying opportunities to associate projects with other scheduled projects.

Measurable Goal: Track annual capital expenditures for stormwater improvements.

7.10 Employee Training on O&M Plan Implementation

Develop materials and conduct employee training on the procedures contained in the O&M plan developed in Section 7.1.

Description: At a minimum, employees in targeted positions (generally employees involved in stormwater management or municipal maintenance) should be trained on the requirements in the stormwater program by the end of permit term. Consider providing brief (1 hour) training to all municipal employees. More specific, specialized training can be developed for specific program areas. In addition to more intensive training, ensure that municipal employees have access to the public education materials produced under the public education minimum measure (Section 2).

Action Plan and Schedule: Once the above items are completed, Stayton will train municipal city staff on operation and maintenance procedures as described in the O&M Manual. The staff training will occur in combination with training for Illicit Discharge and spill plan. Training will be general for all municipal employees and more specific training will be included for specific program areas. “Refresher” training will update staff on changes to the procedures as needed.

The training of staff will begin in year 2 of the program with refresher courses and courses for new staff conducted as the need requires.

Measurable Goal: The number of hours spent in training, along with subjects, will be documented.

7.11 Stormwater Plans for Municipal Facilities

Develop plans for all municipal facilities that would reasonably be expected to discharge contaminated runoff and are not covered under the NPDES Industrial Stormwater General Permit (1200-Z). Submit a permit application for all municipal facilities that are required to be covered under the 1200-Z General Permit.

Description: Some municipally owned or operated industrial facilities that discharge stormwater runoff to surface waters and/or storm drains are required to apply for coverage under DEQ’s Industrial Stormwater General Permit.

Municipal facilities that would reasonably be expected to discharge contaminated runoff and are not covered by the Industrial Stormwater General Permit should also have a stormwater plan developed. These facilities could include parking lots, fair grounds, storage facilities, maintenance facilities, airports, parks/sports fields, municipal buildings and any other municipally owned facilities.

Action Plan and Schedule:

Industrial Stormwater General Permit (1200-Z)

Municipal facilities subject to this permit typically include:

- Landfills that receive or have received any industrial wastes (even closed landfills).
- Vehicle maintenance shops for local public transportation.
- Wastewater treatment plants with a design flow of 1.0 million gallons per day.

- Other municipal facilities could be required to apply for this permit. For more information and a full list of the types of facilities required to apply, see: http://www.deq.state.or.us/wq/wqpermit/StormWaterHome.htm.

Stormwater Plans

To implement this BMP, follow these steps:

1. Assess and Screen Municipal Facilities

Collect information on each municipally-owned or operated facility within your jurisdiction to assess the potential stormwater impact. If necessary, conduct site visits. Assess each facility to determine which of the following categories it falls into:

- Needs an Industrial Stormwater Permit. This facility falls within one of the SIC codes regulated by the permit and discharges to surface waters. Submit an industrial stormwater permit application.
- Some surface water pollution potential. Facilities that are not covered by the Industrial Stormwater Permit may still have the potential to impact surface waters. For facilities that have a potential to discharge contaminated runoff, a stormwater plan should be developed.
- Little/no surface water pollution potential. This facility either doesn't discharge to surface waters or has little or no potential to impact stormwater quality. No stormwater plan is required.

As you assess municipal facilities, consider factors such as distance to storm drains and surface waters, site activities, traffic flow, exposure to potential stormwater contaminants, facility size, existing stormwater BMPs already in place, and other relevant factors.

2. Prepare site-specific stormwater plans

The development of facility-specific pollution prevention plans should be based on guidance in the adopted stormwater management *Manual*. Consider including the following information in each stormwater plan:

- Description of storm drain system
- Materials storage, including exposure of potential pollutants
- Current O&M of storm drain system and structural BMPs
- Education/Training activities on stormwater
- Source Control activities
- New stormwater BMPs and pollutant control strategy
- Roles/responsibilities for stormwater
- Cost estimates

3. Prepare training materials and conduct training

Prepare training materials and conduct training at each facility on the practices described in the stormwater plan. This training should be coordinated with the general employee training as described in section 7.10.

4. Implement stormwater plans

Carry out implementation of the stormwater plan at each facility.

Measurable Goal: Submit permit application for municipal facilities that are required to be covered under the NPDES Industrial Stormwater General Permit (1200-Z). Identify municipal facilities that would reasonably be expected to discharge contaminated runoff and not covered under the 1200-Z General Permit, and develop pollution prevention plans for these facilities.

8.0 EVALUATION AND ASSESSMENT

Once again the City of Stayton is not required to obtain a NPDES Stormwater Permit and therefore nothing above is required under the NPDES stormwater program. Under the Willamette TMDL program it is expected that DMAs under 10,000 give consideration to the six minimum control measures identified in the NPDES Phase II program. Therefore the reporting of these activities to DEQ is unclear, however if the City's record keeping procedures on these activities are in place this will cover the City under stormwater quality requirements by DEQ, EPA and water quality surrounding ESA (Endangered Species Act). This will not cover the City under fish passage requirements.

If under an NPDES permit, and in preparation for the annual reporting requirements, the City of Stayton will document program implementation and progress. The Measurable Goals listed in this Program are initial goals. The City will work towards meeting those requirements for the Phase II permit that are not currently being implemented. The Measurable Goals in this Program reflect the implementation schedule of each of the BMPs. Once the BMP has been implemented, the City will revise the Measurable Goal for that requirement to track the progress of implementation, effectiveness, or environmental improvement as appropriate.

D.4 TMDL

TETRA TECH/KCM
7080 SW Fir Loop
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Technical Memorandum

City of Stayton
STRATEGIES FOR REDUCING POLLUTANTS IN SURFACE WATERS

January 5, 2007

The City of Stayton has been identified as a Designated Management Agency (DMA) in the Willamette River Total Maximum Daily Load (TMDL) program. Stayton is within two drainage basins—Mill Creek and North Santiam—both of which are in the Willamette River Basin. The Oregon Department of Environmental Quality (DEQ) adopted TMDL limits for the Willamette River Basin in September 2006.

This memorandum describes the pollutants of concern under the Willamette Basin TMDL program and presents the best management practices (BMPs) that are appropriate for reducing each of them.

POLLUTANTS OF CONCERN

The Willamette Basin TMDL set limits on bacteria, temperature and mercury for surface waters within the basin. Table 1 summarizes these water quality problems, their sources, and methods for addressing them.

STORMWATER BEST MANAGEMENT PRACTICES

Stormwater pollutant removal can be addressed with both nonstructural and structural BMPs. Nonstructural BMPs typically focus on pollution prevention; structural BMPs typically remove pollutants from stormwater before discharging into the receiving stream or stormwater system.

Nonstructural BMPs

Table 2 summarizes the benefits of nonstructural BMPs that are now or could easily be put in place to address potential causes of water quality problems. It also identifies minimum control requirements under Phase II of the National Pollutant Discharge Elimination System (NPDES) that each BMP helps satisfy. Table 3 translates the benefits of the nonstructural BMPs to the priority pollutants for the Willamette Basin. Pollution reduction as a result of these programs is not easily quantified but tends to occur gradually or incrementally. The nonstructural BMPs with the most easily quantifiable results relate to maintenance activities. Options for improved maintenance activities are described below, followed by descriptions of more general, long-term BMPs.

Storm Drain Maintenance

Improving storm drain maintenance provides immediately quantifiable results in improving stormwater quality. A well-defined stormwater maintenance program is a working tool for the benefit of City maintenance personnel. Such a program provides a general guide to help ensure that the work required to keep the stormwater system functioning properly is performed efficiently and in a timely way.

TABLE 1.
TMDL POLLUTANT SUMMARY

Typical Sources	Potential Solutions
Bacteria—*Bacteria in rivers and streams can pose a health risk.*	
Illicit Discharges	Adopt an illicit discharge program
Leaking Pipes	
Failing Septic Systems	Extend sewer lines and treatment for area-wide failing onsite septic systems
Pet Wastes	Educate public regarding pet waste pick up
	Provide pet waste pick up stations in parks
Agriculture Livestock	Ensure proper management of agriculture lands
Wildlife	Provide vegetated stream buffers
Temperature—*During the summer and early fall, water temperatures in the Willamette River and its tributaries are elevated to levels that are harmful to salmonids.*	
Lack of Shading	Restore riparian areas
Low Stream Flows	Consider temperature impacts when designing stormwater BMPs
Stormwater Runoff	
Mercury—*Mercury is a neurotoxin that can cause damage to the brain and nervous system. Consumption of fish or seafood containing elevated levels of mercury is the primary method of exposure for humans.*	
Soil Erosion	Erosion and sediment control for construction sites
	Stormwater maintenance
Dental Practices	Dental amalgam BMP
Household Products	Community collection events
Atmospheric Mercury Deposits	

The following elements can be included in a stormwater maintenance program:

- **Core maintenance activities**—The essential tasks to be performed to maintain the City's stormwater system such as street sweeping and catch basin cleaning.

  Street sweeping and catch basin cleaning have the benefit of flexibility, in that the equipment can be deployed at times and places as needed. Studies have shown significant improvement in the amount of solids removed from streets, and hence prevented from entering the storm drain system, with increased use of street sweeping and catch basin cleaning. A 1999 Port of Seattle study found that frequent street and catch basin cleaning can offer water quality benefits comparable to the use of a wet vault for stormwater treatment.

- **Guidelines for work in environmentally sensitive areas**—Provide guidelines for maintenance staff to address the specific considerations that must be taken into account when maintenance activities are performed in or near streams, wetlands and steep slopes.

- **Regulatory and permitting considerations**—Provide information to maintenance staff on regulations that may apply and permits that may be required when maintenance work is to be performed.

TABLE 2.
GENERAL BENEFITS OF NONSTRUCTURAL BMPS

	Benefit Area						
BMP	Lack of Cover	Low Flow	Erosion Dust	Waste	Stagnant Water	Illicit Discharge	NPDES[a]
Street Sweeping			◆				4, 5
Catch Basin Cleaning			◆	◆	◆	◆	4, 5
Development Standards	◆		◆	◆	◆	◆	5
Tree City Program	◆		◆				4
Pollution Prevention in City Operations				◆		◆	5
Pet Regulations				◆			5
Trash Container Protection, Separation				◆		◆	5
Illicit Discharge Inspection & Enforcement						◆	3, 5
System Mapping				◆	◆	◆	3, 5
Web Site	◆	◆	◆	◆	◆	◆	1
Bill Inserts	◆	◆	◆	◆	◆	◆	1
Talks, Articles	◆	◆	◆	◆	◆	◆	1
Public Reporting				◆		◆	2
Water Quality Monitoring	◆	◆	◆	◆	◆	◆	5
Farm Animal Management			◆	◆			5

a. Indicates the NPDES minimum control requirements that the BMP helps to satisfy: 1 = Public education; 2 = Public involvement/participation; 3 = Illicit discharge detection & elimination; 4 = Post-construction controls; 5 = Pollution prevention/good housekeeping.

- **Sediment and debris management**—Handling and disposing of the solids, organic debris, and trash that accumulate in facilities such as catch basins, vaults, and swales and should be disposed of appropriately.

Organic debris such as leaves should be composted. Tree limbs should be chipped for mulch or composting. Organic material is considered a valuable resource by many people, and many landfills now provide a separate holding or composting area for these materials.

TABLE 3.
BENEFITS OF NONSTRUCTURAL BMPS FOR PRIORITY POLLUTANTS

	Pollutant Reduction		
BMP	Temperature	Mercury	Bacteria
Street Sweeping		◆	◆
Catch Basin Cleaning		◆	◆
Development Standards	◆	◆	◆
Tree City Program	◆		
Pollution Prevention in City Operations		◆	◆
Pet Regulations		◆	◆
Trash Container Protection, Separation		◆	◆
Illicit Discharge Inspection & Enforcement		◆	◆
System Mapping		◆	◆
Website	◆	◆	◆
Bill Inserts	◆	◆	◆
Talks, Articles	◆	◆	◆
Public Reporting	◆	◆	◆
Water Quality Monitoring	◆	◆	◆
Farm Animal Management			◆

Sediment removed from detention facilities, biofilters, open channels or culverts may be temporarily stockpiled as long as runoff is positively prevented and the pile is covered between November 1 and March 31. Generally, bottom sediments removed from these facilities are not classified as hazardous waste and have heavy metal concentrations less than those of typical wastewater sludge. These sediments can be disposed of by land application, or as required by the City Waste Management Division.

Pollutant-contaminated sediments, waste oil, and debris from oil/water separators must be disposed of in accordance with OAR 340-093 (Solid Waste: General Provisions), and where appropriate OAR 340-093-0170 (Cleanup Materials Contaminated with Hazardous Substances) and OAR 093-0190 (Waste Requiring Special Management).

Oil/water separator waste is often too “dirty” to be recyclable; however, several vendors handle waste oil hauling and disposal. Any standing water removed during maintenance operations should be disposed of in a sanitary sewer.

- **Illicit discharge detection program**—Detection and removal of illicit pollutant discharges to the stormwater system.
- **Safety and training—**Provide training for city maintenance staff on stormwater maintenance and safety.
- **Tracking and recordkeeping**—Efficient ongoing maintenance requires an organized system for recording and tracking maintenance needs and completed activities.

There are many documents to assist communities with developing an overall maintenance program to reduce pollutants and sediment in stormwater. A good document for citywide activities is *Oregon Municipal Stormwater Toolbox for Maintenance Practices* (Oregon Association of Clean Water Agencies, June 1998). The City's road maintenance department should adopt *Routine Road Maintenance; Water Quality and Habitat Guide Best Management Practices* (Oregon Department of Transportation, July 1999).

Vector Control

Vector control is a common concern in stormwater facilities. Regular maintenance is critical to the control of vectors in stormwater facilities. Mosquitoes are of particular concern. Mosquitoes breed in shallow areas of standing water. Regular maintenance to ensure proper function of stormwater facilities prevents clogging, removes overgrown vegetation, mends broken pipes and removes sediment that may block outlets.

Facilities should be designed to minimize mosquito habitat, particularly avoiding standing water for more than 72 hours. For facilities that are designed to hold standing water, regular monitoring is required for the presence of mosquitoes.

A vector control agency can assist in design requirements for reduction of habitat.

Reducing Impervious Surface

Impervious surface area is the single largest cause of the degradation of streams in urban areas. Degradation of streams begins with even small quantities of impervious surface (10-20 percent; Center for Watershed Protection, 1995). The correlation between impervious surface and the quantity of runoff has been a cornerstone of urban drainage studies. The effects of impervious surface on water quality is not as well understood, and the correlation is not as intuitively obvious. Studies have shown that reducing the amount of impervious surface by 20 percent can reduce total suspended solids by up to 90 percent. Runoff volumes can be reduced by 20 to 60 percent with a corresponding reduction in impervious area. A 20- to 40-percent reduction in impervious surface can reduce nitrogen by 40 to 70 percent and phosphorous by 40 to 80 percent (Land Conservation and Development and DEQ, 2000).

In areas with suitable soils, reducing impervious surface allows more infiltration. The increase in infiltration not only removes pollutants but also increases groundwater flow and therefore increases the base flow in streams. Increase base flow generally reduces water temperatures in streams. The following are BMPs that can help to reduce impervious surface area:

- Use of porous pavement for streets or parking areas with low traffic volume, such as fire lanes, parking area turnarounds or sidewalks
- Encouraging narrow roads in rural areas

- Constructing streets without curbs to allow drainage to run into vegetation
- Encouraging common parking areas for multiple businesses or residents
- Encouraging road patterns that minimize impervious surface
- Requiring BMPs, such as vegetated swales, to be installed in parking lots
- Separating sidewalks and housing from the street with a vegetation strip
- Reducing the number and size of cul-de-sacs
- Using smaller parking stalls
- Establishing a maximum number of parking spaces a developer is allowed to install (such as 10 percent over the relevant parking demand ratio)
- Establishing a differential between primary and spillover parking; allow spillover parking to use alternative paving surfaces such as grid pavers, porous pavement, gravel or mowed grass.

The City of Stayton could review its current street design ordinances to allow for and encourage reductions in impervious surfaces.

Sediment and Erosion Control

Erosion can be a large source of sediment loading in stormwater runoff or streams. Erosion comes from a variety of places, including construction sites, unstable slopes, and other surfaces with bare soil. BMPs to control sediment and erosion include encouraging the use and retention of native vegetation, restricting development in areas with steep slopes, and properly installing BMPs at construction sites.

Native vegetation has the additional benefit of reducing the use of water, pesticides and fertilizer. Properly selected native riparian vegetation can provide for shade along stream corridors, which reduces water temperatures.

Many construction BMPs are available, but they must be installed and used correctly to prevent sediment and other pollutants from leaving the site.

The City's 1994 *Storm Design Standards* has a section describing erosion control requirements; however, this section is limited to areas within the banks of a waterway. It is recommended that the standards be revised to require an erosion and sediment control permit and the use of BMPs for all construction projects and earth disturbance projects with ground disturbance greater than 1,000 square feet in area in any 12-month period.

Stream and Wetland Buffers

Stream and wetland buffers provide a natural boundary between development and a stream or wetland. Vegetated stream buffers maintain bank stability, reduce sediment and nutrient loads from overland flow runoff, and allow infiltration to occur. Vegetated buffers reduce pollutant loading when runoff crosses the buffer as sheet flow, not when pipes transport stormwater directly to the creek or when channels are formed and runoff bypasses the vegetation. When a buffer is vegetated and no pesticides or herbicides are applied, total suspended solids can be reduced by 40 to 80 percent. When lawns are not located within a stream buffer, nitrogen reductions of 25 to 65 percent and phosphorous reductions of 30 to

70 percent can be achieved. (Land Conservation and Development and DEQ, 2000). Buffers can be combined with other BMPs to ensure pollutant reduction.

To be effective, stream buffers must be managed and protected during construction and for the ongoing period after construction. Residents can be educated to prevent dumping, trails, tree removal, erosion and lawns encroaching into the buffer. Education can include pamphlets, boundary markers, buffer walks, regular homeowner association meetings and individual maintenance agreements. Residents can also be encouraged to participate in stewardship of buffers and streams. Allowable and unallowable activities in stream buffers should be clearly defined.

Shading

Riparian vegetation performs many beneficial functions for stream ecosystems. One of these is to regulate water temperature through direct shading. Factors that determine the amount of solar radiation that reaches a stream channel include the width of the channel, the type and density of riparian vegetation, the orientation (east-west vs. north-south) of the channel, and the angle of the sun.

Because the sun is usually positioned to the south in the Pacific Northwest, areas with southern exposure receive more direct sunlight than those with northern exposures, resulting in higher water temperatures. Riparian vegetation can provide shade from both sides of the stream, but shading from the southern direction provides the most thermal regulation. On north-south oriented streams, vegetation must grow on both sides to provide a shade canopy over the stream.

Enhancement Methods

Riparian vegetation enhancement can be facilitated in the following ways:

- **Capital improvement projects—**Capital improvement projects to enhance riparian area vegetation
- **Development requirements**—Requirements for improvement and/or protection of riparian vegetation and shading along a stream corridor for development close to stream channels
- **Public involvement/education:**
  - Encourage school and volunteer groups to take on stewardship of stream reaches, including planting and maintaining riparian vegetation
  - Encourage private landowners through education about the benefits of riparian vegetation.

The following could be implemented to maintain and improve shading as part of projects in Stayton that include stream work:

- Maintain trees and plant trees on the south side, to shade creeks.
- Use native, riparian vegetation for landscaping along creeks.

Stream Shade Monitoring

Photo documentation is an easy and cost-effective method for monitoring stream shade and canopy cover (*Stream Shade and Canopy Cover Addendum to the Water Quality Technical Guide Book,* Oregon Watershed Enhancement Boards, July 1999). Procedures for preparing a photo documentation monitoring program, along with several other monitoring methods involving specific monitoring equipment, are described in the document. The addendum should be reviewed prior to development of a riparian shade monitoring program for the City of Stayton.

Farm Animal Management

Stayton is primarily an urban setting; however, there are some agricultural uses within the City. Farm animals contribute to erosion and increase nutrient loads in stormwater. Livestock should be kept out of riparian corridors and away from areas that drain directly to stormwater collection systems. Livestock BMPs include containment of contaminated runoff, proper storage of manure, installation of runoff treatment systems, reduction of livestock densities, and separation of livestock from sensitive water quality areas. The following are some guidelines for livestock from *Water Quality Model Code and Guidebook*:

- **Prohibited Areas—**Livestock shall not be kept within any of the following areas, as applicable, due to the higher intensity living environments of these areas or the potential impact on water quality:
  - Multi-family sub-district
  - Manufactured housing park sub-district
  - Neighborhood commercial sub-district
  - Within a riparian protection overlay.
- **Minimum Lot Size**—No livestock shall be kept on any lot less than 1 acre in area.
- **Density**—Limit the number of livestock over the age of 6 months that may be maintained per acre.
- **Farm Structures**—Establish a minimum distance from the property line for new barns, stables, and other buildings or structures used to house livestock.
- **Storage of fertilizer, pesticide herbicide, or animal waste**—Fertilizer, pesticides, herbicides and similar farm chemicals shall be covered and stored at an elevation 1 foot higher than the 100-year flood elevation. Animal waste that is collected shall also be stored at an elevation 1 foot higher than the 100-year flood elevation.

Structural BMPs

Numerous studies have been done on the effectiveness of structural BMPs. The pollution removal efficiency for structural BMPs vary based on the type of facility used, design, construction, and maintenance. Table 4 lists characteristics of various structural BMPs from *Stormwater Best Management Practices in an Ultra-Urban Setting: Selection and Monitoring* (Federal Highway Administration, May 2000), the Oregon Department of Land Conservation and Development and Department of Environmental Quality *Water Quality Model Code and Guidebook* (October 2000), and the Center for Watershed Protection's *Site Planning for Urban Stream Protection* (December 1995). As summarized in the table, these sources indicate the effectiveness of BMPs in removing a wide range of pollutants. Temperature and bacteria are directly indicated in the table; mercury is included in the listings for total suspended solids (TSS). The table also indicates the BMPs' effectiveness in addressing pollutants of concern other than those included in the Willamette Basin TMDL: biochemical oxygen demand (BOD); oil and grease; total phosphorus (TP); total nitrogen (TN); and metals.

More detail is provided in such references as the City of Portland's *Stormwater Management Manual*, the King County (Washington) *Surface Water Design Manual*, and the Washington Department of Ecology's *Stormwater Management Manual for Western Washington*.

TABLE 4.
STRUCTURAL BMP SELECTION CHARACTERISTICS

BMP Types	Ultra-Urban	Area Served (acres)	BMP Area	Min. Head Req'd (feet)	Summer Temp Increase[a]	Contaminant Removal Percentage TSS	Bacteria[c]	BOD	Oil & Grease	TP	TN	Metals	Capital Costs	Maintenance	O&M Costs	Effective Life (years)
Ext. Detention Wet Pond	no	2 (min)	10-20%	3-6	Yes	46-98	NA	25-45[d]	NA	20-94	28-50	24-89	Mod	Annual Inspection	Low	20-50
Underground Det. Tanks	yes	1-2	0.5-1%	5-8	No	NA	NA	10-20[d]	NA	NA	NA	NA	Mod to High	Frequent cleanout	High	50-100
Infiltration Trench	yes	2-4	2-4%	3-8	No	75-99	60-100	70-90	NA	50-75	45-70	75-99	Mod to High	Sediment and debris removal	Mod	10-15
Infiltration Basin	no	2-20	2-4%	3-4	No	75-99	60-100	70-90	NA	50-70	45-70	50-90	Mod	Mowing	Mod	5-10
Bioretention	yes	1-50	4-10%	2-3	No	75	NA		NA	50	50	75-80	Mod	Mowing / plant replacement	Low	5-20
Catch Basins and Inlets	yes	<1	none		No	20-40	NA	10-20[d]	NA	10-20[d]	10-20[d]	10-20[d]	Low	Frequent Cleanout	Low	?
Catch Basin Inserts	yes	<1	none	1-2	No	NA	NA		up to 90	NA	NA	NA	Low	Frequent Cleanout	Mod to High	10-20
Control Structures/Flow Restrictors	yes				No	20-40	NA	10-20[d]	NA	10-25[d]	10-20[d]	10-25[d]	Low	Frequent Cleanout	Low to Mod	
Manufactured Systems	yes	1-10	none	4	No	NA	NA		up to 96	NA	NA	NA	Mod	Periodic cleanout	Mod	50-100
Premanufactured Vaults[b]																
Storm Vault	yes	no limits	0.5-1%	low	No	86	NA		high	48	NA	36	Mod to High	Periodic cleanout and inspection	Mod	50-100
Vortech	yes		0.5-1%	low	No	80	NA		high	67	54	NA	Mod to High	Frequent cleanout	Mod	50-100
Multi-Chambered Treatment Train	yes	0.2-2.5	0.5-1.5%	4-6	No	83	NA		NA	NA	NA	95	High	Sand filter cleaning and replacement of oil absorbent material	High	5-20
Oil-Grit Separators (Coalescent Plate)	yes	1-2	<1%	3-6	No	20-40	NA	10-20[d]	50-80	<10	<10	<10	Mod	Frequent Cleanout	High	50-100
Ditches (with vegetation)	yes				Yes	0-50	NA	0-25[d]	0-25[d]	0-25[d]	0-25[d]	0-25[d]	Low	Frequent Cleanout	Low to Mod	
Vegetated Swales	yes	2-4	10-20%	2-6	Yes	30-90	NA	50-80	NA	20-85	0-50	0-90	Low to Mod	Mowing	Low	5-20
Vegetated Filter Strips	no	NA	25%	Neg	Yes	27-70	NA	50-80	NA	20-40	20-40	2-80	Low	Mowing	Low	20-50
Constructed Wetlands	no	1 (min)	10%	1-8	Yes	65	NA	40-80	NA	25	20	35-65	Mod to High	Annual Inspection / Plant replacement	Mod	20-50
Natural Streams/Wetlands	no				Yes	50-95	50-98	40-80	40-90	20-85	20-85	40-90	Low	Regular inspection / debris removal / erosion control	Low to Mod	
Vegetated Rock Filters	yes	2-5	3-5%	2-4	No	95	78		NA	82	75	21-80	High	Regular inspection and cleanout	High	5-20
Underground Sand Filters	yes	2-5	2-3%	1-8	No	70-90	NA		NA	43-70	30-50	22-91	High	Annual Media Removal	High	5-20
Surface Sand Filters	no	2-5	2-3%	5-8	No	75-92	NA		NA	27-80	27-71	33-91	Mod	Biannual media removal	Mod	5-20
Organic Media Filters	yes	2-5	2-3%	5-8	No	90-95	90		NA	49	55	48-90	High	Annual media removal	High	5-20
Porous Pavements	no	2-4	NA	NA	No	82-95	NA		NA	60-71	80-85	33-99	Low	Semi annual vacuum cleaning	Mod	15-20

General Source: *FHWA-EP-00-002 Stormwater Best Management Practices in an Ultra-Urban Setting: Selection and Monitoring*, February 2000.

NA means Not Applicable or Not Available

a. Open systems exposed to solar radiation that do not infiltrate assumed to increase water temperature in summer.
b. Per manufacturer's monitoring reports.
c. *Controlling Urban Runoff: A Practical Manual for Planning and Designing Urban BMPs* (Thomas R. Schueler, July 1987), bacteria removal data for infiltration noted bacteria as fecal coliform, pp. 1-6, 2-13. Data for other BMPs is from FHWA; data falls within the 60%-100% removal range, and is presumed to apply to fecal coliform bacteria.
d. Estimated based on 50% particulate fraction

D.5 UIC

Oregon DEQ UIC Program Information

Web Address: http://www.deq.state.or.us/wq/uic/uic.htm
Phone: (503) 229-5945

There is no grandfather clause for existing UIC systems. All systems must go through the registration process and either be permitted or rule authorized. Each UIC is evaluated on a case by case basis, and registration through the DEQ can take up 90 days.

Subsurface infiltration systems, such as drywells, are classified as Class V injection wells in the EPA's federal UIC program. The two requirements of the UIC program are as follows:

- A non-endangerment performance standard must be met, prohibiting discharges that allow movement of fluids containing contaminants into potential underground sources of drinking water.
- All UIC facility owners/operators must provide inventory information by registering the facilities.

Under the federal UIC regulations, the definition of an underground injection well is a bored, drilled, or driven shaft whose depth is greater than the largest surface dimension; a dug hole whose depth is greater than the largest surface dimension; an improved sinkhole; or a subsurface fluid distribution system that includes an assemblage of perforated pipes, drain tiles, or other similar mechanisms intended to distribute fluids below the surface of the ground.

Examples of a UIC well or a subsurface infiltration system are drywells, drain fields, pipe or French drains, and other similar devices that discharge to ground. In addition to the non-endangerment standard, storm water injection systems will qualify as "rule authorized" only if no other disposal option is appropriate. Oregon Administrative Rules (OAR) 340-044-0030 specifically prohibits injection wells with depths greater than their largest surface dimension, if any other treatment or disposal method which "affords better protection of public health or water resources is reasonably available or possible."

All "rule authorized" systems must meet the *General Requirements* in RA 1101. Further provisions in *Basic Requirements* must be met by all injection systems except roof drains. Additional specific *Category Requirements* (per RA 1101) apply to the following categories:

- Municipal systems with 50 or more injection wells
- Municipal systems with less than 50 injection wells
- Industrial/commercial facilities with hazardous substances
- Industrial/commercial facilities without hazardous substances

- Large parking lots
- Small parking lots
- Residential systems included in the UIC Program (e.g. garage floor and driveway drains)

Owners of any category of "rule authorized" storm water injection systems (except residential) must prepare and implement a storm water management plan. The required elements of the plan vary depending on the size of the system. Certain elements – system assessment; Best Management Practices (BMPs) for source control and treatment; spill prevention and response; maintenance plan; employee and public education; and evaluation of plan effectiveness – are required for any size system. For municipal systems with 50 or more injection systems, storm water management plans must also have monitoring and record-keeping plans.

Department of Environmental Quality (DEQ) has developed recommendations for source control measures, spill response, storm water maintenance standards, education outreach, and monitoring. These are documented in "DEQ Underground Injection Control (UIC) Class V BMPs for Groundwater."

If an injection system does not qualify as "rule authorized", the Owner may be required to either: 1) modify the system so it meets the criteria for rule authorized; 2) close the injection system; 3) discharge to a municipal storm sewer, if available; or 4) apply for a Water Pollution Control Facility (WPCF) Permit. DEQ will be developing a general WPCF storm water permit for Class V systems which fail to meet Rule Authorization requirements.

Municipalities with over 50 injection systems need to develop a Decommissioning Plan for injection systems that do not meet the *Basic Requirements* (Oregon Administrative Rules (OAR) 340-044-0018). DEQ documents (Ref. 5 and 6) outline evaluation steps needed, and suggest closure standards for storm water injection systems. DEQ Storm water Management Guidelines outline different methods to remove pollutants from storm water prior to groundwater discharge, including alternatives to injection wells.

Municipalities also have the option to negotiate an area-wide permit or memorandum of agreement with DEQ for systems that fail to meet Rule Authorization requirements. (As of March 2002, no area-wide UIC Class V agreements had yet been negotiated.) An area-wide permit would need to include the following elements:

- Quarterly inventory reporting of new injection systems
- Use of DEQ database spread sheet
- GPS location data
- Monitoring and maintenance plans
- Maintenance schedule

- Storm water management
- Screening for hazardous areas
- Spill plans
- Closure and remediation requirements
- Inspection and enforcement options
- Information on existing land uses and any available data on unsuitable areas (soils)

In summary, any owner or operator of a Class V storm water system is required to:

- Register system prior to use, and provide inventory data to Department of Environmental Quality (DEQ).

- Meet “non-endangerment” performance standard to prevent contamination of groundwater by storm water.

- Submit a closure plan to DEQ, and then properly decommission a banned system or any system when it is no longer in use.

- Comply with other local, state and federal regulations (including requirements of the State Groundwater Act and the Safe Drinking Water Act Standards).

Appendix E
Cost Estimates

KELLER ASSOCIATES

Stayton, OR
Storm Water Master Plan CIP

Priority Improvements						
Item (2007 Project Costs*)	Priority 1	Priority 2	Priority 3	Priority 4	Future	% Benefiting Growth
Priority 1 (2008)						
1A						
Wetland Preservation	$695,800					60%
Shaff Road Detention Basin and piping	$1,753,600					10%
10th Ave Detention Basin and piping	$658,700					15%
PRIORITY 1A SUBTOTAL	$3,108,100					
1B						
Industrial Detention Site Improvements	$95,000					25%
Shaff Road Basin Pipeline Improvements	$3,551,200					5%
10th Avenue Pipeline Improvements	$810,000					15%
Norpac NE Detention Site	$620,800					0%
PRIORITY 1B SUBTOTAL	$5,077,000					
Total Priority 1	***$8,185,100***					
Priority 2 (2010)						
Fir to Regis through Regis HS Parking Lot		$357,000				5%
Evergreen Ave to Norpac Dtn Site		$568,900				5%
3rd and Jefferson to Library Dtn Site		$1,922,400				5%
Millstream Woods to Norpac SW Dtn Site		$1,955,800				10%
5 Additional Manhole Monitoring Equipement		$96,700				0%
Total Priority 2		***$4,900,800***				
Priority 3 (2015)						
Sylvan Meadows Subdivision			$60,500			0%
Gardner Road-Regis High School-Unverified			TBD			5%
Wedgewood Place			$735,800			0%
Western Avenue			$730,800			0%
Total Priority 3			***$1,527,100***			
Priority 4 (2020)						
Library Improvements				$49,500		0%
Pacific Court				$440,900		0%
1st Avenue				$122,300		0%
Washington Street Area				$216,600		42%
North Peach Street				$82,000		50%
Total Priority 4				***$911,300***		
Future**						
Fern Ridge Street Area					$1,700,100	34%
Dozler Property Area					$740,800	48%
Phillips Property Area					$1,991,900	87%
Larch Avenue					$129,700	0%
Detention Facilities					$3,402,000	98%
Pipeline Upsize Costs (over 18")					$1,430,800	0%
Total Future					***$9,395,300***	
TOTAL (rounded)	**$8,185,100**	**$4,900,800**	**$1,527,100**	**$911,300**	**$9,395,300**	**$24,919,600**

* All costs in 2007 Dollars. Costs include engineering and contingencies.
** Timing depends on when growth occurs. Development participation anticipated.

W:\Work\104037 (moved to V)\Design\ExcelFiles\CapitalImprovementPlan

Stayton Storm Water Master Plan
Priority 1 Improvements

Item	Unit	Unit Price	Estimated Quantity	Cost (Rounded)	
Industrial Detention Site Improvements				1A	1B
Rebuild Berm on east edge of dtn pond	CY	$15	540		$8,100
Divert farm flow to ditch to north	CY	$15	4500		$67,500
Mobilization	%	5%			$405
Total Construction Costs					$76,005
Contingency	%	10%			$7,601
Engineering & Legal	%	15%			$11,401
Detention Outlet Control Subtotal					***$95,000***
Wetland Preservation					
Land Acquisition	AC	$17,500	35	$612,500	
Legal and Permitting	EA	$20,000	1	$20,000	
Total Costs				$632,500	
Contingency	%	10%		$63,250	
Wetland Subtotal				***$695,800***	
Shaff Road Basin Improvements				1A	1B
Fir to Hollister on 6th Ave					
Parallel 30" Storm Water Line	LF	$180	250		$45,000
Manholes	EA	$3,500	2		$7,000
Manhole interties	EA	$4,500	2		$9,000
Additional/Replacement Catch Basins	EA	$1,600	6		$9,600
Additional 10" pipe to tie in catch basins	LF	$49	180		$8,820
Additional cost for Control Density Backfill	LF	$40	0		$0
Pavement Repair- 1/2 lane	LF	$30	250		$7,500
Pavement Repair- Full Lane	LF	$52	0		$0
Utilities	LF	$6	250		$1,500
Traffic Control	LF	$2	250		$500
6th Ave to 5th Ave on Hollister					
Parallel 36" Storm Water Line	LF	$200	300		$60,000
Manholes	EA	$3,500	1		$3,500
Manhole interties	EA	$4,500	1		$4,500
Additional/Replacement Catch Basins	EA	$1,600	3		$4,800
Additional 10" pipe to tie in catch basins	LF	$49	90		$4,410
Additional cost for Control Density Backfill	LF	$40	0		$0
Pavement Repair- 1/2 lane	LF	$30	300		$9,000
Pavement Repair- Full Lane	LF	$52	0		$0
Utilities	LF	$6	300		$1,800
Traffic Control	LF	$2	300		$600
Santiam to Robidoux on 6th Ave					
Single 24" Storm Water Line	LF	$115	530		$60,950
Manholes	EA	$3,500	3		$10,500
Manhole interties	EA	$4,500	3		$13,500
Additional/Replacement Catch Basins	EA	$1,600	6		$9,600
Additional 10" pipe to tie in catch basins	LF	$49	180		$8,820
Additional cost for Control Density Backfill	LF	$40	0		$0
Pavement Repair- 1/2 lane	LF	$30	530		$15,900
Pavement Repair- Full Lane	LF	$52	0		$0
Utilities	LF	$6	530		$3,180
Traffic Control	LF	$2	530		$1,060
6th Ave to 5th Ave on Robidoux					
Single 24" Storm Water Line	LF	$115	320		$36,800
Manholes	EA	$3,500	1		$3,500
Manhole interties	EA	$4,500	1		$4,500
Additional/Replacement Catch Basins	EA	$1,600	5		$8,000
Additional 10" pipe to tie in catch basins	LF	$49	150		$7,350
Additional cost for Control Density Backfill	LF	$40	0		$0
Pavement Repair- 1/2 lane	LF	$30	320		$9,600
Pavement Repair- Full Lane	LF	$52	0		$0
Utilities	LF	$6	320		$1,920
Traffic Control	LF	$2	320		$640
Robidoux to Hollister on 5th Ave					
Single 24" Storm Water Line	LF	$115	300		$34,500
Manholes	EA	$3,500	0		$0
Manhole interties	EA	$4,500	0		$0
Additional/Replacement Catch Basins	EA	$1,600	5		$8,000
Additional 10" pipe to tie in catch basins	LF	$49	150		$7,350
Additional cost for Control Density Backfill	LF	$40	0		$0
Pavement Repair- 1/2 lane	LF	$30	300		$9,000

Stayton Storm Water Master Plan
Priority 1 Improvements

Item	Unit	Unit Price	Estimated Quantity	Cost (Rounded)
Pavement Repair- Full Lane	LF	$52	0	$0
Utilities	LF	$6	300	$1,800
Traffic Control	LF	$2	300	$600
5th Ave to 1st Ave on Hollister				
Parallel 36" Storm Water Line	LF	$200	941	$188,200
Manholes	EA	$3,500	4	$14,000
Manhole interties	EA	$4,500	5	$22,500
Additional/Replacement Catch Basins	EA	$1,600	15	$24,000
Additional 10" pipe to tie in catch basins	LF	$49	450	$22,050
Additional cost for Control Density Backfill	LF	$40	941	$37,640
Pavement Repair- 1/2 lane	LF	$30	0	$0
Pavement Repair- Full Lane	LF	$52	941	$48,932
Utilities	LF	$6	941	$5,646
Traffic Control	LF	$2	941	$1,882
Hollister to Cedar on 1st Ave				
Parallel 42" Storm Water Line	LF	$218	800	$174,400
Manholes	EA	$3,500	4	$14,000
Manhole interties	EA	$4,500	4	$18,000
Additional/Replacement Catch Basins	EA	$1,600	15	$24,000
Additional 10" pipe to tie in catch basins	LF	$49	450	$22,050
Additional cost for Control Density Backfill	LF	$40	800	$32,000
Pavement Repair- 1/2 lane	LF	$30	0	$0
Pavement Repair- Full Lane	LF	$52	800	$41,600
Utilities	LF	$6	800	$4,800
Traffic Control	LF	$2	800	$1,600
Cedar to Regis on 1st Ave				
Parallel 36" Storm Water Line	LF	$200	647	$129,400
Manholes	EA	$3,500	3	$10,500
Manhole interties	EA	$4,500	3	$13,500
Additional/Replacement Catch Basins	EA	$1,600	6	$9,600
Additional 10" pipe to tie in catch basins	LF	$49	180	$8,820
Additional cost for Control Density Backfill	LF	$40	647	$25,880
Pavement Repair- 1/2 lane	LF	$30	0	$0
Pavement Repair- Full Lane	LF	$52	647	$33,644
Utilities	LF	$6	647	$3,882
Traffic Control	LF	$2	647	$1,294
1st Ave to Kathy on Regis				
Parallel 36" Storm Water Line	LF	$200	883	$176,600
Manholes	EA	$3,500	3	$10,500
Manhole interties	EA	$4,500	3	$13,500
Additional/Replacement Catch Basins	EA	$1,600	5	$8,000
Additional 10" pipe to tie in catch basins	LF	$49	150	$7,350
Additional cost for Control Density Backfill	LF	$40	0	$0
Pavement Repair- 1/2 lane	LF	$30	883	$26,490
Pavement Repair- Full Lane	LF	$52	0	$0
Utilities	LF	$6	883	$5,298
Traffic Control	LF	$2	883	$1,766
Kathy to Gardner on Regis				
Parallel 36" Storm Water Line	LF	$200	1,460	$292,000
Manholes	EA	$3,500	3	$10,500
Manhole interties	EA	$4,500	3	$13,500
Additional/Replacement Catch Basins	EA	$1,600	9	$14,400
Additional 10" pipe to tie in catch basins	LF	$49	270	$13,230
Additional cost for Control Density Backfill	LF	$40	0	$0
Pavement Repair- 1/2 lane	LF	$30	1,460	$43,800
Pavement Repair- Full Lane	LF	$52	0	$0
Utilities	LF	$6	1,460	$8,760
Traffic Control	LF	$2	1,460	$2,920
Regis to Shaff on Gardner				
Parallel 42" Storm Water Line	LF	$218	1,100	$239,800
Manholes	EA	$3,500	5	$17,500
Manhole interties	EA	$4,500	5	$22,500
Additional/Replacement Catch Basins	EA	$1,600	9	$14,400
Additional 10" pipe to tie in catch basins	LF	$49	270	$13,230
Additional cost for Control Density Backfill	LF	$40	100	$4,000
Pavement Repair- 1/2 lane	LF	$30	0	$0
Pavement Repair- Full Lane	LF	$52	1,100	$57,200
Utilities	LF	$6	1,100	$6,600
Traffic Control	LF	$2	1,100	$2,200

Stayton Storm Water Master Plan
Priority 1 Improvements

Item	Unit	Unit Price	Estimated Quantity	Cost (Rounded)	
Eagle Street to Shaff Road on Quail Run Ave					
Parallel15" Storm Water Line	LF	$63	634		$39,942
Manholes	EA	$3,500	3		$10,500
Manhole interties	EA	$4,500	3		$13,500
Additional/Replacement Catch Basins	EA	$1,600	2		$3,200
Additional 10" pipe to tie in catch basins	LF	$49	60		$2,940
Additional cost for Control Density Backfill	LF	$40	65		$2,600
Pavement Repair- 1/2 lane	LF	$30	0		$0
Pavement Repair- Full Lane	LF	$52	634		$32,968
Utilities	LF	$6	634		$3,804
Traffic Control	LF	$2	634		$1,268
Shaff Road Detention Facility					
Land Acquisition	AC	$20,000	4	$80,000	
Single 48" Storm Water Line	LF	$225	900	$202,500	
Bore under Shaff Road to North side	LF	$900	60	$54,000	
Manholes	EA	$3,500	4	$14,000	
Manhole interties	EA	$4,500	0	$0	
Manhole Monitoring Equipment	EA	$9,200	1	$9,200	
Additional/Replacement Catch Basins	EA	$1,600	4	$6,400	
Additional 10" pipe to tie in catch basins	LF	$49	120	$5,880	
Additional cost for Control Density Backfill	LF	$40	900	$36,000	
Pavement Repair- 1/2 lane	LF	$30	900	$27,000	
Pavement Repair- Full Lane	LF	$52	0	$0	
Utilities	LF	$6	900	$5,400	
Traffic Control	LF	$2	900	$1,800	
Excavation	CY	$15	17,333	$259,995	
Inlet structure	EA	$6,000	1	$6,000	
Outlet control structure	EA	$7,500	1	$7,500	
Outfall Piping - 30"	LF	$180	1,747	$314,460	
Landscaping	SF	$0.95	217,800	$206,910	
Sum				$1,237,045	$2,505,186
Mobilization	%	5%		*$61,900*	*$125,300*
Total Construction Costs				$1,298,945	$2,630,486
Contingency	%	20%		$259,789	$526,097
Engineering & Legal	%	15%		$194,842	$394,573
Shaff Basin Subtotal				***$1,753,600***	***$3,551,200***
10th Avenue Improvements				**1A**	**1B**
Hospital Discharge to 10th Ave					
Single 15" Storm Water Line	LF	$63	740		$46,620
Manholes	EA	$3,500	3		$10,500
Manhole interties	EA	$4,500	2		$9,000
Additional/Replacement Catch Basins	EA	$1,600	7		$11,200
Additional 10" pipe to tie in catch basins	LF	$49	210		$10,290
Additional cost for Control Density Backfill	LF	$40	0		$0
Pavement Repair- 1/2 lane	LF	$30	300		$9,000
Pavement Repair- Full Lane	LF	$52	0		$0
Utilities	LF	$6	740		$4,440
Traffic Control	LF	$2	0		$0
County Housing to Santiam on 10th Ave					
Parallel 12" Storm Water Line	LF	$56	700		$39,200
Manholes	EA	$3,500	2		$7,000
Manhole interties	EA	$4,500	1		$4,500
Additional/Replacement Catch Basins	EA	$1,600	4		$6,400
Additional 10" pipe to tie in catch basins	LF	$49	120		$5,880
Additional cost for Control Density Backfill	LF	$40	0		$0
Pavement Repair- 1/2 lane	LF	$30	700		$21,000
Pavement Repair- Full Lane	LF	$52	0		$0
Utilities	LF	$6	700		$4,200
Traffic Control	LF	$2	700		$1,400
Santiam to Virginia on 10th Ave					
Parallel 18" Storm Water Line	LF	$70	890		$62,300
Manholes	EA	$3,500	2		$7,000
Manhole interties	EA	$4,500	2		$9,000
Additional/Replacement Catch Basins	EA	$1,600	7		$11,200
Additional 10" pipe to tie in catch basins	LF	$49	210		$10,290
Additional cost for Control Density Backfill	LF	$40	0		$0
Pavement Repair- 1/2 lane	LF	$30	890		$26,700

Stayton Storm Water Master Plan
Priority 1 Improvements

Item	Unit	Unit Price	Estimated Quantity	Cost (Rounded)	
Pavement Repair- Full Lane	LF	$52	0		$0
Utilities	LF	$6	890		$5,340
Traffic Control	LF	$2	890		$1,780
12th Ave to 10th Ave on Virginia					
Parallel 18" Storm Water Line	LF	$12	650		$7,800
Manholes	EA	$3,500	3		$10,500
Manhole interties	EA	$4,500	3		$13,500
Additional/Replacement Catch Basins	EA	$1,600	6		$9,600
Additional 10" pipe to tie in catch basins	LF	$49	180		$8,820
Additional cost for Control Density Backfill	LF	$40	0		$0
Pavement Repair- 1/2 lane	LF	$30	650		$19,500
Pavement Repair- Full Lane	LF	$52	0		$0
Utilities	LF	$6	650		$3,900
Traffic Control	LF	$2	650		$1,300
Virginia and 10th to Park Detention Facility					
Single 30" Storm Water Line	LF	$180	600		$108,000
Manholes	EA	$3,500	4		$14,000
Manhole interties	EA	$4,500	2		$9,000
Additional/Replacement Catch Basins	EA	$1,600	6		$9,600
Additional 10" pipe to tie in catch basins	LF	$49	180		$8,820
Additional cost for Control Density Backfill	LF	$40	0		$0
Pavement Repair- 1/2 lane	LF	$30	600		$18,000
Pavement Repair- Full Lane	LF	$52	0		$0
Utilities	LF	$6	600		$3,600
Traffic Control	LF	$2	600		$1,200
Park Detention Facility					
Land Acquisition	AC	$20,000	2	$40,000	
Excavation	CY	$15	12,900	$193,500	
Inlet structure	EA	$6,000	1	$6,000	
Manholes	EA	$3,500	1	$3,500	
Manhole Monitoring Equipment	EA	$9,200	1	$9,200	
Outlet control structure	EA	$7,500	1	$7,500	
Outfall Piping - 18"	LF	$70	1,747	$122,290	
Landscaping	SF	$1	87,120	$82,764	
Sum				$464,754	$571,380
Mobilization	%	5%		*$23,200*	*$28,600*
Total Construction Costs				$487,954	$599,980
Contingency	%	20%		$97,591	$119,996
Engineering & Legal	%	15%		$73,193	$89,997
10th Ave Subtotal				***$658,700***	***$810,000***
Norpac Northeast Facility				**1A**	**1B**
Land Acquisition	AC	$20,000	1.5		$30,000
Excavation	CY	$15	12,907		$193,605
Manholes	EA	$3,500	1		$3,500
Manhole Monitoring Equipment	EA	$9,200	1		$9,200
Inlet structure	EA	$6,000	1		$6,000
Outlet control structure	EA	$7,500	1		$7,500
Outfall Piping - 18"	LF	$70	1,747		$122,290
Landscaping	SF	$1	87,120		$82,764
Sum					$454,859
Mobilization	%	5%			*$22,700*
Total Construction Costs					$477,559
Contingency	%	15%			$71,634
Engineering & Legal	%	15%			$71,634
Norpac Northeast Detention Facility Subtotal					***$620,800***
Total Priority 1 Costs				**$3,108,100**	**$5,077,000**

Stayton Storm Water Master Plan
Priority 2 Improvements

Item	Unit	Unit Price	Estimated Quantity	Cost (Rounded)
Fir to Regis Through Regis High Parking Lot				
Parallel 36" Storm Water Line	LF	$200	880	$176,000
Manholes	EA	$3,500	3	$10,500
Manhole interties	EA	$4,500	3	$13,500
Additional/Replacement Catch Basins	EA	$1,600	6	$9,600
Additional 10" pipe to tie in catch basins	LF	$49	180	$8,820
Additional cost for Control Density Backfill	LF	$40	0	$0
Pavement Repair- 1/2 lane	LF	$30	880	$26,400
Pavement Repair- Full Lane	LF	$52	0	$0
Utilities	LF	$6	880	$5,280
Traffic Control	LF	$2	880	$1,760
Sum				$251,860
Mobilization	%	5%		*$12,600*
Total Construction Costs				$264,460
Contingency	%	20%		$52,892
Engineering	%	15%		$39,669
Fir to Regis Subtotal				***$357,000***
Additional Monitoring Manholes				
Manholes	EA	$3,500	5	$17,500
Manhole Monitoring Equipment	EA	$9,200	5	$46,000
Sum				$63,500
Mobilization	%	5%		*$3,200*
Total Construction Costs				$66,700
Contingency	%	30%		$20,010
Engineering	%	15%		$10,005
Fir to Regis Subtotal				***$96,700***
Evergreen Ave to NE Norpac Dtn Site				
Hollister to Locust on Evergreen Ave				
Parallel 12" Storm Water Line	LF	$56	667	$37,352
Manholes	EA	$3,500	2	$7,000
Manhole interties	EA	$4,500	2	$9,000
Additional/Replacement Catch Basins	EA	$1,600	7	$11,200
Additional 10" pipe to tie in catch basins	LF	$49	210	$10,290
Additional cost for Control Density Backfill	LF	$40	0	$0
Pavement Repair- 1/2 lane	LF	$30	667	$20,010
Pavement Repair- Full Lane	LF	$52	0	$0
Utilities	LF	$6	667	$4,002
Traffic Control	LF	$2	667	$1,334
1st Ave to Douglas on Locust				
Parallel 12" Storm Water Line	LF	$56	1,100	$61,600
Manholes	EA	$3,500	3	$10,500
Manhole interties	EA	$4,500	3	$13,500
Additional/Replacement Catch Basins	EA	$1,600	10	$16,000
Additional 10" pipe to tie in catch basins	LF	$49	300	$14,700
Additional cost for Control Density Backfill	LF	$40	0	$0
Pavement Repair- 1/2 lane	LF	$30	1,100	$33,000
Pavement Repair- Full Lane	LF	$52	0	$0
Utilities	LF	$6	1,100	$6,600
Traffic Control	LF	$2	1,100	$2,200
Locust to Washington on Douglas				
Parallel 12" Storm Water Line	LF	$56	700	$39,200
Manholes	EA	$3,500	2	$7,000
Manhole interties	EA	$4,500	2	$9,000
Additional/Replacement Catch Basins	EA	$1,600	5	$8,000
Additional 10" pipe to tie in catch basins	LF	$49	150	$7,350
Additional cost for Control Density Backfill	LF	$40	0	$0
Pavement Repair- 1/2 lane	LF	$30	700	$21,000
Pavement Repair- Full Lane	LF	$52	0	$0
Utilities	LF	$6	700	$4,200
Traffic Control	LF	$2	700	$1,400
Douglas to Norpak NE Detention on Washington				
Parallel 12" Storm Water Line	LF	$56	300	$16,800
Manholes	EA	$3,500	2	$7,000
Manhole interties	EA	$4,500	1	$4,500
Additional/Replacement Catch Basins	EA	$1,600	2	$3,200
Additional 10" pipe to tie in catch basins	LF	$49	60	$2,940
Additional cost for Control Density Backfill	LF	$40	0	$0
Pavement Repair- 1/2 lane	LF	$30	300	$9,000
Pavement Repair- Full Lane	LF	$52	0	$0
Utilities	LF	$6	300	$1,800

Stayton Storm Water Master Plan
Priority 2 Improvements

Item	Unit	Unit Price	Estimated Quantity	Cost (Rounded)
Traffic Control	LF	$2	300	$600
Sum				$401,278
Mobilization	%	5%		*$20,100*
Total Construction Costs				$421,378
Contingency	%	20%		$84,276
Engineering	%	15%		$63,207
Evergreen to Norpac Subtotal				***$568,900***
3rd and Jefferson to Library Detention				
Jefferson to Virginia on 3rd Ave				
Parllel 18" Storm Water Pipe	LF	$70	550	$38,500
Manholes	EA	$3,500	2	$7,000
Manhole interties	EA	$4,500	2	$9,000
Additional/Replacement Catch Basins	EA	$1,600	12	$19,200
Additional 10" pipe to tie in catch basins	LF	$49	360	$17,640
Additional cost for Control Density Backfill	LF	$40	0	$0
Pavement Repair- 1/2 lane	LF	$30	550	$16,500
Pavement Repair- Full Lane	LF	$52	0	$0
Utilities	LF	$6	550	$3,300
Traffic Control	LF	$2	550	$1,100
3rd Ave to 2nd Ave on Virginia				
Parllel 18" Storm Water Pipe	LF	$70	275	$19,250
Manholes	EA	$3,500	1	$3,500
Manhole interties	EA	$4,500	1	$4,500
Additional/Replacement Catch Basins	EA	$1,600	4	$6,400
Additional 10" pipe to tie in catch basins	LF	$49	120	$5,880
Additional cost for Control Density Backfill	LF	$40	0	$0
Pavement Repair- 1/2 lane	LF	$30	275	$8,250
Pavement Repair- Full Lane	LF	$52	0	$0
Utilities	LF	$6	275	$1,650
Traffic Control	LF	$2	275	$550
Virginia to Marion Ave on 2nd Ave				
Parallel 18" Storm Water Pipe	LF	$70	525	$36,750
Manholes	EA	$3,500	1	$3,500
Manhole interties	EA	$4,500	1	$4,500
Additional/Replacement Catch Basins	EA	$1,600	4	$6,400
Additional 10" pipe to tie in catch basins	LF	$49	120	$5,880
Additional cost for Control Density Backfill	LF	$40	0	$0
Pavement Repair- 1/2 lane	LF	$30	525	$15,750
Pavement Repair- Full Lane	LF	$52	0	$0
Utilities	LF	$6	525	$3,150
Traffic Control	LF	$2	525	$1,050
6th to 2nd on Marion Ave				
Single 18" Storm Water Pipe	LF	$70	1,155	$80,850
Manholes	EA	$3,500	5	$17,500
Manhole interties	EA	$4,500	1	$4,500
Additional/Replacement Catch Basins	EA	$1,600	16	$25,600
Additional 10" pipe to tie in catch basins	LF	$49	480	$23,520
Additional cost for Control Density Backfill	LF	$40	0	$0
Pavement Repair- 1/2 lane	LF	$30	1,155	$34,650
Pavement Repair- Full Lane	LF	$52	0	$0
Utilities	LF	$6	1,155	$6,930
Traffic Control	LF	$2	1,155	$2,310
Salem Ditch to Marion on 6th				
Regrade Gutters	LF	$12	266	$3,192
Gutter grates	LF	$30	266	$7,980
Abandon Existing Stormlines	LF	$10	266	$2,660
Additional/Replacement Catch Basins	EA	$1,600	2	$3,200
Additional cost for Control Density Backfill	LF	$40	0	$0
Pavement Repair- 1/2 lane	LF	$30	266	$7,980
Pavement Repair- Full Lane	LF	$52	0	$0
Utilities	LF	$6	266	$1,596
Traffic Control	LF	$2	266	$532
Salem Ditch to Marion on 5th				
Regrade Gutters	LF	$12	263	$3,156
Gutter grates	LF	$30	263	$7,890
Abandon Existing Stormlines	LF	$10	263	$2,630
Additional/Replacement Catch Basins	EA	$1,600	2	$3,200
Additional cost for Control Density Backfill	LF	$40	0	$0
Pavement Repair- 1/2 lane	LF	$30	263	$7,890
Pavement Repair- Full Lane	LF	$52	0	$0
Utilities	LF	$6	263	$1,578
Traffic Control	LF	$2	263	$526

Stayton Storm Water Master Plan
Priority 2 Improvements

Item	Unit	Unit Price	Estimated Quantity	Cost (Rounded)
Salem Ditch to Marion on 4th				
Regrade Gutters	LF	$12	250	$3,000
Gutter grates	LF	$30	250	$7,500
Abandon Existing Stormlines	LF	$10	250	$2,500
Additional/Replacement Catch Basins	EA	$1,600	2	$3,200
Additional cost for Control Density Backfill	LF	$40	0	$0
Pavement Repair- 1/2 lane	LF	$30	250	$7,500
Pavement Repair- Full Lane	LF	$52	0	$0
Utilities	LF	$6	250	$1,500
Traffic Control	LF	$2	250	$500
Salem Ditch to Marion on 3rd				
Regrade Gutters	LF	$12	200	$2,400
Gutter grates	LF	$30	200	$6,000
Abandon Existing Stormlines	LF	$10	200	$2,000
Additional/Replacement Catch Basins	EA	$1,600	2	$3,200
Additional cost for Control Density Backfill	LF	$40	0	$0
Pavement Repair- 1/2 lane	LF	$30	200	$6,000
Pavement Repair- Full Lane	LF	$52	0	$0
Utilities	LF	$6	200	$1,200
Traffic Control	LF	$2	200	$400
Salem Ditch to Marion on 2nd				
Regrade Gutters	LF	$12	160	$1,920
Gutter grates	LF	$30	160	$4,800
Abandon Existing Stormlines	LF	$10	160	$1,600
Additional/Replacement Catch Basins	EA	$1,600	2	$3,200
Additional cost for Control Density Backfill	LF	$40	0	$0
Pavement Repair- 1/2 lane	LF	$30	160	$4,800
Pavement Repair- Full Lane	LF	$52	0	$0
Utilities	LF	$6	160	$960
Traffic Control	LF	$2	160	$320
Salem Ditch to Marion on 1st				
Regrade Gutters	LF	$12	60	$720
Gutter grates	LF	$30	60	$1,800
Abandon Existing Stormlines	LF	$10	60	$600
Additional/Replacement Catch Basins	EA	$1,600	2	$3,200
Additional cost for Control Density Backfill	LF	$40	60	$2,400
Pavement Repair- 1/2 lane	LF	$30	60	$1,800
Pavement Repair- Full Lane	LF	$52	0	$0
Utilities	LF	$6	60	$360
Traffic Control	LF	$2	60	$120
Virginia to Marion Ave on 2nd Ave				
Parallel 18" Storm Water Pipe	LF	$70	525	$36,750
Manholes	EA	$3,500	1	$3,500
Manhole interties	EA	$4,500	1	$4,500
Additional/Replacement Catch Basins	EA	$1,600	4	$6,400
Additional 10" pipe to tie in catch basins	LF	$49	120	$5,880
Additional cost for Control Density Backfill	LF	$40	0	$0
Pavement Repair- 1/2 lane	LF	$30	525	$15,750
Pavement Repair- Full Lane	LF	$52	0	$0
Utilities	LF	$6	525	$3,150
Traffic Control	LF	$2	525	$1,050
Stayton Christian School to Marion on 1st Ave				
Parallel 10" Storm Water Pipe	LF	$49	1,110	$54,390
Manholes	EA	$3,500	5	$17,500
Manhole interties	EA	$4,500	5	$22,500
Additional/Replacement Catch Basins	EA	$1,600	16	$25,600
Additional 10" pipe to tie in catch basins	LF	$49	480	$23,520
Additional cost for Control Density Backfill	LF	$40	1,110	$44,400
Pavement Repair- 1/2 lane	LF	$30	0	$0
Pavement Repair- Full Lane	LF	$52	1,110	$57,720
Utilities	LF	$6	1,110	$6,660
Traffic Control	LF	$2	1,110	$2,220
2nd Ave to Library Detention on Marion				
Parallel 18" Storm Water Line	LF	$70	600	$42,000
Parallel 24" Storm Water Line	LF	$115	600	$69,000
Bore under 1st Ave	LF	$500	60	$30,000
Manholes	EA	$3,500	8	$28,000
Manhole interties	EA	$4,500	5	$22,500
Additional/Replacement Catch Basins	EA	$1,600	8	$12,800
Additional 10" pipe to tie in catch basins	LF	$49	240	$11,760
Additional cost for Control Density Backfill	LF	$40	60	$2,400
Pavement Repair- 1/2 lane	LF	$30	600	$18,000
Pavement Repair- Full Lane	LF	$52	0	$0
Utilities	LF	$6	600	$3,600

Stayton Storm Water Master Plan
Priority 2 Improvements

Item	Unit	Unit Price	Estimated Quantity	Cost (Rounded)
Traffic Control	LF	$2	600	$1,200
Library Detention Facility				
Land Acquisition	AC	$20,000	0	$0
Manholes	EA	$3,500	3	$10,500
Manhole Monitoring Equipment	EA	$9,200	1	$9,200
Manhole interties	EA	$4,500	1	$4,500
Additional/Replacement Catch Basins	EA	$1,600	2	$3,200
Additional 10" pipe to tie in catch basins	LF	$49	60	$2,940
Additional cost for Control Density Backfill	LF	$40	0	$0
Pavement Repair- 1/2 lane	LF	$30	0	$0
Pavement Repair- Full Lane	LF	$52	0	$0
Utilities	LF	$6	20	$120
Traffic Control	LF	$2	0	$0
Excavation	CY	$15	5,808	$87,120
Inlet structure	EA	$6,000	1	$6,000
Outlet control structure	EA	$7,500	1	$7,500
Outfall Piping - 15"	LF	$63	80	$5,040
Landscaping	SF	$1	87,120	$82,764
Sum				$1,356,204
Mobilization	%	5%		*$67,800*
Total Construction Costs				$1,424,004
Contingency	%	20%		$284,801
Engineering & Legal	%	15%		$213,601
3rd and Jefferson to Library Subtotal				***$1,922,400***
Mill Stream Woods to Norpac SW Detention Site on Ida				
Mill Stream Woods to Norpac SW Detention Site on Ida				
Single 24" Line	LF	$115	4,076	$468,740
Manholes	EA	$3,500	15	$52,500
Manhole interties	EA	$4,500	11	$49,500
Additional/Replacement Catch Basins	EA	$1,600	46	$73,600
Additional 10" pipe to tie in catch basins	LF	$49	1,380	$67,620
Additional cost for Control Density Backfill	LF	$40	60	$2,400
Pavement Repair- 1/2 lane	LF	$30	4,076	$122,280
Pavement Repair- Full Lane	LF	$52	0	$0
Utilities	LF	$6	4,076	$24,456
Traffic Control	LF	$2	4,076	$8,152
Bore under 1st Ave	LF	$500	60	$30,000
Salem Ditch to Ida on 4th Ave				
Regrade Gutters	LF	$12	200	$2,400
Gutter grates	LF	$30	200	$6,000
Abandon Existing Stormlines	LF	$10	200	$2,000
Additional/Replacement Catch Basins	EA	$1,600	0	$0
Additional cost for Control Density Backfill	LF	$40	0	$0
Pavement Repair- 1/2 lane	LF	$30	200	$6,000
Pavement Repair- Full Lane	LF	$52	0	$0
Utilities	LF	$6	200	$1,200
Traffic Control	LF	$2	200	$400
3rd and High to 3rd and Ida				
Regrade Gutters	LF	$12	241	$2,892
Gutter grates	LF	$30	241	$7,230
Abandon Existing Stormlines	LF	$10	241	$2,410
Additional/Replacement Catch Basins	EA	$1,600	0	$0
Additional cost for Control Density Backfill	LF	$40	0	$0
Pavement Repair- 1/2 lane	LF	$30	241	$7,230
Pavement Repair- Full Lane	LF	$52	0	$0
Utilities	LF	$6	241	$1,446
Traffic Control	LF	$2	241	$482
2nd and High to 2nd and Ida				
Regrade Gutters	LF	$12	270	$3,240
Gutter grates	LF	$30	270	$8,100
Abandon Existing Stormlines	LF	$10	270	$2,700
Additional/Replacement Catch Basins	EA	$1,600	0	$0
Additional cost for Control Density Backfill	LF	$40	0	$0
Pavement Repair- 1/2 lane	LF	$30	270	$8,100
Pavement Repair- Full Lane	LF	$52	0	$0
Utilities	LF	$6	270	$1,620
Traffic Control	LF	$2	270	$540
1st and High to 1st and Ida				
Regrade Gutters	LF	$12	330	$3,960
Gutter grates	LF	$30	330	$9,900
Abandon Existing Stormlines	LF	$10	330	$3,300
Additional/Replacement Catch Basins	EA	$1,600	0	$0

Stayton Storm Water Master Plan
Priority 2 Improvements

Item	Unit	Unit Price	Estimated Quantity	Cost (Rounded)
Additional cost for Control Density Backfill	LF	$40	0	$0
Pavement Repair- 1/2 lane	LF	$30	330	$9,900
Pavement Repair- Full Lane	LF	$52	0	$0
Utilities	LF	$6	330	$1,980
Traffic Control	LF	$2	330	$660
3rd and Water to 3rd and Ida				
Single 15" Line	LF	$63	518	$32,634
Manholes	EA	$3,500	2	$7,000
Manhole interties	EA	$4,500	0	$0
Additional/Replacement Catch Basins	EA	$1,600	8	$12,800
Additional 10" pipe to tie in catch basins	LF	$49	240	$11,760
Additional cost for Control Density Backfill	LF	$40	0	$0
Pavement Repair- 1/2 lane	LF	$30	518	$15,540
Pavement Repair- Full Lane	LF	$52	0	$0
Utilities	LF	$6	518	$3,108
Traffic Control	LF	$2	518	$1,036
2nd and Water to 2nd and Ida				
Single 15" Line	LF	$63	350	$22,050
Manholes	EA	$3,500	2	$7,000
Manhole interties	EA	$4,500	0	$0
Additional/Replacement Catch Basins	EA	$1,600	7	$11,200
Additional 10" pipe to tie in catch basins	LF	$49	210	$10,290
Additional cost for Control Density Backfill	LF	$40	0	$0
Pavement Repair- 1/2 lane	LF	$30	350	$10,500
Pavement Repair- Full Lane	LF	$52	0	$0
Utilities	LF	$6	350	$2,100
Traffic Control	LF	$2	350	$700
1st and Florence to 1st and Ida				
Single 15" Line	LF	$63	250	$15,750
Manholes	EA	$3,500	2	$7,000
Manhole interties	EA	$4,500	0	$0
Additional/Replacement Catch Basins	EA	$1,600	6	$9,600
Additional 10" pipe to tie in catch basins	LF	$49	180	$8,820
Additional cost for Control Density Backfill	LF	$40	0	$0
Pavement Repair- 1/2 lane	LF	$30	250	$7,500
Pavement Repair- Full Lane	LF	$52	0	$0
Utilities	LF	$6	250	$1,500
Traffic Control	LF	$2	250	$500
Norpac SW Detention Site				
Land Acquisition	AC	$20,000	1	$20,000
Manholes	EA	$3,500	2	$7,000
Manhole Monitoring Equipment	EA	$9,200	1	$9,200
Manhole interties	EA	$4,500	0	$0
Additional/Replacement Catch Basins	EA	$1,600	2	$3,200
Additional 10" pipe to tie in catch basins	LF	$49	60	$2,940
Additional cost for Control Density Backfill	LF	$40	0	$0
Utilities	LF	$6	20	$120
Traffic Control	LF	$2	0	$0
Excavation	CY	$15	3,230	$48,450
Inlet structure	EA	$6,000	1	$6,000
Outlet control structure	EA	$7,500	1	$7,500
Outfall Piping - 15"	LF	$63	20	$1,260
Landscaping	SF	$1	87,120	$82,764
Sum				$1,379,760
Mobilization	%	5%		*$69,000*
Total Construction Costs				$1,448,760
Contingency	%	20%		$289,752
Engineering	%	15%		$217,314
Mill Stream Woods to Norpac SW Dtn Site Subtotal				***$1,955,800***
Total Priority 2 Costs				**$4,900,800**

Stayton Storm Water Master Plan
Priority 3 Improvements

Item	Unit	Unit Price	Estimated Quantity	Cost (Rounded)
Sylvan Meadows Subdivision Improvements				
From MH in Walking Path to Detn. Pond				
Parallel 10" Storm Water Line	LF	$49	250	$12,250
Manholes	EA	$3,500	3	$10,500
Manhole Monitoring Equipment	EA	$9,200	1	$9,200
Manhole interties	EA	$4,500	2	$9,000
Utilities	LF	$6	250	$1,500
Landscaping	SF	$1	250	$238
Sum				$42,688
Mobilization	%	5%		*$2,100*
Total Construction Costs				$44,788
Contingency	%	20%		$8,958
Engineering	%	15%		$6,718
Sylvan Meadows Subdivision Subtotal				***$60,500***
Gardner Road-Regis High School Improvements				
Gardner Road-TBD				
Single 15" Storm Water Line	LF	$63	0	$0
Manholes	EA	$3,500	0	$0
Manhole interties	EA	$4,500	0	$0
Additional/Replacement Catch Basins	EA	$1,600	0	$0
Additional 10" pipe to tie in catch basins	LF	$49	0	$0
Additional cost for Control Density Backfill	LF	$40	0	$0
Pavement Repair- 1/2 lane	LF	$30	0	$0
Pavement Repair- Full Lane	LF	$52	0	$0
Utilities	LF	$6	0	$0
Traffic Control	LF	$2	0	$0
Locust Street-TBD				
Parallel 12" Storm Water Line	LF	$56	0	$0
Manholes	EA	$3,500	0	$0
Manhole interties	EA	$4,500	0	$0
Additional/Replacement Catch Basins	EA	$1,600	0	$0
Additional 10" pipe to tie in catch basins	LF	$49	0	$0
Additional cost for Control Density Backfill	LF	$40	0	$0
Pavement Repair- 1/2 lane	LF	$30	0	$0
Pavement Repair- Full Lane	LF	$52	0	$0
Utilities	LF	$6	0	$0
Traffic Control	LF	$2	0	$0
Sum				$0
Mobilization	%	5%		*$0*
Total Construction Costs				$0
Contingency	%	20%		$0
Engineering	%	15%		$0
Gardner Road-Regis High School Subtotal				***$0***
Wedgewood Place Improvements				
Wilshire Drive				
Parallel 24" Storm Water Line	LF	$115	1,050	$120,750
Manholes	EA	$3,500	2	$7,000
Manhole interties	EA	$4,500	2	$9,000
Additional/Replacement Catch Basins	EA	$1,600	3	$4,800
Additional 10" pipe to tie in catch basins	LF	$49	0	$0
Additional cost for Control Density Backfill	LF	$40	750	$30,000
Pavement Repair- 1/2 lane	LF	$30	750	$22,500
Pavement Repair- Full Lane	LF	$52	0	$0
Landscaping	SF	$1	300	$285
Utilities	LF	$6	1,050	$6,300
Traffic Control	LF	$2	750	$1,500

Stayton Storm Water Master Plan
Priority 3 Improvements

Item	Unit	Unit Price	Estimated Quantity	Cost (Rounded)
Wedgewood Place-Wilco Road				
Parallel 30" Storm Water Line	LF	$180	1,350	$243,000
Manholes	EA	$3,500	4	$14,000
Manhole interties	EA	$4,500	3	$13,500
Additional/Replacement Catch Basins	EA	$1,600	0	$0
Additional 10" pipe to tie in catch basins	LF	$49	0	$0
Crossing of Wilco Road	LF	$200	100	$20,000
Pavement Repair- commercial area	LF	$30	600	$18,000
Pavement Repair- Full Lane	LF	$52	0	$0
Utilities	LF	$6	1,350	$8,100
Landscaping	SF	$1	300	$285
Traffic Control	LF	$2	0	$0
Sum				$519,020
Mobilization	%	5%		*$26,000*
Total Construction Costs				$545,020
Contingency	%	20%		$109,004
Engineering	%	15%		$81,753
Wedgewood Place Improvements Subtotal				***$735,800***
Western Avenue Improvements				
Western Avenue-Westfield Pl				
Parallel 15" Storm Water Line	LF	$63	2,000	$126,000
Manholes	EA	$3,500	6	$21,000
Manhole interties	EA	$4,500	3	$13,500
Additional/Replacement Catch Basins	EA	$1,600	4	$6,400
Additional 10" pipe to tie in catch basins	LF	$49	50	$2,450
Additional cost for Control Density Backfill	LF	$40	1,700	$68,000
Pavement Repair- 1/2 lane	LF	$30	1,700	$51,000
Pavement Repair- Full Lane	LF	$52	0	$0
Landscaping	SF	$1	300	$285
Utilities	LF	$6	2,000	$12,000
Traffic Control	LF	$2	1,700	$3,400
Western Place-Shaff Road				
Parallel 30" Storm Water Line	LF	$180	700	$126,000
Parallel 12" Storm Water Line	LF	$56	650	$36,400
Manholes	EA	$3,500	5	$17,500
Manhole interties	EA	$4,500	2	$9,000
Additional/Replacement Catch Basins	EA	$1,600	2	$3,200
Additional 10" pipe to tie in catch basins	LF	$49	0	$0
Pavement Repair- commercial area	LF	$30	0	$0
Pavement Repair- Full Lane	LF	$52	0	$0
Utilities	LF	$6	1,350	$8,100
Landscaping	SF	$1	1,350	$1,283
Traffic Control	LS	$10,000	1	$10,000
Sum				$515,518
Mobilization	%	5%		*$25,800*
Total Construction Costs				$541,318
Contingency	%	20%		$108,264
Engineering	%	15%		$81,198
Western Avenue Improvements Subtotal				***$730,800***
Total Priority 3 Costs				**$1,527,100**

Stayton Storm Water Master Plan
Priority 4 Improvements

Item	Unit	Unit Price	Estimated Quantity	Cost (Rounded)
Library Improvements				
Librabry Improvements				
Singe 15" Storm Water Line	LF	$63	350	$22,050
Manholes	EA	$3,500	2	$7,000
Manhole interties	EA	$4,500	0	$0
Utilities	LF	$6	350	$2,100
Abandon Existing Storm Line	LF	$10	350	$3,500
Landscaping	SF	$1	350	$333
Sum				$34,983
Mobilization	%	5%		*$1,700*
Total Construction Costs				$36,683
Contingency	%	20%		$7,337
Engineering	%	15%		$5,502
Library Subtotal				***$49,500***
Pacific Court Improvements				
Pacific Court Improvements				
Single 30" Storm Water Line	LF	$180	1,000	$180,000
Manholes	EA	$3	1	$3
Manhole interties	EA	$4,500	0	$0
Additional/Replacement Catch Basins	EA	$1,600	3	$4,800
Additional 10" pipe to tie in catch basins	LF	$49	60	$2,940
Additional cost for Control Density Backfill	LF	$40	0	$0
Pavement Repair- 1/2 lane	LF	$30	1,000	$30,000
Pavement Repair- Full Lane	LF	$52	0	$0
Utilities	LF	$6	1,000	$6,000
Traffic Control	LF	$2	1,000	$2,000
Landscaping	SF	$1	300	$285
Abandon Existing Storm Line	LF	$10	1,000	$10,000
Underground Detention Facility	LS	$75,000	1	$75,000
Sum				$311,028
Mobilization	%	5%		*$15,600*
Total Construction Costs				$326,628
Contingency	%	20%		$65,326
Engineering	%	15%		$48,994
Pacific Court Subtotal				***$440,900***
1st Avenue Improvements				
1st Avenue Improvements				
Single 15" Storm Water Line	LF	$63	425	$26,775
Manholes	EA	$3,500	1	$3,500
Manhole interties	EA	$4,500	2	$9,000
Additional/Replacement Catch Basins	EA	$1,600	0	$0
Additional 10" pipe to tie in catch basins	LF	$49	5	$245
Additional cost for Control Density Backfill	LF	$40	425	$17,000
Pavement Repair- 1/2 lane	LF	$30	0	$0
Pavement Repair- Full Lane	LF	$52	425	$22,100
Utilities	LF	$6	425	$2,550
Abandon Existing Storm Line	LF	$10	425	$4,250
Traffic Control	LF	$2	425	$850
Sum				$86,270
Mobilization	%	5%		*$4,300*
Total Construction Costs				$90,570
Contingency	%	20%		$18,114

Stayton Storm Water Master Plan
Priority 4 Improvements

Item	Unit	Unit Price	Estimated Quantity	Cost (Rounded)
Engineering	%	15%		$13,586
1st Avenue Subtotal				***$122,300***
Washington Street Improvements				
Washington Street Detention Facility				
Land Acquisition	AC	$20,000	2	$30,000
Manholes	EA	$3,500	3	$10,500
Manhole Monitoring Equipment	EA	$9,200	1	$9,200
Manhole interties	EA	$4,500	1	$4,500
Additional/Replacement Catch Basins	EA	$1,600	0	$0
Additional 10" pipe to tie in catch basins	LF	$49	0	$0
Additional cost for Control Density Backfill	LF	$40	0	$0
Pavement Repair- 1/2 lane	LF	$30	0	$0
Pavement Repair- Full Lane	LF	$52	0	$0
Utilities	LS	$2,500	1	$2,500
Traffic Control	LS	$1,500	1	$1,500
Excavation	CY	$15	2,420	$36,300
Inlet structure	EA	$6,000	1	$6,000
Outlet control structure	EA	$7,500	1	$7,500
Outfall Piping - 12"	LF	$63	80	$5,040
Landscaping	SF	$1	21,780	$20,691
End of Pipe Water Quality Treatment	LS	$25,000	1	$25,000
Sum				$158,731
Mobilization	%	5%		*$7,900*
Total Construction Costs				$166,631
Contingency	%	15%		$24,995
Engineering	%	15%		$24,995
Washington Street Improvements Subtotal				***$216,600***
N. Peach Avenue Improvements				
N. Peach Avenue Improvements				
Single 18" Storm Water Line	LF	$70	525	$36,750
Manholes	EA	$3,500	1	$3,500
Manhole interties	EA	$4,500	1	$4,500
Additional/Replacement Catch Basins	EA	$1,600	2	$3,200
Additional 10" pipe to tie in catch basins	LF	$49	20	$980
Additional cost for Control Density Backfill	LF	$40	0	$0
Pavement Repair- 1/2 lane	LF	$30	0	$0
Pavement Repair- Full Lane	LF	$52	0	$0
Landscaping	SF	$1	525	$499
Utilities	LF	$6	525	$3,150
Abandon Existing Storm Line	LF	$10	525	$5,250
Traffic Control	LF	$2	0	$0
Sum				$57,829
Mobilization	%	5%		*$2,900*
Total Construction Costs				$60,729
Contingency	%	20%		$12,146
Engineering	%	15%		$9,109
Peach Avenue Improvements Subtotal				***$82,000***
Total Priority 4 Costs				**$911,300**

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Stayton Storm Water Master Plan
Future Improvements

Item	Unit	Unit Price	Estimated Quantity	Cost (Rounded)
Fern Ridge Street Area Improvements				
Fern Ridge Street				
Parallel 15" Storm Water Line	LF	$63	400	$25,200
Parallel 18" Storm Water Line	LF	$70	950	$66,500
Manholes	EA	$3,500	1	$3,500
Manhole interties	EA	$4,500	3	$13,500
Additional/Replacement Catch Basins	EA	$1,600	5	$8,000
Additional 10" pipe to tie in catch basins	LF	$49	100	$4,900
Additional cost for Control Density Backfill	LF	$40	1,350	$54,000
Pavement Repair- 1/2 lane	LF	$30	1,350	$40,500
Pavement Repair- Full Lane	LF	$52	0	$0
Utilities	LF	$6	1,350	$8,100
Traffic Control	LF	$2	1,350	$2,700
Pipelines North of Fern Ridge				
Parallel 15" Storm Water Line	LF	$525	400	$210,000
Manholes	EA	$3,500	1	$3,500
Manhole interties	EA	$4,500	1	$4,500
Additional/Replacement Catch Basins	EA	$1,600	0	$0
Additional 10" pipe to tie in catch basins	LF	$49	0	$0
Additional cost for Control Density Backfill	LF	$40	0	$0
Pavement Repair- 1/2 lane	LF	$30	0	$0
Pavement Repair- Full Lane	LF	$52	0	$0
Utilities	LF	$6	400	$2,400
Traffic Control	LF	$2	400	$800
Pipelines South of Fern Ridge				
Storm Water Line	LF	$115	4,500	$517,500
Manholes	EA	$3,500	11	$39,375
Fern Ridge Detention Facility				
Land Acquisition	AC	$20,000	2	$30,000
Manholes	EA	$3,500	1	$3,500
Manhole interties	EA	$4,500	0	$0
Manhole Monitoring Equipment	EA	$9,200	1	$9,200
Additional/Replacement Catch Basins	EA	$1,600	0	$0
Additional 10" pipe to tie in catch basins	LF	$49	0	$0
Additional cost for Control Density Backfill	LF	$40	0	$0
Pavement Repair- 1/2 lane	LF	$30	0	$0
Pavement Repair- Full Lane	LF	$52	0	$0
Utilities	LS	$2,500	0	$0
Traffic Control	LS	$1,500	0	$0
Excavation	CY	$15	6,450	$96,750
Inlet structure	EA	$6,000	1	$6,000
Outlet control structure	EA	$7,500	1	$7,500
Outfall Piping - 12"	LF	$63	0	$0
Landscaping	SF	$1	43,560	$41,382
Sum				$1,199,307
Mobilization	%	5%		*$60,000*
Total Construction Costs				$1,259,307
Contingency	%	20%		$251,861
Engineering	%	15%		$188,896
Fern Ridge Street Area Subtotal				***$1,700,100***
Dozler Property Improvements				
Pipelines				
Storm Water Line	LF	$115	2,300	$264,500
Manholes	EA	$3,500	6	$20,125
Dozler Detention Facility				
Land Acquisition	AC	$20,000	3	$50,000
Excavation	CY	$15	8,070	$121,050
Manholes	EA	$3,500	1	$3,500
Manhole Monitoring Equipment	EA	$9,200	1	$9,200
Inlet structure	EA	$6,000	2	$12,000
Outlet control structure	EA	$7,500	1	$7,500
Outfall Piping - 12"	LF	$63	100	$6,300
Landscaping	SF	$1	30,000	$28,500
Sum				$522,675
Mobilization	%	5%		*$26,100*
Total Construction Costs				$548,775
Contingency	%	20%		$109,755
Engineering	%	15%		$82,316
Dozler Property Area Subtotal				***$740,800***
Phillips Property Area Improvements				

Stayton Storm Water Master Plan
Future Improvements

Item	Unit	Unit Price	Estimated Quantity	Cost (Rounded)
Detention Swale				
Detention Swale	LF	$150	2,500	$375,000
Landscaping	LF	$100	2,500	$250,000
Easements	LF	$50	2,500	$125,000
Pipelines				
Parallel 42" Storm Water Line	LF	$218	350	$76,300
Parallel 36" Storm Water Line	LF	$200	350	$70,000
Single 30" Storm Water Line	LF	$180	2,600	$468,000
Manholes	EA	$3,500	11	$38,500
Manhole interties	EA	$4,500	0	$0
Additional/Replacement Catch Basins	EA	$1,600	0	$0
Additional 10" pipe to tie in catch basins	LF	$49	0	$0
Additional cost for Control Density Backfill	LF	$40	0	$0
Pavement Repair- 1/2 lane	LF	$30	0	$0
Pavement Repair- Full Lane	LF	$52	0	$0
Utilities	LF	$6	400	$2,400
Traffic Control	LF	$2	0	$0
Sum				$1,405,200
Mobilization	%	5%		*$70,300*
Total Construction Costs				$1,475,500
Contingency	%	20%		$295,100
Engineering	%	15%		$221,325
Phillips Property Area Subtotal				***$1,991,900***
Detention Facilities				
Potential Regional Detention Facility	EA	$600,000	4	$2,400,000
Sum				$2,400,000
Mobilization	%	5%		*$120,000*
Total Construction Costs				$2,520,000
Contingency	%	20%		$504,000
Engineering	%	15%		$378,000
Future Detention Facilities Subtotal				***$3,402,000***
Upsize Pipelines				
Future Pipelines				
Storm Water Line upsize ("30 over 18")	LF	$110	8,500	$935,000
Manholes	EA	$3,500	21	$74,375
Sum				$1,009,375
Mobilization	%	5%		*$50,500*
Total Construction Costs				$1,059,875
Contingency	%	20%		$211,975
Engineering	%	15%		$158,981
Future Pipeline Subtotal				***$1,430,800***
Larch Avenue Improvements				
Larch Avenue Improvements				
Single 15" Storm Water Line	LF	$63	525	$33,075
Manholes	EA	$3,500	1	$3,500
Manhole interties	EA	$4,500	1	$4,500
Additional/Replacement Catch Basins	EA	$1,600	2	$3,200
Additional 10" pipe to tie in catch basins	LF	$49	20	$980
Additional cost for Control Density Backfill	LF	$40	525	$21,000
Pavement Repair- 1/2 lane	LF	$30	525	$15,750
Pavement Repair- Full Lane	LF	$52	0	$0
Utilities	LF	$6	525	$3,150
Abandon Existing Storm Line	LF	$10	525	$5,250
Traffic Control	LF	$2	525	$1,050
Sum				$91,455
Mobilization	%	5%		*$4,600*
Total Construction Costs				$96,055
Contingency	%	20%		$19,211
Engineering	%	15%		$14,408
Larch Avenue Improvements Subtotal				***$129,700***
Total Future Costs				**$9,395,300**

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Stayton, Oregon
Storm Water Master Plan
UNIT COST TABLE

ITEM	UNIT	UNIT PRICE
Concrete Detention Outlet Control Structure	EA	$7,500.00
Concrete Inlet Structure - Detention Basin	EA	$6,000.00
Storm Water Manhole	EA	$3,500.00
Manhole Intertie for Parallel Line	EA	$4,500.00
Catch Basin - Standard WQ Features	EA	$1,600.00
Gutter Grates	LF	$30.00
Manhole Monitoring Equipment - Quantity/Quality	EA	$9,200.00
10" Pipe - Excavation and Backfill	LF	$49.00
12" Pipe - Excavation and Backfill	LF	$56.00
15" Pipe - Excavation and Backfill	LF	$63.00
18" Pipe - Excavation and Backfill	LF	$70.00
24" Pipe - Excavation and Backfill	LF	$115.00
30" Pipe - Excavation and Backfill	LF	$180.00
36" Pipe - Excavation and Backfill	LF	$200.00
42" Pipe - Excavation and Backfill	LF	$218.00
48" Pipe - Excavation and Backfill	LF	$225.00
Bore Under County Road	LF	$500.00
48" bore	LF	$900.00
Control Density Backfill - additional cost	LF	$40.00
1/2 Lane Pavement Repair	LF	$30.00
Full lane pavement Repair	LF	$52.00
Curb and Gutter	LF	$12.00
Traffic Control	LF	$2.00
Utilities	LF	$6.00
Detention Pond Excavation	CY	$15.00
Landscaping - sod, walking path, trees &shrubs	SF	$0.95
Wetland Acquisition	AC	$17,500
Detention Site Land Acquistion	AC	$20,000
Abandon Existing Storm Lines	LF	$10
Mobilization - Percent of Item Cost Sum	%	5%
Contingency - % of construction costs-Pipes	%	20%
Contingency - % of construction costs-Dtn Sites	%	15%
Contingency - % of construction costs-wetlands	%	10%
Contingency - % of construction costs-Mont.Eqip	%	30%
Engineering - Percent of construction costs	%	15%
Permitting and Legal	EA	$20,000

Appendix F
Revised Storm Water Standards

KELLER ASSOCIATES

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CITY OF STAYTON

DEPARTMENT OF PUBLIC WORKS

STORM DRAINAGE

DESIGN STANDARDS

2007

Latest Revision Date: February 20, 2007

Appendices

A. Storm Drainage Report and Construction Plan Requirements

B. Hydrology Calculation Requirements

C. Water Quality and Quantity Facility Design

D. Water Quality and Quantity Facility Operations and Maintenance Guidelines

E. City of Stayton Standard Details (To be reviewed and provide by the City of Stayton)

1.0 PURPOSE

The purpose of these Storm Drainage Design Standards is to provide a consistent policy under which certain physical aspects of stormwater management will be implemented. Most of the elements contained in this document are Public Works oriented and most are related to the development or platting process; however, it is intended that they apply to both public and private work designated herein.

These Standards cannot provide for all situations. They are intended to assist but not to substitute for competent work by design professionals. It is expected that engineers will bring to each project the best skills from their respective disciplines.

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

Following from the above purpose, the standards have the objective of developing a stormwater management system which will:

a. be consistent with the Stayton Code and adopted Sector Plans;
b. be of adequate design to safely manage all volumes of water generated upstream and on the site to an approved point of discharge;
c. provide points of discharge for stormwater generated by future development upstream;
d. prevent the uncontrolled or irresponsible discharge of stormwater onto adjoining pubic or private property;
e. prevent the capacity of downstream channels and storm drainage facilities from being exceeded;
f. have sufficient structural strength to resist erosion and all external loads which may be imposed;
g. maintain the runoff characteristics of the original undeveloped drainage basin;
h. protect Stayton’s natural drainage system of streams and wetlands;
i. maintain Stayton’s existing high level of overall water quality;
j. be designed in a manner to allow economical future maintenance; and
k. be designed using materials to insure a minimum practical design life of 50 years.

1.1 SHORTENED DESIGNATION

These City of Stayton’s Storm Drainage Design Standards shall be cited routinely in the text as the “Standards.”

1.2 APPLICABILITY

These Standards shall govern all construction and upgrading of all public and private drainage facilities in the City of Stayton and applicable work within its service areas.

1.3 REFERENCES

The Standards are intended to be consistent with the most currently adopted provisions of:

a. Stayton Code.

b. Stayton Area Comprehensive Plan.

c. City of Stayton Urban Growth Management Plan.

d. Stayton Area Stormwater Management Plan.

e. Stayton Area Water Quality Plan

f. Oregon Statewide Planning Goals and Guidelines

g. Oregon Department of Environmental Quality's Erosion and Sediment Control Manual

1.4 STANDARD SPECIFICATIONS

Except where the standards provide otherwise, design detail, workmanship and materials shall be in accordance with the City of Stayton's current edition of the "Standard Construction Specifications."

1.5 DEFINITIONS AND TERMS

Building Storm Drain—A building storm drain is that part of the piping of a stormwater drainage system which begins at the connection to the building drain at a point five (5) feet outside the established line of the building or structure and conveys stormwater to the approved point of discharge.

City Engineer — the Engineer employed or designated by the City as responsible for technical review of plans, drawings, specifications and making any engineering decisions directly or indirectly related to storm drainage issues.

Creek—Any and all surface water routes generally consisting of a channel having a bed, banks, and/or sides in which surface waters flow in draining from higher to lower land, both perennial and intermittent; the channel, banks, and intervening artificial components, excluding flows which do not persist for more than 24 hours after cessation of one-half (1/2) inch of rainfall in a 24-hour period from October through March.

Cut Sheets—means sheets of tabulated data, indicating stationings, structures, fittings, angle points, beginning of curve, points on curve, end of curves, storm drain slope, staking offset, various elevations, offset cuts, and storm drain depths.

Definition of Words—Wherever in these standards the words directed, required, permitted, ordered, designated, or words of like importance are used, they shall be understood to mean the direction, requirement, permission, or order of designation of the Director. Similarly, the words approved, acceptable, satisfactory, shall mean approved by, acceptable to, or satisfactory to the Director.

Design Engineer—The developer's design or consulting engineer, licensed by the State of Oregon as a Civil Engineer under whose direction plans, profiles, and details for the work are prepared and submitted to the City for review and approval.

Detention—The holding of runoff for a short period of time and then releasing it to the natural water course where it returns to the hydrologic cycle.

Developer — Anyone planning or implementing improvements to any property within the jurisdiction of the City of Stayton that meets one of the type descriptions included in Section 1.8.

Director—The person employed or designated by the City as responsible for implementing policy and administrative issues related to stormwater issues. The Public Works Director will coordinate with and rely upon the City Engineer with regard to issues involving technical and engineering aspects or decisions.

Drainage Facilities—Pipes, ditches, detention basins, creeks, culvert bridges, etc., used singularly or in combination with each other for the purpose of conveying, storing, or providing water quality treatment of runoff.

Drainage Master Plan—A document prepared by Keller & Associates that describes Stayton's existing planned trunk drainage system.

Easement—Easements are areas along the line of all public storm drains which are outside of dedicated storm drain or road easements or rights-of-way, and shall be prepared on City forms granting rights along the line of the storm drain to the City.

French Drain or Leach Line—means a covered underground excavated trench filled with washed gravel that surrounds a perforated delivery pipe used to receive stormwater, wherein 'the sides and bottom of the trench are porous, permitting the stormwater to seep into the ground.

Impervious Areas—Impervious Surfaces. Those hard surface areas located upon real property which either prevent or retard saturation of water into the land surface, as existed under natural conditions pre-existent to development, and cause water to run off the land surface in greater quantities or at an increased rate of flow from that present under natural conditions pre-existent to development. Common impervious surfaces include, but are not limited to rooftops, concrete or asphalt sidewalks, walkways, patio areas, driveways, parking lots or storage areas and graveled, oiled, macadam or other surfaces which similarly impact the natural saturation or runoff patterns which existed prior to development.

Natural Location—The location of those channels, swales, and other nonman-made conveyance systems as defined by the first documented topographic contours existing for the subject property either from maps or photographs.

On-Site Detention—The storage of excess runoff on the development site prior to its entry into a public storm drain system and gradual release of the stored runoff after the peak of the runoff has passed.

Owner—Any individual, partnership, firm, or corporation by whom the project engineer has been retained or who, as a property owner, is making arrangements with the City.

Peak Discharge—The maximum water runoff rate (cfs) determined for the design storm.

Plans—Construction plans, including system site plans, storm drain plans and profiles, cross sections, detailed drawings, etc., or reproductions thereof, approved or to be approved by the City Engineer, which show the location, character, dimensions, and details for the work to be done, in which constitute a supplement to these standards.

Pre-Development—a site with natural vegetation on native soils.

Private Storm Drain—means a storm drain located on private property serving more than one structure on the same premises or parking lot catchbasins.

Project Engineer—see “Design Engineer”.

Public Storm Drain—means any storm drain in public right-of-way or easement operated and maintained by the City.

Receiving Bodies of Water—Creeks, streams, lakes, and other bodies of water into which waters are artificially or naturally directed.

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

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

Retention Facilities—Facilities designed to or which do hold water for a considerable length of time and then consume it by evaporation, plant transpiration, or infiltration into the soil. Any point discharge to a drainage channel or receiving body of water must be addressed in the Storm Drainage Report.

Sedimentation—Disposition of erosional debris-soil sediment displaced by erosion and transported by water from a high elevation to an area of lower gradient where sediments are deposited as a result of slack water.

Silt—Fine textured soil particles including clay and sand as differentiated from coarse particles of sand and gravel.

Siltation—Deposition of (silt) waterborne sediments—fine textured sedimentation—terms used to describe the smoothing or cementing effect of a blanket of silt deposited over sand and gravel areas used by migratory fish for spawning (including colloidal material when the transporting water evaporates).

Standard Plans—The drawings of structures or devices commonly used on City work and referred to on the plans (see standard construction specifications).

Storm Drainage Report—An Engineering Report, prepared by the Developer or a designated agent, that is required by the City of Stayton. The report must provide a hydrologic evaluation of the pre-development and developed site conditions associated with the proposed improvements. The report must demonstrate how the proposed stormwater management and water quality facilities will comply with these standards. The report must be signed and stamped by a professional engineer registered in Oregon.

Streets or Roads—Any public highway, road, street, avenue, alley, way, easement, or right-of-way used or to be used for vehicle movement.

Structures—Those structures designated on the standard plans as catchbasins, manholes, etc. Detailed drawings of structures or devices commonly used in ‘ City work and mentioned in these Standards are included in the standard construction specifications.

Subdivision—means to divide an area or tract of land into four or more lots within a calendar year when such area or tract of land existed as a unit or contiguous units of land under a single ownership at the beginning of such year.

Terrace—A relatively level step constructed in the face of a grade surface for drainage, erosion control, and maintenance purposes.

Trunk Drainage System—The trunk drainage system is that portion of the drainage system of the City which receives waters from an adjacent land area in excess of 20 acres. The trunk drainage system may consist of watercourses or man-made facilities such. as pipes, ditches, and culverts.

Wetlands—Those lands adjacent to watercourses or isolated therefrom which may normally or periodically be inundated by the waters from the watercourse or the drainage waters from the drainage basin in which it is located. These include swamps, bogs, sinks, marshes, and lakes, all of which are considered to be part of the watercourse and drainage system of the City and shall include the headwater areas where the watercourse first surfaces. They may be, but are not necessarily, characterized by special soils such as peat, muck, and mud.

1.6 ENGINEERING POLICY

The engineering policy of the City of Stayton requires strict compliance with Oregon Revised Statute 672 for professional engineers.

All engineering plans, reports, or documents shall be prepared by a registered professional Civil Engineer, or by a subordinate employee under his/her direction, and shall be signed by the engineer and stamped with his/her seal to indicate his/her responsibility for them. It shall be the project engineer's responsibility to review any proposed storm drain system, extension, and/or existing system change with the City, prior to engineering or proposed design work, to determine any special requirements or whether the proposal is permissible. A "Preliminary Review" and/or a "Plans Approval for Construction" stamp of the City, on the plans, and etc., for any job, does not in any way relieve the project engineer of his/her responsibility to meet ail requirements of the City or obligation to protect the life, health, and property of the public. The Plan for any job shall be revised or supplemented at any time it is determined that the full requirements of the City have not been met.

1.7 APPROVAL OF ALTERNATE MATERIALS OR METHODS

Any alternate material or method not explicitly approved herein will be considered for approval on the basis of the objectives set forth in 1.00 PURPOSE. Persons seeking such approvals shall make application in writing. Approval of any major deviation from these Standards will (normally) be in written form. Approval of minor matters will be made in writing if requested.

Any alternate must meet or exceed the minimum requirements set in these Standards.

The written application is to include, but is not limited to, the manufacturer's specifications and testing results, design drawings, calculations, and other pertinent information.

Any deviations or special problems shall be reviewed on a case-by-case basis and approved by the City Engineer. When requested by the City, full design calculations shall be submitted for review with the request for approval.

1.8 GENERAL APPLICABILITY

Permanent drainage facilities shall be provided on all property improvements within the City of Stayton per these Standards for the following types of development:

a. All major or minor partitions and subdivisions.

b. All commercial, industrial, single-family, and multifamily developments creating new impervious surfaces of greater than one thousand square feet in area within any twelve-month period. Individual single family residences maybe reviewed by the City Engineer on a case by case basis. These standards are intended to fulfill the requirements of Section 1406, “Special Storm Sewers,” of the Uniform Plumbing Code for private storm drains.

c. Developments entailing construction which would change the point of discharge of surface waters, the quantity of discharge, or discharge surface waters at a higher velocity than that of the preconstruction discharge rate, or add to pollution of surface waters.

d. Construction or reconstruction of public roadways and temporary detours.

e. Developments entailing construction in or adjacent to any existing stream or surface watercourse including intermittent streams.

f. Developments requiring construction in or adjacent to the 100 year floodplain of any stream.

2.0 GENERAL DESIGN CONSIDERATIONS

Storm drainage design within a development area must include provisions to adequately control runoff and provide water quality treatment from all public and private streets and the roof, footing, and area drains of residential, multifamily, commercial, or industrial buildings sufficient to meet the City's current TMDL requirements for compliance. The Design shall also include provisions to the drainage system in conformance with the adopted Stormwater Drainage Master Plan. These provisions are:

a. Surface or subsurface drainage, caused or affected by the changing of the natural grade of the existing ground or removal of natural ground cover or placement of impervious surfaces, shall not be allowed to flow over adjacent public or private property in a volume or location materially different from that which existed before development occurred, but shall be collected and conveyed in an approved manner to an approved point of discharge.

b. Surface water entering the subject property shall be received at the naturally occurring locations and surface water exiting the subject property shall be discharged at the natural locations with adequate energy dissipaters within the subject property to minimize downstream damage and with no diversion at any of these points.

c. The approved point of discharge for all stormwater may be a storm drain, existing open channel, creek, detention, or retention pond approved by the City Engineer. Acceptance of suggested systems will depend upon the prevailing site conditions, capacity of existing downstream facilities, and feasibility of the alternate design.

d. When private property must be crossed in order to reach an approved point of discharge, it shall be the developer's responsibility to acquire a recorded drainage easement (of dimensions in accordance with those included in Section 4.1.4 from the private property owner meeting the approval of the City Engineer. The drainage facility installed must be a closed conduit system. Temporary drainage ditch facilities, when approved, must be engineered to contain the stormwater without causing erosion or other adverse effects to the private property.

e. The design storm peak discharge from the subject property may not be increased from conditions existing prior to the proposed development.

f. Water Quality: All runoff from impervious areas and developed areas shall be treated for water quality and pollution reduction. The developer and project engineer are encouraged to incorporate "green" or low impact, environmentally friendly controls similar to those included in Appendix C in their designs.

g. The developer shall include sufficient flow control facilities (i.e. detention ponds, lakes, retention areas, infiltration devices, etc.) in the project design to ensure that the releases from the developed condition does not exceed the natural occurring releases from the pre-developed condition. It will be the responsibility of the developer/project engineer to provide hydrologic and design calculations for both the pre-developed and developed conditions (in accordance with Appendix B) and to demonstrate compliance for the 2, 5, 10, 25, 50 and 100 year storm events. Flow control facilities shall be designed in accordance with Appendix C.

h. Minimum width of an access easement from an existing public road to a drainage facility shall be fifteen (15) feet.

i. Temporary and permanent erosion control measures shall be provided in accordance with Section 6.0 of these standards.

g. Stormwater quality facilities shall be provided as required in Section 5.0.

h. A Drainage Report and Drainage Plans shall be submitted in accordance with the guidelines presented in Appendix A.

2.1 DESIGN CRITERIA

2.1.1 Design Storm Recurrence

The intensity-duration design frequency is based on the type area through which the facility (pipe or ditch) passes and the size of the drainage facility. The adopted criteria are listed in Table 2-1.

TABLE 2-1.
DESIGN STORM RECURRENCE

Area	Conveyance: Peak Flow/Recurrence
Residential Areas	25-year storm
Commercial and High Value Districts	25-year storm
Trunk Lines (24” pipe and larger)	25-year storm
Minor Creeks and Drainage Ways (not shown as a flood plain on the Flood Insurance Rate Map (FIRM) (Culverts and Channels)	50-year storm
Major Creeks (shown as a flood plain on the FIRM) (Culverts, Bridges, etc)	100-year storm

2.1.2 Water Quality

All runoff from impervious areas and developed areas shall be treated for water quality and pollution reduction. Facilities shall be sized to treat flow from the Water Quality Storm, calculated from the total precipitation of 0.36 inches falling in 4 hours with a storm return period of 96 hours, as shown in Appendix B.

2.1.3 Flow Control Releases

Stormwater quantity on-site detention facilities shall be designed to capture runoff so the post-development runoff rates from the site do not exceed the pre-development runoff rates from the site, based on a 2 through 25-year, 24-hour return storm. Specifically, the 2, 10, and 25-year post development runoff rates will not exceed their respective 2, 10, and 25-year pre-development runoff rates from each discharge location. Facilities shall be designed with an emergency spillway sized to pass the 50 and 100-year storm event or an approved hydraulic equivalent.

2.2 SUBMITTAL REQUIREMENTS

2.2.1 Storm Drainage Report

A Storm Drainage Report must be submitted in accordance with Appendix A: Storm Drainage Report and Construction Plan Requirements.

Calculations

Design calculations shall be submitted for all drainage facilities and provided in a Drainage Report as outline in Appendix B.

2.2.2 Storm Drainage Construction Plans

Storm Drainage Construction Plans must be submitted in accordance with Appendix A: Storm Drainage Report and Construction Plan Requirements.

2.2.3 Plan Submittal

Construction plans shall be submitted in duplicate to Public Works/Engineering through the Permit Application Center (PAC) for checking to ensure compliance with these Standards, City of Stayton Ordinances, and good engineering practice. Submitted plans shall include specifications, test data, a materials list, drainage calculations, a soils report and design recommendations, easement and right-of-way descriptions, tie to City of Stayton Bench Mark and Monument System, and other material as requested by the City Engineer. A plan check fee will be levied at the time plans are submitted to PAC.

Once the plans are approved and the construction permit issued, the consulting engineer shall be responsible for providing all surveying services necessary to stake the project and prepare the as-built drawings when the project is complete.

3.0 COLLECTION

The following section contains the physical design requirements for the stormwater collection for public storm drains in the city. These design requirements may be used for private systems when plumbing code requirements cannot be met, provided the system is designed by a professional civil engineer.

3.1 SURFACE

In general, storm drains shall be designed to have access for cleaning no further than 400 feet apart with junctions made at manholes, cleanouts, or catchbasins.

3.1.1 Roof Drains

(It is recommended that Keller & Associates provides the requirement for Roof Drains)

3.1.2 Curb and Gutter

Types and Application, see Standards Plan No. 303

In general, curb and gutter shall be installed on all new street construction or reconstruction to control drainage from sheet flowing across the street, to preserve curb exposure during subsequent overlays, and to eliminate cracking new curbs during the street paving operation.

a. Type “A” curb and gutter shall be utilized for all street with slope less than 0.5 ft. per 100 feet.

   The minimum gutter grade permitted shall be 0.25 feet per 100 feet (0.25 percent grade).

b. Rolled Curb may be used in urban developments on private streets only.

c. Type “C” curb may be used with slopes down to a minimum 0.50 feet per 100 feet (.50% grade).

3.1.3 Catchbasin and Connector Pipes

This portion of drainage system is comprised of the curbed gutters of streets, the catchbasin inlets that collect the surface runoff, and ten-inch diameter connector and/or outlet pipes.

The inlet systems are to be designed in accordance with the following criteria:

(a) ODOT Hydraulics Manual.

(b) Hydraulic Engineering Circular No. 22 (FHWA-TS-84-202) Drainage of Highway Pavements.

Cleanouts and Catchbasin Design Requirements

a. Catchbasins and cleanouts may be used for the junction of pipes fifteen (15) inches-or less in diameter, and where the depth from rim to invert is less than four (4.0) feet. Pipe lines eighteen (18) inches in diameter may be connected to the larger dimension of the structure (catchbasin/cleanout) when the structure is formed and poured around the pipe during new construction.

   Variance from the four (4) foot maximum depth will be reviewed on a case by case basis for approval on fifteen (15) and eighteen (18) inch diameter pipes.

b. The maximum length of curb and gutter which may be drained by a catchbasin is five hundred (500) feet. Catchbasins shall be installed where the improvement ends on all streets terminating on a descending grade, and piped to an approved point of discharge.

c. On new main line and lateral construction, catchbasin laterals of thirty (30) feet or less and ten (10) inches in diameter may tie into the main line with a shop fabricated 90^{o} ‘T’, provided said connection is located not more than one hundred (100) feet from a manhole or cleanout on said main line being fifteen (15) inches or larger in diameter.

d. The width of gutter flow on residential street shall not go past the shoulder and one travel lane or top the curb for a twenty (25) year design storm at any point along the street.

e. Catchbasins shall be designed to completely intercept the twenty five (25) year design storm gutter flow.

f. Type 1 catchbasins, Standard Drawings No. 203, shall be used at all locations where other construction (e.g., driveways, pedestrian ramps, etc.) or facilities do not prohibit. Exceptions will be considered on a case-by-case basis.

g. Type “A” grates shall be used in street sags; Type “B” grates shall be used on construction grades.

3.1.4 Manholes

a. Manholes shall be installed at all pipe junctions where the depth from rim to invert exceeds four (4) feet or where the pipe is eighteen (18) inches in diameter or greater except as provided for in Section 3.1.3 (a). Exceptions will be reviewed on a case by case basis for approval.

b. Manholes for pipes twenty-four (24) inches or greater in diameter shall conform to Standard Plan No. 104.

c. Where the pipe size decreases upstream through the manhole, the upstream invert must be set above the downstream invert a distance equal to the difference in the two diameters (the crowns kept at the same elevation).

3.1.5 Slope Intercept Drainage

Slope intercept drains shall be provided at the following locations and shall be designed with the requirements of Section 6.0 of these Standards with respect to erosion control:

a. along the upper boundaries of a development where the natural ground slope exceeds ten (10) percent to intercept drainage from the tributary area above the site.

b. along the lower boundary of a development where the natural ground slope exceeds ten (10) percent to prevent drainage onto a lower tributary area other than by means of an approved point of discharge.

c. along the top of all cuts which exceed four (4) feet with cut slopes which exceed 2:l where the tributary drainage area above the cut slopes towards the hinge point of the cut and has a drainage path greater than forty (40) feet measured horizontally.

3.2 SUBSURFACE DRAINAGE

Subsurface drains (underdrains) shall be provided at the following locations:

a. on all cut and fill slopes in excess of four (4) feet for stability except when a soils report submitted by a registered professional engineer experienced in soils certifies they are not required.

b. for all existing springs or springs intercepted during construction activity for other facilities, i.e., sewer, water mains, or street excavations.

c. where high ground water exists or when it is necessary to reduce the piezometric surface to an acceptable level to prevent land slippage or underfloor flooding of buildings.

The drainage line installed shall begin at a cleanout and terminate at an approved point of discharge. Open jointed storm drain lines will not be considered as an acceptable solution.

4.0 CONVEYANCE

The following section contains the physical design requirements for the stormwater conveyance for public storm drains in the city. These design requirements may be used for private systems when plumbing code requirements cannot be met, provided the system is designed by a professional civil engineer.

4.1 PIPED SYSTEMS

4.1.1 Laterals

This portion of the drainage system begins with a 12 inch or larger diameter pipe at the discharge point of the "CATCHBASIN, GUTTERS, AND CONNECTOR PIPE SYSTEM." This portion of the system is designed to convey the twenty-five year frequency flow of the entire contributing area in its fully developed land use condition. This system terminates at the subsequent downstream point at which it is no longer capable of conveying the flow in an unsurcharged state in an 18 inch diameter pipe, at which point the system becomes a "TRUNKLINE."

4.1.2 Trunk Lines

This portion of the drainage system can be a pipe or an open channel. The trunk line system begins with an equivalent 21 inch diameter or larger pipe at the discharge point of the "LATERAL SYSTEM." The trunk system is designed to convey the twenty-five year frequency storm flow of the entire contributing area in its fully developed land use condition. This assumes on site and/or regional detention is incorporated in the design. This system terminates at the subsequent downstream point at which it is no longer capable of conveying the flow in an unchanged state in a pipe diameter less than 36 inches.

4.1.3 Culvert Design

Culverts provide for passage of water under or through obstructions placed across streams and drainageways. Culverts shall be designed to pass the required flows without compromising public safety or causing new or additional flooding. For pipe systems or culverts that convey flows from or through sensitive areas, a local representative of Oregon Department of Fish and Wildlife (ODFW) or other applicable state or federal agency should be contacted to determine if fish passage is required and to identify site specific design criteria. Additionally, ODFW may require fish passage accommodations on any stream that has a history or the potential for fish production.

4.1.4 Design Criteria

Pipe Materials

Pipe materials for public storm drains shall be concrete pipe, ductile iron pipe, aluminum pipe, or polyvinyl chloride pipe conforming to Section 305.2 of the Standard Construction Specifications of the City of Stayton.

Acceptable abbreviations for existing and proposed types of pipe are as follows:

ABS—Acrylonitrile Butadiene Styrene

AC—Asbestos Cement

CI—Cast Iron

Dl—Ductile Iron

PVC—Polyvinyl Chloride

CP—Concrete Pipe

CSP—Corrugated Steel Pipe

CAP—Corrugated Aluminum Pipe

Aluminum pipe may be used where water or soil pH is in the range of 4.5 to 10 and where the soil resistivity is greater than 1500 ohm-cm.

Private storm drain pipe materials shall conform to Section 1403 of the Uniform Plumbing Code.

Pipe load analysis calculations must be submitted when requested by the City Engineer. Instances for such a request will include shallow cover (less than the minimum specified below), excessive cover and for the most economical pipe class.

As a minimum, except when a pipe load analysis dictates otherwise, nonreinforced precast concrete pipe which is eighteen (18) inches or less in diameter shall be at least Class II (ASTM C-14) with rubber ring bell and spigot joints. Concrete pipe lines twenty-one (21) inches or greater in diameter which are laid transversed to traffic in the street section and which are subject to wheel loads shall be reinforced concrete rubber ringed Class III C-76.

Approval of alternate materials will be reviewed on a case-by-case basis for approval which shall include cast in-place pipe methods.

Pipe Size

Main line and lateral storm drains shall not be less than twelve (12) inches diameter and shall begin at a structure and shall terminate at an approved point of discharge.

Proposed exceptions to the above will be reviewed and considered for approval on a case-by-case basis by the City Engineer.

When two (2) parallel pipes are installed in lieu of a box culvert, the minimum separation between the pipes shall be one (1) foot or one-third the diameter, whichever is greater. This requirement may be waived if the void between the pipes below the spring line is filled by grouting or other approved method/substance.

Minimum Grade

All storm drains shall be laid on a grade which will produce a mean velocity (when flowing full) of at least two and one-half (2-1/2) feet per second, based upon Manning’s pipe friction formula using a roughness coefficient valued at not less than 0.013, or the pipe manufacturer’s recommendations, whichever is greater. The minimum acceptable grade for various pipe sizes with an “n” value of 0.013 are listed below:

TABLE 2-5.
MINIMUM PIPE GRADE

Inside Pipe Diameter (inches)	2.5 ft/sec Grade (feet per 100 feet)	2.0 ft/sec Grade (feet per 100 feet)
4	1.31	0.84
6	0.77	0.49
8	0.52	0.33

10	0.39	0.25
12	0.3	0.19
15	0.23	0.14
18	0.18	0.11
21	0.14	0.09
24	0.12	0.08
27	0.1	0.07
30 (or larger)	0.09	0.06

The minimum grade may be reduced from the above table to produce an absolute minimum velocity of 2.0 fps upon approval of the City Engineer. Cases requiring a flatter grade than permitted above shall also be reviewed on a case-by-case basis for approval by the City Engineer.

In theory, new PVC pipe has a manufacturer's "n" value of 0.009; however, sand and grit as well as slime build-up on the pipe walls render a true "n" value with time of 0.013; hence, an "n" value of less than 0.013 will not be considered for approval.

The use of corrugated aluminum pipe will require approximately one larger pipe size for any given flow, due to a Manning "n" value of 0.24 +/- depending upon corrugation patterns, use of coatings, etc. All use of corrugated aluminum pipe shall be supported by size calculations in accordance with the manufacturer's recommendations.

Alignment

Generally, storm drains shall be laid on a straight alignment between catch basins and between manholes; however, lines 12 inch diameter and smaller may be laid on horizontal curves conforming to the street curvature, but not less than a radius of 200 feet. PVC and aluminum pipe shall be laid on straight alignment only.

Variance for horizontal curves on larger size pipes shall be reviewed on a case by case basis for approval by the City Engineer.

Anchor Walls

Storm drains laid on slopes of twenty (20) percent or greater shall be secured by anchor walls in accordance with Standard Plan No. 113.

Where velocities greater than fifteen (15) per second are attained, special provision shall be made to protect structures against erosion and displacement by shock.

If either of these conditions occur the installation must be approved by the City Engineer.

Cover Requirements

All storm drains shall be laid at a depth sufficient to protect against damage by traffic and to drain building footings where practical. Sufficient depth shall mean the minimum cover from the top of the pipe to finish grade at the storm drain alignment.

Under normal conditions minimum cover shall be twenty-four (24) inches above the top of the pipe in paved areas and thirty (30) inches at all other locations. For PVC pipe, minimum cover shall be thirty-six (36) inches.

In areas of relatively flat terrain, the design engineer must show that sufficient depth is provided at the boundary of the development to properly drain the remainder of the upstream basin area tributary to the site.

Location

Where storm drains are being designed for installation parallel to other utility pipe or conduit lines, the vertical location shall be in such a manner that will permit future side connections of main or lateral storm drains and avoid conflicts with parallel utilities without abrupt changes in vertical grade of main or lateral storm drains.

Storm Drains in Streets or Easements

a. Under normal conditions, storm drains shall be located in the street right-of-way within two (2) feet of the curbline and preferably on the low side of the street, except when catch basin location warrants otherwise. All exceptions shall be reviewed on a case-by-case basis for approval.

b. When it is necessary to locate storm drains in easements, the storm drain shall be centered in the easement. Exception: When the storm drain is 12 inches in diameter and the easement is centered on a property line, the storm drain shall be offset eighteen (18) inches from property line (distances being measured property line to center line of pipe). All storm drain easements shall be exclusive and shall not be used for any purpose which would interfere with the unrestricted use of the storm drain line. Exception to this requirement will be reviewed on a case by case basis, such as a utility corridor in a new subdivision.

c. Easements for storm drain lines fifteen (15) inches or less in diameter shall have a minimum width of ten (10) feet. Pipe line eighteen (18) to thirty-six (36) inches in diameter shall have a minimum width of fifteen (15) feet. All pipe lines greater than thirty-six (36) inches in diameter, shall have a minimum width of twenty (20) feet.

d. Open channels shall have easements sufficient in width to convey the 100-year Floodplain Line when a 100-year design storm is required or fifteen (15) feet from the waterway centerline or ten (10) feet from the top of the recognized bank, whichever is greater. A fifteen (15) foot wide access easement shall be provided on both sides of the channel for channel widths greater than fourteen (14) feet at the top of the recognized bank.

e. Easement locations for public storm drains serving a PUD, apartment complex, or commercial/industrial development shall be in parking lots, private drives, or similar open areas which will permit an unobstructed vehicle access for maintenance by City forces.

f. All easements must be furnished to the City for review and approval prior to recording.

Relation to Creeks and Drainage Channels

Storm drain lines shall enter a creek or drainage channel at 90^{o} or less to the direction of flow. The outlet shall have a head wall and scour pad or riprap to prevent erosion of the existing bank or channel bottom. The size of pipe or channel being entered will govern which protective measures are required. All protective measures must conform to the requirements of Section 6.0 of these Standards with respect to erosion control.

4.2 SURFACE DRAINAGE

4.2.1 Channel Protection

Open channels shall be designed to prevent scouring of the channel. Where rip rap protection is specified, rip rap protection shall be placed over a filter fabric base or a minimum 6” thick gravel base. The following provides additional design guidance in assisting the design Engineer, however, the design Engineer shall be responsible for the final design.

PROTECTION FOR NEW CHANNEL CONSTRUCTION

Velocity at Design Flow (fps)				
Greater than	Less than or equal to	Required Protection	Thickness	Minimum Height above Design Water Surface
0	3	Vegetation Lining	N/A	0.5 ft
3	5	Vegetation Lining and Check Dams	N/A	0.5 ft
5	8	Bioengineered lining* or	N/A	1 ft
		ODOT Class 50** Riprap	1.5 ft	
8	12	ODOT Class 200** Riprap	2.5 ft	2 ft
12	20	Slope Mattress, etc.***	varies	2 ft

* Bioengineered lining allowed for greater than 5 fps.

** ODOT Riprap Class in English Units

*** For high velocity channels, engineering calculations are to be submitted to the City for review

4.2.2 Outfall Protection

Outfalls will be designed to prevent scouring at the outfall discharge and provide velocity reduction prior to discharge to the receiving channel. Where rip rap protection is specified, rip rap protection shall be placed over a filter fabric base or a minimum 6” thick gravel base. The following provides additional design guidance in assisting the design Engineer, however, the design Engineer shall be responsible for the final design.

ROCK PROTECTION AT OUTFALLS					
	Required Protection Minimum Dimensions				
Velocity at Design Flow (fps)	Type	Thickness	Width	Length	Height
0 to 5	ODOT Class 50** Riprap	1.5 ft	Dia. + 6 ft	8 ft or 4x dia, whichever is great	crown + 1 ft
5 to 10	ODOT Class 200** Riprap	2.5 ft	Dia. + 6 ft or 3 x dia, whichever is greater	12 ft or 4x dia, whichever is great	crown + 1 ft
10 to 20	Designed System*	As required	As required	As required	crown + 1 ft
Greater than 20	Energy Dissipater Required				

* For high velocity outfalls, engineering calculation are to be submitted to the City for review.

** ODOT Riprap Class in English Units

*** For high velocity channels, engineering calculations are to be submitted to the City for review

4.2.3 Creeks or Drainage Ways Not Shown with a Floodplain on the Federal Insurance Rate Maps (FIRM) as Published by the Federal Emergency Management Agency (FEMA)

This portion of the drainage system can be a covered facility (pipe, etc.) or an open channel. This portion of the drainage system begins with an equivalent 36 inch diameter or larger pipe at the discharge point of the “trunk system.” This system is designed to convey the 25 year frequency storm flow of the entire contributing area in its fully developed state. This system terminates at the subsequent downstream point of discharge at which the system is clearly a creek whose floodplain is first designated on the FIRM or is determined to be an interim flood hazard area by the City Engineer.

4.2.4 Waterways with Floodplains Shown on the FIRM

These reaches of the drainage system are located on the FIRM, or as otherwise located by the City Engineer, and are always designed for the 100 year frequency storm flow of the entire contributing area in its fully developed land use condition.

4.2.5 Artificial Water Source Requirements

a. Artificial watercourses shall be designed with a “natural” curved alignment with a variable side slope not to exceed four to one, except that in tight spots created by existing natural features (e.g., boulders, large trees, etc.) where the slope can be three to one until the natural feature is bypassed or where steeper slopes are needed and do not impair the hydraulic efficiency of the waterway. The watercourse shall include a low flow channel as described in “e.” below and will be reviewed on a case-by-case basis for approval.

   The bank shall be designed with one (1) foot of free board above the design storm with a minimum top of bank width of six (6) feet. A larger width shall be provided when required by the City Engineer for maintenance purposes. The backslope of the bank shall not exceed two (2) horizontal to one (1) vertical. The existing ground adjacent to the toe of the bank backslope shall be graded to slope away at 2 percent to prevent water ponding at the backslope toe.

b. Design shall be curvilinear with a 100 foot minimum radius. Tighter curves may be used if the City Engineer determines that sufficient erosion control has been incorporated into the design lo maintain stable conditions following development.

c. A low flow channel shall be designed to carry a two year design storm or the normal low water flow of a year-round creek, whichever is greater. Low flow channel slopes shall not exceed two to one and shall be stabilized to the satisfaction of the City Engineer. In general, bank stabilization will be required in any channel with a design flow velocity in excess of three feet per second. The invert shall be paved with concrete if the velocity is less than three (3) feet per second and to prevent local ponding for mosquito abatement purposes.

d. New roadside ditch construction adjacent to public streets by new developments will not be permitted. Exception to this requirement will be reviewed on a case-by-case basis.

e. Capacity of channels shall be determined by the Manning Formula. The value for “n” shall be 0.033 for maintained grass-lines “swales. The value for “n” shall be 0.35 for channels with rock-lined bottoms.

f. Existing ditches approved for the point of discharge for storm drains and culverts shall be provided with rock-lined bottoms and side slopes at the discharge point of storm drain or culvert as specified in Section 4.2.2. These requirements are in addition to those required by Section 4.1.4 “Relation to Creeks and Drainage Channels.”

g. All channel sides and bottoms shall be seeded, sodded, or rock-lined immediately following construction. Bank stabilization measures shall be consistent with the erosion control requirements in Section 6.0 of these Standards unless the City Engineer determines other proposed methods provide equal or greater erosion control.

h. Points of discharge from culverts and storm drains into ditches and swales 15 percent or greater in grade shall be rock-lined with boulders with one face a minimum of 24” in dimension. Said rock lining shall extend for a distance of ten feet minimum from the point of culvert or storm drain discharge and shall have a width three feet in excess of the diameter of the culvert or storm drain. Special energy dissipaters may be substituted for boulders at the discretion of the City Engineer.

4.2.6 Natural Creeks

a. Creek Classification—Creeks in Stayton shall be classified as salmon-producing creeks or other creeks. No in-stream work will be allowed in salmon producing creeks during the months of September or October. The intent is to minimize sediment production in these creeks during critical salmon spawning season. The following creeks shall be included in the salmon-producing classification:

- Mill Creek
- Salem Ditch

A permit must be obtained from the Division of State Lands and the Department of Fish and Wildlife for all work between the creek banks.

4.2.7 Salmon-Producing Creek Requirements

The following requirements must be met in salmon-producing creeks. These are not in replacement of the requirements in 2.24 for natural creeks, but in addition to them.

a. Creek bed alterations shall provide diversified habitats for a variety of creek organisms and a pleasing appearance. Creek bed alternations may be approved by the City Engineer on a case-by-case basis with approval to consider provision of:

   1) Sufficient water depth to support fish and other aquatic life during low flows.

   2) Diversity of water velocities through the use of pools and riffles.

   3) A meandering channel to facilitate a. and b. above.

   4) Sufficient creek bed gradient to provide adequate flow velocities.

b. Creek bed gravel shall be well rounded rock in the following gradations (with larger rock in sufficient quantity to provide adequate riffling) or as approved by the City Engineer:

   Mill Creek Approx. 15% 6”-3”

c. Creek banks and sides shall be designed and constructed so as to provide stability, adequate shading, and cover for fish and other aquatic life, to the approval of the City Engineer. Shading shall be provided by plantings of appropriate types and sufficient quantities per Section 6.0 of these Standards. Creek bank designs and vegetation restoration plans may be approved by the City Engineer on a case-by-case basis.

   Vertical creek banks (walls) should be avoided whenever possible as such a creek channel configuration decreases the creek carrying capacity and increases in-creek velocities during high flows.

d. All creek work and channel design shall include a construction sequence list designed primarily to control erosion (per Section 6.0 of these Standards) and also to facilitate the planned construction. The construction sequence may be modified by the City Engineer during the construction as field conditions warrant. Such modifications may include more or less erosion control and construction shut down.

e. Vegetation disturbance shall be minimized, creek banks shall be revegetated with appropriate native vegetation to provide shading for the creek.

4.2.8 Other Natural Creek Requirements

a. Natural creeks shall be preserved and all work in and adjacent to creeks shall incorporate both temporary and permanent erosion control measures in accordance with Section 6.0 of these Standards. No alteration will be permitted that reduces the overall creek capacity.

c. Creek construction, relocation, and/or reconstruction may be approved if the City Engineer determines that such a proposal will result in an overall benefit to or maintenance of a surface water system of equal quality in terms of water quantity and quality control.

d. Any and all stream work shall be consistent with the floodplain management policies and regulations.

e. Any and all stream work shall be consistent with the City’s Stormwater Management Plan.

5.0 STORMWATER QUALITY AND QUANTITY FACILITIES

City of Stayton Code ?? requires stormwater facilities for development creating new impervious surfaces of greater than one thousand square feet in area within any twelve-month period. These stormwater facility standards are intended to provide guidance toward flow control and reduction in stormwater pollutants. The guidelines are not intended to be a comprehensive list of all stormwater facilities, but provides a general overview of those commonly used.

Stormwater facilities are installed to reduce flow and pollutants from a site prior to entering the cities storm drainage system or natural drainage course.

In selecting the appropriate stormwater facility for a site the designer must consider the site characteristics, anticipated land uses, runoff characteristics, and treatment objectives.

Stormwater facilities shall also be construction in accordance with the following requirement and Appendix C: Water Quality and Quantity Facility Design. Numerous resources are available which provide additional detail and design requirement for stormwater facilities, including City of Portland Stormwater Management Manual, Clean Water Services Design and Construction Standards for Sanitary Sewer and Surface Water Management, the King County Surface Water Design Manual, and the Washington Department of Ecology's (DOE) Stormwater Management Manual for Western Washington.

5.1 WATER QUALITY FACILITIES

Owners of new development and other activities which create new impervious surfaces or increase the amount of stormwater runoff or pollution leaving the site are required to construct or fund permanent water quality facilities to reduce contaminants entering the storm and surface water system.

5.1.1 Criteria for Requiring Construction of a Water Quality Facility

a. A water quality facility shall be constructed on-site unless, in the judgment of the City, any of the following conditions exist:

    1) The site topography or soils makes it impractical, or ineffective to construct an on-site facility;

    2) The site is small, and the loss of area for the on-site facility would preclude the effective development.

    3) There is a more efficient and effective regional site within the subbasin that was designed to incorporate the development or is in the near vicinity with the capacity to treat the site.

    4) The development is for the construction of one or two family (duplex) dwellings on an existing lot of record.

b. If construction of an on-site facility is not required, the owner of the development shall pay a System Development Charge in accordance with City Rules and Regulations. The System Development Charge shall be calculated on an equivalent basis of constructing the minimum Standard Water Quality Swale.

5.1.2 Water Quality Facility Design Standards

a. The stormwater quality facilities shall be designed to remove 80 percent of the total suspended solids from the runoff from 100 percent of the newly constructed impervious surfaces.

b. The total suspended solids removal efficiency specifies only the design requirements and is not intended as a basis for performance evaluation or compliance determination of the stormwater quality control facility installed or constructed pursuant to this document.

c. If an onsite water quality facility cannot be constructed to treat the runoff from the development's impervious surface, then with City approval, an on- or off-site water quality facility may be designed to treat runoff from an equivalent area of adjacent untreated impervious surfaces.

d. Facilities shall be designed such that flow from the development is treated off-line from the storm conveyance system and reconnected to upstream flows following treatment. If an off-line facility is not feasible, additional capacity may be required for upstream flow.

e. Discharges to sensitive areas shall maintain the hydroperiod and flows of pre-development site conditions to the extent necessary to protect the characteristic functions of the sensitive area.

f. The stormwater quality facilities shall be designed for a dry weather storm event totaling 0.36 inches of precipitation falling in 4 hours with an average storm return period of 96 hours.

g. Water quality facilities shall be constructed as part of the subdivision public improvements.

h. Other design options for meeting this section may be considered by the City for approval.

i. All water quality facilities shall be designed in accordance with Appendix C: Water Quality and Quantity Facility Design.

5.1.3 Impervious Area Used In Design

a. For single family and duplex residential subdivisions, stormwater quality facilities shall be sized for all impervious area created by the subdivision and for all existing impervious area proposed to remain on site.

b. For all developments other than single family and duplex, including rowhouses and condominiums, the sizing of stormwater quality facilities shall be based on the impervious area created by the development and for all existing impervious area proposed to remain on site, including structures and all roads and impervious areas. Impervious surfaces shall be determined based upon building permits, construction plans, or other appropriate methods of measurement deemed reliable by City.

c. The City encourages design initiatives that reduce effective impervious area. In developments other than single family and duplex, a decrease in the size of the water quality facility may be possible.

5.2 WATER QUANTITY/FLOW CONTROL FACILITIES

Each new development including, but not limited to new subdivisions, all commercial and industrial development and all parking lots with a total developed area of 1000 square feet or more and all other developments where the City engineer determines control is needed to prevent flooding or damage downstream. must incorporate techniques for mitigating its impacts on the public stormwater system. The City shall determine which of the following techniques may be used to satisfy this mitigation requirement.

a. Construction of permanent on-site stormwater quantity detention facilities designed in accordance with Appendix C: Water Quality & Quantity Facility Design; or

b. Enlargement or improvement of the downstream conveyance system in accordance with Appendix C: Water Quality & Quantity Facility Design; or

c. Payment of a Storm and Surface Water Management System Development Charge (SWM SDC), as provided in City Code ???, which includes a water quantity component to meet these requirements.

5.2.1 Criteria for Requiring On-Site Detention

a. If the on-site facility is required to be constructed, the development shall be eligible for a credit against SWM SDC fees, as provided in City Code ???.

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

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

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

   3) There is a site within the boundary of the development, which would qualify as a regional detention site under criteria or capital plan adopted by the City.

   4) Water quantity facilities as required by City adopted watershed management plans or adopted subbasin master plans.

5.2.2 Water Quantity Facility Design Criteria

a. All water quantity facilities shall be designed in accordance with City guidance documents and be consistent with Appendix C: Water Quality and Quantity Facility Design.

b. When required, stormwater quantity on-site detention facilities shall be designed to capture runoff so the post-development runoff rates from the site do not exceed the pre-development runoff rates from the site, based on a 2 through 25-year, 24-hour return storm. Specifically, the 2, 10, and 25-year post development runoff rates will not exceed their respective 2, 10, and 25-year pre-development runoff rates; unless other criteria are identified in an adopted watershed management plan or subbasin master plan.

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

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

e. Channel Protection shall be provide as required in Section 4.2.1.

f. A downstream analysis shall be preformed as described in Section 5.2.4.

5.2.3 Water Quantity Facility Design Standards

All water quantity facilities shall be designed in accordance with Appendix C: Water Quality and Quantity Facility Design.

5.2.4 Downstream System Analysis

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

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

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

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

6.0 EROSION AND SEDIMENT CONTROL

The applicability of this section shall be for all construction projects and earth disturbance projects with ground disturbance greater than one thousand (1000) square feet in area within any twelve-month period.

Prior to approval of construction an Erosion/Sedimentation Control Plan shall be developed in accordance with the following criteria and the Oregon DEQ guidelines set forth in the *Erosion and Sediment Control Manual*

a. Proposed measures for controlling runoff during all three phases of construction:

   1) Prior to excavation or construction.

   2) During excavation and construction.

   3) After construction until the site is stabilized.

b. For subdivision plats this shall include temporary erosion control measures to be utilized by the applicant during installation of plant improvement and by subsequent builders during construction of dwellings and other lot improvements.

c. Prior to the initial clearing and grading of any land development, provisions shall be made for the interception of all potential silt-laden runoff that could result from said clearing and grading. Said interception shall preclude any silt-laden runoff from discharging from the proposed land development to downstream properties unless previously approved by the City Engineer. Said interception shall cause all silt-laden runoff to be conveyed by open ditch or other means to whatever temporary facility is necessary to remove silt prior to discharge to downstream properties.

d. Prior to initial clearing and grading of construction site, an evaluation of the following factors must be performed:

   1) Soil Erodibility—Soil erodibility should be identified using Soil Conservation Service erodibility ratings. Erosion control techniques shall be designed accordingly.

   2) Slope and Runoff—All cleared areas will require protection from erosion.

   3) Cover—Erosion protection will be required for all disturbed areas.

e. Temporary/permanent hydroseeding or acceptable seeding and mulching must be provided whenever perennial cover cannot be established on sites which will be exposed for 60 days or more.

f. Construction projects and earth disturbance projects with ground disturbance greater than one acre shall obtain a National Pollutant Discharge Elimination System Stormwater Construction General Permit No. 1200-C as required by the Oregon DEQ.

APPENDIX A

STORM DRAINAGE REPORT AND

CONSTRUCTION PLAN REQUIREMENTS

STORM DRAINAGE REPORT

a. The Drainage Report shall be on 8-1/2” x 11” paper and maps shall be folded to 8-1/2” x 11” size unless another format is approved prior to submittal.

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

1) Cover Sheet, including the project name, land use authority case file number, proponent’s name, address and telephone number, Design Engineer, and date of submittal.

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

3) Vicinity Map.

4) Project Description: Describe the type of permit(s) for which the proponent is applying, the size and location of the project site, address or parcel number and legal description of the property, property zoning. Also describe other permits required (e.g. Corps of Engineers 404 Fill Permit, DEQ Erosion Control Permits, etc). Describe the project, including proposed land use, proposed site improvements, proposed construction of impervious surfaces, proposed landscaping, and special circumstances.

5) Existing Conditions:

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

   - Project site topography;
   - Land cover and land use;
   - Abutting property land cover and land use;
   - Offsite drainage to the property;
   - Natural and constructed channels;
   - Sensitive areas, wetlands, creeks, ravines, gullies, steep slopes, springs and other environmentally sensitive areas on or adjacent to the project site.

   b) General soils conditions present within the project site, using SCS soil designations.

   c) Points of discharge for existing drainage from the project site.

   d) Include references to relevant reports such as basin plans, flood studies, groundwater studies, wetland designation, watershed plans, subbasin master plans, sensitive area designation, environmental impact statements, water quality reports, or other relevant documents. Where such reports impose additional conditions on the Proponent, those conditions shall be included in the report.

   e) Soils Report(s), where applicable.

   f) Hydrologic Analysis

g) Basin Map(s), showing boundaries of project, any offsite contributing drainage basins, onsite drainage basins, approximate locations of all major drainage structures within the basins, and depicting the course of stormwater originating from the subject property and extending all the way to the closest receiving body of water. Reference the source of the topographic base map (e.g. USGS), the scale of the map, and include a north arrow.

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

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

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

k) Downstream analysis, include a summary table comparing the pre-developed and developed hydraulic analysis for all discharge points.

l) Hydraulic Design Computations, supporting the design of all proposed stormwater conveyance, quantity and quality control facilities, and verifying the capacity of existing and proposed drainage facilities. These computations may include capacity and backwater analysis required either as part of the proposed drainage design or as part of the downstream drainage investigation, and flood routing computations required for the design of detention/retention storage facilities, for wetland impact analysis, or for floodplain analysis. A description on how the stormwater system will function during the water quality storm, 2-year storm, 25-year storm and the 100-year storm shall also be included.

m) Maintenance and Operation Manual: Required for privately owned and maintained stormwater quantity and quality control facilities. This manual will be an attachment to the maintenance covenant.

n) Appendices: Shall include technical information as necessary.

STORM DRAINAGE CONSTRUCTION PLANS

General

Complete plans and specifications for all proposed drainage improvements including any necessary dedications and easements shall be submitted for approval and must receive the required approval prior to construction permit issuance and beginning of construction.

Plan Preparation

Construction plans and specifications shall be prepared by a professional civil engineer licensed in the State of Oregon. It is the responsibility of the Design Engineer to ensure that engineering plans are sufficiently clear and concise to construct the project in proper sequence, using specified methods and materials, with sufficient dimensions to fulfill the intent of the design guidelines contained in this document.

a. Dimensions—Construction plans shall be clearly and legibly drawn on paper 22 by 34 inches with a 1-112 inch clear margin on the left edge and one inch margins on all other edges.

Plans from consultants for construction permit projects shall be blueline or photocopied drawings meeting the above size (24 by 36 inch blueline prints are acceptable.)

b. Scale—Horizontal scale shall be 1” = 50’; vertical scale shall be 1” = 5’ or as approved by the City Engineer.

c. Form—Title Sheet, Plan and Profiles, Storm Drain Appurtenances, and Site Drainage Plan.

The Drainage Plan shall contain the following:

Title Sheet

a. Plan view (Site Plan) of the entire project, showing street right-of-way and/or subdivision layout to a scale of 1” = 100’. A smaller scale may be used on large projects upon approval of the City Engineer. A project is too large when a minimum dimension of two (2) inches cannot be maintained between the title, system site plan, and vicinity map. A scale of 1” = 200’ may be used in this case. The site plan shall be a composite plan showing all complete properties to be served by the storm drain improvements and properties adjacent to and within 250 feet of those served, existing and proposed natural or artificial streams, swales, and storm drains, line sizes, designations, structures and their numbers, tract names and numbers, lot numbers or property owners’ names, street names, and total acreage including streets directly served.

b. Index of Sheets.

c. Complete legend of symbols used.

d. Vicinity Map to a scale of not less than 1” = 800’ showing the project location and drainage basin used to size the system.

e. Title Block—located in lower right hand comer or right edge of paper with scale, north point, date, drawing number, the Design Engineer’s name, address and official stamp, and where applicable, the owner/developer’s name and address.

f. Temporary and permanent bench marks including their descriptions.

g. General and special notes relating to construction methods. Note: For projects showing five (5) lots or less, the title sheet and plan and profile sheet may be one and the same if approved by the City Engineer.

Project Site

At least one sheet will contain a plan view of the entire project site. In the event the project site is sufficiently large that detailed drainage plans on any given sheet do not encompass the entire project site, then a sheet containing the plan view of the entire site must serve as an index to subsequent detailed plan sheets.

Existing Conditions

A topographical contour map clearly defining existing conditions:

a. Existing contours of the land at two (2) foot intervals or as approved by the City Engineer with the location of existing buildings, structures on the property. Location of any existing building or structure on adjacent property which is within fifteen (15) feet of a proposed public drainage facility;

b. Adjacent streets, including street names.

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

d. All areas, within 250 feet of the site, improved or unimproved, lying upstream and draining to or through the proposed development;

e. Location of existing drainage facilities which transport surface water onto, across, or from the site, including natural watercourses, artificial channels, drain pipes, or culverts.

f. Locations of springs or other subsurface water outlets;

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

h. Arrows indicating drainage direction in all public and private property and for all hydraulic conveyance systems.

Proposed Drainage Improvements Plan

A topographic contour plan clearly defining proposed conditions:

a. Proposed contours of the land after completion of the project at two (2)" foot intervals or as approved by the City Engineer. This shall include elevations, dimensions and location, extent, and slopes of all grading work proposed to be done.

b. Identify cut and fill areas, desilting facilities, interceptor ditches (channels), velocity check dams, soils, topography, vegetation, and areas of proposed reseeding.

c. Proposed structures including roads and road improvements, parking surfaces, building footprints, walkways, landscape areas, etc.

d. Proposed utilities, showing exact line and grade of all proposed utilities at crossings with the proposed drainage system.

e. Setbacks from environmentally sensitive areas.

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

g. Plan and profile of drainage conveyance facilities will include the following information: pipe sizes, pipe types and materials, lengths, slopes, type of structure (e.g. Type 2 CB), location of structures, invert elevations in/out of structures, and top elevations of structures. Notes shall be included referencing details, cross-sections, profiles, etc.

h. Indicate any proposed phasing of construction.

i. Boundaries of all areas that will be paved or otherwise altered in a manner that will increase surface water runoff and boundaries of all areas to remain in an existing or natural condition.

Stormwater Quality and Quantity Facility Plan(s)

A detailed grading plan will be provided for all open stormwater quantity control and/or quality control facilities. This plan shall include the following:

a. Existing ground contours (screened) and proposed ground contours at a minimum of a 2-foot contour interval. Slopes steeper that 6 horizontal to 1 vertical shall be identified.

b. Location of top and toe of slope.

c. Limits of embankment designed to impound water.

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

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

f. Maintenance access, as applicable.

Landscape Plan

A detailed landscape plan will be provided for open stormwater quantity control and/or quality control facilities. This plan shall include the Following:

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

b. Location of top and toe of slope.

c. Maximum water surface elevation.

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

e. Limits of areas to receive amended topsoil.

Cross Sections

Cross sections shall be provided for at least the following:

a. Detention/retention ponds (including parking lot ponds and other multi-use facilities), wet ponds and sediment ponds. This cross section(s) shall graphically illustrate:

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

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

(3) Pavement section or amended soil section as applicable.

b. Proposed ditches and swales, including vegetated swales.

Storm Drain System Plan and Profiles

Plan

Plan view of storm drain lines shall be to a scale of 1” = 50’ and shall contain the following information in addition to the above:

a. Adjacent street curbs and property lines, right-of-way and utility easements referenced to property comers, street intersections, or section lines. Adequate two (2) foot contour lines or property corner and curb elevations to help determine the points of disposal for building storm drains.

b. The location of each manhole and catchbasin shall be numbered and stationed to facilitate checking I the plans with the profiles. The stationing shall be tied to existing property corners and/or street monuments with the relationship of each manhole and catch basin shown to the property corners (minimum two directions). Each line with a separate designation shall be stationed continuously up grade from Station 0+00 at its point of connection to another line.

c. Location of water courses, railroad crossings, culverts, and sanitary sewers that cross the alignment within 250 feet of the proposed extension. All water course channels must show the 100 year flood plain and floodway channel for the design storm as specified by Sections 2.01 and 2.29 of these Standards.

d. Location of water mains, valves, pump stations, blow-offs, services, gas mains, underground power, and other utilities that either cross the alignment within 250 feet of the terminus of the proposed extension or are adjacent to the proposed extension within the public right-of-way or within ten (10) feet of the easement line. The intent is to prevent grade conflicts of all future extensions.

e. The location and elevation of the bench mark used as the basis of vertical control in the design shall be shown on the plans and referenced to property corners and/or street monuments.

Profiles

Profiles for the individual storm drain lines and open channels shall be to the same horizontal scale on the same sheet and drawn immediately below the corresponding plan view to a vertical scale of 1” = 5’ reading from 0+00 left to right (where conditions warrant, right to left may be approved as well as a smaller vertical scale), and shall contain at least the following information in addition to the above:

a. Location of catchbasins, manholes, and other appurtenances with each manhole and catchbasin numbered and stationed as in item 2 of Plan above.

b. Profile of the existing and proposed ground/or pavement surface, storm drain invert, and backwater curve for the design storm.

c. Size, slope, length, and type of material of the line between consecutive catchbasins or manholes (type of pipe may be designated by abbreviations listed under Section 2.13), type of pipe bedding and backfill material.

d. Elevation of original ground, finished grade, proposed rim elevation, and storm drain inverts at each catchbasin or manhole (Mean Sea Level Datum, U.S.G.S.).

e. Railroad crossings, ditch, or creek channels with elevations of the ditch or creek bed and the 100-year flood elevation profile. See Section 2.20 for additional plan requirements.

f. Utility crossings that conflict with the proposed storm drain installation.

g. All existing facilities upon which work is to be performed, i.e., installation, repair, or removal.

   SPECIAL NOTE: The Design Engineer shall field locate and verify the alignment, depth, and inverts of all existing facilities shown on the plans that will be crossed by proposed facilities and shall certify them with a note on the plans. City as-builts are only to be used as an aid to the Design Engineer when field verifying the exiting facilities.

Storm Drain Appurtenances

Detailed drawings shall be included for all storm drain appurtenances including manholes, catchbasins, culverts, head walls, orifice controls, detention diversion structures, etc. Appropriate references to City of Stayton Standard Drawings may be used in lieu of details actually shown on the plans.

Surface Drainage

a. Plan requirements for surface drainage courses shall include the requirements previously specified above and the following supporting data:

   1. Plan drawn to a scale of not less than 1” = 100’ with north arrow and vicinity map. Topography with two (2) foot contours. If in a floodplain shown on the F.I.R.M. show the 100-year floodway contour.

   2. Profile of the channel showing the existing flowline and top of bank, proposed flowline and top of bank and design stormwater surface profile (backwater curve).

   3. A minimum of three (3) cross sections of the existing channel adjoining or crossing the property taken at the upstream, midsection, and downstream boundaries of the property. More section may be required depending on the length of the reach and existing channel alignment.

APPENDIX B

HYDROLOGY CALCULATION REQUIREMENTS

1.0 HYDROLOGIC ANALYSIS

This section presents acceptable methodology for estimating the quantity and characteristics of surface water runoff, as well as the assumptions and data required as input to the methods. These methods should be used to analyze existing and design proposed drainage systems and related facilities.

1.1 Rational Method

The rational method for analyzing small drainage basins is allowed with the following limitations:

a. Only for use in predicting a conservative peak flow rate to be used in determining the required capacity for conveyance elements.

b. Drainage subbasin area cannot exceed 25 acres for a single calculation without approval from the City.

c. The time of concentration shall be five minutes when computed to be less than five minutes.

d. Rainfall intensities shall be from the rainfall intensity-duration curve for City of Stayton as shown on Figure 1.

Runoff Coefficients

The recommended coefficients of runoff (C) are listed in Table 1.

TABLE 1.
RUNOFF COEFFICIENTS, C

Soil Cover	Flat Terrain s<2%	Rolling Terrain 2%<s<40%	Steep Terrain s>10%
Relatively high permeability (lawns, pasture, woods)	0.20	0.25	0.3
Moderate impermeability			
1) Single-family residential in urban areas, except corner lots with duplex potential	0.40	0.45	0.50
2) Gravel parking lots	0.50	0.55	0.60
3) Mobile home parks	0.60	0.65	—
4) Multi-family residential, zero-lot-line single-family residential and potential duplex lots in single-Family residential	0.70	0.75	0.80
High impermeability (roofs and paved areas)	0.90	0.90	0.90

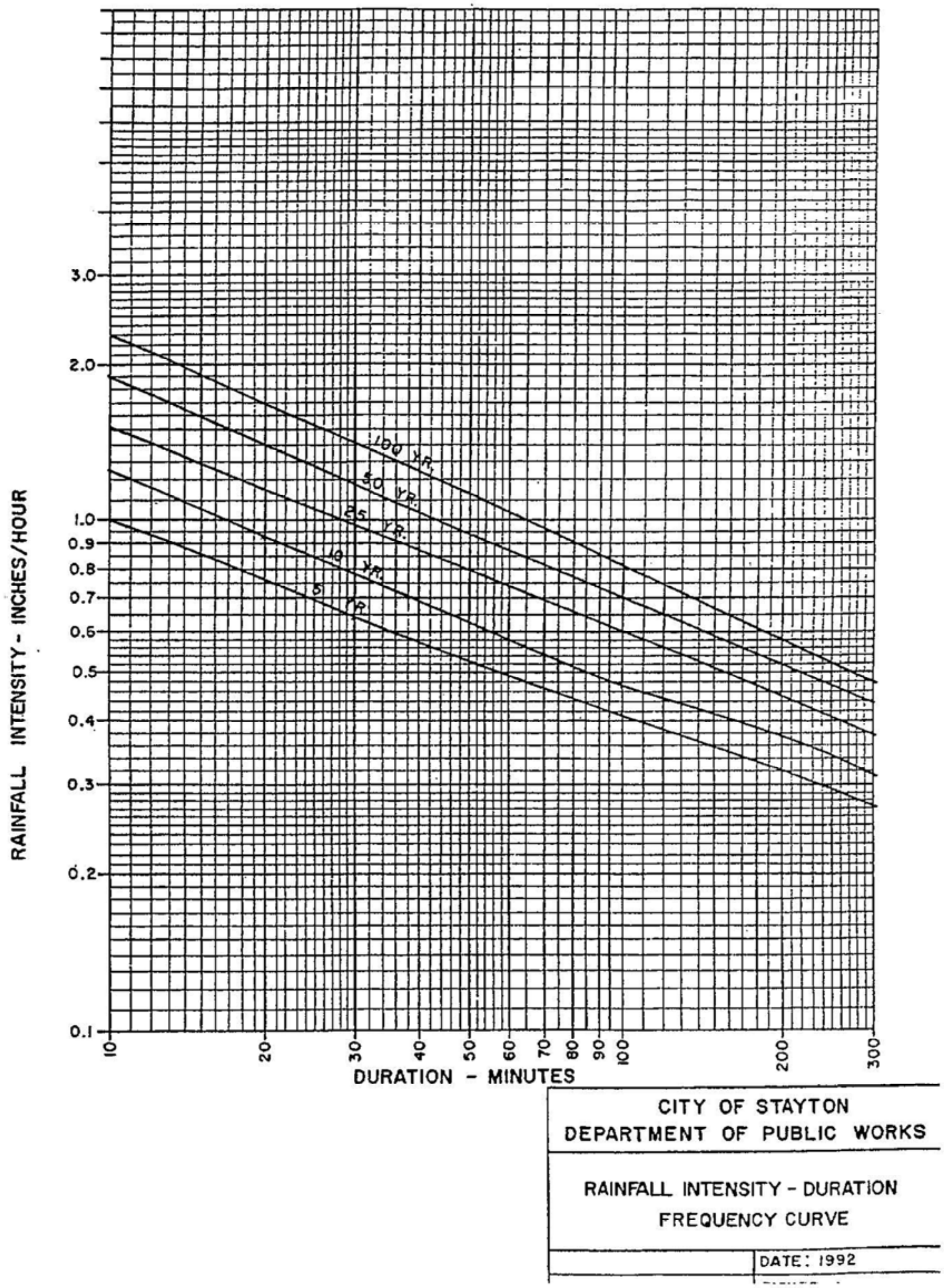

Figure 1. City of Stayton Rainfall Intensity-Duration Frequency Curve

1.2 Unit Hydrograph Methods

a. To obtain a realistic and consistent hydrologic analysis for each development site, all developments shall use the hydrograph analysis method for drainage planning and design unless otherwise approved in advance by the City. The physical characteristics of the site and the design storm shall be used to determine the magnitude, volume and duration of the runoff hydrograph. The Santa Barbara Urban Hydrograph (SBUH) will be the primary acceptable unit hydrograph method.

b. The Design Storm

1. Return frequency and duration specify the design storm event. The design storms shall be based on two parameters:

   - Total rainfall (depth in inches).
   - Rainfall distribution (dimensionless).

c. Design Storm Distribution

1. The rainfall distribution to be used within the City is the design storm of 24-hour duration based on the standard NRCS Type 1A rainfall distribution using the chart on the following page. The total depth of rainfall for storms of 24-hour duration and 2, 5, 10, 25, 50 and 100 year recurrence are 2.7, 3.2, 3.5, 4.0, 4.4, 4.7 inches respectively. As reported in the City of Salem, Stormwater Master Plan, September 2000.
2. The Table 2 contains the NRCS Type 1A precipitation distribution.

TABLE 2. TYPE IA DESIGN STORM DISTRIBUTION CHART								
	Percent Rainfall		**Rainfall Depth (inches)**					
Hour	Incremental	Cumulative	2yr	5 yr	10 yr	25 yr	50 yr	100 yr
			2.7	3.2	3.5	4.0	4.4	4.7
1	2.40	2.40	0.06	0.08	0.08	0.10	0.11	0.11
2	2.60	5.00	0.07	0.08	0.09	0.10	0.11	0.12
3	3.20	8.20	0.09	0.10	0.11	0.13	0.14	0.15
4	3.80	12.00	0.10	0.12	0.13	0.15	0.17	0.18
5	4.44	16.44	0.12	0.14	0.16	0.18	0.20	0.21
6	5.18	21.62	0.14	0.17	0.18	0.21	0.23	0.24
7	6.48	28.10	0.17	0.21	0.23	0.26	0.29	0.30
8	16.44	44.54	0.44	0.53	0.58	0.66	0.72	0.77
9	7.58	52.12	0.20	0.24	0.27	0.30	0.33	0.36
10	5.28	57.40	0.14	0.17	0.18	0.21	0.23	0.25
11	4.96	62.36	0.13	0.16	0.17	0.20	0.22	0.23
12	4.32	66.68	0.12	0.14	0.15	0.17	0.19	0.20
13	4.02	70.70	0.11	0.13	0.14	0.16	0.18	0.19
14	3.42	74.12	0.09	0.11	0.12	0.14	0.15	0.16
15	3.28	77.40	0.09	0.10	0.11	0.13	0.14	0.15
16	3.00	80.40	0.08	0.10	0.11	0.12	0.13	0.14
17	2.80	83.20	0.08	0.09	0.10	0.11	0.12	0.13
18	2.40	85.60	0.06	0.08	0.08	0.10	0.11	0.11
19	2.40	88.00	0.06	0.08	0.08	0.10	0.11	0.11
20	2.40	90.40	0.06	0.08	0.08	0.10	0.11	0.11
21	2.40	92.80	0.06	0.08	0.08	0.10	0.11	0.11
22	2.40	95.20	0.06	0.08	0.08	0.10	0.11	0.11
23	2.40	97.60	0.06	0.08	0.08	0.10	0.11	0.11
24	2.40	100.00	0.06	0.08	0.08	0.10	0.11	0.11

d. Runoff Parameters

The physical drainage basin characteristics listed below shall be used to develop the runoff hydrograph.

1) Area

2) Curve Number

3) Time of Concentration

a) Selection of Area:

To obtain the highest degree of accuracy in hydrograph analysis requires the proper selection of homogeneous basin areas. Significant differences in land use within a given basin must be addressed by dividing the basin area into subbasin areas of similar land use and/or runoff characteristics. Hydrographs should be computed for each subbasin area and superimposed to form the total runoff hydrograph for the basin.

All pervious and impervious areas within a given basin or subbasin shall be analyzed separately. This may be done by either computing separate hydrographs or computing the precipitation excess. The total precipitation excess is then used to develop the runoff hydrograph. By analyzing pervious and impervious areas separately the cumulative errors associated with averaging these areas are avoided and the true shape of the runoff hydrograph is better approximated.

b) Selection of Curve Number:

The Natural Resources Conservation Service (NRCS) (formerly referred to as the Soil Conservation Service (SCS)) has developed "curve number" (CN) values based on soil type and land use. The combination of these two factors is called the "soil-cover complex." The soil-cover complexes have been assigned to one of four hydrologic soil groups, according to their runoff characteristics. Soil Hydrologic Groups may be found in Table 4, Soil Survey of Marion County, Oregon (SCS September 1972).

The following are important criteria/considerations for selection of CN values:

(1) Many factors may affect the CN value for a given land use. For example, the movement of heavy equipment over bare ground may compact the soil so that it has a lower infiltration rate and greater runoff potential.
(2) CN values can be area weighted when they apply to pervious areas of similar CN (within 20 CN points). However, high CN areas should not be combined with low CN areas (unless the low CN areas are less than 15 percent of the subbasin).
(3) Antecedent soil moisture values should be considered. Soil should be considered to be moist prior to the start of the precipitation event.

c) SCS Curve Number Equations:

The rainfall-runoff equations of the NRCS curve number method relate a land area's runoff depth (precipitation excess) to the precipitation it receives and to its natural storage capacity, as follows:

$Q_d = (P_R - 0.2S)2 / (P_R + 0.8S)$ for $P_R > 0.2S$; and
$Q_d = 0$ for $P_R < 0.2S$

Where

Qd = runoff depth in inches over the area,
PR = precipitation depth in inches over the area,
S = potential maximum natural detention, in inches over the area, due to infiltration, storage, etc.

The area's potential maximum detention, S, is related to its curve number, CN:
$S = (1000/CN) - 10$

The computed runoff represents inches over the tributary area. Therefore, the total volume of runoff is found by multiplying Q_d by the area (with necessary conversions):

Total Runoff Volume (cubic-feet) = Q_d (in) x A (ac) x 3,630 (cubic-feet/(ac-in))

When developing the runoff hydrograph, the above equation for Qd is used to compute the incremental runoff depth for each time interval from the incremental precipitation depth given by the design storm hyetograph. This time distribution runoff depth is often referred to as the precipitation excess and provides the basis for synthesizing the runoff hydrograph.

d) Time of Concentration:

Time of concentration (T_c) is the time for runoff to travel from the hydraulically most distant point of the watershed to the point where the hydrograph is to be calculated. Travel time (T_t) is the time it takes water to travel from one location to another in a watershed. T_t is a component of time of concentration (T_c). T_c is computed by summing all the travel times for consecutive components of the drainage conveyance system. T_c influences the shape and peak of the runoff hydrograph.

(1) Sheet Flow
Sheet flow is flow over plane surfaces. It usually occurs in the headwater of streams. For sheet flow up to 300 feet, use the kinematics solution below to directly compute T_t:

Sheet Flow: T_t = (0.93L0.6 x n0.3) / (I0.4 x S0.3)

Where
- T_t = travel time (min)
- n = Manning's effective roughness coefficient for sheet flow
- L = flow length (ft)
- I = rainfall intensity in inches per hour
- S = slope of hydraulic grade line (ft/ft)

Sheet flow shall not be used for distances exceeding 300-feet.

(2) Shallow Concentrated Flow
For slopes less than 0.005 ft/ft the following equations can be used:

a) For Unpaved Surfaces: V = 16.1345 (S)0.5
b) For Paved Surfaces: V = 20.3282 (S)0.5

Where:
- V = velocity in feet per second
- S = Slope in ft/ft

(3) Channel Flow
A commonly used method of computing average velocity of flow, once it has measurable depth, is the following equation:

V = (1.486/n) x R0.6 x S0.5
Where:
- V = velocity (ft/s)

n = Manning's roughness coefficient
S = slope of flow path (ft/ft)
R = area/perimeter

1.3 Water Quality Hydrology

Water Quality

The Water Quality Storm as described below has been derived from the Clean Water Services Water Quality Storm.

The water quality storm is the storm required by regulations to be treated. The storm defines both the volume and rate of runoff.

a. Water Quality Storm: Total precipitation of 0.36 inches falling in 4 hours with a storm return period of 96 hours.

Water quality volume (WQV) is the volume of water that is produced by the water quality storm.

b. Water Quality Volume (WQV): 0.36-inches over 100-percent of the new impervious area.

Water Quality Volume (cf) = 0.36(in) x Area (sf) 12 (in/ft)

c. Water Quality Flow (WQF): The average design flow anticipated from the water quality storm.

Water Quality Flow (cfs) = Water Quality Volume (cf)/14,4000 Sec

or

Water Quality Flow (cfs) = 0.36(in) x Area (sf)/12(in/ft)(4 hr)(60 min/hr)(60 sec/min)

APPENDIX C

WATER QUALITY AND QUANTITY FACILITY DESIGN

1.0 GENERAL REQUIREMENTS FOR WATER QUALITY AND QUANTITY FACILITIES

- Facilities shall be designed to minimize mosquito habitat. Facilities should be designed such that water is not allowed to pond for greater than 72 hours. In facilities that are designed to hold standing water, regular monitoring is required for the presence of mosquitoes.
- An Operations and Maintenance Plan must be developed.
- A geotechnical report may be required to evaluate the suitability of the proposed facility location.

1.1 Erosion Protection

a. Inlets to water quality and quantity facilities shall be protected from erosive flows through the use of an energy dissipater or rip rap stilling basin of appropriate size based on flow velocities. Flow shall be evenly distributed across the treatment area.

b. All exposed areas of water quality and quantity facilities shall be protected using coconut or jute matting. Coconut matting or high density jute matting (Geojute Plus or approved equal) shall be used in the treatment area of swales and below the WQV levels of ponds. Low density jute matting (Econojute or approved equal) may be used on all other zones.

1.2 Vegetation

a. Vegetation shall meet requirements in either the Clean Water Service Design and Construction Standards for Sanitary Sewer and Stormwater Management or City of Portland Stormwater Management Manual.

b. No invasive species shall be planted or permitted to remain within the facility which may affect its function, including, but not limited to the following:

1. Himalayan blackberry (Rubus discolor)
2. Reed canarygrass (Phalaris arundinacea)
3. Teasel (Dipsacus fullonum)
4. English Ivy (Hedra helix)
5. Nightshade (Solanum sp.)
6. Clematis (Clematis ligusticifolia and C. vitabla)
7. Cattail (Typhus latifolia)
8. Thistle (Cirsium arvense and C. vulgare)
9. Scotch Broom (Cytisus scoparius)

1.3 Safety

Fencing or other measures limiting access may be required on a site specific basis, as required by the City Engineer.

1.4 Access

General Access Requirement

Access roads shall be provided for maintenance of all water quality and quantity facilities. The following criteria are considered to be the minimum required for facilities maintained by the City. If the Design Engineer anticipates that any of the requirements will not be met due to the configuration of the proposed development, the Design Engineer is advised to meet with City staff to gain approval for the deviation prior to submittal.

Standard Road Design

1. The road section shall be three (3) inches of class “C” asphaltic concrete; over two (2) inches of ¾”-0” compacted crushed rock; over six (6) inches of 1½”-0” compacted crushed rock; over subgrade compacted to 95-percent AASHTO T-99; or, the Design Engineer may submit an alternate design certified as capable of supporting a 30-ton maintenance vehicle in all weather conditions.
2. Strengthened sidewalk sections shall be used where maintenance vehicles will cross.
3. Maximum grade shall be 10-percent with a maximum 3-percent cross-slope.
4. Minimum width shall be 12 feet on straight runs and 15 feet on curves.
5. Curves shall have a minimum 40-foot interior radius.
6. Access shall extend to within 10-feet of the center of all structures unless otherwise approved by the City.
7. A curb or other delineator shall be provided at the edge of the road unless otherwise approved.
8. The minimum side slope for road embankments shall be 2:1.
9. A vehicle turnaround shall be provided when the access road exceed 40’ in length.

Alternate Access Road

An alternate access road design meeting the requirements of this section may be approved by the City for facilities in which access is required for general maintenance and long term care of the facility, but where there is no structure, as determined by the City, requiring regular maintenance.

1. The road section shall meet the requirements of 1.4.b.1) or an alternate section certified as capable of supporting AASHTO HS- 20 loading.
2. As an alternative to the requirements of 1.4.c.1), a concrete grid paver surface may be constructed by removing all unsuitable material, laying a geotextile fabric over the native soil, placing pavers, filling the honeycombs/grids with soil, and planting appropriate grasses.
3. Strengthened sidewalk sections shall be required.
4. Maximum grade shall be 20-percent with a maximum 3-percent cross-slope.
5. Minimum finished width shall be 12 feet.
6. A curb or other delineator shall be provided at the edge of the road unless otherwise approved.
7. The minimum side slope for road embankments shall be 2:1.

8. A vehicle turnaround shall be provided when the access road exceed 40’ in length.

2.0 WATER QUALITY FACILITY DESIGN

This section presents methodology for designing water quality facilities.

2.1 Water Quality Volumes and Flows

Water Quality Volume and Flows shall be calculated as required in Appendix B.

3.0 WATER QUALITY TREATMENT FACILITIES

The design criteria are not intended to be a comprehensive list of all stormwater facilities, but provides a general overview of those commonly used.

Biofiltration

Biofiltration removes pollutants primarily by the filtering action of vegetation trapping particulates. Other pollutant removal mechanisms include sediment deposition in low-velocity areas, infiltration into the subsoil, and surface adhesion of pollutants to vegetation, biological assimilation, and soil adsorption. Biofiltration BMPs include grass swales, vegetated swales and vegetated filter strips.

Well-designed and -maintained biofilters have been known to remove the majority of suspended sediments and particulate pollutants in stormwater. Biofilters generally do not remove dissolved pollutants effectively. Swales appear to be more effective at removing metals than nutrients; however, accumulations of trace metals in biofilter sediments may occur. Resuspension or remobilization of nutrients may occur, particularly if maintenance is not performed regularly.

Vegetated Swales

Biofiltration swales are long, gently sloped conveyance ditches with flattened sideslopes, designed to remove pollutants by filtering stormwater through vegetation. Grass is the most common vegetation, but other vegetation types, such as emergent wetland species, are often used, depending on site conditions. Swales are designed to distribute flow evenly across the entire width of the densely vegetated bottom, and may employ check dams and wide depressions to increase runoff storage and promote greater settling of pollutants. Often providing both treatment and conveyance of peak design flows, swales can reduce development costs by eliminating the need for separate conveyance systems. Biofiltration swales are best applied on a relatively small scale (generally less than 5 acres of impervious surface).

Swales which are incorporated in the streets are known as Green Streets. Green Streets incorporate curb extensions with biofiltration swales.

Applicable Locations:

Along roadways, driveways, and parking lots.

Hydraulic Design Criteria:

Design Flow: Water Quality Flow

Minimum Hydraulic Residence Time: 9 minutes

Maximum Water Design Depth: 0.5-feet

Minimum Freeboard: 1.0-foot (for facilities not protected from high flows)

Manning “n” Value: 0.24

Maximum Velocity: 2.0-fps based on 25-year flow

Design Criteria:

- Provide an energy dissipater at the entrance to swale, with a minimum length of 4-feet. It will be designed to reduce velocities and spread the flow across the treatment cross section.
- The use of intermediate flow spreaders maybe required.
- Minimum Length: 100-feet
- Minimum Slope: 0.5-percent
- Minimum Bottom Width: 2-foot
- Maximum Treatment Depth (measured from top of gravel): 0.5-feet
- Maximum Side Slope:
- In Treatment Area: 4H:1V
- Above Treatment Area: 2.5H:1V
- The treatment area shall have 2”-¾” river run rock placed 2.5 to 3 inches deep on high density jute or coconut matting over 12 inches of topsoil or base stabilization method as approved by the City. Extend river rock, topsoil, and high density jute or coconut matting to top of treatment area (or WQV level). Extend topsoil and low density jute matting to the edge of water quality tract or easement area.
- Provide an approved outlet structure for all flows.
- Where swales wrap 180-degrees forming parallel channels, freeboard must be provided between each of the parallel channels. A 1-foot (above ground surface) wall may be used above the treatment area to provide freeboard while enabling a narrower system. As an alternative, a soil-based berm may be used. The berm shall have a minimum top width of 1 foot and 2.5:1 side slopes.
- Where swales are designed with ditch inlets and outlet structures and design of maintenance access to such structures may be difficult due to swale location, swales may be designed as flowthrough facilities with unsumped structures. Maintenance access to one end of the facility will still be required.
- Check dams shall be constructed of durable, non-toxic materials such as rock, brick, or concrete, or soil by integrating them into the grading of the swale. Check dams shall be 12 inches in length, by the width of the swale, by 3 to 6 inches in height.
- Swale areas should be clearly marked before site work begins to avoid soil disturbance and compaction during construction. No vehicular traffic, except that specifically used to construct the facility, should be allowed within 10 feet of swale areas.
- Swales are appropriate for all soil types. Topsoil shall be used within the top 12 inches of the facility, or the soil shall be amended to support plant growth.
- Required setback from centerline of swale to property lines is 5 feet, and 10 feet from building foundations unless lined with impermeable fabric.
- Wildflowers, native grasses, and ground covers used for maintained facilities maintained by the city shall be designed not to require mowing. Where mowing

cannot be avoided, facilities shall be designed to require mowing no more than once annually. Turf and lawn areas are not allowed for city-maintained facilities.

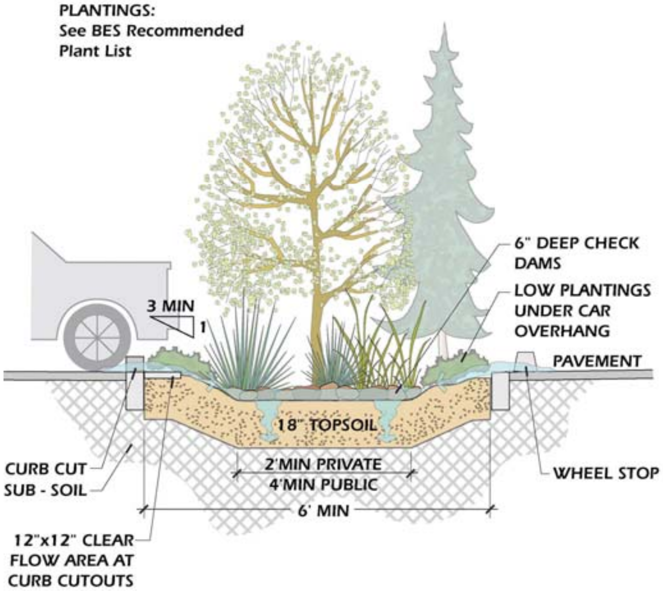

Figure 7. Vegetated Swale (Source City of Portland Stormwater Management Manual, 2004)

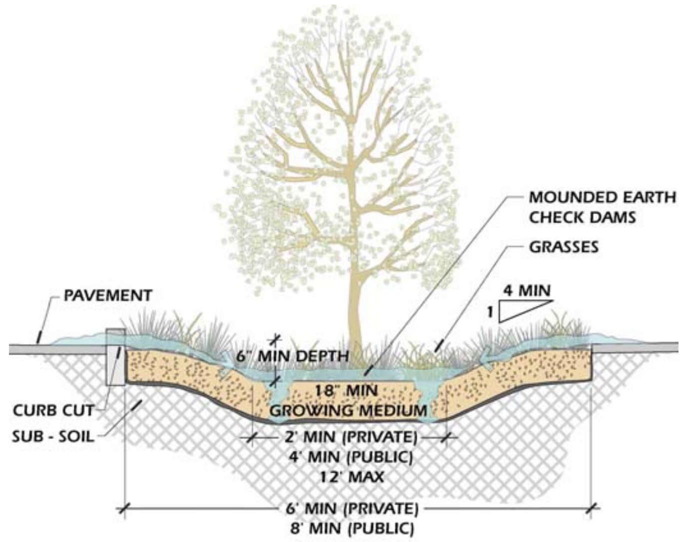

Figure 8. Grassy Swale (Source City of Portland Stormwater Management Manual, 2004)

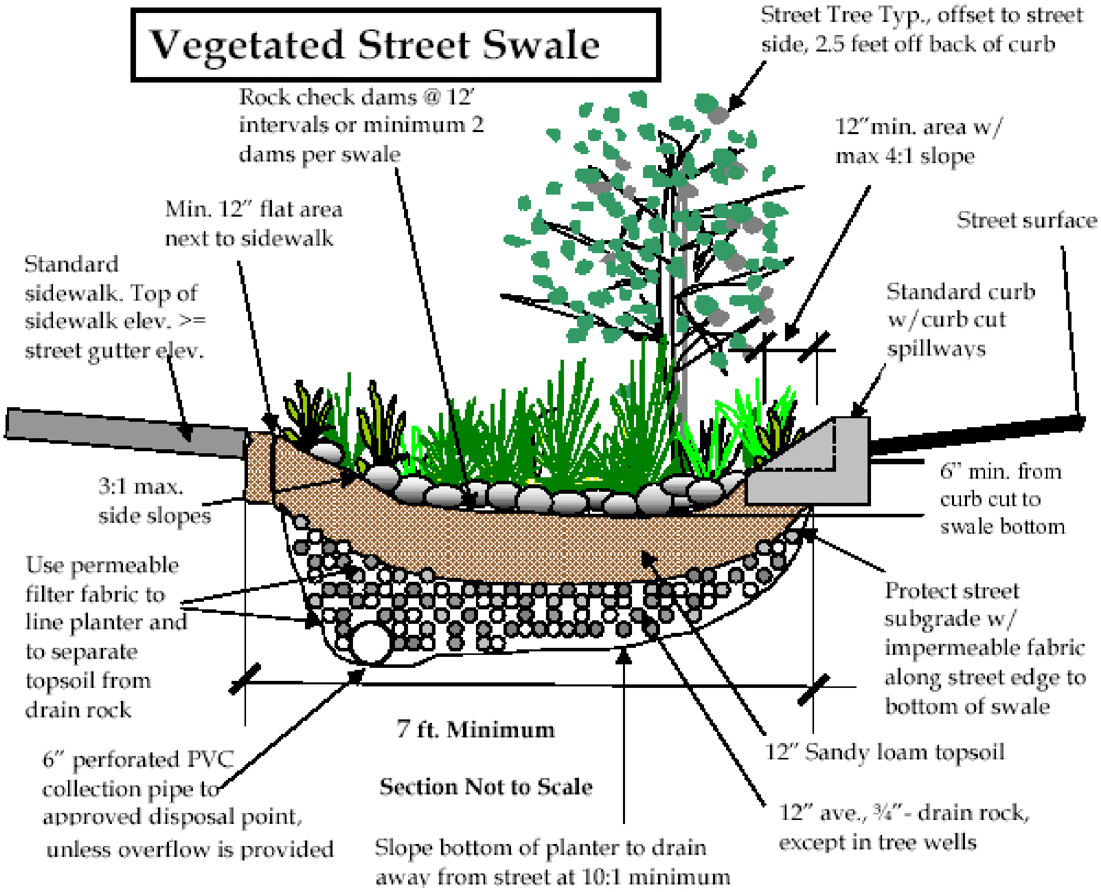

Figure 9. Vegetated Street Swale (Stormwater Management Manual, City of Portland, 2004)

Vegetated Filter Strips

Filter strips are vegetated sections of land designed to accept runoff as overland sheet flow from upstream development. They may adopt any naturally vegetated form, from grassy meadow to emergent wetland to small forest. The dense vegetative cover facilitates pollutant removal. Filter strips differ from swales in that swales are concave conveyance systems, while filter strips are located parallel to the contributing area, have fairly level surfaces, and provide treatment of sheet flow.

Applicable Locations:

Parking lots, residential or small business streets. Treat stormwater from small drainage areas.

Design Considerations:

- When designing vegetated filters, slopes should be kept as flat as possible to prevent erosion. Spreading the flow evenly across the filter is also important in ensuring that the facility functions correctly and avoids flow channeling.
- Vegetated filter areas should be clearly marked before site work begins to avoid soil disturbance during construction. No vehicular traffic, except that specifically used to construct the facility, should be allowed within 10 feet of filter areas. Flow spreaders must be constructed perfectly level to distribute flows evenly across the filter.

- Vegetated filters are appropriate for all soil types. Unless existing vegetated areas are used for the filter, topsoil shall be used within the building foundations unless lined with impermeable fabric.
- Maximum allowable vegetated filter slopes are 10%. Terraces may be used to decrease ground slopes. Minimum slopes are 0.5%.
- Required setback from property lines is 5 feet, and 10 feet from building foundations unless lined with impermeable fabric.
- Unless used for very long, narrow projects such as pathways and trails, vegetated filters cannot be used to manage flow from more than 2,000 square-feet of impervious area. Filters shall be a minimum of 10 feet wide x 10 feet long. A simplified approach sizing factor of 0.2 may be used to receive credit for pollution reduction and flow control. A high-flow by-pass mechanism will not be required in these cases, but a high-flow overflow must be provided at the downstream end of the filter to an approved disposal point.
- Check dams shall be constructed of durable, non-toxic materials such as rock, brick, or concrete, or graded into the native soils. Check dams shall be 12 inches in length, by the width of the filter, by 3 to 5 inches in height.

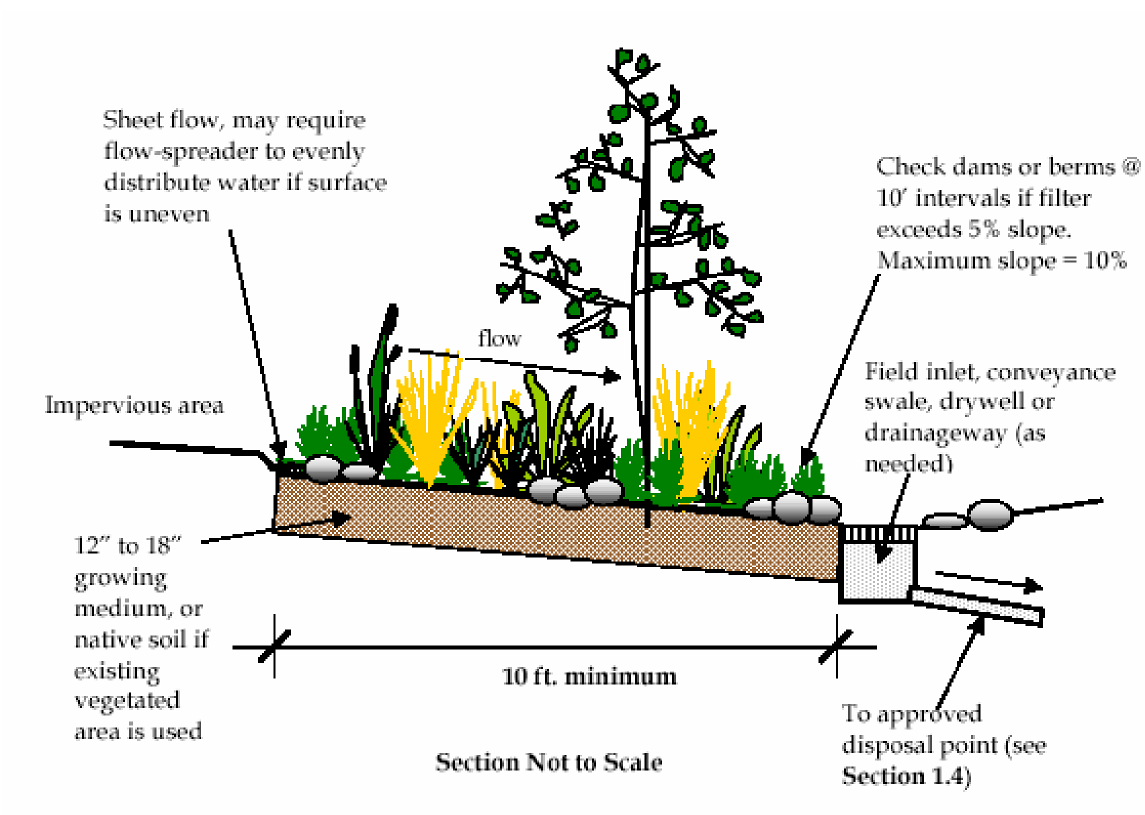

Figure 11. Vegetated Filter Strip (Stormwater Management Manual, City of Portland, 2004)

Extended Dry Basin

Dry detention ponds are vegetated basins designed to fill during storm events and slowly release the water over a number of hours. Dry detention ponds are designed primarily for flow control. Additional water quality facilities are required to meet pollutant reduction requirement unless the bottom of the flow path of the pond should be designed as a vegetated or grass swale in order to meet pollution reduction requirements.

Dry Detention ponds have the opportunity for use as multi-purpose detention facilities. Such facilities include: parking lots, rooftops, sports fields, and recessed plazas.

Applicable Locations:

High density areas, where land availability is limited.

Hydraulic Design Criteria:

- Permanent Pool Depth: 0.4-feet
- Permanent pool is to cover the entire bottom of the basin.
- Water Quality Detention Volume: Water Quality Volume (WQV) + Required Storage
- Water Quality Drawdown Time: 48 hours

  Orifice Size: USE: *D = 24 * [(Q/ (C[2gH]0.5) / π] 0.5*

  Where: *D (in) = diameter of orifice*

  *Q(cfs) = WQV(cf) /(48*60*60)*

  C = 0.62

  H(ft) = 2/3 x temporary detention height to centerline of orifice.

- Maximum Depth of Water Quality Pool (not including Permanent Pool): 4-feet.
- Provide an emergency spillway sized to pass the 100-year storm event or an approved hydraulic equivalent. Emergency spillway to be located in existing soils when feasible and armored with riprap or other approved erosion protection extending to the toe of the embankment.

Design Criteria:

- Minimum of 2 cells, with the first cell (forebay) at least 10% of surface area. The forebay shall also constitute 20% of the treatment volume. Where space limits multi-cell design, use one cell with a forebay at the inlet to settle sediments and distribute flow across the wet pond.
- Inlet and outlet structures shall be designed to avoid direct flow between structures without receiving treatment (i.e. short circuiting of flow). The minimum length-to-width ratio is 3:1, at the maximum water surface elevation. If area constraints make this ratio unworkable, baffles, islands, or peninsulas may be installed, with City approval, to increase the flow path and prevent short-circuiting.
- Minimum Bottom Width: 4-feet
- Maximum Side Slopes in Basin Treatment Area: 3H:1V
- Minimum Freeboard: 1-foot from 25-year design water surface elevation.

- The treatment area shall have high density jute or coconut matting over 12 inches of topsoil or base stabilization method as approved by the City. If required by the City, 2”-¾” river run rock shall be placed 2.5 to 3 inches deep in areas where sustained flow is anticipated to occur. Extend river rock (if required), topsoil, and high density jute or coconut matting to top of treatment area (or WQV level). Extend topsoil and low density jute matting to the edge of water quality tract or easement area
- Provide an approved outlet structure for all flows.
- The Design Engineer shall certify that the pond storm sewer design is in compliance with all requirement in this document and that at normal design water surface that the upstream storm sewer will not be in a surcharged condition for longer than 24 hours
- Adequate grading and drainage must be provided to allow full use of facilities primary purposes following a storm event.
- Facility must be designed to minimize potential safety risks, potential property damage and inconvenience to the facility’s primary purpose.
- Detention Basins designed to function as multi-use/recreational facilities, shall be located in a separate tract, defined easement, or designated open space.
- Minimum distance from the edge of the pond maximum pond water surface to property lines and structures: 20 feet, unless an easement with adjacent property owner is provided.
- Distance from the toe of the pond berm embankment to the nearest property line: one-half of the berm height (minimum distance of 5 feet).
- Minimum distance from the edge of the maximum pond water surface to septic tank, distribution box, or septic tank drain field: 50 feet.
- Surrounding slopes shall not exceed 10%. Minimum distance from the edge of the maximum pond water surface to the top of a slope greater than 15 percent: 200 feet, unless a geotechnical report is submitted and approved by the City.
- Minimum distance from the edge of the maximum pond water surface to a well: 100 feet.
- Access routes to the pond for maintenance purposes must be shown on the plans.

Constructed Water Quality Wetland

A constructed wetland is a shallow, sometimes intermittent, pool constructed to provide suitable conditions for the growth of wetland plants for the purposes of stormwater management. Constructed wetlands often consist of a combination of shallow trenches, marshes, and ponded sections, with a wide variety of vegetation types. Stormwater wetlands are designed to maximize pollutant removal through uptake by plants, retention, and settling.

Created wetlands, are distinct from constructed wetlands, are considered mitigation for an activity, and are *not* used for stormwater management. They are treated as natural wetlands, and are subject to the same protections.

Wetlands can be sources of wildlife habitat, enhancing the aesthetic value of an area and providing opportunities for passive recreation and public education.

Constructed wetlands remove pollutants through gravitational settling, wetland plant uptake, adsorption, filtration, and microbial decomposition. Deep water areas such as wet ponds improve the sedimentation, photosynthetic, biological, and chemical removal of pollutants.

The actual pollutant removal efficiency of constructed wetlands depends on many variables. Numerous field studies indicate these systems are able to remove the majority of the settleable solids and particulate pollutants in stormwater. These detention facilities can also prevent increases in water temperature with a well established vegetated canopy.

Applicable Locations:

Larger Commercial or residential projects where land is available to treat a large drainage area.

Hydraulic Design Criteria:

- Permanent Pool Volume: 0.55 x Water Quality Volume (WQV)
- Water Quality Detention Volume: Water Quality Volume (WQV) + Storage Volume
- Water Quality Drawdown Time: 48 hours

    Orifice Size: USE: D = 24 * [(Q/ (C[2gH]0.5) / π] 0.5

    Where: *D (in) = diameter of orifice*

    *Q(cfs) = WQV(cf) /(48*60*60)*

    C = 0.62

    H(ft) = 2/3 x temporary detention height to centerline of orifice.

- Maximum Depth of Permanent Pool: 2.5-feet or as limited by issuing jurisdiction
- Maximum velocity through the wetland should average less than 0.01-fps for the water quality flow. Design should distribute flows uniformly across the wetland.
- Provide an emergency spillway sized to pass the 100-year storm event or an approved hydraulic equivalent. Emergency spillway to be located in existing soils when feasible and armored with riprap or other approved erosion protection extending to the toe of the embankment.
- Provide for a basin de-watering system with a 24-hour maximum drawdown time.

Design Criteria:

- Minimum of 2 cells, with the first cell (forebay) at least 10% of surface area. The forebay shall also constitute 20-percent of the treatment volume. Where space limits multi-cell design, use one cell with a forebay at the inlet to settle sediments and distribute flow across the wet pond.
- Permanent pool depth to be spatially varied throughout wetland.
- Provide a perimeter zone 10 to 20-feet wide, which is inundated during storm events.
- Maximum Side Slopes for Wetland Planting: 5H:1V
- Maximum Side Slopes for Non-Wetland Planting: 3H:1V
- Overexcavate by a minimum of 20-percent to allow for sediment deposition.

- Minimum Freeboard: 1-foot from 25-year design water surface elevation.
- Provide an approved outlet structure for all flows. A detailed hydraulic analysis must be performed by a Professional Engineer, showing compliance with flow control standards
- All ponds shall have an emergency overflow spillway or structure designed to convey the 100- year, 24-hour design storm for post-development site conditions, assuming the pond is full to the overflow spillway or structure crest. The overflow shall be designed to convey these extreme event peak flows around the berm structure for discharge into the downstream conveyance system. The overflow shall be designed and sited to protect the structural integrity of the berm. This will assure that catastrophic failure of the berm is avoided, property damage is avoided, and water quality of downstream receiving water bodies is protected.

Sand Filters

Stormwater filtering systems have been used successfully in ultra-urban areas due to their relatively small footprint and moderate physical and head drop requirements. A number of filtering systems have been developed for use in heavily urbanized areas. Filters typically contain the same basic components: a sedimentation area to retain the largest particles; and a chamber containing the filter medium that captures soluble pollutants.

A typical sand filter consists of a flow spreader, sand bed, and an underdrain. Pretreatment is required for removal of larger particulates and reduce velocities. Sand filters can be used in residential, commercial and industrial area, where debris, large particulates, and oil & grease will not clog the filter. Sand filters can be located either above or below ground.

Applicable Locations:

Small Commercial and industrial areas projects. Small footprint allows for installation in areas where land availability is limited.

Design Requirements:

- Sand filters must be lined with an impermeable liner.
- Facility storage depth must be at least 12 inches, unless a larger-than-required planter square-footage is used. Minimum sand filter width is 18 inches. Filter slopes shall be less than 0.5%.
- Required setback from property lines is 5 feet, unless the sand filter height is less than 30 inches. Required setback from building structures is 10 feet, unless the sand filter is properly lined. Special attention needs to be paid to the filter waterproofing if constructed adjacent to building structures.
- Sand filter walls shall be made of stone, concrete, brick, or wood. Chemically treated wood that can leach out toxic chemicals and contaminate stormwater shall not be used.
- Sand filters sized with the simplified approach shall be designed to receive less than 15,000 square-feet of impervious area runoff. For these projects, a simplified approach sizing factor of 0.06 may be used to receive credit for pollution reduction and flow control. For projects with more than 15,000 square feet of impervious surface, additional facilities may be required to meet flow control requirements. A high-flow overflow must be provided to an approved

disposal point. Sand filters shall be designed to pond water for less than 4 hours after each storm event.

- Plantings are optional in sand filters. For aesthetic purposes, potted plants may be submerged in the sand filter.
- The sand filter inlet structure shall spread the flow of incoming water uniformly across the surface of the filter medium during all anticipated flow conditions. This flow shall be spread in a manner that prevents roiling or otherwise disturbing the filter medium.
- The length-to-width ratio of the filter shall be 2:1 or greater.
- Sand used as filter medium shall be certified by a testing laboratory as meeting or exceeding the specifications presented below:
- The filter bed medium shall consist of clean medium to fine sand with no organic material, or other deleterious materials and meeting the following gradation:

•

Sieve Size	Percent Passing
3/8”	100
#4	95-100
#8	80-100
#16	45-85
#30	15-60
#50	3-15
#100	<4

- The underdrain piping system shall consist of appropriately sized (minimum 4-inch diameter) collector manifold with perforated lateral branch lines. The pipe used in this conveyance system shall be schedule 40 polyvinyl chloride (PVC) material or an approved equal. Lateral spacing shall not exceed 10 feet. The underdrain laterals shall be placed with positive gravity drainage to the collector manifold. The collector manifold shall have a minimum 1 percent grade toward the discharge point. All laterals and collector manifolds shall have cleanouts installed, accessible from the surface without removing or disturbing filter media.
- The sand bed configuration may be either of the two configurations shown in Figure 12. All depths shown are final depths. The effects of consolidation and/or compaction must be taken into account when placing medium materials. The surface of the filter medium shall be level.

Sand Bed with Gravel Filter (Figure 12:A)

- The top layer shall be a minimum of 18 inches of approved sand.
- The sand shall be placed over an acceptable geofabric material covering a layer of ½- to 2-inch washed drain rock. The finished depth of this drain rock shall be sufficient to provide a minimum of 2 inches of cover over the underdrain piping system.
- No gravel is required below the underdrain piping system.
- The piping shall be underlain with an impermeable liner.

Sand Bed Using Trench Design (Figure 12:B)

- The top layer shall be a minimum of 12 inches of approved sand.
- The sand shall be placed over an acceptable geotextile fabric material covering a layer of ½ to 2-inch washed drain rock. The finished depth of this drain rock shall be sufficient to provide a minimum of 2 inches of cover over the underdrain piping system.
- The piping and gravel shall be underlain with an impermeable liner.

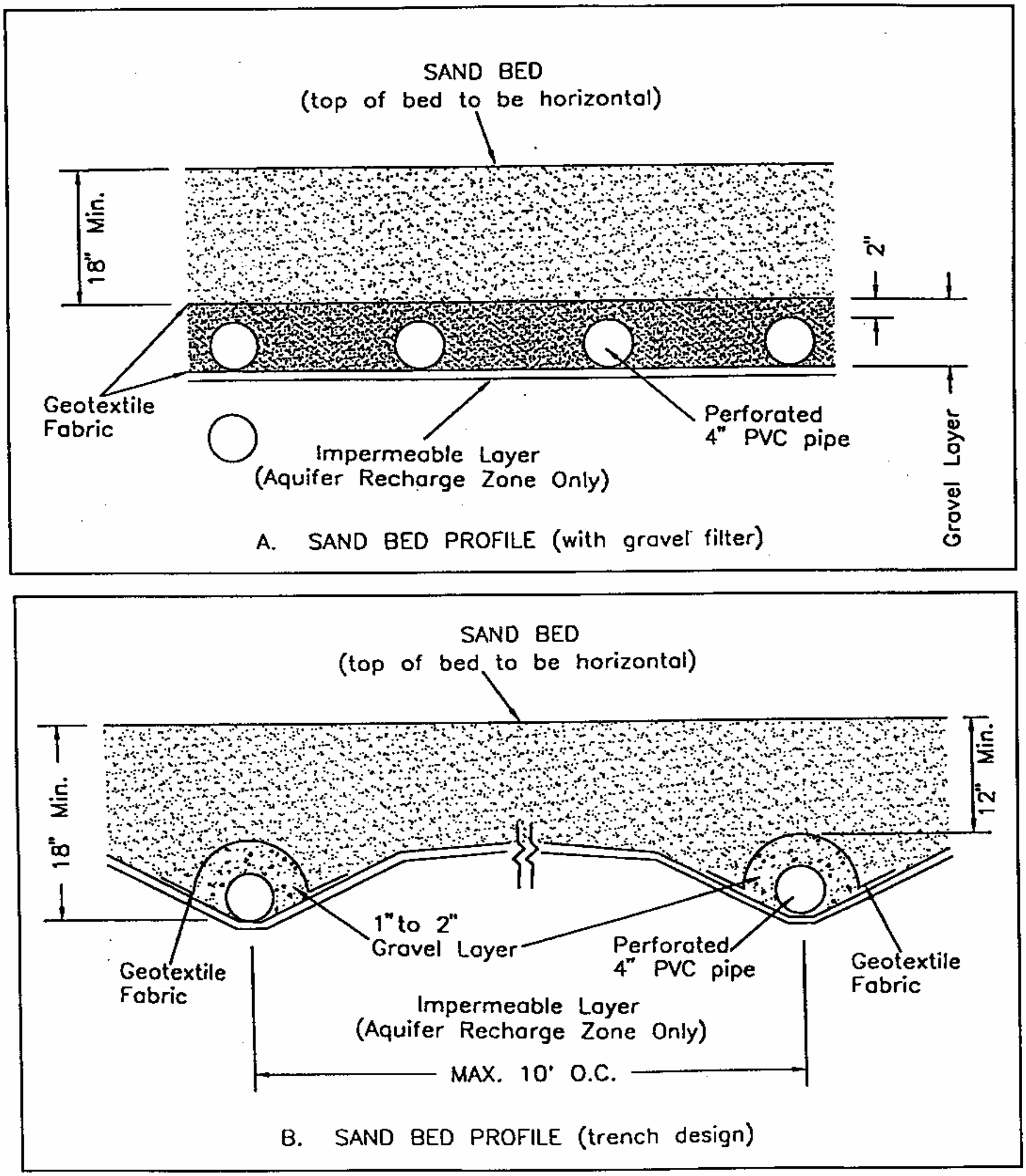

Figure 12. Sandfilters (Source City of Portland Stormwater Management Manual, 2004)

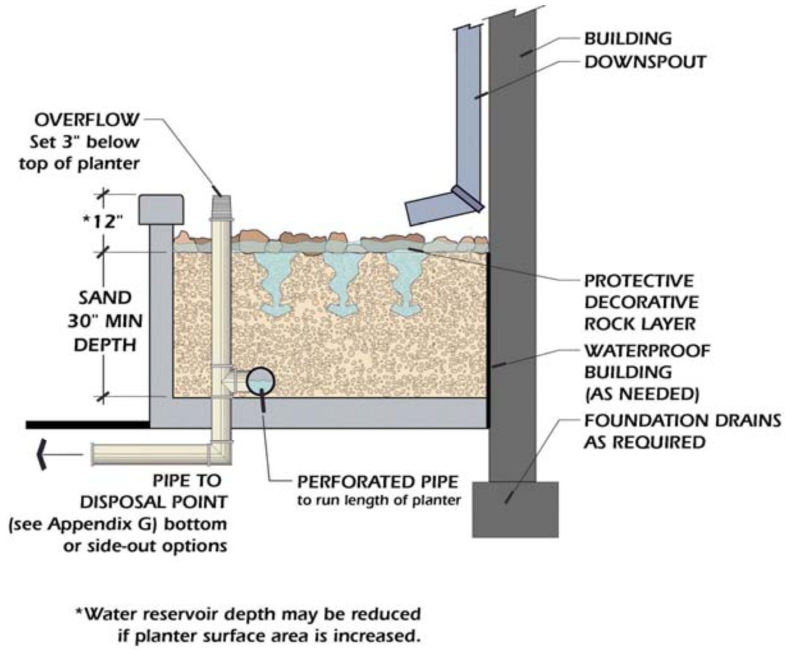

Figure 13. Downspout Sandfilter (Source City of Portland Stormwater Management Manual, 2004)

3.4 Other Water Quality Treatment Facilities

The use of other forms of water quality treatment is allowed with the approval of the City. However, the applicant must provide evidence of the ability of the facility to meet the City's performance criteria and long term maintenance requirements.

4.0 WATER QUANTITY FACILITY DESIGN

4.1 Hydraulic Design Criteria:

a. Detention design shall be assessed by dynamic flow routing through the basin. Documentation of the proposed design shall be included in the drainage report.

Acceptable analysis programs include:

1. HYD;
2. HEC-1;
3. HEC-HMS;
4. SWMM;
5. HYDRA;
6. HYDROCAD
7. Others as approved.

b. Stormwater quantity on-site detention facilities shall be designed to capture runoff so the post-development runoff rates from the site do not exceed the pre-development runoff rates from the site, based on a 2 through 25-year, 24-hour return storm. Specifically, the 2, 10, and 25-year post development runoff rates will not exceed their respective 2, 10, and 25-year pre-development runoff rates; unless other criteria are identified in an adopted watershed management plan or subbasin master plan.

c. A pond overflow system shall provide for discharge of the design storm event without overtopping the pond embankment or exceeding the capacity of the emergency spillway. Vortex valve discharge control should be considered to optimize effective pond volume.

d. Provide an emergency spillway sized to pass the 100-year storm event or an approved hydraulic equivalent. Emergency spillway to be located in existing soils when feasible and armored with riprap or other approved erosion protection extending to the toe of the embankment.

4.2 Design Criteria:

a. The facility can be a combined water quality and quantity facility provided it meets all relevant criteria. If a water quality component in not incorporated into the detention facility additional water quality treatment must be provided.

b. Interior side slopes up to the Maximum Water Surface: 3H:1V

c. If interior slopes need to be mowed – maximum side slope: 4H:1V

d. Maximum Exterior Side Slopes: 2H:1V, unless analyzed for stability by a geotechnical engineer.

e. Over excavate by a minimum of 20-percent to allow for sediment deposition.

f. Minimum Freeboard: 1-foot from 25-year design water surface elevation.

g. Provide an approved outlet structure for all flows.

h. Detention facilities shall be designed to protect public and private property.

i. Facilities shall be designed to minimize mosquito habitat. Facilities should be designed such that water is not allowed to pond for greater than 72 hours. In facilities that are designed to hold standing water, regular monitoring is required for the presence of mosquitoes.

j. An Operations and Maintenance Plan must be developed.

k. A geotechnical report may be required to evaluate the suitability of the proposed facility location.

4.3 Walls in Water Quantity Facilities

a. Retaining walls may serve as pond walls if the design is prepared and stamped by a registered professional engineer and a fence is provided along the top of the wall. At least 25% of the pond perimeter will be vegetated to a maximum side slope of 3:1.

b. Walls that are 4 feet or higher must meet all of the following criteria:

1. Be approved by a licensed structural or geotechnical engineer;
2. The City shall not have maintenance responsibility for the wall. The party responsible for maintenance of the walls within the water quantity tract or easement shall be clearly documented on the plat or in alternate form as approved by the City.

APPENDIX D

STORMWATER FACILITY

OPERATION AND MAINTENANCE REQUIREMENTS

DRY DETENTION PONDS

Operations and Maintenance (adapted from the City of Portland Stormwater Management Manual, 2004)

All facility components, vegetation, and source controls shall be inspected for proper operations and structural stability. These inspections shall occur, at a minimum, quarterly for the first 2 years from the date of installation, and 2 times per year thereafter, and within 48 hours after each major storm event. The facility owner must keep a log, recording all inspection dates, observations, and maintenance activities. The following items shall be inspected and maintained as stated:

- Inlet pipe shall be cleared when conveyance capacity is plugged. Sources of sediment and debris shall be identified and corrected.
  - Determine if pipe is in good condition:
    - If more than 1 inch of settlement, add fill material and compact soils.
    - If alignment is faulty, correct alignment.
    - If cracks or openings exist indicated by evidence of erosion at leaks, repair or replace pipe as needed.
- Embankment, Dikes, Berms & Side Slopes retain water in the pond.
  - Slopes shall be stabilized using appropriate erosion control measures when native soil is exposed or erosion channels are forming.
  - Structural deficiencies shall be corrected upon discovery:
    - If cracks exist, repair or replace structure.
    - If erosion channels deeper than 2 inches exist, stabilize surface. Sources of erosion damage shall be identified and controlled.
- Control Devices (e.g., weirs, baffles, etc.) shall direct and reduce flow velocity. Structural deficiencies shall be corrected upon discovery:
  - If cracks exist, repair or replace structure.
- Overflow Structure conveys flow exceeding reservoir capacity to an approved stormwater receiving system.
  - Overflow structure shall be cleared when 50% of the conveyance capacity is plugged. Sources of sediment and debris shall be identified and corrected.
  - Sources of erosion damage shall be identified and controlled when native soil is exposed at the top of overflow structure or erosion channels are forming.
- Remove Debris and sediment from ponding area. Debris and sediment shall be tested and disposed of in accordance with federal and state regulations.
- Vegetation shall be healthy and dense enough to protect underlying soils from erosion.
  - Grass (where applicable) shall be mowed to 4”-9” high and grass clippings shall be removed.
  - Fallen leaves and debris from deciduous plant foliage shall be raked and removed.

- Nuisance or prohibited vegetation (such as blackberries or English Ivy) shall be removed when discovered. Invasive vegetation contributing up to 25% of vegetation of all species shall be removed and replaced.

- Spill Prevention measures shall be exercised when handling substances that can contaminate stormwater. Releases of pollutants shall be corrected as soon as identified.
- Training and/or written guidance information for operating and maintaining ponds shall be provided to all property owners and tenants. A copy of the O&M Plan shall be provided to all property owners and tenants.
- Access to the facility shall be safe and efficient. Egress and ingress routes shall be maintained to design standards. Roadways shall be maintained to accommodate size and weight of vehicles, if applicable.
  - Obstacles preventing maintenance personnel and/or equipment access to the wet pond shall be removed.
  - Gravel or ground cover shall be added if erosion occurs, e.g., due to vehicular or pedestrian traffic.
- Insects & Rodents shall not be harbored in the pond. Pest control measures shall be taken when insects/rodents are found to be present.
  - If sprays are considered, then a mosquito larvicide, such as Bacillus thurendensis or Altoside formulations can be applied only if absolutely necessary, and only by a licensed individual or contractor.
  - Holes in the ground located in and around the pond shall be filled.

If used at this site, the following will be applicable:

- Signage shall clearly convey information.
  - Broken or defaced signs shall be replaced or repaired.
- Fences shall be maintained to preserve their functionality and appearance.
  - Collapsed fences shall be restored to an upright position.
  - Jagged edges and damaged fences and shall be repaired or replaced.

BIOFILTRATION

Swales

Operations and Maintenance (adapted from the City of Portland Stormwater Management Manual, 2004)

All facility components, vegetation, and source controls shall be inspected for proper operations and structural stability, at a minimum, quarterly for the first 2 years from the date of installation, 2 times per year thereafter, and within 48 hours after each major storm event. The facility owner must keep a log, recording all inspection dates, observations, and maintenance activities. The facility owner must keep a log, recording all inspection dates, observations, and maintenance activities. The following items shall be inspected and maintained as stated:

- Swale Inlet (such as curb cuts or pipes) shall maintain a calm flow of water entering the swale.
  - Source of erosion shall be identified and controlled when native soil is exposed or erosion channels are forming.
  - Sediment accumulation shall be hand-removed with minimum damage to vegetation using proper erosion control measures. Sediment shall be removed if it is more than 4" thick or so thick as to damage or kill vegetation.
  - Inlet shall be cleared when conveyance capacity is plugged. Sources of sediment and debris shall be identified and corrected.
  - Rock splash pads shall be replenished to prevent erosion.
- Side Slopes shall be maintained to prevent erosion that introduces sediment into the swale.
  - Slopes shall be stabilized and planted using appropriate erosion control measures when native soil is exposed or erosion channels are forming.
- Swale Media shall allow stormwater to percolate uniformly through the landscape swale. If the swale does not drain within 48 hours, it shall be tilled and replanted according to design specifications.
  - Annual or semi-annual tilling shall be implemented if compaction or clogging continues.
  - Debris in quantities that inhibit operation shall be removed routinely (e.g., no less than quarterly), or upon discovery.
- Swale Outlet shall maintain sheet flow of water exiting swale unless a collection drain is used. Source of erosion damage shall be identified and controlled when native soil is exposed or erosion channels are forming.
  - Outlets such as drains and overland flow paths shall be cleared when 50% of the conveyance capacity is plugged.
  - Sources of sediment and debris shall be identified and corrected.
- Vegetation shall be healthy and dense enough to provide filtering while protecting underlying soils from erosion.
  - Mulch shall be replenished as needed to ensure survival of vegetation.
  - Vegetation, large shrubs or trees that interfere with landscape swale operation shall be pruned.

- Fallen leaves and debris from deciduous plant foliage shall be removed.
- Grassy swales shall be mowed to keep grass 4” to 9” in height.
- Nuisance and prohibited vegetation (such as blackberries and English Ivy) shall be removed when discovered. Invasive vegetation contributing up to 25% of vegetation of all species shall be removed and replaced.
- Dead vegetation and woody material shall be removed to maintain less than 10% of area coverage or when swale function is impaired. Vegetation shall be replaced within 3 months, or immediately if required to maintain cover density and control erosion where soils are exposed.

- Spill Prevention measures shall be exercised when handling substances that contaminate stormwater. Releases of pollutants shall be corrected as soon as identified.
- Training and/or written guidance information for operating and maintaining swales shall be provided to all property owners and tenants. A copy of the O&M Plan shall be provided to all property owners and tenants.
- Access to the swale shall be safe and efficient. Egress and ingress routes shall be maintained to design standards. Roadways shall be maintained to accommodate size and weight of vehicles, if applicable.
  - Obstacles preventing maintenance personnel and/or equipment access to the swale shall be removed.
  - Gravel or ground cover shall be added if erosion occurs, e.g., due to vehicular or pedestrian traffic.
- Insects & Rodents shall not be harbored in the swale. Pest control measures shall be taken when insects/rodents are found to be present.
  - If sprays are considered, then a mosquito larvicide, such as Bacillus thurendensis or Altoside formulations can be applied only if absolutely necessary, and only by a licensed individual or contractor.
  - Holes in the ground located in and around the swale shall be filled.
- If Check Dams are used in the facility they shall control and distribute flow.
  - Causes for altered water flow shall be identified, and obstructions cleared upon discovery.
  - Causes for channelization shall be identified and repaired.

Vegetated Filter Strips

Operations and Maintenance (adapted from the City of Portland Stormwater Management Manual, 2004)

All facility components and vegetation shall be inspected for proper operations and structural stability. These inspections shall occur, at a minimum, quarterly for the first 2 years from the date of installation, 2 times per year thereafter, and within 48 hours after each major storm event. The facility owner must keep a log, recording all inspection dates, observations, and maintenance activities. The following items shall be inspected and maintained as stated:

- Flow Spreader shall allow runoff to enter the vegetative filter as predominantly sheet flow.
  - Source of erosion damage shall be identified and controlled when native soil is exposed or erosion channels are forming.
- Sediment build-up near or exceeding 2” in depth shall be removed.
- Filter Inlet shall assure unrestricted stormwater flow to the vegetative filter.
  - Sources of erosion shall be identified and controlled when native soil is exposed or erosion channels are present.
  - Sediment accumulation shall be hand-removed with minimum damage to vegetation using proper erosion control measures. Sediment shall be removed if it is more than 4 inches thick or so thick as to damage or kill vegetation.
  - Inlet shall be cleared when conveyance capacity is plugged.
  - Rock splash pads shall be replenished to prevent erosion.
- Filter Media shall allow stormwater to percolate uniformly through the vegetative filter.
  - If the vegetative filter does not drain within 48 hours, it shall be regraded and replanted according to design specifications. Established trees shall not be removed or harmed in this process.
  - Debris in quantities more than 2” deep or sufficient to inhibit operation shall be removed routinely (e.g., no less than quarterly), or upon discovery.
- Check Dams shall direct and control flow.
  - Causes for altered water flow and channelization shall be identified, and obstructions cleared upon discovery.
  - Cracks, rot, and structural damage shall be repaired.
- Filter Outlet shall allow water to exit the vegetative filter as sheet flow, unless a collection drainpipe is used.
  - Sources of erosion damage shall be identified and controlled when native soil is exposed or erosion channels are deeper than 2 inches.
  - Outlet shall be cleared when 50% of the conveyance capacity is plugged. Sources of sediment and debris shall be identified and corrected.
- Vegetation shall be healthy and dense enough to provide filtering while protecting underlying soils from erosion.

- Fallen leaves and debris from deciduous plant foliage shall be raked and removed.
- Nuisance and prohibited vegetation (such as blackberries and English Ivy) shall be removed when discovered. Invasive vegetation contributing up to 25% of vegetation of all species shall be removed and replaced.
- Dead vegetation shall be removed to maintain less than 10% of area coverage or when vegetative filter function is impaired. Vegetation shall be replaced immediately to control erosion where soils are exposed and within 3 months to maintain cover density.

- Spill Prevention measures shall be exercised when handling substances that contaminate stormwater. Releases of pollutants shall be corrected as soon as identified.
- Training and/or written guidance information for operating and maintaining vegetated filters shall be provided to all property owners and tenants. A copy of the O&M Plan shall be provided to all property owners and tenants.
- Access to the vegetative filter shall be safe and efficient. Egress and ingress routes shall be maintained to design standards.
    - Obstacles preventing maintenance personnel and/or equipment access to the facility shall be removed.
    - Gravel or ground cover shall be added if erosion occurs, e.g., due to vehicular or pedestrian traffic.
- Insects & Rodents shall not be harbored in the vegetated filter. Pest control measures shall be taken when insects/rodents are found to be present.
    - If sprays are considered, then a mosquito larvicide, such as Bacillus thurendensis or Altoside formulations can be applied only if absolutely necessary, and only by a licensed individual or contractor.
    - Holes in the ground located in and around the vegetated filter shall be filled.

CONSTRUCTION WETLAND

Operations and Maintenance (adapted from the City of Portland Stormwater Management Manual, 2004)

All facility components, vegetation, and source controls shall be inspected for proper operations and structural stability. These inspections shall occur, at a minimum, quarterly for the first 2 years from the date of installation, and 2 times per year thereafter, and within 48 hours after each major storm event. The facility owner must keep a log, recording all inspection dates, observations, and maintenance activities. The following items shall be inspected and maintained as stated:

- Inlet shall assure unrestricted stormwater flow to the wetland.
  - Inlet pipe shall be cleared when conveyance capacity is plugged. Sources of sediment and debris shall be identified and corrected.
  - Determine if pipe is in good condition:
    - If more than 1 inch of settlement, add fill material and compact soils.
    - If alignment is faulty, correct alignment.
    - If cracks or openings exist indicated by evidence of erosion at leaks, repair or replace pipe as needed.
- Fore bay traps coarse sediments, reduces incoming velocity, and distributes runoff evenly over the wetland. A minimum 1-foot freeboard shall be maintained.
  - Sediment buildup exceeding 50% of the facility capacity shall be removed every 2-5 years, or sooner if performance is being affected.
- Embankment, Dikes, Berms & Side Slopes retain water in the wetland.
  - Slopes shall be stabilized using appropriate erosion control measures when native soil is exposed or erosion channels are forming.
  - Structural deficiencies shall be corrected upon discovery:
    - If cracks exist, repair or replace structure.
    - If erosion channels deeper than 2 inches exist, stabilize surface. Sources of erosion damage shall be identified and controlled.
- Control Devices (e.g., weirs, baffles, etc.) shall direct and reduce flow velocity.
  - Structural deficiencies shall be corrected upon discovery:
  - If cracks exist, repair or replace structure.
- Overflow Structure conveys flow exceeding reservoir capacity to an approved stormwater receiving system.
  - Overflow structure shall be cleared when 50% of the conveyance capacity is plugged. Sources of sediment and debris shall be identified and corrected.
  - Sources of erosion damage shall be identified and controlled when native soil is exposed at the top of overflow structure or erosion channels are forming.
  - Rocks or other armament shall be replaced when only one layer of rock exists above native soil.
- Sediment & Debris Management shall prevent loss of wetland volume caused by sedimentation.
  - Wetlands shall be dredged when 1 foot of sediment accumulates.

- Gauges located at the opposite ends of the wetland shall be maintained to monitor sedimentation. Gauges shall be checked 2 times per year.
- Sources of restricted sediment or debris, such as discarded lawn clippings, shall be identified and prevented.
- Debris in quantities sufficient to inhibit operation shall be removed routinely, e.g. no less than quarterly, or upon discovery.

- Vegetation shall be healthy and dense enough to provide filtering while protecting underlying soils from erosion and minimizing solar exposure of open water areas.
  - Mulch shall be replenished when needed.
  - Vegetation, large shrubs or trees that limit access or interfere with wetland operation shall be pruned.
  - Fallen leaves and debris from deciduous plant foliage shall be raked and removed.
  - Nuisance or prohibited vegetation (such as blackberries or English Ivy) shall be removed when discovered. Invasive vegetation contributing up to 25% of vegetation of all species shall be removed and replaced.
  - Dead vegetation shall be removed to maintain less than 10% of area coverage or when wetland function is impaired. Vegetation shall be replaced within 3 months, or immediately if required to maintain cover density and control erosion where soils are exposed.
  - Vegetation producing foul odors shall be eliminated.
- Spill Prevention measures shall be exercised when handling substances that can contaminate stormwater. Releases of pollutants shall be corrected as soon as identified.
- Training and/or written guidance information for operating and maintaining treatment wetlands shall be provided to all property owners and tenants. A copy of the O&M Plan shall be provided to all property owners and tenants.
- Access to the wetland shall be safe and efficient. Egress and ingress routes shall be maintained to design standards. Roadways shall be maintained to accommodate size and weight of vehicles, if applicable.
  - Obstacles preventing maintenance personnel and/or equipment access to the wetland shall be removed.
  - Gravel or ground cover shall be added if erosion occurs, e.g., due to vehicular or pedestrian traffic.
- Insects & Rodents shall not be harbored in the constructed treatment wetland. Pest control measures shall be taken when insects/rodents are found to be present.
  - If sprays are considered, then a mosquito larvicide, such as Bacillus thurendensis or Altoside formulations can be applied only if absolutely necessary, and only by a licensed individual or contractor.
  - Holes in the ground located in and around the constructed treatment wetland shall be filled.

If used at this site, the following will be applicable:

- Signage shall clearly convey information.

    - Broken or defaced signs shall be replaced or repaired.
- Fences shall be maintained to preserve their functionality and appearance.
    - Collapsed fences shall be restored to an upright position.
    - Jagged edges and damaged fences and shall be repaired or replaced.

SAND FILTERS

Operations and Maintenance (adapted from the City of Portland Stormwater Management Manual, 2004)

All facility components, vegetation, and source controls shall be inspected for proper operations and structural stability. These inspections shall occur, at a minimum, quarterly for the first 2 years from the date of installation, and 2 times per year thereafter, and within 48 hours after each major storm event. The facility owner must keep a log, recording all inspection dates, observations, and maintenance activities. The following items shall be inspected and maintained as stated:

- Filter Inlet shall allow water to uniformly enter the sand filter as calm flow, in a manner that prevents erosion.
  - Inlet shall be cleared of sediment and debris when 40% of the conveyance capacity is plugged.
  - Source of erosion shall be identified and controlled when native soil is exposed or erosion channels are forming.
  - Sediment accumulation shall be hand-removed if it is more than 4 inches thick.
  - Rock splash pads shall be replenished to prevent erosion.
- Reservoir receives and detains stormwater prior to infiltration. If water does not drain within 2-3 hours of storm event, sources of clogging shall be identified and correction action taken.
  - Debris in quantities more than 1 cu ft or sufficient to inhibit operation shall be removed routinely (e.g., no less than quarterly), or upon discovery.
  - Structural deficiencies in the sand filter box including rot, cracks, and failure shall be repaired upon discovery.
- Filter Media shall allow to stormwater to percolate uniformly through the sand filter. If water remains 36-48 hours after storm, sources of possible clogging shall be identified and corrected.
  - Sand filter shall be raked and if necessary, the sand/gravel shall be excavated, and cleaned or replaced.
  - Sources of restricted sediment or debris (such as discarded lawn clippings) shall be identified and prevented.
  - Debris in quantities sufficient to inhibit operation shall be removed no less than quarterly, or upon discovery.
  - Holes that are not consistent with the design structure and allow water to flow directly through the sand filter to the ground shall be filled.
- Underdrain Piping (where applicable) shall provide drainage from the sand filter, and Cleanouts (where applicable) located on laterals and manifolds shall be free of obstruction, and accessible from the surface.
  - Underdrain piping shall be cleared of sediment and debris when conveyance capacity is plugged. Cleanouts may have been constructed for this purpose.
  - Obstructions shall be removed from cleanouts without disturbing the filter media.
- Overflow or Emergency Spillway conveys flow exceeding reservoir capacity to an approved stormwater receiving system.

- Overflow spillway shall be cleared of sediment and debris when 50% of the conveyance capacity is plugged.
- Source of erosion damage shall be identified and controlled when erosion channels are forming.
- Rocks or other armament shall be replaced when sand is exposed and eroding from wind or rain.

Appendix G
Storm Water System User Fee Data

KELLER
ASSOCIATES

Stayton, OR
Storm Water Master Plan
Potential Funding Sources

Program Name	Overview	Potential Application to Statyon's Storm Water Master Plan
Access & Habitat Program, Oregon Department of Fish & Wildlife	To qualify for A&H funding, a project must improve wildlife habitat and/or increase public hunting access to private land. A&H activities are designed to be grassroots in nature and encourage cooperative working relationships....	This funding could be used for the wetland preservation or riparian creation along detention swales if it can be shown to improve wildlife habitat
Bonneville Environmental Foundation Watershed Program	BEF supports only long-term (10-year) and monitoring-intenisve Model Watershed restoration programs. In selected Model Watersheds, BEF provides 10-year funding to support monitoring and assessment activities, long-term oversight, and the services of an i...	Can be used to fund TMDL Implementation Plan water quality monitoring and BMP implementation because it is part of the Willamette Basin restoration.
Bullitt Foundation - Aquatic Ecosystems Program	The mission of The Bullitt Foundation is to protect, restore, and maintain the natural physical environment of the Pacific Northwest for present and future generations. The Foundation invites proposals from nonprofit organizations that serve Washington, O...	Can be used for water quality measures or possibly for wetland. Cannot be used for land acquistion.
Bullitt Foundation - Training, Communications, and Unique Opportunities	The mission of The Bullitt Foundation is to protect, restore, and maintain the natural physical environment of the Pacific Northwest for present and future generations. The Foundation invites proposals from nonprofit organizations that serve Washington, O...	Could be used for the purchase of water quality monitoring samplers or other technology needs related to the master plan implementation.
Clean Water State Revolving Fund Loan Program - Oregon	The Clean Water State Revolving Fund (CWSRF) Loan Program provides low-cost loans for the planning, design and construction of water pollution control facilities and activities. Oregon's DEQ is committed to working with Oregon communities to attain or mai...	Can be used to fund non-point source pollution reduction strategies in the implementation plan.
Drinking Water Protection Loan Fund (DWPLF) - Oregon	The Safe Drinking Water Act, as amended in 1996, established the Drinking Water State Revolving Fund (DWSRF) to make funds available to drinking water systems to finance infrastructure improvements. The program also emphasizes providing funds to small and...	This loan might be applicable to storm water activities that reduce pollutant loading to surface or ground water used for drinking water.
Environmental Monitoring for Public Access and Community Tracking (EMPACT) Grants, EPA	The goal of EMPACT is to provide public access to clearly communicated, time-relevant, useful, and accurate environmental monitoring data in an ongoing and sustainable manner in 86 of the largest U.S. metropolitan areas. Projects may address clean air, cl...	Could be used for the purchase of water quality monitoring samplers.
Environmental Systems Research Institute (ESRI) Conservation Program	ESRI provides donations and discounts of Geographic Information Systems (GIS) software, data, books, and training to non-profits, governments, and other eligible groups....	Could get training and software for GIS system expansion for continued storm water mapping.
FishAmerica Foundation	The FishAmerica Foundation's mission is to provide funding for local, hands on-projects to enhance fish populations, restore fisheries habitat, improve water quality, and advance fisheries research in North America to increase the opportunity for sportfis...	Could be used for portions of the master plan shown to improve the water quality to fish habitats such as the Mill Creek or the North Santiam.
Flood Mitigation Assistance Program, FEMA	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). Th...	Can be used for general capital improvement funding that mitigates flooding risks.
General Purpose Grants - M.J. Murdock Charitable Trust	The Trust's mission is to enrich the quality of life in the Pacific Northwest by providing grants to organizations that seek to strengthen the region's educational and cultural base in creative and sustainable ways. Although major emphases are education...	Projects shown to enhance the quality of life - especially for youth. This could aid in funding a youth internship for water quality monitoring or restoration projects. This would fill public education requirements of the NPDES phase II program.
Hatfield Restoration Program, Oregon	Former U.S. Senator Mark O. Hatfield established the Upper Klamath Basin Working Group (UKBWG) to address ecosystem restoration and water quality, economic stability, and drought impacts. Funding is available for projects which address watershed restorati...	Applicable to watershed restoration projects.

Program Name	Overview	Potential Application to Statyon's Storm Water Master Plan
Jubitz Family Foundation	AREAS OF INTEREST: • Early childhood development and youth education, with an emphasis on children at-risk. • Environmental stewardship, with an emphasis on rivers and their watershed ecosystems. • Peacemaking activities, with an emphasis on teaching p...	River and watershed ecosystem projects such as the wetlands, erosion prevention, riparian management etc.
Land and Water Conservation Fund - Oregon	Land & Water Conservation Fund grant funds may be used for the acquisition and development of state and local facilities that provide recreational opportunities. Recreation enhancement may be accomplished throught the preservation of open space, forests, ...	Could be used for detention facilities that double as recreational facilites.
Lawrence Foundation, The	The Lawrence Foundation makes contributions and grants to organizations that are working to solve pressing educational, environmental, and health issues....	General applicablity to storm water improvements funding
Nonpoint Source Implementation Grant (319) Program - Oregon	Section 319 of the 1987 Clean Water Act authorizes grants for implementation of nonpoint source pollution control programs and projects to help protect or improve water quality. The Department of Environmental Quality, the state agency authorized to carry...	Non-point source bmp funding
Oregon Wildlife Heritage Foundation	The mission of the Oregon Wildlife Heritage Foundation is to initiate, organize, and support projects through public and private partnerships that benefit Oregon's Fish and Wildlife....	Projects shown to enhance fish and wildlife habitats
Pacific Grassroots Salmon Initiative, National Fish and Wildlife Foundation	The PGSI seeks to catalyze and support salmon-friendly activities at the local, grassroots level in west-coast states of California, Oregon, and Alaska. The initiative will benefit native anadromous fishes and their aquatic and riparian habitats through p...	If salmon are in either the Mill Creek or N. Santiam, projects improving the quality of those rivers may qualify for funding.
Partnership Planning Grants for Economic Development Districts, Indian Tribes, & Other Eligible Area	Planning grants provide support for the formulation and implementation of local economic development programs as well as strategies designed to create and retain permanent jobs and income, and provide new employment opportunities in economically distress...	Implementation of some of the storm water improvements both enhance the city and provides permanent jobs.
Pedestrian & Bicycle Facility Improvement Grant Program	Oregon's Bicycle and Pedestrian Program provides funding for bicycle and pedestrian improvements. ...	This could be used in conjuction with regional detention facilities that double as parks, walking paths, and recreation sites.
PGE Foundation	The Foundation's giving interests include art and humanities, civic and public affairs, education, the environment, health and social services. The Foundation seeks to preserve and enhance environmental quality throughout Oregon. We support a variety of ...	General applicablity to storm water improvements funding
Plum Creek Foundation	The Plum Creek Foundation is the major channel of philanthropy for Plum Creek Timber Company, Inc. and its subsidiaries. The Plum Creek Foundation has been established to provide a philanthropic contribution program to support and improve the general welf...	Applies to community development, parks and recreation facilities, and public education portions of the master plan or TMDL implementation plan.
Recreational Trail Program (RTP) Grants - Oregon	The RTP is a Federal-aid assistance program to help States provide and maintain recreational trails for both motorized and non-motorized trail use. The program provides funds for all kinds of recreational trail use, such as pedestrian use, which includes ...	Applies to trails as related to parks and detention facilities
Renewable Energy Program, Bonneville Environmental Foundation	The Bonneville Environmental Foundation (BEF) was founded in 1998 to support watershed restoration programs and develop new sources of renewable energy. Funding for these efforts has been provided in a way that would be called unusual for most foundations...	Applies to watershed restoration facets of storm water master plan or TMDL IP
Watershed Restoration Grant Program, OWEB	OWEB focuses on projects that approach natural resources management from a whole-watershed perspective. OWEB encourages projects that foster interagency cooperation, include other sources of funding, provide for local stakeholder involvement, include yout...	Applies generally to the storm water master plan