Lyons, Oregon

Storm Drainage Plan

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EXECUTIVE SUMMARY

The City of Lyons experiences regular nuisance flooding during heavy rainfall events. Its stormwater drainage system consists of piped storm drain systems, culverts, open channel drainageways, and detention facilities. A current stormwater plan is necessary for the City to manage development and growth. In February of 2011, the City contracted with Ukiah Engineering, Inc. to update the existing Stormwater Drainage Plan.

This storm water report identifies overall goals and objectives for both the City and its jurisdictional neighbors. The regulatory framework which governs stormwater management in Oregon include Oregon Administrative Rules, the Clean Water Act, NPDES, Stormwater TMDL programs, Endangered Species Act (ESA), MRCI limits within the ESA, Oregon's Comprehensive Land-Use Plan, and the National Flood Insurance Program.

The study area includes the City of Lyons. The climate, topography, land use, vegetation, soils, watersheds and flood plains are summarized for the model.

General flood management techniques include increasing conveyance, detention, diversion and property acquisition. Some or all of these may be applicable in the City of Lyons. Water Quality Best Management Practices that may be applicable include tree planting, stream banks stabilization, vegetative buffers, in stream stabilization, and increasing floodplain function.

Using a state of the art storm water analysis, a model has been constructed for the City of Lyons. Results indicate locations where some additional measures should be taken to reduce the potential of flooding.

The report presents recommendations for a Capital Improvement Program. The recommendations include correcting the Timberview outfall and providing a Central Business District high flow by pass. A Capital Maintenance Plan is also presented. Budget estimates are included for the items in the Capital Improvement Plan. Additional funding sources which may finance these recommendations are suggested.

BACKGROUND

The City of Lyons has a drainage plan that was drafted in December 1975. With the growth that the City has experienced this plan is now out of date. The study area needs to be reviewed and the plan updated to reflect current conditions and regulations.

Goals and Objectives of the Plan

Evaluate Existing Infrastructure

1. Identify the current infrastructure.
2. Prepare an Inventory of existing drainage facilities within the urban growth boundary.
3. Plot and map the existing facilities.

Identify Potential Opportunities/Obstacles to the Development of the Infrastructure

1. Present regulatory requirements.
2. Assess impact of local comprehensive plan and development regulations.
3. Evaluate possible improvements and alternatives.
4. Describe a project selection process.

Preliminary Plans

1. Develop preliminary schematic designs for the proposed infrastructure improvements including cost estimates.
2. Determine and identify any additional property or acquisition of right of way necessary.

Complete an Operations Plan for the Infrastructure

1. Develop an annual budget set aside for the completion of the proposed improvements.
2. Develop an annual budget for operations and maintenance.
3. Identify potential funding sources that might be used to complete the recommended improvements.

The Stormwater Challenge

Storm Drainage Goals

- Protect the public’s safety, health, and property through flood control measures.
- Reduce the discharge of pollutants in stormwater runoff.
- Protect, restore and maintain the area’s watersheds.

Community Goals for Stormwater Management:

- Coordinate the City's flood control resources.
- Involve and educate the public.
- Enhance riparian corridors.
- Develop innovative applications of best management practices.
- Control runoff and pollution at the source.
- Maximize the use of natural systems in water quality and drainage control.
- Develop funding mechanisms that implement the plan's recommendations.
- Ensure that costs are in balance with benefits.

Regional Goals of a Management Plan:

- Coordinate program activities with other affected communities and/or agencies.
- Encourage consistent design and development standards for stormwater control facilities.
- Find cost sharing opportunities.

The Hydrological Challenge

In an urban area, rain falls on impervious areas such as buildings, parking lots, playgrounds, streets and sidewalks, and cannot seep into the ground. The excess surface water runoff is collected and conveyed by storm facilities including drains, catch basins, pipes, culverts, detention ponds, open drainage ditches, and groundwater, natural streams or waterways. At times of intense rainfall, the flow capacity of these facilities and natural waterways may be exceeded and flooding occurs. Stormwater management identifies locations, frequencies of flooding, and mitigation options.

Surface water runoff transports sediments and pollutants. Pollutants of concern may include phosphorus, nitrogen, oxygen demanding organic material, disease causing bacteria, oil and grease, heavy metals, and other toxics. Human activities such as washing cars, fertilizing lawns, disposing of liquid wastes and application of pesticides and herbicides, and caring for animals affect water quality.

The stormwater management planning process reduces pollutants through enhanced maintenance practices, erosion control and changes in development techniques or standards. The plan identifies locations where stormwater treatment facilities can be created or enhanced. Capital improvements programs are developed for funding and implementing these projects.

Regulatory Framework

Oregon Administrative Rules

Chapter 660, Division 11 of the Oregon Administrative Rules (OAR), enforced by the Land Conservation and Development Commission (LCDC) require a public facilities plan for areas located within an urban growth boundary containing greater than 2,500 persons. Although the City has not reached that threshold, the principles dictated by these rules provide guidance for development in small urban environments. The Storm Drainage Plan presented herein satisfies the drainage related public facility plan requirements under Oregon Administrative Rules (OAR) 660-11-010.

Clean Water Act

Growing public awareness and concern for controlling water pollution in the late 1960's led to the federal enactment of the Water Pollution Control Act Amendments of 1972. As amended in 1977, this law has become commonly known as the Clean Water Act (CWA). The CWA established the basic structure for regulating discharges of pollutants into the waters of the United States. It gives the Environmental Protection Agency (EPA) the authority to implement pollution control programs such as setting wastewater standards for industry. The CWA also sets water quality standards for all contaminants in surface waters. The Act makes it unlawful for any person to discharge any pollutant from a point source into navigable waters, unless a permit was obtained under its provisions. It recognizes the need for planning to address the critical problems posed by nonpoint source pollution.

The EPA has delegated some states the authority to administer the regulations of the CWA. In Oregon, the Department of Environmental Quality (DEQ) has been authorized to oversee many of the federal environmental, health and safety regulations, including the CWA.

NPDES Stormwater Program

Pursuant to Title IV, Sections 402 and 405 of the CWA Linn County is regulated by the National Pollutant Discharge Elimination System (NPDES). The NPDES program is a congressionally mandated program under the CWA. It is a comprehensive two-phased national program for addressing the non-agricultural sources of stormwater discharges that adversely affect water quality. The program is implemented locally through DEQ. The DEQ issues permits to applicable entities that participate in and/or oversee activities, which are recognized as potential sources of pollutants. Municipal Separate Storm Sewers Systems (MS4), industrial activities and construction activities all potentially require an NPDES permit.

Although the City of Lyons is not governed by the NPDES program, almost all of its requirements are included in a County NPDES program and the City's TMDL Plan.

The NPDES program requires the City to reduce pollutants being discharged by the City's stormwater system to the "maximum extent practicable" This can be achieved by implementing a storm drainage plan which specifically identifies Best Management Practices (BMPs) that reduce pollutants.

TMDL Program

Section 303(d) of the CWA requires states to develop a list of waterbodies that do not meet water quality standards and thus require additional pollution controls. These waters are referred to as "water quality limited" and must be periodically identified in each state in a document commonly referred to as the "303(d) List". Water Quality Limited waterbodies require the development and implementation of a Total Maximum Daily Load (TMDL) for bringing a water body into compliance with water quality standards. The North Santiam River has been identified by DEQ as Water Quality Limited for temperature and dissolved oxygen.

The TMDL process determines the pollutants or stressors causing water quality impairments; identifies maximum permissible loading capacities for the water body for each relevant pollutant; and assigns pollutant load allocations to each identified and permitted source. It addresses both point (waste load) and non-point (load) sources in the watershed. Water quality management plans recommend source controls and BMPs needed meet water quality standards.

The TMDL Implementation Plan incorporates the load allocations set forth in the North Santiam River TMDL. It establishes goals and procedures to achieve pollution targets that will meet TMDL requirements.

Endangered Species Act (ESA)

The Endangered Species Act (ESA) provides for the conservation of threatened and endangered plants and animals and the habitats in which they are found. The National Oceanic Atmospheric Administration Marine Fisheries Service (NOAA Fisheries) and the U. S. Fish and Wildlife Service (USFWS) both have administrative authority and management responsibility for different species under the ESA. A species may be listed under the ESA as either *endangered*, "in danger of extinction throughout all or a significant portion of its range," or *threatened*, "likely to become endangered within the foreseeable future throughout all or a significant portion of its range."

Section 9 of the ESA prohibits the “take” of any threatened or endangered species. “Take” is defined as harassing, harming, pursuing, hunting, shooting, wounding, killing, trapping, capturing, collecting, or attempting to engage in any such conduct. “Harm” is further defined to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing behavioral patterns such as breeding, feeding, or sheltering.

For species listed as threatened, section 4(d) of the ESA requires NOAA Fisheries or USFWS to put “take” prohibitions in place, and approve programs for activities that contribute to conserving listed species. These actions are termed “4(d) rules.” If a municipality undertakes activities listed in the 4(d) rules, it can develop a program for approval by the jurisdictional agency (NOAA Fisheries or USFWS) to reduce liability under the ESA; or the municipality can implement activities to ensure no “take” results.

Within the 4(d) rules there are several limits. One such limit that is directly applicable to Lyons is the: Municipal, Residential, Commercial, and Industrial (MRCI) Development and Redevelopment limit.

MRCI

The MRCI limit contains twelve sub-parts, which outline considerations for development and redevelopment in protection of a listed species.

1. Avoid inappropriate areas such as unstable slopes, wetlands, areas of high habitat value, and similarly constrained sites.
2. Avoid stormwater discharge that could impact water quality and quantity or influence the hydrograph of the watershed.
3. Require adequate riparian buffers around perennial and intermittent streams, lakes, or wetlands.
4. Avoid stream crossings by roads whenever possible. When stream crossings are necessary, minimize impacts through choice of mode, sizing, and placement.
5. Protect the historic stream meander pattern and channel migration zones. Avoid hardening of stream banks.
6. Protect wetlands and wetland functions.
7. Preserve the hydrologic capacity of any intermittent or permanent stream sufficient to pass peak flows.
8. Landscape with native plants to reduce need for watering and application of herbicides, pesticides, and fertilizer.
9. Prevent erosion and sediment runoff during construction.
10. Assure that water supply demands for new development can be met without impacting flows needed for threatened solmonoids either

directly or through groundwater withdrawals, and that any new water diversions are positioned and screened in a manner that prevents injury or death of solmonoids.

11. Provide all necessary enforcement, funding, reporting, and implementation mechanisms.
12. Ensure that development complies with all other state and federal environmental or natural resource laws and permits.

Within the study area Steelhead and Chinook are listed as threatened species and are under the administrative jurisdiction of NOAA Fisheries. These species are located in both the North Santiam River and Trask Creek. 4(d) rules apply to Pacific Northwest Salmon and Steelhead ESA listings.

National Flood Insurance Program (NFIP)

The National Flood Insurance Program (NFIP) is a federal program that allows property owners to purchase flood insurance protection. Participation in the NFIP is based on an agreement between local communities and the federal government. Communities must implement measures to reduce future flood risks. These measures involve restrictions on the construction of habitable structures within the mapped floodplains and floodways. NFIP flood insurance is available through licensed property insurance agents or brokers.

As part of the NFIP, local FEMA administrators work with members from each participating community to establish a local Flood Insurance Rate Map (FIRM). The map is intended to show areas within the 100-year flood boundary, also known as Special Flood Hazard Areas (SFHAs), which are subject to minimum floodplain management standards. A 100-year flood is a flood level that has a 1 percent chance of being equaled in any given year.

> Floodplain management standards in SFHAs:
>
> Prevent new development from increasing flood threat.
>
> Protect buildings from future flood events.

To ensure that appropriate construction materials and methods have been used, local permitting offices are required to obtain detailed documentation on construction techniques for all new development and substantial redevelopment.

FEMA may designate a *floodway* in urban areas to avoid significantly increasing upstream flood elevations. A *floodway* is defined as the river channel and adjacent floodplain that must remain unobstructed in order to discharge the base flood without increasing flood levels by more than one foot.

Under NFIP, communities must prohibit any development in the designated floodway that could cause an additional rise in the base flood elevation.

Oregon Comprehensive Land Use Planning

The Comprehensive Plan provides the framework for protecting and enhancing water quality and the management of flood hazard areas. All water quality provisions in the land development code should be supported by the appropriate Comprehensive Plan goals and policies. There are three key goals that are of particular interest; Goals 5, 6 and 7.

- *Goal 5* – Natural Resources, Scenic and Historic Areas, and Open Spaces Inventory- Requires local governments to inventory and evaluate resources and develop land use programs that conserve and protect significant resources. A local inventory and protection strategy must be developed for three resources by completion of the jurisdiction's next periodic review. These resources are: riparian corridors, including water and riparian areas and fish habitats, wetlands and wildlife habitat.
- *Goal 6* – Air, Water and Land Resources Quality - Requires that "all waste and process discharges from future development, when combined with such discharges from existing developments shall not threaten to violate, or violate applicable state or federal environmental quality statutes, rules and standards." Wastewater and pollutants include pollutants carried by stormwater, as well as impacts on habitat that result from stormwater flows. Jurisdictions must insure that their comprehensive planning processes are in compliance with federal and state water quality regulations and with their comprehensive planning process.
- *Goal 7* – Areas Subject to Natural Disasters and Hazards - Requires that Comprehensive Plans "should consider as a major determinant, the carrying capacity of the air, land and water resources… (and) should not exceed the carrying capacity of such resources." In protecting against floods and other natural disasters, local governments may limit development within floodways and reduce impervious surfaces.

Healthy Streams

Watersheds drain water from topographical divides to a network of streams and rivers that flow to the ocean. A watershed *collects* water from rainfall and snowmelt, *stores* water in various amounts and for various durations within the landscape, and *discharges* water as runoff when its storage capacity is exceeded. A watershed also provides *pathways* along which physical and chemical processes take place and *habitat* for the flora and fauna that promote the biological cycles of the system. Maintaining the integrity of these functions is critical to the survival of a healthy watershed.

Ecologically healthy watersheds are subject to natural disturbances such as fire, landslides, floods, channel migration, animal manipulation and will respond and adjust to changing conditions. Natural disturbances create variability and diversity in the system. The vegetated riparian area adjacent to the streams and associated wetlands is the key to a healthy watershed. The riparian channel form is created by specific soil/water interactions, water movement and whether it is high up near the headwaters or down in the lower reaches. Riparian forests and wetlands also affect and are affected by habitat dynamics and water quality.

Conflicts

Watersheds are subject to conflicting needs. For some individuals it is clean water and wildlife in their back yards or along a greenway. For others it is water for irrigation or an industrial process forming an economic base. Yet others yet rely on it for transportation or recreation.

Flood Management

Flood management reduces flooding by drainage and flood control programs. Current approaches favor policies that preserve natural drainageways and floodplains in structural and nonstructural ways. Nonstructural approaches recognize the natural drainage system and seek to preserve these features. Structural approaches change floodwater distribution by conveying it, storing it or a combination of these strategies.

Developing the flood management plan involves a five-step process:

1. Establish the program goals.
2. Identify the primary techniques of implementing flood management.
3. Apply these techniques to control flood impacts and comply with the adopted design criteria.
4. Develop a management plan for each major drainage basin.
5. Document unit cost data for developing CIP construction costs.

Flood Management Planning Goals

The goal for storm drainage facilities planning is to create and maintain a drainage management system that manages the amount and rate of surface water runoff, minimizes property damage from runoff, and controls pollutants entering the receiving stream. The community objectives related to the water quality aspects of stormwater management generally include:

1. Integrating both drainage control and water quality needs in the City's watersheds that emphasize the use of natural systems.
2. Coordinating and/or consolidating the City's resources to focus efforts on flood control and on the reduction of pollutants associated with stormwater runoff.
3. Implementing funding mechanisms that equitably allocate costs.
4. Ensuring that expenditures of program elements are commensurate with their benefits.

Flood Management Techniques

Once it is determined that a flood risk is unacceptable, there are several techniques available to mitigate the risk to a more acceptable level. These include:

1. Increasing conveyance or capacity of pipes, culverts and open channels to carry peak flood flows. This includes installation of new storm drainage systems.
2. Increasing detention storage both locally and regionally to delay or reduce peak flood flows downstream of the storage location.
3. Increasing the in-stream storage available or changing the threshold stream flow at which the available floodplain storage starts to be utilized.
4. Diverting high stream flows away from or around a flooding problem to a place downstream where greater capacity exists.
5. Acquiring properties or conservation easements in flood prone areas, as they become available.
6. Reducing effective impervious surface and/or disconnecting from the storm sewer system impervious surfaces such as roofs and parking areas. Local infiltration devices such as bioswales can accomplish this.
7. Pumping.

Increase Conveyance

This technique focuses on increasing the capacity of the downstream conveyance system to carry the flood flows more efficiently by reducing the upstream flood elevations. Ideally conveyance improvements should be designed to take full advantage of the natural system without impacting property, streams, wetlands, or receiving water. When the natural system is inadequate because of site-specific factors, it may be necessary to construct structural conveyance devices. This involves either replacing existing culverts or storm drain systems with larger facilities, removing debris or certain types of vegetation, or lining the channel with armoring rock or other materials to reduce channel friction and erosion. Water quality improvement is improved when erosion is reduced.

Many structural facilities increase the concentration of stormwater pollutants by directly discharging to streams and bypassing natural filtration processes. In some instances these can increase downstream flood peaks. However, structural conveyance remains one of the most effective means of mitigating flood risk.

Increased conveyance may be necessary to resolve the local flooding in areas not currently served by storm systems. These streets include Kapok, 5th from Cedar to Main, and along Ash.

Detention

Detention, either local on-site or regional, can mitigate downstream flood risks by reducing flows. The resulting water surface near the at-risk site drops to an acceptable range. In-line detention constricts the channel, usually with an undersized culvert, in order to back up floodwaters into enlarged floodplain storage areas. Off-line detention uses storage located immediately adjacent to the stream. The storage remains dry during low flows when downstream capacity exists. It is designed to start filling as the channel begins to exceed its capacity.

Off-line detention is a preferred detention technique because it makes more efficient use out of a given storage volume. Little storage is used when downstream capacity exists. It does not require obstructing the natural channel as with in-line detention. The storage areas also offer more potential for secondary uses; they only flood when the creek is at or near flood stage, whereas in-line detention floods much more frequently.

Effective detention of either type must be engineered. Detention can greatly increase the duration of channel altering flows. For example, in instances such as new development where erosive channel altering flow is a concern, it is appropriate to “over detain”. Over detention matches a developed, post-project flow to an existing flow of a smaller event. For example, 10-year flow in a developed area is reduced to a 1 -2 year flow.

In-line facilities require flow control within the main channel. They are best confined to local sites. Along main channels where in-stream controls are neither practical nor desirable, off-line detention can be considered. Extensive storage volumes are required to reduce downstream flows. Regional detention can be an effective flood mitigation technique when large off-creek areas are available.

Increase In-Stream Storage

In-stream storage is similar to detention in that additional volume is provided to delay and therefore reduce peak flood flows. The storage is in-line and thus less efficient and without any restriction or control on outflows. Benefits accrue to natural resources or habitat in the form of a protective buffer around the stream. This improves in-stream water quality. However flood reductions require extensive overbank flooding. The most desirable way to implement this technique is by excavating on adjacent floodplain without using check dams or other restricting structures. This would raise the streambed, encourage channel siltation, and decrease the ultimate capacity of the stream channel.

Divert or Bypass High Flows

This technique augments the existing system with an additional path for high flows that bypasses the downstream flood risk. This can be as small as adding a second culvert or bridge opening alongside the existing one or as large as constructing a second high flow channel outside of the existing corridor. This technique would be identical to increasing conveyance. Diversions can provide secondary benefits by conveying flows to nearby wetlands or detention areas. The flood reduction from diverting high flows into bypass channels is very site specific. It depends upon the downstream water surface at the location where the diversion rejoins the main stream, the elevation difference along the diversion channel, and the geometry of the main stream channel. To provide benefit, the diversion must bypass local features that significantly retard flow.

Restrictions may include a constricted stream section, extensive meanders, or in-stream structures. Without a restriction in the channel, it is difficult to significantly reduce the upstream water surface elevation. It will remain dependent on the downstream water surface, which is unaffected by the diversion. Diversion channel design must consider the upstream flood depth, downstream flow and slope, and downstream depth. Engineering a diversion channel often requires the use of a detailed backwater hydraulic model such as HEC-RAS and can yield a channel size that significantly exceeds that of the main channel.

Diversion can be as simple as the addition of extra culverts or bridge openings at an existing, constricted location. This can result in a lower project cost than upsizing to a single, much larger culvert or bridge. Adding culverts or bridge openings was treated as a conveyance improvement in this report.

Diversion could provide for relief of flooding conditions present in the Central Business District. Construction of a bypass line would redirect high flows from the hydraulically constrained discharge channel along the railroad drainage ditch to the Freres Park wetlands. This would eliminate flooding events along Main Street.

Diversion should also be evaluated for all areas throughout the City for a 100 year storm. Areas which previously have had only nuisance flooding might experience property damage if overflow relief is not provided. All new development should be conditioned to include a 100 year overflow route to the closest channel with 100 year capacity.

Acquire Properties

In many instances, it is more cost effective to purchase flood-prone properties than increase capacity or detention. This can be considered when buildings flood and their value is less than the flood mitigation measure. Mitigating flood risk to a few high-risk sites can mean that other at-risk structures remain unprotected because mitigation opportunities and resources are limited.

The public interest may be served by gradually acquiring land and property within a floodplain. Public ownership of the floodplain allows the setting aside of land for flood conveyance purposes. It may also allow a more comprehensive restoration of wildlife habitat within the riparian corridor.

Many areas limit these acquisitions to instances where there is a willing seller of floodplain property. Properties most vulnerable to flooding are those within the 10-year floodplain and are given the highest priority for acquisition. These properties can be used for a number of additional purposes where flood risk is more tolerable, such as open space, active or passive recreation, or natural resource enhancement.

FEMA guidance limits construction in the 100 year flood plain. The currently delineated 100-year floodplain includes much of John Neal Park. Any new construction should be completed in compliance with FEMA regulations.

Reduce Effective Impervious Area

Reducing effective impervious area (EIA) is defined as disconnecting impervious surfaces such as sidewalks, rooftops, parking areas, and streets from the drainage system so that runoff does not flow directly to storm sewer systems. This allows the watershed’s hydrologic cycle to respond in a manner that more closely reflects pre-disturbed conditions. Infiltration is increased through the use of rain gardens or porous pavement. Rooftop drains are diverted to discharge on pervious areas such as lawns or bio-retention/infiltration areas.

EIA reduction should also be considered for new construction, remodeling in the Central Business District, and for multifamily developments. EIA reduction should be part of any new development or redevelopment.

Pumping

Formation of a drainage district to construct dikes and operate a pumping system is a solution to prevent future flooding in John Neal Park. This solution is costly and requires an ongoing pump maintenance program.

Water Quality Best Management Practices (BMP's)

Water quality is more effectively achieved when viewed from a systems approach, as opposed to individual projects. That is, the pollutant control is viewed as the sum of the parts, taking into account the range of effectiveness associated with each single practice, the costs of each practice, and the resulting overall cost and effectiveness. Some individual practices may not be very effective alone but, in combination with others, may provide a key function in highly effective systems.

The EPA's Phase II rule encourages such system-building by stating the minimum requirements in more general terms, which allows for the use of appropriate situation-specific sets of practices that will achieve the minimum measures. Once pollutants are present in a waterbody, or after a receiving waterbody's physical structure and habitat have been altered, it is much more difficult and expensive to restore it to an undegraded condition. A management system approach that relies on preventing degradation of receiving waters is recommended.

Structural BMP's

Structural BMP's are those that require capital expenditures by the City. They fall into three broad categories; Natural Resource Enhancements, Regional Water Quality Projects and Retrofit of Urban Storm Systems. The first two categories (*i.e.,* natural resources enhancements and regional water quality projects) deal with the stream and its associated riparian corridor. The third category, Retrofit Urban Storm Systems, deals with techniques applied to the storm drainage systems that are tributary to the streams themselves.

Natural Resource Enhancements

Water quality improvement techniques applied along or within the stream channel itself. These techniques reduce sediment and associated pollutants that originate near or in the stream channel itself. They include:

1. Tree Planting - Planting trees and other woody vegetation along the stream provides shading for temperature reduction and wildlife habitat.
2. Vegetative Buffers - Establishing an open pervious area or buffer along a stream that is vegetated provides for filtering of overland flow moving to the stream as well as wildlife habitat.
3. Stream bank Stabilization - Bio-engineering techniques that utilize natural vegetation and live plants arranged in a structurally sound pattern that can help stabilize eroding stream banks, lower suspended sediment concentrations and provide for better fish habitat.
4. In-Stream Stabilization - Placing woody debris to encourage in-stream sedimentation that can help stabilize a degrading channel to reduce erosion, lower suspended sediment concentrations and provide for better fish habitat.
5. Increase Floodplain Function - This enhancement increases the frequency and duration of a stream's use of its floodplain. It provides water quality benefits by trapping sediments on the stream's overbanks or floodplains. This technique requires engineering and involves in-stream control structures. The Freres Park Area offers the opportunity for this type of water quality enhancement.

Regional Water Quality Projects

A higher level of engineering and hydraulic design is usually required for these types of projects. They treat stormwater from a large area. These projects are located on land parcels traversed by a stream, and require greater land area than required for natural resource enhancements.

These projects involve some land modifications through grading to provide the water quality improvement.

1. Sedimentation/Detention - Construction of wet ponds create open water and a significant amount of dead storage volume (*i.e.,* water stored in the pond below the minimum outlet elevation). This encourages the deposition of sediments entering the facility. The pond's negative impact on stream temperature can be reversed by the use of an extended dry design such that during a wet weather event a wet pond with considerable dead storage volume is created. However, this dead storage volume is gradually drained between storm events by the use of weep holes in control structures or infiltration trenches.

2. Bio-filtration/Swales - Construction of large, well vegetated and primarily grassed areas designed to provide for shallow, slow stormwater flow to maximize potential infiltration and sediment filtration.
3. Biological Uptake/Created Wetlands - A man-made wetland requires hydric soil conditions and good hydrologic control. Hydric soils are soils formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper part. The wetland vegetation provides the desired biological reduction of various pollutants. These include nutrients that reduce dissolved oxygen in the water. Other processes such as sediment filtration, sedimentation and infiltration also occur in a created wetland facility. Good design requires the upstream removal of excessive sediments, metals and toxics through the use of a sedimentation pond or other sedimentation device upstream of the wetland.

Retrofitting Urban Storm Systems

These techniques involve the potential retrofit of key portions of urban storm systems. Retrofitting modifies these systems to intercept or passively treat the contaminated stormwater before it reaches the stream. The processes include sedimentation, bio-filtration and filtration. Urban storm system retrofits are expensive since they generally involve engineered structures that must be fit into an urban area and often installed underground.

These facilities will then need to be maintained or cleaned on a regular basis. In a retrofit situation, it is a common practice to design a high flow bypass such that all storms up to a specified water quality storm receive treatment. Flows greater than the water quality design flow are bypassed. Retrofit techniques could be used to reduce stormwater pollutants throughout the Lyons study area.

1. Traditional Sedimentation Devices - These are passive sedimentation devices such as sediment trapping water quality inlets and sedimentation or pollution control manholes. All of these devices rely on the use of an enclosed sump or sediment storage area below the outlet pipe that accumulates sediment through a natural sedimentation process.
2. Enhanced Sedimentation Devices - Specialty devices that are generally located underground and are designed to capture more and finer sediment than the traditional devices described above.

3. Bio-swales - Grassy swales are designed at the outfall of a storm system to filter sediment and other pollutants from stormwater before it enters the stream.
4. Enhanced Filtration Devices - Specialty stormwater filtration devices that can provide a high level of sediment and associated pollutant reduction through the use of various filtration media such as composted leaves or a combination of sand and peat.
5. Reduce Effective Impervious Surfaces - Disconnecting roof drains that are directly connected to the storm system. Disconnection techniques involve the use of porous pavement or porous pavers to replace impervious surfaces.
6. Proprietary Systems
    a. STORMCEPTOR®
    b. VORTECHS®
    c. DOWNSTREAM DEFENDER®

Techniques	Water Quality Problems Addressed								Other Benefits	
	Higher Temp	Upland Erosion	Instream Erosion	Sediment Deposition	Higher Nutrients	Higher Metals	Higher Bacteria	Higher Oxygen Demand	Reduce Flood	Improve Habitat
Natural Resources Enhancement										
Tree Planting	H	N/A	L	N/A	N/A	N/A	N/A	N/A	N/A	M
Vegetative Buffers	M	N/A	M	L	L	L	L	L	L	M
Streambank Stabilization	H	N/A	H	L	M	L	L	L	L	M
In-Stream Stabilization	L	N/A	H	M	M	L	L	L	L	H
Increase Floodplain Function	N/A	N/A	N/A	H	L	L	L	L	M	L
Regional Water Quality Projects										
Sedimentation/Detention	L	N/A	N/A	H	L	M	L	L	H	L
Bio-Filtration/Swales	M	N/A	N/A	M	M	M	L	L	M	L
Created Wetlands	L	N/A	N/A	M	H	M	H	M	M	H
Retrofit Urban Storm Systems										
Traditional Sedimentation Devices	N/A	M	N/A	M	L	M	L	L	N/A	N/A
Enhanced Sedimentation Devices	N/A	H	N/A	H	L	H	L	L	N/A	N/A
Bio-Swales	L	L	N/A	L	L	M	L	L	L	L
Media Filtration Devices	N/A	H	N/A	H	M	H	H	M	N/A	N/A
Reduce Impervious Surface	L	L	N/A	N/A	N/A	N/A	N/A	N/A	L	N/A

H – High M – Medium L – Low N/A – Not Applicable

Table 1 – Structural Water Quality Improvement Benefits

Non Structural Water Quality Improvements

Non-structural water quality improvements do not require a governmental expenditure of capital dollars. Public involvement and public education are classic examples of non-structural water quality improvement techniques. City and other governmental regulations, ordinances and permit programs requiring water quality protection are also examples of non-structural water quality improvement techniques. A good example is the City's current regulation that requires permanent stormwater control facilities for all new development.

STUDY AREA CHARACTERISTICS

Location

The study area is located in north central Linn County Oregon approximately 23 miles east of the City of Salem on the south side of the North Santiam River. The study area includes the City of Lyons City limits and designated Urban Growth Boundary (UGB) as well as contributing drainage outside the UGB. The boundaries of the study area are the North Santiam on the North Side of the City, the western boundary for the City, the north side of McCully Mountain from the drainage divide, and to the east a stream corridor draining directly to the North Santiam. The size of the study area is approximately 945 acres or approximately 1.5 square miles. .

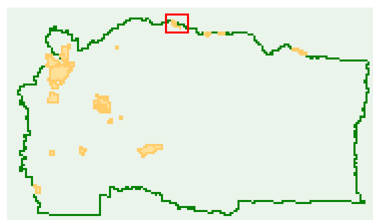


Figure 1 – Linn County Vicinity Map

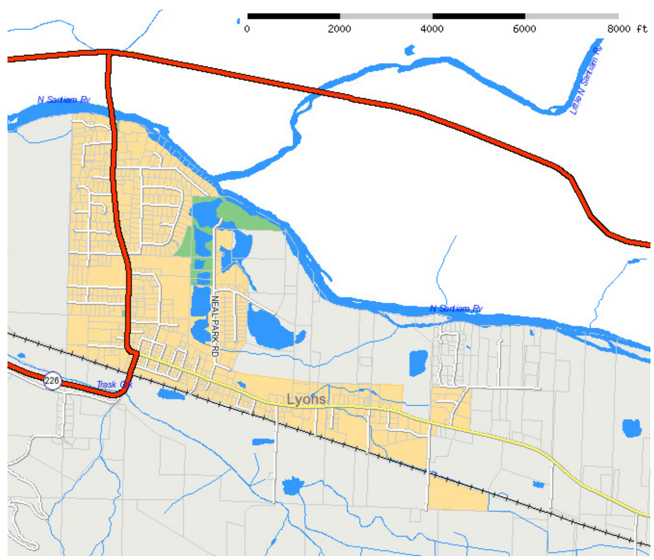
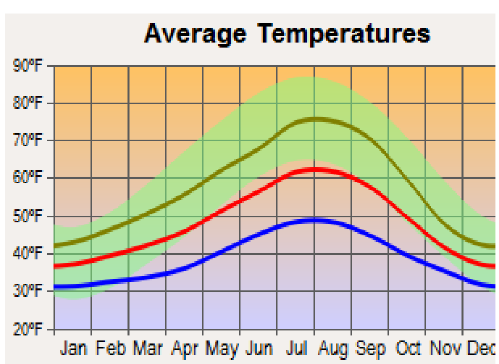


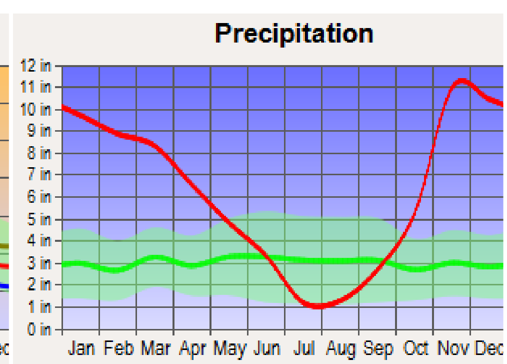
Figure 2 – Study Area

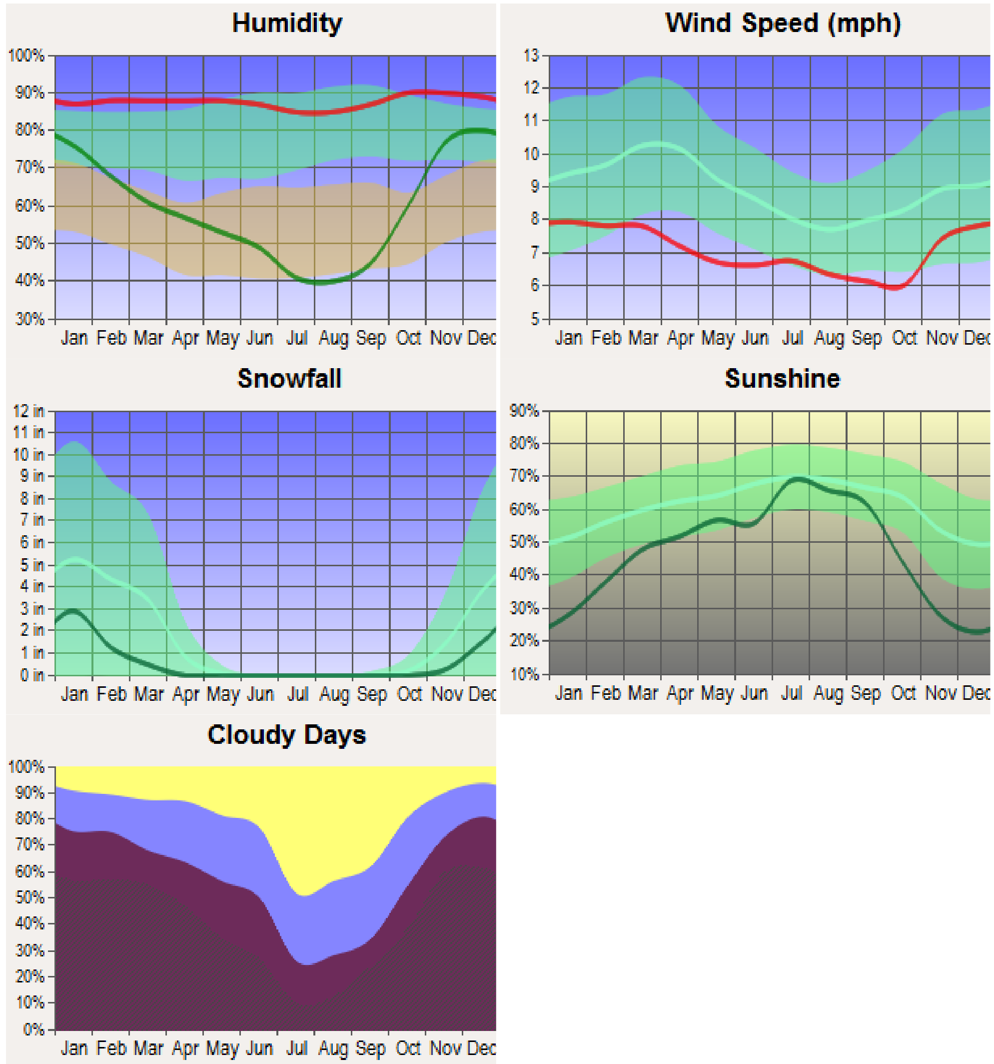
Figure 3 – Aerial Photograph

Climate Data

The region experiences approximately 70+ inches of precipitation in an average year. Almost one half of the annual precipitation occurs in the November through February period. Runoff that occurs on frozen ground, and results from precipitation coincident with snow melt, will produce the most critical flood and drainage situations.







Topography

The study area is a tiered flat plain above the North Santiam River and moderately steep, forested slopes on the north side of McCully Mountain. The northern boundary is the North Santiam River and the southern boundary is the old Southern Pacific Railroad line running east to west.

There are three tiered terraces created by the river's meandering and flood sediment deposits. This has resulted in generally flat areas sloped away from the river to channels running east to west before turning north to the river as it follows a historic meander of the North Santiam.

Trask Creek is the southern most of these channels and intercepts all of the runoff from the hillsides to the south. Trask Creek continues west for over a mile before discharging to the North Santiam. South of the terraces is a moderately sloped and forested hillside to McCully Mountain, with several drainage tributaries to Trask Creek. Elevations range from 620 at the northwest corner of the City to 710 at the southeast. The forested hillside of McCully Mountain, which drains north to Trask Creek climbs to an elevation of 1500.

The lower terrace lies adjacent to the North Santiam River and tributary drainageways. It is characterized by irregular topography, old channel meanders, and predominantly wooded ground cover with some pastureland. This terrace is has been partially developed within the City limits and in adjacent unincorporated land to the east. Several abandoned gravel borrow sites remain local ponds as a result of gravel operations. The lower portions of this terrace lie within the flood plain of the North Santiam River and must comply with flood development standards and restrictions.

The intermediate terrace lies adjacent to Highway 226/5th Street between the North Santiam River and the downtown area. The original drainageways have been altered and partially replaced by a ditch and storm sewer system along Highway 226. Subsequent development and lack of maintenance have left some areas without natural drainage. They rely on surface infiltration for flood protection and have been subject to nuisance flooding. Land use is predominantly single family residential.

The upper terrace level includes the Central Business District, and commercial/ industrial properties lying adjacent to County Highway 222 (Main Street) and the railroad. Drainage is generally in the southeast to northwest direction. However, the Central Business District drainage has been routed west to the railroad drainage and along the west section of Main Street.

Areas south of the tracks are primarily industrial and drain to Trask Creek. This area is outside the City limits but is designated as an Urban Growth Area. Trask Creek is on the south side of the railroad, running from east to west parallel to the tracks. It drains all of the industrialized area south of the City which includes most of the UGB and the steeper slopes of McCully Mountain.

History

Lyons, a town of 1,161 is in the foothills of the Cascade Mountains. In 1880, Captain James C. Lyons and Henry Lyons, two Irish brothers, founded Lyons in the scenic North Santiam Canyon, 23 miles east of Salem. Other settlers soon followed from Scotland, Kansas and the Plains. The timber industry and the railroad played an important role in Lyons' economy. It was incorporated in 1958. The timber industry is still strong and in recent years the North Santiam River, which rushes along the northern side of town, has become well known for its fishing and white water recreational activities.

Land Use

Based on the City's zoning, the existing land use distribution within the study area is shown in Figure 4 and tabulated in **Error! Reference source not found.**. The majority of the study area is zoned Residential most of which is Single Family and is of a low density. Multi-Family Residential land has not been fully developed. The total residential zoned area, including low, medium and high density, comprises approximately 65% of the study area.

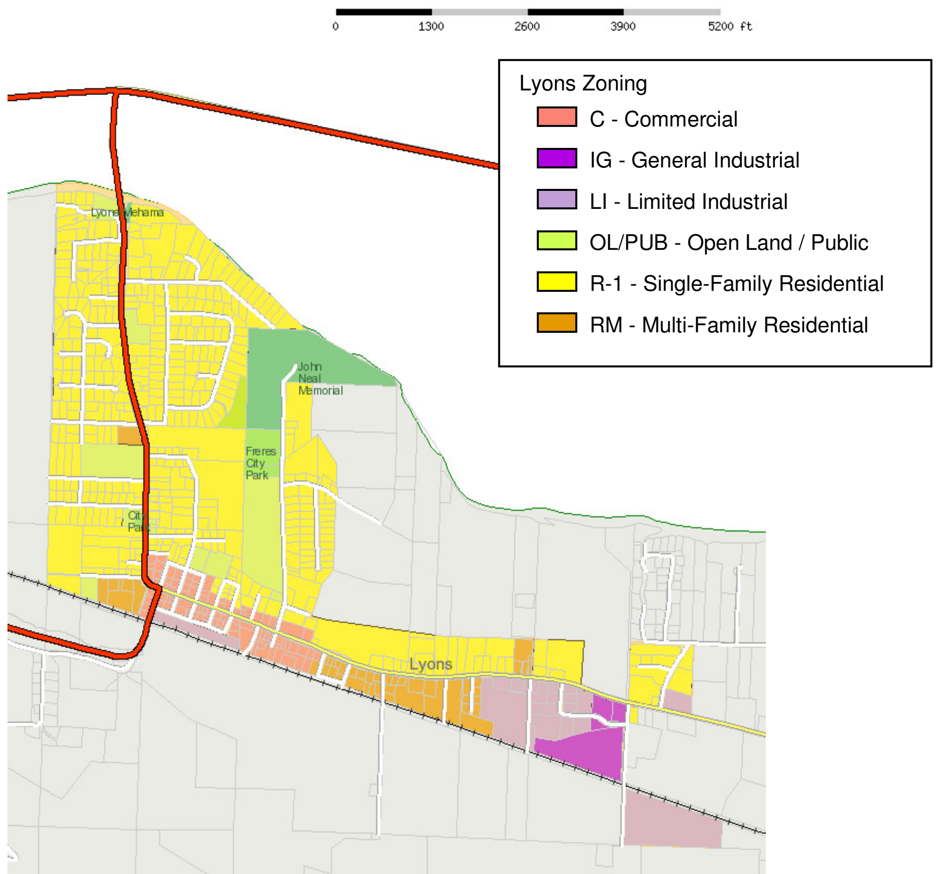


Figure 4 – Land Use

Public lands include parks and open spaces. The commercial land is located in the Central Business District. Industrial land, primarily serving the timber industry, is located on the east side of the City.

Development in Multi-Family Residential zone and redevelopment in the Industrial Commercial Zone will offer an opportunity for the City to correct drainage deficiencies.

ZONING	ZONE NAME	ACREAGE	PERCENTAGE
COM	COMMERCIAL	24	4.30%
IND	INDUSTRIAL	62	11.12%
RES	MULTIFAMILY RES	31.5	5.65%
PUB	OPEN LAND/PUBLIC	46	8.25%
RES	SINGLE FAM RES	328	58.83%
ROW	RIGHT OF WAY	66	11.84%

Table 2 – Land Use

Vegetation

Vegetation within an area impacts the runoff generated from a storm. A dense forest will intercept significant precipitation before it reaches the ground. An area with very few trees and grass vegetation coverage allows more precipitation to reach the ground and become runoff. The urban vegetation designation refers to lawns and smaller trees that would be located in landscaped areas. 'Urban' coverage generally coincides with the areas of residential zoning. More highly developed commercial and industrial areas with less vegetation experience higher runoff rates.

Soils

The area is underlain by igneous rock formations. Soils resulting from geologically young rocks tend to be medium textured, shallow, and stony. The City is situated on three levels of terraced, gravelly loam soils. Gravels are exposed at numerous locations throughout the City. In other locations, there is only shallow soil overburden on the gravels.

Soil Classification System

Category A - Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Category B - Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Category C - Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Category D - Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

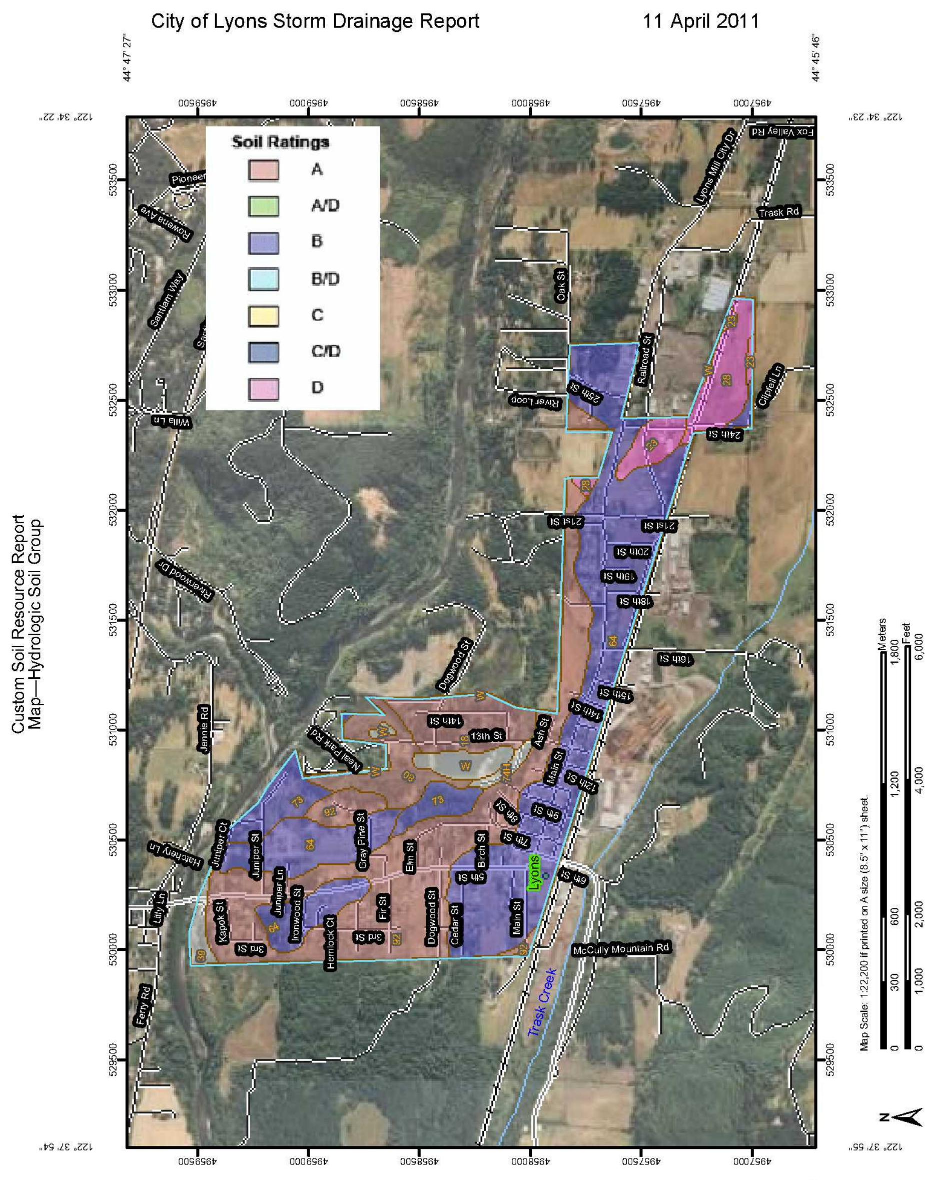


Figure 5 – Hydro Soils Map

Soils pH is in the relatively neutral range of 6.0 to 8.0. Deterioration of buried pipes due to soil reaction should be at a minimum. Both concrete and plain galvanized metal drainage structures are considered acceptable for most installations. Lyons is fortunate to have predominately permeable well draining Class A and B soils within the City limits. This has allowed a minimal storm infrastructure to provide adequate drainage. However with increasing development and long term disturbance and compaction of the surface soils, natural permeability decreases over time.

Watersheds

A watershed is an area that drains to a specific river, creek or waterway. All of the study area drains to the North Santiam River and is included in the North Santiam Watershed.

Most of the areas south of the railroad tracks drain to Trask Creek at the base of McCully Mountain. North of the railroad natural drainage has been interrupted by development including the railroad tracks and highways. Areas west of Highway 226 shed water to the west and ultimately into the North Santiam in unnamed shallow natural drainage channels. East of Highway 226 is an unnamed tributary flowing generally northwest from the southeast corner of the City through Freres Park and then into the North Santiam. For the purposes of this report the unnamed tributary will be called 21st Creek. This creek collects several natural drainage channels created by the tiered terraces as well as all the pipe drainage systems.

Within the study area there are small residential areas in close proximity to the North Santiam draining directly into the river.

Stormwater Collection Systems

The existing stormwater collection system consists of natural channels, ditches, pipe systems and infiltration facilities. Recent development in the study area has included stormwater detention facilities.

Most of the main drainageways are ditches and open channels with culverts at road crossings. The piped collection systems are constructed within the Central Business District, the north end of Highway 226 and recent developments. The older developed areas, those constructed prior to 1970s, rely on surface infiltration with no designated drainage ditches or stormwater infrastructure.

Flood Plains

The low lying areas alongside the North Santiam River are adjacent to the 100 year flood zone established by FEMA. The flood zone elevations are 617 at the Northwest corner of the City to 639 in John Neal Park. Figure 6 shows that residences along the river are adjacent to the 100 year flood plan.

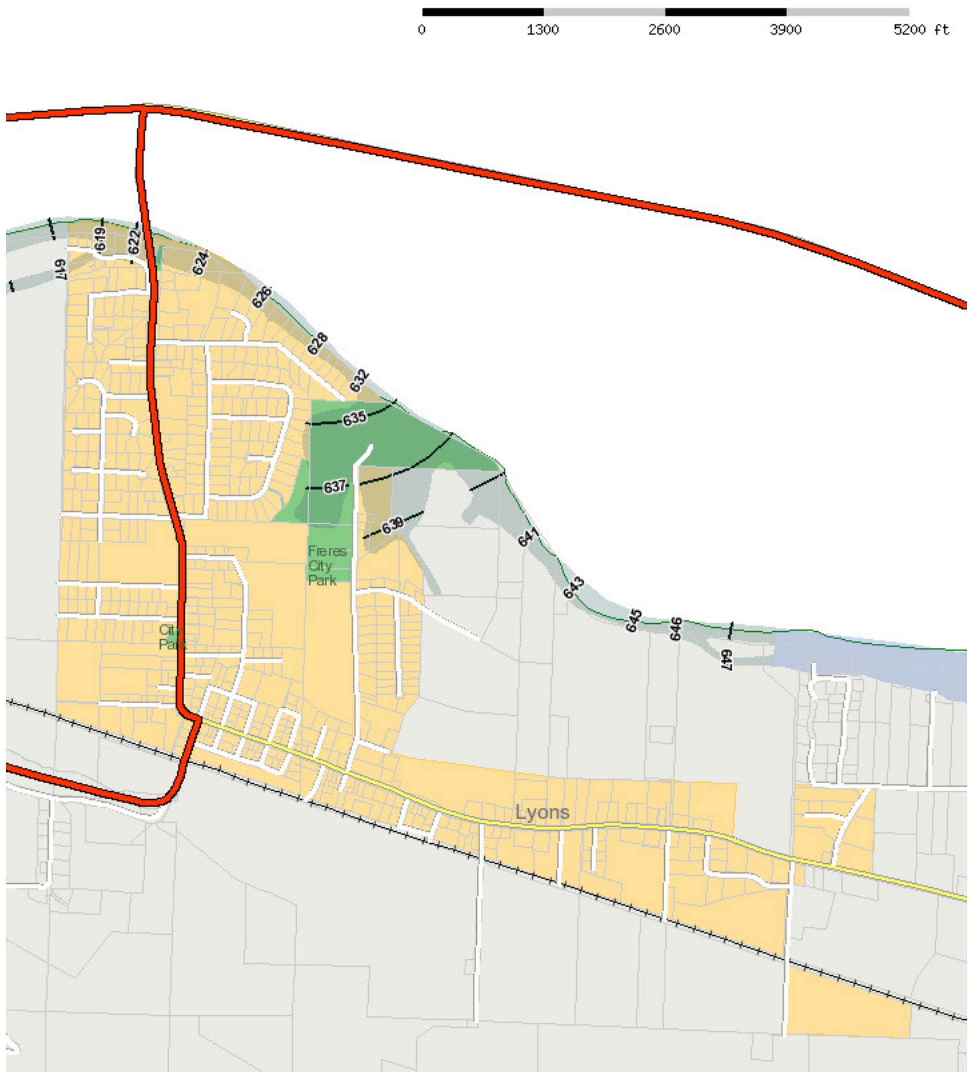


Figure 6 – Flood Plain Map for the City of Lyons

REVIEW OF EXISTING CONDITIONS

The existing drainage system consists of:

1. Surface drainage to roadside ditches.
2. Streams.
3. Privately installed and publicly owned storm drainage systems in residential developments.
4. Infiltration.
5. County, railroad and state installed storm drain systems.
6. Culverts.

Streams

Two primary streams serve the study area, Trask Creek and 21st Creek.

21st Creek

An unnamed creek flows through the City from the south east after originating in the fields immediately outside the City. For the purposes of this study this creek is referred to as 21st Creek. This area outside the City has reported frequent flooding though the years. Several ditches have been constructed across property lines and basins to alleviate flooding conditions. The soils in this area have very low permeability. The flooding is likely the result of groundwater from the adjacent hills percolating to the surface under pressure as opposed to surface drainage. Culvert sizing along 21st creek appears to be insufficient to accommodate excess flows.

Figure 7 – Pollution

Flow to 21st Creek crosses the railroad tracks at two locations. The eastern most culvert crosses under the railroad tracks and parallels the railroad right of way to 24th Street. Two 24 inch culverts cross under 24th Street continuing west. Another ditch along 24th Street contributes to the flow along with undocumented pipe connections to the ditch along 24th. This area floods annually. Recent maintenance cleared the 2nd culvert of debris.

West of 24th Street, 21st Creek continues parallel to the railroad tracks to a point where it joins a second tributary culvert from the south under the railroad tracks. The creek drains to the southwest through culverts under 21st and Lyons Mill City Drive at 19th Street. It continues south and west through primarily pastureland before crossing under 13th Street/John Neal Park Road into Freres Park.

The water quality condition of 21st Creek is poor as evidenced by a layer of sludge along the streambeds adjacent to industrial areas and discolored water downstream of industrial areas. There is no buffer for the creek.

Trask Creek

Trask Creek originates on the McCully Mountain hillside to the southeast of the City and flows along the bottom of the hills to the west. It collects drainage from the hillside and the industrial area south of the City. In the City UGB area there are several industries utilizing water from Trask Creek for mill operations and discharge back to Trask Creek. Trask Creek is an identified fish bearing stream in the 2002 Watershed Analysis.

Trask Creek has beavers that routinely create dams in the creek that cause local flooding. To the southeast, ditching has occurred between basins to alleviate some of the localized flooding. However, this adds to the existing drainage through the City.

Residential

The drainage systems for residential areas vary widely. Residential developments in the City appear to be served by surface runoff. The newer developments, Canyon Meadows 2, Timberview, Quest, and Canterbury have roadside swales installed. Street drainage is provided by both infiltration facilities and roadside ditches connected to a piped storm drain system. Kapok Street has reported standing high water in an isolated drainage ditch.

Some residential areas have no defined drainage, relying entirely on infiltration and surface flows. Construction materials and geometry for existing ditches vary widely. Ditches are filled in at numerous locations by landscaping. Additionally:

1. The west side of City, from Golden Leaf to the railroad tracks reports flooding.
2. City installed drainage from south of City Hall to Ash Street, adjacent to Hwy 226, was installed (1985) but appears to have failed

Public Parks

Much of John Neal Park is below the flood plain as established by the FEMA 100 year flood event; Zone X. This area has a 1% probability of flooding during any given year. All of John Neal Park is in the Zone X designation which puts them in the 500 year flood plain with most in the 100 year flood plain.

Central Business District and Main Street

The Central Business District along Main Street is served by a storm drain installed by the County from 5th Street to 13th Street. It drains to the west and then south to the south side railroad drainage ditch in an ODOT drainage easement. Drainage from there is maintained by the railroad. The easement to the railroad is overgrown and drainage structures are not maintained. From previous records it appears to be both an open ditch with inlets and a culvert section connecting to the railroad ditch. An inlet on the south side is covered in dirt. The parking lot for the Corner Market reportedly floods regularly with poor drainage along the rest of the line.

Industrial property between Front Street and the railroad has no drainage infrastructure. There is no railroad ditch along this section on the north side of the railroad tracks.

Industrial Area

The industrial areas on the east side of the City are served on site by undocumented private drainage system discharging to 21st Creek and roadside ditches south of Lyons Mill City Drive. This area has industrial development adjacent to 21st Creek with no buffer or protection. This Creek is unhealthy, as evidenced by the algae growth. It flows into Freres Park.

Figure 8 – No Buffer Area

Along the stream corridor which includes the Railroad ROW ditch, several culverts are blocked by debris which causes flooding. In addition adjacent industries may have inadvertently filled in the ditches/drainageways. Along 24th Street are undocumented culverts and private connections that have flooded in the past but currently appear clear.

A smaller industrial site along 25th Street has an onsite water quality facility prior to infiltrating low flows back into the soils. High flows are directed to a public drainage line along 25th Street

Figure 9 – Blocked Culvert

1:

and then to the west in a natural drainage channel.

ODOT Highway 226/5th St

ODOT Highway 226/5th St goes through town north to south crossing the North Santiam River on the ODOT Bridge at the north end. A storm drainage system extends a half mile to the south. All highway runoff is discharged untreated adjacent to the bridge where it flows into the North Santiam River.

Figure 10 – Unmaintained Outlet

From Fir Street to 5th Street there are no drainage facilities except for an inadequately sized and failed infiltration system between Cedar and Ash, which relies on a drywell adjacent to City hall. Localized flooding occurs in this section and is dispersed by surface infiltration.

From 5th Street to the railroad, drainage is to County facilities installed on Main Street and to the railroad ditch. An ODOT easement, behind the Corner Market is overgrown and inaccessible from the north and south. An inlet on the line adjacent to the railroad is buried.

County Highway, CR 6 Main Street, Lyons Mill City Drive

East of 13th Street, drainage crosses Lyons Mill City Drive south to north in several culverts most of which were replaced or newly constructed in 2004. There are no reported drainage problems along this section of the Highway.

Design Standards

In 2003, the City passed Resolution #305, Guidelines for Public Works, Street and Storm Drain Design Standards for the City. There are two major observations.

The design standards are not specific when it comes to defining the needed hydraulic parameters. For example, specific rainfall numbers are not specified. Water quality is addressed by a single requirement for an oil water separator to be installed by the developers.

Secondly, they are not evenly applied throughout the community. Examples are:

1. Road side ditches in residential areas are not meeting the standards.
2. Driveway culverts do not appear to meet the design standards.
3. There are no records available of video inspection.

4. Access for maintenance does not appear to be provided. Some storm facilities are inaccessible and some outlets cannot be located and/or have no easements.
5. Easements specified by the standards are lacking. The 2004 plat for Timberview Phase 2 did not provide an easement for discharge from two public storm drain lines between Lots 12 and 44. In 2002, the PI Subdivision was platted without an easement for major drainage or the needed setbacks and protection.

Figure 11 – Filled Catch Basin

6. Lack of engineering effort including as-built drawings and engineered stormwater facilities.
7. No program for private drainage system compliance inspection was found.

Maintenance

Maintenance is limited to bi annual cleaning of the catch basins. Other storm facilities, culverts, pipes, manholes, ponds and drainageways are addressed as problems occur. Culverts may have decreased capacity from sediment and damage. Drainageways lack buffers.

Figure 12 – Water Detention

Water Quality

Water quality facilities are not generally recorded on City As Built plans. Only one public oil water separator on Juniper Court as part of the Nydeggar Partition was found. A private facility was also identified at the fire station. No records of any maintenance for water quality facilities were located.

The natural drainageways and ditches provide some level of water quality treatment. Lack of formal protection and little required onsite water quality treatment limit their effectiveness.

Water Detention

Three existing detention basins in the City of Lyons were identified. No design data is available for them.

The detention basin designed for Timberview Phase 2 discharges to the Quest/Canterberry detention basin. The emergency overflow requires maintenance.

Immediately downstream of the Timberview detention basin is the Quest/Canterberry detention basin. This detention basin also appears to function as a water quality swale. Discharge is directly to the North Santiam River; therefore detention should not be required. Detention at this location could increase peak flows in the river a small amount by delaying water release to coincide with higher upstream peak. However since flood elevations of the adjacent North Santiam are higher than the bottom of the basin, it provides flood storage.

A detention pond was also installed with the PI Subdivision. This basin reportedly fills with stream flow during high water events in the adjacent stream. There is no record of maintenance for these facilities. The following drawings illustrate these findings.

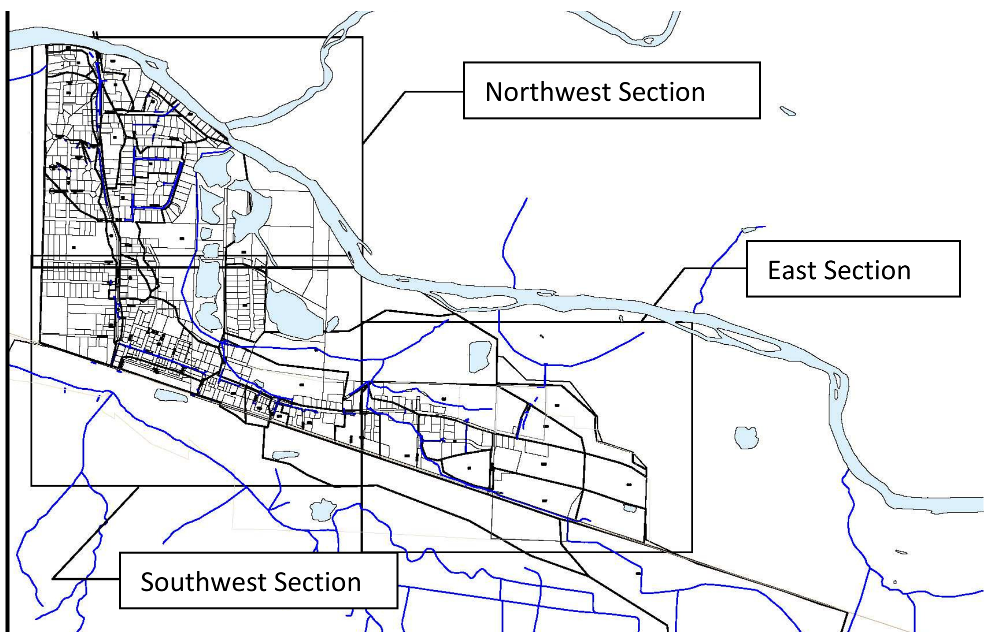


Figure 13 – Key Map

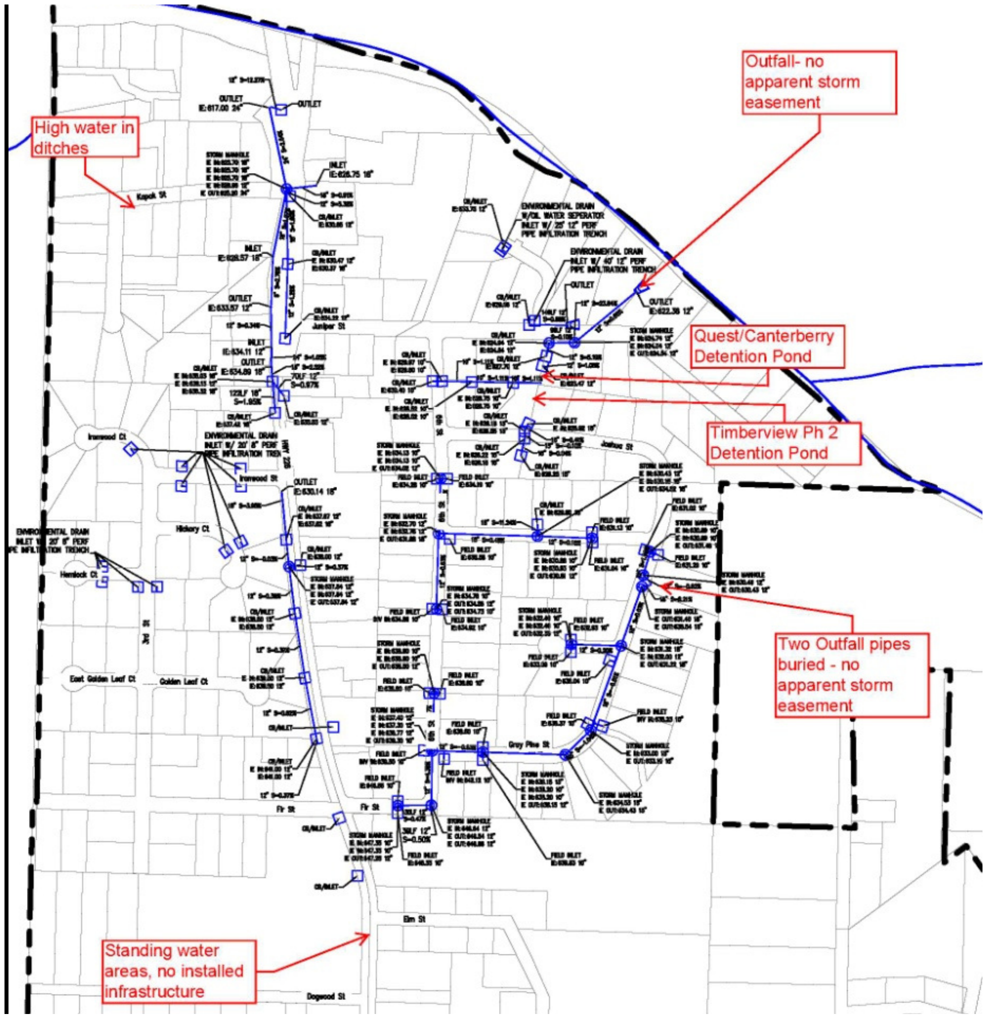


Figure 14 – Assessment Northwest Section

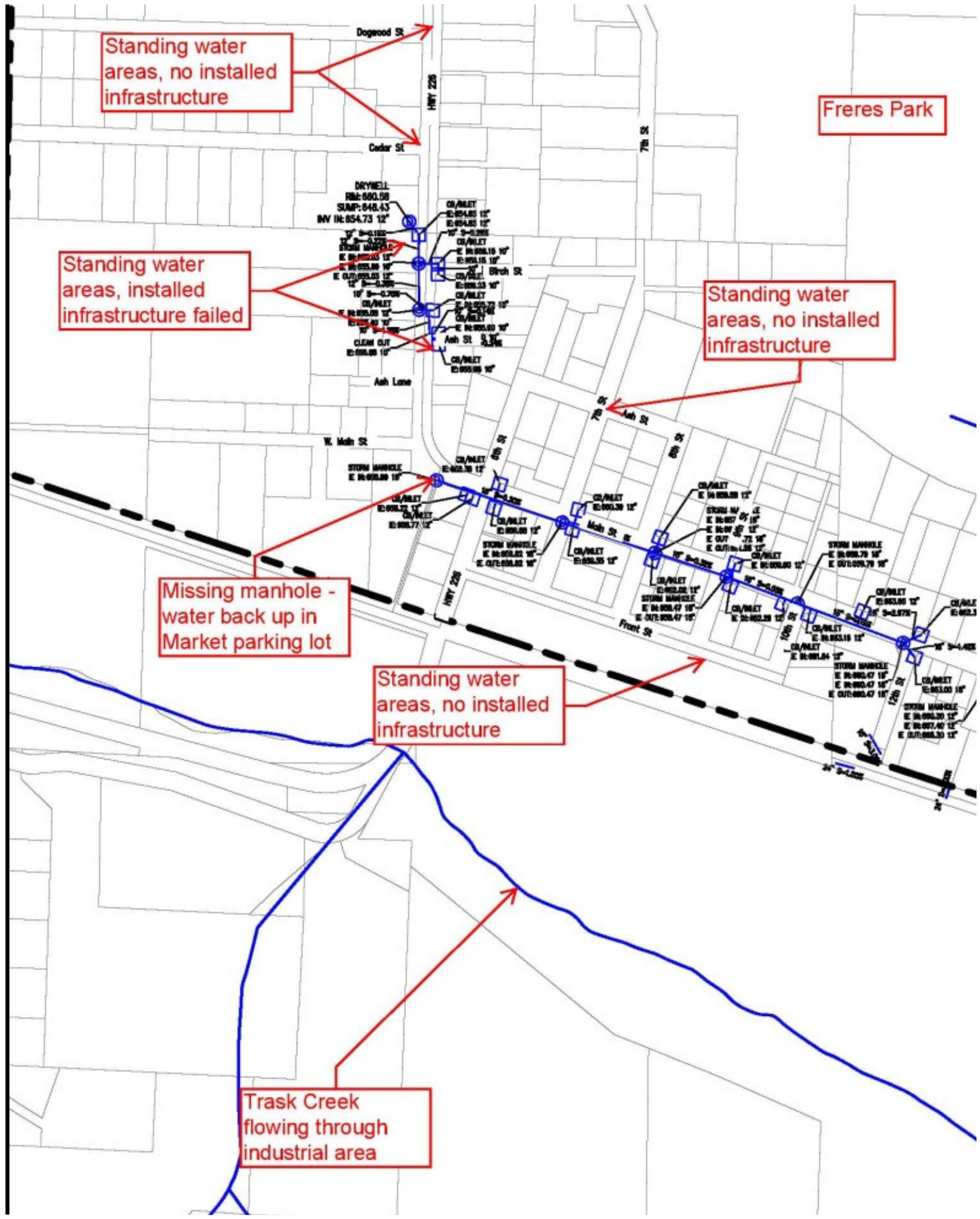


Figure 15 – Assessment Southwest Section

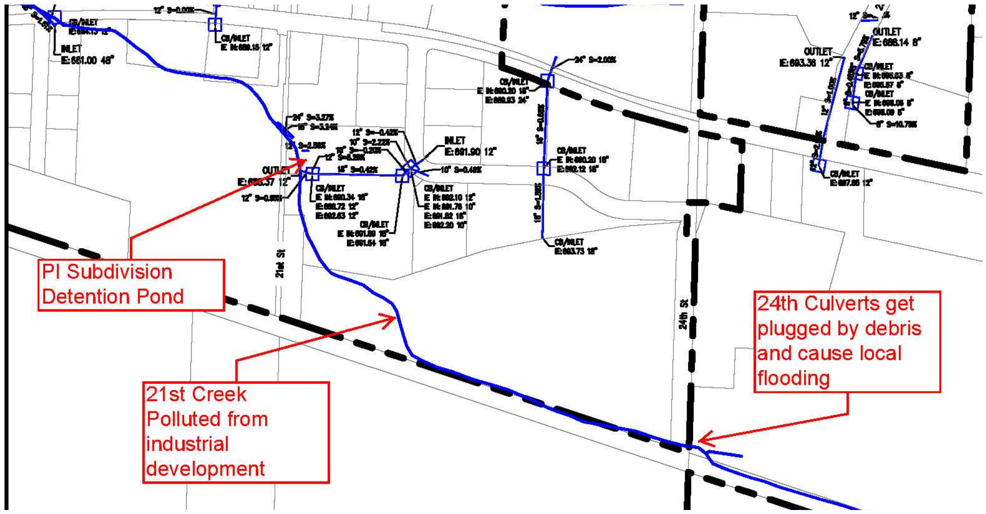


Figure 16 – Assessment East Section

HYDROLOGIC AND HYDRAULIC ANALYSES

A hydrologic analysis estimates peak flows and runoff volumes. Peak flows are used to evaluate hydraulic capacities and deficiencies in existing culverts and closed pipe systems. The analysis sizes open channels and pipe systems to correct deficiencies.

In a predevelopment hydrologic cycle some precipitation is intercepted by vegetation before it reaches the ground; some becomes surface runoff and the remainder infiltrates through the surface layers of soil to become groundwater. Surface runoff is a significant factor in determining the topography of the land. Groundwater flows maintain base flows in streams and wetlands. When there is loss of vegetation the surface soils compact and precipitation infiltrates at a much lesser rate. Deep groundwater recharge is affected and surface runoff volumes increase.

In urban areas reduced impervious surface and stormwater drainage lines replace the pervious natural conditions. The “hardscape” circumvents the typical hydrologic cycle. The loss of topsoil retention time and groundwater recharge results in less base flow in the streams. An increase in the frequency and volume of runoff can damage the physical structure of stream channels and alter wetland hydro periods. Storm events that were once absorbed by the landscape become “flash” flows; rapidly rising and falling surface waters that correlate with passing storms. These flows reach stream systems faster.

Santa Barbara Hydrological Modeling

The hydrologic model used to estimate peak flows and volumes of stormwater throughout the study area is the Santa Barbara Urban Hydrograph (SBUH) methodology. This hydrologic model is based on the Soil Conservation Services TR 55 methodology as adapted for urban environments.

The SBUH program includes these basic components to create the model:

1. Basin Definition, size, land and soil type, time of concentration and curve number.
2. Design Storms – typically defined as 24 Hour storm event with a specific return period (probability).
3. Reach Definitions – flow channels without contributory areas.
4. Routing Diagrams showing the linkages between the basins and reaches.

Basin Definitions

The basins are delineated based on their characteristics. They can be as small as a parking lot or very large rural runoff areas. Each drains to a single point which is where the hydrologic curve is computed. Downstream of these basins the hydrographs are mathematically combined based on flow times and volumes.

Thirty nine sub-basins for the Lyons' report are defined based on LIDAR data, the prior Storm Report and map, existing City maps and record plans, and site investigation. The basins are named based on the development name, adjacent street or map feature. Time of concentration calculations are based on LIDAR data and evaluation of the Aerial map.

Design Storms

The SBUH model calculates peak flows from Standard Storms identified by the National Oceanic and Atmospheric Administration (NOAA) based on historical data. For western Oregon these are Type 1A. Runoff from each section of land (called a drainage basin) is graphed over a period of time coinciding with the beginning of the defined storm. These graphs are called a hydrograph. The period of time is generally defined for a 6 hour event or a 24 hour event with a defined return period. The return period is typically set at 2, 5, 10, 25, 50 or 100 years which correlate to the probability that the event will reoccur. The model used the following data to calculate peak flows

Recurrence Interval (year)	Annual Chance of Occurrence (%)	24 Hour Rainfall Depth (inches)	Criteria Comments
2	50	3.4	Flow rate to evaluate scouring ability of channels. Channels with slower than 2 fps (feet per second) will be subject to sedimentation and plugging.
10	10	4.4	Stormwater facilities to convey storm drainage runoff without surcharge
25	4	5.3	For key but not critical stormwater facilities such as highway culverts. All drainage design must maintain 1' of hydraulic freeboard from surface
100	1	6.3	For critical stormwater facilities and overflow emergency routing

Table 3 – Storm Data

Reach Definitions

Key channels are defined as "reaches" to allow hydraulic evaluation of the flow at key locations. The locations were selected based on the model and known problem areas and then modeled hydraulically to identify capacity limitations.

Channel Definitions

These are generally clear and maintained channels. For pipes and culverts this means a clear pipe with a known size and slope. For ditches and streams it would require a known channel section based on measured or surveyed geometry. This report assumed the following geometry for ditches and streams and invert elevations for pipelines and culverts from available LIDAR data.

1. Standard roadside ditch 3:1 side slopes
2. Steepened side roadside ditch 1:1 side slopes
3. Small stream trapezoidal 4:1 side slopes 2' bottom
4. Large stream trapezoidal 4:1 side slopes 4' bottom

Basin Model Routing Diagram

The Basin Model contains the physical characteristics of the modeled watershed. A physical schematic of the watershed is created using watershed elements, which are *sub-basins, reaches, ponds, and junctions*. Each of these elements is linked together to develop a schematic representation of the actual watersheds. This model used the sub basin, reach, and junction elements.

1. **Sub-basin** - a given, small watershed area. The element requires drainage area, a loss rate method, a transformation method and a base flow method. The delineation of the sub-basin areas are based on localized topography, streets, areas of concern and the existing stormwater collection system.
2. **Reach -** a conveyance system used to route or transport flow from one point to another downstream point in the watershed. It can be an open channel or a closed pipe. The required input for a reach is the routing method, shape, length, slope, cross sectional dimensions and roughness coefficient. A reach is needed to connect each of the junctions used in the watershed model.
3. **Junction -** a location within a watershed where one or more sources of flow are combined. It may represent two reaches combining. Sub basins discharge into a reach or any combination of sub basin and reaches coming together also form a reach. System reaches are used to connect the junctions through the watershed. There are no parameters required in the hydrologic model for junctions other than a name.
4. **Pond -** locations where flow can be stored to lower or attenuate peak flow. Examples of ponds are detention ponds, old gravel borrow site

impoundments, and beaver dams. The input for a reservoir is the relationship between total storage volume and outflow from the reservoir.

Basin Delineations

The watershed is divided into major basins, sub-basin areas, and an interconnecting network of major stream reaches. The starting point for the Lyons study area was the sub basin boundaries previously identified by the 1975 Drainage Map and supplemented with LIDAR topographic information.

Curve Number

The curve number determines the runoff factor for designated land uses. Each land use; farming, residential, industrial etc, has a curve number which also varies by the hydrologic soil classification of the land. A higher number represents a higher runoff. Type A soils have higher permeability and lower curve numbers. These soils dominate most of the study area and result in less runoff and flooding.

Modeling Results

Complete analysis detail is presented in Appendix B.

The SBUH model verified two known constraints. The first constraint is the discharge from the Central Business District to the Railroad Ditch and the lack of capacity for the 24th Street culvert. The Central Business District discharge cannot convey flood volumes during heavy rain events resulting in back up in the system. In addition, due to the flat grade, the line may be plugged due to accumulated sediment deposition. That condition would result in back up and flooding at the catch basins.

Secondly, the 24th Street culvert has a similar lack of capacity which results in water flowing over the street. Lack of maintenance of these systems will increase the severity and frequency of flooding conditions.

A third capacity constraint also exists at the Timberview discharge to Freres Park. It appears the discharge pipes are buried resulting in very limited discharge capacity. While some water passes through the soil, a large storm event will eventually cause a slope failure and undercut the existing street. The resulting debris would then flow across private landscape lawns.

Location	SBUH model node	Storm Event	Peak Flow (cfs)	Channel Capacity (cfs)	Notes
Timberview Outfall	11 Timberview South	2 yr	1.23	0	Buried outfall discharging into road fill. Likely failure scenario.
Main Street discharge pipe	18 CBD	25 yr	34.78	7.12	High flow with insufficient capacity. Low flows lack self scouring velocity.
24th Street/railroad culverts	36 - 21st	25 yr	45.49	42.87	Flows over road and floods industrial area

Table 4 – Modeling Results

RECOMMENDATIONS

Criteria

Drainage Planning

Planning criteria establish a desired level of protection against flooding. This desired level of protection is balanced against the risk of flooding throughout a drainage system. When the flood risk is greater than the desired level of protection, flood mitigation measures are analyzed. The choices range from do nothing to constructing facilities that provide 100% certainty of protection from floods.

Both flood risks and levels of protection against which those risks are measured using the concept of storm recurrence interval or return period and its reciprocal function; the probability of exceedance. If a hydraulic structure is designed using a 100-year storm recurrence interval, the probability that the design flow will be exceeded in any given year is only 1 percent, so the level of protection against flooding would be very high. If the design was based on a 2-year storm recurrence interval, the probability of exceedance would be very high (50 percent probability in any given year) and the level of protection would be low. The obvious trade-off in the planning and design of drainage facilities is the cost of the facility. A facility designed to withstand a 100-year flood peak will cost considerably more than one designed to only pass the 2-year flood.

The flood planning criteria defines a problem. In a simple sense, it defines when something is broken and needs to be fixed. When establishing criteria, it is appropriate to discuss the specific nature of the flooding problem. For example, if the problem involves floodwaters flowing over the road, the type of roadway becomes an important issue. The desired level of protection for a major highway or arterial could be quite different from that for a residential collector street. Also, the desired level of flood protection for homes and businesses could be quite different from that for a parking lot or roadway.

Table 5 provides an example of drainage planning criteria to identify deficient structures, and to design replacements. It lists the maximum frequency of flooding above which a deficiency would be identified, and the minimum frequency design flow that must be safely passed.

Type of At-Risk Structure or Property	Existing Condition Must Safely Pass	Improved Condition Must Safely Pass
Roadway Culvert or Bridge		
Local Street (Juniper St)	10 year	25 year
Collector (e.g. 7th St)	25 year	100 year
Arterial (Hwy 226, Main)	50 year	100 year
Buildings		
Houses and Apartments	100 year	100 year
Commercial, Institutional Industrial	100 year	100 year
Garages, Sheds, Outbuilding	10 year	25 year
Open Space		
School Yards	10 year	25 year
Backyards	10 year	10 year
Active Parks	2 year	2 year
Natural Park	1 year	1 year
Pasture Land/Fields	1 year	1 year

Table 5 – Flood Risk Planning Criteria

Stormwater Detention

Stormwater detention is currently a code requirement at both City and County levels. The City criteria is that peak runoff is limited to the historic 10 year peak runoff. However, neither the historic condition nor the design return period is specified. County requirements are adopted from the State Hydraulic Manual which requires site runoff not to exceed predevelopment runoff for the 2, 10 and 50 year flood.

There have been 3 detention ponds installed in the last 15 years. They are located in the Quest, Canterberry, Timberview, and PI Subdivisions. Design information is not available for these ponds. The Quest, Canterberry and Timberview facilities are directly connected with Timberview flowing into the Quest, Canterberry detention facility. The PI Subdivision facility discharges to 21st Creek.

For the purposes of this model detention facilities were considered at capacity providing no storage capacity for the peak storm events. This results in a conservative (higher) peak flow estimate.

Hydraulic Capacity Constraints

Constraints are defined as those elements where inadequate capacity can cause damage and hazard or locations where known flooding exists. An undersized culvert may cause water to flow over the road, creating driving hazards and causing roadway damage. Constraints are identified based on potential hazard and existing flooding reports.

Data required for the hydraulic capacity analysis included material, dimensions, shape, slope and inlet type, and for culverts, the available head at the inlet. This information was gathered using three sources; existing plans, reports and photographs, and the 1975 drainage map.

Areas along Hwy 226 between Fir and Main Street are not serviced and are known to experience local flooding. Other areas with no stormwater drainage experiencing similar problems include areas along Kapock Street and Ash Street north of the Central Business District.

The only hydraulically constrained location appears to be the discharge at the railroad right of way at the southwest corner of the City. This area is constrained by an adverse grade on the discharge pipe and inadequate capacity of the ditch along the railroad right of way.

Constraints caused by lack of maintenance are not included in this analysis. 24th Street has many reported flooding incidents which appear to be related to poor maintenance and blockage to the drainage channel and culverts. In addition, an unknown contribution of ground water from the shallow impervious bedrock to the southeast of the City is likely adding an unknown base flow to this stream corridor.

The recommendations have been broken down into CIP Items, Programmatic Items, and Long Range Strategic Objectives. A detailed Capital Improvement Project plan follows.

CIP Items

Capital Improvement Plan

Adopt the Capital Improvement Plan.

Capital Maintenance Plan

Adopt the Capital Maintenance Plan.

Programmatic Items

Design and Construction Standards

Review the City’s design and construction standards and make revisions as necessary to bring standards within currently accepted practices. Consider adapting the City of Albany's or Salem's standards to fit local needs. Require engineered standard for all developments. Make backwater analyses part of the required engineering.

Detention Facilities

Detention may not be an effective means of flood control for most of the City of Lyons. It would add to peak flood flows by delaying water volume discharge to coincide with upstream peak flows. Areas discharging directly to the North Santiam should have no detention. Areas discharging to an existing drainage channel should only detain if no local downstream flooding results.

Review Best Management Practices

Review Best Management Practices.

Surface Water Considerations in Development

Verify that your code establishes reasonable and enforceable standards for development which implement City standards including adopted BMP's.

Long Range Strategic Objectives

Public Education

Implement a public education program to improve current levels of public awareness of stormwater concerns.

Conduct Stream Assessments

Evaluate streams to focus water quality improvements on those areas that have the best return on investment.

CAPITAL IMPROVEMENT PLAN

Potential Flood Management Projects

Timberview Outfall

Locate existing pipe outfalls, acquire public easement, install pipe to Freres Park.

Central Business District (CBD) High Flow Bypass

Split hi flows from CBD discharge; install public storm line to Freres Park.

Central Business District Outfall

Replace existing pipe with 12" public storm pipe with positive grade.

24th Street Culvert Replacement

Replace existing culverts with 48" culvert and headwalls.

226 Cedar to Main

Install public drainage system. Connect to CBD bypass.

East Ash Street Drainage system

Install public drainage system. Connect to CBD discharge line

Kapok Street Outfall

Install public drainage system

John Neal Park Flood Mitigation

Acquire properties or require retrofit to FEMA flood proof standards and code compliance.

Potential Water Quality Projects

Projects are based on known deficiencies. Some projects may be eligible for federal or state programs.

Stream Assessment Trask Creek

Evaluate Trask Creek for water quality and fish passage.

Stream Assessment 21st Creek

Evaluate 21st Creek for water quality and fish passage.

ODOT Hwy 226 Outfall

Install water quality facility for outfall at bridge.

UIC Compliance Retrofit

Retrofit UICs with water quality inlets to meet DEQ standards and reduce the potential of contamination of groundwater based drinking water supply.

Timberview South Water Quality Swale

Install water quality facility at Timberview discharge to Freres Park.

Juniper Street Outfall

Install water quality facility to Juniper Street outfall to North Santiam River.

Stream Protection Setbacks and Buffers

Acquire easements and buffers to Trask and 21st Creeks.

Capital Maintenance Projects

All systems require regularly scheduled maintenance to extend their life span.

Construction Standards

Verify that design and construction standards meet current practice and that they implement TMDL programs.

Catch Basin Inventory

Complete photo inventory and condition inspection of existing inlets.

Culverts and Outlets Inventory

Complete inventory and condition inspection of culverts and outlets facilities.

Pipe Systems Inventory

Perform an inventory and condition inspection of piped drainage systems.

Water Quality and Detention Pond Inventory

Inventory and condition inspection of water quality and detention pond facilities.

UICs

Inventory and condition inspection.

General Operations

1. Conduct annual review of standards and operations.
2. Conduct 5 year review and update of Drainage Plan.
3. Biannual inspection of inlets culverts, inlets and outlets, cleaning as necessary.
4. Inspect pipe system on 5 year rotating schedule.
5. Inspect detention ponds and perform maintenance each spring and summer.
6. Verify ongoing UIC compliance per UIC registration.

Preliminary Plans

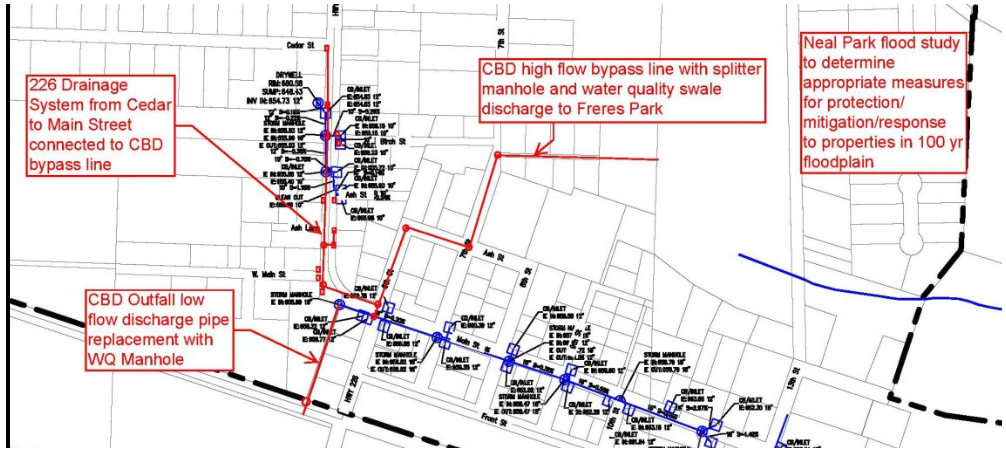


Figure 17 – Southwest Proposed CIP

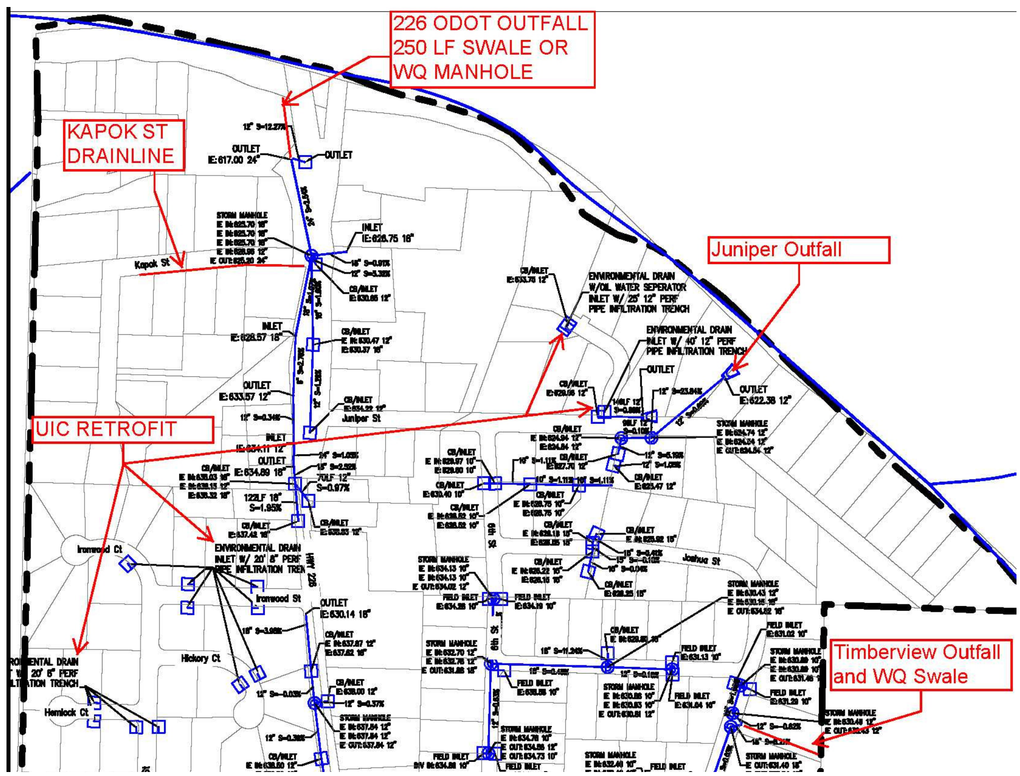


Figure 18 – Proposed CIP for Northwest Section

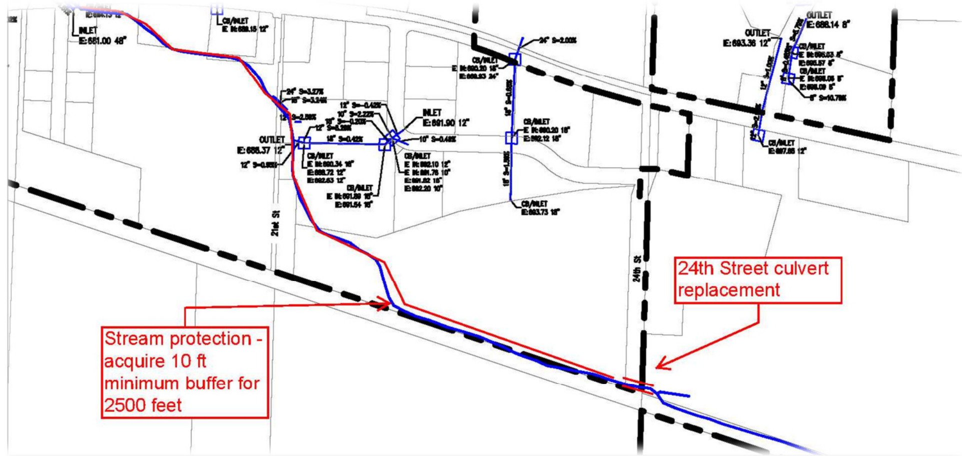


Figure 19 – Proposed CIP for East Section

CIP COSTS

Costs presented herein are planning level analyses. This level of estimating is sufficient to establish feasibility, evaluate alternate solutions, and identify order of magnitude financial need. The costs are based on those experienced by the Oregon Department of Transportation.

	City of Lyons CIP Estimate	
	Summary Listing	
1	CBD Bypass	$ 665,015
2	226 Cedar to Main	$ 535,982
3	Kapock	$ 133,752
4	Stream Protection	$ 130,000
5	CBD Outfall	$ 112,130
6	226 Outfall	$ 97,123
7	East Ash	$ 81,570
8	Timberview WQ Swale	$ 80,046
9	Timberview Outfall	$ 67,311
10	24th St Culvert Replacement	$ 57,979
11	UIC Retrofit	$ 32,018
12	21st Creek Assessment	$ 19,500
13	Neal Park	$ 19,500
14	Trask Creek Assessment	$ 19,500
15	Juniper Outfall	$ 17,076

City of Lyons CIP Estimate

DESCRIPTION	UNIT	UNIT COST	Flood Control Projects: Timberview Outfall		CBD Bypass		CBD Outfall	
Engineering 15 %				6,105		65,028		10,964
Permits 3%				1,221		13,006		2,193
Land easement	S.F.	$ 1	3,750	3,750		-		-
Buffer	S.F.	$ 5						
Studies	L.S.							
Landscaping	S.F.	$ 3		-	1,600	4,800	4,300	12,900
				-		-		-
Site Preparation				-		-		-
Mobe & Demobe @ 15%	L.S.	$ 5,000		5,309		55,920		7,852
Pavement Sawcutting	L.F.	$ 2		-	6,000	12,000		-
Asphalt Removal	S.F.	$ 9		-	9,000	82,800		-
Curb Removal	L.F.	$ 3		-		-		-
Traffic Control @ 10%	LS	$ -		3,218		25,273		4,759
Erosion Control @ 10%	LS.	$ -		2,925	1,333	22,975	143	4,326
Paving and Resurfacing								
Asphalt Pavement including Base	S.F.	$ 5		-	7,500	33,750		-
Curb Replacement	L.F.	$ 14		-		-		-
Pipe incl ex and backfill								
12-inch diameter	L.F.	$ 60		-		-		-
18-inch diameter	L.F.	$ 82		-		-	430	35,260
24-inch diameter	L.F.	$ 97	250	24,250	1,500	145,500		-
30-inch diameter	L.F.	$ 115		-		-		-
36-inch diameter	L.F.	$ 122		-		-		-
42-inch diameter	L.F.	$ 180		-		-		-
48-inch diameter	L.F.	$ 193		-		-		-
Headwalls (culverts only)								
12-inch diameter	EA.	$ 165		-		-		-
18-inch diameter	EA.	$ 170		-		-		-
24-inch diameter	EA.	$ 273		-		-		-
30-inch diameter	EA.	$ 400		-		-		-
36-inch diameter	EA.	$ 800		-		-		-
42-inch diameter	EA.	$ 1,500		-		-		-
48-inch diameter	EA.	$ 1,800		-		-		-
Structures								
Manholes <8'	EA.	$ 3,000		-		-		-
Manholes >8'	EA.	$ 4,000		-	5	20,000		-
Inlets	EA.	$ 1,500		-		-		-
Miscellaneous				-		-		-
T.V. Inspection	L.F.	$ 1		-	1,500	1,500		-
Water Quality Facilities								
Swale	LF	$ 150		-	160	24,000		-
WQ Inlet	EA.	$ 1,500		-		-		-
WQ Manhole	EA.	$ 8,000		-		-	1	8,000
Outfall	EA.	$ 5,000	1	5,000	1	5,000		-
Facility costs				40,701		433,517		73,096
Engr, Permit, Plan				11,076		78,033		13,157
Contingency 30%				15,533		153,465		25,876
Total Costs				$ 67,311		$ 665,015		$ 112,130

City of Lyons CIP Estimate

			Flood Control Project					
DESCRIPTION	UNIT	UNIT COST	24th St Culvert Replacement		226 Cedar to Main		East Ash	
Engineering 15 %				5,669		52,410		7,976
Permits 3%				1,134		10,482		1,595
Land easement	S.F.	$ 1		-		-		-
Buffer	S.F.	$ 5						
Studies	L.S.							
Landscaping	S.F.	$ 3	1,200	3,600		-		-
				-		-		-
Site Preparation				-		-		-
Mobe & Demobe @ 15%	L.S.	$ 5,000		4,460		45,574		6,936
Pavement Sawcutting	L.F.	$ 2		-	6,000	12,000	1,560	3,120
Asphalt Removal	S.F.	$ 9		-	9,000	82,800	1,560	14,352
Curb Removal	L.F.	$ 3		-		-	30	90
Traffic Control @ 10%	LS	$ -		2,703		19,003		2,607
Erosion Control @ 10%	LS	$ -		2,458	1,333	17,275	144	2,370
Paving and Resurfacing								
Asphalt Pavement including Base	S.F.	$ 5		-	7,500	33,750	1,040	4,680
Curb Replacement	L.F.	$ 14		-		-	30	420
Pipe incl ex and backfill								
12-inch diameter	L.F.	$ 60		-	750	45,000	260	15,600
18-inch diameter	L.F.	$ 82		-	750	61,500		-
24-inch diameter	L.F.	$ 97		-		-		-
30-inch diameter	L.F.	$ 115		-		-		-
36-inch diameter	L.F.	$ 122		-		-		-
42-inch diameter	L.F.	$ 180		-		-		-
48-inch diameter	L.F.	$ 193	75	14,475		-		-
Headwalls (culverts only)								
12-inch diameter	EA	$ 165		-		-		-
18-inch diameter	EA	$ 170		-		-		-
24-inch diameter	EA	$ 273		-		-		-
30-inch diameter	EA	$ 400		-		-		-
36-inch diameter	EA	$ 800		-		-		-
42-inch diameter	EA	$ 1,500		-		-		-
48-inch diameter	EA	$ 1,800	2	3,600		-		-
Structures								
Manholes <8'	EA	$ 3,000		-		-		-
Manholes >8'	EA	$ 4,000		-	4	16,000		-
Inlets	EA	$ 1,500		-	10	15,000	2	3,000
Miscellaneous				-		-		-
T.V. Inspection	L.F.	$ 1	1,500	1,500	1,500	1,500		-
Water Quality Facilities								
Swale	LF	$ 150		-		-		-
WQ Inlet	EA	$ 1,500		-		-		-
WQ Manhole	EA	$ 8,000		-		-		-
Outfall	EA	$ 5,000	1	5,000		-		-
Facility costs				37,796		349,402		53,175
Engr, Permit, Plan				6,803		62,892		9,571
Contingency 30%				13,380		123,688		18,824
Total Costs				$ 57,979		$ 535,982		$ 81,570

City of Lyons CIP Estimate

			Flood Control Project				Water Quality Projects	
DESCRIPTION	UNIT	UNIT COST	Kapock		Neal Park		21st Creek Assessment	
Engineering 15 %				13,079		-		-
Permits 3%				2,616		-		-
Land easement	S.F.	$ 1		-		-		-
Buffer	S.F.	$ 5						
Studies	L.S.					15,000		15,000
Landscaping	S.F.	$ 3		-		-		-
				-		-		-
Site Preparation				-		-		-
Mobe & Demobe @ 15%	L.S.	$ 5,000		11,373		-		-
Pavement Sawcutting	L.F.	$ 2	2,100	4,200		-		-
Asphalt Removal	S.F.	$ 9	2,100	19,320		-		-
Curb Removal	L.F.	$ 3	15	45		-		-
Traffic Control @ 10%	LS.	$ -		4,750		-		-
Erosion Control @ 10%	LS.	$ -	292	4,319		-		-
Paving and Resurfacing								
Asphalt Pavement including Base	S.F.	$ 5	2,100	9,450		-		-
Curb Replacement	L.F.	$ 14	15	210		-		-
Pipe incl ex and backfill								
12-inch diameter	L.F.	$ 60	525	31,500		-		-
18-inch diameter	L.F.	$ 82		-		-		-
24-inch diameter	L.F.	$ 97		-		-		-
30-inch diameter	L.F.	$ 115		-		-		-
36-inch diameter	L.F.	$ 122		-		-		-
42-inch diameter	L.F.	$ 180		-		-		-
48-inch diameter	L.F.	$ 193		-		-		-
Headwalls (culverts only)								
12-inch diameter	EA.	$ 165		-		-		-
18-inch diameter	EA.	$ 170		-		-		-
24-inch diameter	EA.	$ 273		-		-		-
30-inch diameter	EA.	$ 400		-		-		-
36-inch diameter	EA.	$ 800		-		-		-
42-inch diameter	EA.	$ 1,500		-		-		-
48-inch diameter	EA.	$ 1,800		-		-		-
Structures								
Manholes <8'	EA.	$ 3,000		-		-		-
Manholes >8'	EA.	$ 4,000		-		-		-
Inlets	EA.	$ 1,500	1	1,500		-		-
Miscellaneous				-		-		-
T.V. Inspection	L.F.	$ 1	525	525		-		-
Water Quality Facilities								
Swale	LF	$ 150		-		-		-
WQ Inlet	EA.	$ 1,500		-		-		-
WQ Manhole	EA.	$ 8,000		-		-		-
Outfall	EA.	$ 5,000		-		-		-
Facility costs				87,192		-		-
Engr, Permit, Plan				15,695		15,000		15,000
Contingency 30%				30,866		4,500		4,500
Total Costs				$ 133,752		$ 19,500		$ 19,500

City of Lyons CIP Estimate								
					Water Quality Project			
DESCRIPTION	UNIT	UNIT COST	Trask Creek Assessment		226 Outfall		UIC Retrofit	
Engineering 15 %				-		9,497		3,131
Permits 3%				-		1,899		626
Land easement	S.F.	$ 1		-		u8		-
Buffer	S.F.	$ 5						
Studies	L.S.			15,000				
Landscaping	S.F.	$ 3		-		-		-
				-		-		-
Site Preparation				-		-		-
Mobe & Demobe @ 15%	L.S.	$ 5,000		-		8,258		2,723
Pavement Sawcutting	L.F.	$ 2		-		-		-
Asphalt Removal	S.F.	$ 9		-		-		-
Curb Removal	L.F.	$ 3		-		-		-
Traffic Control @ 10%	LS	$ -		-		5,005		1,650
Erosion Control @ 10%	LS.	$ -		-		4,550		1,500
Paving and Resurfacing								
Asphalt Pavement including Base	S.F.	$ 5		-		-		-
Curb Replacement	L.F.	$ 14		-		-		-
Pipe incl ex and backfill								
12-inch diameter	L.F.	$ 60		-		-		-
18-inch diameter	L.F.	$ 82		-		-		-
24-inch diameter	L.F.	$ 97		-		-		-
30-inch diameter	L.F.	$ 115		-		-		-
36-inch diameter	L.F.	$ 122		-		-		-
42-inch diameter	L.F.	$ 180		-		-		-
48-inch diameter	L.F.	$ 193		-		-		-
Headwalls (culverts only)								
12-inch diameter	EA.	$ 165		-		-		-
18-inch diameter	EA.	$ 170		-		-		-
24-inch diameter	EA.	$ 273		-		-		-
30-inch diameter	EA.	$ 400		-		-		-
36-inch diameter	EA.	$ 800		-		-		-
42-inch diameter	EA.	$ 1,500		-		-		-
48-inch diameter	EA.	$ 1,800		-		-		-
Structures								
Manholes <8'	EA.	$ 3,000		-		-		-
Manholes >8'	EA.	$ 4,000		-		-		-
Inlets	EA.	$ 1,500		-		-		-
Miscellaneous				-		-		-
T.V. Inspection	L.F.	$ 1		-		-		-
Water Quality Facilities								
Swale	LF	$ 150		-	250	37,500		-
WQ Inlet	EA.	$ 1,500		-		-	10	15,000
WQ Manhole	EA.	$ 8,000		-	1	8,000		-
Outfall	EA.	$ 5,000		-		-		-
Facility costs				-		63,313		20,873
Engr, Permit, Plan				15,000		11,396		3,757
Contingency 30%				4,500		22,413		7,389
Total Costs				$ 19,500		$ 97,123		$ 32,018

City of Lyons CIP Estimate

DESCRIPTION	UNIT	UNIT COST	Water Quality Project: Timberview WQ Swale		Juniper Outfall		Stream Protection	
Engineering 15 %				7,827		1,670		-
Permits 3%				1,565		334		-
Land easement	S.F.	$ 1		-		-	25,000	100,000
Buffer	S.F.	$ 5						
Studies	L.S.							
Landscaping	S.F.	$ 3		-		-		-
				-		-		-
Site Preparation				-		-		-
Mobe & Demobe @ 15%	L.S.	$ 5,000		6,806		1,452		-
Pavement Sawcutting	L.F.	$ 2		-		-		-
Asphalt Removal	S.F.	$ 9		-		-		-
Curb Removal	L.F.	$ 3		-		-		-
Traffic Control @ 10%	LS	$ -		4,125		880		-
Erosion Control @ 10%	LS.	$ -		3,750		800		-
Paving and Resurfacing								
Asphalt Pavement including Base	S.F.	$ 5		-		-		-
Curb Replacement	L.F.	$ 14		-		-		-
Pipe incl ex and backfill								
12-inch diameter	L.F.	$ 60		-		-		-
18-inch diameter	L.F.	$ 82		-		-		-
24-inch diameter	L.F.	$ 97		-		-		-
30-inch diameter	L.F.	$ 115		-		-		-
36-inch diameter	L.F.	$ 122		-		-		-
42-inch diameter	L.F.	$ 180		-		-		-
48-inch diameter	L.F.	$ 193		-		-		-
Headwalls (culverts only)								
12-inch diameter	EA.	$ 165		-		-		-
18-inch diameter	EA.	$ 170		-		-		-
24-inch diameter	EA.	$ 273		-		-		-
30-inch diameter	EA.	$ 400		-		-		-
36-inch diameter	EA.	$ 800		-		-		-
42-inch diameter	EA.	$ 1,500		-		-		-
48-inch diameter	EA.	$ 1,800		-		-		-
Structures								
Manholes <8'	EA.	$ 3,000		-		-		-
Manholes >8'	EA.	$ 4,000		-		-		-
Inlets	EA.	$ 1,500		-		-		-
Miscellaneous				-		-		-
T.V. Inspection	L.F.	$ 1		-		-		-
Water Quality Facilities								
Swale	LF	$ 150	250	37,500		-		-
WQ Inlet	EA.	$ 1,500		-		-		-
WQ Manhole	EA.	$ 8,000		-	1	8,000		-
Outfall	EA.	$ 5,000		-		-		-
Facility costs				52,181		11,132		-
Engr, Permit, Plan				9,393		2,004		100,000
Contingency 30%				18,472		3,941		30,000
Total Costs				$ 80,046		$ 17,076		$ 130,000

PRIORITIZED CITY ACTION PLAN

The following plan has been developed based on a prioritization of all of the recommendations in this report. The recommendations have been prioritized based on the potential cost of the item, the flood risk and the extent of the benefit of the item. Thus low cost items receive a high “cost” rating, those with a record of flooding receive a high “flood” rating and those which impact the greatest number of residents would receive a high” impact” rating. The ratings are numerically added and then arranged from high to low. This forms the basis for an initial prioritized listing.

City of Lyons Work Plan

	Item	Cost Rating	Flood Rating	Impact Rating	Total Rating
1	Construction Standards	10	3	10	23
2	Catch Basin Inventory	10	3	10	23
3	Culverts and Outlets Inventory	10	3	10	23
4	Pipe Systems Inventory	10	3	10	23
5	CBD Bypass	2	10	10	22
6	226 Cedar to Main	2	8	8	18
7	Neal Park	1	8	8	17
8	East Ash	3	6	8	17
9	Juniper Outfall	7	5	5	17
10	CBD Outfall	3	5	8	16
11	Timberview WQ Swale	3	5	8	16
12	Water Quality and Detention Pond Inve	10	1	5	16
13	226 Outfall	3	5	7	15
14	UIC Retrofit	5	2	8	15
15	21st Creek Assessment	7	2	6	15
16	Trask Creek Assessment	7	2	6	15
17	24th St Culvert Replacement	3	6	5	14
18	Timberview Outfall	3	5	5	13
19	Kapock	2	6	4	12
20	Stream Protection	2	6	4	12

OPERATIONS PLAN FOR INFRASTRUCTURE

Annual Budget for Proposed Plan

Total Improvements; - 2,068,503.00

10 year buildout 225,000.00/yr

Suggested Commercial Residential Split; 90 – 10

Annual Maintenance Plan

Inspection and Cleanout: $50,000.00

Funding Sources

Local Improvement District (LID)

Local Improvement District projects have a definable benefit and are funded with long term bonds repaid by affected property owners. It may also be an option for the Central Business District which experiences a much larger zone of benefit; however with other stakeholders, Linn County and ODOT, other programs may provide a better choice.

Fee Based Utility Service for Storm Drainage

A fee based on impervious surface area including a fixed amount for single family residences to fund maintenance.

System Development Charges

As new development occurs, projects associated with new development would pay into an account associated with system wide costs. Currently there are no projects identified related to growth.

Transportation Funds

This is the current funding source for all drainage improvement maintenance activity and is shared with general road maintenance.

General Funds

General funds are used to cover all costs not covered by other sources. This fund should be the last resort.

Regional, State and National Programs

There are numerous programs available to fund or partially fund drainage improvements. Many of them require matching funds on the part of the jurisdiction. These programs typically require a grant writer from staff or hired on a consultant basis. The following are known to have general or infrastructure funding programs:

USDA Rural Development Funds Infrastructure Projects - http://www.rurdev.usda.gov/Home.html

ODOT Stormwater Program - http://www.oregon.gov/ODOT/HWY/GEOENVIRONMENTAL/storm_management_program.shtml

Clean Water Act Section 319 - Polluted Runoff - http://www.epa.gov/owow_keep/NPS/cwact.html

Over 400 Watershed restoration programs - http://efc.boisestate.edu/

Community Block Grants - http://www.orinfrastructure.org/Learn-About-Infrastructure-Programs/Interested-in-a-Community-Development-Project/Community-Development-Block-Grant/

LID Guidance: http://www.leg.state.or.us/comm/commsrvs/district.pdf

ABBREVIATIONS

1. BMP – Best Management Practice
2. CBD –Central Business District
3. CWA – Clean Water Act
4. DEQ – Oregon Department of Environmental Quality
5. EIA – Effective Impervious Area
6. EPA – Environmental Protection Agency
7. ESA – Endangered Species Act
8. FEMA – Federal Emergency Management Agency
9. FES – Fishman Environmental Services
10. FIRM – Flood Insurance Rate Map
11. FIS – Flood Insurance Study
12. GIS – Geographic Information System
13. HEC-RAS - a computer program that models the hydraulics of water flow through natural rivers and other channels. The program was developed by the US Department of Defense, Army Corps of Engineers in order to manage the rivers, harbors, and other public works under their jurisdiction; it has found wide acceptance by many others since its public release in 1995.
14. LCDC – Land Conservation and Development Commission
15. LIDAR - Light Detection And Ranging: Surveying based on reflected laser data collection
16. MEP – Maximum Extent Practicable
17. MRCI – Municipal, Residential, Commercial, and Industrial
18. MS4 – Municipal Separate Storm Sewers Systems
19. NFIP – National Flood Insurance Program
20. NMFS – National Marine Fisheries Service
21. NOAA Fisheries – National Oceanic Atmospheric Administration Marine Fisheries Service
22. NPDES – National Pollution Discharge Elimination System
23. OAR – Oregon Administrative Rule
24. PRF – Pollutant Reduction Facility
25. PWFOA – People with Fear of Acronyms
26. RLIS – Regional Land Information System
27. ROW – Right of Way
28. SBUH - Santa Barbara Urban Hydrograph
29. SCS – Soil Conservation Service
30. SDC – System Development Charge
31. SFHA – Special Flood Hazard Area

32. SMA – Soil Moisture Accounting
33. SWMP – Storm Water Management Plan
34. TMDL – Total Maximum Daily Load
35. UIC – Underground injection control - Any man-made design, structure or activity which discharges below the ground or subsurface. Common uses include: stormwater discharge, industrial/commercial and process waste water disposal, large domestic onsite systems and cesspools, sewage drill holes, aquifer remediation systems, motor vehicle waste disposal, agricultural drainage, geothermal systems and aquifer storage and recovery (ASR). Common designs include drywells, trench drains, sumps, perforated piping, floor drains, drain fields and drill holes. The intent of the program is to protect groundwater resources, primarily used for drinking water, from contamination. All groundwater aquifers in Oregon are considered suitable as drinking water. There are numerous federal classes and types of injection systems. All classes and types are required to be registered with DEQ.
36. USB – Urban Services Boundary
37. USFWS – U.S. Fish and Wildlife Service

APPENDIX A

Full Size Drawings

1. Area and Key Map
2. Existing Facilities NW Sheet, Sheet 1 of 3
3. Existing Facilities SW Sheet, Sheet 2 of 3
4. Existing Facilities East Sheet, Sheet 3 of 3
5. CIP Projects NW Sheet, Sheet 1 of 3
6. CIP Projects SW Sheet, Sheet 2 of 3
7. CIP Projects East Sheet, Sheet 3 of 3

APPENDIX B

Hydraulic Calculation Output