Homestreet Plat
Preliminary Drainage & Erosion Control Report

Prepared for:

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Date:

April 27, 2020

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Project No: 19-059
Project Name: Homestreet Plat
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I. PROJECT ENGINEER'S CERTIFICATE

I hereby state that this Preliminary Drainage and Erosion Control Plan for, Homestreet Plat located in Lewis County, Washington, 98532, has been prepared by me or under my supervision and meets the minimum standards of Lewis County and normal standards of engineering practice. I hereby acknowledge and agree that the jurisdiction does not and will not assume liability for the sufficiency, suitability, or performance of drainage facilities designed by me.

Signature

4/27/20
Date

Seal

II. DRAINAGE REPORT

Section 1 – Project Description

The Homestreet Plat project is located south of Bishop Road, east of Interstate 5, and connects to the east end of the existing Holloway Springs Division 2. The proposed plat is accessible from Rush Road via Rose Marie Drive and Holloway Drive leading to Harold Drive and Wind River Drive. The Homestreet Plat project is located in Lewis County within the Urban Growth Area of the City of Chehalis, in Section 14, Township 13N, Range 2W, West, W.M. on Tax Parcel # 017875734078. See Figure 1: Vicinity Map. This project proposes to construct 69 single-family homes, along with 3,031 linear feet of new public roads with sidewalks and landscaping. See Figure 2: Preliminary Site Plan.

The proposed project will require grading, encroachment, building, and utility permits. Water and sewer will be provided via connections to the City of Chehalis' existing utilities. Zoning for the property is C-1, which allows for residential uses.

The stormwater system is divided into two basins. Each basin will collect the roadway-generated stormwater in wet ponds, treat the runoff, release to a detention pond, and subsequently meter out at the preexisting discharge rates. Individual lots will all be graded to drain towards the street, as will driveways and roofs, all to be collected into the conveyance system. The stormwater system was designed in accordance with the Department of Ecology's 2019 Stormwater Management Manual for Western Washington along with the requirements of the Lewis County.

Section 2 – Existing Conditions

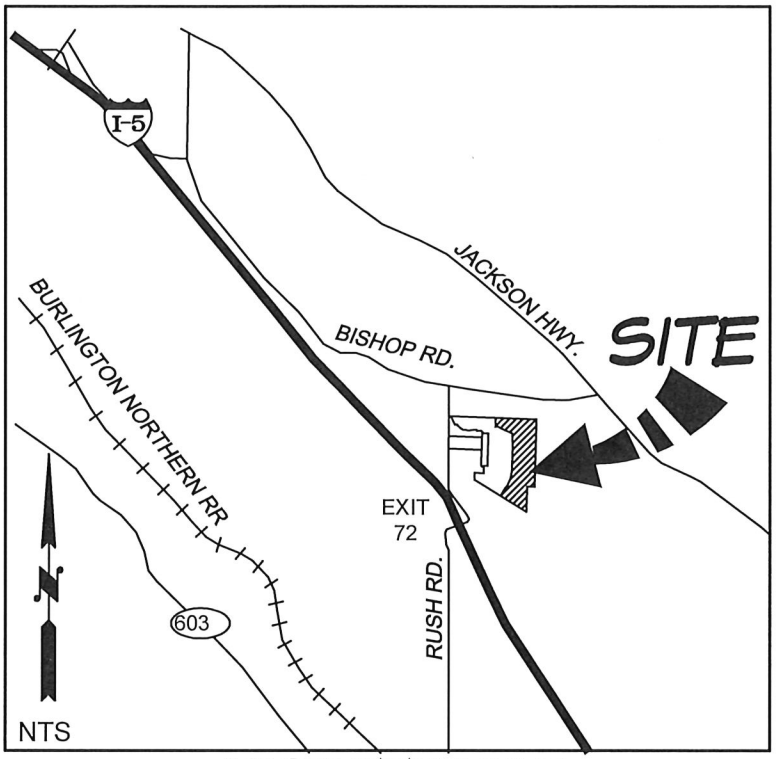
The site is irregular in shape and has a distinct ridge line near the middle running east-west, with the high point of the ridge at the east end. The land slopes both to the north and south away from the ridge line in the direction of Category III wetlands located at the Northern and Southern boundaries of the site. The site consists mostly of native grasses with limited shrubs. Runoff generally drains to the north and south away from the ridge, eventually making its way to the Newaukum River. See Appendix B for LIDAR and County GIS Maps of the existing site and area.

Section 3 – Soils Report

Soils on-site are listed in the Natural Resources Conservation Service (NRCS) Soil Survey of Lewis County Washington as Lacamas Silt Loam and Prather Clay Loam. In addition, Geotechnical Testing Labs conducted extensive on-site soils investigations to ascertain the specific locations and design parameters for the soils on-site. Their findings have been detailed in a report dated June 24, 2005. See Appendix A for the NRCS Soil Survey results and the 2005 Geotechnical Testing Labs report.

Figure 1 – Vicinity Map

HOMESTREET PLAT



VICINITY MAP

FIGURE 1 - VICINITY MAP

Figure 2 – Site Plan

HOMESTREET PLAT

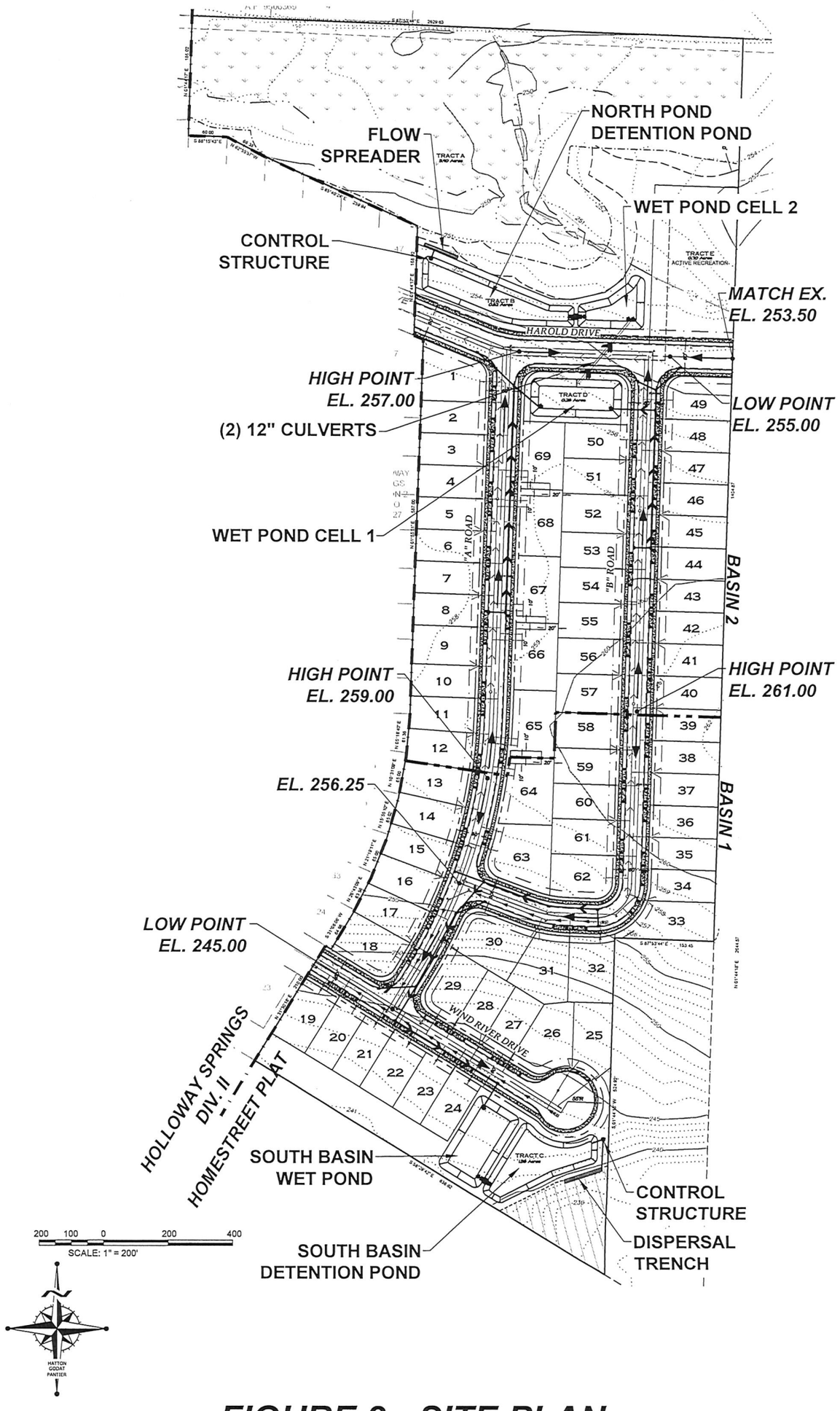


FIGURE 2 - SITE PLAN

Section 4 – Wells and Septic Systems

Records at Lewis County and the Department of Ecology were searched in order to locate wells and septic systems that may be located within the setback distances from the stormwater pond(s). In addition, the Project Engineer, or someone under his direct supervision, has visited the site to verify the presence or absence of wells and septic systems as best can be done visually without trespassing onto other properties. All wells and septic systems found to be located within the setback distances from the stormwater pond(s) have been shown on the plans.

Section 5 – Fuel Tanks

Records at Lewis County and the Department of Ecology were searched in order to locate the presence of above and below ground fuel storage tanks that may be located within the setback distances from the stormwater pond(s). In addition, the Project Engineer, or someone under his direct supervision, has visited the site to verify the presence or absence of fuel tanks as best can be done visually without trespassing onto other properties. All fuel tanks found to be located within the setback distances from the stormwater pond(s) have been shown on the plans.

Section 6 – Sub-basin Description

Appendix B shows the drainage areas used in the analysis of the existing site conditions and the developed conditions. The site has been divided into two sub-basins with separate drainage facilities for each basin.

Section 7– Analysis of 100-Year Flood

The Federal Emergency Management Agency prepares maps for all areas within Lewis County, including the incorporated cities therein. These maps depict the areas, if any, subjected to flooding in the vicinity of this project. By inspection of this map, this project is in Zone C, outside of the 100-year floodplain, an area of minimal flooding. An exception is a small portion of the extreme southeast corner which is in the floodplain but is well beyond and below any of the proposed improvements.

Section 8 – Aesthetic Considerations

All above ground stormwater facilities will be hydroseeded upon completion. Additional landscaping shall also be provided throughout the project in conformance with the approved landscaping plan and as otherwise required by the approving authority.

Section 9 – Facility Sizing and Downstream Analysis

Tributary area calculations are included in a spreadsheet located in Appendix C. A Drainage Basin Map can be found in Appendix B. Table 9.1 summarizes tributary areas to the North and South ponds.

Table 9.1 – Tributary Area Summary

	North Basin	*South Basin*
Total Area (ac)	7.65	8.44
Roof Area (ac)	1.81	1.91
Asphalt & Concrete (ac)	1.81	2.15
Total Impervious Area (ac)	**3.62**	**4.06**
Pervious Area (ac)	3.41	3.71
Pond Area (ac)*	0.62	0.68
Total Pervious (ac)	**4.03**	**4.38**
Percent Impervious	47%	48%

*The pond area included in stormwater modeling adds Impervious area to the DWL for the pond design.

The site has been analyzed using the SCS method in the HYDRA computer-modeling program. All runoff is collected in the new roadways and conveyed by piping, which discharge into water quality wet ponds for treatment. The stormwater then enters detention ponds and is metered out to existing low areas at predevelopment flow rates. The following criteria were used as the basis of the modeling.

Rainfall Totals (per WSDOT Runoff Manual):

2-year, 24-hour	= 2.2 inches
10-year, 24-hour	= 3.0 inches
25-year, 24-hour	= 3.5 inches
100-year, 24-hour	= 4.3 inches

Soil Hydraulic Characteristics:	CN
Impervious:	98
Landscaped Pervious:	86 (CN = 85 for predeveloped conditions)

The 100-year, 24-hour storm event was analyzed in order to evaluate the conveyance system and total volume required in the detention ponds. 64% of the 2-year event was used to calculate wet pond storage amounts using methods from Chapter III-1 of the DOE. Manual. The SCS Type 1A rainfall distribution hyetograph resolved to 10-minute intervals was used per the DOE. Manual section III-1.4.1. The detention pond was sized not to exceed the pre-developed two-year, ten-year and one hundred-year off-site flow. Model results can be found in Appendix D.

Treatment: Wet ponds - The wet ponds were sized to treat runoff from all proposed roadways as shown on the basin map in Appendix B. Size is based on volume of the 6-month storm equal to 64% of the 2-year storm. Design depth shall be 3 ft. Length to width ratio

shall be >3:1. Sizing guidelines per the DOE Stormwater Manual, along with required sizing calculations, are provided in Appendix C. Results are summarized below:

North Pond Minimum Volume = 18,000 cf
South Pond Minimum Volume = 20,000 cf

Metered Release Calculations:

Predevelopment site runoff provides allowable release rates based on the HYDRA model results for relevant events. Detailed model results can be found in Appendix D and are also summarized below.

Table 9.2 - Discharge Rates (cfs)

Event	2-yr	10-yr	100-yr
Existing North Basin	0.97	1.81	3.37
North Pond Discharge	0.97	1.77	3.26
Existing South Basin	1.20	2.26	4.18
South Pond Discharge	1.15	2.17	4.17

Detention Pond Volume Calculations:

The North Pond has a required volume of 16,621 cf for the 100-year storm. The 2-year volume is a little over half of the 100-year at 8,417 cf. A 5-13/16-inch diameter orifice controls flows for up to the 2-year storm, at which time either a notch weir or secondary orifices will be incorporated for the 10 and 100-year controlled discharge rates. A total volume of 16,800 cf is proposed in this preliminary design for the North Pond at a design pond depth of slightly under 2-feet.

The South Pond has a required volume of 15,780 cf for the 100-year storm. The 2-year volume is a little over half of the 100-year at 8,472 cf. A 6-5/16-inch diameter orifice controls flows for up to the 2-year storm, at which time either a notch weir or secondary orifices will be incorporated for the 10 and 100-year controlled discharge rates. A total volume of 16,000 cf is proposed in this preliminary design for the North Pond at a design pond depth of a little less than 2-feet.

See Appendix C – Drainage Calculations

Section 10 – Covenants, Dedications, and Easements

All stormwater facilities located on private property shall be owned, operated, and maintained by the property owners, their heirs, successors, and assigns.

Section 11 – Articles of Incorporation

All residential subdivisions shall form a Homeowner's Association for the purpose of assigning responsibility and liability for the operation and maintenance of stormwater facilities jointly serving lots within the subdivision. The association is not required for facilities that serve a single property owner.

Articles of Incorporation shall be developed for the association and submitted to the governing body prior to final project approval.

III. EROSION CONTROL PLAN

Section 1 – Construction Sequence

Prior to commencing any grading or filling upon the site, all erosion control measures, including installation of a stabilized construction entrance, shall be installed in accordance with this plan and the details shown on the drawings. More specifically, the following construction sequence shall be observed:

1. Construction on this site shall be conducted substantially in accordance with the construction sequence described on the plans and in this erosion control plan. Deviations from this sequence shall be submitted to the project engineer and permitting jurisdiction. Deviations must be approved prior to any site disturbing activity not contained within these plans.

2. For each phase of the development of this site, the following general sequence shall be observed:

    a. Install perimeter filter fabric fence as shown.

    b. Install inlet protection for existing inlets in the vicinity of areas to be disturbed.

    c. Call for inspection by the project engineer.

    d. Construct temporary sedimentation trap(s) and outlet(s).

    e. Perform grading directing site runoff towards the sediment trap prior to discharge from the site.

    f. Install temporary piping, as required, to direct runoff towards the sediment trap.

3. Once the site is disturbed, continue operations diligently toward completion.

4. Monitor all erosion control facilities, and repair, modify, or enhance as directed or as required.

Section 2 – Trapping Sediment

Sediment ponds shall be constructed at the beginning of each phase of construction to perform as temporary sediment traps. Protection of off-site properties against sedimentation is an absolute necessity. Additional measures may be required to provide full protection of downstream areas. Additional measures may include, but are not limited to, use of sediment bags in existing catch basins, increased filters within sediment ponds such as hay bales, introduction of coagulants to the sediment

ponds, and other such measures. Continuous monitoring of the erosion control systems, depending upon site and weather conditions, shall be ongoing throughout project development.

Vehicle tracking of mud off-site shall be avoided. Installation of a stabilized construction entrance shall be installed at the start of construction at the exit point to be used by equipment. This entrance is a minimum requirement and may be supplemented if tracking of mud onto public rights-of-way becomes excessive. Washing down roads daily to remove excessive mud may be required. Wash water shall be directed to the temporary sediment traps installed on-site and shall not be allowed to discharge downstream without treatment.

Section 3 – Site Restoration

Disturbed areas on and off-site shall be hydroseeded or otherwise landscaped or stabilized upon project completion to provide permanent erosion control where required. Erosion control measures shall remain in place until final site stabilization is imminent (e.g., paving scheduled with a favorable weather forecast).

Section 4 – Geotechnical Analysis

Existing slopes in the area of the stormwater ponds are generally less than 5% but occasional may be as steep as 15%. Although much of the permanent detention and water quality ponds will be excavated into native soils, some embankment will be required. Compaction and material requirements for these embankments shall be per the geotechnical engineer's recommendations. The temporary sediment ponds will be excavated into the native soil.

Section 5 – Inspection Sequence

The Project Engineer, or someone under his direct supervision, and the permit authority shall inspect the temporary erosion control facilities (construction entrance, sediment traps, and erosion control barriers) prior to commencement of construction. During and following construction, the Engineer shall inspect the construction of the permanent stormwater facilities and report to the permit authority his findings as to performance and operability of the completed system.

Section 6 – Control of Pollutants other than Sediments

A centralized equipment marshalling area and containment area is to be provided on-site for equipment maintenance and storage of any equipment service materials. An area on-site will be selected as a temporary debris and stockpile area for materials that will be removed from the site. Erosion control containment and berming of this area will be provided for pollutant containment and sheeting provided for coverage or lining if applicable.

STORMWATER MAINTENANCE PLAN

Homestreet Plat
April 13, 2020

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Return Address:

_____
_____
_____

DECLARATION OF COVENANTS ASSOCIATED WITH PRIVATELY MAINTAINED STORM DRAINAGE FACILITIES

GRANTOR(S): **Homefirst Development, LLC**

GRANTEE: **CITY OF CHEHALIS DEPARTMENT OF PUBLIC WORKS**

LEGAL DESCRIPTION (abbreviated):

COUNTY ASSESSOR'S PROPERTY TAX PARCEL NO.:_____

Declaration of Covenant

In consideration of approval of the development known as_____
_____, relating to real property legally described as

follows: (Insert Full Legal Description)

The undersigned, as owner(s), covenant and agree that:

1. If at any time the City of Chehalis reasonably determines that maintenance or repair work is required to be done to the existing, approved storm drainage facilities installed on the property described above and located outside of any public right-of-way (which will mean repair and or clean out of the existing system only to the same standards as originally installed and approved), the Director of the Department of Public Works shall give the current owners seven days notice that the City intends to perform such maintenance or repairs, or to have them performed by others.

   If the current owners have not completed or are not diligently pursuing the repair or maintenance of the system and it becomes necessary for City of Chehalis to perform the work, the current owners will assume responsibility for the cost of such maintenance or repair and will reimburse the City within thirty days of receipt of the invoice. Overdue payments will require payment of interest at the current legal rate for liquidated judgments, and any costs or fees incurred by the City, should any legal action be required to collect such payments, will be borne by the parties responsible for said reimbursements.

2. If at any time City of Chehalis reasonably determines that the existing and approved storm drainage system on the property poses a hazard to life and limb, or endangers property, or adversely affects the safety and operations of a public way, due to failure, damage or non-maintenance of the existing on-site storm system, and that the situation is so adverse as to preclude written notice to said owners, the Director of the Department of Public Works may take the measures necessary to eliminate the hazardous situation (which will mean repair or clean out of the existing system only to the same standards as originally installed and approved) provided the Director has first made a reasonable effort to locate said owner before acting.

   The current owners will assume responsibility for the cost of such maintenance or repair; and will reimburse the City within thirty days of receipt of the invoice. Overdue payments will require payment of interest at the current legal rate for liquidated judgments, and any costs or fees incurred by the City, should any be borne by the parties responsible for said reimbursements.

3. The owner shall keep the City of Chehalis Public Works Department informed at all times as to the name, address and telephone number of the contact person responsible for the performance of maintenance or repair work to the storm drainage facilities.

   These covenants are intended to protect the value and desirability of the real property described above, and to benefit all the citizens of the City of Chehalis. They shall run with the land and be binding on all parties having or acquiring from the current owners or their successors, any right, title or interest therein, and to the benefit of all the citizens of the City of Chehalis.

_____
Signature

_____
Owner

_____
Address

_____
City, State, Zip

Phone:_____

STATE OF WASHINGTON)
) ss
COUNTY OF _____)

On this _____ day of _____20_____, before me personally appeared _____ to me known to be the _____of_____., a Washington Limited Liability Company that executed the foregoing instrument, and acknowledged said instrument to be the free and voluntary act and deed of said Limited Liability Company, for the uses and purposes therein mentioned, and on oath stated that are authorized to execute said instrument.

_____
Notary Public in and for the State of Washington, residing at _____
My commission expires _____

II. STORMWATER FACILITY MAINTENANCE GUIDE

INTRODUCTION

What is Stormwater Runoff?

When urban and suburban development covers the land with buildings, streets and parking lots, much of the native topsoil, duff, trees, shrubs and grass are replaced by asphalt and concrete. Rainfall that would have soaked directly into the ground instead stays on the surface as *stormwater runoff* making its way into storm drains (including man-made pipes, ditches, or swale networks), stormwater ponds, surface and groundwater, and eventually to Puget Sound.

What is a Storm Drain System and how does it work?

The storm drain system for most developments includes measures to *carry, store, cleanse, and release* the stormwater. Components work together to reduce the impacts of development on the environment. Impacts can include *flooding* which results in property damage and blocked emergency routes, *erosion* which can cause damage to salmon spawning habitat, and *pollution* which harms fish and/or drinking water supplies.

The storm drain system provides a safe method to carry stormwater to the treatment and storage area. Swales and ponds filter pollutants from the stormwater by *physically* settling out particles, *chemically* binding pollutants to pond sediments, and *biologically* converting pollutants to less harmful compounds. Ponds also store treated water, releasing it gradually to a nearby stream or to groundwater.

What does Stormwater Runoff have to do with Water Quality?

Stormwater runoff must be treated because it carries litter, oil, gasoline, fertilizers, pesticides, pet wastes, sediments, and anything else that can float, dissolve or be swept along by moving water. Left untreated, polluted stormwater can reach nearby waterways where it can harm and even kill aquatic life. It can also pollute groundwater to the extent that it requires treatment before it is suitable for drinking. Nationally, stormwater is recognized as a major threat to water quality. Remember to keep everything out of stormwater systems except the rainwater they are designed to collect.

Your Stormwater Facility

Different types of ponds are designed for different purposes. For example, wet ponds primarily provide treatment of stormwater. Dry ponds or infiltration ponds are designed to provide storage for stormwater and allow for its gradual release downstream or into the ground.

Who is Responsible for Maintaining Stormwater Facilities?

All stormwater facilities require maintenance. Regular maintenance ensures proper functioning and preserves visual appeal. This Stormwater Facility Maintenance Guide was designed to explain how stormwater facilities work and provide user-friendly, straightforward guidance on facility maintenance.

You are responsible for regularly maintaining privately owned ponds, catch basins, pipes and other drainage facilities on your property. Stormwater facilities located in public rights-of-way are maintained by local governments.

How to Use the Stormwater Facility Maintenance Guide

This Maintenance Guide includes a Site Plan specific to your development and a Facility Key that identifies the private stormwater facilities you are responsible for maintaining. A "Quick List" of maintenance activities has also been included to help you identify the more routine needs of your facility.

Included in This Guide

- Comprehensive Maintenance Checklists that provide specific details on required maintenance
- Pollution Prevention Tips that list ways to protect water quality and keep storm drain systems functioning smoothly
- Resources to provide more information and technical assistance

A Regional Approach to Stormwater Management

The City of Chehalis together with Lewis County are taking steps to educate and involve area residents in water quality issues and stormwater management. Stormwater runoff is a widespread cause of water quality impairment and stream degradation. The jurisdictions are working together with residents, businesses, community groups and schools to address this problem. This guide focuses on providing information on ways that you can reduce stormwater impacts through pollution prevention and proper facility maintenance.

YOUR STORMWATER FACILITIES

This section consists of two parts that are to be used together: the ***Facility Key*** and the ***Site Plan***. Review the site plan and identify the numbers denoting a feature of the system. Then check the facility key for the feature type and checklist name.

FACILITY KEY

The stormwater facility in your neighborhood is comprised of the following elements:

Type of Feature & Checklist Name	Location on Site Plan
Pond	1
Catch Basins, Manholes, and Inlets	2
Grounds and Landscaping	3
Access Roads and Easements	4

SITE PLAN

HOMESTREET PLAT

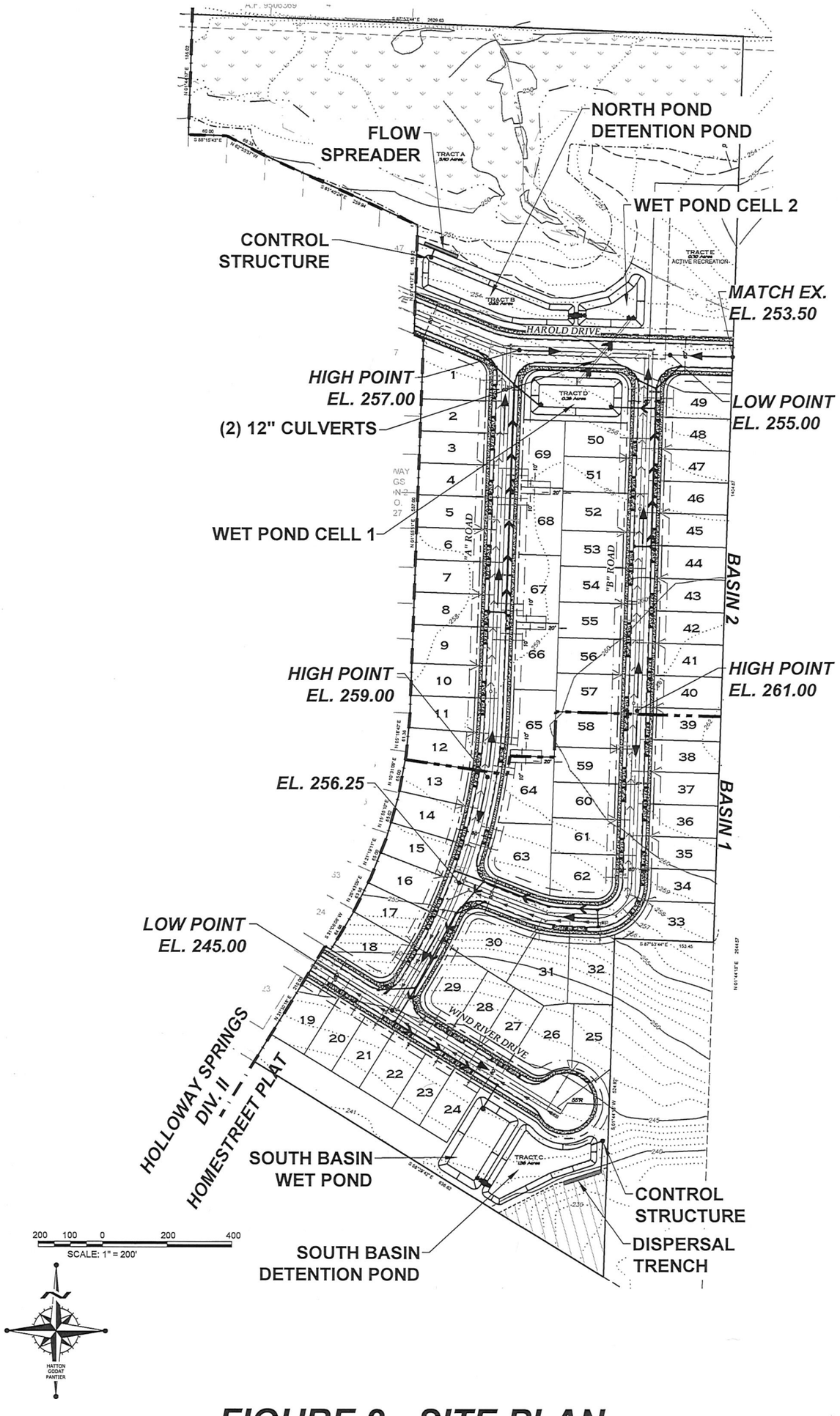


FIGURE 2 - SITE PLAN

QUICK LIST

The following is an abbreviated checklist of the most common types of maintenance required. Please go over this checklist after heavy rains. The list represents minimum maintenance to be performed and should be completed in conjunction with the other checklists for an effective maintenance program.

- ☐ Inspect catch basin grates to see that they are not clogged or broken. Remove twigs, leaves, or other blockages. Contact the local jurisdiction to replace the grate if it is broken.

- ☐ Inspect inlet and outlet pipes for blockages. Clear all blockages.

- ☐ Inspect filter strip, swale and pond walls for erosion or caved in areas.

- ☐ Inspect riprap (rocks) at the inlets and outlets of culverts and other pipes. If they are silted in or eroded away, replace them.

MAINTENANCE CHECKLISTS

The Maintenance Checklists in this packet are for your use when inspecting the stormwater facilities on your property. This packet has been customized so that only the checklists for your facilities are included. If you feel you are missing a checklist, or you have additional facilities not identified or addressed in this packet, please contact your local jurisdiction.

The checklists are in tabular format for ease of use. Each describes the area to inspect, inspection frequency, what to look for, and what action to take. A log sheet is included toward the end of the chapter to help you track maintenance of your storm drainage system.

Although it is not intended for the maintenance survey to involve anything too difficult or strenuous, there are a few tools that will make the job easier and safer including:

- A flashlight
- A long pole or broom handle
- Some kind of pry bar or lifting tool for pulling manhole and grate covers
- Gloves

A resource list is included in the next chapter. Here you will find the phone numbers of the agencies referred to in the tables, as well as the contractors and consultants who designed and constructed your facilities.

SAFETY WARNING: In keeping with OSHA regulations, you should never stick your head or any part of your body into a manhole or other type of confined space. When looking into a manhole or catch basin, stand above it and use the flashlight to help you see. Use a long pole or broom handle to check sediment depths in confined spaces. *NO PART OF YOUR BODY SHOULD BREAK THE PLANE OF THE OPEN HOLE.*

Ponds

There are essentially three kinds of ponds: treatment ponds, infiltration ponds, and detention ponds. Although each pond has unique maintenance requirements, there are also many things they have in common. Your facility is a wet/detention pond.

INSPECTION AREA	FREQUENCY	LOOK FOR	ACTION
Entire Pond	Quarterly	Yard waste such as grass clippings and branches in basin; presence of glass, plastic, metal, foam, or coated paper.	Remove trash and debris and dispose of properly.
Entire Pond	Quarterly	Vegetation that may constitute a public hazard, e.g., tansy ragwort, poison oak, stinging nettles, devils club.	Remove invasive or noxious vegetation. Do not spray chemicals on vegetation without obtaining guidance from WSU Cooperative Extension and approval from City or County.
Entire Pond	Quarterly	Presence of chemicals such as natural gas, oil, and gasoline, noxious odor, or sludge.	First, attempt to locate source of pollution; then call Moderate Risk Waste program at Thurston County Environmental Health to report the hazard.
Entire Pond	Quarterly	Sparse, weedy, or overgrown grass in grassy (dry/infiltration) ponds; presence of invasive species or sparse growth of plants in wet ponds.	Grassy ponds: selectively thatch, aerate, and re-seed ponds. Grass should be kept less than 8 inches high. Wet ponds: hand-plant nursery-grown wetland plants in bare areas. Contact WSU Cooperative Extension for guidance on invasive species. Pond bottoms should have uniform dense coverage of desired plant species.
Entire Pond	Quarterly	Evidence of rodent holes if facility is a dam or berm. Water should not flow through rodent holes.	Destroy rodents and repair dam or berm. Contact Thurston County Health Department for guidance.
Entire Pond	Quarterly	Nuisance insects such as wasps, hornets or mosquitoes that may interfere with maintenance	Destroy or remove insects. Contact WSU Cooperative Extension for guidance.
Entire Pond	Annually	Confirmation that trees are not interfering with maintenance (i.e., mowing, silt removal, or access.)	Prune tree limbs to allow for maintenance. Some trees may be cut.
Inlet	Annually	Confirmation that the riprap under the inlet pipe is intact and that no native soil is exposed. Also, look for accumulations of sediment greater than half the height of the rocks.	Replace rocks and/or remove sediment.
Outlet	Quarterly	A free-flowing overflow that is clear of debris.	Replace riprap if missing. Remove trash or debris and dispose of properly.
Side Slopes	Annually	Signs of erosion around inlets and outlets. Inspect berms for signs of sliding or settling. Take action if eroded damage is over 2 inches deep and where there is potential for continued erosion.	Attempt to determine the cause of erosion and repair it. Stabilize slopes by reinforcing with rock, planting grass, or compacting soil. Contact WSU Cooperative Extension for guidance on slope reinforcement.
Storage Area	Annually	Sediment build-up on pond bottom. A buried or partially buried outlet structure or very slow infiltration rate may indicate significant sediment deposits.	Remove the sediment and re-seed the pond if necessary to improve infiltration and control erosion.
Dikes	Annually	Significant settling of any part of dike.	Build dike back to the original elevation.
Overflow Spillway	Annually	Intact riprap protective area. Repair if any native soil is exposed.	Replace rocks so all native soil is covered.
Trench Drain	Quarterly	Confirmation that the grate is clear of debris and that the drain is not plugged.	Remove debris from grate, clean drain.

Catch Basins and Inlets

These structures are typically located in the streets and public rights-of-way. Local jurisdictions are responsible for routine maintenance of the pipes and catch basins in rights-of-way, while you are responsible for keeping the grates clear of debris in all areas as well as pipes and catch basins in private areas.

INPSECTION AREA	FREQENCY	LOOK FOR	ACTION
Catch basin opening	During and after major storms	Accumulation of trash or debris in front of catch basin opening that prevents water from flowing in	Remove blocking trash or debris with a rake and clean off the grate.
Catch basin	Quarterly	Sediment or debris in the basin. No more than half the depth from the bottom of the pipe to the bottom of the basin should be allowed to accumulate. Use a long stick or broom handle to poke into sediment and determine depth.	Remove debris from catch basin.
Inlet and outlet pipes	Quarterly	Trash or debris in the pipes that has exceeded 1/5 of their height. Ensure there are not tree roots or other vegetation growing in the pipes.	Remove trash or debris from inlet and outlet pipes.
Inlet and outlet pipe joints	Annually	Cracks wider than ½ inch and longer than 12-inches at the joint of any inlet or outlet pipe. Also check for evidence of sediment entering the catch basin through cracks.	Repair cracks or replace the joints.
Grate	Quarterly	Cracks longer than 2 inches or multiple cracks.	Replace grate if necessary.
Frame	Quarterly	Confirmation that the frame is sitting flush on top of the concrete structure (slab). A separation of more than ¾ inch between the frame and the slab should be corrected.	Repair or replace the frame so it is flush with the slab.
Catch basin	Annually	Cracks wider than ½ inch and longer than 3 feet. Also check for any evidence of sediment entering the catch basin through cracks. Determine whether or not the structure is sound.	Replace or repair the basin. Contact a professional engineer for evaluation.
Catch basin	Quarterly	Chemicals such as natural gas, oil, and gasoline have may have entered the catch basin. Check for noxious odor or oily sludge.	Clean out catch basin. Contact your local jurisdiction or Thurston County Environmental Health if you detect a color, odor, or oily sludge.
Oil / water separator (downturned elbow or "T" in catch basin)	Quarterly	Significant sludge, oil, grease, or scum layer covering all or most of the water surface.	Remove the catch basin lid and skim off oil layer. Pour oil into a disposable container, seal container, wrap securely in newspaper, and place in trash. Water surface should be clear of oily layer.
Pipe elbow	Quarterly	Damage to top or bottom of pipe; determine whether pipe is plumb.	If pipe is broken, replace pipe in accordance with approved plans on file with your local jurisdiction.

Fencing, Shrubbery Screens, and Gates

Fences and shrubbery screens aren't typically required for stormwater ponds. If the slopes of the sides are too steep, usually some kind of barricade is constructed.

INSPECTION AREA	FREQUENCY	LOOK FOR	ACTION
Fence or shrubbery screen	Quarterly	Inspect the fence or screen to ensure that it blocks easy entry to the facility. Make sure erosion hasn't created an opening under fence.	Mend the fence, repair erosion, or replace the shrubs to form a solid barrier.
Shrubbery screen	Quarterly	Confirm that shrubbery is not growing out-of-control or that it is not infested with weeds.	Trim and weed shrubbery to provide appealing aesthetics. Do not use chemicals to control weeds.
Wire Fences	Annually	Confirmation that fence is still in alignment.	Straighten posts and rails if necessary.
Wire Fences	Annually	Missing or loose tension wire.	Replace or repair tension wire so it holds fabric.
Wire Fences	Annually	Missing, loose, or sagging barbed wire.	Replace or repair barbed wire so that it doesn't sag between posts.
Wire Fences	Annually	Rust or scaling	Paint or coat rusting or scaling parts with a protective coating.
Wire Fences	Quarterly	Confirm that there are no holes in the fabric or fencing.	Repair holes so that there are no openings in the fabric or fencing.
Gate	Quarterly	Confirm that the gate is not broken, jammed, or missing and that it opens easily.	Repair or replace the gate to allow entry of maintenance people and equipment. If a lock is used, make sure you have a key.

Grounds and Landscaping

INSPECTION AREA	FREQUENCY	LOOK FOR	ACTION
Landscaped Areas	Quarterly	Uncontrolled weed growth in landscaped areas.	If possible, pull weeds by hand to avoid using chemical weed controls.
Landscaped Areas	Quarterly	Presence of poison ivy or other poisonous vegetation or insect nests.	Remove poisonous vegetation or insect nests.
Landscaped Areas	Quarterly	Yard waste or litter	Remove and dispose of properly.
Landscaped Areas	Quarterly	Noticeably visible rills in landscaped areas.	Identify the causes of erosion and take steps to slow down or disperse the water. Fill in contour; seed area.
Trees and shrubs	Annually	Split, broken or otherwise damaged tree parts and shrubs	Trim trees and shrubs to restore shape. Replace severely damaged trees and shrubs.
Trees and shrubs	Annually	Blown down or knocked over trees or shrubs	Replant trees or shrubs, inspecting for injury to stem or roots. Replace if severely damaged.
Trees and Shrubs	Annually	Exposed roots, inadequate support, severe leaning	Place stakes and rubber-coated ties around young trees/shrubs for support.

Access Roads and Easements

INSPECTION AREA	FREQUENCY	LOOK FOR	ACTION
General	One Time	Adequate access to your stormwater facilities for maintenance vehicles.	If there is not enough access, check with your local jurisdiction to determine whether an easement exists. If so, a maintenance road may need to be constructed.
Access road	Quarterly	Debris that could damage vehicle tires (glass or metal).	Clear all potentially damaging debris.
Access road	Annually	Any obstructions that reduce clearance above and along the road to less than 14 feet.	Clear along and over roadway so there is enough clearance.
Road surface	Annually	Potholes, ruts, mushy spots, or woody debris that limit access by maintenance vehicles.	Add gravel or remove wood as necessary.
Shoulders and ditches	Annually	Erosion along the roadway.	Repair erosion with additional soil or gravel.

RESOURCE LISTING

If you suspect a problem exists, please contact your local jurisdiction at one of the numbers below and ask for Technical Assistance.

Contact Numbers:

City of Chehalis Public Works	(360) 748-0238
Lewis County Engineering	(360) 740-1148

Developer Information:

Homestreet Development, LLC
1868 State Avenue NE
Olympia, WA 98506

Engineer's Information:

HATTON GODAT PANTIER
3910 Martin Way E., Suite B
Olympia, WA 98506

LOG SHEET

Use log sheets to track maintenance checks and what items, if any, are repaired or altered. The completed sheets will serve as a record of maintenance activity and will provide valuable information about how your facilities are operating. Log sheets should be kept in a dry, readily accessible place.

INSPECTION DATE: _____

PERFORMED BY: _____

PHONE NUMBER: _____ ADDRESS: _____

POSITION ON HOA: _____ CITY, ST, ZIP: _____

PART OF FACILITY INSPECTED	OBSERVATIONS (LIST REQUIRED MAINTENANCE ACTIVITIES)	ACTION TAKEN	DATE OF ACTION

III. POLLUTION SOURCE CONTROL PROGRAM

Purpose

Many products and practices commonly used in and around the home are hazardous to both the environment and us. Many of these products can end up in our stormwater systems and groundwater. This document gives alternatives, where possible, for those types of products and practices. The Best Management Practices (BMPs) described here, include "good housekeeping" practices that everyone can use.

Recommended Pollution Control Practices For Homeowners

It has been said that the average home today contains more chemicals than the average chemical lab of 100 years ago. When many of these chemicals are used industrially, they can be subject to various health and safety standards; yet these same substances are used freely and often carelessly in our homes.
The BMPs in this section are divided into four categories: **Household Hazardous Wastes**, **Pesticides**, **Remodeling**, and **Septic Maintenance**. Each section includes information on available alternatives.

Household Hazardous Wastes

Many of the cleaning agents, solvents, polishes, etc. commonly used in the home are considered hazardous. These products may be toxic, corrosive, reactive, flammable, and/or carcinogenic. It is critical that these products are handled with care and are properly disposed of. A list of common household hazardous materials is presented in Table 1.
In addition, many hazardous household chemicals persist for long periods of time in the environment. Manufacturers may truthfully state that a product is "biodegradable"; most products are biodegradable, but what is important is the rate at which they are broken down and the products they are broken down into. The term "biodegradable" on its own is misleading at best, unless the product is rapidly degraded into harmless substances.
It is important to note here that the term "biodegradable" currently has no legal definition in this state. This means that any product can use this term according to the manufacturer's own definition. This definition may not be at all similar to the consumer's perception. The following ideas will help you reduce the risks of stormwater and ground water contamination from many household products:

Household Product Management:

1. Read product labels before purchasing. Toxic product labels will carry many warnings. Either bypass such products or purchase in small quantities. If you cannot use the entire product, try to give it away instead of disposing of it. Lewis County periodically facilitates product exchanges for leftover paints and other hazardous wastes. Call the Lewis County Health Department for more information.
2. Buy only those detergents that contain little or no phosphorus. Phosphorus can cause algae blooms if washed into lakes or streams. Most detergents that are low or phosphate free are labeled as such.

3. Use no more than the manufacturer's suggested amount of any cleanser. More is not necessarily better.

4. Products such as oven cleanser, floor wax, furniture polish, drain cleaners, and spot removers often contain toxic chemicals. Buy the least toxic product available or use a non-toxic substitute if one can be found. For example, ovens can be cleaned by applying table salt to spills, then scrubbing with a solution of baking soda and water. Table 2 lists substitutes for many commonly used household products.

   If it is necessary to use a product that contains toxic chemicals, use the product only as directed. Do not combine products, as they may become more dangerous when mixed (e.g., mixing chlorine bleach and ammonia produces dangerous gases). Use eye protection and rubber gloves as appropriate.

   Contact the Hazardous Substance Hotline at 1-800-633-7585 if you have any questions regarding disposal of a product or empty container. The County has both hazardous waste collection days and permanent facilities where residents can bring hazardous wastes. Call the Lewis County Health Department at (360) 740-1148 for more information.

5. Chemicals left over from activities, such as photography and auto repair, are hazardous and should not be flushed down the sink. This is especially important if your home is hooked up to a septic system. Toxic chemicals can kill the beneficial bacteria in the tank used to treat sewage and can pollute water supply wells.

6. Be sure all containers are clearly labeled.

7. Common batteries (not automobile) are one of the largest sources of heavy metals (such as lead, nickel, cadmium, and mercury) found in landfills. Instead of throwing them away, dispose of them at a hazardous waste collection site.

Automotive Usage, Care and Maintenance:

From a waste management standpoint, automobile maintenance is best done by professionals at facilities designed to handle, store, and dispose of the waste products properly. Many of these facilities do an excellent job of dealing with waste oils, antifreezes, other fluids, batteries and tires. They often charge a small fee to cover the added expenses, but it's worth it. However if you repair your car at home, please consider these helpful tips:

1. Cars should be serviced regularly. Leaky lines or valves should be replaced.

2. Dumping oil, degreasers, antifreeze, and other automotive liquids into a stream or a storm drain violates city, county and state laws or ordinances. Do not dump them onto the ground because they will end up in stormwater runoff or in groundwater. Do not use oil to reduce dust levels on unpaved areas. Instead, recycle used oil and antifreeze. Keep them in separate containers. Call the Recycling Hotline at 1-800-RECYCLE or call the Lewis County Health Department for the location of the nearest recycling center or, inquire whether your local automotive service center recycles oil. Some may also take used oil filters.

3. Wrap empty oil or antifreeze containers in several layers of newspaper, tie securely and place in a covered trashcan. Antifreeze is sweet tasting, but poisonous to people, fish, pets and wildlife.

4. Sweep your driveway instead of hosing it down. Fluids and heavy metals associated with automobiles can build up on driveway surfaces and be washed into local surface or groundwater when driveways are hosed down.

5. When washing vehicles, do so over your lawn or where you can direct soapsuds onto the lawn or another vegetated area to keep the soaps from washing into the storm drain system or local surface water. Your stormwater pond cannot cleanse soapy water.

6. Small spills of oil and other fluids can be absorbed with materials such as kitty litter or sawdust. Wrap the used absorbent and any contaminated soil in a plastic bag and place in the garbage.

   If a spill reaches surface water, you must notify the nearest regional office of the Department of Ecology Immediately! The Southwest Regional Office number is (360) 407-6300 or call 911. There are fines for failure to notify the appropriate agency when a spill occurs.

7. De-icing chemicals (various types of salt) can harm concrete less than three years in age, burn vegetation, and be corrosive to cars and other metal objects. De-icing chemicals and their additives can be toxic. (Cyanide is formed from the breakdown of a common anti-caking agent used in de-icing chemicals.)

   Urea salts are an alternative to other types of salt de-icers, but great care must be used in applying them. These salts contain large quantities of nitrogen, which can severely burn plants and encourage algae growth if over-applied.

   The use of these chemicals should be minimized or avoided. Instead, shovel walks clear and apply a dusting of sand to improve footing.

TABLE 1. HAZARDOUS HOUSEHOLD SUBSTANCES LIST

AUTO, BOAT AND EQUIPMENT MAINTENANCE	REPAIR AND REMODELING	CLEANSING AGENTS
Batteries	Adhesives, glues, cements	Oven cleaners
Waxes and cleansers	Roof coatings, sealants	Degreasers and spot removers
Paints, solvents and thinners	Caulking and sealants	Toilet, drain and septic tank cleaners
Additives	Epoxy resins	Polishes, waxes and strippers
Gasoline	Solvent-based paints	Deck, patio and chimney cleaners
Flushes	Solvents and thinners	Solvent cleaning fluids
Auto repair materials	Paint removers and strippers	
Motor oil		
Diesel oil		
Antifreeze		
PESTICIDES	**HOBBY AND RECREATION**	**MISCELLANEOUS**
Insecticides	Paints, thinners and solvents	Ammunition
Fungicides	Chemicals (photo and pool)	Asbestos
Rodenticides	Glues and cements	Fireworks
Molluscicides	Inks and dyes	
Wood preservatives	Glazes	
Moss retardants	Chemistry sets	
Herbicides	Bottled gas	
Fertilizers	White gas	
	Charcoal starter fluid	

Source: Guidelines for Local Hazardous Waste Planning, Ecology, No. 87-18 1987.

TABLE 2. NON- OR LESS TOXIC ALTERNATIVES TO TOXIC PRODUCTS

HAZARDOUS PRODUCT	ALTERNATIVE(S)
Air fresheners	Set out a dish of vinegar; simmer a potpourri of cinnamon and cloves; set out herbal bouquets or potpourri in open dishes; burn scented candles
Bleach	Borax or oxygen bleaches or reduce bleach by ½ and add ¼ - ½ C baking soda; line dry clothes
Brass polish	Worcestershire sauce
Chrome polish	Apple cider vinegar; a paste of baking soda and water; a lemon
Coffee pot cleaner	Vinegar; remove coffee stains with moist salt paste
Copper cleaner	Mixture of lemon juice and salt or tomato catsup
Drain cleaner	Use a plunger followed by ½ C baking soda mixed in ½ C vinegar. Let sit 15 minutes, pour into drain followed by 2 qt. boiling water.
Furniture polish	Linseed, olive or almond oils; a mixture of 3 parts olive oil to 1 part white vinegar; a mixture of 1T lemon oil and 1 pint mineral oil
Garbage disposal deodorizer	Lemon rind or baking soda
Glass cleaner	Mixture of 2T vinegar and 1quart water
Grease remover	Paste of borax and water on damp cloth
Ink stain remover	Spray with non-aerosol hairspray before washing
Laundry soap	Borax; baking soda; washing soda
Linoleum floor cleaner	Mixture of 1 C white vinegar and 2 gallons water
Mildew remover	Equal parts vinegar and salt
Mothballs	Cedar chips or blocks; dried tansy, lavender or peppercorns
Oil spills	Kitty litter; sawdust
Oil stain remover	White chalk rubbed into stain prior to washing
Oven cleaner	Cover fresh spills with salt; scrape off after the oven cools. A soda water solution will cut grease. Paint ammonia on spills with a paintbrush, then rinse off.
Paint brush softener	Hot vinegar
Paint stripper	Use mechanical sanding instead of chemical strippers
Paint or grease remover	Wear gloves or try baby oil
Pet odor remover	Cider vinegar
Pitch or sap remover	Butter, margarine or vegetable shortening
Porcelain stain remover	Baking soda
Refrigerator deodorizer	Open box of baking soda
Rug/carpet cleaner	(General) Use a soap-based non-aerosol rug shampoo, vacuum when dry. (Spots) Pour club soda or sprinkle cornmeal or cornstarch on the rug, let sit for at least 30 minutes; vacuum.
Rust remover	Lemon juice and sunlight
Rusty bolt remover	Carbonated beverage
Scorch mark remover	Grated onion
Scouring powder	Baking soda or non-chlorine scouring powder
Silver polish	Soak silver in warm water with 1T soda, 1T salt and a piece of aluminum foil.

Stainless steel polish	Mineral oil
Toilet bowl cleaner	Paste mixture of borax and lemon juice
Tub and tile cleaner	¼ C soda and ½ C white vinegar mixed with warm water
Upholstery spot remover	Club soda
Water mark remover	Toothpaste
Water softener	¼ C vinegar

Pesticides[1] And Fertilizers

Pesticides and fertilizers are commonly used by homeowners in their quest for bigger, healthier plants and greener, lusher lawns. These chemicals are often overused and misapplied. These chemicals are easily introduced into stormwater runoff and can cause algae blooms (fertilizers) or kill off aquatic organisms (pesticides).

Fertilizer Management:

Fertilizing a lawn can be done in an environmentally sensitive manner. Here are some ideas:

1. Before fertilizing, test your soil's pH by using a readily available kit, or through tests provided by WSU Cooperative Extension. Use only the recommended amount of fertilizer, and any soil amendments, such as lime, that are recommended in your test results.
2. Use fertilizers that are appropriate for your area and for the types of plants you are growing. Work the fertilizer into the soil directly around the plant's drip line. By incorporating the fertilizer in the soil, there will be less likelihood of contaminated runoff. Contact the Lewis Conservation District for more information.
3. Water before fertilizing. Water enough to dampen the ground thoroughly, but not enough to cause surface runoff. Dampening the soil prevents fertilizer from being washed from the surface of dry soil in the first rain or watering after application
4. Many soils can benefit from the use of organic fertilizers such as compost or peat. Not only do these substances add nutrients to soil, they also increase the porosity of the soil and increase its ability to hold water.
5. Slow release fertilizers (which are generally resin-coated) can be used in addition to organic fertilizers. They are not mobile in the soil, and are only applied once.

Integrated Pest Management:

Rather than bringing out the sprayer whenever a pest infestation occurs in the garden, consider using Integrated Pest Management (also known as IPM). IPM emphasizes the evaluation of all factors including environmental effects before chemicals are applied. Pesticides should only be

[1] As used here, the word pesticide can mean any herbicide, insecticide, rodenticide, miticide, or other types of chemicals used in the same manner.

used as a last resort. Some of the tactics that can be used to decrease or eliminate the use of pesticides include:

1. Use of Natural Predators, Pathogens: Because chemical sprays generally kill many beneficial insects instead of just the target pest, it may be necessary to introduce natural predators back into the garden. Ladybugs, lacewings, predatory wasps, and nematodes are all commercially available. Garter snakes and toads are also predators and should not be eliminated from the garden.

   There are some bacteria, viruses, and insect parasites that are specific to pests and will not harm other insects or animals. A commonly used bacterium in the Puget Sound area is Bacillus thuringiensis (Bt), which is intended to control infestations of tent caterpillars. Products containing Bt are available at your nursery.

2. Habitat Changes: Many times a change of habitat can control pest infestations. Removal of old tires can cut down on the mosquito population by removing a convenient water-filled location for them to breed in. Crop rotation, even in a small garden, can reduce the number of pest infestations. Removing last year's leaves from under rose bushes can cut down on the incidence of mildew and blackspot, as these fungi overwinter in dead leaves.

3. Timing: Crops that can overwinter (such as leeks or carrots) should be planted in the fall. This gives them time to become established before pests arrive in the spring.

4. Mechanical: Many eggs, larvae, cocoons, and adult insects can be removed by hand. Be sure that the insect is properly identified prior to removing it so those beneficial insects are not destroyed in error. Drowning insects in plain water or spraying them with soapy water are alternatives to squashing them.

5. Resistant Plants: Plants that are native to this area are often more resistant to pests and climate, etc. than are introduced plants. Many plant cultivars have been developed which are resistant to such diseases as verticilium wilt and peach leaf curl. Grass seed mixes are also available for lawns that need much less watering, mowing, and chemical use.

6. Growing Conditions: Plants, such as hostas, that require some shade are more susceptible to pests when they are growing in the sun. Improperly fertilized or watered plants are less vigorous in growth and tend to attract pests. Plants that prefer an acid soil, such as azaleas, will perform better and be less susceptible to pests when they are grown in soil with the proper pH.

7. Chemicals: Chemicals are a small part of the IPM plan and should be applied only as needed after reviewing all other alternatives.

Pesticide Management:

When use of a chemical is the best or only option, follow these simple guidelines:

1. Know your target pest before spraying. Use the pesticide according to the manufacturer's instructions and buy only the needed quantity. Many pesticides have a limited shelf life and may be useless or degrade into even more toxic compounds if for extended periods of time.

2. Do not apply more than the specified amount. Overuse can be dangerous to your health as well as the health of wildlife and the environment. If more than one chemical can be used to control

the pest, choose the least toxic. The word "caution" on the label means that the chemical is less toxic than one that is labeled "warning".

3. Do not spray on windy days, in the morning of what will be a very hot day, or when rain is likely. Herbicides can drift and injure valuable ornamental plants. Do not water heavily after application. Plants should be lightly watered BEFORE application to prevent burning of the foliage, and to help evenly spread the chemical.
4. Never apply pesticides near streams, ponds, or wetlands (exception: approved applications for aquatic weeds). Do not apply pesticides to bare eroded ground (exception: use of low toxicity herbicides such as Round-up to allow growth of desired planting in small areas). Many pesticides bind to soil particles and can be easily carried into a stream or storm drain.
5. Pesticides should be stored well away from living areas. Ideally, the storage area should have a cement floor and be insulated from temperature extremes. Always keep pesticides in their original containers with labels in tact. Labels often corrode and become illegible in this climate and may have to be taped onto the container.
6. Federal law now requires that all pesticides be labeled with the appropriate disposal method. Leftovers should never be dumped anywhere, including a landfill. Take unwanted pesticides to the County's hazardous waste collection days or Hazo House at the landfill.
7. Empty containers should be triple-rinsed and the rinse water used as spray. Once containers are triple-rinsed, they are not considered hazardous waste and may be disposed of in most landfills. However, call your local landfill before putting the container in the garbage.
8. If a pesticide is spilled onto pavement, it can be absorbed using kitty litter or sawdust. The contaminated absorbent should be bagged, labeled and taken to Hazo House.
9. If the pesticide is spilled onto dirt, dig up the dirt, place it in a plastic bag and take it to Hazo House.
10. Many pest control companies and licensed applicators have access to pesticides that are more toxic than those available to the consumer. Check with the company before they spray indoors or outdoors to find out what spray they will be using and what precautions, if any, are necessary after the operator leaves.

Home Remodeling

Remodeling uses some of the most toxic substances found in the home. Paints, preservatives, strippers, brush cleaners, and solvents all contain a wide range of chemicals, some of which are suspected to be carcinogenic (cancer causing). These products should never be dumped in a landfill or put down a sewer or septic system.

1. When building a deck consider using wood or wood alternatives such as recycled wood/plastic decking instead of concrete. Wood decking allows rainwater to drip onto the ground below, keeping it from becoming surface runoff.
2. Decks and sidewalks can also be built out of brick interlocking pavers or modular concrete. If these surfaces are placed on a bed of well-drained soil gravel or sand, rainwater can infiltrate into the ground around them.

3. To reduce disposal problems, buy only the needed amount. Used turpentine or brush cleaner can be filtered and reused. Paint cans should be allowed to dry and then be disposed of during a hazardous waste collection day or at Hazo House.
4. Leftover paint can be given away, for example to a theater group. Contact the Lewis County Health Department at (360) 427-9670 for other options.
5. Roof downspouts can be adjusted to infiltrate runoff to a well drained area. The runoff from them can enter a gravel bed where it can infiltrate into the ground. For design criteria, see your jurisdiction's drainage manual.
6. When gardening on slopes, reduce the potential for surface runoff by using terraces across the face of the hill. These can be as simple as little soil "bumps" or more elaborate using timbers, masonry or rock walls.

Septic System Care and Management

While septic systems do not seem to have a direct relationship with stormwater runoff, they can in some instances be related.

1. Roof drains and stormwater runoff should be diverted away from drainfields. Excess water reduces the capacity of the drainfield to absorb effluent from the septic tank.
2. Water from hot tubs should not be drained into a septic system all at once. They are not designed to handle large volumes of chlorinated water. Either use the water on plants in the yard, or drain the hot tub slowly over a period of days.
3. Septic tanks should be pumped regularly. Ponded water, damp places in the yard, foul odors and/or a dark gray or black soil color may indicate septic drain field failure. Effluent from a malfunctioning septic can cause disease and nitrate problems in groundwater. For septic system assistance, contact the Lewis County Health Department at (360) 740-1148.

References

Puget Sound Water Quality Authority, Managing Nonpoint Pollution - an Action Plan for Puget Sound Watersheds, 88-31, June 1989.
Washington State Dept. of Ecology, Water Quality Guide - Recommended Pollution Control practices for Homeowners and Small Farm Operators 87-30, revised June 1991.
Washington State Dept. of Ecology, Hazardous Waste Pesticides, 89-41, August 1989.

IV. GLOSSARY

BEST MANAGEMENT PRACTICE (BMP) - Structures, conservation practices, or regulations that improve quality of runoff or reduce the impact of development on the quantity of runoff.

BIOFILTER (SWALE) - A wider and flatter vegetated version of a ditch over which runoff flows at uniform depth and velocity. Biofilters perform best when vegetation has a thick mat of roots, leaves, and stems at the soil interface (such as grass).

BIOFILTRATION - The process through which pollutant concentrations in runoff are reduced by filtering runoff through vegetation.

BUFFER - The zone that protects aquatic resources by providing protection of slope stability, attenuation of runoff, and reduction of landslide hazards. An integral part of a stream or wetland ecosystem, it provides shading, input of organic debris, and coarse sediments to streams. It also allows room for variation in stream or wetland boundaries, habitat for wildlife, and protection from harmful intrusion.

CATCH BASIN - An inlet for stormwater set into the ground, usually rectangular and made of concrete, and capped with a grate that allows stormwater to enter.

CHECK DAM - A dam (e.g., rock, earthen, log) used in channels to reduce water velocities, promote sediment deposition, and/or enhance infiltration.

COMPOST STORMWATER FILTER - A treatment facility that removes sediment and pollutants from stormwater by percolating water through a layer of specially prepared bigleaf maple compost.

CONSTRUCTED WETLAND - A wet pond with dead storage at varied depths and planted with wetland plants to enhance its treatment capabilities.

CONTROL STRUCTURE (FLOW RESTRICTOR) - A manhole and/or pipe structure with a flow-regulating or metering device such as a weir or plates with small holes known as orifices. This structure controls the rate at which water leaves the pond.

CONVEYANCE - A mechanism or device for transporting water including pipes, channels (natural and man-made), culverts, gutters, manholes, etc.

CRITICAL AREA - Areas such as wetlands, streams, steep slopes, etc. as defined by ordinance or resolution by the jurisdiction. Also known as "environmentally sensitive areas."

CULVERT - A conveyance device (e.g., concrete box, pipe) that conveys water from a ditch, swale, or stream under (usually across) a roadway or embankment.

DEAD STORAGE - The volume of storage in a pond below the outlet that does not drain after a storm event. This storage area provides treatment of the stormwater by allowing sediments to settle out.

DETENTION FACILITY - A facility (e.g., pond, vault, pipe) in which surface and storm water is temporarily stored.

DETENTION POND - A detention facility in the form of an open pond.

DISPERSION TRENCH - An open-top trench filled with riprap or gravel that takes the discharge from a pond, spreads it out, and spills (bubbles) the flow out along its entire length. Dispersion trenches are

used to simulate "sheet flow" of stormwater from an area, and are often used to protect sensitive adjacent areas, such as wetlands.

DRAINAGE SYSTEM - The combination of Best Management Practices (BMPs), conveyances, treatment, retention, detention, and outfall features or structures on a project.

DROP STRUCTURE - A structure for dropping water to a lower elevation and/or dissipating energy. A drop may be vertical or inclined.

DRY POND - A detention facility that drains completely after a storm. This type of pond has a pipe outlet at the bottom.

EASEMENT - A right afforded a person to make limited use of another's real property. Typical easements are for pipes or access to ponds, and may be 15 to 20 feet wide.

EMERGENCY OVERFLOW OR SPILLWAY - An area on the top edge of the pond that is slightly lower in elevation than areas around it. This area is normally lined with riprap. The emergency overflow is used only if the primary and secondary outlets of the pond fail, in the event of extreme storms, or if the infiltration capability of the pond becomes significantly diminished. If the emergency overflow ever comes into play, it may indicate the pond needs to be upgraded.

ENERGY DISSIPATER - A rock pad at an outlet designed to slow the velocity, spread out the water leaving the pipe or channel, and reduce the potential for erosion.

FREEBOARD - The vertical distance between the design high water mark and the elevation of the top of the pond. Most ponds have one to two feet of freeboard to prevent them from overflowing.

INFILTRATION - The soaking of water through the soil surface into the ground (percolation). (Many ponds are designed to fully infiltrate stormwater, and thus do not have a regularly used discharge pipe.)

INFILTRATION FACILITY (or STRUCTURE) - A facility (pond or trench) that retains and percolates stormwater into the ground, having no discharge (to any surface water) under normal operating conditions.

JUNCTION - Point where two or more drainage pipes or channels converge (e.g., a manhole).

JURISDICTION - Olympia, Lacey, Tumwater, or Thurston County (as applicable).

LINED POND or CONVEYANCE - A facility, the bottom and sides of which have been made impervious (using, for example, a plastic liner or clay/silt soil layer) to the transmission of liquids.

LIVE STORAGE - The volume of storage in a pond above the outlet that drains after a storm event. This storage area provides flood control and habitat protection for nearby streams.

MANHOLE - A larger version of a catch basin, often round, with a solid lid. Manholes allow access to underground stormwater pipes for maintenance.

NATURAL CHANNEL - Stream, creek, river, lake, wetland, estuary, gully, swale, ravine, or any open conduit where water will concentrate and flow intermittently or continuously.

OIL-WATER SEPARATOR - A structure or device used to remove oil and greasy solids from water. They operate by using gravity separation of liquids that have different densities. Many catch basins have a downturned elbow that provides some oil-water separation.

OUTFALL - The point where water flows from a man-made conduit, channel, or drain into a water body or other natural drainage feature.

RETENTION FACILITY - An infiltration facility.

RETENTION POND - A retention facility that is an open pond.

REVETMENTS - Materials such as rock or keystones used to sustain an embankment, such as in a retaining wall.

RIP RAP - Broken rock, cobbles, or boulders placed on earth surfaces, such as on top of a berm for the emergency overflow, along steep slopes, or at the outlet of a pipe, for protection against the action of water. Also used for entrances to construction sites.

RUNOFF - Stormwater.

SAND FILTER - A treatment facility that removes sediment and pollutants from stormwater by percolating water through a layer of sand.

STORMWATER - That portion of precipitation that falls on property and that does not naturally percolate into the ground or evaporate, but flows via overland flow, channels or pipes into a defined surface water channel, or a constructed infiltration facility. Stormwater includes washdown water and other wastewater that enters the drainage system.

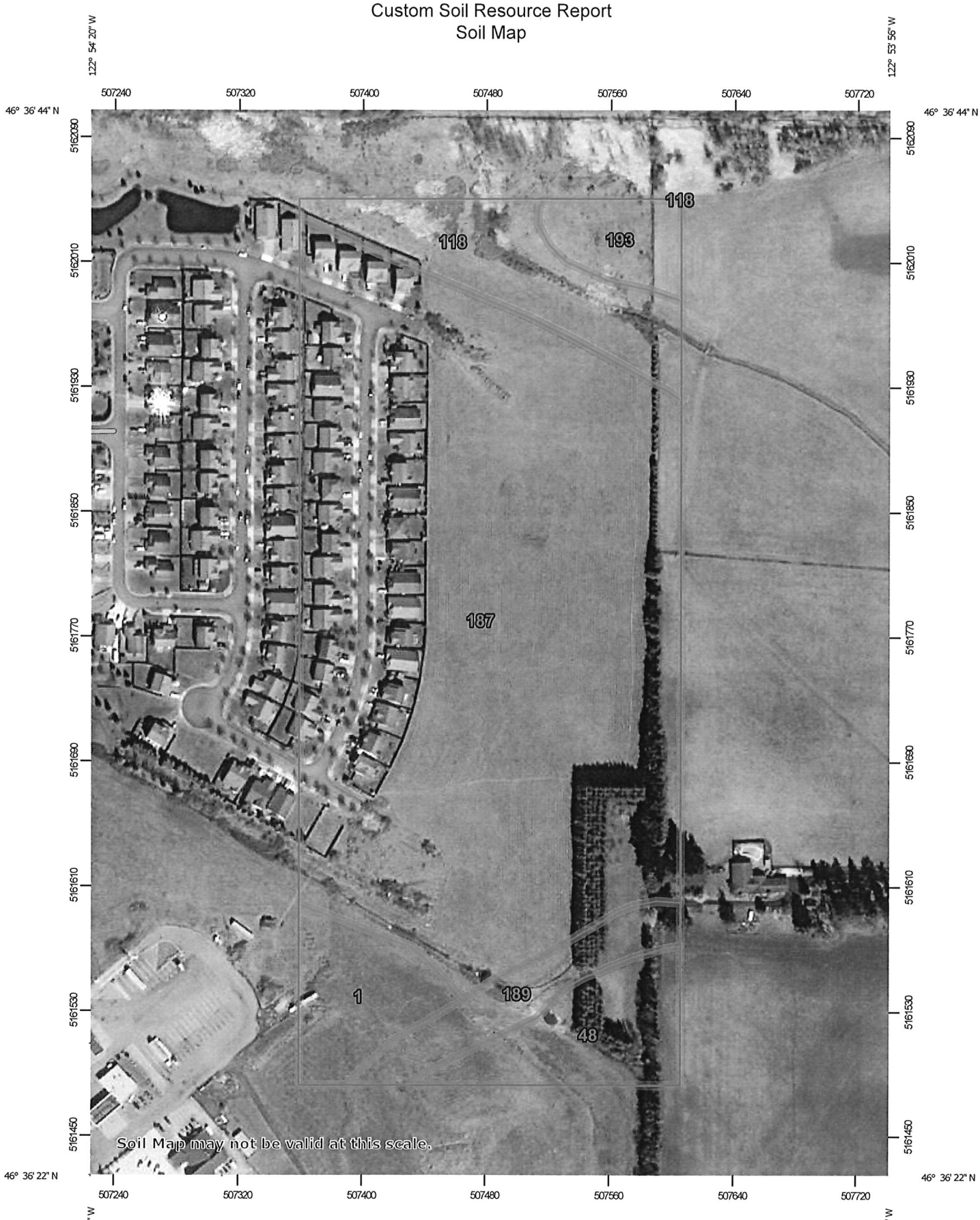
SWALE - A shallow drainage conveyance with relatively gentle side slopes, generally with flow depths less than one foot. This term is used interchangeably with "BIOFILTER".

TRASH RACK or BAR SCREEN - A device (usually a screen or bars) that fits over a pipe opening to prevent large debris such as rocks or branches from entering and partially blocking the pipe.

WET POND - A stormwater treatment pond designed with a dead storage area to maintain a continuous or seasonal static water level below the pond outlet elevation.

APPENDIX A – Soils Analysis

Custom Soil Resource Report
Soil Map



Map Scale: 1:3,320 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 45 90 180 270

Feet: 0 150 300 600 900

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 10N WGS84

Hydric soil rating: Yes

Reed

Percent of map unit: 5 percent
Landform: Flood plains
Hydric soil rating: Yes

118—Lacamas silt loam, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 2h8l
Elevation: 250 to 1,200 feet
Mean annual precipitation: 40 to 70 inches
Mean annual air temperature: 48 to 50 degrees F
Frost-free period: 125 to 200 days
Farmland classification: Prime farmland if drained

Map Unit Composition

Lacamas, drained, and similar soils: 60 percent
Lacamas, undrained, and similar soils: 30 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Lacamas, Drained

Setting

Landform: Flood plains, terraces

Typical profile

H1 - 0 to 7 inches: silt loam
H2 - 7 to 17 inches: silt loam
H3 - 17 to 27 inches: silty clay
H4 - 27 to 60 inches: clay

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Very low (0.00 in/hr)
Depth to water table: About 12 to 18 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Moderate (about 6.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: C/D
Forage suitability group: Seasonally Wet Soils (G002XV202WA)
Hydric soil rating: Yes

Description of Lacamas, Undrained

Setting

Landform: Flood plains, terraces

Typical profile

H1 - 0 to 7 inches: silt loam
H2 - 7 to 17 inches: silt loam
H3 - 17 to 27 inches: silty clay
H4 - 27 to 60 inches: clay

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Very poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Very low (0.00 in/hr)
Depth to water table: About 0 to 6 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Moderate (about 6.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 5w
Hydrologic Soil Group: C/D
Forage suitability group: Seasonally Wet Soils (G002XV202WA)
Hydric soil rating: Yes

Minor Components

Klaber

Percent of map unit: 5 percent
Landform: Depressions
Hydric soil rating: Yes

Prather

Percent of map unit: 3 percent
Hydric soil rating: No

Scamman

Percent of map unit: 2 percent
Landform: Terraces
Hydric soil rating: Yes

187—Salkum silty clay loam, 0 to 5 percent slopes

Map Unit Setting

National map unit symbol: 2hc2
Elevation: 200 to 1,000 feet
Mean annual precipitation: 40 to 70 inches

Mean annual air temperature: 48 to 50 degrees F
Frost-free period: 150 to 210 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Salkum and similar soils: 90 percent
Minor components: 4 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Salkum

Setting

Landform: Terraces
Parent material: Glacial drift

Typical profile

H1 - 0 to 14 inches: silty clay loam
H2 - 14 to 52 inches: silty clay
H3 - 52 to 60 inches: silty clay

Properties and qualities

Slope: 0 to 5 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: High (about 9.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: C
Forage suitability group: Soils with Few Limitations (G002XV502WA)
Hydric soil rating: No

Minor Components

Lacamas

Percent of map unit: 3 percent
Landform: Terraces
Hydric soil rating: Yes

Scamman

Percent of map unit: 1 percent
Landform: Terraces
Hydric soil rating: Yes

189—Salkum silty clay loam, 15 to 30 percent slopes

Map Unit Setting

National map unit symbol: 2hc4
Elevation: 200 to 1,000 feet
Mean annual precipitation: 40 to 70 inches
Mean annual air temperature: 48 to 50 degrees F
Frost-free period: 150 to 210 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Salkum and similar soils: 90 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Salkum

Setting

Landform: Ridges, mountain slopes
Parent material: Glacial drift

Typical profile

H1 - 0 to 14 inches: silty clay loam
H2 - 14 to 52 inches: silty clay
H3 - 52 to 60 inches: silty clay

Properties and qualities

Slope: 15 to 30 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: High (about 9.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: C
Forage suitability group: Sloping to Steep Soils (G002XV702WA)
Hydric soil rating: No

Minor Components

Scamman

Percent of map unit: 5 percent
Landform: Terraces
Hydric soil rating: Yes

Subsurface Soils Investigation

Holloway Springs

Off Rush Road

Lewis County, WA

Prepared for
Hatton Godat Pantier

by
Geotechnical Testing Lab
Olympia, WA

June 29, 2005

GEOTECHNICAL TESTING LABORATORY

HATTON GODAT PANTIER
1840 BARNES BLVD. SW
TUMWATER, WA 98512

Attn: Dan Biles

RE: SUBSURFACE SOILS INVESTIGATION
PROJECT: HOLLOWAY SPRINGS
REPORT DATE: 6/24/2005

Gentlemen:

As per your request, we have conducted a soils exploration and foundation evaluation for the above referenced subdivision. The results of this investigation, together with our recommendations, are to be found in the following report. We have provided three copies for your review and distribution.

During our exploration, four test borings were advanced and soil samples submitted for laboratory testing from the project site. The data has been carefully analyzed to determine soils bearing capacities and footing embedment depths. The results of the exploration and analysis indicate that conventional spread and continuous wall footings appear to be the most suitable type of foundation for the support of the proposed structures. Very little variability was encountered in comparing the soil profiles of the site. Net allowable soil pressures, embedment depth, and total expected settlements have been presented for the site, later in the report.

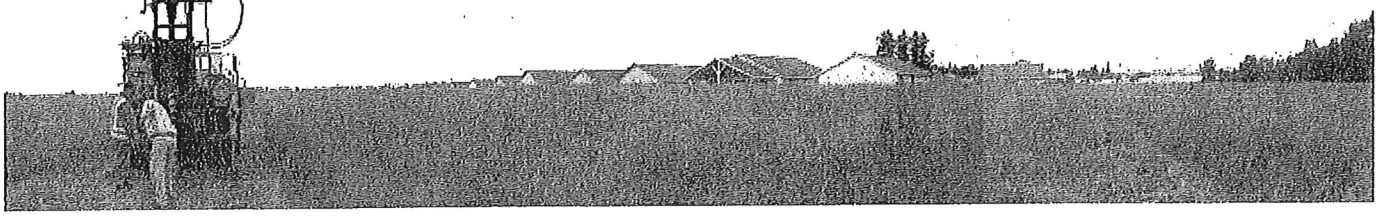
Often, because of design and construction details that occur on a project, questions arise concerning soil conditions. We would be pleased to continue our role as geotechnical consultants during the project implementation. We appreciate this opportunity to be of service to you and we look forward to working with you in the future. If you have any questions concerning the above items, the procedures used, or if we can be of any further assistance please call us at the phone number listed below.

State of Washington
Engineering Geologist
827
Licensed Geologist
HAROLD PARKS
Exp. 7-31-06

Respectfully Submitted,
GEOTECHNICAL TESTING LABORATORY

Harold Parks

Harold Parks
Engineering Geologist



GEOTECHNICAL TESTING LABORATORY

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GEOTECHNICAL TESTING LABORATORY

Subsurface Investigation

INTRODUCTION:
This report presents the results of a soils exploration and foundation analysis for Holloway Springs Division II and III. This investigation was conducted for the engineering firm of Hatton Godat Pantier.

AUTHORIZATION:
Authorization to perform this exploration and analysis was in the form of a written authorization to proceed from Dan Biles.

PURPOSE:
The purpose of this foundation exploration and analysis was to determine the various soil profile components, the engineering characteristics of the foundation materials and to provide criteria for use by the design engineers and architects in preparing or verifying the suitability of the foundation design.

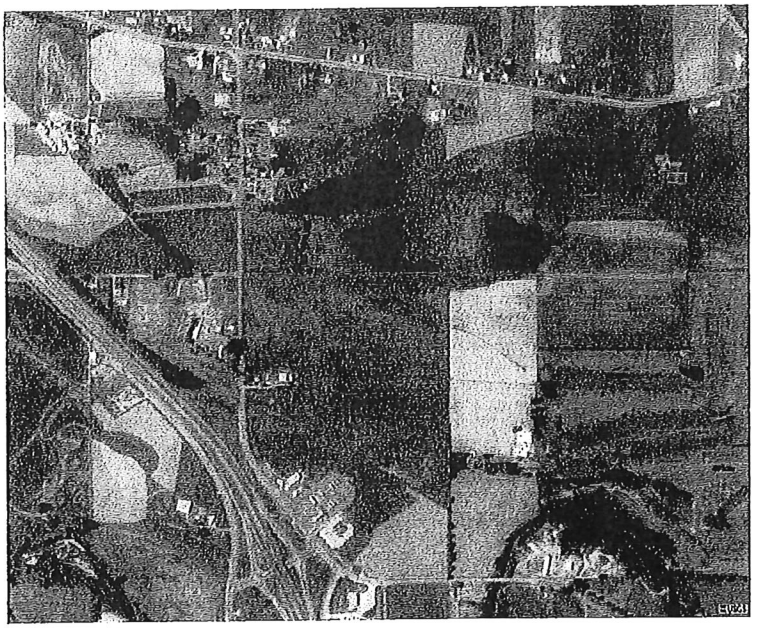
SCOPE:
The scope of the exploration and analysis included a review of geological maps of the area and a review of geologic and related literature, a reconnaissance of the immediate site, the subsurface exploration, field and laboratory testing, and an engineering analysis and evaluation of the foundation materials.

We were not requested to provide an Environmental Site Assessment for this property. Any comments concerning onsite conditions and/or observations, including soil appearances and odors, are provided as general information. Information in this report is not intended to describe, quantify or evaluate any environmental concern or situation.

GENERAL:
The exploration and analysis of the foundation conditions reported herein are considered sufficient in detail and scope to form a reasonable basis for the foundation design. Any revision in the plans for the proposed structure from those enumerated in this report should be brought to the attention of the soils consultant so that he may determine if changes in the foundation recommendations are required. If deviations from the noted subsurface conditions are encountered during construction, they should also be brought to the attention of the soils consultant.

The soils consultant warrants that the findings, recommendations, specifications, or professional advice contained herein have been promulgated after being prepared according to generally accepted professional engineering practice in the fields of foundation engineering, soil mechanics and engineering geology. No other warranties are implied or expressed.

This report has been prepared for the exclusive use of Hatton Godat Pantier and their retained design consultants. Findings and recommendations within this report are for specific application to the proposed project. All recommendations are according to generally accepted soils and foundation engineering practices.

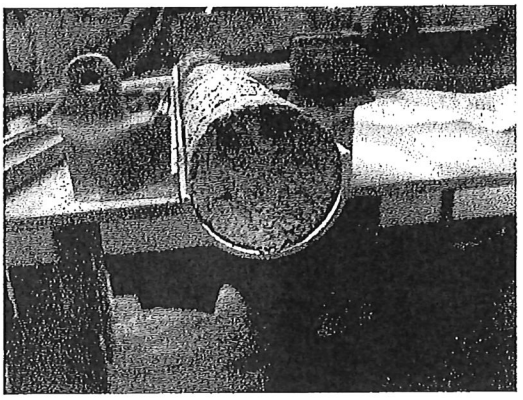


GEOTECHNICAL TESTING LABORATORY

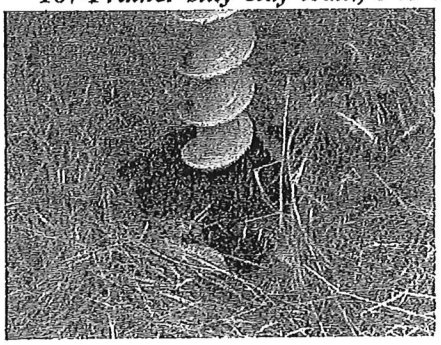
GEOLOGY OF AREA:

The geology of the site and surrounding area as taken from the USDA Soil Conservation Service Survey consists of Lacamas Silt Loam, 0 to 3 percent slopes; and Prather silt clay loam 0 to 5 percent slopes. The survey describes these soils as follows:

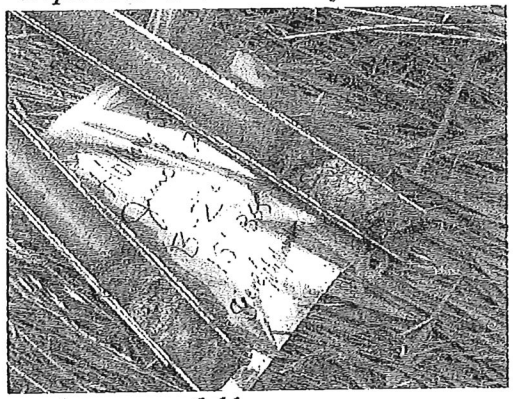
118-Lacamas silt loam, 0 to 3 percent slopes. *This very deep, poorly drained soil is on broad plains, terraces, and bottom lands. Drainage has been altered by tiling. This soil formed in mixed material of glaciofluvial or sedimentary origin. Slopes generally are nearly level or concave. The native vegetation is mainly deciduous trees and a few mixed conifers. Elevation is 250 to 1,200 feet. The average annual precipitation is 40 to 70 inches, the average annual air temperature is about 50 degrees F, the average growing season (at 28 degrees) is 175 to 240 days, and the average frost-free season (at 32 degrees) is 150 to 200 days. Typically, the upper part of the surface layer is very dark grayish brown silt loam about 7 inches thick and the lower part is mottled, dark grayish brown and grayish brown silt loam about 10 inches thick. The upper 19 inches of the subsoil is mottled, olive gray silty clay, and the lower part to a depth of 60 inches or more is mottled, olive gray clay. Included in this unit are as much as 5 percent Klaber soils and Lacamas soils that have slopes of more than 3 percent. Also included are small areas of somewhat poorly drained Galvin and Scamman soils, moderately well drained Prather soils, and Lacamas soils that have pebbles at a depth of less than 36 inches. About 35 percent of this unit is undrained Lacamas soils that have a seasonal high water table at or near the surface in winter and early in spring. Permeability of this Lacamas soil is very slow. Available water capacity is moderately high. Effective rooting depth is about 27 inches. Runoff is very slow, and the hazard of water erosion is slight. Water is perched above the subsoil in winter and early in spring. In areas of this unit that are not used as cropland or where drainage has not been altered, Douglas-fir, red alder, and lodgepole pine are the main woodland species. Among the trees of limited extent are western hemlock, western red cedar, big leaf maple, bitter cherry, and Oregon ash. The seasonal perched water table limits the use of equipment to dry periods in summer. Because the rooting depth is restricted by the seasonal perched water table, trees frequently are subject to windthrow. Among the common forest understory plants are willow, rose, vine maple, salal, western brackenfern, northern twinflower, trailing blackberry, holly fern, red huckleberry, western hazel, violet, insideout flower, rushes, and sedges. If this unit is used for homesite development, the main limitations are the perched water table and shrink-swell potential. Tile drainage can be used to lower the water table if suitable outlets are available. The effects of shrinking and swelling can be minimized by using proper engineering designs and by backfilling with material that has low shrink swell potential. Septic tank absorption fields do not function properly because of wetness and very slow permeability; therefore, community sewage systems are needed.*



167-Prather silty clay loam, 0 to 5 percent slopes. *This very deep, moderately well drained soil is on broad till plains and terraces. It formed in highly weathered ancient glacial drift deposits. Slopes generally are plane. The native vegetation is mainly conifers and a few deciduous trees. Elevation is 200 to 1,000 feet. The average annual precipitation is 40 to 60 inches, the average annual air temperature is about 50 degrees F, the average growing season (at 28 degrees) is 175 to 240 days, and the average frost-free season (at 32 degrees) is 150 to 200 days. Typically, the surface is covered with a mat of partially decomposed organic litter about 2 inches thick. The upper part of the surface layer is very dark brown silty clay loam about 7 inches thick, and the lower part is dark brown silty clay loam about 7 inches thick.*



The upper 12 inches of the subsoil is dark brown silty clay, the next 25 inches is mottled, dark brown silty clay and yellowish brown clay, and the lower part to a depth of 60 inches or more is mottled, dark reddish brown, gray, and brown clay. Included in this unit are as much as 5 percent well drained Salkum soils, 5 percent somewhat poorly drained Galvin and Scamman soils, 5 percent Lacamas soils in or near drainageways and other depressional areas, and 5 percent Prather soils that have slopes of more than 5 percent. Also included are small areas of Prather soils that have pebbles at a depth of less than 36 inches. Permeability of this Prather soil is slow. Available water capacity is high. Effective rooting depth is 60 inches or more, but few roots are below a depth of 26 inches. Runoff is slow, and the hazard of water erosion is slight. Water is perched above the clay subsoil in winter and early in spring. This unit is used mainly for timber production, wildlife habitat, and watershed. It is also used for hay, pasture, and field crops. Some areas are used for homesite and urban development. Douglas-fir and red alder are the main woodland species on this unit. Among the common forest understory plants are vine maple, cascade Oregon-grape, bedstraw, red huckleberry, violet, trailing blackberry, salal, northern twinflower, and western swordfern. The main limitation is the perched water table. Tile drainage can be used to lower the water table if suitable outlets are available. Corn for silage, wheat, oats, and strawberries commonly are grown on this unit. In summer, irrigation is needed for maximum production of most crops. If this unit is used for homesite development, the main limitations are the perched water table and slow permeability. Tile drainage can be used to lower the water table if suitable outlets are available.



The Geologic Map of the Centralia Quadrangle, Washington (Open file report 87-11) by Schasse (1987) describes the site soils. The soil type is identified as Hayden Creek Drift (Qoh). The report reads:

Hayden Creek drift, outwash deposits – Sand and gravel deposits along the Cowlitz River mapped by Weigle and Foxworthy (1962) and Dethier and Bethel (1981), and extended westward to include terrace deposits extending to Chehalis along the south fork of the Newaukum River, Oxidation extends to a depth of 2 to 3 meters.

The *Geologic Map of Washington – Southwest Quadrant* (2002) has mapped the northern portion site geology as The Hayden Creek Drift (Qaop). The report reads:

Consists of outwash deposits of The Hayden Creek and Wingate Hill Drifts and of Logan Hill Formation. Hayden Creek unit has an age range of 70,000 to 140,000 years before present with a preferred age of 140,000 years. The Wingate Hill is older than 140,000 years and possibly as old as 500,000 years. The age range of The Logan Hill unit is uncertain, but its high degree of weathering suggests an early Pleistocene to late Pliocene age.

CLIMATE OF AREA:

The climate of the site and surrounding area as taken from the USDA Soil Conservation Service Survey consists of an average annual precipitation of 40 to 70 inches, an average annual air temperature of about 50 degrees F, an average growing season (at 28 degrees) of 175 to 240 days, and an average frost-free season (at 32 degrees) of 150 to 200 days.

GEOTECHNICAL TESTING LABORATORY
Field Exploration

GENERAL NOTES:
The field exploration to determine the engineering characteristics of the foundation materials included a reconnaissance of the project site, excavating the test borings, performing field penetrometer and vane shear tests and recovering disturbed grab samples. A total of 4 test borings were placed on the site. Test borings were advanced to a maximum of 15 feet below the existing ground surface. Test borings were located by the field crew as near as possible to the midpoint of the proposed building and street centers. A site plan supplied by Hatton Godat Pantier was used to locate the proposed building and street orientation and position the excavations. The test borings were located by the field technician by means of normal taping and pacing procedures and are presumed to be accurate to within a few feet. After completion, the test borings were backfilled with excavated soils and the site cleaned and leveled.

DRILLING & SAMPLING PROCEDURES:
The soil borings were performed with a conventional tire-mounted Mobil B-40 hollow stem auger drill rig. Representative samples were obtained from the borings at 5 ft. soil intervals. The samples obtained by this procedure were classified in the field by a soils technician, identified according to test boring number and depth, placed in plastic bags to protect against moisture loss and transported to the laboratory for additional testing.

Standard penetration was measured using a two-inch outside diameter, split-spoon sampler driven by a pin-guided, 140-pound weight, free falling 30 inches. The blows per six-inch interval were recorded. The first six-inch drive interval is allowed for seating the sampler.

The blow counts for two six-inch intervals, when combined, yield the Standard Penetration Resistance (N-Value) of the soils encountered in the sample interval. The number of blows required to drive the sampler the last 12 inches provides a measure of the relative density of granular soils or the consistency of cohesive soils. When the number of blows exceeds 50 for a six-inch or less advancement of the sampler, refusal is inferred.

The results obtained from the Standard Penetration Test, along with other tests and geotechnical judgments, were used to develop the recommendations of this report.

In addition to the N-value, we tested the soils in the sampler tip using a pocket penetrometer. The data developed by this test presents an estimate of the bearing capacity of the soils by measuring the resistance to penetration. This information is presented with the boring log.

LABORATORY TESTING PROGRAM:
Along with the field investigation, a supplemental laboratory testing program was conducted to determine additional pertinent engineering characteristics of the foundation materials necessary in analyzing the behavior of the proposed building structure. The laboratory testing program included supplementary visual classification and water content determinations on all samples. In addition, selected samples were subjected to Atterburg Limits Tests - ASTM designation D-4318, and Grain Size Analysis - ASTM designation C-117, C-136. All phases of the laboratory testing program were conducted according to applicable ASTM Specifications and the results of these tests are to be found on the accompanying Logs located in the Appendix.

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GEOTECHNICAL TESTING LABORATORY

Project Description

The site of the proposed housing development upon which this soils exploration has been made is located about 2 miles north of Napavine, and will be accessed via Rush Road The site topography is relatively flat. The site drains to the north, eventually making its way to the Newaukum River. The site vegetation consists of native grasses.

The purpose of this section is to enumerate details of the proposed structures. The following information was provided by the project engineer. The buildings will be one and two story conventional wood frame structures. No basements are planned. Conventional spread footings and slab-on-grade floors are contemplated. Differential settlements are limited to 3/4 inch. A pavement section has been provided within this report. Loads of 2,000 pounds per lineal foot for wall footings and 80,000 pounds for columns were assumed for settlement calculations.

Subsurface Conditions

GENERAL NOTES:
The types of foundation materials encountered have been visually classified and are described in detail on the test boring logs provided in the Appendix. The results of the field penetrometer and vane shear tests, moisture contents and other laboratory tests are presented on the logs. It is recommended that the logs not to be used for estimating quantities due to highly interpretive results.

DESCRIPTION OF FOUNDATION MATERIALS:
The surface of the proposed construction site is covered with 12 to 18 inches of topsoil that should be removed prior to the start of any construction due to the high compressibility of these soils.

The soil profiles encountered were relatively consistent among the four borings. Silt to clayey loam layers were encountered beneath the existing topsoil and extended to depths beyond the scope of this investigation. Lines of demarcation represent the approximate boundaries between the soil types, but the transitions may be gradual. It is to be noted that, whereas the test borings were placed and sampled by an experienced technician, it is sometimes difficult to record changes in stratification within narrow limits. In the absence of foreign substances, it is also difficult to distinguish between discolored soils and clean soil fills. It is recommended that the logs not be used for estimating quantities due to highly interpretive results.

Foundation Discussion And Recommendations

GENERAL NOTES:
Various foundation types have been considered for the support of the proposed buildings and roads. Two requirements must be satisfied in the design of foundations. First, the load must be less than the ultimate bearing capacity of the foundation soils to maintain stability, and secondly, the differential settlement must not exceed an amount that will produce adverse behavior to the structures. The allowable settlement is usually exceeded before bearing capacity considerations become important; thus, the allowable bearing pressure is normally controlled by settlement considerations.

Considering the subsurface conditions and the proposed construction, it is recommended that the structures be founded upon conventional spread and continuous wall footing foundations. Settlements should not exceed tolerable limits if the following design and construction recommendations are observed.

FOUNDATION DESIGN RECOMMENDATIONS:
On the basis of the data obtained from the site and the test results from the various laboratory tests performed, We recommend that the following guidelines be used for the net allowable soils bearing capacity.

Footing Depth	ASTM D 1557 Subgrade Compaction	Net Allowable Soils Bearing Capacity
18 inches	90 %	1,500 lbs/ft^2

The footings should be proportioned to meet the stated bearing capacity and the International Building Code's 2003 minimum requirements. Total settlement should be limited to 1 inch total with differential settlement of ¾ inch. Any excessively loose or soft spots or areas that do not meet the compaction requirements that are encountered in the footing subgrade will require over-excavation and backfilling with at least 2 feet of structural fill. In order to minimize the effects of any slight differential movement that may occur due to variations in the characters of the supporting soils and any variations in seasonal moisture contents, it is recommended that all continuous footings be reinforced to IBC standards.

Construction Considerations

EARTHWORK:
Excessively organic top soils generally undergo high volume changes when subjected to loads. This is detrimental to the behavior of pavements, floor slabs, structural fills and foundations placed upon them. It is recommended that excessively organic top soils be stripped from these areas to depths of 8-18 inches and wasted or stockpiled for later use. Exact depths of stripping should be adjusted in the field to assure that the entire root zone is removed. It is recommended that the final exposed subgrade be inspected by a representative of the soils consultant. This inspection should verify that all organic material has been removed. Any soft spots or deflecting areas should be removed to sound bearing and replaced with structural fill.

Once the existing soils are excavated to the design grade, proper control of the subgrade conditions (i.e., moisture content) and the placement & compaction of new fill (if required) should be maintained by a representative of the soils consultant. The recommendations for structural fill presented within this report, can be utilized to minimize the volume changes and differential settlements that are detrimental to the behavior of footings and floor slabs. Enough density tests should be taken to monitor proper compaction. For structural fill beneath building structures, one in-place density test per lift for every 1,000 ft^2 is recommended. In parking and driveway areas this can be increased to two tests per lift for every 1,000 ft^2.

Excavation equipment may disturb the bearing soils and loose pockets can occur at the bearing level that were not disclosed by the soils borings. For this reason, it is recommended that the bottoms of the excavations be compacted in place by vibratory compactors. The upper 12 inches should be recompacted to achieve an in-place density of not less than 95% of the maximum dry density as determined by ASTM D-1557.

STRUCTURAL FILL:
Structural fill should consist of a 3 inch minus select, clean, granular soil with no more than 9% fines (-#200). The fill should be placed in lifts not to exceed 12 inches in thickness. Each layer of structural fill should be compacted to a minimum density of 95% of the maximum dry density as determined by ASTM designation D-1557. For structural fill below footings, the area of the compacted backfill must extend outside the perimeter of the foundation for a distance at least equal to the thickness of the fill between the bottom of the foundation and the underlying soils. If it is elected to utilize a compacted backfill for the support of foundations, the subgrade preparation and the placing of the backfill should be monitored continuously by a qualified geologist or his representative so that the work is performed according to these recommendations.

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The use of on-site soils as structural fill is not recommended. These materials require very high moisture contents for compaction and require a long time to dry out if natural moisture contents are too high. This makes moisture content, lift thickness, and compactive effort difficult to control.

EXCAVATIONS:
Shallow excavations required for construction of foundations that do not exceed four feet in depth may be constructed with side slopes approaching vertical. Below this depth it is recommended that slopes not exceed one vertical to one horizontal. For deep excavations, the soils present cannot be expected to remain in position. These materials can be expected to fail and collapse into any excavation, thereby undermining the upper silt materials. This is especially true when working at depths near the water table. Proper care must be taken to protect personnel and equipment.

Care must be taken so that all excavations made for the foundations are properly backfilled with suitable material compacted according to the procedures outlined in this report. Before the backfill is placed, all water and loose debris should be removed from these excavations.

This information is provided for planning purposes. It is our opinion that maintaining safe working conditions is the responsibility of the contractor. Jobsite conditions such as soil moisture content, weather condition, earth movements and equipment type and operation can all affect slope stability. All excavations should be sloped or braced as required by applicable local, state and federal requirements.

LATERAL EARTH PRESSURES:
Lateral earth pressures are dependent upon the backfill materials and their configuration and moisture content. Three inch minus sand and gravel mixtures that are free draining are recommended for backfilling walls greater than four feet tall. There are no below grade retaining walls or walls designed for retaining earthen fills on this project.

Lateral loads may be resisted by friction on the base of footings and floor slabs and as passive pressure on the sides of footings. We recommend that an allowable coefficient of friction of 0.40 be used to calculate friction between the concrete and the underlying soil. Passive pressure may be determined using an allowable equivalent fluid density of 150 pcf (pounds per cubic foot). Factors of safety have been applied to these values.

The weight of the footing and any overlying backfill may be neglected. The allowable bearing value may be increased by one-third for transient loads such as those induced by seismic events or wind loads. The following values may be used for this site for the silty soils located above the water table.

Active Earth Pressure:	0.35	Coefficient
Passive Earth Pressure:	100	lbs./ft^2/ft depth

FLOOR SLAB-ON-GRADE:
Before the placing of concrete floors or pavements on the site, or before any floor supporting fill is placed, the organic, loose or obviously compressive materials must be removed. The subgrade should then be proof rolled to confirm that the subgrade contains no soft or deflecting areas. Areas of excessive yielding should be excavated and backfilled with structural fill.

Any additional fill used to increase the elevation of the floor slab should meet the requirement for structural fill. Structural fill should be placed in layers of not more than 12 inches in thickness, at moisture contents at or above optimum, and compacted to a minimum density of 95% of the maximum dry density as determined by ASTM designation D-1557.

A granular mat should be provided below the floor slabs. This should be a minimum of four inches in thickness and properly compacted. The mat should consist of sand or a sand and gravel mixture with non-plastic fines.

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The material should all pass a ¾ inch sieve and should contain less than 10% passing the #200 sieve. Because groundwater can be expected to be at shallower depths during the winter months a moisture barrier should be placed beneath all floor slabs.

GROUNDWATER CONTROL:
Groundwater was encountered at the time the field exploration was conducted. Groundwater is not expected to cause any difficulties during construction of this project. It is recommended that runoff caused by wet weather be directed away from all open excavations. The onsite silty soils can be expected to become soft and pump if subjected to excessive traffic after becoming wet during periods of bad weather. This can be avoided by constructing temporary or permanent driveway sections should wet weather be forecast.

GEOSEISMIC SETTING:
According to the Seismic Zone Map of the United States contained in the 2003 International Building Code (IBC), the project site is located where the maximum spectral response acceleration is 45 percent of gravity (g).

Based on the subsurface conditions observed at the site, we interpret the site conditions to correspond to a seismic Soil Profile Type E, for Slightly Compact Soil, as defined by Table 1615.1.1 (IBC). This is based on the range of SPT (Standard Penetration Test) blow counts and/or probing with a ½-inch diameter steel probe rod. The shallow soil conditions were assumed to be representative for the site conditions beyond the depths explored.

LIQUEFACTION POTENTIAL:
Based on our review of the subsurface conditions, we conclude that the site soils are only mildly susceptible to liquefaction. The near-surface soils are generally in a slightly compact condition and the static water table is located far enough below the surface to have no negative impact. However, shaking of the soil is not apt to produce a denser configuration and subsequently excess pore water pressures are not likely to be produced.

The *Liquefaction Susceptibility Map of Lewis County, Washington* by Palmer, Magsino, Poelstra, Bilderback, Folger, and Niggemann (September 2004) maps the site area as having a very low liquefaction potential.

Pavement Design Recommendations

On the basis of the results of laboratory tests and the assumed traffic counts of the proposed project, the pavement profile should consist of the following recommendations:

EXISTING SUBGRADE:

1) All subgrade preparation work to be performed should be monitored by a representative of our firm.

2) Over-excavate any areas that exhibit pumping of the subgrade soils at least 12 inches (or as directed by a representative from our firm). Replace with gravel base material. If subgrade is saturated or pumping excessively after over-excavating then it may be necessary to place quarry spalls on the subgrade prior to placement of any gravel base material.

3) On the basis of the existing soils type, the onsite conditions, and the anticipated traffic conditions we recommend that the existing subgrade being compacted to 95% of the maximum dry density as determined by ASTM D-1557 (Modified Proctor).

4) Under certain site conditions the existing subgrade can be accepted by proof-rolling the subgrade using a fully loaded dump truck. This procedure (if used) should be witnessed and accepted by a representative of our firm.

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GEOTEXTILE MATERIAL:

1) A geotextile fabric should be placed upon the approved subgrade to maintain the structural integrity of the pavement profile. The fabric should be a type of fabric specifically made for use in road construction.

GRAVEL BASE:

1) The gravel base material should consist of 8 inches of material that is placed and compacted to 95% of the maximum dry density as determined by ASTM D-1557 (Modified Proctor).

2) The gravel base material should consist of a clean free draining granular material that has less than 10% passing the #200 sieve. This material should meet one of the following specifications, WSDOT Section 9-03.10 Aggregate for Gravel Base, WSDOT Section 9-03.14(1) Gravel Borrow, WSDOT Section 9-03.14(2) Select Borrow, APWA Class A Pit Run, or APWA class B Pit Run. Material that does not meet one of the specifications should be submitted for approval.

3) The material should be placed in lifts not to exceed 12 inches uncompacted, with each lift being compacted and verified.

CRUSHED SURFACING:

1) The crushed surfacing material should consist of 2 inches of WSDOT Section 9-03.9(3) Crushed Surfacing (Base Course Specs) that is placed and compacted to 95% of the maximum dry density as determined by ASTM D-1557 (Modified Proctor).

2) The crushed surfacing material could at the contractor's option consist of WSDOT Section 9-03.9(3) Crushed Surfacing (Top Course Specs) that is placed and compacted to 95% of the maximum dry density as determined by ASTM D-1557 (Modified Proctor).

3) The crushed surfacing material should be placed to provide the proper grade and drainage for the asphalt pavement.

ASPHALTIC CONCRETE PAVEMENT:

1) The asphalt pavement should consist of at least 3.0 inches of WSDOT Class B asphalt that is placed and compacted to at least 92% of the theoretical maximum density as determined by ASTM D-2041 (Rice Method).

2) The pavement should be placed in lifts not to exceed 2.0 inches, with each lift compacted and verified.

3) Provide a tack coat on all concrete surfaces that the pavement will be placed against, and for multiple lifts that are not placed at the same time.

Summary

When the plans and specifications are complete, or if significant changes are made in the character or location of the proposed structures, a consultation should be arranged to review them regarding the prevailing soil conditions. Then, it may be necessary to submit supplementary recommendations. It is recommended that the services of a qualified soils engineering firm be engaged to test and evaluate the soils in the footing excavations before placing concrete to determine that the soils meet the compaction requirements. Monitoring and testing should also be performed to verify that suitable materials are used for structural fills and that they are properly placed and compacted.

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GEOTECHNICAL TESTING LABORATORY

Geotechnical General Notes

SOIL PROPERTY SYMBOLS

N: Standard "N" penetration: Blows per foot of a 140 pound hammer falling 30 inches on a 2 inch O.D. split-spoon.
Q_u: Unconfined compressive strength, tons/ft^2
Q_p: Penetrometer value, unconfined compressive strength, lbs/ft^2
V: Vane value, ultimate shearing strength, lbs/ft^2
M: Water content, %
LL: Liquid limit, %
PI: Plasticity index, %
D: Natural dry density, lbs/ft^3
WT: Apparent groundwater level at time noted after completion.

DRILLING AND SAMPLING SYMBOLS

SS: Split-Spoon - 1 3/8" I.D., 2" O.D., except where noted.
ST: Shelby Tube - 3" O.D., except where noted.
AU: Auger Sample.
GB: Grab Sample.
DB: Diamond Bit.
CB: Carbide Bit.
WS: Washed Sample.

RELATIVE DENSITY AND CONSISTENCY CLASSIFICATION

Terms (Non-Cohesive Soils)	Standard Penetration Resistance
Very Loose	0 - 2
Loose	2 - 4
Slightly Compact	4 - 8
Medium Dense	8 - 16
Dense	16 - 26
Very Dense	Over 26

Terms (Cohesive Soils)	Q_u - (tons/ft^2)
Very Soft	0 - 0.25
Soft	0.25 - 0.50
Firm (Medium)	0.50 - 1.00
Stiff	1.00 - 2.00
Very Stiff	2.00 - 4.00
Hard	4.00+

PARTICLE SIZE

Boulders	8 in. +	**Coarse Sand**	5 mm - 0.6 mm	**Silts**	0.074 mm - 0.005 mm
Cobbles	8 in. - 3 in.	**Medium Sand**	0.6 mm - 0.2 mm	**Clays**	0.005 mm & Smaller
Gravel	3 in. - 5 mm	**Fine Sand**	0.2 mm - 0.074 mm		

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GEOTECHNICAL TESTING LABORATORY

Site Plan with Boring Log Locations

GEOTECHNICAL TESTING LABORATORY

Boring Log #1

Date: 6/16/2005 **File #:** 05-1929-5
Boring Log #: 1 N46 36.696 W122 54.259 **Client:** Holloway Springs
Boring Type: B-40 Drill Rig **Depth Drilled:** 15 feet

Depth (feet)	Field Description	Change in Soils	% M	N	Q_u	Q_p	V	LL	PL	PI	Percent Minus 3/4"	#4	#200	Comments
0.5														Light Brown Silty Sand
1.0														
1.5														
2.0														Moist Reddish Brown
2.5														Sandy Silt
3.0														
3.5														
4.0														
4.5														
5.0	SM, Silty Sand			9							100.0%	97.3%	14.7%	Mottled Clayey Material
5.5														Yellow and Black Particles
6.0														Some Pebbles, heavy iron
6.5														staining on pebbles
7.0														
7.5														
8.0														
8.5														
9.0														
9.5	SW-SC, Well-graded Sand													
10.0	with Silty Clay and Gravel			11							90.0%	68.6%	11.0%	
10.5														
11.0														
11.5														
12.0														Very Moist Reddish Brown
12.5														silty sand
13.0														
13.5														
14.0	**Groundwater**	▽												**Groundwater Encountered**
14.5	GW, Well-graded Gravel													
15.0	with Sand			18							93.8%	69.6%	10.9%	Hammer Refusal
	end of boring													

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GEOTECHNICAL TESTING LABORATORY

Boring Log #2

Date: 6/16/2005 **File #:** 05-1929-5
Boring Log #: 2 N46 36.648 W122 54.209 **Client:** Holloway Springs
Boring Type: B-40 Drill Rig **Depth Drilled:** 15 feet

Depth (feet)	Field Description	Change in Soils	% M	N	Q_u	Q_p	V	LL	PL	PI	Percent Minus 3/4"	Percent Minus #4	Percent Minus #200	Comments
0.5														Dark Brown Top Soil
1.0														Reddish Brown Silty Sand
1.5														
2.0														
2.5														
3.0														
3.5														
4.0														
4.5														
5.0	SM, Silty Sand			12							100.0%	92.9%	14.0%	
5.5														
6.0														
6.5														
7.0														Reddish Brown Gravelly
7.5														Silty Sand
8.0														
8.5														
9.0														
9.5														
10.0	SM, Silty Sand with Gravel			42							93.8%	79.8%	14.1%	Silty Sand with Gravel
10.5														
11.0														
11.5														
12.0														Wet Silty Sand
12.5														
13.0														
13.5														
14.0		▽												Groundwater Encountered
14.5	SW-SC, Well-graded Sand													
15.0	with Silty Clay and Gravel			15							95.5%	82.6%	9.7%	Sandy Silty Gravels
	end of boring													

GEOTECHNICAL TESTING LABORATORY

Boring Log #3

Date: 6/16/2005 **File #:** 05-1929-5
Boring Log #: 3 N46 36.595 W122 54.143 **Client:** Holloway Springs
Boring Type: B-40 Drill Rig **Depth Drilled:** 10 feet

Depth (feet)	Field Description	Change in Soils	% M	N	Q_u	Q_p	V	LL	PL	PI	Percent Minus 3/4"	#4	#200	Comments
0.5														Dark Brown Top Soil
1.0														Reddish Brown Silty Sand
1.5														
2.0														
2.5														
3.0														
3.5														
4.0														
4.5														
5.0	SW, Well-graded Sand			7							100.0%	58.5%	4.8%	
5.5	with Gravel													
6.0														
6.5														
7.0														Rocky Layer
7.5														Cuttings are slightly lighter
8.0														in color
8.5														
9.0														Silty Sand with Gravel
9.5	GW, Well-graded													
10.0	Gravel with Sand			42							92.5%	44.3%	3.7%	Rock
	end of boring													

GEOTECHNICAL TESTING LABORATORY

Boring Log #4

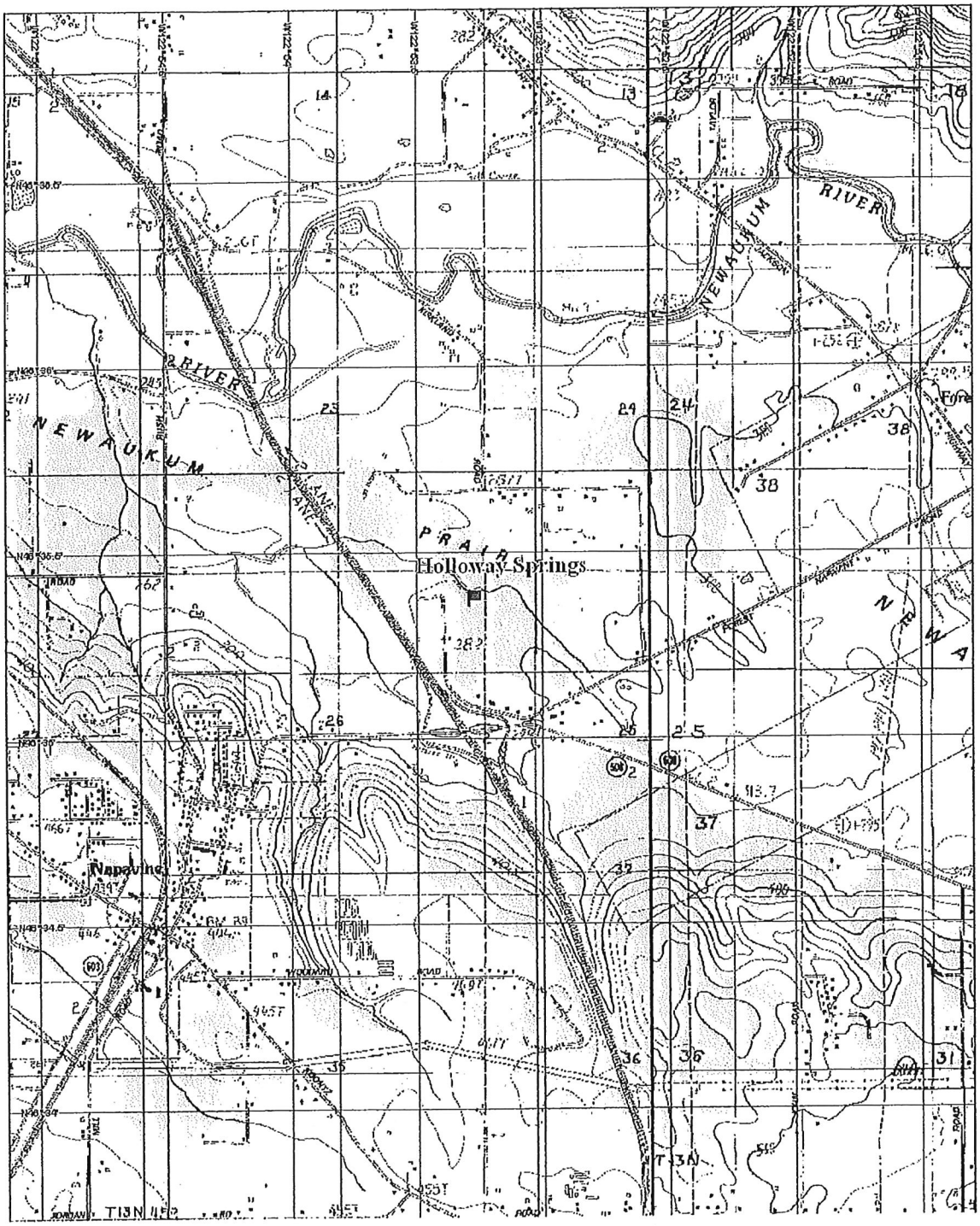
Date: 6/16/2005 **File #:** 05-1929-5
Boring Log #: 4 N46 36.581 W122 54.100 **Client:** Holloway Springs
Boring Type: B-40 Drill Rig **Depth Drilled:** 10 feet

Depth (feet)	Field Description	Change in Soils	% M	N	Q_u	Q_p	V	LL	PL	PI	Percent Minus 3/4"	#4	#200	Comments
0.5														Dark Brown Top Soil
1.0														Reddish Brown Silty Sand
1.5														
2.0														
2.5														
3.0														
3.5														
4.0														
4.5														
5.0	SM, Silty Sand			7							100.0%	92.4%	11.4%	
5.5														
6.0														
6.5														
7.0														
7.5														
8.0														
8.5														
9.0														
9.5	GW, Well-graded													
10.0	Gravel with Sand			42							88.4%	53.2%	5.8%	Rock

end of boring -- Groundwater Not Encounter

GEOTECHNICAL TESTING LABORATORY

Area Map

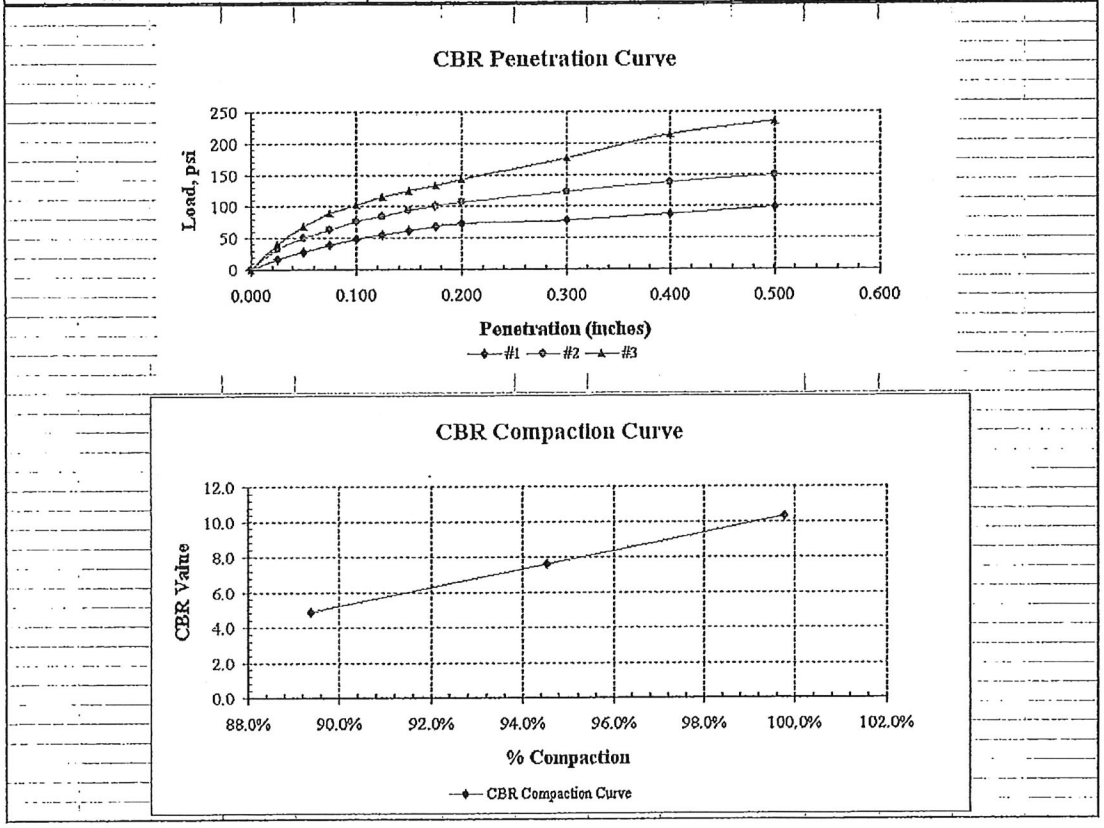


GEOTECHNICAL TESTING LABORATORY

California Bearing Ratio

		Source: Halloway				CBR Load Recell		
		Date Obtained: 6/16/2005				Calibrated At: 3/24/2005		
		Sample ID: #428A						
		ASTM D 2487 Classification: clayey silt loam				m	b	
		Maximum Dry Density: 99.2 lbs/ft³						
Test Standard								
AASHTO T99:		Weight of Mold+Soils:	20.2	20.7	21.1 lbs/ft3			
ASTM D 698:		Weight of Mold:	12.4	12.4	12.4 lbs/ft3			
AASHTO T 180: X		Wet Weight of Soils:	7.8	8.3	8.7 lbs/ft3			
ASTM D 1557:		Wet Density:	103.9	109.9	116.0 lbs/ft³			
Method: A		% Moisture:	17.2%	17.2%	17.2%			
		Dry Density:	88.7	93.8	99.0 lbs/ft³			
Sample Prepared		% Compaction:	89.4%	94.5%	99.8%			
Moist: X		Initial Swell Reading:	0.337	0.424	0.519			
Dry:		Final Swell Reading:	0.341	0.43	0.528			
Manual:		% Swell:	0.07%	0.13%	0.20%			
Mechanical: X		CBR:	4.9	7.6	10.3			

Dial Reading	#1 Load	Depth Inches	#1 psi	CBR Value	Dial Reading	#2 Load	Depth Inches	#2 psi	CBR Value	Dial Reading	#3 Load	Depth Inches	#3 psi	CBR Value
0	0	0.000	0		0	0	0.000	0		0	0	0.000	0	
48	48	0.025	16		98	98	0.025	33		120	120	0.025	40	
85	85	0.050	28		150	150	0.050	50		206	206	0.050	69	
119	119	0.075	40		189	189	0.075	63		267	267	0.075	89	
146	146	0.100	49	5	228	228	0.100	76	8	309	309	0.100	103	10
167	167	0.125	56		253	253	0.125	84		347	347	0.125	116	
183	183	0.150	61		280	280	0.150	93		374	374	0.150	125	
204	204	0.175	68		301	301	0.175	100		401	401	0.175	134	
218	218	0.200	73	5	319	319	0.200	106	7	428	428	0.200	143	10
233	233	0.300	78	4	369	369	0.300	123	6	529	529	0.300	176	9
264	264	0.400	88	4	414	414	0.400	138	6	643	643	0.400	214	9
297	297	0.500	99	4	446	446	0.500	149	6	704	704	0.500	235	9



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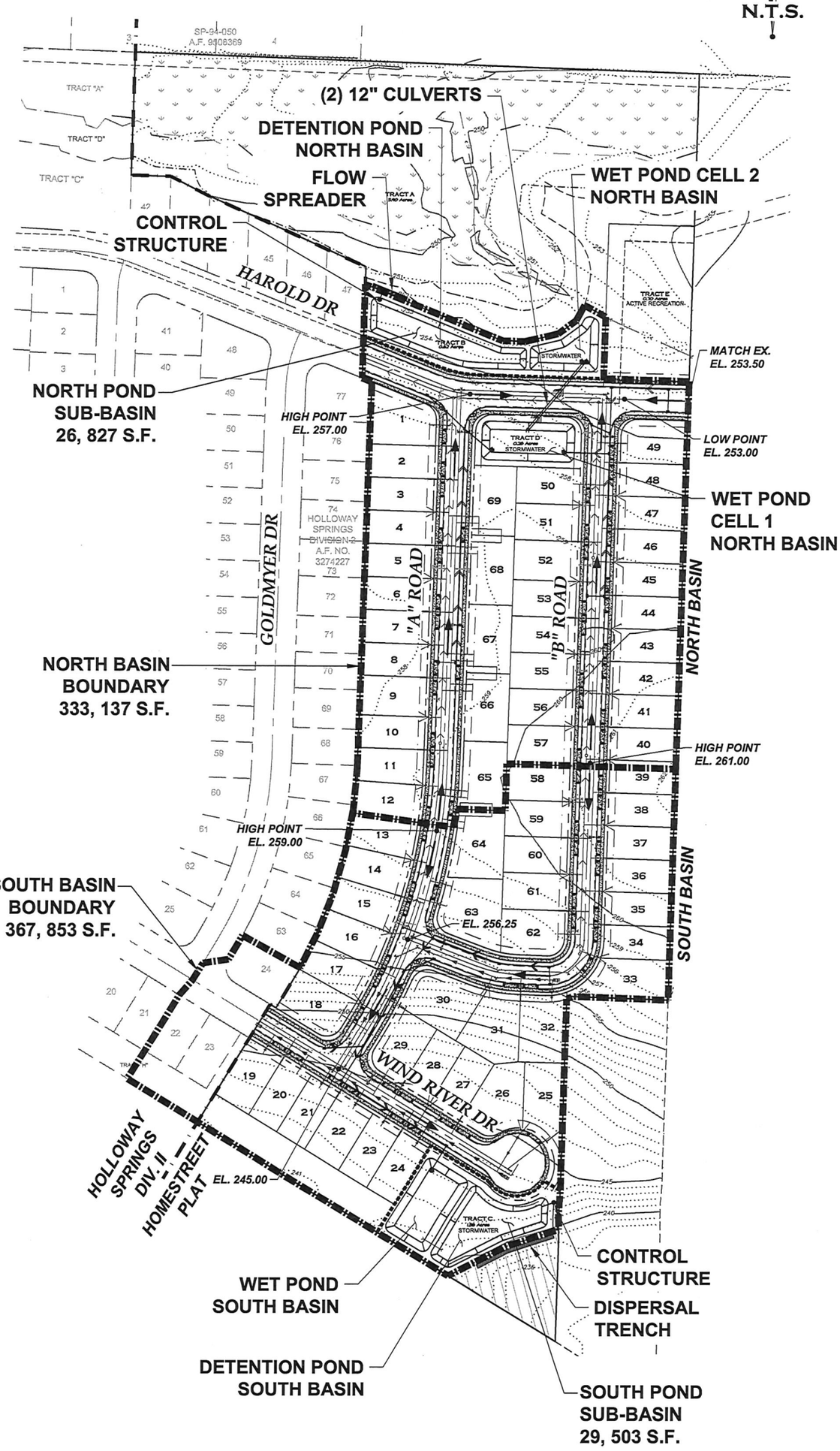
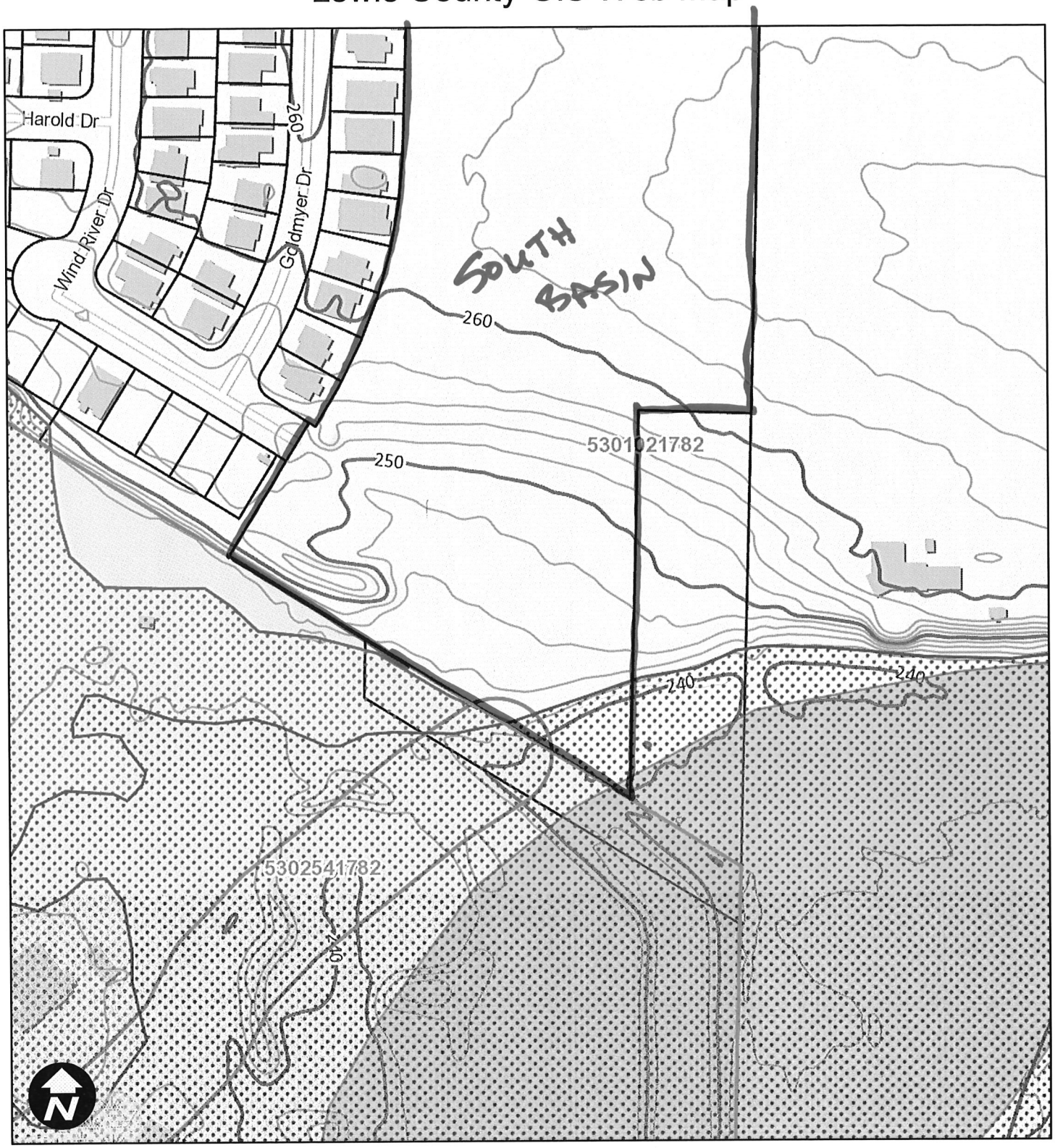
APPENDIX B – Drainage Exhibits

HOMESTREET PLAT
DRAINAGE BASINS

N.T.S.



Lewis County GIS Web Map



2/4/2020, 11:16:32 AM

1:2,257

Wetlands
FEMA BFE (NAVD88)
FEMA Panels
FEMA 100-Year
FEMA 500-Year
Floodway
Stream Buffers
Shoreline 150'
Fish 150'
Non-Fish 75'
Parcels
2ft Contour
2ft
10ft

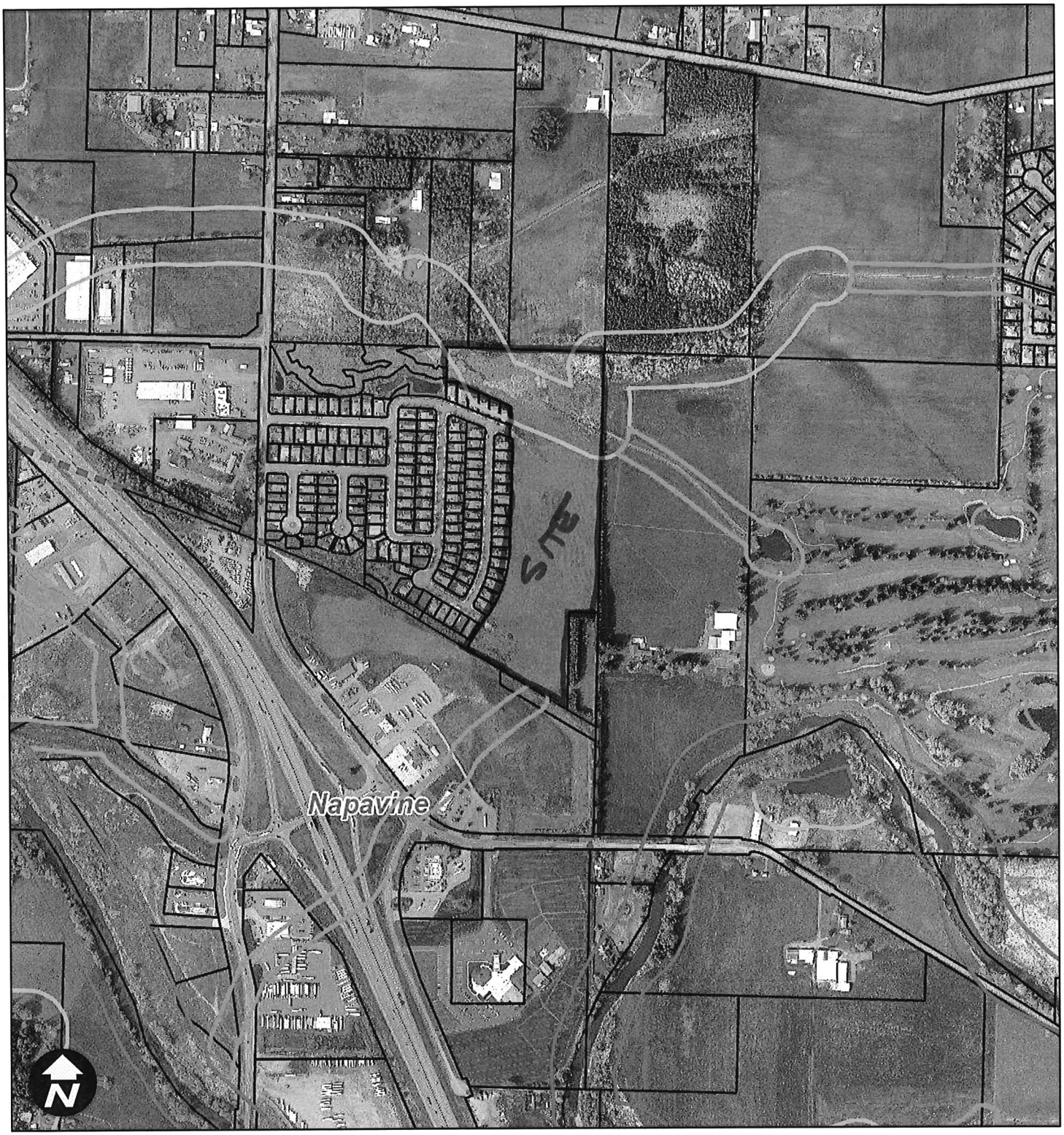
0 100 200 400 ft

NAD 1983 StatePlane Washington South FIPS 4602 Feet

LEWIS COUNTY
est. 1845

Lewis County G.I.S.

Lewis County GIS Web Map



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Stream Buffers

- Shoreline 150'
- Fish 150'
- Non-Fish 75'
- Parcels

City Limits

0 400 800 1,600 ft

NAD 1983 StatePlane Washington South FIPS 4602 Feet

LEWIS COUNTY
... est. 1845 ...

Lewis County G.I.S.

Lewis County does not guarantee the accuracy of the information shown on this map and is not responsible for any use or misuse by others regarding this material. It is provided for general informational purposes only. This map does not meet legal, engineering, or survey standards. Please practice due diligence and consult with licensed experts before making decisions.

APPENDIX C – Drainage Calculations

Component Parameters Used:

Individual Roof Area	2,250 sf	North Pond Tributary Area	333,137 sf	7.65 ac	NP Det Pond DWL	11,588 sf
Individual Driveway Area	320 sf	North Pond Sub-Basin Area	26,827 sf	0.62 ac	NP Wet Pond DWL	11,695 sf
Harold Dr Width	36 ft	South Pond Tributary Area	367,853 sf	8.44 ac	SP Det Pond DWL	11,077 sf
A & B Rds + Wind River Dr Width	28 ft	SP Basin Total Area	29,503 sf	0.68 ac	SP Wet Pond DWL	8,309 sf
Wind River Dr Cul-De-Sac Radius	45 ft	Total Disturbed/Tributary Area	700,990 sf	16.1 ac		
Sidewalk Width	5 ft					

Basin	Roof Count	Roof Area (sf)	Drive-way Count	Drive-way Area (sf)	Harold Dr (LF)	Goldmyer Dr & Wind River Dr (LF)	Wind River Drive CDS (sf)	Road-way Area (sf)	Side-walks (LF)	Side-walk Area (sf)	Total Imper-vious Area (sf)	Total Imper-vious Area (ac)	Tributary Lawn/ Landscape Area (sf)	Total Pervious Area (ac)	% Imper.	% Perv
North Pond Basin:																
Roads/Lots	35	**78,750**	35	**11,200**	500	1,180	-	**51,040**	3,360	**16,800**	157,790	3.62	148,520	3.41	47%	45%
No. Pond	-	-	-	-	-	-	-	-	-	-	23,283	0.53	3,544	0.08	87%	13%
											Basin Total	**4.16**		**3.49**	**54%**	**46%**
South Pond Basin:																
Roads/Lots	37	**83,250**	37	**11,840**	-	1,470	**6,362**	**59,282**	2,940	**16,192**	176,926	4.06	161,424	3.71	48%	44%
So. Pond	-	-	-	-	-	-	-	-	-	-	19,386	0.45	10,117	0.23	66%	34%
											Basin Total	**4.51**		**3.94**	**53%**	**47%**
TOTALS:	72	162,000	72	23,040	500	2,650	6,362	110,322	6,300	32,992	377,385	8.66	323,605	7.43	54%	46%
													Total Area (ac):	**16.1**		

Homestreet Plat
North Basin Detention Pond

HGP #19-059
4/25/2020

Trapezoidal Basin

Length	210 ft			Width (average)	32 ft
side slope 1	3			side slope 1	3
side slope 2	3			side slope 2	3
		Pond Bottom Area:	**6,720 sf**		
Base elevation	0.0 ft				
step	0.10 ft				

Orifice Control

		Notch		
Outlet Elevation	0.0	depth	0.82	FT
c	0.62	length	1	in

	elevation	ft	Orifice Diameter (inch)	
Btm Orifice	0.00		5.81	(5 -13/16")
Inter. Notch	1.12		0.00	

Intermediate notch calculations

top to ie	1.94	feet
P	1.12	feet
H max	0.82	
h = elevation-p	10.8	

Depth (ft)	Water Surface Area (sf)	Pond Vol (cf)	Notch Flow (cfs)	Bottom Orifice Flow (cfs)	Total Discharge (cfs)	
0.00	6,720	0	0	0.00	0.00	
0.10	6,866	679	0	0.29	0.29	
0.20	7,012	1,373	0	0.41	0.41	
0.30	7,159	2,081	0	0.50	0.50	
0.40	7,307	2,804	0	0.58	0.58	
0.50	7,455	3,542	0	0.65	0.65	
0.60	7,604	4,295	0	0.71	0.71	
0.70	7,754	5,062	0	0.77	0.77	
0.80	7,905	5,843	0	0.82	0.82	
0.90	8,056	6,640	0	0.87	0.87	
1.00	8,208	7,452	0	0.92	0.92	
1.10	8,361	8,278	0	0.96	0.96	2 Yr depth = 1.12 ft
1.20	8,514	9,119	0.07	1.00	1.08	
1.30	8,668	9,976	0.25	1.05	1.30	
1.40	8,823	10,847	0.50	1.08	1.58	
1.50	8,979	11,733	0.80	1.12	1.92	
1.60	9,135	12,635	1.14	1.16	2.30	
1.70	9,292	13,552	1.54	1.20	2.73	
1.75	9,371	14,016	1.75	1.21	2.96	
1.80	9,450	14,484	1.97	1.23	3.20	
1.90	9,609	15,431	2.44	1.26	3.71	100 Yr depth = 1.94 ft
2.00	9,768	16,393	2.96	1.30	4.26	
2.10	9,928	17,371	3.51	1.33	4.84	
2.20	10,089	18,364	4.10	1.36	5.46	
2.30	10,250	19,373	4.73	1.39	6.12	
2.40	10,412	20,398	5.40	1.42	6.82	
2.50	10,575	21,437	6.10	1.45	7.55	Overflow Spillway Volume
2.60	10,739	22,493	6.84	1.48	8.32	
2.70	10,903	23,564	7.62	1.51	9.12	
2.80	11,068	24,651	8.43	1.53	9.96	
2.90	11,234	25,754	9.28	1.56	10.84	
3.00	11,400	26,873	10.16	1.59	11.75	Top of Pond Berm

Volume of 6-month 24-hour event

Percent impervious	0.47	*Tributary area less Pond DWL*
CN (impervious)	98	
CN (pervious)	86	
CN (weighted average)	91.6	
Rainfall amount (inch)		
2-year	2.2	
6-month	**1.4**	*64% of 2-year event*
Total Tributary Area (ac)	7.03	*Tributary area less Pond DWL*

Calculations

S = 0.91 *Per eqn below = (1000/CN) - 10*

Q_d = 0.70 *in, Depth of Runoff over tributary area per equation below*

Volume = **17,929** *cf, Tributary Area in sq ft x Runoff Depth in inches*

STORMWATER MANAGEMENT MANUAL FOR THE PUGET SOUND BASIN

$Q_d = (P_R - 0.2S)^2 / (P_R + 0.8S)$ for $P_R \geq 0.2S$

and $Q_d = 0$ for $P_R < 0.2S$

where:

Q_d = runoff depth in inches over the area,
P_R = precipitation depth in inches over the area, and
S = potential maximum natural detention, in inches over the area, due to infiltration, storage, etc.

The area's potential maximum detention, S, is related to its curve number, CN:

$S = (1000 / CN) - 10$

The combination of the above equations allows for estimation of the total runoff volume by computing total runoff depth, Q_d, given the total precipitation depth, P_R. For example, if the curve number of the area is 70, then the value of S is 4.29. With a total precipitation for the design event of 2.0 inches, the total runoff depth would be:

$Q_d = [2.0 - 0.2 (4.29)]^2 / [2.0 + 0.8 (4.29)] =$ <u>0.24 inches</u>

This computed runoff represents inches over the tributary area. Therefore, the total volume of runoff is found by multiplying Q_d by the area (with necessary conversions):

Total runoff Volume (cu. ft.)	=	3,630 (cu. ft./ac. in.)	x	Q_d (in)	x	A (ac)

If the area is 10 acres, the total runoff volume is:

3,630 cu. ft./ac. in. x 0.24 in. x 10 ac. = <u>8,712 cu. ft.</u>

When developing the runoff hydrograph, the above equation for Q_d is used to compute the incremental runoff depth for each time interval from the incremental precipitation depth given by the design storm hyetograph. This time distribution of runoff depth is often referred to as the precipitation excess and provides the basis for synthesizing the runoff hydrograph.

Homestreet Plat
South Basin Detention Pond

HGP #19-059
4/25/2020

Trapezoidal Basin

Length	165 ft			Width (average)	43 ft
side slope 1	3			side slope 1	3
side slope 2	3			side slope 2	3
		Pond Bottom Area:	**7,095 sf**		
Base elevation	0.0 ft				
step	0.10 ft				

Orifice Control

		Notch		
Outlet Elevation	0.0	depth	0.81	FT
c	0.62	length	1	in

	elevation	ft	Orifice Diameter (inch)	
Btm Orifice	0.00		6.31	(6 -5/16")
Inter. Notch	1.09		0.00	

Intermediate notch calculations

top to ie	1.90	feet
P	1.09	feet
H max	0.81	
h = elevation-p	10.8	

Depth (ft)	Water Surface Area (sf)	Pond Vol (cf)	Notch Flow (cfs)	Bottom Orifice Flow (cfs)	Total Discharge (cfs)	
0.00	7,095	0	0	0.00	0.00	
0.10	7,220	716	0	0.34	0.34	
0.20	7,346	1,444	0	0.48	0.48	
0.30	7,473	2,185	0	0.59	0.59	
0.40	7,600	2,938	0	0.68	0.68	
0.50	7,728	3,705	0	0.76	0.76	
0.60	7,857	4,484	0	0.84	0.84	
0.70	7,986	5,275	0	0.90	0.90	
0.80	8,116	6,080	0	0.97	0.97	
0.90	8,247	6,898	0	1.03	1.03	
1.00	8,379	7,728	0	1.08	1.08	
1.10	8,511	8,572	0.00	1.13	1.14	2 Yr depth = 1.09 ft
1.20	8,644	9,428	0.12	1.18	1.31	
1.30	8,778	10,298	0.32	1.23	1.56	
1.40	8,913	11,181	0.58	1.28	1.86	
1.50	9,048	12,078	0.90	1.32	2.22	
1.60	9,184	12,987	1.26	1.37	2.63	
1.70	9,321	13,910	1.66	1.41	3.07	
1.75	9,389	14,377	1.88	1.43	3.31	
1.80	9,458	14,847	2.11	1.45	3.56	
1.90	9,596	15,797	2.60	1.49	4.09	100 Yr depth = 1.90 ft
2.00	9,735	16,761	3.13	1.53	4.66	
2.10	9,875	17,738	3.70	1.57	5.26	
2.20	10,015	18,729	4.30	1.60	5.90	
2.30	10,156	19,734	4.94	1.64	6.58	
2.40	10,298	20,752	5.62	1.68	7.30	
2.50	10,440	21,785	6.34	1.71	8.05	Overflow Spillway Volume
2.60	10,583	22,831	7.10	1.74	8.84	
2.70	10,727	23,891	7.89	1.78	9.66	
2.80	10,872	24,966	8.72	1.81	10.52	
2.90	11,017	26,055	9.58	1.84	11.42	
3.00	11,163	27,158	10.48	1.87	12.35	Top of Pond Berm

Volume of 6-month 24-hour event

Percent impervious	0.48	*Tributary area less Pond DWL*
CN (impervious)	98	
CN (pervious)	86	
CN (weighted average)	91.8	
Rainfall amount (inch)		
2-year	2.2	
6-month	**1.4**	*64% of 2-year event*
Total Tributary Area (ac)	7.77	*Tributary area less Pond DWL*

Calculations

S = 0.90 *Per eqn below = (1000/CN) - 10*

Q_d = 0.71 *in, Depth of Runoff over tributary area per equation below*

Volume = **20,015** *cf, Tributary Area in sq ft x Runoff Depth in inches*

STORMWATER MANAGEMENT MANUAL FOR THE PUGET SOUND BASIN

$Q_d = (P_R - 0.2S)^2 / (P_R + 0.8S)$ for $P_R \geq 0.2S$

and $Q_d = 0$ for $P_R < 0.2S$

where:

Q_d = runoff depth in inches over the area,
P_R = precipitation depth in inches over the area, and
S = potential maximum natural detention, in inches over the area, due to infiltration, storage, etc.

The area's potential maximum detention, S, is related to its curve number, CN:

$$S = (1000 / CN) - 10$$

The combination of the above equations allows for estimation of the total runoff volume by computing total runoff depth, Q_d, given the total precipitation depth, P_R. For example, if the curve number of the area is 70, then the value of S is 4.29. With a total precipitation for the design event of 2.0 inches, the total runoff depth would be:

$$Q_d = [2.0 - 0.2\ (4.29)]^2 / [2.0 + 0.8\ (4.29)] = \underline{0.24 \text{ inches}}$$

This computed runoff represents inches over the tributary area. Therefore, the total volume of runoff is found by multiplying Q_d by the area (with necessary conversions):

Total runoff Volume (cu. ft.)	=	3,630 (cu. ft./ac. in.)	x	Q_d (in)	x	A (ac)

If the area is 10 acres, the total runoff volume is:

3,630 cu. ft./ac. in. x 0.24 in. x 10 ac. = <u>8,712 cu. ft.</u>

When developing the runoff hydrograph, the above equation for Q_d is used to compute the incremental runoff depth for each time interval from the incremental precipitation depth given by the design storm hyetograph. This time distribution of runoff depth is often referred to as the precipitation excess and provides the basis for synthesizing the runoff hydrograph.

Travel Time Calculator

Basin: **North Developed**

Sheet flow:

n_s	0.24	from table B-2
Length	120	ft
P_2	2.2	2-year, 24 hour rainfall in.
s_o	0.02	slope (ft/ft)
T_t	20	min

Channel Flow (intermitient):

k	42	from table B-2
s_o	0.01	slope (ft/ft)
Length	1000	ft
T_t	4	min
T_c	**24**	**min**

Basin: **North Undeveloped**

Sheet flow:

ns	0.15	from table B-2
Length	200	ft
P2	2.2	2-year, 24 hour rainfall in.
so	0.02	slope (ft/ft)
Tt	21	min

Channel Flow (intermitient):

k	9	from table B-2
so	0.01	slope (ft/ft)
Length	1000	ft
Tt	19	min
Tc	**39**	**min**

Basin: **South Developed**

Sheet flow:

n_s	0.24	from table B-2
Length	120	ft
P_2	2	2-year, 24 hour rainfall in.
s_o	0.02	slope (ft/ft)
T_t	21	min

Channel Flow (intermitient):

k	42	from table B-2
s_o	0.01	slope (ft/ft)
Length	500	ft
T_t	2	min
T_c	**23**	**min**

Basin: **South Undeveloped**

Sheet flow:

ns	0.15	from table B-2
Length	200	ft
P2	2.2	2-year, 24 hour rainfall in.
so	0.02	slope (ft/ft)
Tt	21	min

Channel Flow (intermitient):

k	9	from table B-2
so	0.01	slope (ft/ft)
Length	500	ft
Tt	9	min
Tc	**30**	**min**

Figure 2-4 Inches to Rainfall Coefficients

Location	2-Year MRI		5-Year MRI		10-Year MRI		25-Year MRI		50-Year MRI		100-Year MRI	
	m	n	m	n	m	n	m	n	m	n	m	n
Aberdeen and Hoquiam	5.10	0.488	6.22	0.488	7.06	0.487	8.17	0.487	9.02	0.487	9.86	0.487
Bellingham	4.29	0.549	5.59	0.555	6.59	0.559	7.90	0.562	8.89	0.563	9.88	0.565
Bremerton	3.79	0.480	4.84	0.487	5.63	0.490	6.68	0.494	7.47	0.496	8.26	0.498
Centralia and Chehalis	3.63	0.506	4.85	0.518	5.76	0.524	7.00	0.530	7.92	0.533	8.86	0.537
Clarkston and Colfax	5.02	0.628	6.84	0.633	8.24	0.635	10.07	0.638	11.45	0.639	12.81	0.639
Colville	3.48	0.558	5.44	0.593	6.98	0.610	9.07	0.626	10.65	0.635	12.26	0.642
Ellensburg	2.89	0.590	5.18	0.631	7.00	0.649	9.43	0.664	11.30	0.672	13.18	0.678
Everett	3.69	0.556	5.20	0.570	6.31	0.575	7.83	0.582	8.96	0.585	10.07	0.586
Forks	4.19	0.410	5.12	0.412	5.84	0.413	6.76	0.414	7.47	0.415	8.18	0.416
Hoffstadt Cr. (SR 504)	3.96	0.448	5.21	0.462	6.16	0.469	7.44	0.476	8.41	0.480	9.38	0.484
Hoodsport	4.47	0.428	5.44	0.428	6.17	0.427	7.15	0.428	7.88	0.428	8.62	0.428
Kelso and Longview	4.25	0.507	5.50	0.515	6.45	0.509	7.74	0.524	8.70	0.526	9.67	0.529
Leavenworth	3.04	0.530	4.12	0.542	5.62	0.575	7.94	0.594	9.75	0.606	11.08	0.611
Metaline Falls	3.36	0.527	4.90	0.553	6.09	0.566	7.45	0.570	9.29	0.592	10.45	0.591
Moses Lake	2.61	0.583	5.05	0.634	6.99	0.655	9.58	0.671	11.61	0.681	13.63	0.688
Mt. Vernon	3.92	0.542	5.25	0.552	6.26	0.557	7.59	0.561	8.60	0.564	9.63	0.567
Naselle	4.57	0.432	5.67	0.441	6.14	0.432	7.47	0.443	8.05	0.440	8.91	0.436
Olympia	3.82	0.466	4.86	0.472	5.62	0.474	6.63	0.477	7.40	0.478	8.17	0.480
Omak	3.04	0.583	5.06	0.618	6.63	0.633	8.74	0.647	10.35	0.654	11.97	0.660
Pasco and Kennewick	2.89	0.590	5.18	0.631	7.00	0.649	9.43	0.664	11.30	0.672	13.18	0.678
Port Angeles	4.31	0.530	5.42	0.531	6.25	0.531	7.37	0.532	8.19	0.532	9.03	0.532
Poulsbo	3.83	0.506	4.98	0.513	5.85	0.516	7.00	0.519	7.86	0.521	8.74	0.523
Queets	4.26	0.422	5.18	0.423	5.87	0.423	6.79	0.423	7.48	0.423	8.18	0.424
Seattle	3.56	0.515	4.83	0.531	5.62	0.530	6.89	0.539	7.88	0.545	8.75	0.5454
Sequim	3.50	0.551	5.01	0.569	6.16	0.577	7.69	0.585	8.88	0.590	10.04	0.593
Snoqualmie Pass	3.61	0.417	4.81	0.435	6.56	0.459	7.72	0.459	8.78	0.461	10.21	0.476
Spokane	3.47	0.556	5.43	0.591	6.98	0.609	9.09	0.626	10.68	0.635	12.33	0.643
Stevens Pass	4.73	0.462	6.09	0.470	8.19	0.500	8.53	0.484	10.61	0.499	12.45	0.513
Tacoma	3.57	0.516	4.78	0.527	5.70	0.533	6.93	0.539	7.86	0.542	8.79	0.545
Vancouver	2.92	0.477	4.05	0.496	4.92	0.506	6.06	0.515	6.95	0.520	7.82	0.525
Walla Walla	3.33	0.569	5.54	0.609	7.30	0.627	9.67	0.645	11.45	0.653	13.28	0.660
Wenatchee	3.15	0.535	4.88	0.566	6.19	0.579	7.94	0.592	9.32	0.600	10.68	0.605
Yakima	3.86	0.608	5.86	0.633	7.37	0.644	9.40	0.654	10.93	0.659	12.47	0.663

Appendix D – Hydraulic Analysis

Note: The elevations noted on the Hydra calculations are not related to plan elevations. The elevations were arbitrary and only used to establish various capacities of pipes and swales.

Status of DEFAULTS at start of run. (* May be reset by SET)

Command file	C:\HYDRA\CMD\TEST.CMD
Input units are read as	USA
* Output sent to display	Brief
* Output sent to printer	Brief
* Output sent to file	Brief
Paper width in inches	8.000
String to reset printer	27 38 108 54 68 27 40 115 49 48 72
String to set printer to compressed	17.16 27 38 107 48 56 72
String to set printer to 8 lines/inch	8 27 38 108 56 68
Name of printer	Hewlett-Packard, LaserJet/LaserJet Plus
Print heading at top of page	True
Number of steps in hydrograph	150
Step length in minutes	10
Significant flow in hydrograph	0.000
* Maximum plot value	Selected by HYDRA
Type of hydrographic plot	Compact
Sanitary flow by	Diurnal Curve
Delay to start of actual storm	0.00
Rational Method computations	Off
SCS computations	Santa Barbara
Continuous simulation computations	On
* Maximum d/D for pipe design/analysis	0.900
* Match point position on pipe	0.00 or Invert
* Number of allowable diam drops	999
* Mimimum drop thru manhole	0.000
Routing technique	Quick
* Calculate sanitary flows	True
* Calculate infiltration flows	True
* Calculate storm flows	True
* Calculate misc flows	True

```
  1: JOB Homestreet Plat; -  2 yr Event
  2: REM HGP 19-059
  3: REM File 19-059(2yr).cmd; Spiller PC; C:\DOSfiles\Hydra\CMD
  4:
  5: REM Compute Existing Flows first - then Pond Sizing
  6: REM 2 yr Storm Event; Rainfall per WSDOT Hydraulics Manual
  7: REM 2yr: 2.2, 10yr: 3.0, 25yr 3.5, 100yr 4.3
  8:
  9: TOT 2.2
 10:
 11: REM Use Type 1-A SCS storm per DOE Drainage Manual
 12: FIL doe.inc
------START OF SUB-FILE------
```

19-059cmd2

```
  1: HYE 10 0.00 0.040 0.040 0.040 0.040 0.040 0.040 0.040 0.040 0.040 0.0
       40+
  2:     0.050 0.050 0.050 0.050 0.050 0.050 0.060 0.060 0.060 0.060 0.060
        0.060+
  3:     0.070 0.070 0.070 0.070 0.070 0.070 0.082 0.082 0.082 0.082 0.082
        0.082+
  4:     0.095 0.095 0.095 0.095 0.095 0.095 0.134 0.134 0.134 0.180 0.180
        0.340+
  5:     0.540 0.270 0.180 0.134 0.134 0.134 0.088 0.088 0.088 0.088 0.088
        0.088+
  6:     0.088 0.088 0.088 0.088 0.088 0.088 0.072 0.072 0.072 0.072 0.072
        0.072+
  7:     0.072 0.072 0.072 0.072 0.072 0.072 0.057 0.057 0.057 0.057 0.057
        0.057+
  8:     0.057 0.057 0.057 0.057 0.057 0.057 0.050 0.050 0.050 0.050 0.050
        0.050+
  9:     0.050 0.050 0.050 0.050 0.050 0.050 0.040 0.040 0.040 0.040 0.040
        0.040+
 10:     0.040 0.040 0.040 0.040 0.040 0.040 0.040 0.040 0.040 0.040 0.040
        0.040+
 11:     0.040 0.040 0.040 0.040 0.040 0.040 0.040 0.040 0.040 0.040 0.040
        0.040+
 12:     0.040 0.040 0.040 0.040 0.040 0.040 0.040 0.040 0.040 0.040 0.040
        0.040+
 13:     0.040 0.040
------ END OF SUB-FILE ------
 13: PDA .012 12 2 1 2 .005 12
 14:
 15: NEW North Basin - Existing conditions
 16: SCS 7.65 0 98 85 39
 17: INL 99
 18: PIP 1 100 100 ^use pipe command to print flow rate
 19: NEW North Basin - Developed Condition
 20: SCS 7.65 0.544 98 86 24
 21: INL 99
 22:
 23: RES 100 0/0 8500/0.97 12000/1.8 14000/2.2 +
 24:         17000/3.35 21000/7
 25:
 26: NEW South Basin - Existing Conditions
 27: SCS 8.44 0 98 85 30
 28: INL 99
 29: PIP 1 100 100 ^use pipe command to print flow rate
 30: NEW South Basin - Developed Conditions
 31: SCS 8.44 0.534 98 86 23
 32: INL 99
 33:
 34: RES 100 0/0 8500/1.14 12000/2.25 13500/2.8 16000/4.1 +
 35:         21000/7
 36:
 37:
 38: END
```

♀

C:\HYDRA\CMD\TEST.CMD 10:14 25-Apr-120

------ S U M M A R Y O F A N A L Y S I S ------

Run number on command file : 99
Number of links : 4
Number of hydrographs : 46

19-059cmd2

Total sanitary population	:	0
Total sanitary area	:	0.00 Acres
Total storm area	:	32.18 Acres
Number of pumps	:	0
Number of reservoirs	:	2
Number of diversion structures	:	0
Number of inlets	:	4
Length of new pipe	:	2.00 Feet
Length of existing pipe	:	0.00 Feet
Length of channel	:	0.00 Feet
Length of gutter	:	0.00 Feet
Length of transport units	:	0.00 Feet
Length of pressure pipe	:	0.00 Feet

♀

C:\HYDRA\CMD\TEST.CMD 10:14 25-Apr-120

Homestreet Plat; - 2 yr Event

*** North Basin - Existing condition Pipe Design

Link	Long	Diam	Invert Up/Dn	Slope	Depth Up/Dn	Min Cover	San Inf	Sto Mis	Vel d/D	Design CFS	Estimated Cost
1	1	12	97.92	0.0050	2.08	1.00	0.0	1.0	2.66	0.97	0
			97.91		2.09		0.0	0.0	0.46		

Lateral length= 1 Upstream length= 1

*** North Basin - Developed Conditio Reservoir

Link	Invert Up/Dn	Maximum Flow Values	San	Inf	Sto	Mis	Design	Cost
2	Unknown	Discharge :	0.00	0.00	0.97	0.00	0.97	0
	Unknown	Stored :	0	0	8417	0	8417	
		Incoming :	0.00	0.00	2.29	0.00	2.29	

Lateral length= 0 Upstream length= 0

*** South Basin - Existing Condition Pipe Design

Link	Long	Diam	Invert Up/Dn	Slope	Depth Up/Dn	Min Cover	San Inf	Sto Mis	Vel d/D	Design CFS	Estimated Cost
3	1	12	97.92	0.0050	2.08	1.00	0.0	1.2	2.85	1.20	0
			97.91		2.09		0.0	0.0	0.52		

Lateral length= 1 Upstream length= 1

*** South Basin - Developed Conditio Reservoir

Link	Invert Up/Dn	Maximum Flow Values	San	Inf	Sto	Mis	Design	Cost
4	Unknown	Discharge :	0.00	0.00	1.15	0.00	1.15	0
	Unknown	Stored :	0	0	8472	0	8472	
		Incoming :	0.00	0.00	2.55	0.00	2.55	

Lateral length= 0 Upstream length= 0

♀

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Olympia, Washington Page 1

C:\HYDRA\CMD\TEST.CMD 10:12 25-Apr-120

Status of DEFAULTS at start of run. (* May be reset by SET)

Command file	C:\HYDRA\CMD\TEST.CMD
Input units are read as	USA
* Output sent to display	Brief
* Output sent to printer	Brief
* Output sent to file	Brief
Paper width in inches	8.000
String to reset printer	27 38 108 54 68 27 40 115 49 48 72
String to set printer to compressed	17.16 27 38 107 48 56 72
String to set printer to 8 lines/inch	8 27 38 108 56 68
Name of printer	Hewlett-Packard, LaserJet/LaserJet Plus
Print heading at top of page	True
Number of steps in hydrograph	150
Step length in minutes	10
Significant flow in hydrograph	0.000
* Maximum plot value	Selected by HYDRA
Type of hydrographic plot	Compact
Sanitary flow by	Diurnal Curve
Delay to start of actual storm	0.00
Rational Method computations	Off
SCS computations	Santa Barbara
Continuous simulation computations	On
* Maximum d/D for pipe design/analysis	0.900
* Match point position on pipe	0.00 or Invert
* Number of allowable diam drops	999
* Mimimum drop thru manhole	0.000
Routing technique	Quick
* Calculate sanitary flows	True
* Calculate infiltration flows	True
* Calculate storm flows	True
* Calculate misc flows	True

```
  1: JOB Homestreet Plat; -  10 yr Event
  2: REM HGP 19-059
  3: REM File 19-059(10yr).cmd; Spiller PC; C:\DOSfiles\Hydra\CMD
  4:
  5: REM Compute Existing Flows first - then Pond Sizing
  6: REM 10 yr Storm Event; Rainfall per WSDOT Hydraulics Manual
  7: REM 2yr: 2.2, 10yr: 3.0, 25yr 3.5, 100yr 4.3
  8:
  9: TOT 3.0
 10:
 11: REM Use Type 1-A SCS storm per DOE Drainage Manual
 12: FIL doe.inc
------START OF SUB-FILE------
```

♀

HGA, Consulting Engineers HYDRA Version 4.59
Olympia, Washington Page 2

C:\HYDRA\CMD\TEST.CMD 10:12 25-Apr-120

```
  1: HYE 10 0.00 0.040 0.040 0.040 0.040 0.040 0.040 0.040 0.040 0.040 0.0
       40+
  2:     0.050 0.050 0.050 0.050 0.050 0.050 0.060 0.060 0.060 0.060 0.060
        0.060+
  3:     0.070 0.070 0.070 0.070 0.070 0.070 0.082 0.082 0.082 0.082 0.082
        0.082+
  4:     0.095 0.095 0.095 0.095 0.095 0.095 0.134 0.134 0.134 0.180 0.180
        0.340+
  5:     0.540 0.270 0.180 0.134 0.134 0.134 0.088 0.088 0.088 0.088 0.088
        0.088+
  6:     0.088 0.088 0.088 0.088 0.088 0.088 0.072 0.072 0.072 0.072 0.072
        0.072+
  7:     0.072 0.072 0.072 0.072 0.072 0.072 0.057 0.057 0.057 0.057 0.057
        0.057+
  8:     0.057 0.057 0.057 0.057 0.057 0.057 0.050 0.050 0.050 0.050 0.050
        0.050+
  9:     0.050 0.050 0.050 0.050 0.050 0.050 0.040 0.040 0.040 0.040 0.040
        0.040+
 10:     0.040 0.040 0.040 0.040 0.040 0.040 0.040 0.040 0.040 0.040 0.040
        0.040+
 11:     0.040 0.040 0.040 0.040 0.040 0.040 0.040 0.040 0.040 0.040 0.040
        0.040+
 12:     0.040 0.040 0.040 0.040 0.040 0.040 0.040 0.040 0.040 0.040 0.040
        0.040+
 13:     0.040 0.040
------ END OF SUB-FILE ------
 13: PDA .012 12 2 1 2 .005 12
 14:
 15: NEW North Basin - Existing conditions
 16: SCS 7.65 0 98 85 39
 17: INL 99
 18: PIP 1 100 100 ^use pipe command to print flow rate
 19: NEW North Basin - Developed Condition
 20: SCS 7.65 0.544 98 86 24
 21: INL 99
 22:
 23: RES 100 0/0 8500/0.97 12000/1.8 14000/2.2 +
 24:         17000/3.35 21000/7
 25:
 26: NEW South Basin - Existing Conditions
 27: SCS 8.44 0 98 85 30
 28: INL 99
 29: PIP 1 100 100 ^use pipe command to print flow rate
 30: NEW South Basin - Developed Conditions
 31: SCS 8.44 0.534 98 86 23
 32: INL 99
 33:
 34: RES 100 0/0 8500/1.14 12000/2.25 13500/2.8 16000/4.1 +
 35:         21000/7
 36:
 37:
 38: END
♀
```


------ S U M M A R Y O F A N A L Y S I S ------

Run number on command file : 98
Number of links : 4
Number of hydrographs : 46

19-059cmd10

Total sanitary population	:	0
Total sanitary area	:	0.00 Acres
Total storm area	:	32.18 Acres
Number of pumps	:	0
Number of reservoirs	:	2
Number of diversion structures	:	0
Number of inlets	:	4
Length of new pipe	:	2.00 Feet
Length of existing pipe	:	0.00 Feet
Length of channel	:	0.00 Feet
Length of gutter	:	0.00 Feet
Length of transport units	:	0.00 Feet
Length of pressure pipe	:	0.00 Feet

♀

C:\HYDRA\CMD\TEST.CMD 10:12 25-Apr-120

Homestreet Plat; - 10 yr Event

*** North Basin - Existing condition Pipe Design

Link	Long	Diam	Invert Up/Dn	Slope	Depth Up/Dn	Min Cover	San Inf	Sto Mis	Vel d/D	Design CFS	Estimated Cost
1	1	12	97.92	0.0050	2.08	1.00	0.0	1.8	3.25	1.81	0
			97.91		2.09		0.0	0.0	0.67		

Lateral length= 1 Upstream length= 1

*** North Basin - Developed Conditio Reservoir

Link	Invert Up/Dn	Maximum Flow Values	San	Inf	Sto	Mis	Design	Cost
2	Unknown	Discharge :	0.00	0.00	1.77	0.00	1.77	0
	Unknown	Stored :	0	0	11780	0	11780	
		Incoming :	0.00	0.00	3.45	0.00	3.45	

Lateral length= 0 Upstream length= 0

*** South Basin - Existing Condition Pipe Design

Link	Long	Diam	Invert Up/Dn	Slope	Depth Up/Dn	Min Cover	San Inf	Sto Mis	Vel d/D	Design CFS	Estimated Cost
3	1	12	97.92	0.0050	2.08	1.00	0.0	2.3	3.46	2.26	0
			97.91		2.09		0.0	0.0	0.77		

Lateral length= 1 Upstream length= 1

*** South Basin - Developed Conditio Reservoir

Link	Invert Up/Dn	Maximum Flow Values	San	Inf	Sto	Mis	Design	Cost
4	Unknown	Discharge :	0.00	0.00	2.17	0.00	2.17	0
	Unknown	Stored :	0	0	11614	0	11614	
		Incoming :	0.00	0.00	3.84	0.00	3.84	

Lateral length= 0 Upstream length= 0

♀

Status of DEFAULTS at start of run. (* May be reset by SET)

```
|
|  Command file : C:\HYDRA\CMD\TEST.CMD
|  Input units are read as                : USA
|* Output sent to display                 : Brief
|* Output sent to printer                 : Brief
|* Output sent to file                    : Brief
|  Paper width in inches                  : 8.000
|  String to reset printer                : 27 38 108 54 68 27 40 115 49 48 72
|  String to set printer to compressed    : 17.16 27 38 107 48 56 72
|  String to set printer to 8 lines/inch  : 8 27 38 108 56 68
|  Name of printer                        : Hewlett-Packard, LaserJet/LaserJet Plus
|  Print heading at top of page           : True
|
|  Number of steps in hydrograph          : 150
|  Step length in minutes                 : 10
|  Significant flow in hydrograph         : 0.000
|* Maximum plot value                     : Selected by HYDRA
|  Type of hydrographic plot              : Compact
|
|  Sanitary flow by                       : Diurnal Curve
|  Delay to start of actual storm         : 0.00
|  Rational Method computations           : Off
|  SCS computations                       : Santa Barbara
|  Continuous simulation computations     : On
|
|* Maximum d/D for pipe design/analysis   : 0.900
|* Match point position on pipe           : 0.00 or Invert
|* Number of allowable diam drops         : 999
|* Mimimum drop thru manhole              : 0.000
|  Routing technique                      : Quick
|
|* Calculate sanitary flows               : True
|* Calculate infiltration flows           : True
|* Calculate storm flows                  : True
|* Calculate misc flows                   : True
|
+-----------------------------------------------------------------

  1: JOB Homestreet Plat; - 25 yr Event
  2: REM HGP 19-059
  3: REM File 19-059(25yr).cmd; Spiller PC; C:\DOSfiles\Hydra\CMD
  4:
  5: REM Compute Existing Flows first - then Pond Sizing
  6: REM 25 yr Storm Event; Rainfall per WSDOT Hydraulics Manual
  7: REM 2yr: 2.2, 10yr: 3.0, 25yr 3.5, 100yr 4.3
  8:
  9: TOT 3.5
 10:
 11: REM Use Type 1-A SCS storm per DOE Drainage Manual
 12: FIL doe.inc
------START OF SUB-FILE------
♀
```

```
  1: HYE 10 0.00 0.040 0.040 0.040 0.040 0.040 0.040 0.040 0.040 0.040 0.0
       40+
  2:     0.050 0.050 0.050 0.050 0.050 0.050 0.060 0.060 0.060 0.060 0.060
        0.060+
  3:     0.070 0.070 0.070 0.070 0.070 0.070 0.082 0.082 0.082 0.082 0.082
        0.082+
  4:     0.095 0.095 0.095 0.095 0.095 0.095 0.134 0.134 0.134 0.180 0.180
        0.340+
  5:     0.540 0.270 0.180 0.134 0.134 0.134 0.088 0.088 0.088 0.088 0.088
        0.088+
  6:     0.088 0.088 0.088 0.088 0.088 0.088 0.072 0.072 0.072 0.072 0.072
        0.072+
  7:     0.072 0.072 0.072 0.072 0.072 0.072 0.057 0.057 0.057 0.057 0.057
        0.057+
  8:     0.057 0.057 0.057 0.057 0.057 0.057 0.050 0.050 0.050 0.050 0.050
        0.050+
  9:     0.050 0.050 0.050 0.050 0.050 0.050 0.040 0.040 0.040 0.040 0.040
        0.040+
 10:     0.040 0.040 0.040 0.040 0.040 0.040 0.040 0.040 0.040 0.040 0.040
        0.040+
 11:     0.040 0.040 0.040 0.040 0.040 0.040 0.040 0.040 0.040 0.040 0.040
        0.040+
 12:     0.040 0.040 0.040 0.040 0.040 0.040 0.040 0.040 0.040 0.040 0.040
        0.040+
 13:     0.040 0.040
------ END OF SUB-FILE ------
 13: PDA .012 12 2 1 2 .005 12
 14:
 15: NEW North Basin - Existing conditions
 16: SCS 7.65 0 98 85 39
 17: INL 99
 18: PIP 1 100 100 ^use pipe command to print flow rate
 19: NEW North Basin - Developed Condition
 20: SCS 7.65 0.544 98 86 24
 21: INL 99
 22:
 23: RES 100 0/0 8500/0.97 12000/1.8 14000/2.2 +
 24:         17000/3.35 21000/7
 25:
 26: NEW South Basin - Existing Conditions
 27: SCS 8.44 0 98 85 30
 28: INL 99
 29: PIP 1 100 100 ^use pipe command to print flow rate
 30: NEW South Basin - Developed Conditions
 31: SCS 8.44 0.534 98 86 23
 32: INL 99
 33:
 34: RES 100 0/0 8500/1.14 12000/2.25 13500/2.8 16000/4.1 +
 35:         21000/7
 36:
 37:
 38: END
```

♀

C:\HYDRA\CMD\TEST.CMD 10:10 25-Apr-120

------ S U M M A R Y O F A N A L Y S I S ------

Run number on command file : 97
Number of links : 4
Number of hydrographs : 46

Total sanitary population	:	0
Total sanitary area	:	0.00 Acres
Total storm area	:	32.18 Acres
Number of pumps	:	0
Number of reservoirs	:	2
Number of diversion structures	:	0
Number of inlets	:	4
Length of new pipe	:	2.00 Feet
Length of existing pipe	:	0.00 Feet
Length of channel	:	0.00 Feet
Length of gutter	:	0.00 Feet
Length of transport units	:	0.00 Feet
Length of pressure pipe	:	0.00 Feet

♀

C:\HYDRA\CMD\TEST.CMD 10:10 25-Apr-120

Homestreet Plat; - 25 yr Event

*** North Basin - Existing condition Pipe Design

Link	Long	Diam	Invert Up/Dn	Slope	Depth Up/Dn	Min Cover	San Inf	Sto Mis	Vel d/D	Design CFS	Estimated Cost
1	1	12	97.92	0.0050	2.08	1.00	0.0	2.4	3.51	2.39	0
			97.91		2.09		0.0	0.0	0.80		

Lateral length= 1 Upstream length= 1

*** North Basin - Developed Conditio Reservoir

Link	Invert Up/Dn	Maximum Flow Values	San	Inf	Sto	Mis	Design	Cost
2	Unknown	Discharge :	0.00	0.00	2.22	0.00	2.22	0
	Unknown	Stored :	0	0	13940	0	13940	
		Incoming :	0.00	0.00	4.19	0.00	4.19	

Lateral length= 0 Upstream length= 0

*** South Basin - Existing Condition Pipe Design

Link	Long	Diam	Invert Up/Dn	Slope	Depth Up/Dn	Min Cover	San Inf	Sto Mis	Vel d/D	Design CFS	Estimated Cost
3	1	12	97.92	0.0061	2.08	1.00	0.0	3.0	3.98	2.98	0
			97.91		2.09		0.0	0.0	0.89		

Lateral length= 1 Upstream length= 1

*** South Basin - Developed Conditio Reservoir

Link	Invert Up/Dn	Maximum Flow Values	San	Inf	Sto	Mis	Design	Cost
4	Unknown	Discharge :	0.00	0.00	2.83	0.00	2.83	0
	Unknown	Stored :	0	0	13429	0	13429	
		Incoming :	0.00	0.00	4.67	0.00	4.67	

Lateral length= 0 Upstream length= 0

♀

Status of DEFAULTS at start of run. (* May be reset by SET)

Command file	C:\HYDRA\CMD\TEST.CMD
Input units are read as	USA
* Output sent to display	Brief
* Output sent to printer	Brief
* Output sent to file	Brief
Paper width in inches	8.000
String to reset printer	27 38 108 54 68 27 40 115 49 48 72
String to set printer to compressed	17.16 27 38 107 48 56 72
String to set printer to 8 lines/inch	8 27 38 108 56 68
Name of printer	Hewlett-Packard, LaserJet/LaserJet Plus
Print heading at top of page	True
Number of steps in hydrograph	150
Step length in minutes	10
Significant flow in hydrograph	0.000
* Maximum plot value	Selected by HYDRA
Type of hydrographic plot	Compact
Sanitary flow by	Diurnal Curve
Delay to start of actual storm	0.00
Rational Method computations	Off
SCS computations	Santa Barbara
Continuous simulation computations	On
* Maximum d/D for pipe design/analysis	0.900
* Match point position on pipe	0.00 or Invert
* Number of allowable diam drops	999
* Mimimum drop thru manhole	0.000
Routing technique	Quick
* Calculate sanitary flows	True
* Calculate infiltration flows	True
* Calculate storm flows	True
* Calculate misc flows	True

```
  1: JOB Homestreet Plat; - 100 yr Event
  2: REM HGP 19-059
  3: REM File 19-059(100yr).cmd; Spiller PC; C:\DOSfiles\Hydra\CMD
  4:
  5: REM Compute Existing Flows first - then Pond Sizing
  6: REM 100 yr Storm Event; Rainfall per WSDOT Hydraulics Manual
  7: REM 2yr: 2.2, 10yr: 3.0, 25yr 3.5, 100yr 4.3
  8:
  9: TOT 4.3
 10:
 11: REM Use Type 1-A SCS storm per DOE Drainage Manual
 12: FIL doe.inc
------START OF SUB-FILE------
```

```
  1: HYE 10 0.00 0.040 0.040 0.040 0.040 0.040 0.040 0.040 0.040 0.040 0.0
       40+
  2:     0.050 0.050 0.050 0.050 0.050 0.050 0.060 0.060 0.060 0.060 0.060
        0.060+
  3:     0.070 0.070 0.070 0.070 0.070 0.070 0.082 0.082 0.082 0.082 0.082
        0.082+
  4:     0.095 0.095 0.095 0.095 0.095 0.095 0.134 0.134 0.134 0.180 0.180
        0.340+
  5:     0.540 0.270 0.180 0.134 0.134 0.134 0.088 0.088 0.088 0.088 0.088
        0.088+
  6:     0.088 0.088 0.088 0.088 0.088 0.088 0.072 0.072 0.072 0.072 0.072
        0.072+
  7:     0.072 0.072 0.072 0.072 0.072 0.072 0.057 0.057 0.057 0.057 0.057
        0.057+
  8:     0.057 0.057 0.057 0.057 0.057 0.057 0.050 0.050 0.050 0.050 0.050
        0.050+
  9:     0.050 0.050 0.050 0.050 0.050 0.050 0.040 0.040 0.040 0.040 0.040
        0.040+
 10:     0.040 0.040 0.040 0.040 0.040 0.040 0.040 0.040 0.040 0.040 0.040
        0.040+
 11:     0.040 0.040 0.040 0.040 0.040 0.040 0.040 0.040 0.040 0.040 0.040
        0.040+
 12:     0.040 0.040 0.040 0.040 0.040 0.040 0.040 0.040 0.040 0.040 0.040
        0.040+
 13:     0.040 0.040
------ END OF SUB-FILE ------
 13: PDA .012 12 2 1 2 .005 12
 14:
 15: NEW North Basin - Existing conditions
 16: SCS 7.65 0 98 85 39
 17: INL 99
 18: PIP 1 100 100 ^use pipe command to print flow rate
 19: NEW North Basin - Developed Condition
 20: SCS 7.65 0.544 98 86 24
 21: INL 99
 22:
 23: RES 100 0/0 8500/0.97 12000/1.8 14000/2.2 +
 24:         17000/3.35 21000/7
 25:
 26: NEW South Basin - Existing Conditions
 27: SCS 8.44 0 98 85 30
 28: INL 99
 29: PIP 1 100 100 ^use pipe command to print flow rate
 30: NEW South Basin - Developed Conditions
 31: SCS 8.44 0.534 98 86 23
 32: INL 99
 33:
 34: RES 100 0/0 8500/1.14 12000/2.25 13500/2.8 16000/4.1 +
 35:         21000/7
 36:
 37:
 38: END
```


------ S U M M A R Y O F A N A L Y S I S ------

Run number on command file : 95
Number of links : 4
Number of hydrographs : 46

19-059cmd100

Total sanitary population	:	0
Total sanitary area	:	0.00 Acres
Total storm area	:	32.18 Acres
Number of pumps	:	0
Number of reservoirs	:	2
Number of diversion structures	:	0
Number of inlets	:	4
Length of new pipe	:	2.00 Feet
Length of existing pipe	:	0.00 Feet
Length of channel	:	0.00 Feet
Length of gutter	:	0.00 Feet
Length of transport units	:	0.00 Feet
Length of pressure pipe	:	0.00 Feet

♀

Homestreet Plat; - 100 yr Event

*** North Basin - Existing condition Pipe Design

Link	Long	Diam	Invert Up/Dn	Slope	Depth Up/Dn	Min Cover	San Inf	Sto Mis	Vel d/D	Design CFS	Estimated Cost
1	1	12	97.92	0.0077	2.08	1.00	0.0	3.4	4.49	3.37	0
			97.91		2.09		0.0	0.0	0.89		

Lateral length= 1 Upstream length= 1

*** North Basin - Developed Conditio Reservoir

Link	Invert Up/Dn	Maximum Flow Values	San	Inf	Sto	Mis	Design	Cost
2	Unknown	Discharge :	0.00	0.00	3.26	0.00	3.26	0
	Unknown	Stored :	0	0	16621	0	16621	
		Incoming :	0.00	0.00	5.38	0.00	5.38	

Lateral length= 0 Upstream length= 0

*** South Basin - Existing Condition Pipe Design

Link	Long	Diam	Invert Up/Dn	Slope	Depth Up/Dn	Min Cover	San Inf	Sto Mis	Vel d/D	Design CFS	Estimated Cost
3	1	12	97.92	0.0119	2.08	1.00	0.0	4.2	5.58	4.18	0
			97.90		2.10		0.0	0.0	0.89		

Lateral length= 1 Upstream length= 1

*** South Basin - Developed Conditio Reservoir

Link	Invert Up/Dn	Maximum Flow Values	San	Inf	Sto	Mis	Design	Cost
4	Unknown	Discharge :	0.00	0.00	4.07	0.00	4.07	0
	Unknown	Stored :	0	0	15780	0	15780	
		Incoming :	0.00	0.00	6.01	0.00	6.01	

Lateral length= 0 Upstream length= 0

♀