Mason County

Update of County's
Stormwater Policies/Regulations and
Development of Comprehensive
Stormwater Management Plan

Hoodsport Rural Activity Center
Stormwater Management Plan

Submitted to:
Mason County
Department of Public Works
411 N. Fifth Street
Shelton, WA 98584

Submitted by:
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May, 2008

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Mason County

Update of County's Stormwater Policies/Regulations and Development of Comprehensive Stormwater Management Plans

Hoodsport Rural Activity Center
Stormwater Management Plan

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Preface / Acknowledgements

Hoodsport Rural Activity Center Stormwater Management Plan

This document, entitled Hoodsport Rural Activity Center (RAC) Stormwater Management Plan (SWMP), has been prepared as part of the County's proposed stormwater management strategy to protect and enhance the County's natural resources by addressing the stormwater management (SWM) issues in the urban, and urbanizing areas of the County. This County wide strategy includes the development of a Comprehensive Countywide SWM Plan, with more in-depth technical studies in the areas of Allyn, Belfair, and Hoodsport. The County's Comprehensive SWM Plan and technical studies assume a watershed based management philosophy for the protection of natural resources and the establishment of effective stormwater management throughout the County using a phased implementation strategy.

The County is committed to enhancing water quality and promoting effective stormwater management especially in its urban and urbanizing areas, which are often located within and adjacent to sensitive natural resource areas. This SWM planning strategy, as documented in the Countywide Comprehensive SWM Plan currently under development, is intended to address the drainage related impacts of existing and future development, and to protect and enhance water quality, shellfish, habitat and groundwater. *(The draft Comprehensive Countywide SWM Plan is scheduled for release to the public later this year.)* Developing a Comprehensive Countywide SWM Plan at this time allows the County to address the requirements of the Puget Sound Water Quality Management Plan, as well as begin to prepare the County to come into compliance with a future National Pollution Discharge Elimination System (NPDES) Phase II Municipal Stormwater Permit.

Allyn and Belfair UGA SWM Plans (completed summer 2007) complement and support the development of the Comprehensive Countywide SWM Plan. Shellfish protection and recovery plans are currently under development for the Oakland and Annas Bay areas. These SWM technical documents (including the Hoodsport SWMP) will be reviewed by the public, approved by the BOCC, and included as technical appendices to the County's Comprehensive SWM Plan.

Acknowledgement of Combined State and Local Funding

The development of the Stormwater Management Plan for the Hoodsport Rural Activity Center (RAC) has been funded in part by a grant to Mason County by the Washington State Department of Ecology, and is also supported by a local match from Mason County.

Table of Contents

Hoodsport Rural Activity Center —Stormwater Management Plan

Preface / Acknowledgements
Executive Summary....1
Section 1—Introduction....22
Section 2—Characterization of the Hoodsport RAC....27
Section 3—Existing Stormwater Facilities....41
Section 4—Future Conditions....51
Section 5—Regulatory Criteria....55
Section 6—SWM Impacts, Analysis and Strategies....67
Section 7—SWM Plan: Capital Projects....72
Section 8—SWM Plan: Programmatic Elements and Regulatory Compliance....77
Section 9—Costs, Funding and Implementation....94
Section 10—Public Review and Approval....102

List of Tables

Table E-1—Recommended Maintenance
Table E-2—Hoodsport RAC Six Year Capital Improvement Program
Table E-3—Recommended SWM Programmatic Elements and Costs
Table E-4—Financial Plan for the Hoodsport SWM Plan Annualized Revenue Needs Over the Planning Period
Table E-5—Potential SWM Funding Sources and Estimated Revenues
Table 2-1—Hoodsport RAC Subbasin Characteristics
Table 2-2—Subbasin Slope Characteristics
Table 2-3—Hydrologic Soil Groups
Table 4-1—Hoodsport RAC Zoning
Table 5-1—Ecology 2005 Manual: Minimum Stormwater Management Requirements
Table 7-1—Recommended Maintenance
Table 7-2—Hoodsport RAC Six Year Capital Improvements Program
Table 8-1—Recommended SWM Programmatic Elements and Costs
Table 9-1—Financial Plan for the Hoodsport Stormwater Management Plan Annualized Revenue Needs Over the Planning Period
Table 9-2—Potential SWM Funding Sources and Estimated Annual Revenues

Table of Contents
Continued

Figures

Figure E-1—Location Map
Figure E-2—Existing Drainage Basin Boundaries
Figure 1-1—Location Map
Figure 2-1—Existing Drainage Basin Boundaries
Figure 2-2—Site Soils
Figure 2-3—Hydric Soils
Figure 2-4—Sensitive Areas
Figure 3-1—Existing Conditions
Figure 3-2—Drainage Deficiency Map
Figure 4-1—Existing Land Use – Zoning
Figure 7-1—Six Year CIP Program

Appendices

Appendix A—Culvert Inventory Data
Appendix B—Stormwater Questionnaire
Appendix C—Low Impact Development Techniques
Appendix D —Capital Project Construction Cost Estimates

Hoodsport Stormwater Management Plan
Executive Summary

Purpose

Hoodsport is one of three urbanizing areas within Mason County, along with Allyn and Belfair that have been selected by the County for the development of comprehensive stormwater management plans (SWM Plans). These SWM Plans are needed to protect the water quality of Hood Canal by managing existing stormwater runoff and by guiding continued growth within the region. The following SWM Plan presents an evaluation of the drainage system within the area, including capital projects needed to address local drainage problems, and suggests a series of SWM activities to begin to address the elements of the Puget Sound Water Quality Management Plan and prepare the County for the receipt of a National Pollution Discharge Elimination System (NPDES) Permit within the next few years.

Study Area

The Hoodsport Rural Activity Center (RAC) is one of three RACs within the Mason County Growth Management Plan, along with Taylor Town I and II. The Hoodsport RAC contains about 605 acres and is located at the north end of Hoods Canal, as shown in Figure E-1. The majority of the area (95%) is zoned residential, with only about 20% of the area currently being developed. A small commercial area exists along both sides of Highway 101, which generally follows the shoreline along Hood Canal. A number of relatively short residential streets connect the residential areas with the highway and local business community. The total number of miles of road within the RAC is estimated to be about twelve, with the County routinely maintaining about four miles of the local transportation system, and Washington Department of Transportation (WSDOT) maintaining the four miles associated with Highway 101 and State Route 119 (SR 119) (North Lake Cushman Road). The remaining four miles of roads are privately owned and maintained.

Land Use and Growth

The majority of land within the Hoodsport RAC is currently zoned as rural residential (RR2.5) which allows one dwelling unit per two and one-half acres. (See Title 17 Zoning of the Mason County Code for a more detailed explanation of the zoning.) Small amounts of the RAC are zoned for rural commercial (RR3), rural multi-family (RMF), and rural tourist-campground (RT). As a result of this zoning, the Hoodsport RAC consists primarily of low-density residential, vacant/rural, and forested areas with a small commercial area along Highway 101.

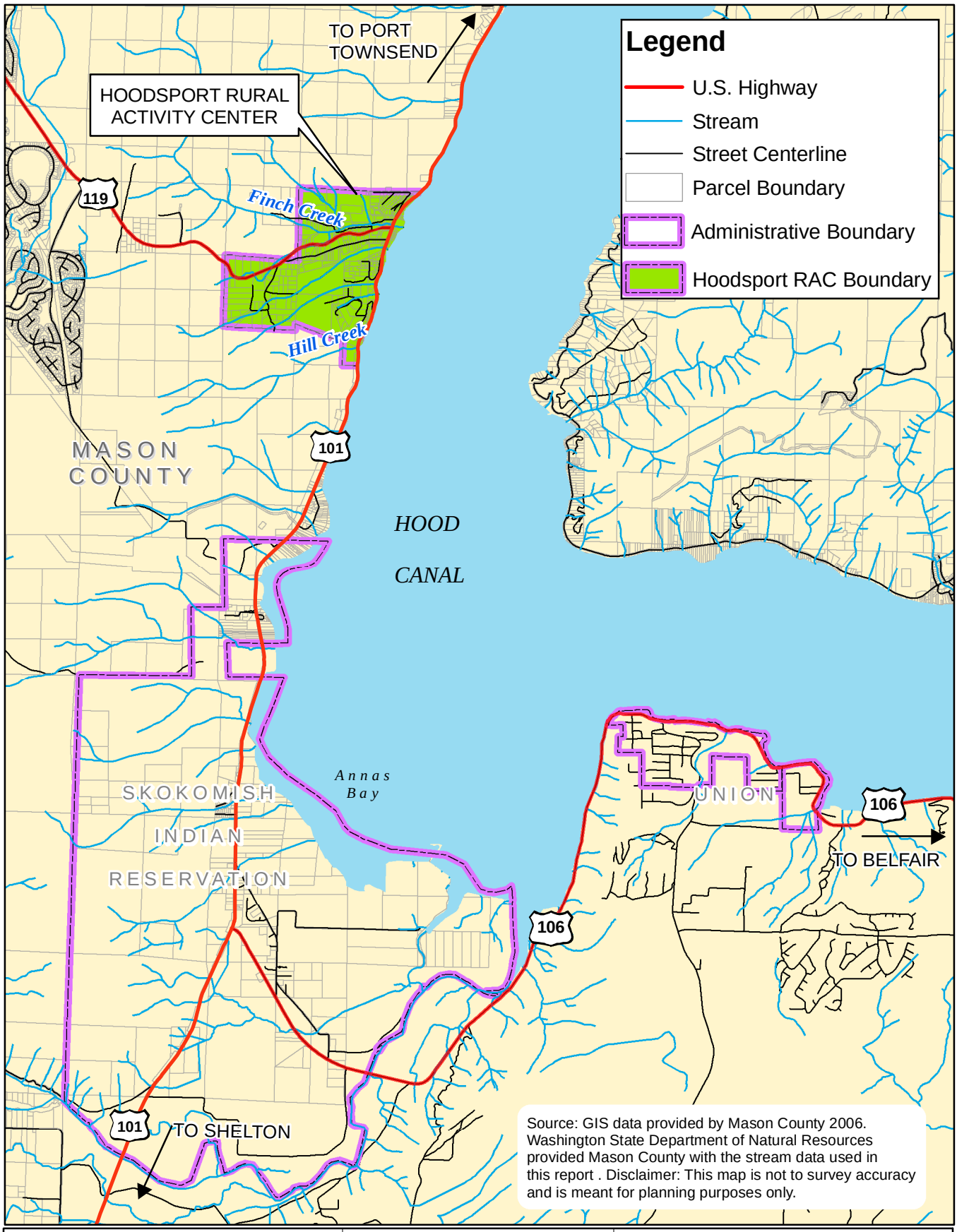

Figure E-1
Location Map

Hoodsport Stormwater Management Plan

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0 5,100 Feet

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Currently, there are approximately 258 residential homes within the Hoodsport RAC, which support an estimated population of about 642 individuals, including seasonal residents. Existing lots range in size from about one-quarter to five acres, with much of the undeveloped land within the RAC zoned for 5 acre minimum lot sizes. The current rate of growth is about 3.5%, or about nine new homes per year, along with an occasional commercial development. At this rate, and with a substantial amount of the area yet to be developed, it will take 20 or more years for the area to fully develop.

A small amount of commercial land use is located within the Hoodsport RAC and is concentrated principally along Highway 101 and along SR 119 near Highway 101. Approximately 38 businesses are located in the Hoodsport RAC, with some industrial land occurring along Highway 101 near Hill Creek.

Development within the RAC is subject to the Mason County New Development and Redevelopment – Minimum Standards (Mason County Code 14.48.140), which applies to both residential and commercial development and redevelopment. If development within the Hoodsport RAC continues to follow the Mason County's existing and proposed development and drainage codes, there should be little increase in stormwater runoff due to the large lot sizes, retainage of natural vegetation, and relatively less dense levels of development.

Hydrology

The Hoodsport area average annual precipitation is about 90 inches per year based on the Cushman Powerhouse 2 precipitation stations. These are the closest rain gauges to the Hoodsport area. The 90 inch average is based on the period of record from July 1973 through June 2007, as reported by the Western Regional Climate Center. Average monthly precipitation from November through January exceeds 14 inches per month. The lowest rainfall month is July, with an average monthly rainfall of about 1.1 inches.

Natural and Environmental Characteristics

- Topography—ranges from 0-5% slope near the shoreline to 15-30% within the upland areas; most available land is located within the upper, steeper areas
- Drainage—area is served by nine subbasins, with 43% of the land draining to Finch Creek.
- Soils—fine grained, closely packed with little to no infiltration capabilities
- Sensitive Areas—are numerous and consist of wetlands, shorelines, steep slopes, highly erodible areas, forested wetlands, and streams with regulated buffers.
- Fish Bearing Streams—all five of the streams in the planning area are fish bearing,

including Finch and Hill Creeks and the smaller three unnamed creeks; a dam 0.25 miles up on Finch Creek limits access.

- Fish Hatcheries—two hatcheries are located in the area, including a salmon hatchery at the mouth of Finch Creek and a trout hatchery upstream along Hill Creek.
- Fish and Wildlife Habitat Conservation Areas—are numerous and include shorelines, streams, shellfish beds, kelp and eel grass beds, and wetlands.
- Water Quality—water quality standards are reported being violated for fecal coliforms in the lower reaches of Finch Creek and along the shoreline of Hood Canal; low dissolved oxygen levels occur just north of the area, and shellfish beds have been contaminated since the late 1980s.
- Shellfish—shellfish harvesting has been prohibited within the area for the last 20 years, and those prohibitions are still in effect today.

Character of Natural and Man-Made Drainage System

The Hoodsport RAC generally slopes from west to east downward towards Hood Canal. Slopes range from nearly flat (0-5%) along the creek valley and shoreline, to over 30% in hills to the west of the urban areas and along the shoreline bluffs directly above the salt water. There are five creeks, including Finch Creek, Hill Creek, and three smaller unnamed creeks that convey water from west to east to Hood Canal, as shown in Figure E-2.

The RAC is made up of almost entirely Group C soils which have limited infiltration capacity. Most rain falling on this area generally flows across the surface, with some infiltration occurring along the way, follows the contours and collects in small natural ravines that lead downstream into a system of larger ravines and smaller creeks and ultimately into Hood Canal. Much of the stormwater runoff from streets and roadways collects in shallow ditches and is conveyed directly into Hood Canal or downstream via a system of larger ditches along Highway 101 and SR 119, passing the runoff along and under the highways via culverts into Hood Canal.

The drainage system operated by the County within the Hoodsport RAC is made up primarily of road side ditches and culverts that collect and convey runoff to creeks or directly into Hood Canal, as shown in Figure E-2. County culverts typically range from 12 to 18 inches in diameter. The Washington State Department of Transportation (WSDOT) also maintains a system of ditches and culverts along US 101 and SR 119 (N Lake Cushman Road) within the Hoodsport RAC. Combined with the natural drainage system, the system of ditches and culverts operated by the County and WSDOT comprise the region's drainage system.

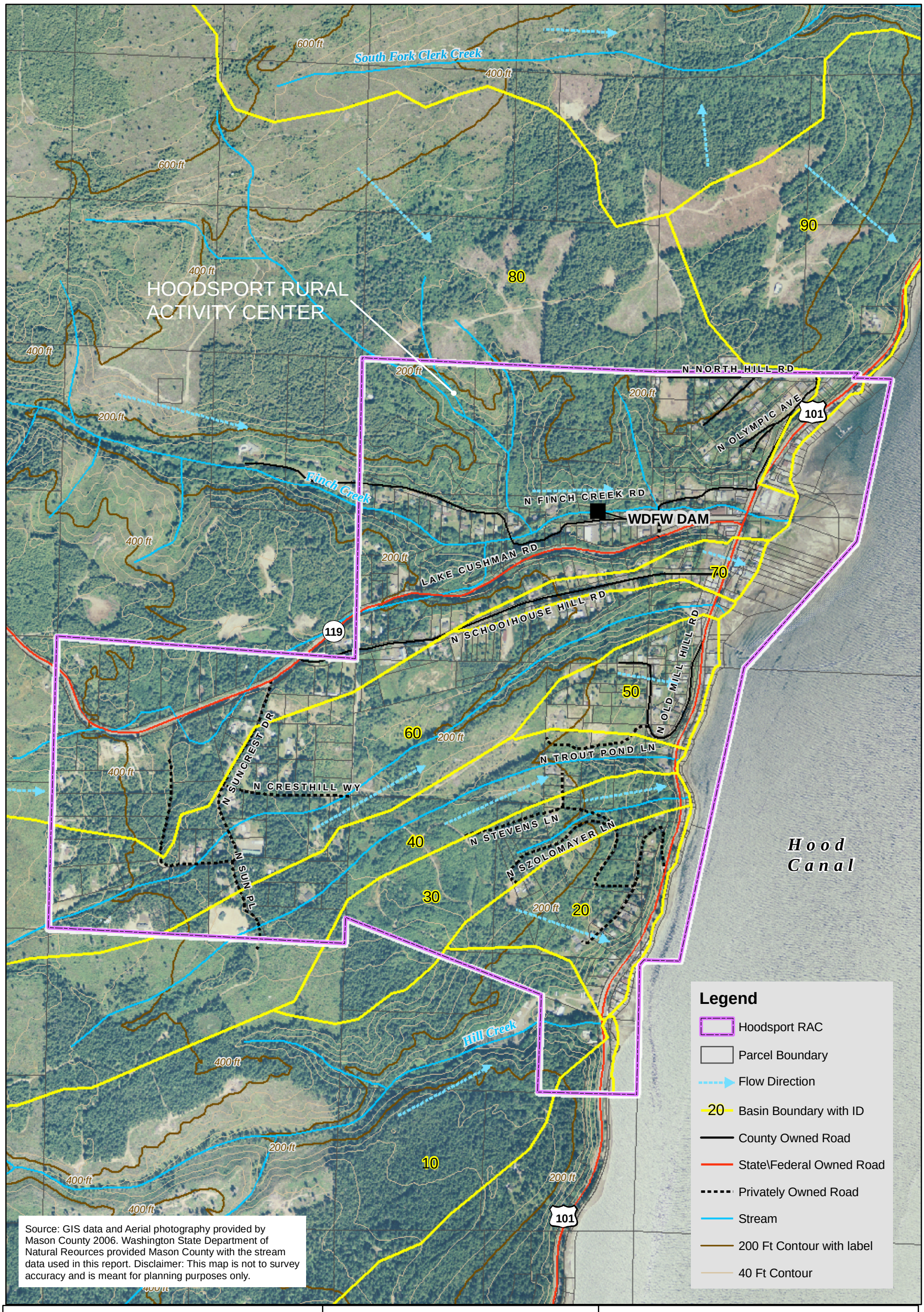

Figure E-2
Existing Drainage Basin Boundaries
Hoodsport Stormwater Management Plan

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SWM Plan: Elements, Priorities and Costs

The Stormwater Management Plan for the Hoodsport RAC includes two main elements, infrastructure/facility needs and programmatic needs. Addressing the facility needs ensures the drainage system has adequate capacity to reduce local flooding, address water quality, and protect property and public safety. Addressing the programmatic needs gives the County the tools and funding needed to guide future development and comply with existing and future regulatory and financial requirements.

The following is a summary of the stormwater management plan developed for the Hoodsport RAC. A five/six year implementation plan presents a strategy to phase in the various elements of the proposed SWM Plan over time as future revenues allow.

Stormwater Management Program: Existing/Future Facilities and Costs

Enhanced Maintenance

The primary focus of the stormwater management plan for the Hoodsport RAC is to enhance maintenance of the existing drainage system to avoid blockages and maintain the existing capacity and continue in to allow continued development and redevelopment in regard to new impervious area, zoning and lot sizes. Recommended locations for more frequent maintenance are provided in Table E-1.

Table E-1 Recommended Maintenance

Facility in need of maintenance	Function when maintained	Deficiency when not maintained	Responsible Jurisdiction
Ditches and Culverts	N. Schoolhouse Hill Road conveyance	Capacity is reduced when clogged; results in flooding along N. Schoolhouse Hill Rd.	Mason County
Finch Creek Intake structure	Bypasses water to the Hatchery	Capacity is reduced when clogged; results in flooding along N. Finch Creek Rd.	WDFW
Ditches and Culverts	SR 119 (Lake Cushman Road) conveyance	Capacity is reduced when clogged; increased runoff to N. Finch Creek Rd.; results in flooding along Finch Creek Rd.	WSDOT

Capital Infrastructure Improvements

Along with enhanced annual maintenance, a few capital improvement projects (CIP) have also been recommended for those areas where the existing drainage systems are insufficient, as reported by local residents and Mason County Staff. A total of four CIP projects have been identified and are discussed below in Table E-2. The total cost of these projects is $423,000, and they are intended to be constructed over a six year period, as local funding allows.

Table E-2 Hoodsport RAC Six Year Capital Improvement Program		Project Cost
# 1	N. North Hill Drainage Improvements	$ 185,000
# 2	N. Schoolhouse Hill Road Ditch Improvements	$ 121,000
# 3	Replace Half-Pipe with 18-inch Diameter Culvert	$ 56,000
# 4	Filterra Device for WQ Retrofit (retrofits 0.8 ac)	$ 61,000
	Total Cost of Six Year CIP Program	$ 423,000*

*Note that these capital costs do not include any water quality treatment retrofit projects.

Effective operation of the capital SWM facilities within the Hoodsport RAC also assume routine coordination with WSDOT to ensure an adequate level of maintenance is being continually provided to optimize existing culvert capacity along and underneath Highway 101 and SR 119.

Future Emphasis on Water Quality Treatment

It is important to mention the discussions currently underway within Mason County to develop a Countywide SWM Program initiative to design, fund, and build a series of water quality treatment facilities within the more urban areas of the County, including the Hoodsport RAC. The request has been made by Ecology and the Puget Sound Partnership to treat all existing runoff from the more urban areas of the County in order to protect sensitive receiving waters.

Under this initiative, low impact development (i.e. bio-retention facilities within County road right-of-ways) would be used to treat runoff prior to discharge to Hood Canal and Puget Sound. These facilities will cost approximately $40K each, if construction on County owned land.

It is likely that one or two of these facilities may be built within the Hoodsport RAC over the next two to six years. Funding may initially come from a $750 grant that the County recently received from Ecology. Later, additional local funding, possibly including the

formation of stormwater utility, may be needed to continue to fund the SWM Program within the Hoodsport RAC.

(Note that the cost of these potential water quality retrofit facilities has not been included in the funding needs identified in Section 9 of the Hoodsport SWMP, and are assumed to be part of the County's emerging program to retrofit drainage facilities within existing urban areas throughout the County for water quality treatment.)

Programmatic Overview

The County's existing annual SWM Program within the Hoodsport RAC consists primarily of annual maintenance (of about $25K per year) and development related review, construction, and inspection/enforcement services, as paid for through developer permit fees. Additional SWM activities provided on an as needed basis include:

- Response to spills and complaints
- Comprehensive land use planning
- Participation in local and regional planning
- Annual maintenance
- Public education and involvement

One of the purposes of this study is to review the County's existing levels of funding and staffing to determine its effectiveness and adequacy to address local drainage issues and regulatory compliance. As defined in this SWMP, it is anticipated that the Hoodsport SWM Program will be enhanced and incorporated into the County's larger comprehensive SWM Program. It is anticipated that the SWM Program for Hoodsport RAC will be one of the elements of the Countywide SWM Program, and will benefit from future county funding and staffing appropriations. Increased funding for SWM throughout the County is currently being considered to support the County's growing SWM obligations and regulatory compliance needs.

Need for Regulatory Compliance

Compliance with the Puget Sound Water Quality Management Plan

There are a series of existing regulatory requirements related to stormwater management, water quality, and habitat that apply to the Hoodsport RAC. The most significant are the municipal stormwater elements of the Puget Sound Water Quality Management Plan (PSWQMP), and its associated 2007-2009 Conservation Plan. Compliance with these requirements consists of addressing thirteen different municipal stormwater management program elements including:

1. Stormwater controls for new development and redevelopment
2. Stormwater site plan review

3. Inspection of construction sites
4. Maintenance of permanent facilities
5. Source control
6. Illicit discharges and water quality
7. Identification and ranking of problems
8. Public involvement and education
9. Low impact development practices
10. Watershed or basin planning
11. Funding
12. Monitoring
13. Schedule for implementation

Other requirements of the PSWQMP include compliance with local water quality TMDLs, which for the receiving waters in and around the Hoodsport RAC do not currently exist. There are, however, concerns about the impacts of continued and increased stormwater discharges to the local water quality of Hood Canal and the shellfish beds in nearby natural and commercial rearing areas. Elevated concentrations of coliforms have been documented by Ecology in nearby Annas Bay.

National Pollution Discharge Elimination System Phase II Municipal Stormwater Permit

Preparing the County for compliance with a future Phase II NPDES Municipal Stormwater Permit requires the County to add stormwater programmatic elements to its existing annual SWM Program, many of which are the same as those required under the PSWQMP. Future compliance with the NPDES Phase II Permit will include:

- Developing and conducting a public education program.
- Implementing a public involvement program.
- Initiating an illicit discharge detection and elimination program.
- Adopting the 2005 Manual and maintaining effective and responsive development review program, that includes inspection and enforcement, especially for erosion control.
- Conducting annual maintenance consistent with the protocols and frequencies listed in the Phase II Permit.
- Setting up a comprehensive stormwater management program, and conducting annual reporting and assessments of program effectiveness using adaptive management.

SWM Activities Needed for Compliance with PSWQMP and NPDES Phase II Permit

Due to the similarities of the PSWQMP and the Phase II NPDES Permit, and the likelihood of the County will be receiving an NPDES Phase II Permit within the next few years, the following regulatory gap, or programmatic, analysis has been performed and will be used to develop the comprehensive SWMP for the Hoodsport RAC. These NPDES Phase II requirements were issued in January of 2007 to most, smaller municipalities (with populations less than 100,000) throughout the State.

The various existing regulatory requirements have been grouped into nine stormwater management program (SWMP) elements, to form the primary elements of the Hoodsport SWMP. A listing of each regulatory requirement and recommended actions for compliance are provided below.

SWMP Element #1—Public Education and Outreach

Develop and distribute a County-wide brochure for the public that addresses stormwater pollution issues and what homeowners can to do to help solve them. Ensure it covers those issues specific to the Hoodsport RAC, including the benefits of low impact development (LID). Consider the use of the Puget Sound Action Team's recently updated general education brochure on LID, which is available on its web site.

SWMP Element #2—Public Involvement and Participation

Engage the local stakeholders of the Hoodsport in SWM planning and implementation within the Hoodsport RAC. Organize volunteers to assist in the development of a Stream Team for Finch Creek and Hill Creek, regional surface water management water quality monitoring, and facility inventory and mapping.

SWMP Element #3—Illicit Discharge Detection and Elimination (IDDE)

Illicit discharge and spill education is a topic that should be incorporated into products developed under SWMP Public Education Element #1. An element of the IDDE requirement that would be useful in the short-term is an accurate inventory of facilities and a survey of key drainage facilities electronically recorded in the County's GIS/mapping system. This could be done in annual increments over the next few years.

SWMP Element #4—Controlling Runoff from New Development, Redevelopment and Construction Sites

For the Hoodsport RAC, the County needs to update its current SWM ordinance and adopt standards that are consistent with the requirements of the 2005 Ecology Manual, and support the use of LID for new development. To do this, additional training on 2005 Ecology Manual and LID, will likely be required for both County staff and local developers.

The County's existing design criteria for stormwater are based largely on the 1992 Ecology Manual. When the County was more rural that level of treatment may have been adequate, however, as urban centers have emerged throughout the County pollutant loadings have increased and impacts to water quality, fish habitat, and shellfish rearing areas have been documented. It is widely understood that untreated or inadequately treated surface water runoff, particularly from the more intensely developed areas, may be a major contributor to these problems in local receiving waters. Adoption of the 2005 Ecology Manual and LID ordinance is strongly recommended to address both local flow and potential water quality related problems.

SWMP Element #5—Pollution Prevention &Operations/Maintenance for Municipal Operations

Review the adequacy of current annual maintenance practices and their effectiveness. Annually review and update their effectiveness to improve water quality. Maintain the County's existing level of maintenance effort within the Hoodsport RAC; enhance frequency of inspection and maintenance of known problem areas, as discussed in Section 7.

SWMP Element #6—Stormwater Management Program Implementation

Develop and implement a routine tracking system for County SWMP implementation that includes the SWM activities associated with the Hoodsport SWM Plan. Evaluate annually using adaptive management and make annual refinements as needed, involving local citizen, stakeholder, and regulatory input.

SWMP Element #7—Total Maximum Daily Load (TMDL) Allocations

At the present time, there are no TMDLs established within the Hoodsport RAC, however, strategies to protect surface waters from water quality degradation are included in recommended actions of other SWMP elements, including the adoption of the 2005 Ecology Manual and development/adoption of an LID ordinance.

Local water quality monitoring of major outfalls has been recommended in SWM Element #12 to assess impacts of stormwater and the effectiveness of existing SWM controls and practices, as future funding allows. *(The future Phase II permit requires compliance with established TMDLs. These would be identified in Appendix 2 of the permit, if the County had been issued one.)*

Note that current discussions are underway for the County to develop, fund, and implement a countywide program to retrofit the runoff from existing development using bio-retention and other LID types of facilities. The Hoodsport RAC, along with the GMA areas of Allyn and Belfair are being targeted as high priority areas for this type of water quality enhancement program. (Constructing one of these types of LID facilities within the Hoodsport RAC would cost about $40K per year; the design and construction of a couple of these

facilities within Hoodsport RAC may be possible using the funds within the $750K grant recently received by the County from Ecology.)

SWMP Element #8—Monitoring (of SWM Program)

As the Countywide SWM Program is established over the next several years, an annual monitoring program to review the effectiveness of individual SWMP activities should be established; the should be SWMP modified as needed on an annual basis using the principals of adaptive management.

SWMP Element #9—Reporting

Develop and implement an annual internal reporting system for County SWM Program implementation that includes the SWM activities contained within the recommended Hoodsport SWM Plan. As mentioned in Element #8, documenting and evaluating the effectiveness of the proposed SWMP should be done annually in order to review and refine the program and continue to address the high priority needs.

SWM Programmatic Elements Required for Consistency between NPDES II and PSWQMP

Note that the requirements of the NPDES II Permit are similar in many ways to the requirements of the PSWQMP. However, there are elements that are specifically stated in the PSWQMP that are not specifically spelled out in the Phase II Permit. These include conducting watershed or basin planning, creating adequate local funding, and implementing annual water quality monitoring to assess program effectiveness. To ensure consistency of the County's response to the various stormwater requirements, the following three elements from the PSWQMP should also be included in the recommended Hoodsport SWM Plan.

SWMP Element #10—Watershed or Basin Planning

The PSWQMP calls for the use of watershed or basin planning processes to identify and rank existing problems that degrade water quality, aquatic species, habitat, and natural hydrological processes; this element of the Plan also calls for the development of action plans/schedules, along with the identification of funding strategies to fix local drainage problems. This Hoodsport SWM Plan and the County's larger evaluation of its SWM needs and funding is consistent with this requirement.

Note that the County plans on taking the initiative to develop a comprehensive stormwater management program for the Hoodsport RAC that involves a programmatic approach to stormwater management, as described in the PSWQMP. This approach includes the enhancement of development criteria (by the adoption of the Ecology 2005 Manual and an LID Ordinance), as well as the enhancement of annual maintenance procedures and practices, as described in this SWM Plan. The County will continue to participate in regional

coordination efforts and in making additional SWM program enhancements in a phased approach, as more knowledge of the relationship of stormwater discharges to local and regional receiving waters is acquired.

SWMP Element #11—Funding

The PSWQMP calls for the creation of funding capacity, such as a utility, to ensure adequate, permanent funding for SWM program activities and regional stormwater projects.
It will be important for the County to work with local citizens to create a stormwater management utility throughout the Hoodsport RAC (and urban areas throughout the County). Also explore the development of a system development charge for new development and redevelopment to help the County off-set some of the costs of building the future conveyance systems and water quality treatment systems that will be needed in the future.

SWMP Element #12—Water Quality Monitoring

The PSWQMP calls for monitoring of program implementation and environmental conditions and trends over time to measure the effectiveness of program activities and to share the results with others.

At this point in time, consistent with the Allyn and Belfair SWM Plans, water quality monitoring will consist primarily of documenting the effectiveness of LID retrofit facilities that are being designed to treat existing runoff. Implementation of an annual monitoring program (programmatic in nature; i.e. not involving any water quality monitoring) to track progress and assess effectiveness is recommended.

In the future, as funding allows, water quality monitoring of major outfalls, as well as the effectiveness of annual maintenance and new development review practices, should be considered by the County. This monitoring program should be annually tailored to focus on local flooding problems and water quality and habitat priorities, especially if local TMDLs have not been established by Ecology.

Stormwater Management Program: Summary of Elements and Costs

Recommended SWM Programmatic elements listed above have been summarized along with annual costs in Table E-3. These activities, presented as SWM Program Elements, represent an enhancement of the County's existing SWM Program within the Hoodsport RAC. They emphasize the need to control/guide new development, enhance maintenance where needed, repair/enhance existing facilities, conduct annual program monitoring, and initiate a local public involvement/education program, along with other a series of other activities. The annual costs for these SWM Programmatic Elements averages about $70,000

Table E-3—Recommended SWM Programmatic Elements and Costs											
SWMP Element	Recommended Action	Satisfies Program Needs			Costs ($1,000's)						
		PSWQMP	NPDES Phasell Permit	WQ Habitat Shellfish	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Yr 6	Total
1	Public Education* - SWM (LID) Brochure	X	X	X	$5	$5	$5	$5	$5	$5	$30
2	Public Involvement* - Organize Volunteers/Mtgs	X	X	X	$10	$10	$10	$10	$10	$10	$60
3	Illicit Discharges (IDDE) - Facility Inventory & Mapping	X	X	X	$0	$10	$10	$10	$0	$0	$30
4	New Development - Ordinance - 05 DOE Manual - Ordinance - LID	X	X	X	$0*	$0*	$0*	$0*	$0*	$0*	$0*
	- Training - 05 Manual - Training - LID	X	X		$0*2	$0*2	$0*2	$0*2	$0*2	$0*2	$0*2
5	Maintenance - Annual (Inc. Enhancements)	X	X	X	$25	$25	$25	$25	$25	$25	$150
6	SWM Program* Implementation - Develop Tracking System	X	X		$5	$5	$5	$5	$5	$5	$30
	- Annual Program Evaluation	X	X		$5	$5	$5	$5	$5	$5	$30
7	TMDLs		X	X	$0	$0	$0	$0	$0	$0	$0
8	SWM Program Monitoring (Addressed in Element #6)	X	X		$0	$0	$0	$0	$0	$0	$0
9	Reporting* (Internal)		X		$5	$5	$5	$5	$5	$5	$30
10	Basin Planning (Part of current Co-wide study.)	X		X	$0*	$0*	$0*	$0*	$0*	$0*	$0*
11	Funding - Develop SWM Utility	X			$0*	$0*	$0*	$0*	$0*	$0*	$0*
	- SDC Feasibility Study	X			$0*	$0*	$0*	$0*	$0*	$0*	$0*
12	WQ Monitoring - Annual WQ Monitoring	X		X	$5 *3	$5 *3	$5 *3	$5 *3	$5 *3	$5 *3	$30
	Total:				$60	$70	$70	$70	$60	$60	$390
*Future County Staff (~ 0 FTE)					$0*4	$0*4	$0*4	$0*4	$0*4	$0*4	$0
Outside Services					$5	$5	$5	$5	$5	$5	$30
Total Annual Budget					$65	$75	$75	$75	$65	$65	$420

* - Activity included in the development and implementation of the Countywide SWM Program; no additional funding needed at the local planning level.

*2 – Development Review labor is paid by developer fees; no additional county funding is required.
*3 – The emphasis of the water quality monitoring program is to evaluate the effectiveness of water quality retrofit bio-retention facilities installed in road right of ways to treat existing runoff. Labor for WQ monitoring of these facilities to determine their effectiveness will be provided by volunteers; costs included are primarily for laboratory related analyses.
*4 – County staffing required to administer the Hoodsport annual SWM Program will be included in the administration and management of the County-wide SWM Program; approximately $15K, (or about 0.20 FTE, equivalent to 400 hours, or about 10 weeks per year), has been set aside for annual tracking, program evaluation, and reporting in SWM Elements #6 and #9.

per year. These resources are addition to those resources the County is planning to spend within the Allyn and Belfair UGA areas, as part of the initial phase of the development.

Recommended SWM Plan: Summary of Elements and Costs

It is suggested that the programmatic SWM elements identified above be developed and integrated with the proposed capital improvements proposed to create a Comprehensive Stormwater Management Plan for the Hoodsport RAC. Total SWMP costs for the next six years, including both capital and programmatic needs, amount to $843,000. Annual SWM costs are about $140,000, $70,000 per year for the SWM programmatic elements, as shown in Table E-3, and $70,000 per year for the capital elements, as shown in Table E-2. Annual costs and funding are presented in the implementation plan presented in the following section.

Recommended SWM Plan: Integration with Countywide SWM Program

The funding and implementation of the Hoodsport SWMP is only one aspect of a much larger, integrated countywide SWM Program that is currently under consideration. The concept of the County is to develop a comprehensive SWM Program throughout the County over the next five years. The program would initially focus on the most urbanized areas, including the Allyn and Belfair Growth Management Areas and the rural activity centers of Hoodsport and Taylor Town I and II.

The program, complete with the adoption of the 2005 Manual and a Low Impact Development Ordinance, along with the generation of local funding, such as a stormwater utility, would be implemented by phasing in stormwater management requirements annually, according to the following five phases:

- Phase I – Allyn and Belfair Urban Growth Areas
- Phase II – Hoodsport and Taylor Town I and II Rural Activity Centers
- Phase III – Water Quality and Shellfish Sensitive Areas
- Phase IV – Shoreline areas
- Phase V – The remaining unincorporated areas of the County

As noted above in the listing and estimate of SWM Programmatic costs for the Hoodsport SWMP, many of the administrative and management costs of the Hoodsport SWMP will be supported by the larger, centrally funded Countywide SWM Program. The Countywide SWM Program would be supported by dedicated SWM staff that would be responsible for the Hoodsport SWMP, as well as the administration and implementation of SWM planning throughout the County.

SWM Plan: Funding and Implementation

Hoodsport SWM Plan: Program Elements, Priorities, Schedule and Costs

Annual Revenue Needs

The Comprehensive SWM Program for the Hoodsport RAC has been created by integrating the capital needs/costs identified in Section 7 with the programmatic and regulatory compliance needs/costs presented in Section 8. The recommended plan includes a combination of programmatic activities and capital improvement projects over the next six years, 2009 to 2012.

- Total SWMP costs for the next six years, including both capital and programmatic needs, amounts to $840,000 or about $140,000 annually.
- Capital projects consist of four projects that total $423,000 (rounded to $420,000), or about $70K annually. *(Note that these costs do not include water quality retrofit projects; the retrofit projects will be included in the County-wide Stormwater Management Program.)*
- Programmatic and regulatory compliance needs include various activities ranging from public education/involvement to SWM Program monitoring, and include the adoption of new ordinances, development of new funding mechanisms, completion of inventory and GIS mapping of existing drainage facilities, along with a number of other SWMP activities. Programmatic costs have been estimated to be $420,000 over the six years or about $70,000 annually.

The funding/revenue needed to implement the recommended SWMP for the Hoodsport RAC is presented below in Table E-4.

Table E-4—Financial Plan for the Hoodsport Stormwater Management Plan Annualized Revenue Needs Over the Six Year Planning Period							
Relative Priority for Implementation	Schedule & Costs by Years ($1000s)						
	1	2	3	4	5	6	Total
SWM Programmatic Needs	$65	$75	$75	$75	$65	$65	$420
SWM Capital Needs	$70	$70	$70	$70	$70	$70	$420
Total*	**$135**	**$145**	**$145**	**$145**	**$135**	**$135**	**$840**

*Average Annual SWM cost for years #1-6 is $420K/6 years = $140K per year.

Funding Analysis

Presented in Table E-4 is an estimate of the cost of the recommended SWM Plan for the Hoodsport RAC. New revenue is needed over the next six years to support programmatic initiatives, as well as over the next 20 or more years to support both future programmatic and capital projects that will be needed to support ultimate buildout.

SWM Policies Guide Selection of Financial Options

The SWM management policies and approaches preferred by the County, as presented in this plan, play a large role in determining the funding strategies to implement the proposed SWM Plan for the Hoodsport RAC. In general, the proposed funding strategy has been guided by the following policies and technical decisions that have been created to manage stormwater within the Hoodsport RAC:

- Low impact development will be required for all new development and redevelopment.
- No regional detention facilities will be created to accommodate either existing or future development; if needed, detention will be provided onsite by each new developer on an as needed basis.
- New development/redevelopment will pay for the cost of onsite water quality treatment (per the adoption of the 2005 Manual by the County).
- New development/redevelopment may help pay for future regional conveyance facilities, as/if needed to support future growth through the establishment of SEPA mitigation and system developer charges.
- There are currently no major flooding or maintenance problems associated with the current drainage system within the Hoodsport RAC.
- Retrofitting existing homes and businesses for detention or water quality treatment has not been included at this time, but is currently being considered as part of the County's new stormwater grant from Ecology.

- As the County builds new roads within the RAC, the County will design and pay for some new water qualities retrofit systems that will be located within the County road right-of-ways to collect and treat road runoff.

Review and Evaluate Potential Funding/Revenue Options

Discussions with the County suggest that there are several financial options that should be considered to fund stormwater management within the Hoodsport RAC. A preliminary review of these potential funding sources suggests that multiple sources of funding will likely be needed; no single source of funding will likely be adequate by itself. Funding sources that are currently being considered include:

- **Formation of a Local Drainage/Stormwater Improvement District,** which would have an annual assessment usually based on assessed property value, or some other equitable means of establishing value and/or benefit to the various rate payers.
- **Real Estate Excise Tax (REET) Funding,** which currently amounts to about $750K per year for the County, and is currently being used to pay for a number of capital projects throughout the County. Securing periodic appropriations from REET funding for either capital or program needs may be available on an annual basis depending on other County project priorities.
- **Annual County Portion of State Sales Tax,** which has recently been raised from .08% to .09%; this will amount to about $450K per year for the County with the recent increase to 0.09 per cent.
- **Public Sector Funding,** such as grants and low interest loans from the State (Ecology or the Puget Sound Action Team) or federal government, including federal 319 Water Quality Grants, and the State Public Works Trust Fund and State Revolving Fund. While available, they potential funding sources are generally limited in duration and amount. They are also very competitive and have limitations regarding timing, applicability, reporting, and administrative costs.
- **Formation of a Local Stormwater Utility** throughout the Hoodsport RAC, where a monthly service fee is assessed to rate payers, often based on the amount of impervious area per parcel.
- **Continued collection and use of developer fees** to review and approve plans for new development and re-development, as well as conducting inspection and enforcement in the field.
- **System Development Charges (SDCs),** where any person moving into an upstream drainage area by the purchase of a home would be required to pay for a portion of the downstream collection, conveyance, detention, treatment, and outfall facilities that may be needed to support continued development within the drainage

basin. These would be assessed to the developer prior to the construction of the home during the County's permitting process.

- **SEPA Mitigation Funds,** which would be established on a per development basis as a project enters and is ultimately approved through the State SEPA review process. This has historically been used very successfully by the County for additional infrastructure that has directly resulted from new proposed development/ redevelopment.
- **Partnering with prospective developers,** land owners and other State agencies can be especially effective in establishing funding for larger regional drainage facilities. These are usually project-specific types of funding agreements based on use or contribution of stormwater runoff.
- **Other potential, but less likely sources of direct internal county funding,** include the General Fund, Road Fund, Park Fund and the Utility (Sewer) Fund; however, these funds are perhaps best used as potential sources for the *joint funding of projects* with common community purposes.

From this list of ten potential sources of funding, the most likely sources of new future funding for SWM within the Hoodsport RAC, in relative order of priority, are the following:

1. Forming a **Stormwater Utility** to support programmatic SWM activities.
2. Ensuring **developer and permit fees** are adequate to support development review, inspection, and enforcement services.
3. Using project related **SEPA mitigation** funding to support capital projects, especially those required by an increase in capacity within a regional conveyance system.
4. Establishing **System Development Charges** for new growth-related capital drainage projects; this is also another good source of funding for regional conveyance and/or treatment systems.
5. Annually appropriating a portion of Annual State **Sales Tax Returns**.
6. Securing periodic appropriations from **REET funding** for either capital or program needs.
7. Obtaining capital project funding, from **Future Road, Park, and/or Utility Projects,** with common objectives that include stormwater management opportunities.

Summary of New Potential Annual Revenue Sources

(Creation of Multiple Funding Sources to Realize Needed Revenue)

By optimizing the revenue potential of the proposed SWM funding mechanisms, approximately $110,000 - $130,000 may be realized on an annual basis to support the development and implementation of the Hoodsport RAC SWM Plan, as shown in

Table E-5. Approximately $67,000 in annual programmatic funding and $100,000 to $120,000 in annual capital funding could be realized from these sources.

Table E-5 Potential SWM Funding Sources and Estimated Annual Revenues			
Funding Source	Potential Estimated Annual Revenue		
	Amount	Programmatic	Capital
#1: Stormwater Utility	$27,000	X	Ok for either
#2: Developer and Permit Fees	$0	---	---
#3: SEPA Mitigation	$20,000	---	X
#4: System Development Charges	$12,000	---	X
#5: Sales Tax Returns	$20,000	X	Ok for either
#6: REET Funding	$20,000	X	Ok for either
#7: Project-Specific Funding	$10K - $30K	---	X
Annual Total:	~$110K-$130K	~$67K	~$100K-$120K

Adequacy of Potential Future Funding Mechanisms

(Matching Available Funding with the Revenue Needs of the Implementation Plan)

Assessment of Proposed Stormwater Management Funding Strategy

The proposed Hoodsport SWM Plan totaling averaging $140,000 over each of the next six years is a reasonable level of funding that matches the local drainage needs, as well as the County's and community's ability to pay.

As shown in Table E-5, estimated annual revenues from the above listed funding sources totals about $110K to $130K per year. With the annual capital appropriation of $70,000, the total average annual level of funding needed over the next six years is $140,000, and closely matches available resources, projected in above in Table E-5.

While the overall funding is about $10K-$20K short per year, it is suggested that there is adequate funding for the $70K needed per year for the programmatic SWM activities, and about $50K-$60K per year for capital projects. If the four capital projects are completed over an eight year period rather than a six year period, the proposed level of funding would be adequate to meet the needs of the proposed Hoodsport SWM Program and this Hoodsport SWM Plan. Alternatively, in order to build the proposed capital projects within the next six years, the County may choose to prioritize the $70K to the capital projects and appropriate the $50K to programmatic SWM activities.

(Note that this initial funding analysis has not estimated any annual increases in the amount of annual funding available from each of the seven proposed funding mechanisms. It is likely that future funding from

these sources will increase along with the increased annual funding needs of the Hoodsport SWM Program. Also, new funding mechanisms may present themselves as the SWM Program is implemented. For example, future grants would be an excellent way to augment these local funding mechanisms and should be actively and aggressively pursued. Additional funding analyses may be needed to substantiate and further refine this conceptual funding plan, as the various proposed funding mechanisms are developed, approved, and implemented.)

SWM Plan: Findings and Conclusion

The Hoodsport RAC area is a unique geographic, environmental, and cultural area of Mason County. This SWMP has been prepared to fix deficiencies within the drainage infrastructure, assess proposed land uses and develop guidelines for new development, and assist the County in addressing existing and future regulatory requirements. In the course of doing this a financial plan has been developed to facilitate implementation with the primary intent of protecting and maintaining the unique water quality and habitat functions of the region.

Consistent with the State's Growth Management Planning process, this Stormwater Management Plan for the Hoodsport Rural Activity Center demonstrates that here is adequate local funding to develop and maintain the needed drainage infrastructure and associated SWM Program as required to support continued economic development within the Hoodsport RAC.

Section 1—Introduction

1.1 Purpose

Mason County currently has a Stormwater Management (SWM) Program that does not address current federal, state, regional, and local stormwater related regulatory requirements. The purpose of this report is to present a Stormwater Management Plan (SWM Plan) for the Hoodsport Rural Activity Center (RAC) that is consistent with the County's SWM Program and the Puget Sound Water Quality Management Plan, begins to address required stormwater related program responsibilities, and prepares the County for the receipt of a Phase II NPDES Municipal Stormwater Permit. The Hoodsport RAC is located at the north end of Hood Canal along Highway 101, as shown in Figure 1-1, just east of the Skokomish River junction with Hood Canal.

1.2 Authorization

This study has been authorized by the Mason County Board of Commissioners and is being jointly implemented by the Departments of Public Works and Community Development. The Mason County Department of Health Services has also been invited to participate. The development of the Hoodsport RAC Stormwater Management Plan has been funded in part by a grant to Mason County by the Washington State Department of Ecology.

This study is part of a larger county-wide, stormwater and regulatory compliance planning effort, currently being undertaken by the County entitled: *Update of County's Stormwater Policies/Regulations and Development of Comprehensive Stormwater Management Plan for Mason County and the Communities of Belfair, Allyn, and Hoodsport*. This larger county-wide stormwater management planning program is expected to be completed in the summer of 2008 and includes the development of a comprehensive stormwater management program for the County and stormwater management plans for the areas of Allyn, Belfair, and Hoodsport. It includes the development and adoption of updated design criteria, policies, and funding mechanisms for stormwater management throughout the County.

1.3 Countywide Stormwater Mission Statement: Goals/Objectives

Listed below are excerpts from the Mason County Vision Statement, as documented in the Mason County Comprehensive Plan (2005). These statements document the County's intent to "protect the environment in a way which is compatible with the needs of a growing population."

Mason County Vision Statement

Mason County will remain a primarily rural county where residents will enjoy peace and quiet, privacy, natural views, and rural enterprise. Although rural character means different things to different people, aspects of it include: natural vistas, wildlife, and natural ecosystems; fewer restrictions and more privacy than

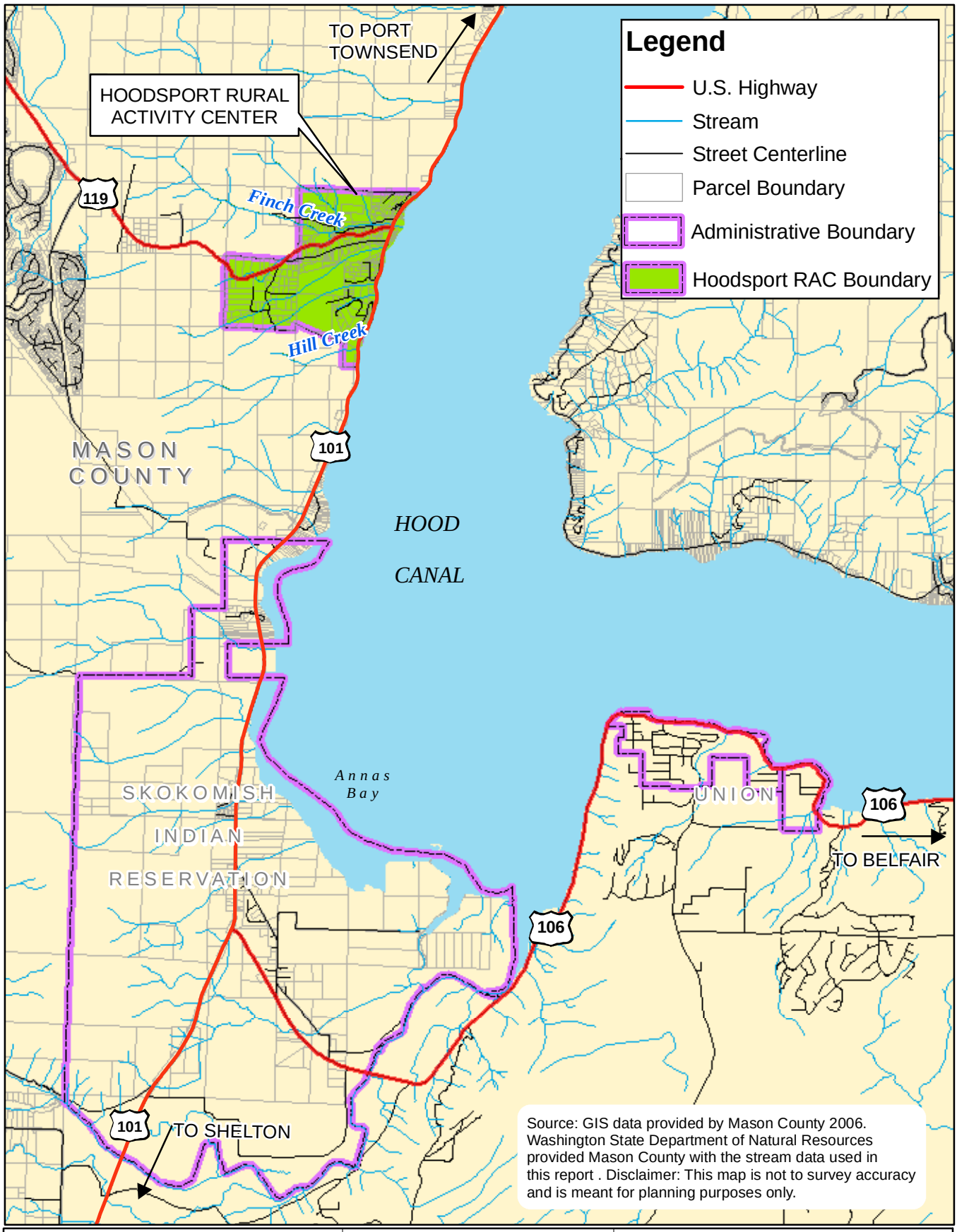

Figure 1-1
Location Map

Hoodsport Stormwater Management Plan

N

0 5,100 Feet

411 North 5th, P.O. Box 279
Shelton, Washington 98584
Phone: (360) 427-9670
Fax: (360) 427-8425

10230 NE Points Drive, Suite 400
Kirkland, Washington 98033
Phone: (425) 822-4446
Fax: (425) 827-9577

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in an urban area; the easy operation of resource based industries such as timber, mining and agriculture; and the close ties of family and community to the land.

The Rural Areas

Natural resources will continue to provide the foundation of the County's economy. Forestry, agriculture, aquaculture including shellfish and other fisheries industries, Christmas tree farming and mining will provide employment for County residents. The County's abundance of natural amenities including mountains, lakes, rivers, and wildlife will continue to support the county's thriving tourist industries, including Master Planned Resorts. The county's land use regulations will protect natural resource lands and industries against encroachment from incompatible, competing uses.

The Environment and Open Space

Mason County will protect the environment in a way which is compatible with the needs of a growing population. One focus will be watersheds and their water quality. The County will also conserve an open space network that will include wildlife habitat and corridors, greenways, estuaries, parks, trails and campgrounds. This system will help preserve the county's environment and the rural character, support the County's tourism industry, and meet the recreation needs of County residents.

1.4 Scope of the Hoodsport SWM Planning Project

The Hoodsport RAC SWM Plan has been prepared as part of a County-wide stormwater management strategy. The County-wide strategy aims to protect and enhance the County's most sensitive natural resources by addressing the SWM issues in the urban and urbanizing areas of the County.

The scope of this Stormwater Management Plan includes:

1. Characterization of existing stormwater conditions within the Hoodsport RAC.
2. The location and reduction of flooding and drainage related problems.
3. An estimate of future conditions based on continued development allowed by current zoning, as defined in the County's 2005 Comprehensive Plan; engineering analyses to determine the size and location of facilities needed to accommodate existing and future growth.
4. The identification and creation of development of design standards, consistent with the 2005 Ecology stormwater design manual for Western Washington.
5. The development of a comprehensive stormwater management plan that addresses regulatory requirements, protects habitat and water quality, and protects the health, safety, and property of its inhabitants, including projects and activities, costs, priorities, permitting, financing, and implementation considerations over a six and twenty year planning period.

1.5 Other Planning Efforts within the Region

In addition to comprehensive land use and stormwater management, several other planning and monitoring initiatives within the region have identified a number of stormwater related issues concerning water quality, habitat, and shellfish. A brief overview is provided below, with additional information provided in Section 8.

- Water quality monitoring is conducted by the Washington State Department of Ecology, Mason County Department of Health, and the Washington State Department of Health, Office of Shellfish Programs.

- Salmon recovery planning has been conducted by the Shared Strategy for Puget Sound and the Hood Canal Coordinating Council, in conjunction with the National Marine Fisheries Service (NMFS) of the National Oceanic and Atmospheric Administration (NOAA).

- The Watershed Planning Act (RCW 90.82) provides local governments a framework and resources for developing local solutions to watershed issues on a watershed basis. As a component of this process, the WRIA 16 Planning Unit was formed, and is comprised of a variety of public and non-governmental stakeholders in the Hood Canal region, including the Port of Hoodsport. The Planning Unit has prepared reports that assess water quality, quantity, fish habitat, and instream flow conditions within the WRIA 16 watershed (Golder Associates, 2002; EnviroVision, 2005) adjacent to Hood Canal. Furthermore, the Planning Unit has consolidated the WRIA 16 data and a series of recommendations into a broad-based and comprehensive watershed plan for WRIA 16 (WRIA 16 Planning Unit, 2006).

- Washington State has also developed the 2000 Puget Sound Water Quality Management Plan, which presents the State's long-term strategy for managing and protecting the Sound, and coordinating the roles and responsibilities of federal, state and local governments.

- The Puget Sound Partnership defines, coordinates and implements Washington State's environmental agenda for Puget Sound and has been providing leadership in the area of low impact development (LID) and regional watershed planning.

- The Hood Canal Coordinating Council (HCCC) was established in 1985, with the mission to improve regulatory decision making by providing a forum for discussion of regional water quality issues affecting Hood Canal.

- The Hood Canal Dissolved Oxygen Program (HCDOP) is a partnership of 28 organizations that conducts monitoring and analysis and develops potential corrective actions to address the low dissolved oxygen problem in Hood Canal.

- Gray & Osborne, Inc. has developed a Wastewater Facility Plan (Plan) for the community of Hoodsport, Mason County Washington. This Plan evaluates wastewater treatment and disposal alternatives for the Hoodsport RAC and develops cost estimates. The intent of this plan was to address the on-site treatment system problems identified in the Hood Canal Low Dissolved Oxygen Preliminary Assessment and Corrective Action (PACA) Plan. The PACA plan was developed through a collaborative and cooperative arrangement between the Puget Sound Action Team, the State's Partnership for Puget Sound, Mason County, and the council of governments within the Hood Canal watershed.

1.6 Regulatory Requirements

This stormwater management plan has been prepared to be consistent with the requirements set forth in the Ecology 2005 Stormwater Management Manual for Western Washington (Ecology 2005 Manual) and existing Mason County codes and regulations. These design criteria are also consistent with the 2000 Puget Sound Water Quality Management Plan and its 2007-2009 biennial work plan. Additional discussion of the design criteria used to develop the Hoodsport Stormwater Management Plan is presented in Section 5.

1.7 Report Content and Organization

The Hoodsport RAC Stormwater Management Plan is presented in a series of sections that generally follow the flow of work, culminating in the presentation of recommended capital projects and costs. The report is composed of the following ten sections:

Section 1—Introduction
Section 2—Characterization of the Hoodsport RAC
Section 3—Existing Stormwater Facilities
Section 4—Future Conditions
Section 5—Regulatory Criteria
Section 6—SWM Impacts, Analysis and Strategies
Section 7—SWM Plan: Capital Projects
Section 8—SWM Plan: Programmatic Elements and Regulatory Compliance
Section 9—Costs, Funding and Implementation
Section 10—Public Review and Approval

Section 2—Characterization of the Hoodsport RCA

2.1 Study Area

The Hoodsport RAC is one of three rural activity centers (RACs) identified within the Mason County GMA Plan. It contains about 605 acres and is located at the north end of Hoods Canal, as shown in Figure 2-1. The majority of the area is zoned for residential, with the vast majority of the area currently in an undeveloped state. The Hoodsport RAC is about 1.3 miles long north to south and averages about 1.2 miles wide east to west. Of this area, less than five percent is currently developed as commercial-industrial, with the entire RAC being less than about 15% developed.

The area is unique in that it is zoned primarily for residential within the uplands area, with a thin strip of commercial area located along Highway 101, directly adjacent to Hood Canal. All surface water runoff from the Hoodsport RAC flows directly into Hood Canal. Existing conditions relating to stormwater management within the Hoodsport RAC are described in the following paragraphs.

2.2 Topography and Drainage Subbasins

The majority of the land within the Hoodsport RAC, approximately 43-percent, drains to Finch Creek, which flows into Hood Canal via a narrow channel that discharges next to the State Fish Hatchery just on the southern side of State Highway 101. The Hoodsport RAC generally slopes from west to east, and is characterized by the Finch/Lilliwaup drainage basin that conveys surface water runoff from west to east, as shown in Figure 2-1. Slopes range from relatively flat (0 to 5 percent) in the lower creek valleys and low lying areas and beaches adjacent to Hood Canal, to over 30-40 percent in the steeper portions of the upstream drainage basins and the bluffs along the shoreline.

A total of nine drainage subbasins, identified as Subbasins 10 through 90, have been delineated within the Hoodsport RAC. These are shown in Figure 2-1, together with principal directions of flow and contours. Subbasin delineations are based on County-provided GIS topography, site visit observations, and discussions with County staff.

Significance of Local Soils to Surface Water Management:
The challenge of continued development within the Hoodsport RAC will be the steep slopes and the almost uniform presence of soils with limited infiltration capacity. Due to these unique natural conditions, it will be important to limit future development to lower densities and require the preservation of 65% or more of the native vegetation on site, along with the use of numerous types of on-site low impact development (LID) techniques.

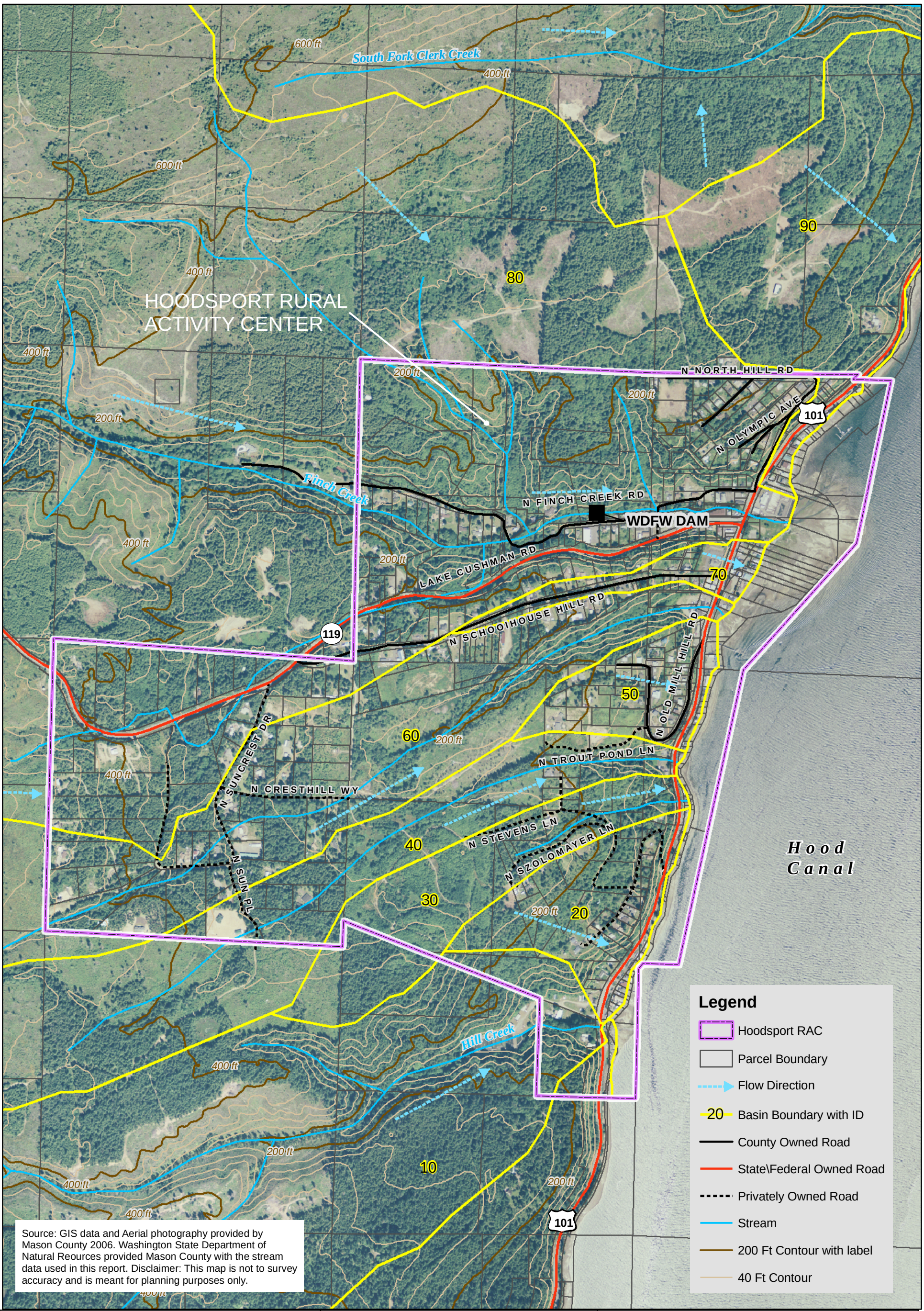

Figure 2-1
Existing Drainage Basin Boundaries

Hoodsport Stormwater Management Plan

411 North 5th, P.O. Box 279
Shelton, Washington 98584
Phone: (360) 427-9670
Fax: (360) 427-8425

10230 NE Points Drive
Kirkland, Washington 98033
Phone: (425) 822-4446
Fax: (425) 827-9577

0 500 1,000 2,000 Feet

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2.3 Existing Drainage Basin Characteristics Summary

The existing characteristics of the Hoodsport RAC subbasins are summarized in Tables 2-1 and 2-2. Table 2-1 includes subbasin areas, subbasin discharge location, and primary and secondary hydrologic soil groups. Table 2-2 characterizes subbasins by topographic slope information. This information has been used in part to develop stormwater management strategies for each subbasin, as presented in Section 6.

Table 2-1 Hoodsport RAC Subbasin Characteristics

Subbasin ID #	Total Area	Area Within RAC	Discharge Location	Hydrologic Soil Group			
				Primary		Secondary	
	(ac)	(ac)		Group	(%)	Group	(%)
5	4.5	4.5	Hood Canal	C	100%	---	---
10	743.3	16.8	Hill Creek	C	82%	B	18%
20	42.5	42.5	Hood Canal	C	89%	B	10%
30	58.1	41.6	Creek #1	C	100%	---	---
40	216.7	56.9	Creek #2	C	100%	---	---
50	28.9	28.9	Hood Canal	C	99%	---	---
60	277.2	133.9	Creek #3	C	100%	---	---
70	15.5	15.5	Hood Canal	C	94%	B	6%
80	2248.2	257.8	Finch Creek	C	81%	B	13%
90	141.1	7.0	Hood Canal	C	75%	A	25%
Totals*	3776.0	605.3		C	90%	B	8%

*The remaining 2% of the area is made up of hydrologic Soil Groups A and D.

Table 2-2 Subbasin Slope Characteristics							
Subbasin ID #	Within RAC	Slope <15%		15%≤ Slope ≤30%		Slope ≥ 30%	
	(ac)	(ac)	(%)	(ac)	(%)	(ac)	(%)
5	4.5	1.9	42%	0.6	14%	2.0	44%
10	16.8	7.3	43%	2.2	13%	7.4	44%
20	42.5	20.5	48%	10.8	25%	11.2	26%
30	41.6	24.4	59%	11.9	29%	5.2	13%
40	56.9	37.2	65%	13.6	24%	6.1	11%
50	28.9	15.6	54%	8.6	30%	4.7	16%
60	133.9	86.6	65%	24.4	18%	22.9	17%
70	15.5	11.5	75%	2.7	18%	1.2	8%
80	257.8	107.4	42%	51.3	20%	99.1	38%
90	7.0	3.4	49%	1.1	16%	2.5	36%
Totals	605.3	315.8	52.2%	127.2	21.0%	162.3	26.8%

Note: Totals may not equal 100% due to rounding.

2.4 Soils

The soils within the Hoodsport RAC are generally relatively shallow, fine grained in nature and allow only a minimum amount of infiltration. The soils of the RAC, as mapped by the Natural Resources Conservation Service (NRCS) (formerly the U.S. Soil Conservation Service (SCS)), are shown in Figure 2-2. The soils groups, shown in Figure 2-2, are generally classified based on their ability to infiltrate surface water runoff, and are listed in Table 2-3. They are dominated by Group C soils, which provide little infiltration.

Map Unit Symbol	Soil Description
Cc	Cloquallum silt loam, 5 to 15 percent slopes
Gh	Grove gravelly sandy loam, 0 to 5 percent slopes
Gk	Grove gravelly sandy loam, 5 to 15 percent slopes
Hd	Hoodsport gravelly sandy loam, 5 to 15 percent slopes
He	Hoodsport gravelly sandy loam, 15 to 30 percent slopes
Hf	Hoodsport gravelly sandy loam, 30 to 45 percent slopes
Jd	Juno sandy loam, 0 to 3 percent slopes
Ra	Riverwash, 0 to 3 percent slopes
Tb	Tanwax peat, 0 to 2 percent slopes

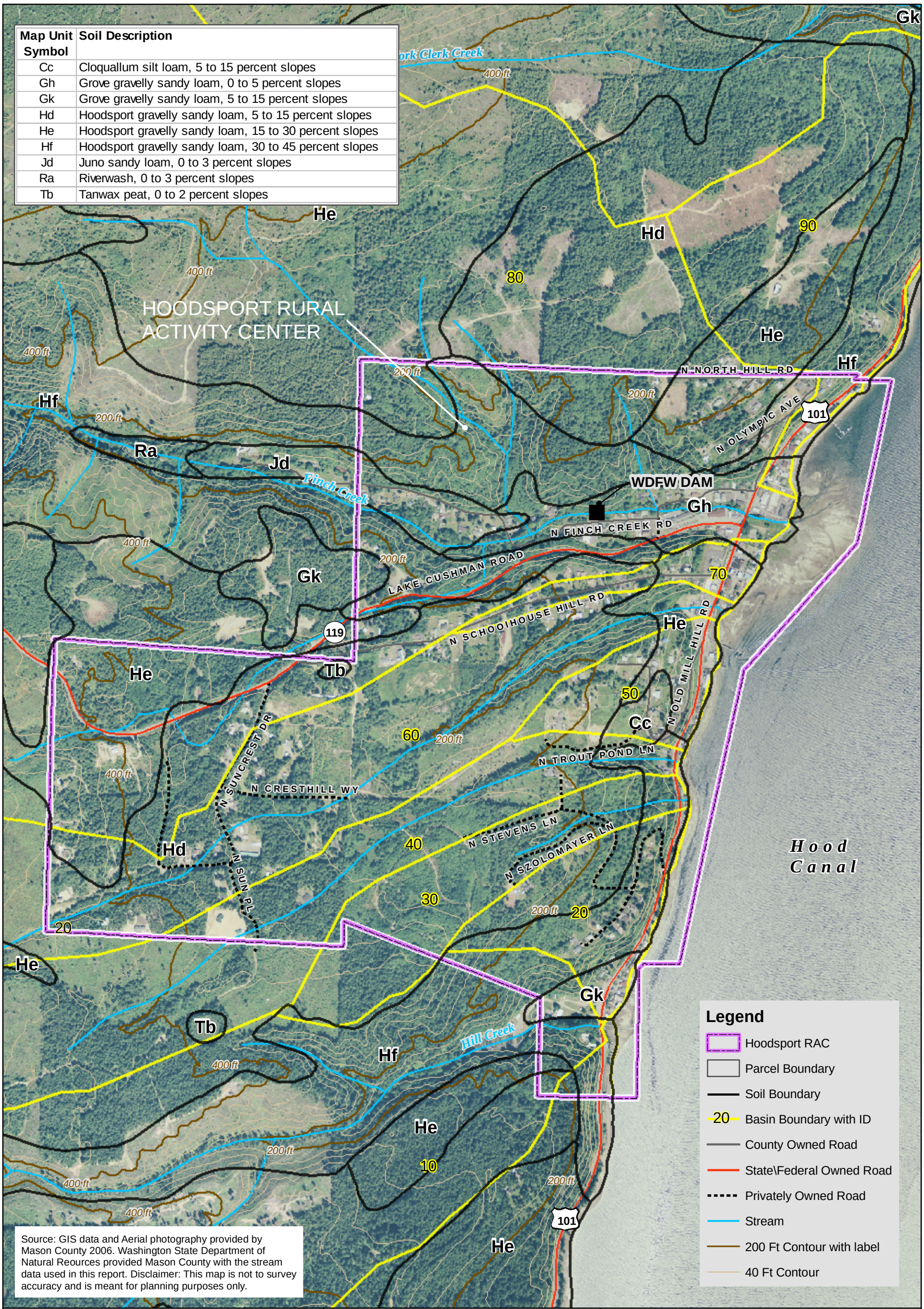

Figure 2-2
Site Soils

Hoodsport Stormwater Management Plan

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0 500 1,000 2,000 Feet

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Table 2-3 Hydrologic Soil Groups			
Soil Group	Infiltration Characteristic	Area Within RAC (ac)	Percent of RAC area (%)
A	High infiltration, low runoff, as for deep sand or loess, aggregated silts	15 acres	2%
B	Moderate infiltration, as for moderately coarse-textured soils such as sandy loam	42 acres	8%
C	Slow infiltration, as for fine-textured soil such as clay loam, shallow sandy loam, soils low in organic content	547 acres	90%
D	Very slow infiltration, such as swelling and plastic clay-pan	< 1 acre	< 1%

The distribution of soils within the RAC by their hydrologic soil group is shown in Figure 2-3. The RAC is made up of almost entirely Group C soils, with minor areas of Group A, Group B, and Group D soils. Group A and B soils, which are located in the lower, flatter areas, generally promote the infiltration of runoff. In these areas, infiltration would be a preferred method of stormwater disposal.

Significance of Local Soils to Surface Water Management:
Group C soils, which cover almost the entire study area, particularly the more steeply sloped upland areas, have limited infiltration capacity. As a result, constructed stormwater facilities will be needed to support increased development in these areas, and eventually a regional conveyance system to safely convey peak runoff may be needed to convey excess surface water flows directly to Hood Canal.

2.5 Land Use

The majority of land within the Hoodsport RAC is currently zoned as rural residential (RR2.5) which allows one dwelling unit per two and one-half acres (see Title 17 Zoning of the Mason County Code for a more detailed explanation of the zoning). Small amounts of the RAC are zoned for rural commercial (RR3), rural multi-family (RMF), and rural tourist-campground (RT). As a result of this zoning, the Hoodsport RAC consists primarily of low-density residential, vacant/rural, and forested areas with a small commercial area along State Highway 101.

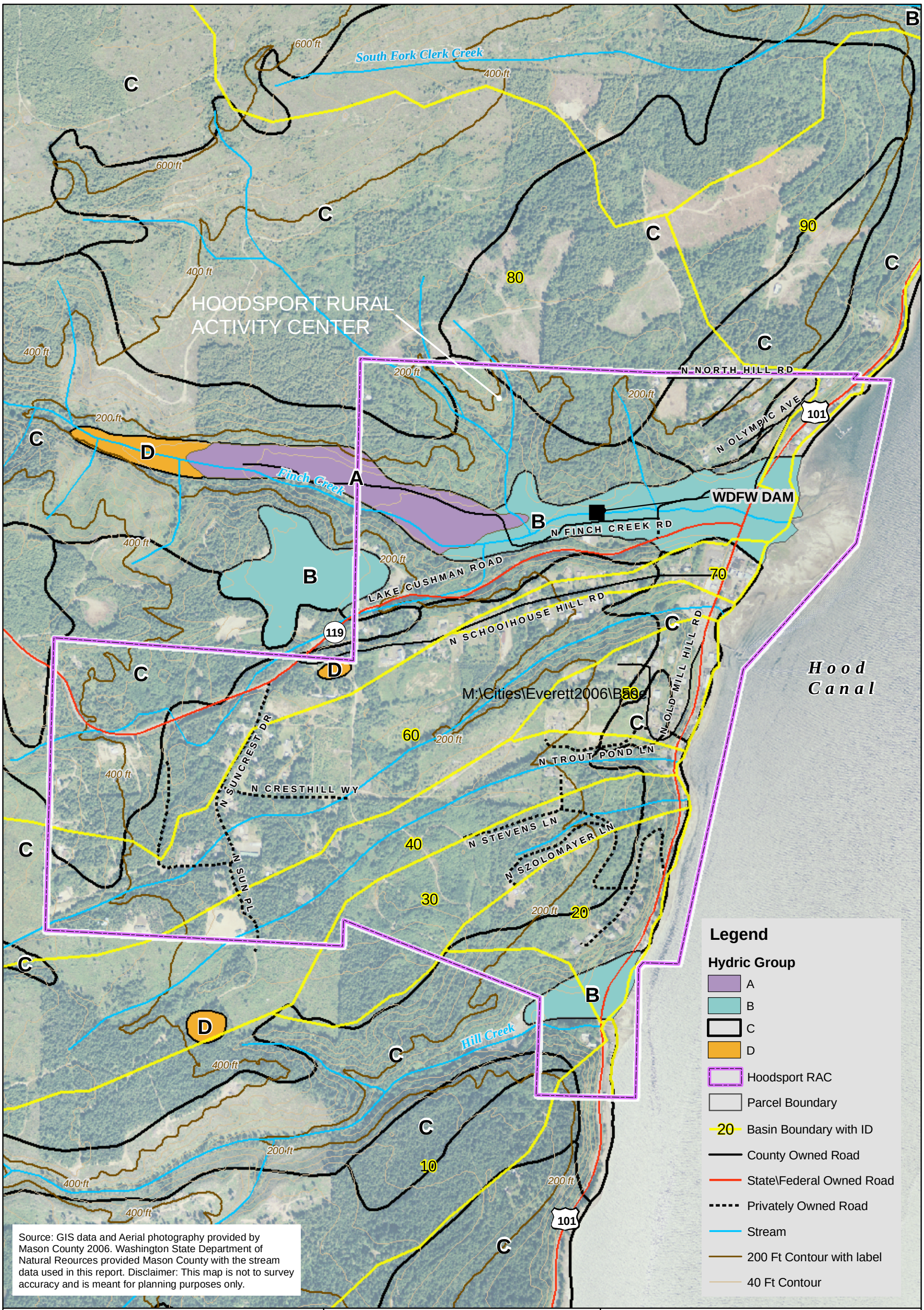

Figure 2-3
Hydric Group

Hoodsport Stormwater Management Plan

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The Wastewater Facility Plan prepared for the Hoodsport RAC in 2007 recorded 258 residential housing units in the Hoodsport RAC; and estimated a population within the RAC of 642 individuals (in 2005; estimate also includes seasonal residents). A small amount of commercial land use is located within the Hoodsport RAC and is concentrated principally along Highway 101 and SR 119, near Highway 101. According to the Wastewater Facility Plan, approximately 38 businesses are located in the RAC, with a small amount of industrial land use located along Highway 101 near Hill Creek.

2.6 Hydrology

The Hoodsport area average annual precipitation is about 90 inches per year based on the Cushman Powerhouse 2 precipitation stations. These are the closest rain gauges to the Hoodsport area. The 90 inch average is based on the period of record from July 1973 through June 2007, as reported by the Western Regional Climate Center. Average monthly precipitation from November through January exceeds 14 inches per month. The lowest rainfall month is July, with an average monthly rainfall of about 1.1 inches.

2.7 Sensitive or Critical Areas

Sensitive areas within the RAC (as provided by Mason County) are delineated in Figure 2-4. These sensitive/critical areas have been identified and defined in Mason County Code 8.40.020 and Chapter 17 (of Mason County Resource Ordinance 77-93) and include frequently flooded areas, critical aquifer recharge areas, wetlands, geologic hazards, which include landslide, seismic and erosion hazards, and fish and wildlife habitat conservation areas. (Refer to Mason County Resource Ordinance Adopted 12-27-06 for information on Geological Hazardous Areas.)

Frequently Flooded Areas: Frequently flooded areas are defined by Mason County as areas occurring within the 100-year floodplain, as defined by the Federal Emergency Management Agency (FEMA) and the Washington State Department of Ecology's Coastal Zone Atlas. Within the Hoodsport RAC, frequently flooded areas are limited and are primarily associated with the lower reaches of Finch Creek and the marine shoreline along Hood Canal. Development and land uses in frequently flooded areas are subject to provisions and requirements outlined in Chapter 17 of the Mason County Code. Note that during the December 2-4, 2007 storm event, the bridge over Finch Creek above the Highway 101 bridge was washed away.

Critical Aquifer Recharge Areas: Aquifer recharge areas are defined by Mason County as "those areas which are determined to have an important recharging effect on aquifers used as a

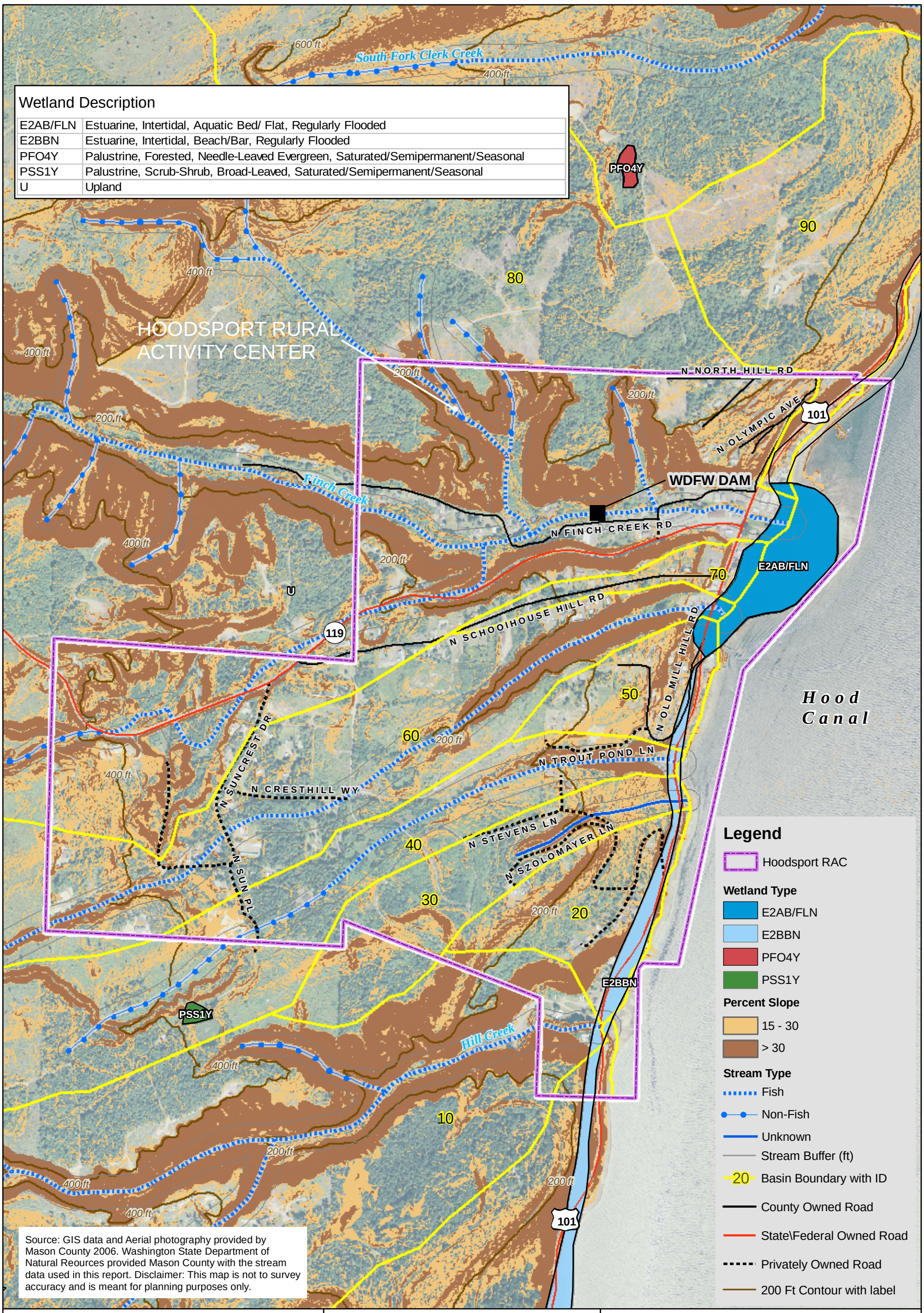

Figure 2-4
Sensitive Areas
Hoodsport Stormwater Management Plan

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source for potable water and are vulnerable to contamination from recharge (MCC, 17.01.080)." This classification of aquifer recharge areas is based on their potential for use as potable groundwater, and their susceptibility to contamination, ranging from Category I (highly susceptible) to Category IV (low susceptibility). Note that no critical aquifer recharge areas have been identified within the Hoodsport RAC.

Wetlands: Wetlands are also present in the RAC, based on data from the National Wetlands Inventory (NWI) database. These consist of estuarine, inter-tidal, regularly flooded wetlands and are located along the shoreline (Wetland data provided by Mason County.), as shown in Figure 2-4. No other NWI-identified wetlands are present within the Hoodsport RAC; however, numerous other, unmapped wetlands are likely present throughout the RAC. These are likely to consist of smaller wetlands associated with springs and hillside seeps, riparian habitat, and topographical depressions across the landscape.

Details concerning wetland delineation and categorization are provided in Mason County Code 17.01.070, and associated buffer widths, development and land use regulations, and mitigation approaches are likewise provided in that chapter.

Geologic Hazards: Geologic hazards, per Mason County Code (MCC) Chapter 17, consist of three hazard subtypes: landslide hazards, seismic hazards, and erosion hazards.

Landslide hazard areas are defined as the following per MCC:

- Areas with any indications of earth movement such as debris slide earthflows, slumps and rock falls.
- Areas with artificial over-steepened or un-engineered slopes, i.e. cuts or fills.
- Areas with slopes containing soft or potentially liquefiable soils.
- Areas over-steepened or otherwise unstable as a result of stream incision, stream bank erosion, and undercutting by wave action.
- Slopes greater than 15-percent (8.5 degrees) and having the following:
    - Hillsides intersecting geologic contacts with a relatively permeable sediment overlying a relatively impermeable sediment or bedrock (e.g. sand overlying clay); and
    - Springs or groundwater seepage.
- Any area with a slope of forty percent or steeper and with a vertical relief of ten or more feet except areas composed of consolidated rock. A slope is delineated by establishing its toe and top and measured by averaging the inclination over at least ten feet of vertical relief.

Landslide hazard areas within the Hoodsport RAC with slopes greater than 15% and having either permeable soils underlain with impermeable sediment or a prevalence of springs/seeps, include portions of the steep slopes of Finch Creek. Provisions regulating the designation of landslide hazard areas, their development and buffers, and associated requirements for geotechnical reports may be found in MCC 17.01.100.

Seismic hazard areas are prone to severe disturbance from seismic events, and per the MCC include the following:

- Areas with geologic faults;
- Deep road fills and areas of poorly compacted artificial fill;
- Areas with artificially steepened slopes (i.e. old gravel pits);
- Postglacial stream, lake or beach sediments;
- River deltas;
- Areas designated as potential Landslide Hazard Areas;
- Bluff areas; and
- Areas underlain by potentially liquefiable soils

According to the 2007 Hoodsport Wastewater Plan, the areas within the Hoodsport RAC designated as seismic hazard areas are associated with the interface between shoreline and Hood Canal, along Highway 101 from Potlatch to Lilliwaup. Provisions regulating the designation of seismic hazard areas and their development may be found in MCC 17.01.100.

Erosion hazard areas are defined as areas that are susceptible to severe erosion as a result of disturbance. Soils that are relatively unconsolidated and/or are associated with steep slopes may meet the criteria for being considered erosions hazard areas. Within the Hoodsport RAC, erosion hazard areas are associated with the steep, relatively unconsolidated slopes along Finch Creek. Development standards for erosion hazard areas are outlined in MCC 17.01.104.

Fish and Wildlife Habitat Conservation Areas (FWHCAs): According to Mason County Code, FWHCAs are defined as areas managed "for maintaining species in suitable habitats within their natural geographic distribution so that isolated populations are not created (MCC 17.01.110)."

Areas designated as FWHCAs in Mason County include the following habitat types and categories:

- Commercial and recreational shellfish areas.
- Kelp and eelgrass beds; herring, sand lance, and smelt spawning areas.

- Naturally occurring lakes and ponds under twenty acres and their submerged aquatic beds that provide fish or wildlife habitat.
- Streams.
- Saltwater shorelines, and lakes 20 acres and greater in surface area.
- Lakes, ponds, streams, and rivers planted with game fish by a governmental or tribal entity.
- State Department of Natural Resources natural area preserves and natural resource conservation areas.
- Areas with which Federal or State endangered, threatened and sensitive species of fish and wildlife have a primary association. Protection of species habitats is determined by the State or Federal listing, and their actual presence near the site subject to review.
- Other areas that contain habitats and species of local importance (which include juvenile salmon migration areas). Species of local importance may include, but are not limited to, Washington State Candidate and Monitor species.

Details concerning protection and management of FWHCAs, including buffer establishment, allowable activities, stewardship activities, permitting, and habitat management plans are found in MCC 17.01.110.

Marine habitat FWHCAs (commercial/recreational shellfish areas, kelp and eelgrass beds, saltwater shorelines, etc.) are associated with the shoreline and shallow tidal areas to the east of the Hoodsport RCA. The following Section 2.8 provides detail on one type of FHWCA mapped within the Hoodsport RCA: stream habitat—specifically, fish-bearing stream habitat.

2.8 Fish Bearing Creeks

There are five creeks located within the RAC, as graphically shown in Figure 2-4, including Finch and Hill Creeks, along with three unnamed smaller streams. The largest and most productive from both a flow and a fish perspective is Finch Creek, which has the largest contributing drainage area.

As shown in Figure 2-4, the lower reaches and much of the main stem of all five creeks have been classified as fish bearing by the WDNR. Only the upper reaches and very small tributaries have been classified as Non-Fish creeks.

The creek locations are from Mason County's GIS database which uses the Washington State Department of Natural Resources (WDNR) stream location data. The permanent water type classification associated with these streams is also taken from the WDNR. The

classification definitions are provided below. Note that since the non-fish RAC streams have not been differentiated as "Np" or "Ns" by WDNR, "N" has been used for non-fish creeks.

- Type "F"—Fish-bearing or containing habitat suitable for fish
- Type "S"—Waterbodies or streams designated as Shorelines of the State
- Type "Np"—Non-Fish-bearing; Perennial
- Type "Ns"—Non-Fish-bearing; Seasonal
- Letter "N"—Non-Fish-bearing
- Letter "U"—Unknown, untyped

Washington State Department of Fish and Wildlife (WDFW) operate two fish hatcheries within the Hoodsport RAC: a salmon hatchery at the mouth of Finch Creek, east of Highway 101, and a trout hatchery on Hill Creek west of Highway 101. Currently, Finch Creek supports populations of spawning Coho salmon, fall run Chinook salmon, fall run Chum salmon, pink salmon, and winter steelhead runs, as well as sea-run cutthroat. The upper reaches of Finch Creek are generally inaccessible to anadromous salmonids, due to the presence of the WDFW-operated diversion dam exists approximately 0.25 miles upstream of Hood Canal.

Each of the five creeks that flow through the Hoodsport RAC has a stream buffer (150-feet by ordinance on either side of the creek at most locations) and steep slopes that are within the stream buffer and extend outside of the buffers; these sensitive areas will limit development adjacent to streams per MCC 17.01.110.

2.9 Receiving Water Quality

The Hoodsport RAC is located in Ecology's Water Resources Inventory Area (WRIA) 16, Skokomish-Dosewallips. The receiving water for Hoodsport RAC runoff is Hood Canal. Runoff reaches Hood Canal directly or via Finch Creek, Hill Creek, or one of the other three unnamed creeks within the RAC which discharge to Hood Canal.

DOE considers Finch Creek impaired due to fecal coliform bacterial loading in the system. Impaired water listings from Ecology's 2002/2004 303(d) list within WRIA 16 include a Category 5 listing for fecal coliform contamination in the lower reaches of Finch Creek. Category 5 listings denote that the water body is impaired for the parameter in question, and that the water body does not have a Total Maximum Daily Load (TMDL) or other adequate pollution control plan in place to address the contamination. Fecal coliform contamination within Finch Creek is likely due to a combination of failing on-site sewage (septic) systems

and animal waste, with septic system contribution providing the primary input of contamination.

Areas of the Hood Canal, just to the north of the Hoodsport RAC, are listed by DOE as Category 5 for low dissolved oxygen (DO) concentrations. Other portions of the Hood Canal to the south and east have likewise been given a Category 5 listing by DOE for low DO concentrations. DOE staff generally attributes low DO concentrations in these areas of Hood Canal to man-made (i.e. anthropogenic sources).

WDFW considers shellfish in this area to be unfit for human consumption at any time. The Washington State Department of Health (DOH) has prohibited shellfish harvesting in the marine waters of the Hood Canal within the immediate vicinity of Hoodsport and the Hoodsport Hatchery (Hood Canal Area #6), due to fecal coliform contamination. These restrictions have been in place since the late 1980's, and remain in place today.

Section 3—Existing Stormwater Facilities

3.1 Introduction

The Hoodsport RAC relies heavily on the use of its natural drainage systems to collect, convey, treat, and infiltrate surface water runoff. These natural facilities have been augmented by a series of man-made systems consisting of ponds, ditches, culverts, outfalls, and conveyance pipes. As the RAC continues to develop, it will be critical to retain these natural areas and continue to integrate new man made facilities with these natural systems in order to maintain the hydrology and hydraulics of the region and support habitat areas.

3.2 Existing Stormwater Facilities

Stormwater facilities within the Hoodsport RAC, consist of a series of drainage facilities owned and operated by three different agencies. Mason County constructs and maintains the public drainage facilities, consisting primarily of ditches and culverts, within County road right-of-ways. The Washington State Department of Transportation also builds and maintains a system of drainage ditches and culverts that keep surface water off of state highways, while the Washington State Department of Fish Wildlife has modified the natural drainage system of Finch Creek to provide clean, clear, cool water to support their local hatchery. At the present time, there are no County, WSDOT, WSDFW or private stormwater treatment and few detention/retention facilities located in the Hoodsport RAC.

County Drainage Facilities

The County drainage system in the Hoodsport RAC consists of a series of road side ditches and culverts that collect and convey runoff from about four miles of County roads to local creeks and Hood Canal. Most of these drainages are along:

- N Finch Creek Road,
- N Schoolhouse Hill Road,
- N North Hill Road,
- N Olympic Road, and
- N Old Mill Hill Road.

Within these roadside systems, County culverts typically range from 12 to 18 inches in diameter, as shown in the culvert inventory data provided in Appendix A.

In addition to roadside ditch/culvert conveyances, the County has installed a drainage system to collect surface water resulting from spring activity along the north side of Finch Creek Road at the base of the hill between Highway 101 and the bridge over Finch Creek. Installed approximately four or five years ago, this drainage system includes a series of catch basins connected by 12-inch diameter perforated pipes in drain rock with outfalls to Finch

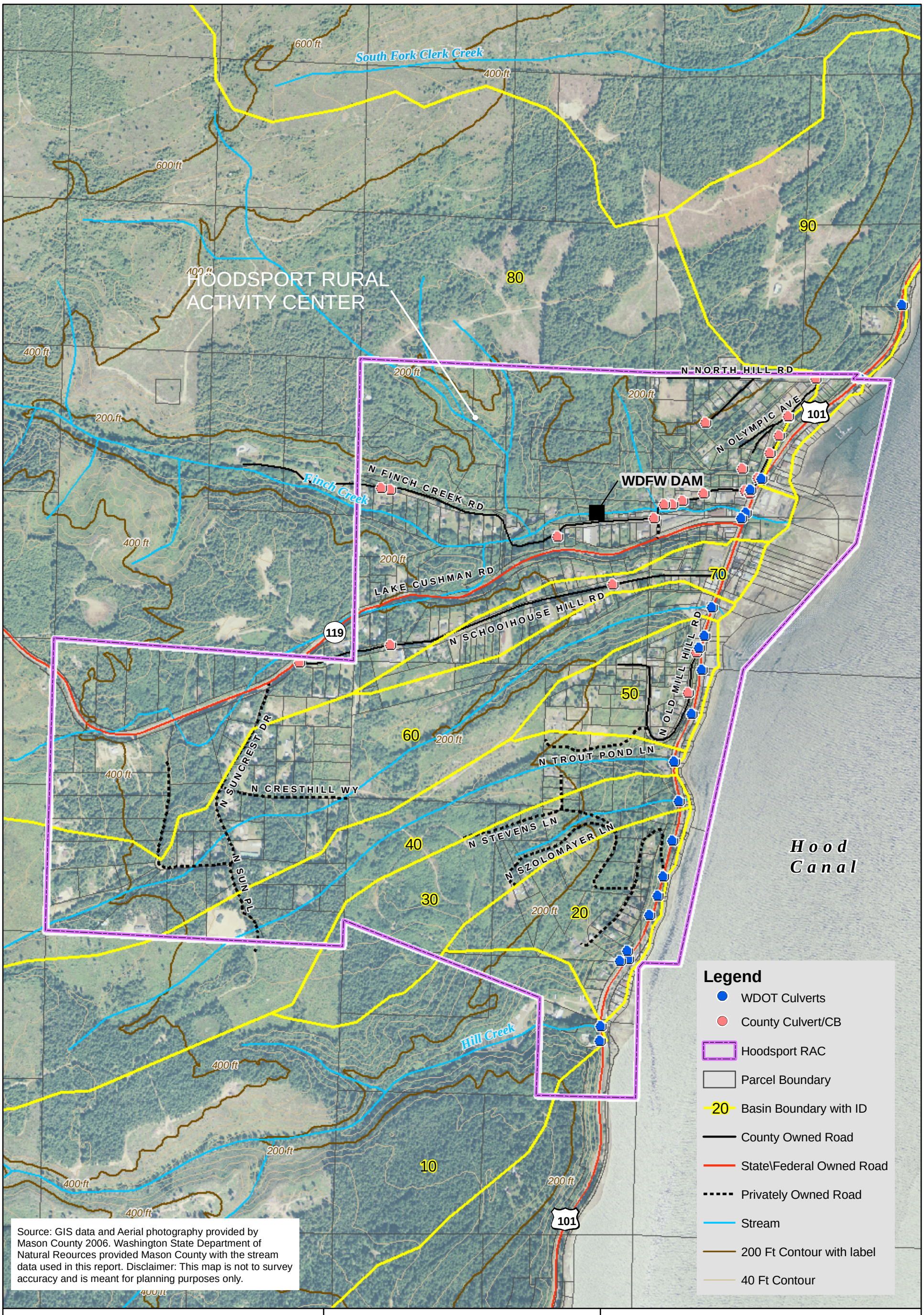
Creek. These drainage improvements address both the surface and subsurface water problems that were historically plaguing this area. County identified culvert and catchbasin locations are shown in Figure 3-1.

WSDOT Drainage Facilities

The Washington State Department of Transportation (WSDOT) also maintains a system of ditches and culverts four about four miles along Highway 101 and SR 119 (N Lake Cushman Road) within the Hoodsport RAC. Like the County, WSDOT culverts typically range from 12 to 18 inches in diameter, except where larger drainage pipes are needed at the crossings at Finch Creek and Hill Creek/Highway 101. WSDOT also maintains the associated bridge where Highway 101 crosses Finch Creek and the 3' x 3' box culvert where Highway 101 crosses Hill Creek. WSDOT culverts along Highway 101 are shown in Figure 3-1, with a culvert inventory data provided in Appendix A.

WDFW Drainage Facilities

The Hoodsport WDFW salmon hatchery, receives water diverted from Finch Creek via an intake structure diversion dam, located approximately one-quarter mile upstream from the hatchery. The intake structure provides water for the hatchery and helps reduce flooding in the lower reach of Finch Creek during smaller storm events.



Source: GIS data and Aerial photography provided by Mason County 2006. Washington State Department of Natural Reources provided Mason County with the stream data used in this report. Disclaimer: This map is not to survey accuracy and is meant for planning purposes only.

Figure 3-1
Existing Conditions
Hoodsport Stormwater Management Plan

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3.3 Local Drainage Issues and Deficiencies

Existing localized problem areas were defined from a variety of sources including, County staff, WSDOT maintenance staff, and public input from the comments received via a stormwater questionnaire distributed throughout the Hoodsport postal service area.

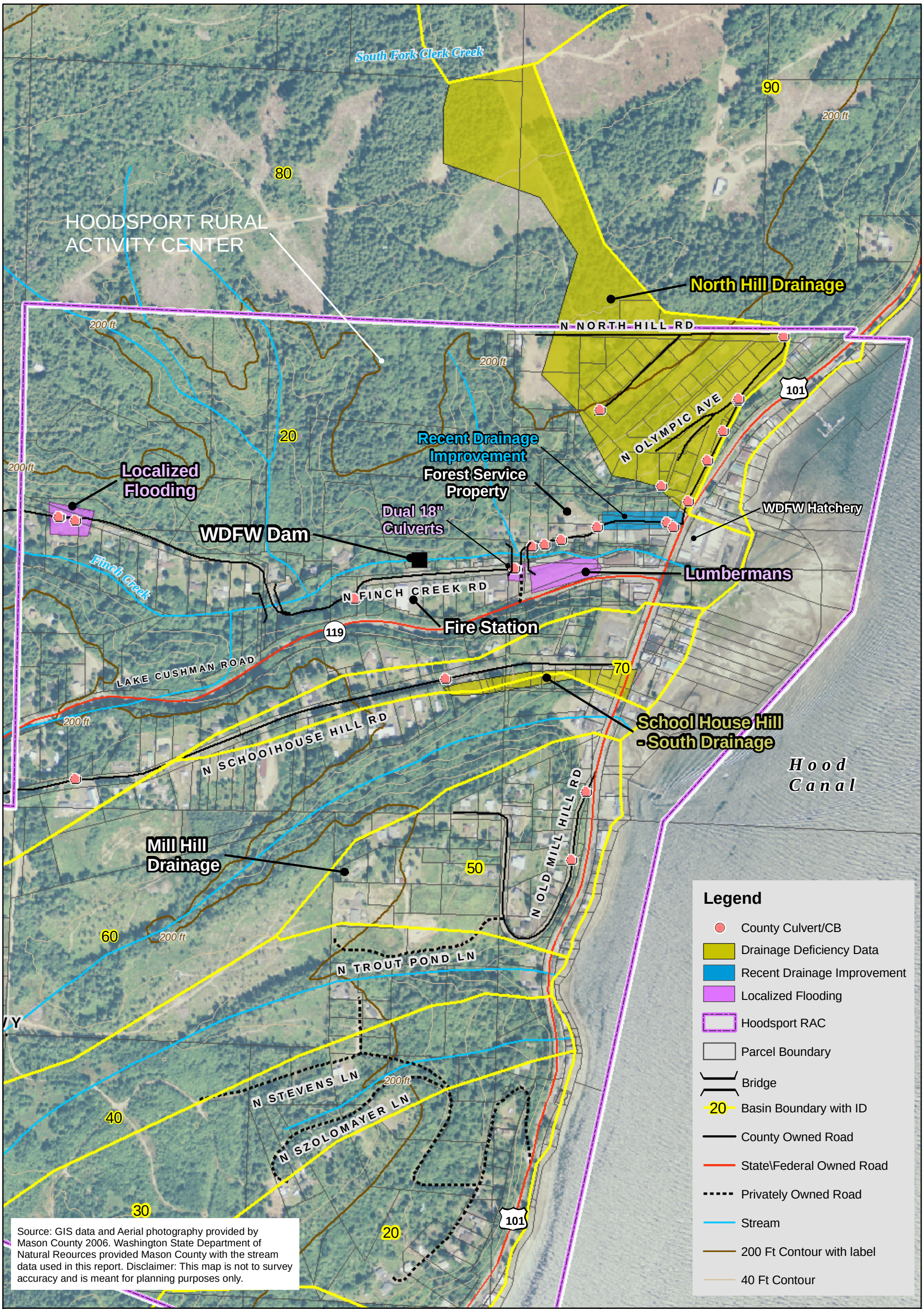
County Identified Drainage Deficiencies

Citizen drainage complaints submitted to the County are routinely recorded on "green sheets" and stored within County's Road maintenance files. However, within the Hoodsport area, no citizen complaints were recorded. So drainage deficiency areas were determined primarily from interviews with County Staff [personal communication with Allan Eaton, Assistant Road Operation and Maintenance Manager]. These interview were supplemented by the use of a special drainage questionnaire that was mailed out to each resident, as described in Section 3.4. Those reported by the County road maintenance crew are shown in Figure 3-2 and described below.

#1 - Finch Creek

Erosion/Sedimentation Maintenance of Hatchery Intake by WSDFW

Finch Creek flows full during most storm events, but normally does not flood Finch Creek Road, Highway 101, or other nearby roads. When it flows full, it is highly erosive and carrying and depositing large amounts of sediment within the lower reaches of the stream, especially within the channel adjacent to the WSDFW hatchery just before the stream discharges into Hood Canal. To stop bank erosion that was threatening a nearby home, the County has installed some rock armoring along the north bank of the creek under the bridge.



Source: GIS data and Aerial photography provided by Mason County 2006. Washington State Department of Natural Reources provided Mason County with the stream data used in this report. Disclaimer: This map is not to survey accuracy and is meant for planning purposes only.

Figure 3-2
Drainage Deficiency Map

Hoodsport Stormwater Management Plan

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0 300 600 1,200 Feet

K:/project/30700/30784/GIS/mxds/Hoodsport/Figures/DrainageDeficiencyMap3.mxd

Finch Creek requires routine maintenance following major storm events, but generally does overflow and create local damage property. This maintenance usually takes the form of debris and sediment removal needed to protect the dam structure and maintain the diversion to the Hoodsport Salmon Hatchery. WDFW hatchery personnel routinely remove this sediment and debris that deposits at the intake structure.

#2 - Finch Creek Road

Most Systems Adequate with Some Localized Flooding During Large Storms

There is spring activity along the north side of Finch Creek Road at the base of the hill between Highway 101 and the bridge over Finch Creek. Approximately four or five years ago, Mason County installed a drainage system to collect this water and discharge it into Finch Creek. The drainage system includes a series of catch basins connected by 12-inch diameter perforated pipe in drain rock with outfalls to Finch Creek. The drainage improvement addressed both the surface and subsurface water that was collecting in this area.

At the Forest service property, there is a storm drainage system on the west side of the building comprised of French drains, three catch basins, and three culverts that discharge to Finch Creek. There is also a drainage system on the east side of the building. There are no reported problems at this location, but the County's drainage inventory should be updated to include this system.

Localized flooding can occur near the west end of Finch Creek road where two culverts cross under the road from north to south, then drain through a culvert system to Finch Creek. The capacity of this system is exceeded during larger storm events and can cause localized drainage problems.

#3 - Double, 18-inch Diameter Culverts

Localized Flooding if SR 119 System Is Not Adequately Maintained by WSDOT

Flooding on Finch Creek Road has been reported in the vicinity of where two, eighteen inch culverts cross under Finch Creek Road, near Lumberman's and the bridge. According to County staff, flooding does not usually occur here unless the storm drainage system along SR 119 (N Lake Cushman Road) becomes plugged with debris. When the SR 119 system becomes restricted, stormwater runs down SR 119, and crosses under SR 119 towards the two, eighteen inch culverts. This stormwater from SR119 can result in flooding at the ditch between SR 119, along Finch Creek Road, and within the Lumberman parking lot. This drainage deficiency is more of a routine maintenance issue than a capacity issue since flooding only occurs when the SR 119 system becomes plugged.

Culverts at SR 119

#4 - North Hill

Small Undersized System along Baskin Lane

During the larger rain events, drainage from the upper areas of North Hill exceeds the capacity of the 12-inch diameter Baskin Lane drainage system. When the system capacity is exceeded, stormwater runs down Basin Lane, and North Hill Road, then flows over the hillside down towards homes along Finch Creek Road, where soils are already saturated by spring activity. The 12-inch drainage system is likely undersized for the amount of development that has taken place within the drainage subbasin. Although there were no reported problems during the winter of 2006-2007, but there have been drainage problems here during several of the past several winters.

#5 - Old Mill Hill

Large Amount of Runoff into Canyon But No Major Flooding Problems

There is a large amount of runoff from the Old Mill Hill area, according to the County's maintenance crew, however the existing canyon system seems to be able to handle it. The lower portion of the road (i.e. the west end of the road) has catch basins that collect runoff and route water down the hill towards Highway 101. There are no reported problems in this drainage area.

#6 - School House Road

Localized System Has Limited Capacity but No Major Flooding Problems

Runoff from the west, along School House Road, crosses the road from south to north via a culvert located near the Quest telephone building; there are no reported problems with this system. Drainage from that culvert and areas to the east, collect along the north side of the road and enter the WSDOT drainage system. Stormwater from the south side of the road does not have a collection system and can flow onto adjacent properties.

#7 - Future Road Improvements

County Currently Considering Local LID Projects to Treat Road/Development Runoff

Roadway improvement projects are important because they provide an opportunity to make drainage improvements and apply low impact development drainage improvements. The County currently does not have any County road improvements planed for the next six years within the Hoodsport RAC, although they are currently considering the use of LID bio-retention facilities within the County road right-of-ways to treat runoff from existing development.

3.4 Public Identified Drainage Deficiencies from Drainage Survey

Mason County conducted a mail-in drainage survey for the Hoodsport RAC and surrounding area using a questionnaire. The surveys were sent out to all Hoodsport addresses and covered a few areas that were just outside of the RAC. Participation in this survey was voluntary.

The County received 103 completed questionnaires. The results of the survey were reviewed and used in the development of this Stormwater Management Plan. A copy of the questionnaire and a summary of the responses received are included as Appendix B.

Results of Questionnaire

When asked if they had experienced flooding in Hoodsport:

- Eighty eight percent of respondents reported no flooding.
- Within the Lake Cushman area, west of the Hoodsport RAC, not only reported very little flooding but responded by saying that "We have great drainage here in Lake Cushman."
- Nine percent responded "yes," indicating that they had experienced flooding within Hoodsport area. While some of these responses came from outside of the RAC, flooding was reported primarily within the RAC, along both North Finch Creek Road and North Schoolhouse Hill Road.

- Three percent gave no response and did not return their survey questionnaire.

Summary and Conclusions of Survey Questionnaire

In general, flooding was described as occurring mostly in yards along and driveways. Some flooding along Highway 101 was reported; however, the flooding was located outside of the RAC near SR 106 and is associated with the Skokomish River. While the dates of the reported flooding varied, most people agreed that flooding follows a "long, heavy rain."

Opinions as to what is causing the flooding included a variety of answers such as: clogged drains, clear cutting and development within the watershed, alterations made to Finch Creek, poor infiltrating soils, and "Mother Nature." It is recommended that the County focus on the factors that they can control such as maintenance, and development in addressing localized drainage issues within the Hoodsport RAC.

3.5 December 2-3, 2007 Flooding

Mason County incurred a significant amount of damage resulting from flooding that occurred during December 2-3, 2007 rainfall event. This event was significant because it was a rain-on-snow event, which created a large amount of surface water runoff over a relatively short period of time. At the Cushman Powerhouse precipitation gage, 7 inches of rain fell on the snow that had fallen the previous day resulting in a tremendous amount of stormwater runoff (precipitation data is provided by the Office of the Washington State Climatologist).

Although other areas of the County were much harder hit, Hoodsport experienced some damage along Finch Creek. The Finch Creek County Bridge on North Finch Creek Road was washed away during the storm. Another Finch Creek Bridge located at the upper, west end of North Finch Creek Road was damaged where high flows were hitting the bridge abutment; fortunately this bridge was repairable. The bridge were Highway 101 crosses Finch Creek was not damage during the storm, and water did not overtop Highway 101 at this location or anywhere else within the Hoodsport RAC.

Holiday Beach, located approximately one mile north of the RAC, experienced water over Highway 101, as did other areas of the County. Other than the Finch Creek bridges, there was no major or permanent damage to the Hoodsport drainage system according to Mason County maintenance personnel. Mason County considers this as evidence that the drainage system in Hoodsport is in good working order and of the appropriate size to be able to handled such a large storm with relatively few major flooding problems or major damage to property or infrastructure.

3.6 Areas Needing Routine Maintenance

Enhanced maintenance is suggested to address the two following drainage problem areas within the Hoodsport RAC.

North Finch Creek Road

Enhanced Maintenance by WSDFW at the Intake Structure on Finch Creek

Flooding along this road is reported to coincide with high tides that occur when the creek is flowing full following a large rain. It was also reported that flooding is less frequent when the hatchery clears out the gravel and sediment that accumulates at the intake structure. Based on these reports, a more frequent maintenance regime by WSDFW at the intake structure would be expected to reduce the frequency of flooding along N Finch Creek Road.

North Schoolhouse Hill Road

Enhanced Ditch Maintenance by County along the Road

Another maintenance issue are the ditches along North Schoolhouse Hill Road. Clogged ditches have been reported as the source of flooding at the west end of this road. More frequent maintenance to clean out the ditches should reduce the frequency of flooding along North Schoolhouse Hill Road.

Technical Information to Local Residents

At the east end of North Schoolhouse Hill Road, there are no ditches and water has been reported to run down the road and down peoples' driveways. To improve this situation, the County may want to offer information to residents on how they can improve the drainage in their yards and driveways. For example, diagonal driveway berms could be use to direct runoff to trench infiltration systems that residents could build in their yards. Examples of these drainage features are available in the County's small parcel ordinance and in the 2005 King County Surface Water Manual, Appendix C – Small Project Drainage Requirements.

Section 4—Future Conditions

4.1 Future Conditions

The future land use conditions assume that as population growth occurs in the RAC, any currently undeveloped land will be developed or existing developments may be redeveloped according to the current County zoning.

4.2 RAC Zoning

There are four different zoning classifications used in the Hoodsport RAC as shown in Figure 4-1. These classifications are:

1. Rural Residential (RR2.5)
2. Rural Commercial (RC3)
3. Rural Multi Family (RMF)
4. Rural Tourist-Campground (RT)

The majority of land within the Hoodsport RAC is zoned as rural residential (RR2.5—one dwelling unit per two and one-half acres). A small amount of the RAC is zoned for rural commercial (RR3), rural multi-family (RMF), and rural tourist-campground (RT). As a result of this zoning, the Hoodsport RAC consists primarily of low-density residential, vacant/rural, and forested areas with a small commercial area. A summary of zoning classification by subbasin is in Table 4-1.

Table 4-1 Hoodsport RAC Zoning

Subbasin ID #	Area within RAC (acre)	Zoning							
		RR2.5		RC3		RMF		RT	
		(acre)	(%)	(acre)	(%)	(acre)	(%)	(acre)	(%)
5	4.5	4.5	100%	0.0	0%	0.0	0%	0.0	0%
10	16.8	8.1	48%	8.7	52%	0.0	0%	0.0	0%
20	42.5	41.2	97%	1.3	3%	0.0	0%	0.0	0%
30	41.6	41.6	100%	0.0	0%	0.0	0%	0.0	0%
40	56.9	56.5	99%	0.3	1%	0.0	0%	0.0	0%
50	28.9	27.3	94%	1.6	6%	0.0	0%	0.0	0%
60	133.9	124.5	93%	8.0	6%	0.0	0%	1.4	1%
70	15.5	12.4	80%	3.1	20%	0.0	0%	0.0	0%
80	257.8	245.7	95%	10.1	4%	2.0	1%	0.0	0%
90	7.0	6.3	90%	0.3	5%	0.0	0%	0.4	6%
Totals	**605.3**	**568.0**	**94%**	**33.5**	**6%**	**2.0**	**0%**	**1.8**	**0%**

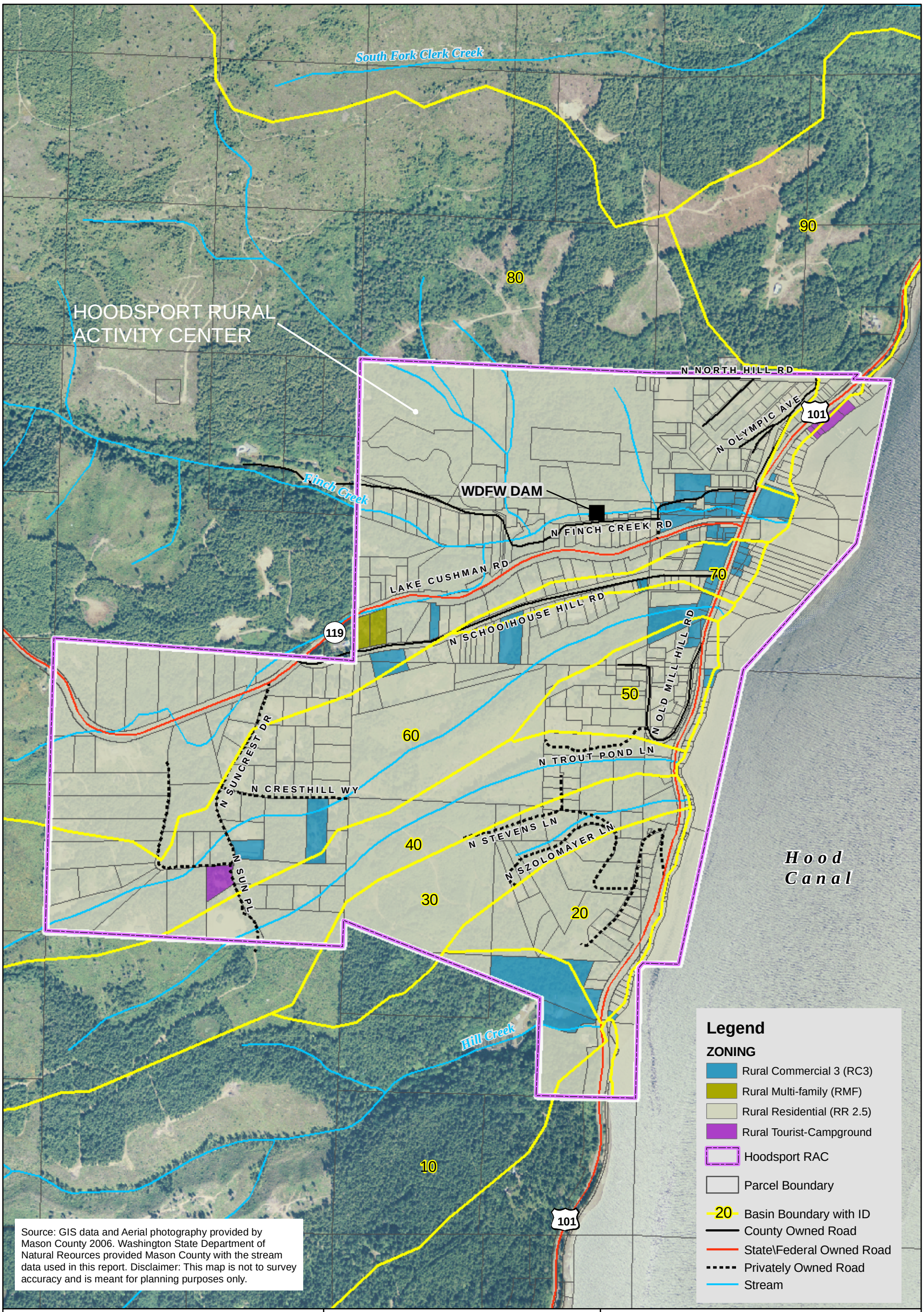


Figure 4-1
Existing Land Use - Zoning
Hoodsport Stormwater Management Plan

411 North 5th, P.O. Box 279
Shelton, Washington 98584
Phone: (360) 427-9670
Fax: (360) 427-8425

10230 NE Points Drive
Kirkland, Washington 98033
Phone: (425) 822-4446
Fax: (425) 827-9577

K:/project/30700/30784/GIS/mxds/Hoodsport/Figures/ExistingLandUse_Zoning.mxd

4.3 Future Growth Over the Next Six Years

Projected Population Growth

In the *Hoodsport RAC Wastewater Facility Plan (July 2007)*, an annual population growth rate of 3.5 percent was suggested by Mason County. Based on the 2005 population of 642 persons and the 3.5-percent growth rate, about 9 new building permits will be received next year, supporting a population of about 690 in 2007 and an additional 40-50 resident in 2008. The population is estimated to be 840 at the end of the six year planning period in 2013.

Assessment of Growth and its Drainage Related Impacts

Development and redevelopment in Hoodsport that adheres to Mason County Code should not increase runoff in the future. As the County phases in the use of the low impact development and the 2005 Ecology Manual within the County's most urban areas, including urban growth areas and rural activity centers like Hoodsport, those developments that generate 5,000 square feet or more of new impervious surface will be subject to the treatment and discharge requirements of the 2005 Manual. Developments that generate fewer then 5,000 square feet of new impervious surface will be subject to Mason County Code Chapter 14.48, which is based on the 1992 Ecology Manual and includes the Small Parcel Development Requirements and New Development and Redevelopment – Minimum Standards (Mason County Codes 14.48.130, and 14.48.140 respectively).

As development continues throughout the Hoodsport RAC, increased runoff is not expected because low density development such as RR2.5 leaves enough undeveloped land (with un disturbed native vegetation) on each site that stormwater runoff from the new structures can be treated and infiltrated on site through the use of Low Impact Development (LID) techniques, resulting in no increase in surface water runoff from the site.

Where this may not apply, is where parcels zoned RR2.5 but are less than 2.5 acres. Such parcels are the result of previous subdivisions, which are no longer allowed. The issue is with those parcels that are currently undeveloped. If parcels are too small, then setting aside enough open space to treat and infiltrate stormwater on site through the use of LID techniques becomes more difficult. Sites that are too small to infiltrate all of their runoff on site will need to provide on-site water quality treatment and rate control before stormwater is discharged from their site.

Redevelopment is also subject to the New Development and Redevelopment – Minimum Standards (Mason County Code 14.48.140); therefore, any redevelopment that occurs in Hoodsport will likely result in a reduced amount of stormwater runoff leaving the site

compared to existing conditions. The County's New Development and Redevelopment Minimum Standards apply to both residential and commercial redevelopment.

Section 5—Regulatory Criteria

5.1 Introduction

Existing Development Criteria

Within the Hoodsport Rural Activity Center (RAC) the growth rate is approximately 3.5%, which accounts for about 9 new building permits per year. Most of these permits are for new residents, with the occasional commercial permit request. To guide new development within the Hoodsport RAC the County uses a series of land use, design manuals, and development codes and ordinances.

The general develop guidance document for the Hoodsport RAC is the County's Comprehensive Land Use Plan (2005). This global planning document is supplemented by the use of more detailed development guidance that takes the form of Stormwater Design Criteria and Development Regulations, as described in Sections 5.2 and 5.3 below.

Need for New Development Guidelines

While these existing development guidance practices have served the County well for many years, the County is now considering additional design criteria to address the more intense and cumulative impacts of development. As rural densities begin to make the transition to form rural activity centers, and then to continue to evolve into even more densely developed urban areas, described as growth management areas in the County's Comprehensive Land Use Plan, impacts to the County's sensitive natural systems are occurring. Streams are being impacted by higher flows, increasing erosion and sedimentation, and the destruction of habitat and critical spawning areas. Continually elevated pollutant loadings are affecting receiving waters causing water quality violations, which result in low dissolved oxygen levels creating fish kills and contaminating sensitive shellfish rearing areas throughout Hood Canal and the most sensitive areas of south Puget Sound (i.e. North Bay and Oakland). (Reference: Addenda to Allyn and Belfair Stormwater Management Plans; September, 2007.)

To address these more intense and accumulative impacts of continued, increasingly dense urban development, the County is considering the requirement of the use of low impact development (LID) techniques and the establishment of new, more effective stormwater design criteria. LID techniques are currently being used throughout the Puget Sounds basin to improve the protection and retention of natural systems and natural functions on development sites and to limit the impacts of new impervious areas. These LID techniques are being coupled with the use of more defined stormwater design criteria (i.e. the 2005 Ecology Stormwater Deign Manual for Western Washington (2005 Ecology Manual)) in order to reduce the impacts of peak flows and improve water quality by managing and treating the runoff from new development on site, enhancing treatment and infiltration on site as local soils allow, and making sure that post development rates of runoff do not exceed those of the predeveloped site.

(Note #1: It should be noted that the adoption and routine use of the 2005 Ecology Manual is also one of the requirements for all municipalities that discharge into Puget Sound, as described in the Municipal Stormwater section of the 2000 Puget Sound Water Quality Management Plan and 2007 Conservation Plan.

(Note #2: It should also be noted that the engineering analyses and capital project recommendations presented in this Stormwater Management Plan for the Hoodsport RAC have been based on the application of the 2005 Ecology Manual for Western Washington, per the requirements of Ecology's grant to Mason County.)

5.2 Existing Development and Redevelopment Criteria

Requirements for Small and Large Parcels

The minimum requirements for new and redevelopment are triggered at different amounts of impervious surface for both residential and non-residential developments. The two existing Countywide stormwater management ordinances—one for parcels with greater than 2,000 square feet of impervious area or land disturbing activities of one acre or greater, and one for the smaller parcels with less than 2,000 square feet impervious—are located in Chapter 14.48, Article VII, of the Mason County Municipal Code, and are summarized below. (For the complete text of these ordinances, refer to the Mason County web site: http://www.co.mason.wa.us/code/commissioners/index.htm.)

Small Parcel Minimum Requirements for New Development/Redevelopment (Mason County Code 14.48.130)

Due to the large number of relatively small residential sites that were continually being developed throughout the County, a special ordinance was recently created and approved by the County Board of Commissioners (CBOC) to address the special needs of the smaller, more rural sites. Many other counties within the Puget Sound region have similar ordinances.

This new small parcel ordinance imposes stormwater management requirements on developments, and redevelopments, with less than 2,000 square feet of impervious surface and land disturbing activities of less than one acre. This ordinance is significant because prior to its adoption, there were no stormwater management requirements to reduce the amount of erosion and sedimentation from the new impervious area resulting from these smaller developments.

Requirements for Small Parcels: Impervious Area Less Than 2,000 Square Feet for Residential Sites
Prepare a small parcel erosion and sediment control plan that complies with the small parcel minimum requirements #1 - #4 described in this section 14.48.130. These small parcel

requirements are designed to control erosion and sediment during construction and to permanently stabilize soils that were exposed during construction.

1. Construction Access Route.
2. Stabilization of Potentially Erodible Denuded Areas.
3. Protection of Adjacent Properties.
4. Maintenance of Best Management Practices (BMP's).

New Development/Redevelopment Requirements (Mason County Code 14.48.140)

All residential sites and nonresidential sites fall under this ordinance. This ordinance addresses special stormwater requirements for small and larger residential sites as well as non-residential sites when the triggers mentioned below are reached.

Requirements For All Sites Of New Residential Development Or Redevelopment With An Impervious Area Of 2,000 Square Feet Or Greater.

Any residential development that creates or adds more than 2,000 square feet of impervious surface area is to:

- Prepare a small parcel erosion and sediment control plan that complies with the small parcel minimum requirements described section 14.48.130. These small parcel requirements are designed to control erosion and sediment during construction and permanently stabilize soils that were exposed during construction.
- Small parcels are also required to prepare a residential site improvement plan that includes a description of the proposed development and construction process.
- Some sites, located on steeper slopes or adjacent to sensitive areas, may also be required to prepare small parcel drainage plans (examples of which are available from the County upon request).

Requirements For Non-Residential Development With An Area Greater Than 5,000 Square Feet Impervious Or Land Disturbing Area Of One Acre Or More OR Residential Development With One Acre Or More Of Land Disturbing Activity.

Under the current Mason County Code, non-residential developments and redevelopments, exceeding five thousand square feet of impervious surface area and/or land disturbing activities of one acre or more and residential sites with one acre or more of land disturbing activity, are required to comply with the following eleven minimum requirements (or requirements 2 – 11 and the small parcel minimum requirements in section 14.48.130):

1. Perform erosion and sediment control during pre and post construction activities.
2. Conduct basin planning.
3. Preserve and protect the natural drainage systems.
4. Provide source controls.
5. Enhance water quality leaving the site using BMPs.

6. Maintain and protect stream banks from erosion.
7. Preserve and protect wetlands, maintaining natural hydroperiods.
8. Protect and preserve aquifer recharge and water quality sensitive areas.
9. Provide offsite downstream analysis and mitigation.
10. Perform routine operation and maintenance during construction.
11. Provide financial securities to ensure liabilities are addressed.

5.3 Discussion of Existing County SWM Design Criteria for Large Parcels

Compliance with the large parcel minimum requirements, listed in Section 5.2 above, is to be demonstrated through the development and implementation of an approved stormwater site plan that includes a large parcel erosion and sediment control plan and a permanent stormwater quality control plan.

The existing stormwater design criteria for Mason County are generally based on the Ecology 1992 Manual, as further refined by County Ordinance 14.48, which emphasizes the use of onsite detention to mitigate the impacts of site development and the addition of new impervious areas. In general, non-residential developments must address the Ecology 1992 Manual requirements. Smaller residential parcels have a series of flow, erosion, and treatment requirements specifically tailored to the construction impacts associated with smaller, more isolated construction sites. Highlights of the County's existing stormwater design criteria for new development include the following:

- Thresholds: The use of stormwater design criteria is required for all new development or redevelopment that exceeds 5,000 square feet of new impervious area or one acre of land disturbance. A stormwater and erosion mitigation plan is required for 2,000 of more square feet of new impervious area for smaller residential developments. This would include all new residences as well as any new commercial developments. (Note that the County's small parcel development ordinance applies to the smaller residential developments.)
- Hydrologic Analysis Methodology: The Ecology 1992 Manual requires the use of the Santa Barbara Unit Hydrograph methodology which generally selects a unit hydrograph that represents the rainfall and estimates the amount and duration of one-half of the 2, 10, and 100 year design rainfall events. Resulting flows are estimated and required volumes of onsite detention/retention are estimated. Usually, required peak flow detention is achieved with the design and construction of onsite detention/retention ponds. The treatment of runoff is designed for the 6 month, 24 hour storm event and erosion controls are usually designed for 0.64 of the 2 year, 24 hour event.
- Flow Control: According to the Ecology 1992 Manual, post-development discharges from the site must match the pre-existing conditions. Flow control requirements are

usually achieved via onsite detention/retention facilities. As local soil conditions allow, much if not all of the new runoff can often be infiltrated onsite.

- Downstream Analysis: If the runoff from the site is not directly flowing into a major water body, a downstream analysis is required to ensure the peak flows are conveyed safely and that they enter into the natural drainage system without significant erosion or sedimentation, or habitat or water quality damage.
- Water Quality Treatment: In the Ecology 1992 Manual, water quality treatment is achieved through the use of one or more best management practices (BMPs). A common site water quality BMP is the grass-lined swale or the design of a wet pond in the bottom of the required detention/retention facility.
- Erosion Control: Erosion control is required on all new development sites. On most of the smaller residential and commercial sites erosion control consists of an erosion control plan for during construction as well as a permanent site stabilization plan. The County has created a small parcel stormwater application package to help facilitate the permitting process.
- Other additional special stormwater design criteria: In general, the main concern of any new development in Mason County with regard to stormwater, is the downstream impacts which include water quality, erosion/sedimentation, increased flow rates, and impacts to habitat areas.

These stormwater design criteria work in conjunction with the County's other land use practices and development controls that include:

- Following the allowed building densities allowed per the zoning rules in the County's Comprehensive Plan.
- Consistency with the County's flood plain protection and set back guidelines.
- Adherence to the various setbacks and buffers described in the County's Shoreline Management Plan and Sensitive/Critical Areas Ordinance that provides additional protection and preservation of lakes, streams, steep slopes, wetlands, and aquifer infiltration areas.
- Routine onsite inspection of construction to ensure that erosion control and proper construction practices are being performed and regularly enforced.

5.4 Future County SWM Design Criteria Using Low Impact Development

Use of the above stormwater design criteria have served the County well for many years, particularly in the more rural locations and for the smaller less intensely developed sites, however additional stormwater design criteria and techniques are going to be needed to continue to protect and preserve the sensitive natural resources of Mason County.

Ecology encourages the use of LID techniques for stormwater management where appropriate. The Low Impact Development Technical Guidance Manual for the Puget Sound describes LID as follows: *Low impact development (LID) is a stormwater strategy that emphasizes conservation and use of natural site features integrated with distributed, small-scale stormwater controls to more closely mimic natural hydrologic patterns in residential, commercial, and industrial settings.* LID methods are presented in Appendix C. Design guidance for LID methods are also available from:

- The 2005 Ecology Manual
  www.ecy.wa.gov/programs/wq/stormwater/manual.html
- The Puget Sound Action Team
  http://www.psat.wa.gov/Publications/LID_tech_manual05/lid_index.htm

LID techniques have been considered in the development of the stormwater alternatives for the Hoodsport RAC. LID techniques may reduce or eliminate the size of stormwater facilities and infrastructure. Even though the Hoodsport RAC has predominantly Type C soils (which may not be suitable for infiltration), there is still a large variety of LID options available. Descriptions of potential LID options are included in Appendix C.

The County currently uses a series of stormwater related codes, ordinances, and design criteria. Their current design criteria for new development and re-development are patterned after the 1992 Ecology Manual. Currently, the use of continuous modeling for flows is not required and there is no requirement for water quality treatment or the use of best management practices (BMPs). Adoption of the Ecology 2005 Manual will update these requirements.

The County is considering, and will likely soon pass an ordinance that promotes the use of LID techniques and may make the use of LID mandatory within certain urban and/or sensitive areas throughout the County. Recommendations for the County to update their current ordinances and design standards are included as Stormwater Element #4 in Section 8 of this document.

5.5 Future County SWM Design Criteria: 2005 Ecology Manual

The County is currently considering whether larger developments, exceeding five thousand square feet of impervious surface area, should be required to comply with the Ecology 2005 Manual. Due to the likelihood of this occurring in the near future, the minimum stormwater requirements for new development, as described in the 2005 Ecology Manual, are summarized below.

Minimum Stormwater Management Requirements

The regulatory requirements for stormwater management are contained in Ecology's 2005 Stormwater Management Manual for Western Washington (Ecology 2005 Manual). The Ecology 2005 Manual sets forth ten minimum requirements for stormwater management. These are required for both development and redevelopment and are listed in Table 5-1.

All stormwater plans must demonstrate compliance with the following applicable minimum requirements.

Table 5-1
Ecology 2005 Manual: Minimum Stormwater Management Requirements

Minimum Requirement	Requirement
1. Preparation of Stormwater Site Plans	All projects meeting the thresholds [outlined in the Ecology 2005 Manual] shall prepare a Stormwater Site Plan for local government review.
2. Construction Stormwater Pollution Prevention (SWPP)	–Projects in which the new, replaced, or new plus replaced impervious surfaces total 2,000 square feet or more, or disturb 7,000 square feet or more of land must prepare a Construction SWPP Plan as part of the Stormwater Site Plan.
3. Source Control of Pollution	All known, available and reasonable source control Best Management Practices (BMPs) shall be selected, designed, and maintained according to the Ecology 2005 Manual.
4. Preservation of Natural Drainage Systems and Outfalls	Natural drainage patterns shall be maintained, and discharges from the project site shall occur at the natural location, to the maximum extent practicable. Then manner by which runoff is discharged from the project site must not cause significant adverse impact to downstream receiving waters and down gradient properties. All outfalls require energy dissipation.
5. Onsite Stormwater Management	Projects should employ Onsite Stormwater Management BMPs to infiltrate, disperse, and retain stormwater runoff onsite to the maximum extent feasible without causing flooding or erosion impacts.
6. Runoff Treatment	Direct discharge of untreated stormwater from pollution-generating impervious surfaces to ground water is prohibited, except for the discharge achieved by infiltration or dispersion of runoff from residential sites through use of Onsite Stormwater Management BMPs; the construction of stormwater treatment facilities is required.

7. Flow Control	Projects must provide flow control to reduce the impacts of stormwater runoff from impervious surfaces and land cover conversions. This requirement applies to projects that discharge stormwater directly, or indirectly through a conveyance system, into a fresh water – except for projects that discharge to an approved direct discharge receiving water.
8. Wetlands Protection	Discharges to wetlands shall maintain the hydrologic conditions, hydrophytic vegetation, and substrate characteristics necessary to support existing conditions.
9. Basin/Watershed Planning	Projects may be subject to equivalent or more stringent minimum requirements… as identified in Basin/Watershed Plans.
10. Operation and Maintenance	An operation and maintenance manual… shall be provided for all proposed stormwater facilities and BMPs, and the party (or parties) responsible for the maintenance and operation shall be identified.

Minimum Requirements for New Development

As described in the Ecology 2005 Manual: *All new development shall be required to comply with Minimum Requirement #2, entitled Construction Stormwater Pollution Prevention.*

New development shall comply with Minimum Requirements #1 through #5 for the new and replaced impervious surfaces and the land disturbed if the proposed new development:

1. *Creates or adds 2,000 square feet, or greater, of new, replaced, or new plus replaced impervious surface area, or*
2. *Has land disturbing activity of 7,000 square feet or greater.*

The following new development shall comply with Minimum Requirements #1 through #10 for the new impervious surfaces and the converted pervious surfaces if the proposed new development:

1. *Creates or adds 5,000 square feet, or more, of new impervious surface area, or*
2. *Converts ¾ acres, or more, of native vegetation to lawn or landscaped areas, or*
3. *Converts 2.5 acres, or more, of native vegetation to pasture.*

Minimum Requirements for Redevelopment

As quoted from the 2005 Manual: *All redevelopment shall be required to comply with Minimum Requirement #2. In addition, all redevelopment that exceeds certain thresholds shall be required to comply with additional Minimum Requirements as follows:*

1. *Redevelopment shall comply with Minimum Requirements #1 through #5 for the new and replaced impervious surfaces and the land disturbed if:*
   - The new, replaced, or total of new plus replaced impervious surfaces is 2,000 square feet or more, OR
   - The redevelopment involves more than 7,000 square feet or more land disturbing activities.

2. *Redevelopment shall comply with Minimum Requirements #1 through #10 for the new impervious surfaces and converted pervious areas if the new redevelopment:*
   - Adds 5,000 square feet or more of new impervious surfaces or,
   - Converts ¾ acres, or more, of native vegetation to lawn or landscaped areas, or
   - Converts 2.5 acres, or more, of native vegetation to pasture.
3. *If the runoff from the impervious surfaces and converted pervious surfaces is not separated from runoff from other surfaces on the project site, the stormwater treatment facilities must be sized for the entire flow that is directed to them.*
4. *Also note that: The local government may allow the Minimum Requirements to be met for an equivalent (flow and pollution characteristics) area within the same site. For public roads' projects, the equivalent area does not have to be within the project limits, but must drain to the same receiving water.*

Flow Rate Control Requirements

Flow control stormwater compliance criteria used in this stormwater planning study are taken directly from Ecology's 2005 SWM Manual for Western Washington. The compliance criteria, set forth in the 2005 SWM Manual for basins requiring rate control, are as follows:

1. *Stormwater discharge shall match pre-developed conditions flow duration values from ½ of the 2-year flow frequency through the 50-year flow frequency. (Matching flow durations ensures that any potential erosion problems downstream of the development are not exacerbated by the proposed development.)*
2. *Developed peak discharge rates shall match pre-developed conditions peak flows for the 2-, 10-, and 50- year return periods. (Matching peak flows ensures that the downstream system will continue to have the capacity to carry the expected flow rates.)*

Direct Discharges to Saltwater Do Not Require Detention

The Ecology 2005 Manual does not define flow control requirements for freshwater discharges into salt water receiving water bodies. Thus for the Hoodsport RAC, stormwater discharges into salt water such as Hood Canal, do not need to meet any special detention requirements and may be directly discharged into Hood Canal. However, the flow control requirements of the 2005 Ecology Manual do apply to those stormwater discharges that directly enter fresh water systems, such as streams, rivers, wetlands, and smaller lakes.

Water Quality Treatment Requirements

The Ecology 2005 Manual presents two sets of requirements for the selection of water quality treatment methods, depending on the type of development that is being constructed. The *Basic Treatment Menu* is the standard for most residential developments, including those that discharge into salt water. However, there is also the *Enhanced Treatment Menu* that applies to developments with a more intense use of impervious areas and greater potential for

pollutants leaving the site, including new roads, highways, and commercial developments or discharges to fish-bearing streams. These two menus are summarized below:

The *Basic Water Quality Treatment Menu* allows any of the following options to be used:

-Bio-infiltration Swale
-Infiltration
-Sand Filters
-Bio-filtration Swales
-Filter Strips
-Basic Wetpond
-Stormwater Treatment Wetland
-Combined Detention and Wetpool Facilities
-Bioretention/Rain Garden
-Ecology Embankment
-"StormFilter" with ZPG™ media
-Wetvault

To meet the Basic requirements, it is common for a developer to use either bio-infiltration/bio-filtration swales or some form of a wetpond, depending on the shape and amount of space available on the site. Wetponds can be sized with continuous simulation models to treat the volume associated with 91% of all flows during the period of simulation, which is generally equivalent to 0.72 times the amount of precipitation of the 2-year, 24 hour storm event.

The *Enhanced Water Quality Treatment Menu* allows any of the following options to be utilized:

-Infiltration with Appropriate Pretreatment
-Large Sand Filter
-Amended Sand Filter
-Stormwater Treatment Wetland
-Compost-amended Filter Strip
-Two Facility Treatment Train
-Bioretention/Rain Garden
-Ecology Embankment

To meet the Enhanced requirements, a developer will often use a two of the above facilities connected in series to create a "treatment train" or to develop a constructed wetland. Sand filters may also be required for special pollutant removals such as nutrients, which are not readily removed using the above listed techniques.

5.6 Timing and Scope of Future SWM Design Criteria (In Mason County and the Hoodsport RAC)

Due to the continuing documentation of the impacts of existing and proposed future development on the health of the natural systems (i.e. streams, water quality, fisheries, and shellfish) throughout the County, the Mason County Board of Commissioners is considering the use of the additional stormwater design methodologies and techniques, as described above (i.e. use of LID and the 2005 Ecology Manual), to both retrofit existing development

and improve the mitigation of the impacts associated with new development/redevelopment.

When and how these new requirements will be put into affect is unclear at this point in time. However, discussions with County staff suggest that the LID ordinance will be completed and presented to the public and BOCC for review and approval by the end of the year (or perhaps even sooner; 3-6 months), depending on the results of the public and regulatory review processes scheduled to begin within the next several months.

Discussions concerning the adoption of the 2005 Ecology Manual suggest that it will eventually be adopted throughout the County using a phased approach. Those areas that will first be required to use the 2005 Ecology Manual for new development and redevelopment will be those that are the most urbanized, including the Growth Management Areas (GMAs) of Allyn and Belfair. The next most likely areas for adoption and use of the 2005 Ecology Manual would be the urbanized/urbanizing areas associated with the rural activity centers of Hoodsport and Taylor Town I and II. There has also been some discussion of including the rapidly developing area of Union and the near-shoreline areas adjacent to Hood Canal and south Puget Sound, along with the remaining unincorporated areas of the County.

A possible, but yet undecided approach for the adoption and use of LID and the 2005 Ecology Manual throughout Mason County includes the following potential phases and timeline.

- Phase I – 2008 – Allyn and Belfair GMAs,
- Phase II – 2009 – Hoodsport and Taylor Town I and II,
- Phase III – 2010 – Water Quality and Shellfish Sensitive Areas
- Phase IV – 2011 – Union and Near-Shore Areas, and
- Phase V – 2012 – The remaining unincorporated areas throughout the County.

The concept is to adopt the LID ordinance and 2005 Ecology Manual together, and to implement them together using a four phased approach over the next four years, until the entire County would come under the same set of development guidelines.

Section 6—SWM Impacts, Analysis and Strategies

6.1 Introduction and Overview

Due to the relatively sparse and rural type of existing and projected development within the RAC, the approach for stormwater management within the Hoodsport RAC has not been on the development and use of large, expensive regional facilities. Rather, the recommended approach for stormwater management has focused on;

- The identification and correction of the relatively small, localized deficiencies within the **existing drainage system**,
- The relatively minor impacts of the runoff associated with the **development/ redevelopment** of the remaining rural density parcels within the RAC, and
- The need to address the County's newly adopted goal of retrofitting existing drainage facilities for **water quality treatment** prior to discharge into Hood Canal.

The following section presents the results of the engineering analysis and recommendations for stormwater management throughout the Hoodsport RAC.

6.2 Engineering Approach and Methodology

Approach

The engineering approach used to develop stormwater management strategies for the Hoodsport RAC was to identify the various categories of existing deficiencies, project future development impacts, and to determine the appropriate method to deal with each.

Existing Identified Drainage Deficiencies

The approach used to identify existing drainage deficiencies included a site visit, interviews with County and WSDOT road maintenance crews, discussions with planning/development review staff, and the use of a local drainage questionnaire that was sent our to the public. Once identified, the deficiencies were divided by whether they were on public or private property and also if the source of the excess runoff was from road runoff and other public properties.

New Development and Redevelopment

The drainage issues associated with new development and redevelopment were estimated based on the type of development and the type of land use zoning. With so many of the future parcels being relatively large and being used primarily for residential development, there would be less future runoff generated than from the smaller existing parcels that would be developed or redeveloped in the future for either residential or commercial purposes.
In order to estimate the impacts of future, ultimate development based on the zoning and land uses presented in the County's Comprehensive Plan, the following categories of future

land use were analyzed and the future amounts of stormwater runoff were estimated for each different type of future land use.

- Existing residential platted parcels less than 2.5 acres
- Vacant parcel
- Redevelopment on existing developed parcel
- Redevelopment on existing commercial parcels
- Vacant parcels – RR2.5 zoning
- Vacant parcels – RC3 zoning
- Vacant parcels – RMF zoning
- Vacant parcels – RT zoning

Water Quality Retrofit Existing Development

At the request of regulatory agencies (Ecology and the Puget Sound Partnership), the County is undertaking a program to retrofit existing drainage facilities in some of the more urban areas of the County in order to collect and treat the runoff from existing development, especially County roads and right-of-ways. To accomplish this water quality treatment goal within the Hoodsport RAC, opportunities to use LID type of retrofit using bio-retention facilities were investigated both on public right-of-ways (i.e. along County roads) as well as in association with commercial development.

Methodology

The methodology for each of the three major categories presented above is discussed below.

Drainage Deficiencies.

As mentioned above, the analysis of the existing drainage problems within the Hoodsport RAC began with a site visit, a tour of existing facilities, and the identification of problem areas by local residents and County staff. A mail-in questionnaire to the public was also used to help identify problem areas.

Those drainage facilities observed in the field were compared with inventories from the County and WSDOT, along with previous studies and reports. Observed facilities and existing problem areas are shown in Figure 3-2. Approaches to address the observed existing problems were analyzed and capital projects and/or enhanced maintenance activities were proposed to address these types of observed existing problem areas.

Development and Redevelopment.

The methodology used to address the drainage issues associated with new development and redevelopment is defined in the County's zoning ordinances and stormwater regulations that were in-place at the time of platting or submittal of the building permits application. The low density nature of the zoning within the Hoodsport RAC will allow many of the low impact development (LID) technique, such as dispersion, filtration and preservation of natural vegetation to be used, as described in the County's small parcel ordinance. The use of LID usually reduces the need for the more traditional and often more expensive and more land intensive engineering approaches.

Water Quality Retrofit Projects.

The methodology for selecting and designing water quality retrofit projects within the RAC will follow the approach contained it in the scope of work presented in the County's October 2007 grant application to the Washington State Department of Ecology. This scope includes an assessment of potential retrofit projects in the Belfair and Allyn UGAs, and the Hoodsport RAC. Potential water quality retrofit sites within each of these three urban areas will be selected, and those top ranked six to eight projects will be selected for design and construction over the next few years, as local funding allows.

6.3 Engineering Analysis: Results

Engineering Results

The engineering analysis identified the need for increased maintenance at three critical locations, as well as the design and construction of two small capital projects to reduce two areas of localized flooding.

Need for Increased Routine Maintenance

Of the drainage deficiencies identified and recorded in Section 3, a number of those deficiencies associated with the public drainage facilities can be corrected and/or reduced in magnitude by increased maintenance. The most important of those facilities needing increased maintenance include the following:

- The WSDOT drainage system along SR 119 needs regular removal of debris to avoid becoming plugged and overflowing, impacting the County's downstream drainage system,
- The Department of Fish and Wildlife hatchery dam on Fitch Creek requires the regular and routine removal of accumulated gravel and sediment in order to avoid overtopping and creating localized flooding, and

- The County drainage ditches along the west end of North Schoolhouse Road could benefit from increased routine maintenance due the limited conveyance capacity of the system.

Need for Capital Projects

Those deficiencies identified in Section 3 for correction via capital improvement projects include:

- The construction of a stormwater collection and conveyance system in the public right-of-way on the east end of North Schoolhouse Road to eliminate road runoff from entering private properties, and
- The construction of replacement or supplemental conveyance capacity for the North Hill area to eliminate drainage impacts to private properties along the east end of Fitch Creek Road.

Results of the Public Drainage Questionnaire

The results of the public questionnaire process indicated limited and infrequent flooding of private property throughout the Hoodsport RAC. Most problems were reported to result for prolonged heavy rainfall, as is common with many urban drainage systems. The correction of drainage problems on private property is generally considered to be the responsibility of the individual property owners, unless the runoff originates from public properties and facilities. For the two areas where runoff from public right-of way was impacting private properties (i.e. along North Schoolhouse Road and within the North Hill area, additional maintenance activities and two small CIP projects, as presented above, have been recommended.

6.4 Summary of Stormwater Strategies and Recommendations

Summary of Findings and Recommendations

In general, due to the predominant rural character and relatively limited amount of existing residential and commercial development within the Hoodsport RAC, the existing drainage system is generally adequate and there are few drainage related problems. It is also likely that there will be few future drainage problems as the RAC continues to develop due to the County's proposed use of enhanced stormwater design criteria and the preservation and use of the remaining larger rural types of lots within the RAC for future development. Specific recommendations follow.

Existing Drainage System

Of the few, small localized drainage problems that were identified; they can be readily addressed by either increased regular maintenance, or increased maintenance along with two small local capital projects.

New Development/Redevelopment

A detailed engineering analysis was not performed to estimate the drainage related impacts associated with ultimate buildout within the RAC; however, an engineering assessment based on past professional engineering modeling and drainage design experience within the Allyn and Belfair UGAs, was performed. This analysis estimated that future drainage problems should be minimal and should be able to be adequately addressed on-site by individual developers using the County's new proposed stormwater design criteria, involving the use of LID and the 2005 Ecology Manual, on the larger rural density parcels remaining within the RAC.

Retrofitting for Water Quality Treatment

Water quality retrofit opportunities within the more densely developed areas of the RAC along US Highway 101 will be examined by the County in the near future and sites for water quality retrofit projects will be identified for design and construction within the next few years, as local funding allows.

Summary of Stormwater Strategies

Short-Term Strategy

The short-term strategy for the Hoodsport RAC is to:

- Work with WSDOT and WDFW to increase the level of maintenance along SR 119 and the hatchery dam, respectively, and
- To increase the level of maintenance performed by County crews on the ditches at the west end of North School House Road.

Long-Term Strategy

The recommended long-term strategy is to:

- Maintain existing rural land use zoning, adopt the new LID and 2005 Ecology Manual standards for future development/redevelopment, and continue to monitor conditions within the RAC drainage basins as development takes place, and
- Identify and implement water quality retrofit projects for commercial areas along Highway 101 and SR 119, using County and WSDOT rights-of-way, as the availability of local funding allows.

Section 7—SWM Plan: Programmatic and Capital Projects

7.1 Introduction and Overview

Based on the methodologies described in Section 6, stormwater management strategies involving both enhanced maintenance and new capital projects have been proposed for the Hoodsport RAC. These programmatic initiatives and projects presented below first focus on maintaining the drainage systems that are currently functioning well (through enhanced maintenance), upgrading those parts of the drainage system that are underperforming (through capital improvements), and then enhancing the design criteria for new developments so that currently functioning systems will not become overwhelmed by future development.

7.2 Stormwater Management Recommendations: Programmatic

Two programmatic stormwater management methods are recommended for the Hoodsport RAC: enhanced maintenance and the adoption of the LID ordinance and the Ecology 2005 Manual. (These are also included in the discussion of the Programmatic SWM elements in the following section, Section 8.)

Stormdrain System Maintenance

As discussed in Sections 3 and 6, there are areas within the Hoodsport RAC that experience flooding when the capacity of the existing system is reduced due to the collection of excessive amounts of debris. Recommended locations for more frequent maintenance were discussed in Section 6 and are provided **in Table 7-1.**

Table 7-1 Recommended Maintenance

Facility in need of maintenance	Function when maintained	Deficiency when not maintained	Responsible Jurisdiction
1. Ditches and Culverts	N. Schoolhouse Hill Road conveyance	Capacity is reduced when clogged; results in flooding along N. Schoolhouse Hill Rd.	Mason County
2. Finch Creek Intake structure	Bypasses water to the Hatchery	Capacity is reduced when clogged; results in flooding along N. Finch Creek Rd.	WDFW
3. Ditches and Culverts	SR 119 (Lake Cushman Road) conveyance	Capacity is reduced when clogged; increased runoff to N. Finch Creek Rd.; results in flooding along Finch Creek Rd.	WSDOT

Adoption of LID and the Ecology 2005 Manual

It is recommended that the County adopt and use LID along with the Ecology 2005 Manual within the Hoodsport RAC to address the drainage and related impacts associated with new development and redevelopment. Adoption of the LID Ordinance and Ecology Manual will impose detention and water quality treatment requirements on new development and re-development and protect the existing stormdrainage systems from increased runoff in the future. The facilities required to meet these requirements will be constructed and funded by private developers, and have therefore not been included in this SWM plan or CIP program.

7.3 Stormwater Management Recommendations: Capital Improvements

CIP projects are recommended for areas where the existing drainage system is insufficient according to site visits, the public questionnaire, and reports from local residents and Mason County Staff. Three CIP projects are recommended to address existing problem areas, along with one project to begin to address the area's water quality treatment needs. The total cost of this Six-year CIP is $423,000. Each proposed project is discussed below.

Table 7-2 Hoodsport RAC Six Year Capital Improvement Program		Project Cost
# 1	N. North Hill Drainage Improvements	$ 185,000
# 2	North Schoolhouse Hill Road Ditch Improvements	$ 121,000
# 3	Replace Half-Pipe w. 18-inch Culvert: SR119 to Finch Creek	$ 56,000
# 4	Filterra Device for WQ Retrofit (retrofits 0.8 ac of County road)	$ 61,000
	Total Cost of Six Year CIP (Annual CIP cost is about $70,000.)	$ 423,000*

*A detailed cost estimate for each CIP is included in Appendix D.

CIP Project #1 – North Hill Drainage Improvements

It is recommended that the County increase the capacity of the roadside ditch and driveway culverts along N. North Hill Road. It is also recommended that the roadside ditches along N. Baskin Lane and N. Olympic Drive be cleaned out. This system is currently undersized and stormwater has been reported to run off the road towards Highway 101 and private properties at the east end of N. Finch Creek Road. The runoff that flows towards Highway 101 appears to be contributing to an unstable hillside. With this CIP, approximately 3,000 lineal feet of ditch will be cleaned out and 470 lineal feet of driveway culverts will be upsized by 6-inches (from 12-inch to 18-inch, or from 18-inch to 24-inch culverts). The locations of these improvements are shown on Figure 7-1, with an estimated construction cost of $185,000.

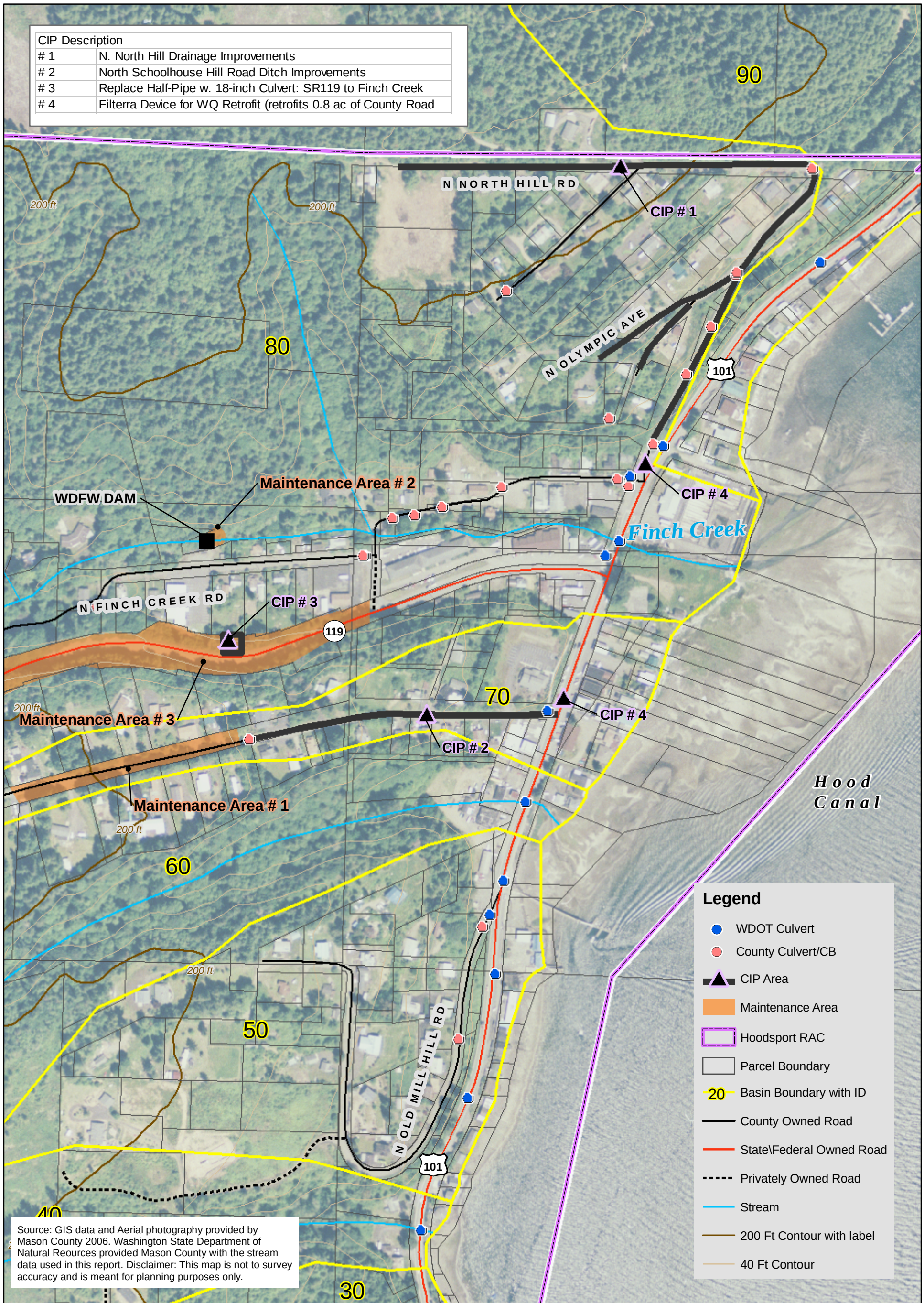


Figure 7-1
6-Year CIP Program

Hoodsport Stormwater Management Plan

411 North 5th, P.O. Box 279
Shelton, Washington 98584
Phone: (360) 427-9670
Fax: (360) 427-8425

10230 NE Points Drive
Kirkland, Washington 98033
Phone: (425) 822-4446
Fax: (425) 827-9577

0 150 300 600 Feet

K:/project/30700/30784/GIS/mxds/Hoodsport/Figures/SixYearCIP.mxd

CIP Project #2 – North Schoolhouse Hill Road Ditch

It is recommended that the County construct a roadside ditch, with driveway culverts along the east end of North Schoolhouse Hill Road. There are no ditches here and stormwater has been reported to run off the road and down private driveways. With this CIP, approximately 1,000 lineal feet of new ditch will be created along one side of the road and 120 lineal feet of 18-inch diameter driveway culverts will be installed. The location of this improvement is shown on Figure 7-1, and has an estimated construction cost of $121,000.

CIP Project #3 – Replace Half-Pipe with 18-inch Diameter Culvert: SR 119 to Finch Creek

It is recommended that the County replace the existing half pipe culvert that flows down the hillside from SR 119 to Finch Creek with a closed, 18-inch diameter pipe. The closed pipe will reduce the amount of debris entering the pipe. The estimated length of this pipe is 200 lineal feet. This improvement is located near the fire station as shown on Figure 7-1, and has an estimated construction cost of $56,000.

CIP Project #4 – Water Quality Retrofit

Consistent with the County's new water quality retrofit objective, it is recommended that the County install Filterra water quality treatment devices (or its approved equivalent) for water quality retrofit in roadway areas that currently have no water quality treatment. This CIP project includes the installation of two water quality retrofit devices, each with the capacity of treating up to 0.40 acres each for a total of 0.80 acres of water quality treatment. Surface water quality retrofit options, such as bioswales, were considered but were found to be less feasible due to the tight, steep terrain of the Hoodsport RAC. Recommended locations for water quality retrofit are at the downstream ends of N. North Hill Road and North Schoolhouse Hill Road, as shown on Figure 7-1. The estimated construction cost of this CIP is $61,000.

Note for Recommended Downstream Analysis

It is suggested that a downstream analysis be performed to verify that the capacity of the existing downstream systems are adequate to convey the increased peak flows that may result from these enhanced conveyance improvements. Such an analysis has not been performed as part of this engineering analysis. A downstream analysis should be performed when these CIPs are designed to ensure there will not be adverse downstream impacts.

7.4 Countywide Stormwater Management Initiative to Retrofit Existing Stormwater Runoff

It is important to mention the discussions currently underway within Mason County to develop a Countywide SWM Program initiative to design, fund, and build a series of water quality treatment facilities within the more urban areas of the County, including the Hoodsport RAC. The request has been made by Ecology and the Puget Sound Partnership to treat all existing runoff from the more urban areas of the County in order to protect sensitive receiving waters.

Under this initiative, low impact development (i.e. bio-retention facilities within County road right-of-ways) would be used to treat runoff prior to discharge to Hood Canal and Puget Sound. These facilities will cost approximately $40K each, if construction on County owned land.

It is likely that one or two of these facilities may be built within the Hoodsport RAC over the next two to six years. Funding may initially come from a $750 grant that the County recently received from Ecology. Later, additional local funding, including the formation of stormwater utility, may be needed to continue to fund the SWM Program within the Hoodsport RAC.

(Please refer to Section 9 for a more detailed discussion of funding needs and potential revenue sources. Note that the cost of these potential water quality retrofit facilities has not been included in the funding needs identified for the Hoodsport SWM Program in Section 9.)

Section 8—SWM Plan: Programmatic Elements and Regulatory Compliance

8.1 Introduction

For the last two years Mason County has been undertaking the development of a comprehensive County-Wide Stormwater Management (SWM) Program. The elements of this program include:

- Updating the County's SWM related Policies and Ordinances,
- Development of Stormwater Management Plans for the areas of Belfair, Allyn, and Hoodsport, and the
- Development of a County-Wide SWM Program, with a dedicated funding mechanism.

This report is the regional SWM Study for the Hoodsport RAC. The intent of this plan is to:

- Assess the capacity of the existing drainage system,
- Plan for growth by projecting the runoff from new development over the next six years,
- Provide guidance for new development and redevelopment to ensure future design criteria support this SWM Plan and continue to support local economic development,
- Assist the County in achieving compliance with existing regulatory requirements, including the Puget Sound Water Quality Management Plan (PSWQMP) and address local water quality issues, as recorded in local TMDLs issued by Ecology,
- Provide advance planning to the County in anticipation of its future NPDES Phase II Municipal Stormwater Permit, that contains regulatory requirements similar to those of the PSWQMP, and
- Protect local and regional water quality, habitat, and groundwater functions and resources.

8.2 Strategy to Manage Existing and Future Runoff

The recommended strategy and proposed programmatic initiatives and capital project to manage existing and future runoff have been previously discussed in Sections 6 and 7. In general the recommended SWMP for the Hoodsport RAC includes:

- Enhanced maintenance at three locations,
- The design and construction of two conveyance enhancements,
- The construction of retrofit facilities to treat runoff from 0.8 acres of County road, and
- The adoption of an LID ordinance and the 2005 Ecology Manual.

8.3 Review of County's Existing SWM Program

Programmatic Overview

Mason County is in the process of conducting a review of the existing stormwater management program for the Hoodsport RAC, as well as for the entire County. This review will document existing SWM activities, legal authorities, staffing, resources and equipment. During this review a regulatory gap analysis will be preformed, comparing the existing Hoodsport SWM Program with its existing SWM responsibilities and obligations.

The County's existing annual SWM Program within the Hoodsport RAC consists primarily of annual maintenance (of about $25K per year) and development related review, construction, and inspection/enforcement services, as paid for through developer permit fees. Additional SWM activities provided on an as needed basis include:

- Response to spills and complaints,
- Comprehensive land use planning,
- Participation in local and regional planning,
- Annual maintenance, and
- Public education and involvement.

One of the purposes of this study is to review the County's existing levels of funding and staffing to determine its effectiveness and adequacy to address local drainage issues and regulatory compliance. Once defined, it is anticipated that the Hoodsport SWM Program will be enhanced and incorporated into the County's larger comprehensive SWM Program. It is anticipated that the SWM Program for Hoodsport RAC will be one of the elements of the Countywide SWM Program, and will benefit from future County funding and staffing appropriations. Increased funding for SWM throughout the County is currently being considered to support the County's growing SWM obligations and regulatory compliance needs.

Existing SWM Policies and Legal Authority

As part of the analysis of the County's existing SWM Program, a review was completed of the County's stormwater management policies, as presented in the updated SWM policies included in the County's Comprehensive Plan. These updated policies were presented to the Planning Commission and adopted by the County BOCC in December 2006.

In addition to these updated SWM policies, other existing legal authorities were also reviewed, including the County's use of the 1992 Ecology Manual, and the recently adopted small parcel drainage requirements. The County is also considering adoption of an LID ordinance, along with the adoption of the 2005 Ecology Manual.

Review of the County's existing code suggests that current legal authorities will not be adequate to fully implement the proposed SWM Plans for Hoodsport, Belfair, and Allyn. Existing codes, design manuals and legal authorities will need to be expanded and updated to satisfy exiting and future water quality and regulatory compliance needs, as well as develop needed funding. Implementation of the Countywide Comprehensive Stormwater Management Plan, and the associated specific SWM Plans for Allyn, Belfair, and Hoodsport, will need updated legal authorities for the successful implementation. The specific legal authorities needed will be identified in the upcoming County-wide Regulatory and SWM Program Gap Analysis, soon to be undertaken by the County as part of the broader county-wide comprehensive stormwater management planning process that is currently underway.

8.4 Regulatory Compliance: Regulatory Gap Analysis

Overview

Compliance with the Puget Sound Water Quality Management Plan

There are a series of existing regulatory requirements related to stormwater management, water quality, and habitat that apply to the Hoodsport RAC. The most significant are the municipal stormwater elements of the Puget Sound Water Quality Management Plan (PSWQMP), and its associated 2007-2009 Conservation Plan. Compliance with these requirements consists of addressing thirteen different municipal stormwater management program elements including:

1. Stormwater controls for new development and redevelopment
2. Stormwater site plan review
3. Inspection of construction sites
4. Maintenance of permanent facilities
5. Source control
6. Illicit discharges and water quality
7. Identification and ranking of problems
8. Public involvement and education
9. Low impact development practices
10. Watershed or basin planning
11. Funding

12. Monitoring
13. Schedule for implementation

Other existing requirements may include local water quality TMDLs, which for the receiving waters in and around the Hoodsport RAC do not currently exist. There are, however, concerns about the impacts of continued and increased stormwater discharges to the local water quality of Hood Canal and the shellfish beds in nearby natural and commercial rearing areas. Elevated concentrations of coliforms have been documented by Ecology in nearby Annas Bay.

National Pollution Discharge Elimination System Phase II Municipal Stormwater Permit

Preparing the County for compliance with a future Phase II NPDES Municipal Stormwater Permit requires the County to add stormwater programmatic elements to its existing annual SWM Program, many of which are the same as those required under the PSWQMP. Future compliance with the NPDES Phase II Permit will include:

- Developing and conducting a public education program,
- Implementing a public involvement program,
- Initiating an illicit discharge detection and elimination program,
- Adopting the 2005 Manual and maintaining effective and responsive development review program, that includes inspection and enforcement, especially for erosion control,
- Conducting annual maintenance consistent with the protocols and frequencies listed in the Phase II Permit, and
- Setting up a comprehensive stormwater management program, and conducting annual reporting and assessments of program effectiveness using adaptive management.

SWM Activities Needed for Compliance with PSWQMP and NPDES Phase II Permit

Due to the similarities of the PSWQMP and the Phase II NPDES Permit, and the likelihood of the County will be receiving an NPDES Phase II Permit within the next few years, the following regulatory gap analysis has been performed and will be used to develop the comprehensive SWMP for the Hoodsport RAC. These NPDES Phase II requirements were issued in January of 2007 to most, smaller municipalities (with populations less than 100,000) throughout the State. The requirements are grouped into nine stormwater management program (SWMP) elements. A brief summary of the requirements of each element, its applicability to the County, and recommended actions for the Hoodsport RAC, are provided below.

SWMP Element #1—Public Education and Outreach

Develop and implement a public education and outreach program designed to achieve measurable improvements in stakeholders understanding of stormwater pollution sources and impacts and what they can do to address these issues. The program needs to include efforts to measure the results of any education activities as well as maintaining records of activities undertaken.

Applicability:
Public education and outreach is an effective and low-cost method for addressing stormwater pollution issues within the County and can be focused on those specific issues relevant for the Hoodsport RAC, especially those related to existing water quality impairments such as fecal coliform contamination and low dissolved oxygen levels.

Recommended Actions:
Develop and distribute a County-wide brochure for the public that addresses stormwater pollution issues and what homeowners can to do to help solve them. Ensure it covers those issues specific to the Hoodsport RAC, including the benefits of low impact development (LID). Consider the use of the Puget Sound Action Team's recently updated general education brochure on LID, which is available at no charge on its web site.

SWMP Element #2—Public Involvement and Participation

Develop and implement a public involvement and participation program to create ongoing opportunities for the public to participate in the decision making processes involved in the development, implementation and update of the SWMP and make all program documents available on the County website.

Applicability:
Public involvement and outreach is vital to the success of stormwater management and compliance with regulations. There is an increasing realization that government programs with limited resources cannot do the job alone and that citizens share the responsibility of finding, funding, and implementing solutions to local stormwater problems. It is equally important to keep the public informed about program goals, objectives, priorities, available resources, and strategies.

Recommended Actions:
Engage the local stakeholders of the Hoodsport in SWM planning and implementation within the Hoodsport RAC. Organize volunteers to assist in the development of a Stream

Team for Finch Creek and Hill Creek, regional surface water management water quality monitoring, and facility inventory and mapping.

SWMP Element #3—Illicit Discharge Detection and Elimination (IDDE)

Develop and implement an ongoing program to detect and remove illicit discharges and spills to the County's stormwater system. The program needs to include system mapping, an ordinance to prohibit such discharges that includes escalating enforcement procedures and actions, field assessment procedures and activities, and procedures for characterizing discharges, tracing sources, notifying the appropriate parties, and removing sources.

Applicability:
Due to the small amount of stormwater infrastructure within the Hoodsport RAC and the relatively high expense of program development and implementation, this element is not being considered for the Hoodsport SMW Plan at this time. If spills or obvious pollution does occur these should be reported to Ecology for cleanup and possible enforcement activities.

Recommended Actions:
Illicit discharge and spill education is a topic that can be incorporated into products developed under SWMP Public Education Element #1. An element of the IDDE requirement that would be useful in the short-term is an accurate inventory of facilities and a survey of key drainage facilities electronically recorded in the County's GIS/mapping system. This could be done in annual increments over the next few years.

SWMP Element #4—Controlling Runoff from New Development, Redevelopment and Construction Sites

Develop and implement a program designed to reduce pollutants in stormwater runoff. The program needs to include a stormwater runoff control ordinance that allows the use of low impact development (LID) and specifies site plan review and permitting processes. It also needs to establish maintenance standards and regulations to enforce long term operations and maintenance of facilities.

Applicability:
The County currently operates under an existing stormwater runoff control ordinance and conducts development review and inspection activities for new development, redevelopment and construction sites. The County recently worked with the Puget Sound Action Team under its LID Local Regulation Assistance Project to develop recommendations on how to incorporate the use of LID into its existing regulations. A draft ordinance was developed and

is currently under internal County review. The County is also considering the adoption of the Ecology 2005 Manual using a phased approach that focuses on the more urban and urbanizing areas of the County.

Recommended Actions:
For the Hoodsport RAC, the County needs to update its current SWM ordinance and adopt standards that are consistent with the requirements of the 2005 Ecology Manual, and support the use of LID for new development. To do this, additional training on 2005 Ecology Manual and LID, will likely be required for both County staff and local developers.

SWMP Element #5—Pollution Prevention & Operations/Maintenance for Municipal Operations

Develop and implement an operations and maintenance program designed to prevent or reduce pollutant runoff from municipal operations. The program needs to include establishment of maintenance standards, policies and procedures, inspections, maintenance practices, staff training, and recordkeeping.

Applicability:
Due to the small amount of stormwater infrastructure within the Hoodsport RAC and the relatively high expense of program development and implementation, enhancement of the County's existing level of maintenance is not being recommended for the Hoodsport SWM Plan at this time, except at known problem areas such as;

- N. North School House Road, and
- North Finch Creek Road.

Recommended Actions:
Review the adequacy of current annual maintenance practices and their effectiveness. Annually review and update their effectiveness to improve water quality.
Maintain the County's existing level of maintenance effort within the Hoodsport RAC; enhance frequency of inspection and maintenance of known problem areas, as discussed in Section 7.

SWMP Element #6—Stormwater Management Program Implementation

Develop and implement a stormwater management program (SWMP) consistent with permit requirements. to the Hoodsport RAC The SWMP needs to include program cost tracking and coordination mechanisms and be designed to reduce the discharge of pollutants to the Maximum Extent Practicable (MEP), meet All Known, Available, and Reasonable methods of prevention, control and Treatment (AKART).

Applicability:
The County is not yet subject to the NPDES Phase II permit requirements, however, it understands the value of tracking SWMP implementation activities for the purposes of annual reporting, so that they can be used as part of an adaptive management strategy to help annually measure the effectiveness of the SWM Program.

Recommended Actions:
Develop and implement a routine tracking system for County SWMP implementation that includes the SWM activities associated with the Hoodsport SWM Plan. Evaluate annually using adaptive management and make annual refinements as needed.

SWMP Element #7—Total Maximum Daily Load (TMDL) Allocations

The Phase II permit requires compliance with established TMDLs identified in Appendix 2 of the permit.

Applicability:
There currently are no established TMDLs for the receiving waters within the Hoodsport RAC; however, there are depressed dissolved oxygen and elevated fecal coliform concentrations along the shoreline of Hood Canal, according to Ecology and County Department of Health reports.

Recommended Actions:
Strategies to protect surface waters from water quality degradation are included in recommended actions of other SWMP elements, including the adoption of the 2005 Ecology Manual and development/adoption of an LID ordinance. Local water quality monitoring of major outfalls has been recommended in SWM Element #12 to assess impacts of stormwater and the effectiveness of existing SWM controls and practices.

Note that current discussions are underway for the County to develop, fund, and implement a countywide program to retrofit the runoff from existing development using bio-retention and other LID types of facilities. The Hoodsport RAC, along with the GMA areas of Allyn and Belfair are being targeted as high priority areas for this type of water quality enhancement program. (Constructing one of these types of LID facilities within the Hoodsport RAC would cost about $40K per year; the design and construction of a couple of these facilities within Hoodsport RAC may be possible using the funds within the $750K grant recently received by the County from Ecology.)

SWMP Element #8—Monitoring (of SWM Program)

The Phase II permit requires an assessment of the appropriateness of best management practices (BMPs) in the SWMP and any changes made or proposed to those previously selected. It also specifies steps to be taken in preparation for future stormwater monitoring in the next permit cycle, which starts in 2012.

Applicability:
Annual assessments of the appropriateness and effectiveness of the BMPs to be implemented as part of the SWMP are recommended as part of the tracking and evaluation activities identified in SWMP Element 6—Stormwater Management Program Implementation. Water quality monitoring is also addressed in SWMP Element #12.

Recommended Actions:
As the Countywide SWM Program is established over the next several years, an annual monitoring program to review the effectiveness of individual SWMP activities should be established; the SWMP modified as needed on an annual basis using the principals of adaptive management.

SWMP Element #9—Reporting

The Phase II permit requires that permittees submit annual reports that include its SWMP, formal report forms that summarize the status of implementation, progress toward meeting minimum performance standards, and description of activities, an implementation schedule and a summary of its SWMP evaluation.

Applicability:
The County is not yet subject to these requirements of the Phase II permit, however, as mentioned in SWMP Element #6—Program Implementation, there is value in the tracking of SWMP implementation activities for the purposes of annually evaluating SWM Program effectiveness. The annual SWM Program effectiveness evaluation could also be used as part of an adaptive management strategy to help document the effectiveness of the existing SWM Program. Annual reports are also useful for informing the public and elected officials of implementation progress and results.

Recommended Actions:
Develop and implement an annual internal reporting system for County SWM Program implementation that includes the SWM activities contained within the recommended Hoodsport SWM Plan. Review and refine the program annually using adaptive management.

Required for Consistency Between NPDES II and PSWQMP
Note that the requirements of the NPDES II Permit are similar in many ways to the requirements of the PSWQMP. However, there are elements that are specifically stated in the PSWQMP that are not specifically spelled out in the Phase II Permit. These include conducting watershed or basin planning, creating adequate local funding, and implementing annual water quality monitoring to assess program effectiveness. To ensure consistency of the County's response to the various stormwater requirements, the following three elements from the PSWQMP should also be included in the recommended Hoodsport SWM Plan. Similar to the above permit requirements, those listed below within SWMP Elements 10, 11, and 12, should also be included in the recommended SWMP for the Hoodsport RAC.

SWMP Element #10—Watershed or Basin Planning
The PSWQMP calls for the use of watershed or basin planning processes to identify and rank existing problems that degrade water quality, aquatic species, habitat, and natural hydrological processes; this element of the Plan also calls for the development of action plans/schedules, along with the identification of funding strategies to fix local drainage problems.

Applicability:
The development of the Hoodsport SWM Plan fulfills this requirement since it based on both basin characterization and problem assessment within the Hoodsport RAC. Both capital and programmatic recommendations are included in the recommended Plan, together with implementation costs, schedule, and funding strategy to address regulatory SWM obligations and water quality and habitat needs.

Recommended Actions:
This Hoodsport SWM Plan and the County's larger evaluation of its SWM needs and funding is consistent with this requirement. Implementation of the recommended actions described in the various SWMP Elements presented in Section 8 demonstrates the initial benefits of conducting local basin planning.

SWMP Element #11—Funding

The PSWQMP calls for the creation of funding capacity, such as a utility, to ensure adequate, permanent funding for SWM program activities and regional stormwater projects.

Applicability:
Developing and maintaining an adequate level of annual local funding is the key to the long-term success of the program and the support of an effective capital improvement program. Creating adequate local funding is the focus of the financial analysis presented in the following section.

Recommended Actions:
Work with local citizens to create a stormwater management utility throughout the Hoodsport RAC (and urban areas throughout the County). Also explore the development of a system development charge for new development and redevelopment to help the County off-set some of the costs of building the larger regional conveyance systems and water quality treatment systems that will be needed in the future.

SWMP Element #12—Water Quality Monitoring

The PSWQMP calls for monitoring of program implementation and environmental conditions and trends over time to measure the effectiveness of program activities and to share the results with others.

Applicability:
The need for program effectiveness and water quality monitoring within the Hoodsport RAC is discussed in SWMP Elements #6—Program Implementation, #7—TMDLs, and #8—Monitoring as well as in Section 8.5 Water Quality, Habitat, and Shellfish Needs.

Recommended Actions:
Implementation of an annual monitoring program (programmatic in nature; i.e. not involving any water quality monitoring) to track progress and assess effectiveness is recommended, as described in the various SWMP Elements and as presented in Section 8, is recommended.

At this point in time, consistent with the Allyn and Belfair SWM Plans, water quality monitoring will consist primarily of documenting the effectiveness of LID retrofit facilities that are being designed to treat existing runoff.

In the future, as funding allows, water quality monitoring of major outfalls, as well as the effectiveness of annual maintenance and development review practices, should be considered by the County. This monitoring program should be annually tailored to focus on local flooding problems and water quality priorities, if local TMDLs have not been established by Ecology.

8.5 Guidance for Future Development/Redevelopment

The County's existing design criteria for stormwater are based largely on the 1992 Ecology Manual. When the County was more rural that level of treatment may have been adequate, however, as urban centers have emerged throughout the County pollutant loadings have increased and impacts to water quality, fish habitat, and shellfish rearing areas have been documented. It is widely understood that untreated or inadequately treated surface water runoff, particularly from the more intensely developed areas, may be a major contributor to these problems in local receiving waters.

Adoption and the routine use of the most current design criteria are needed to reduce the loadings of additional pollutants from new and redevelopment. This SWM Plan for the Hoodsport RAC has been based on the latest stormwater management techniques, as described in the 2005 Ecology Manual. It is strongly recommended that the County adopt these same design standards for all future development and redevelopment within the Hoodsport RAC, along with the County's proposed LID ordinance.

Recommended SWM Plan: Programmatic Elements
Adoption of the 2005 Ecology Manual and LID ordinance is strongly recommended to address both local flow and potential water quality related problems.

8.6 Regional Water Resource Planning

As summarized in Section 1.5 there are a number of planning initiatives underway within the region that collectively influence the development and implementation of policy and regulation related to water resource management that are discussed below.

- The Washington State Department of Ecology conducts water quality assessments and categorizes water bodies depending on water quality conditions. These assessments are published in Ecology's 303(d) list and generally show elevated concentrations of coliforms and other pollutants being generated within urban areas

and being discharged directly into local receiving waters with little to no advance water quality treatment.

- The Washington Department of Health, Office of Shellfish Programs also conducts water quality monitoring of shellfish growing areas for the purposes of classification. Many historical shellfish rearing areas, both commercially and recreationally, are being impacted by stormwater runoff, including the Annas Bay and Oakland Bay areas where shellfish harvesting has been curtailed due to elevated coliform concentrations.
- In the Hoodsport area, along with other areas of Puget Sound, salmon recovery planning has been conducted by the Shared Strategy for Puget Sound. This is a voluntary coalition of federal, tribal, state and local governments and business and environmental organizations that is working to protect and restore regional salmon populations. The National Marine Fisheries Service (NMFS) of the National Oceanic and Atmospheric Administration (NOAA) has worked with the Shared Strategy to produce a recovery plan for Puget Sound Chinook that was adopted on January 19, 2007. The Puget Sound Salmon Recovery Plan is built on the foundation of fourteen local watershed planning areas across Puget Sound, with a tailored approach for recovery based on local characteristics.
- To coordinate government actions for protecting and restoring Puget Sound, the Washington State legislature enacted Chapter 90.71 RCW, Puget Sound Water Quality Protection. Under this authority, the state developed the Puget Sound Water Quality Management Plan, which is the state's long-term strategy for managing and protecting the Sound and coordinating the roles and responsibilities of federal, state and local governments. Each biennium a work plan is developed (2007-2009 Puget Sound Conservation Recovery Plan) that prescribes the necessary federal, state and local actions needed to maintain and enhance Puget Sound water quality.
- The Puget Sound Action Partnership defines, coordinates, and implements Washington State's environmental agenda for Puget Sound and has been providing leadership in the area of low impact development (LID). LID is a more environmentally sensitive approach to developing land and managing stormwater runoff. Many jurisdictions in Puget Sound are turning to LID techniques to help protect their waters and natural resources. Between 2005 and 2006, the Puget Sound Action Team lead a project to help twelve cities and seven counties, including Mason County, integrate low impact development into their regulations and development standards. A draft ordinance was developed for Mason County and is currently under review.
- The Watershed Planning Act (RCW 90.82) provides local governments a framework and resources for developing local solutions to watershed issues on a watershed

basis. The watershed plans are required to address water quantity with optional elements of water quality, habitat, and flood control. The Hoodsport RAC is located within Water Resource Inventory Area (WRIA) 16, the Skokomish-Dosewallips watershed. A draft watershed plan for WRIA 16 has been developed, but has not yet been approved by all parties, and is currently awaiting implementation.

Summary of Recommended SWM Plan: Programmatic Elements

The County plans on taking the initiative to develop a comprehensive stormwater management program for the Hoodsport RAC that involves a programmatic approach to stormwater management as described in the PSWQMP, that includes the enhancement of development criteria (by the adoption of the Ecology 2005 Manual and an LID Ordinance), as well as the enhancement of annual maintenance procedures and practices, as described in this SWM Plan. The County will continue to participate in regional coordination efforts and in making additional SWM program enhancements in a phased approach, as more knowledge of the relationship of stormwater discharges to local and regional receiving waters is acquired.

8.7 SWM Programmatic Elements: Priorities and Costs

Recommended SWM Programmatic elements listed above have been summarized along with annual costs in Table 8-1. These activities represent an enhancement of the County's existing SWM Program within the Hoodsport RAC. They emphasize the need to control/guide new development, enhance maintenance where needed, conduct annual program monitoring, and initiate a local public involvement/education program. Annual costs for these SWM Programmatic Elements averages about $70,000 per year, and are addition to resources the County is planning to spend within the Allyn and Belfair UGA areas, as part of the initial phase of the development, implementation, and funding of the County-Wide SWM Program.

Table 8-1—Recommended SWM Programmatic Elements and Costs											
SWMP Element	Recommended Action	Satisfies Program Needs			Costs ($1,000's)						
		PSWQMP	NPDES PhaseII Permit	WQ Habitat Shellfish	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Yr 6	Total
1	Public Education* - SWM (LID) Brochure	X	X	X	$5	$5	$5	$5	$5	$5	$30
2	Public Involvement* - Organize Volunteers/Mtgs	X	X	X	$10	$10	$10	$10	$10	$10	$60
3	Illicit Discharges (IDDE) - Facility Inventory & Mapping	X	X	X	$0	$10	$10	$10	$0	$0	$30
4	New Development - Ordinance - 05 DOE Manual - Ordinance - LID	X	X	X	$0*	$0*	$0*	$0*	$0*	$0*	$0*
	- Training - 05 Manual - Training - LID	X	X		$0*2	$0*2	$0*2	$0*2	$0*2	$0*2	$0*2
5	Maintenance - Annual (Inc. Enhancements)	X	X	X	$25	$25	$25	$25	$25	$25	$150
6	SWM Program* Implementation - Develop Tracking System	X	X		$5	$5	$5	$5	$5	$5	$30
	- Annual Program Evaluation	X	X		$5	$5	$5	$5	$5	$5	$30
7	TMDLs		X	X	$0	$0	$0	$0	$0	$0	$0
8	SWM Program Monitoring (Addressed in Element #6)	X	X		$0	$0	$0	$0	$0	$0	$0
9	Reporting* (Internal)		X		$5	$5	$5	$5	$5	$5	$30
10	Basin Planning (Part of current Co. study.)	X		X	$0*	$0*	$0*	$0*	$0*	$0*	$0*
11	Funding - Develop SWM Utility	X			$0*	$0*	$0*	$0*	$0*	$0*	$0*
	- SDC Feasibility Study	X			$0*	$0*	$0*	$0*	$0*	$0*	$0*
12	WQ Monitoring - Annual WQ Monitoring	X		X	$5 *3	$5 *3	$5 *3	$5 *3	$5 *3	$5 *3	$30
	Total:				$60	$70	$70	$70	$60	$60	$390
*Future County Staff (~ 0 FTE)					$0*4	$0*4	$0*4	$0*4	$0*4	$0*4	$0
Outside Services					$5	$5	$5	$5	$5	$5	$30
Total Annual Budget					$65	$75	$75	$75	$65	$65	$420

* - Activity included in the development and implementation of the Countywide SWM Program; no additional funding needed at the local planning level.
*2 – Development Review labor is paid by developer fees; no additional county funding is required.
*3 – The emphasis of the water quality monitoring program is to evaluate the effectiveness of water quality retrofit bio-retention facilities installed in road right of ways to treat existing runoff. Labor for WQ monitoring of these facilities to determine their effectiveness will be provided by volunteers; costs included are primarily for laboratory related analyses.
*4 – County staffing required to administer the Hoodsport annual SWM Program would be included in the administration and management of the County-wide SWM Program; approximately $15K, (or about 0.20 FTE , equivalent to 400 hours, or about 10 weeks per year), has been set aside for annual tracking, program evaluation, and reporting in SWM Elements #6 and #9.

Recommended SWM Plan: Summary of Elements and Costs

It is suggested that the programmatic SWM elements identified above be developed and integrated with the proposed capital improvements proposed to create a Comprehensive Stormwater Management Plan for the Hoodsport RAC. Total SWMP costs for the next six years, including both capital and programmatic needs, amount to $843,000. Annual SWM costs are about $140,000, $70,000 per year for the SWM programmatic elements, as shown in Table 8-1, and $70,000 per year for the capital elements, as shown in Table 7-2. Annual costs and funding analysis are presented in the implementation plan presented in the following section.

Recommended SWM Plan: Integration with Countywide SWM Program

The funding and implementation of the Hoodsport SWMP is only one aspect of a much larger, integrated countywide SWM Program that is currently under consideration. The concept of the County is to develop a comprehensive SWM Program throughout the County over the next five years. The program would initially focus on the most urbanized areas, including the Allyn and Belfair Growth Management Areas and the rural activity centers of Hoodsport and Taylor Town I and II.

The program, complete with the adoption of the 2005 Manual and a Low Impact Development Ordinance, along with the generation of local funding, such as a stormwater utility, would be implemented by phasing in stormwater management requirements annually, according to the following five phases:

- Phase I – Allyn and Belfair Urban Growth Areas
- Phase II – Hoodsport and Taylor Town I and II Rural Activity Centers
- Phase III – Water Quality and Shellfish Sensitive Areas
- Phase IV – Shoreline areas
- Phase V – The remaining unincorporated areas of the County

As noted above in the listing and estimate of SWM Programmatic costs for the Hoodsport SWMP, many of the administrative and management costs of the Hoodsport SWMP will be supported by the larger, centrally funded Countywide SWM Program. The Countywide SWM Program would be supported by dedicated SWM staff that would be responsible for the Hoodsport SWMP, as well as the administration and implementation of SWM planning throughout the County.

Section 9—Costs, Funding and Implementation

9.1 Introduction and Overview

The intent of this section is to address the annual revenue needs identified in the recommended SWM Plan for the Hoodsport RAC.

- The first part of this analysis combines the capital and programmatic SWM needs, as identified previously in Sections 7 and 8 respectively, so that total annualized costs can be identified in Section 9.2.
- Section 9.3 summarizes the short and long term SWM program and capital needs, and presents annualized costs to revenue needs for the next six years.
- Funding alternatives are reviewed and preferred revenue options and recommendations are selected and presented in Section 9.4.
- Section 9.5 assesses the adequacy of potential revenue sources and identifies revenue gaps that may be anticipated in the future. The funding analysis concludes with an evaluation of the adequacy of the proposed revenue sources to address the future stormwater management needs within the RAC.

9.2 Recommended Hoodsport SWM Plan: Funding and Implementation

Hoodsport SWM Plan: Program Elements, Priorities, Schedule and Costs

Annual Revenue Needs

The Comprehensive SWM Program for the Hoodsport RAC has been created by integrating the capital needs/costs identified in Section 7 with the programmatic and regulatory compliance needs/costs presented in Section 8. The recommended plan includes a combination of programmatic activities and capital improvement projects over the next six years, 2009 to 2012.

- Total SWMP costs for the next six years, including both capital and programmatic needs, amounts to $840,000 or about $140,000 annually.
- Capital projects consist of four projects that total $423,000 (rounded to $420,000), or about $70K annually. *(Note that these costs do not include water quality retrofit projects; the retrofit projects will be included in the County-wide Stormwater Management Program.)*
- Programmatic and regulatory compliance needs include various activities ranging from public education/involvement to SWM Program monitoring, and include the adoption of new ordinances, development of new funding mechanisms, completion of inventory and GIS mapping of existing drainage facilities, along with a number of other SWMP activities. Programmatic costs have been estimated to be $420,000 over the six years or about $70,000 annually.

The funding/revenue needed to implement the recommended SWMP for the Hoodsport RAC is presented below in Table 9-1.

Table 9-1—Financial Plan for the Hoodsport Stormwater Management Plan Annualized Revenue Needs Over the Six Year Planning Period							
Relative Priority for Implementation	Schedule & Costs by Years ($1000s)						
	1	2	3	4	5	6	Total
SWM Programmatic Needs	$65	$75	$75	$75	$65	$65	$420
SWM Capital Needs	$70	$70	$70	$70	$70	$70	$420
Total*	**$135**	**$145**	**$145**	**$145**	**$135**	**$135**	**$840**

*Average Annual SWM cost for years #1-6 is $420K/6 years = $140K per year.

Funding Analysis

Presented in Table 9-1 is an estimate of the cost of the recommended SWM Plan for the Hoodsport RAC. New revenue is needed over the next six years to support programmatic initiatives, as well as over the next 20 or more years to support both future programmatic and capital projects that will be needed to support ultimate buildout.

SWM Policies Guide Selection of Financial Options

The SWM management policies and approaches preferred by the County, as presented in this plan, play a large role in determining the funding strategies to implement the proposed SWM Plan for the Hoodsport RAC. In general, the proposed funding strategy has been guided by the following policies and technical decisions that have been created to manage stormwater within the Hoodsport RAC:

- Low impact development will be required for all new development and redevelopment.
- No regional detention facilities will be created to accommodate either existing or future development; if needed, detention will be provided onsite by each new developer on an as needed basis.
- New development/redevelopment will pay for the cost of onsite water quality treatment (per the adoption of the 2005 Manual by the County).
- New development/redevelopment may help pay for future regional conveyance facilities, as/if needed to support future growth through the establishment of SEPA mitigation and system developer charges.
- There are currently no major flooding or maintenance problems associated with the current drainage system within the Hoodsport RAC.
- Retrofitting existing homes and businesses for detention or water quality treatment has not been included at this time, but is currently being considered as part of the County's new stormwater grant from Ecology.

- As the County builds new roads within the RAC, the County will design and pay for some new water qualities retrofit systems that will be located within the County road right-of-ways to collect and treat road runoff.

Review and Evaluate Potential Funding/Revenue Options

Discussions with the County suggest that there are several financial options that should be considered to fund stormwater management within the Hoodsport RAC. A preliminary review of these potential funding sources suggests that multiple sources of funding will likely be needed; no single source of funding will likely be adequate by itself. Funding sources that are currently being considered include:

- **Formation of a Local Drainage/Stormwater Improvement District,** which would have an annual assessment usually based on assessed property value, or some other equitable means of establishing value and/or benefit to the various rate payers.
- **Real Estate Excise Tax (REET) Funding,** which currently amounts to about $750K per year for the County, and is currently being used to pay for a number of capital projects throughout the County. Securing periodic appropriations from REET funding for either capital or program needs may be available on an annual basis depending on other County project priorities.
- **Annual County Portion of State Sales Tax,** which has recently been raised from .08% to .09%; this will amount to about $450K per year for the County with the recent increase to 0.09 per cent.
- **Public Sector Funding,** such as grants and low interest loans from the State (Ecology or the Puget Sound Action Team) or federal government, including federal 319 Water Quality Grants, and the State Public Works Trust Fund and State Revolving Fund. While available, they potential funding sources are generally limited in duration and amount. They are also very competitive and have limitations regarding timing, applicability, reporting, and administrative costs.
- **Formation of a Local Stormwater Utility** throughout the Hoodsport RAC, where a monthly service fee is assessed to rate payers, often based on the amount of impervious area per parcel.
- **Continued collection and use of developer fees** to review and approve plans for new development and re-development, as well as conducting inspection and enforcement in the field.
- **System Development Charges (SDCs),** where any person moving into an upstream drainage area by the purchase of a home would be required to pay for a portion of the downstream collection, conveyance, detention, treatment, and outfall facilities that may be needed to support continued development within the drainage

basin. These would be assessed to the developer prior to the construction of the home during the County's permitting process.

- **SEPA Mitigation Funds,** which would be established on a per development basis as a project enters and is ultimately approved through the State SEPA review process. This has historically been used very successfully by the County for additional infrastructure that has directly resulted from new proposed development/ redevelopment.
- **Partnering with prospective developers,** land owners and other State agencies can be especially effective in establishing funding for larger regional drainage facilities. These are usually project-specific types of funding agreements based on use or contribution of stormwater runoff.
- **Other potential, but less likely sources of direct internal county funding,** include the General Fund, Road Fund, Park Fund and the Utility (Sewer) Fund; however, these funds are perhaps best used as potential sources for the *joint funding of projects* with common community purposes.

From this list of ten potential sources of funding, the most likely sources of new future funding for SWM within the Hoodsport RAC, in relative order of priority, are the following:

1. Forming a **Stormwater Utility** to support programmatic SWM activities.
2. Ensuring **developer and permit fees** are adequate to support development review, inspection, and enforcement services.
3. Using project related **SEPA mitigation** funding to support capital projects, especially those required by an increase in capacity within a regional conveyance system.
4. Establishing **System Development Charges** for new growth-related capital drainage projects; this is also another good source of funding for regional conveyance and/or treatment systems.
5. Annually appropriating a portion of Annual State **Sales Tax Returns**.
6. Securing periodic appropriations from **REET funding** for either capital or program needs.
7. Obtaining capital project funding, from **Future Road, Park, and/or Utility Projects,** with common objectives that include stormwater management opportunities.

Estimate of Potential Annual Revenues

Funding Source #1: Stormwater Utility

Type/Source of Funding: A monthly service fee to residences and businesses based on the amount of impervious area on each parcel. Rates are usually in the $6-$12 per month per equivalent rate unit (ERU).
Allowed Uses: These funds can be used for both capital and programmatic needs.
Estimated Annual Amount: $27,000
Assumes: 300 ERUs* in the Hoodsport RAC at $7.50/mo X 12 months = $27,000 per year; utility funding is good for both programmatic and capital costs.

**Note that ERU estimates are conservative; the actual ERU count may be as high as 350 or more, depending on future impervious area measurements. This would allow projected rates to be reduced or capital project funding to be accelerated.*

Funding Source #2: Developer and Permit Fees

Type/Source of Funding: These are the fees that developers pay for plan and permit review and approval by the County. These generally entirely paid for by developers with little to no subsidies from the County. These funds reimburse the County for development review staff time, as well as field time in the field during construction for inspection and enforcement.
Allowed Uses: Reimburses County for staff time; has limited direct cash value to SWM Program.
Estimated Annual Amount: $0 directly to SWM Fund (usually goes into the General Fund). These revenues support the SWM effort and pay for some of the regulatory compliance costs, but generally do not provide additional cash that can be used for other programmatic or capital needs.

Funding Source #3: SEPA Mitigation

Type/Source of Funding: These are payments made by developers to the County to mitigate the impacts associated with new development. These payments are usually project specific and are often used to provide additional supporting infrastructure such as access roads, or lighting, or downstream flow attenuation, or wetland impact mitigation.
Allowed Uses: Usually these payments go toward new capital facilities; normally not useful for addressing programmatic costs.
Estimated Annual Amount: About $20,000 per year. (The annual amount is difficult is predict since the County does not have a long history to track these types of payments.)

Funding Source #4: System Development Charges

Type/Source of Funding: These are specific payments that developers make to support drainage utilities and infrastructure within the region. They are common to support the extension of roads and water and sewer services to new developments. Lately, they have been growing in popularity and are used in the development of new revenue to help pay for new capacity in detention, treatment, conveyance capacity, and outfall drainage systems. Similar in some ways to a SWM utility in establishing a unit price for each residential unit, usually about $400-$600 per home, with new commercial developments paying more based on a measured number of equivalent residential units.
Allowed Use: These funds are primarily used of future capital improvements associated with future growth.
Estimated Annual Amount: $3,000 per year (over the next six years)
Assumes:

- 20 homes X $600/home = $12,000/6 years = 2,000 per year
- 10 business units X $600/unit = $60,000/6 years = $ 10,000 per year

Funding Source #5: Sales Tax Returns

Type/Source of Funding: These funds are provided to the County from the State based on a formula that distributes a portion of the State sales tax returns back to local governments. Recently, the per cent return has increased from 0.08 to 0.09%; annually this amounts to about $450K.
Allowed Uses: Could be used to address either capital or programmatic costs.
Estimated Annual Amount: $20,000

Funding Source #6: REET Funding

Type/Source of Funding: A portion of annual real estate sales throughout the County, as determined by the local real estate tax, are annually returned to the County. This currently amounts to about $750K per year.
Allowed Uses: These funds could go right into the SWM Fund for either capital projects or programmatic needs.
Estimated Annual Amount: About $20,000

Funding Source #7: Road, Park, Utility Common Capital Projects

Type/Source of Funding: When other departments of the County build capital projects, a portion of their project often is needed to address local drainage related impacts and needs. Some times these types of projects provide direct funding to SWM to build projects or the SWM fund could contribute to create larger drainage related projects that have regional benefits. A good example is when the Road Fund builds future roads in Hoodsport; the Road Fund will likely be used to pay for portions of the regional conveyance collection and/or treatment facilities proposed in the Hoodsport SWM Plan.

Allowed Uses: Primarily for capital project assistance.
Estimated Annual Amount: Estimated to be about $10K-$30K per year.

Summary of New Potential Annual Revenue Sources

(Creation of Multiple Funding Sources to Realize Needed Revenue)
By optimizing the revenue potential of the proposed SWM funding mechanisms, approximately $110,000 - $130,000 may be realized on an annual basis to support the development and implementation of the Hoodsport RAC SWM Plan, as shown in **Table 9-2.** Approximately $67,000 in annual programmatic funding and $100,000 to $120,000 in annual capital funding could be realized from these sources.

Table 9-2 Potential SWM Funding Sources and Estimated Annual Revenues

Funding Source	Potential Estimated Annual Revenue		
	Amount	Programmatic	Capital
#1: Stormwater Utility	$27,000	X	Ok for either
#2: Developer and Permit Fees	$0	---	---
#3: SEPA Mitigation	$20,000	---	X
#4: System Development Charges	$12,000	---	X
#5: Sales Tax Returns	$20,000	X	Ok for either
#6: REET Funding	$20,000	X	Ok for either
#7: Project-Specific Funding	$10K - $30K	---	X
Annual Total:	~$110K-$130K	~$67K	~$100K-$120K

Adequacy of Potential Future Funding Mechanisms

(Matching Available Funding with the Revenue Needs of the Implementation Plan)

Assessment of Proposed Stormwater Management Funding Strategy

The proposed Hoodsport SWM Plan totaling averaging $140,000 over each of the next six years is a reasonable level of funding that matches the local drainage needs, as well as the County's and community's ability to pay.

As shown in Table 9-2, estimated annual revenues from the above listed funding sources totals about $110K to $130K per year. With the annual capital appropriation of $70,000, the total average annual level of funding needed over the next six years is $140,000, and closely matches available resources, projected in above in Table 9-2.

While the overall funding is about $10K-$20K short per year, it is suggested that there is adequate funding for the $70K needed per year for the programmatic SWM activities, and about $50K-$60K per year for capital projects. If the four capital projects are completed over an eight year period rather than a six year period, the proposed level of funding would be adequate to meet the needs of the proposed Hoodsport SWM Program and this Hoodsport SWM Plan. Alternatively, in order to build the proposed capital projects within the next six years, the County may choose to prioritize the $70K to the capital projects and appropriate the $50K to programmatic SWM activities.

(Note that this initial funding analysis has not estimated any annual increases in the amount of annual funding available from each of the seven proposed funding mechanisms. It is likely that future funding from these sources will increase along with the increased annual funding needs of the Hoodsport SWM Program. Also, new funding mechanisms may present themselves as the SWM Program is implemented. For example, future grants would be an excellent way to augment these local funding mechanisms and should be actively and aggressively pursued. Additional funding analyses may be needed to substantiate and further refine this conceptual funding plan, as the various proposed funding mechanisms are developed, approved, and implemented.)

9.6 Findings and Conclusion

The Hoodsport RAC area is a unique geographic, environmental, and cultural area of Mason County. This SWMP has been prepared to fix deficiencies within the drainage infrastructure, assess proposed land uses and develop guidelines for new development, and assist the County in addressing existing and future regulatory requirements. In the course of doing this a financial plan has been developed to facilitate implementation with the primary intent of protecting and maintaining the unique water quality and habitat functions of the region.

Consistent with the State's Growth Management Planning process, this Stormwater Management Plan for the Hoodsport Rural Activity Center demonstrates that here is adequate local funding to develop and maintain the needed drainage infrastructure and associated SWM Program, as required to support continued economic development within the Hoodsport RAC.

Section 10—Public Review and Approval

10.1 Public Involvement Process

Meet and Greet with the County and the Port of Hoodsport

Mason County is planning an open house style of public meeting to review and receive comment on this proposed SWM Plan, with its proposed capital projects and funding sources. The public meeting and will be held in the Mason County conference room, located in the same building as the Board of Commissioner's meetings. This public meeting will be followed by a formal public meeting, to be held approximately two months after the public meeting.

Hoodsport Stormwater Questionnaire

In addition to the public meeting and public hearing, Mason County conducted a drainage survey for the Hoodsport Rural Activity Center and surrounding areas. The results of this survey were reviewed and used in the development of this Stormwater Management Plan. Participation in this survey was voluntary. A copy of the questionnaire and more detailed results are included as **Appendix B.** The surveys were sent out to all Hoodsport addresses and therefore covered areas that are outside of the RAC. The County received 103 filled out questionnaires.

10.2 Public Meeting

10.3 Formal Review and Approval Process

The remaining elements of the formal review and approval process include the following:

- Issuance of the draft SWM Plan to the public for additional comment.
- Presentation of the draft SWM Plan to the County Planning Commission for additional discussion, and potential edits and/or revisions.
- Presentation to the Board of County Commissioners.
- Another public meeting and public hearing to receive additional public comment prior to final review/approval by the Board of County Commissioners.

Appendix A — Culvert Inventory Data

Culvert Inventory Report
Schoolhouse Hill Road

Road #	Milepost	Waterway	Span	Length	Cpcty	Skew	Slope	Rise	Barrel Cond.
44360	0.197	CROSS-CULVERT	1.00	33.00		30.00	5.50	1.00	7
44360	0.598	CROSS-CULVERT	1.00	41.00		60.00	0.50	1.00	7
44360	0.759	CROSS-CULVERT	1.50	47.00		90.00	5.10	1.50	7

Culvert Inventory Report
North Hill Road

Road #	Milepost	Waterway	Span	Length	Cpcty	Skew	Slope	Rise	Barrel Cond.
45650	0.000	CROSS-CULVERT [CB]	1.00	161.00		10.00	1.60	1.00	7
45650	0.020	CROSS-CULVERT [CB]	1.00	30.00		80.00	10.30	1.00	7
45650	0.068	CROSS-CULVERT	1.00	44.00		30.00	13.60	1.00	9
45650	0.103	CROSS-CULVERT	1.00	48.00		30.00	10.20	1.00	9
45650	0.140	CROSS-CULVERT	1.00	68.00		60.00	4.70	1.00	7
45650	0.140	CROSS-CULVERT	1.50	73.00		60.00	5.80	1.50	7
45650	0.266	CROSS-CULVERT	1.50	45.00		90.00	4.20	1.50	9

Culvert Inventory Report
Finch Creek Road

Road #	Milepost	Waterway	Span	Length	Cpcty	Skew	Slope	Rise	Barrel Cond.
45140	0.012	CROSS-CULVERT [CB]	1.00	28.00		90.00	2.10	1.00	7
45140	0.049	PIPE DELETED	0.70			90.00		0.70	7
45140	0.089	CROSS-CULVERT	0.70	174.00		60.00	3.60	0.70	9
45140	0.126	CROSS-CULVERT [CB]	1.00	36.00		85.00	0.60	0.20	9
45140	0.144	CROSS CULVERT [CB]	1.00	30.00		85.00	0.70	0.20	9
45140	0.158	CROSS CULVERT [CB]	1.00	30.00		90.00	0.70	0.20	9

Culvert Inventory Report
Baskin Lane

Road #	Milepost	Waterway	Span	Length	Cpcty	Skew	Slope	Rise	Barrel Cond.
45430	0.093	CROSS-CULVERT [CB]	0.70	30.00		80.00	13.30	0.70	7

Culvert Inventory Report
Harrison Ave.

Road #	Milepost	Waterway	Span	Length	Cpcty	Skew	Slope	Rise	Barrel Cond.
45660	0.102	CROSS-CULVERT	1.00	27.00		90.00	0.40	1.00	7

Culvert Inventory Report
Old Mill Hill

Road #	Milepost	Waterway	Span	Length	Cpcty	Skew	Slope	Rise	Barrel Cond.
44110	0.016	CROSS-CULVERT	1.00	30.00		90.00	6.60	1.00	7
44110	0.090	CROSS-CULVERT [CB]	1.00	29.00		75.00	1.40	1.00	7

Culvert Inventory Report
Upper Finch Creek Rd.

Road #	Milepost	Waterway	Span	Length	Cpcty	Skew	Slope	Rise	Barrel Cond.
44880	0.007	CROSS-CULVERT	2.00	52.00		90.00	0	2.00	9
44880	0.007	CROSS-CULVERT	2.00	52.00		90.00	0.20	0.10	7
44880	0.183	CROSS-CULVERT	1.50	118.00		30.00	1.30	1.50	7
44880	0.515	CROSS-CULVERT	1.00	32.00		90.00	2.20	1.00	7
44880	0.532	CROSS-CULVERT	1.00	30.00		30.00	0.30	1.00	7

WSDOT culverts along US 101 near Hoodsport
Culvert information provided by WSDOT plans

WSDOT_ID	Station (m)	Diameter (in)	Length (ft)	Type	Comment
1	220+15	24	75	Reinf. Conc.	Culvert crossing 101
2	228+50	18	30	Reinf. Conc.	Culvert crossing 101
3	234+00	18	30	Reinf. Conc.	Culvert crossing 101
4	241+40	18	30	Reinf. Conc.	Culvert crossing 101
5	246+50	12	30	Plain Conc.	Drainage along west side of 101
6	244+50	NA	25	Conc. Slab Bridge	Finch Creek Crossing 101
7	246+50	12	30	Plain Conc.	Drainage along west side of 101
8	251+00	12	40	Plain Conc.	Drainage along west side of 101
9	253+75	3'x3'	52	Reinf. Conc. Box	Unnamed drainage crossing 101
10	256+85	18	30	Reinf. Conc.	Culvert crossing 101
11	258+30	12	20	Plain Conc.	Drainage along west side of 101
12	259+00	18	30	Reinf. Conc.	Culvert crossing 101
13	261+82	18	33	Conc.	Culvert crossing 101
14	265+00	18	36	Reinf. Conc.	Culvert crossing 101
15	268+40	3'x3'	70	Reinf. Conc. Box	Unnamed drainage crossing 101
16	271+20	18	48	Reinf. Conc.	Culvert crossing 101
17	277+17	18	42	Reinf. Conc.	Culvert crossing 101
18	279+50	18	45	Conc.	Drainage along west side of 101
19	280+60	24	42	Reinf. Conc.	Culvert crossing 101
20	289+00	12	21	Plain Conc.	Drainage along west side of 101
21	289+50	18	33	Reinf. Conc.	Culvert crossing 101
22	290+00	12	21	Plain Conc.	Drainage along west side of 101
23	294+10	8'x6'	60	Reinf. Conc. Box	Unnamed drainage crossing 101
24	295+50	12	42	Plain Conc.	Drainage along west side of 101

Appendix B — Stormwater Questionnaire

HOODSPORT RURAL ACTIVITY CENTER
STORMWATER PLAN
QUESTIONNAIRE

Mason County Public Works
415 N 6th Street
Shelton WA 98584
(360) 427-9670 ext. 450

Mason County is conducting a drainage survey for the Hoodsport Rural Activity Center. The results of this survey will be used in the development of a Stormwater Management Plan for Hoodsport. Participation in this survey is voluntary. If you wish to participate, please respond in writing.

The following questionnaire has been prepared to identify and evaluate drainage, flooding and/or stormwater quality problems within your area. After completing the questionnaire, fold it at the dashed lines, tape or staple it at the open end and place it in the mail. Postage is prepaid. Your cooperation and participation are greatly appreciated.

RESPONDENTS NAME(Optional): _____
PHONE NUMBER(Optional): _____
ADDRESS(Please Include): _____

1. How many years have you lived or conducted business at the above address? _____
2. Have you ever experienced flooding at this location? Yes _____ No _____
3. What type(s) of flooding have you experience? (Circle and describe below.)
   (a) Severe yard flooding of extended duration: _____
   (b) Severe street flooding of extended duration: _____
   (c) Flooding of business or residence: _____
   (d) Other (please describe): _____
4. What date(s) do you recall flooding occurring? If you cannot remember exact date(s), give approximate date(s). If you have no idea, leave blank. _____
5. What type of storm causes flooding of your property? (Circle and describe below.)
   (a) A short intense rain, such as a thunderstorm: _____
   (b) A long moderate rain: _____
   (c) A long heavy rain:_____
   (d) Other(please describe): _____
6. If your <u>house</u> or <u>business</u> experiences flooding, how often does it occur? (Circle appropriate answer.)
   (a) Four times a year
   (b) Twice a year
   (c) Once a year
   (d) Once every two years
   (e) Once every five years
   (f) Less than once every five years
7. If your <u>yard</u> or <u>parking lot</u> experiences flooding, how often does it occur? (Circle appropriate answer.)
   (a) Four times a year
   (b) Twice a year
   (c) Once a year
   (d) Once every two years
   (e) Once every five years
   (f) Less than once every five years
8. If your street experiences flooding, how often does it occur?(Circle appropriate answer.)
   (a) Four times a year
   (b) Twice a year
   (c) Once a year
   (d) Once every two years
   (e) Once every five years
   (f) Less than once every five years
9. Please name the streets and describe the locations that flood in your area: _____
   _____
   _____

10. What do you feel is the cause or major contributing factor to the flooding in your area? (Please describe.) _____
_____
_____

11. Are you aware of any water quality problems associated with stormwater runoff in your area? Yes _____ No _____ (Please describe.) _____
_____
_____
Possible source of pollution: _____
_____
_____

12. Please provide any additional comments you wish relating to drainage, flooding and/or water quality in your area: _____
_____
_____

(fold) ----------

(fold) ----------

(insert Pre-Paid Postage stamp)

Mason County Public Works
PO Box 1850
Shelton, WA 98584

Tape or Staple here

Tape or Staple here

Of the surveys mailed, 103 were returned. The following summarizes the results of those responses:

Respondents Name
69 survey respondents (67%) volunteered this information.
Phone Number
54 survey respondents (52.4%) volunteered this information.
Address
94 survey respondents (91.3%) volunteered this information.

1. How many years have you lived or conducted business at the above address
99 survey respondents answered this question, with the average being 12.9 years and the most frequently occurring response being 12 years.

2. Have you ever experienced flooding at this location?

91 survey respondents (88.3%) responded "No". It is important to note that several survey respondents marked "No", yet still answered questions 3-8 which relate to flooding.
9 survey respondents (8.7%) responded "Yes".
3 survey respondents (2.9%) gave no response.

3. What type(s) of flooding have you experienced?
3 survey respondents (2.9%) selected (a) Severe yard flooding of extended duration.
Of those, one described "3 times"; one described "flooding in driveway"; and one gave no description
2 survey respondents (1.9%) selected (b) Severe street flooding of extended duration.

Of those, one described "due to leaves in drain" and the other "winter rain turns to ice"
2 survey respondents (1.9%) selected (c) Flooding of business or residence.
Of those, one described "2 days" and the other "basement"
8 survey respondents (7.8%) selected (d) Other
Of those, one described "Finch Creek flooding - short duration"; one "yard flooding during peak rain/high tide for several hours"; one "sump pump under house"; one "in driveway and [puddle in cul de sac]"; one "When creek & tide are high it could go over Hwy 101"; one "neighbors yard floods (lower than ours)"; one "just flooding over HWY 101 on my way to work"; and one "run-off from road into garage".
88 survey respondents (85.4%) did not select any option.
Of those, one did note "drainage excellent in this area"

4. What dates do you recall flooding occurring?
8 survey respondents (7.8%) gave an answer. These were varied and were as follows:
Of those, one answered "2004"; one "Once every ten years"; one "during the Fall 1999 - present"; one "winter after heavy rain or snow and heavy rain"; one "rain (storms)"; one "Nov to March on heavy rain days"; one "2005?"; and one "[19]98(??)"

5. What type of storm causes flooding on your property?
1 survey respondent (1%) selected (a) A short intense rain, such as a thunderstorm
Respondent described "water stands in driveway"
1 survey respondent (1%) selected (b) A long moderate rain
Respondent gave no description
9 survey respondents (8.7%) selected (c) A long heavy rain
Of those, one described "Finch Creek and small tributary (front yard)", one described "at different times - driveway", and the remaining gave no description
92 survey respondents (89.3%) did not select any option

6. If your house or business experiences flooding, how often does it occur?
1 survey respondent (1%) selected (a) Four times a year
Respondent gave no description
1 survey respondent (1%) selected (b) Twice a year
Respondent gave no description
1 survey respondent (1%) selected (c) Once a year
Respondent gave no description
0 survey respondents (0%) selected (d) Once every two years

0 survey respondents (0%) selected (e) Once every five years
5 survey respondents (4.9%) selected (f) Less than once every five years
Of those, one described "if I remove the leaves and open the drain"
94 survey respondents (91.3%) did not select any option

7. If your yard or parking lot experiences flooding, how often does it occur?
3 survey respondents (2.9%) selected (a) Four times a year
Respondents gave no description
3 survey respondents (2.9%) selected (b) Twice a year
Respondents gave no description
2 survey respondents (1.9%) selected (c) Once a year
Respondents gave no description
0 survey respondents (0%) selected (d) Once every two years
0 survey respondents (0%) selected (e) Once every five years
3 survey respondents (2.9%) selected (f) Less than once every five years
Of those, one described "if I remove the leaves and open the drain"
1 survey respondent created their own option "(G) every time it rains"
91 survey respondents (88.4%) did not select any option

8. If your street experiences flooding, how often does it occur?
1 survey respondent (1%) selected (a) Four times a year
Respondent gave no description
2 survey respondents (1.9%) selected (b) Twice a year
Respondents gave no description
0 survey respondents (0%) selected (c) Once a year
0 survey respondents (0%) selected (d) Once every two years
0 survey respondents (0%) selected (e) Once every five years
2 survey respondents (1.9%) selected (f) Less than once every five years
Respondents gave no description

9. Please name the streets and describe the locations that flood in your area:
9 survey respondents (8.7%) named streets or described locations, these are as follows:
"101 N & Skokomish River"
"Flooding usually occurs in Finch Creek but sometimes occurs in small tributary when culverts become plugged along Finch Creek Rd"
"Further north near 27190 it floods there often. If the drain clogs it's a lake."
"I have a Rhody garden 1 1/2 ac. Also my driveway approx 400 ft. Both of these locations flood."
"I live on top of the hill oh School House Hill Rd. so the only flooding that occurs is in my driveway. On number 7#d I put a (G) every time it rains"
"It doesn't flood in my area, as we are up high Lake Cushman"
"Main fork Skokomish River"
"N. Standstill Dr. S. just pass the new fire hall"
"No flooding at residence on North Hill but have been isolated due to Skokomish River flooding Highway 101 & 106"
94 survey respondents (91.3%) did not name any streets or describe any locations.

10. What do you feel is the cause or major contributing factor to the flooding in your area?
9 survey respondents (8.7%) answered, these are as follows:
"Clear cutting, road building in upper watershed of So. Fork Skokomish River"
"Clear cutting upstream watershed"
"ditches need cleaning"
"Drainage is poor, it does not seep thru ground fast enough"
"Finch Creek was altered (late 1800s or early 1900s[)] from a meandering stream to a more or less straight channel. Also, land clearing and residential development and stream bank hardening."
"Hillside run off"
"If any were to happen it'd be "mother nature's RAIN""
"Land development behind me, and a creek that has been diverted."
"logging"
94 survey respondents (91.3%) did not answer.

11. Are you aware of any water quality problems associated with stormwater runoff in your area?

4 survey respondents (3.9%) responded "Yes"

Of these the answers were as follows:

"old septic system along Finch Creek"

"Bacterial contamination (fecal coliform) from failing sewage disposal systems. Some have been upgraded in past years."

"The culvert flowing from School House [R]oad under Finch Cr. Rd onto our property"

62 survey respondents (60.2%) responded "No"

Of these, one respondent answered "bird poop (Mother Nature again)"

37 survey respondents (35.9%) did not select either option

Of these, on respondent answered "people throwing debris in the creek up the hill behind the Tides Restaurant"

12. Please provide any additional comments you wish relating to drainage, flooding and/or water

33 survey respondents (32.0%) answered "none"

27 survey respondents (26.2%) had comments, these were as follows:

Few times during prolonged heavy rain, the culvert under Lake Cushman Rd (MP 5.7) becomes clogged and Keene Creek runs over the road rather than under it. This has happened perhaps twice in 18 years.

I have never experienced flooding within at least a 6 mile radius of my home.

I have none

It can rain 100 inches a year in this area, but being about 780 above sea level & with no major streams nearby - this rain is usually absorbed quite well - with nothing more than some short term puddles being formed.

I've never had any flooding in my area of Hoodsport - the water quality is fair to good

Live in Lake Cushman area

n/a

No ditches (culverts) along the road - water runs down the road into driveway

no flooding here

No flooding here.

No flooding problems at all. Excellent drainage.

No problem with flooding

Our area is fine!

See #9 (No flooding at residence on North Hill but have been isolated due to Skokomish River flooding Highway 101 & 106)

Skokomish Tribe Fishing with nets dead fish cleaning fish in canal dumping garbage-gas-oil-batteries sinking old boats [check] it out

Thank you for putting in new pipes and new [well]. It will help with water quality.

The ditches on Schoolhouse need to be cleaned out. I do mine - but some culverts are pretty constipated - yuk!

This area really needs to be looked at

We are above Lake Cushman and do not have flooding

We are fortunate to be on the slightly higher ground above the driving range

We are glad to see a move toward development of a stormwater management plan for this area.

We do not experience flooding here.

We have great drainage here in Lake Cushman

We have never experienced flooding anywhere near our business, nor have we seen flooding in the greater Hoodsport area EVER! Not only have I owned a business for 18 years, I have lived here for 40 years and the above comments still pertain.

When it rains heavily my septic fills quickly and it does not drain well and we will have back up when flushing toilet. It has to be heavy raining for days.

When the hatchery clears the gravel and sediment at the intake we have less flooding

You should ensure that the Cushman dams remain in place & in full operation to prevent downstream flooding

43 survey respondents (41.7%) did not answer this question.

Survey	Name (First)	Name (Last)	Phone	Address 1	Address 2	City	State	Zip	RAC
1	Blase	Cylwik		132 N Harrison Ave	PO Box 1806	Hoodsport	WA	98548	in
2	G Shepard	Houghton		27920 N Hwy 101		Hoodsport	WA	98548	
3				50 N Potlatch Pl		Hoodsport	WA	98548	out
4				N 70 View Dri		Hoodsport	WA	98548	out
5	Russell E.	Bubemyre		41 N Beaver Dr	PO Box 1900	Hoodsport	WA	98548	out
6	Katherine L.	Stafford		N 131 Beaver Dr	PO Box 903	Hoodsport	WA	98548	out
7	Hugo L.	VanPaassen		5811 N Lake Cushman Rd		Hoodsport	WA	98548	
8				24370 Hwy 101		Hoodsport	WA	98548	
9						Hoodsport	WA	98548	
10				23560 N Hwy 101		Hoodsport	WA	98548	
11	Richard & Anita	Greil		70 N Canal View Rd		Hoodsport	WA	98548	out
12				27210 N Hwy 101		Hoodsport	WA	98548	N of RAC
13	Maurice E.	Durbin	(360) 877-5980	851 N Potlatch Dr		Hoodsport	WA	98548	out
14	Hoodsport Family Clinic				PO Box 279	Hoodsport	WA	98548	
15	Russell V.	Twolly	(360) 877-5315	20 N Kokane Cove Way		Hoodsport	WA	98548	out
16				760 Dow Creek Drive		Hoodsport	WA	98548	out
17	J.W.	Kemp	(360) 877-5014	N 80 Kokanee Ridge Dr		Hoodsport	WA	98548	out
18				N 321 Marine View Dr		Hoodsport	WA	98548	out
19	Mary	Krisher	(360) 877-5087		PO Box 1183	Hoodsport	WA	98548	
20	James	Harris	(360) 877-6553	21 N Par Court		Hoodsport	WA	98548	out
21	John	Riggs	(360) 877-0111	41 Wynoochee Dr		Hoodsport	WA	98548	out
22	B.T.	Steinruck	(360) 877-9295	23540 N HWY 101		Hoodsport	WA	98548	
23	James	Ockerman	(360) 877-5702	380 N Olympic Way		Hoodsport	WA	98548	
24	Mike	Ritke		60 N Kokanee Ridge Dr		Hoodsport	WA	98548	out
25						Hoodsport	WA	98548	
26	Kay A.	Gere		610 Duckabush Dr. N.		Hoodsport	WA	98548	out
27	Joe & Gail	Cochran	(360) 877-5059	90 N Kimta Dr		Hoodsport	WA	98548	out
28				33 N Oxbow Pl		Hoodsport	WA	98548	out
29				460 N Duckabush Dr E		Hoodsport	WA	98548	out
30	Gene	Langford	(360) 877-9543	130 N Mt Noyes Way		Hoodsport	WA	98548	out
31	Isabel R.	Hobson	(360) 877-9573	N 30 Mardell Ave		Hoodsport	WA	98548	out
32	Richard	Bambans	(360) 877-5806	25800 N HWY 101		Hoodsport	WA	98548	N of RAC
33	K.T.	Keiffer	(360) 877-9143	160 N Fairway Dr W	PO Box 223	Hoodsport	WA	98548	
34				320 N Mt. View Dr.		Hoodsport	WA	98548	out
35	George	Bowen	(360) 877-9768	251 N Northill		Hoodsport	WA	98548	in
36				821 N Marine View Dr.		Hoodsport	WA	98548	out
37						Hoodsport	WA	98548	
38	Jean	McDherreu		40 N Deer Lane E		Hoodsport	WA	98548	out
39									

Survey	Name (First)	Name (Last)	Phone	Address 1	Address 2	City	State	Zip	RAC
40	Neil and Donna	Simmons	(360) 877-5747	N 631 Finch Creek Rd	PO Box 126	Hoodsport	WA	98548	in
41	Gordon	Earsley	(360) 877-5711	360 N Finch Creek Rd		Hoodsport	WA	98548	in
42	Raymond S.	Dumke	(360) 877-9491		PO Box 1805	Hoodsport	WA	98548	
43	Jimmie R.	Hughes	(360) 877-9262	152 N Hill Rd		Hoodsport	WA	98548	in
44				N 410 & N 430 Kokanee Ridge		Hoodsport	WA	98548	out
45				691 N Dow Creek Rd		Hoodsport	WA	98548	out
46	Tim	Sheldon	(360) 490-0351	22221 N HWY 101		Hoodsport	WA	98548	
47	Dennis N.	Brown	(360) 877-6390	42 N Jen's Place		Hoodsport	WA	98548	
48				N 240 Finch Creek Rd		Hoodsport	WA	98548	in
49	Robin	Pichahchy	(360) 877-6591	221 Schoolhouse Hill		Hoodsport	WA	98548	in
50				131 N Mountain View Dr		Hoodsport	WA	98548	out
51	Richard	Manning	(360) 877-5348	43 N Park Creek Pl		Hoodsport	WA	98548	out
52	Jerry	Ballantyne	(360) 877-6362	193 N Cresthill Way		Hoodsport	WA	98548	out
53		Coryell		41 N Tyee Pl		Hoodsport	WA	98548	out
54			(360) 877-9228	410 Old Mill Hill Rd		Hoodsport	WA	98548	in
55	Renee	Young	(360) 877-0028	161 N Eagle Pl		Hoodsport	WA	98548	out
56	James	Good	(360) 877-6570	181 N Mt Noyes Way		Hoodsport	WA	98548	Lake Cushman
57		Savlness		N 33 Divot Pl		Hoodsport	WA	98548	out
58	Charles	Bevens	(360) 877-2007	31 N Olympic Ct S		Hoodsport	WA	98548	
59				Old Mill Hill Rd		Hoodsport	WA	98548	in
60	Lawrence E.	Vail	(360) 877-5602		PO Box 833	Hoodsport	WA	98548	
61	Robert & Wilfred	Carrier	(360) 877-9347	91 N Wigeon Pl		Hoodsport	WA	98548	out
62	Creekside Inn		(360) 877-9686	27131 HWY 101 N		Hoodsport	WA	98548	
63	G	Stroebeck Jr.	(360) 877-6436	130 N Union Dr		Hoodsport	WA	98548	out
64	Bernice E.	Sundholm	(360) 877-9429	PO Box 185		Hoodsport	WA	98548	
65	Arthur E.	Day	(360) 877-5794	140 N Schoolhouse Hill Rd		Hoodsport	WA	98548	in
66	Orville & Vera	Baker	(360) 877-9526	PO Box 879		Hoodsport	WA	98548	
67	Jeanette	Wolfenbarger	(360) 877-9304	650 N Schoolhouse Hill Rd		Hoodsport	WA	98548	in
68				330 Old Mill Hill Rd		Hoodsport	WA	98548	in
69				231 N Fairway Dr E		Hoodsport	WA	98548	out
70	Mark & Stefanie	McDougall	(360) 877-9883	24281 N HWY 101		Hoodsport	WA	98548	in
71	Pat	Heavy	(360) 877-6816	280 N Standstill Dr S		Hoodsport	WA	98548	out
72	Lildew	Lory	(360) 877-6747	111 N Hamma Hamma Dr E		Hoodsport	WA	98548	out
73	Richard and Darla	Brown	(360) 877-9530	141 N Standstill Dr N		Hoodsport	WA	98548	out
74	Larry & Nancy	Hager	(360) 877-6124	N 360 Suncrest Dr		Hoodsport	WA	98548	in
75				140 N Potlatch Dr N		Hoodsport	WA	98548	out
76	Rain	Ramos		832 Lk Cushman Rd		Hoodsport	WA	98548	
77	Chadwicke	Harrison	(808) 352-4782	26272 N HWY 101		Hoodsport	WA	98548	N of RAC
78	Eric	Edmisten		301 N Mt View Dr		Hoodsport	WA	98548	out

Survey	Name (First)	Name (Last)	Phone	Address 1	Address 2	City	State	Zip	RAC
79				10 N Sundown Dr		Hoodsport	WA	98548	out
80	Duane	Phenning	(360) 877-5736	230 Samantha Way		Hoodsport	WA	98548	out
81	Karen	Bowen		251 N North Hill Rd		Hoodsport	WA	98548	in
82	Ann	Connors	(360) 877-9015	N 651 Dow Creek Dr	PO Box 1537	Hoodsport	WA	98548	out
83				280 N Beaver Dr		Hoodsport	WA	98548	out
84	George A. & Ann	Carlile	(360) 877-9554	141 N Hill Rd		Hoodsport	WA	98548	in
85	Dorothy	Rhone	(360) 877-0085	470 Mt View Dr		Hoodsport	WA	98548	out
86			(360) 877-5334	26476 N HWY 101		Hoodsport	WA	98548	
87				2671 N Lake Cushman		Hoodsport	WA	98548	
88				271 N Duckabush Dr		Hoodsport	WA	98548	out
89				N 10 Deer Lane W		Hoodsport	WA	98548	out
90	Dennis	Rhone	(360) 877-5838	N 141 Wynoochee Dr		Hoodsport	WA	98548	out
91	Stan	Lien	(360) 490-7132	161 School House Hill Rd		Hoodsport	WA	98548	in
92				121 N Vi-Ken Ln		Hoodsport	WA	98548	out
93	Gary E	Henneke	(206) 935-2486	No 70 Backhorn Ct		Hoodsport	WA	98548	out
94	Al	Goeckler	(360) 877-6765	101 N Deer Ln E		Hoodsport	WA	98548	out
95		Johnston	(360) 877-6003	38 Mt Seattle Way North		Hoodsport	WA	98548	out
96	Roger	Thompson	(360) 877-6671	40 N Hamma Hamma Dr N		Hoodsport	WA	98548	out
97				421 N Wynoochee Dr		Hoodsport	WA	98548	out
98				24180 N HWY 101		Hoodsport	WA	98548	
99		Sahr		90 N Duckabush W		Hoodsport	WA	98548	out
100						Hoodsport	WA	98548	
101	M.	Walmsley		Dow M&N Pl (Lake Cushman - Div. 5)		Hoodsport	WA	98548	out
102	Lloyd G.	Mett	(360) 877-9715	120 N Duckabush Dr N		Hoodsport	WA	98548	out
103	Carol	Murray	(360) 877-5456	560 N Mt View Dr		Hoodsport	WA	98548	out

Survey (See: "Identification" tab for additional information)	1. How many years have you lived or conducted business at the above address?	2. Have you ever experienced flooding at this location? Yes/No	3. What types of flooding have you experienced? (a) severe yard flooding (b) severe street flooding of extended duration (c) flooding of business or residence (d) other - please describe	4. What date(s) do you recall flooding occurring? If you cannot remember exact date(s), give approximate date(s). If you have no idea, leave blank.	5. What type of storm causes flooding of our property? (a) A short intense rain (b) a long moderate rain (c) a long heavy rain (d) other	6. If your house or business experiences flooding, how often does it occur? (a) four times a year (b) twice a year (c) once a year (d) once every two years (e) once every five years (f) less than once every five years	7. If your yard or paddock experiences flooding, how often does it occur? (a) four times a year (b) twice a year (c) once a year (d) once every two years (e) once every five years (f) less than once every five years	8. If your street experiences flooding, how often does it occur? (a) four times a year (b) twice a year (c) once a year (d) once every two years (e) once every five years (f) less than once every five years	9. Please name the streets and describe the locations that flood in your area.	10. What do you feel is the cause or major contributing factor to the flooding in your area?	11. Are you aware of any water quality problems associated with stormwater runoff in your area? Yes/No		12. Please provide any additional comments you wish relating to drainage, flooding and/or water quality in your area.
1	2	no	n/a	n/a	n/a	n/a	n/a	n/a	no response	n/a	Yes	old septic system along Finch Creek	none
2	22	no	n/a	n/a	n/a	n/a	n/a	n/a	no response	n/a	no response		none
3	no response	no	n/a	n/a	n/a	n/a	n/a	n/a	no response	n/a	No		none
4	12	no	n/a	n/a	n/a	n/a	n/a	n/a	no response	n/a	No		none
5	9	no	n/a	n/a	n/a	n/a	n/a	n/a	no response	n/a	No		none
6	20	no	n/a	n/a	n/a	n/a	n/a	n/a	no response	n/a	No		none
7	18	no	n/a	n/a	n/a	n/a	n/a	n/a	no response	n/a	No		Few times during prolonged heavy rain, the culvert under Lake Cushman Rd (MP 5.7) becomes clogged and Keene Creek runs over the road rather than under it. This has happened perhaps twice in 18 years.
8	8	no	n/a	n/a	n/a	n/a	n/a	n/a	no response	n/a	no response		none
9	20	no	n/a	n/a	n/a	n/a	n/a	n/a	no response	n/a	no response		none
10	13	no	n/a	n/a	n/a	n/a	n/a	n/a	no response	n/a	No		none
11	3.3	no	n/a	n/a	n/a	n/a	n/a	n/a	101 N & Skokomish River	n/a	no response		none
12	9	yes	b	due to leaves in drain	2004 c	f	if I remove the le f	if I remove the le n/a	no response	storm drain clogged	No		none
13	12	no	n/a		n/a	n/a	n/a	n/a	no response	n/a	no response		none
14	7	no	n/a		n/a	n/a	n/a	n/a	no response	n/a	No		none
15	15	no	n/a		n/a	n/a	n/a	n/a	no response	n/a	No		none
16	5	no	n/a		n/a	n/a	n/a	n/a	no response	n/a	No		none
17	31	no	n/a		n/a	n/a	n/a	n/a	no response	n/a	no response		none
18	12	no	n/a		n/a	n/a	n/a	n/a	no response	n/a	no response		none
19	6	no	n/a		n/a	n/a	n/a	n/a	no response	If any were to happen it'd be "mother nature's RAIN"	No	?Bird poop (Mother Nature again)	none
20	3	no	n/a		n/a	n/a	n/a	n/a	no response	n/a	No		none
21	4	no	n/a		n/a	n/a	n/a	n/a	no response	n/a	No		I have never experienced flooding within at least a 6 mile radius of my home.
22	25	no	n/a		n/a	n/a	n/a	n/a	no response	n/a	no response		none
23	3	no	n/a		n/a	n/a	n/a	n/a	no response	n/a	no response		none
24	1	no	n/a		n/a	n/a	n/a	n/a	no response	n/a	No		No flooding problems at all. Excellent drainage.
25	26	no	n/a		n/a	n/a	n/a	n/a	no response	n/a	no response		No flooding here.
26	14	no	n/a		n/a	n/a	n/a	n/a	no response	n/a	no response		none
27	4	no	n/a		n/a	n/a	n/a	n/a	no response	n/a	no response		none
28	5	no	n/a		n/a	n/a	n/a	n/a	no response	n/a	no response		none
29	2	no	n/a		n/a	n/a	n/a	n/a	no response	n/a	no response		none
30	1	no	n/a		n/a	n/a	n/a	n/a	no response	n/a	no response		none
31	30	no	n/a		n/a	n/a	n/a	n/a	no response	n/a	no response		none
32	15	yes	c	2 days	no response	a	b	b	no response	no drainage	No		none
33	7	no	n/a		n/a	n/a	n/a	n/a	no response	n/a	No		none
34	15	no	n/a		n/a	n/a	n/a	n/a	no response	n/a	No		No problem with flooding
35	35	no	n/a		n/a	n/a	n/a	n/a	No flooding at residence on North Hill but have been isolated due to Skokomish River flooding Highway 101 & 106	Clear cutting, road building in upper watershed of So. Fork Skokomish River	No		See #9 (No flooding at residence on North Hill but have been isolated due to Skokomish River flooding Highway 101 & 106)
36	11	no	n/a		n/a	n/a	n/a	n/a	no response	n/a	no response		none
37	28	no	n/a		n/a	n/a	n/a	n/a	no response	n/a	No		none
38	19	no	n/a		n/a	n/a	n/a	n/a	It doesn't flood in my area, as we are up high Lake Cushman	n/a	No		none
39	no response	no	n/a		n/a	c	n/a	b	b	S.R.101 - downtown drains in street need cleaning	State & County not doing good job	Yes		Skokomish Tribe Fishing with nets dead fish cleaning fish in canal dumping garbage-gas-oil-batteries sinking old boats [check] it out
40	42	yes	d	Finch Creek flooding - short duration	no response	c	Finch Creek and small tributary (front yard)	no response	c	no response	Flooding usually occurs in Finch Creek but sometimes occurs in small tributary when culverts become plugged along Finch Creek Rd	Finch Creek was altered (late 1800s or early 1900s[)] from a meandering stream to a more or less straight channel. Also, land clearing and residential development and stream bank hardening.	Yes	Bacterial contamination (fecal coliform	We are glad to see a move toward development of a stormwater management plan for this area.
41	33	yes	a	3 times	once every ten years	c		c	c	no response	no response	no response	Yes	The culvert flowing from School House	When the hatchery clears the gravel and sediment at the intake we have less flooding
42	16	no	n/a		n/a	n/a	n/a	n/a	n/a	n/a	no response	no response	No		no response
43	6	no	n/a		n/a	n/a	n/a	n/a	n/a	n/a	no response	no response	No		no flooding here
44	28	no	n/a		n/a	n/a	n/a	n/a	n/a	n/a	no response	no response	No		no response
45	23	no	n/a		n/a	n/a	n/a	n/a	n/a	n/a	no response	no response	No		no response
46	26	no	n/a		n/a	n/a	n/a	n/a	n/a	n/a	no response	no response	no response		no response
47	9	no	n/a		n/a	n/a	n/a	n/a	n/a	n/a	no response	no response	No		no response
48	8	yes	d	yard flooding during peak rain/high tide for several hours	no response	c		f	no response	no response	no response	Clear cutting upstream watershed	No		no response
49	3	no	n/a		n/a	n/a	n/a	n/a	n/a	n/a	no response	no response	no response		The ditches on Schoolhouse need to be cleaned out. I do mine - but some culverts are pretty constipated - yuk!
50	10	no	n/a		n/a	n/a	n/a	n/a	n/a	n/a	no response	no response	no response		no response
51	37	no	n/a		n/a	n/a	n/a	n/a	n/a	n/a	none	no response	No		no response
52	13	yes	a		during the Fall 1999-present	b	none	b	no response	I have a Rhody garden 1 1/2 ac. Also my driveway approx 400 ft. Both of these locations flood.	Land development behind me, and a creek that has been diverted.	No		This area really needs to be looked at
53	2.5	No	n/a		n/a	n/a	n/a	n/a	n/a	n/a	no response	no response	No		We do not experience flooding here.
54	22	no	none		never	none	never	n/a	n/a	n/a	no response	no response	no response		no response
55	12	no	n/a		n/a	n/a	n/a	n/a	n/a	n/a	no response	no response	No		no response
56	6	yes	d	sump pump under house	winter after heavy rain or snow and heavy rain	c	as above	b/c	none	none	none	snow followed by heavy rain. (ground water level just comes up to ground level	No		no response
57	32	no	n/a		n/a	n/a		n/a	n/a	n/a	no response	no response	No		We are fortunate to be on the slightly higher ground above the driving range
58	1	no	n/a		n/a	n/a		n/a	n/a	n/a	no response	no response	No		no response
59	20	no	n/a		n/a	n/a		n/a	n/a	n/a	no response	no response	no response		no response
60	5	no	n/a		n/a	n/a		n/a	n/a	n/a	no response	no response	No		no response
61	6	no	d	in driveway and puddle in cu del sack	no response	c	at different times - driveway	a	a	a	Wigeon Pl N div 18	ditches need cleaning	No		I have none

Survey (See: "Identification" tab for additional information)	1. How many years have you lived or conducted business at the above address?		2. Have you ever experienced flooding at this location? Yes/No		3. What types of flooding have you experienced? (a) severe yard flooding (b) severe street flooding of extended duration (c) flooding of business or residence (d) other - please describe		4. What date(s) do you recall flooding occurring? If you cannot remember exact date(s), give approximate date(s). If you have no idea, leave blank.	5. What type of storm cause flooding of our property? (a) A short intense rain (b) a long moderate rain (c) a long heavy rain (d) other		6. If your house or business experiences flooding, how often does it occur? (a) four times a year (b) twice a year (c) once a year (d) once every two years (e) once every five years (f) less than once every five years		7. If your yard or paddock experiences flooding, how often does it occur? (a) four times a year (b) twice a year (c) once a year (d) once every two years (e) once every five years (f) less than once every five years		8. If your street experiences flooding, how often does it occur? (a) four times a year (b) twice a year (c) once a year (d) once every two years (e) once every five years (f) less than once every five years		9. Please name the streets and describe the locations that flood in your area.	10. What do you feel is the cause or major contributing factor to the flooding in your area?	11. Are you aware of any water quality problems associated with stormwater runoff in your area? Yes/No		12. Please provide any additional comments you wish relating to drainage, flooding and/or water quality in your area.
62	6		no		d	When creek & tide are high it could go over the hwy	n/a	n/a		f		f		no response		Further north near 27190 it floods there often. If the drain clogs it's a lake.	no response	no response	people throwing debris in the creek up	Thank you for putting in new pipes and new [well]. It will help with water quality.
63	8		no		n/a		n/a	n/a		n/a		n/a		n/a		no response	no response	No		no response
64	28		no		n/a		n/a	n/a		n/a		n/a		n/a		no response	no response	No		no response
65	4		no		n/a		n/a	n/a		n/a		n/a		n/a		no response	no response	No		no response
66	no response		no	not even mud pu	n/a	drainage excellent in this area	n/a	n/a		n/a		n/a		n/a		no response	no response	No		no response
67	5		yes		a	flooding in driveway 1 to 2 inches	rain (storms)	a/b/c	water stands in driveway	no response			(G) every time it	no response		I live on top of the hill oh School House Hill Rd. so the only flooding that occurs is in my driveway. On number 7#d I put a (G) every time it rains	Drainage is poor, it does not seep thru ground post enough	No		When it rains heavily my septic fills quickly and it does not drain well and we will have back up when flushing toilet. It has to be heavy raining for days.
68	no response		no		n/a		n/a	n/a		n/a		n/a		n/a		no response	no response	no response		no response
69	23		no		n/a		n/a	n/a		n/a		n/a		n/a		no response	no response	No		no response
70	18		no		n/a		n/a	n/a		n/a		n/a		n/a		no response	no response	No		We have never experienced flooding anywhere near our business, nor have we seen flooding in the greater Hoodsport area EVER! Not only have I owned a business for 18 years, I have lived here for 40 years and the above comments still pertain.
71	18		no		b	winter rain turns to ice	Nov to March on heavy rain day	b/c		n/a		n/a		b		N. Standstill Dr. S. just pass the new fire hall	The fire hall combined lots. There was always a problem. Now it's worse because of the added lots and area of the "new" firehouse.	No		no response
72	4		no		n/a		n/a	n/a		n/a		n/a		n/a		no response	no response	no response		Our area is fine!
73	20	part time	no		n/a		n/a	n/a		n/a		n/a		n/a		no response	no response	no response		no response
74	6		no		n/a		n/a	n/a		n/a		n/a		n/a		no response	no response	No		no response
75	12		no		n/a		n/a	n/a		n/a		n/a		n/a		no response	no response	No		None
76	15		no		n/a		n/a	n/a		n/a		n/a		n/a		no response	no response	No		I've never had any flooding in my area of Hoodsport - the water quality is fair to good
77	2	part time	no		d	neighbors yard flooded (lower than ours)	n/a	n/a		n/a		n/a		n/a		no response	no response	no response		no response
78	4.5		no		d	just flooding over HWY 101 on my way to work	2005?	n/a		f		f		f		no response	Skokomish River (on HWY 101)	No		no response
79	0.75		no		n/a		n/a	n/a		n/a		n/a		n/a		no response	no response	no response		no response
80	4.5		no		n/a		n/a	n/a		n/a		n/a		n/a		no response	no response	No		no response
81	35		no		n/a		n/a	n/a		n/a		n/a		n/a		Main fork Skokomish River	logging	No		no response
82	7		no		n/a		n/a	n/a		n/a		n/a		n/a		NA	no response	no response		no response
83	9		no		n/a		n/a	n/a		n/a		n/a		n/a		no response	no response	no response		no response
84	20		no			n/a	n/a	n/a		n/a		n/a		n/a		no response	no response	No		no response
85	3		no		n/a		n/a	n/a		n/a		n/a		n/a		no response	no response	no response		no response
86	25		no		n/a		n/a	n/a		n/a		n/a		n/a		no response	no response	no response		no response
87	1.5		no		n/a		n/a	n/a		n/a		n/a		n/a		no response	no response	No		no response
88	12		no		n/a		n/a	n/a		n/a		n/a		n/a		no response	no response	No		no response
89	10		no		n/a		n/a	n/a		n/a		n/a		n/a		no response	no response	No		no response
90	5		no		n/a		n/a	n/a		n/a		n/a		n/a		US HWY 101 at the Skokomish River Bridge	Refusal to dredge the river bed	No		You should ensure that the Cushman dams remain in place & in full operation to prevent downstream flooding
91	1		no response		d	run-off from road into Garage	no response	c		no response		a		no response		School House Hill Road	Street run-off	No		No ditches (culverts) along the road - water runs down the road into driveway
92	2		no		n/a		n/a	n/a		n/a		n/a		n/a		no response		no response		no response
93	30		no		n/a		n/a	n/a		n/a		n/a		n/a		no response	no response	No		Live in Lake Cushman area
94	2		no		n/a		n/a	n/a		n/a		n/a		n/a		no response	no response	No		no response
95	5		no		n/a		n/a	n/a		n/a		n/a		n/a		no response	no response	no response		We are above Lake Cushman and do not have flooding
96	14.5		no		n/a		n/a	n/a		n/a		n/a		n/a		no response	no response	No		We have great drainage here in Lake Cushman
97	7		no		n/a		n/a	n/a		n/a		n/a		n/a		no response	no response	no response		no response
98	4		no		n/a		n/a	n/a		n/a		n/a		n/a		[none]	n/a	No		n/a
99	4.5		no		n/a		n/a	n/a		n/a		n/a		n/a		no response	no response	No		no response
100	10	plus	yes		c	basement	[19]98(??)	c		f		a		f		no response	Hillside run off	No		no response
101	18		no		n/a		n/a	n/a		n/a		n/a		n/a		no response	no response	no response		It can rain 100 inches a year in this area, but being about 780 above sea level & with no major streams nearby - this rain is usually absorbed quite well - with nothing more than some short term puddles being formed.
102	21		no		n/a		n/a	n/a		n/a		n/a		n/a		no response	no response	no response		no response
103	18		no		n/a		n/a	n/a		n/a		n/a		n/a		no response	no response	No		no response
	Question 1 - Summary		Question 2 - Summary		Question 3 - Summary		Question 4 - Summary	Question 5 - Summary		Question 6 - Summary		Question 7 - Summary		Question 8 - Summary		Question 9 - Summary	Question 10 - Summary	Question 11 - Summary		Question 12 - Summary
	12.8893939 Average (years) 12 Mode (years)		9 Yes 91 No 3 No response		3 a 2 b 2 c 8 d 88 no response		*Qualitative*	1 a 1 b 9 c 0 d 92 no response		1 a 1 b 1 c 0 d 100 no response		3 a 3 b 2 c 0 d 95 no response		1 a 2 b 0 c 0 d 100 no response			*Qualitative*	4 Yes 62 No 37 no response		See above.

Appendix C — Low Impact Development Techniques

Appendix C—Low Impact Development

Introduction

Low Impact Development (LID) is an innovative approach that uses state-of-the-art science and technology to manage urban stormwater by working with the hydrological cycle and its associated natural processes. The goal of LID is to design new development or redevelopment in a way that minimizes the impacts of the new impervious surfaces, its surface water runoff, and its non-point sources of pollution sources, in a way that that is consistent with the natural hydrological cycle for the site and the watershed. Using LID, stormwater is managed in a series of small, cost-effective landscape features, similar to existing natural systems, located on each lot rather than being conveyed and managed in larger pond facilities, located at the bottom of the basin.

Applicability to Mason County

Much of the Mason County Area is largely undeveloped. Due to the site-specific nature of LID designs, it is difficult to propose LID site planning on such a large planning level, without conceptual drawings of the proposed development(s). Therefore, the intent of this appendix is to introduce general LID concepts, strategies, and case studies in the form of a brief literature review that may be applied within Mason County. LID designs for surface water management generally do not replace needed surface water management detention and water quality treatment facilities; however, they can be used to reduce the size of these facilities. They are also often used to achieve infiltration, water quality enhancement, aquifer recharge, low flow augmentation, and other natural functions that most conventional surface water management facilities are not normally designed to achieve.

LID Goals

The primary goal of LID is to mimic the predevelopment site hydrology by using site specific design techniques to store, treat, infiltrate, evaporate, and detain runoff. Using these techniques helps to reduce off-site runoff, enhance groundwater recharge, and provide opportunities for improving water quality (Prince George's County, Maryland, 1999). Reported water quality benefits of LID practices are summarized in Table C.1. In general, LID strategies are most effective at removing total suspended solids and metals, followed by biological oxygen demand and bacteria, and finally by the removal of total phosphorous and nitrogen.

Table C.1 Reported Pollutant Removal Efficiency of LID Practices							
LID Practice	TSS	Total P	Total N	Zinc	Lead	BOD	Bacteria
Bio-retention	-	81	43	99	99	-	-
Dry Well	80-100	40-40	40-60	80-100	80-100	60-80	60-80
Infiltration Trench	80-100	40-60	40-60	80-100	80-100	60-80	60-80
Filter/Buffer Strip	20-100	0-60	0-60	20-100	20-100	0-80	-
Vegetated Swale	30-65	10-25	0-15	20-50	20-50	-	-
Infiltration Swale	90	65	50	80-90	80-90	-	-
Wet Swale	80	20	40	40-70	40-70	-	-

Reference #4 and #7

By attempting to maintain the pre-development hydrological balance, LID designs often contribute to other environmental benefits. For example, many LID practices incorporate landscape plantings which create habitat features. Landscaping can also be used to attenuate heating-island effects common in many urban areas.

Comparison of Conventional and LID Stormwater Management Approaches

The fundamental concept of LID design is to treat rainfall on-site through site and building specific designs. One LID design objective is to capture as much rainfall on site as possible, and then return it to its natural hydrologic pathways (i.e. infiltration and evapotranspiration) or reuse it at the source. On the other hand, conventional stormwater management typically routes water to a pond or infiltration area, often located off site.

Table C.2 summarizes how conventional stormwater management and LID can be used to alter or preserve the natural hydrologic regime.

Table C.2 Comparison of Conventional and LID Stormwater Management Impacts on the Hydrologic Cycle		
Hydrologic Parameter	Conventional	LID
Vegetation/Natural Cover	typically not incorporated into drainage designs.	used to maintain pre-development hydrology
Time of Concentration	shortened, reduced as a by-product of drainage efficiency	increased where possible to approximate predevelopment conditions
Runoff Volume	increases in runoff volume	controlled to predevelopment conditions
Peak Discharge	controlled to predeveloped design criteria	controlled to predeveloped conditions for all storms
Runoff Frequency	increased, especially for small, more frequent storms	controlled to predeveloped conditions for all storms
Rainfall Abstractions (Interception, Infiltration, Depression Storage)	large reduction in all elements	maintained to predevelopment conditions
Groundwater Recharge	reduction in recharge	maintained to predevelopment conditions

Reference#1.

LID Designs and Practices

LID practices to maintain hydrologic functions can include the following:

- *Impervious Surface Control Devices*—alternative pavers, green roof, etc.
- *Infiltration Facilities*—dry well, infiltration trench, etc.
- *Semi-natural Conveyance System*—bioretention, grass swale, bioswale, etc.
- *Storage* – cistern, rain barrel
- *Landscaping* – effective grading, installation of plants for water quality and quantity control.

Each of these LID practices is briefly described below.

Impervious Surface Control Devices

Runoff from new impervious surfaces is the primary cause of flooding and stream degradation. Reducing the amount of new impervious surface area in development is one of the most effective methods to achieve a reduction in the total volume of runoff. For example, most residential streets can be as narrow as 22 to 26 feet wide without sacrificing emergency access, on-street parking, or vehicular and pedestrian safety. A shift to narrower streets can result in a 5 to 20 percent overall reduction in impervious area. Reducing road area also reduces paving costs.

Examples of narrow residential street widths from different regions of the country are listed in Table C.3.

Table C.3 Examples of Narrow Residential Street Widths		
State	Jurisdiction	Standard
Arizona	City of Phoenix	28 feet(parking on both sides)
California	City of Novato	24 feet (both sides, 2 to 4 du) 28 feet (both sides, 5 to 15 du)
Colorado	City of Boulder	20 feet (150 ADT) 20 feet (no parking, 350 – 1000 ADT) 22 feet (one side, 350 ADT) 26 feet (both sides, 350 ADT) 26 feet (one side, 500 – 1000 ADT)
Delaware	Delaware DOT	21 feet (one side)
Florida	City of Orlando	28 feet (both sides, res. lots <55 feet wide) 22 feet (both sides, res. lots >55 feet wide)
Maine	City of Portland	24 feet (one side)
Maryland	Howard County	24 feet (1000 ADT)
Michigan	City of Birmingham	26 feet (both sides) 20 feet (one side)
Montana	City of Missoula	26 feet (both sides, 3 – 80 du) 32 feet (both sides, 81 – 200 du) 12 feet (alley)
New Mexico	Albuquerque	28 feet (one side)
New Jersey		20 feet (no parking, 0 – 3500 ADT) 28 feet (one side, 0 – 3500 ADT)
Oregon	City of Portland	26 feet (both sides) 20 feet (one side)
Pennsylvania	Bucks County	12 feet (alley) 16 – 18 feet (no parking, 200 ADT) 20-22 feet (no parking, 200 – 1000 ADT) 26 feet (one side, 200 ADT) 28 feet (one side, 200 – 1000 ADT)

Tennessee	City of Johnson City	22 feet (<240 ADT) 24 feet – 28 feet (240 – 1500 ADT) 28 feet (>1500 ADT)
Vermont	City of Burlington	30 feet (both sides)
Washington	City of Kirkland	12 feet (alley) 20 feet (one side) 24 feet (both sides, low density only) 28 feet (both sides)
W. Virginia	Morgantown	22 feet (one side)
Wisconsin	City of Madison	27 feet (both sides, <3 du/ac) 28 feet (both sides, 3 – 10 du/ac)
ADT = average daily traffic du = dwelling unit		

Reference #2 and #3

Other typical LID approaches include alternative roadway layout (Figure C.1) and reduced parking standards (Table C.4). The potential results of impervious surface reduction, or on the overall effective impervious area, are listed in Table C.5. Note how small reductions in the total impervious area can have a relatively large reduction of the amount of on-site impacts and resulting effective impervious area within the watersheds.

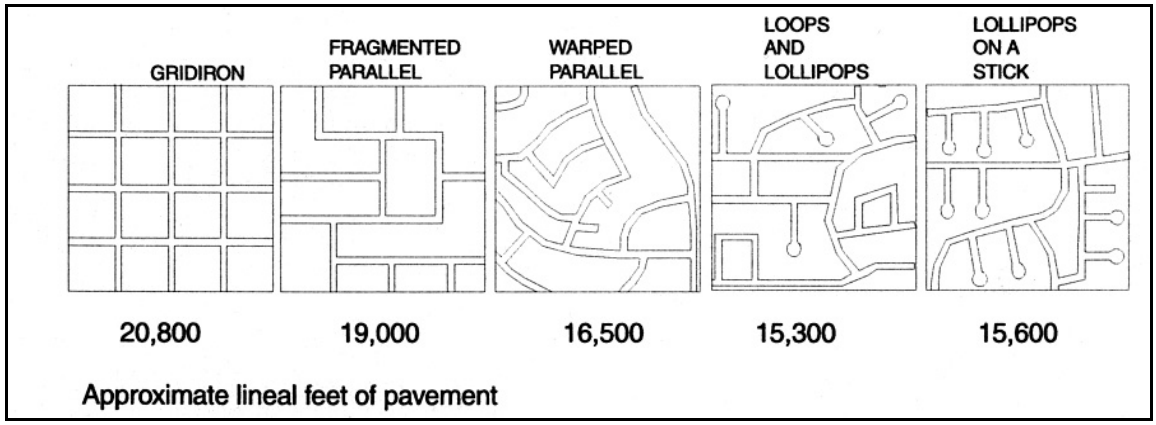


Figure C.1 – Length of pavement of various roadway layout options.
Reference #11

Table C.4 Conventional Minimum Parking Ratios			
Land Use	Parking Requirement		Actual Average Parking Demand
	Parking Ratio	Typical Range	
Single-family homes	2 spaces per dwelling unit	1.5 – 2.5	1.11 spaces per dwelling unit
Shopping center	5 spaces per 1000 ft2 GFA	4.0 – 6.5	3.97 per 1000 ft2 GFA
Convenience store	3.3 spaces per 1000 ft2 GFA	2.0 – 10.0	—
Industrial	1 space per 1000 ft2 GFA	0.5 – 2.0	1.48 per 1000 ft2 GFA
Medical/dental office	5.7 spaces per 1000 ft2 GFA	4.5 – 10.0	4.11 per 1000 ft2 GFA
GFA = Gross floor area of a building without storage or utility spaces.			

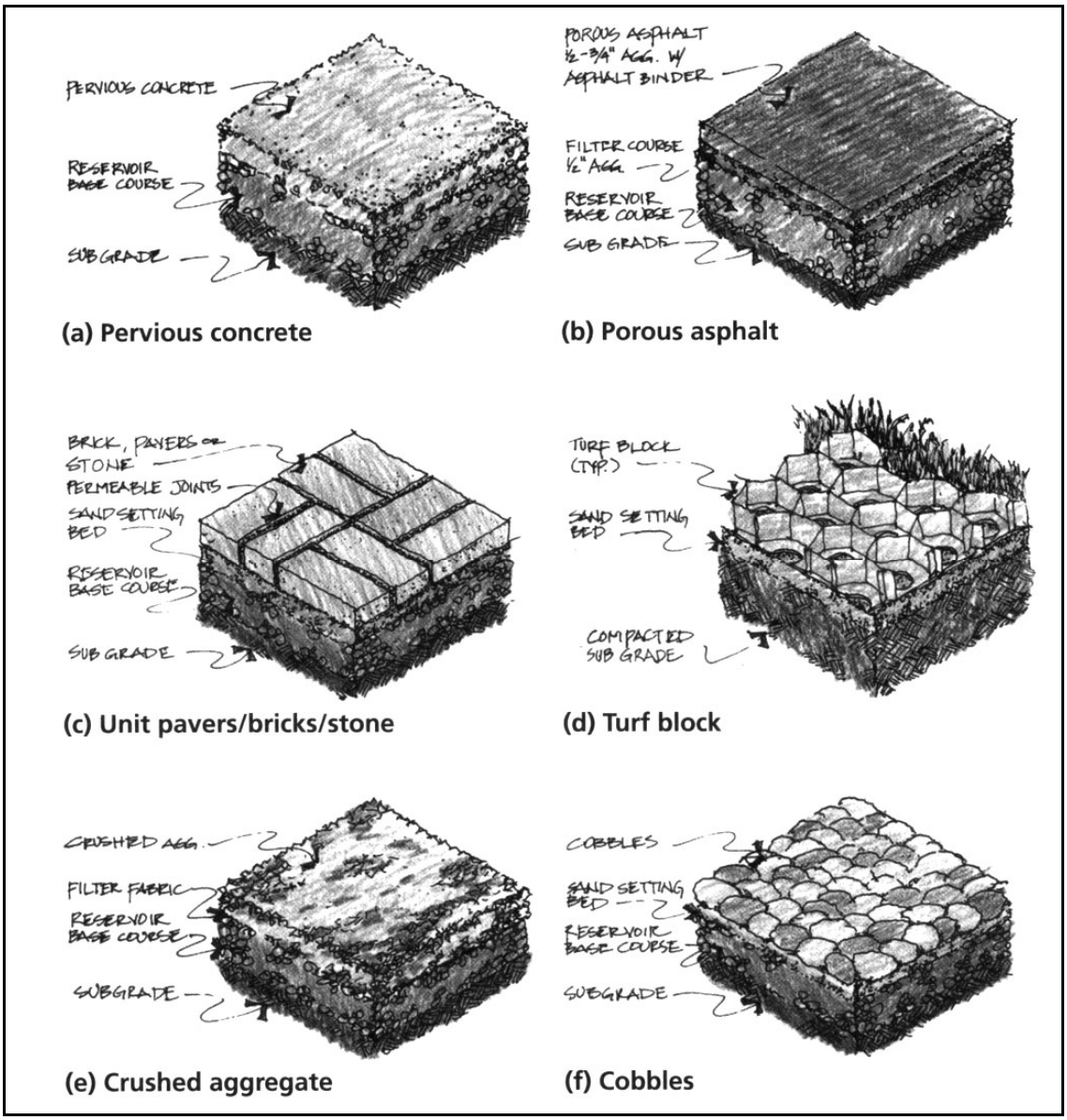
Reference # 11, #14, and #15

Table C.5 Basin and Site Coverage Assessment Reduction Analysis Results					
Potential Strategy		Impervious Surface Reduction Percentages (%)			
		Site-Specific		Basinwide	
		Total	Effective	Total	Effective
Reduce residential sidewalks by 50 percent by installing the walks on one side of the street only.		1.33	1.00	1.59	0.83
Reduce residential sidewalks from 5 feet width to 4 feet width.		0.53	0.40	0.64	0.33
3.	Reduce local access street widths from 32 feet to 27 feet.	2.50	2.00	2.98	3.12
	Reduce local access street widths from 32 feet to 25 feet.	3.50	2.80	4.17	4.37
	Reduce local access street widths from 32 feet to 20 feet.	6.00	4.80	7.15	7.49
	Reduce commercial parking by 5 percent.	2.67	2.67	1.04	1.37
	Reduce commercial parking by 10 percent.	5.33	5.33	2.09	2.74
	Reduce commercial parking by 20 percent.	10.67	10.67	4.18	5.47
	Reduce multifamily parking by 5 percent.	0.74	0.74	0.16	0.21
	Reduce multifamily parking by 10 percent.	1.48	1.48	0.32	0.42
	Reduce multifamily parking by 20 percent.	2.95	2.95	0.64	0.84
	Reduce commercial, industrial, and multifamily roof areas by 10 percent.	4.25	4.25	1.38	.094
	Reduce commercial, industrial, and multifamily roof areas by 20 percent.	8.50	8.50	2.76	1.89

Reference #15

Alternative Pavers

Alternative pavers are permeable or semi-permeable surfaces that can be used for driveways, parking lots, and walkways. Figure C.2 shows typical alternative pavers. The effectiveness of alternative pavers will vary depending on the soil layer underneath. Underlying soils need to have a permeability between 0.5 and 3.0 inches per hour. The City of Seattle gives credit for porous pavement (Table C.6) in computing runoff rates from a developed site.



Reference #17

Figure C.2 – Alternative Pavers

Table C.6 Porous Pavement Impervious Surface Reduction Credit				
	SCS Hydrologic Soil Group			
	A	B	C	D
Curve Number (without credit)	98	98	98	98
Curve Number (with credit)	78	85	89	91

Reference #16

Due to the permeability of porous pavers, there is some risk of contaminating groundwater, although most paving alternatives have some pollutant removal effects through the infiltration process. Therefore, they should be located at least two to five feet above the seasonally high groundwater table and at least 100 feet away from drinking water wells[1]. Other design considerations for alternative pavers are listed as Table C.7.

Table C.7 Design Criteria for Alternative Pavers	
Design Criterion	Guidelines
Site Evaluation	Take soil boring to a depth of at least 4 feet below bottom of pavers to check for soil permeability, porosity, depth of seasonally high water table, and depth to bedrock.
	Not recommended on slopes greater than 5%. Best with slopes as flat as possible.
	Minimum infiltration rate 3 feet below bottom of pavers: 0.5 inches per hour.
	Minimum depth to bedrock and seasonally high water table: 4 feet.
	Minimum setback from water supply wells: 100 feet.
	Minimum setback from building foundations: 10 feet downgradient, 30 meters (100 feet) upgradient.
	Not recommended in areas where wind erosion supplies significant amounts of windblown sediment.
	Drainage area should be less than 15 acres.
Traffic Conditions	Use for low-volume automobile parking areas and lightly used access roads.
	Avoid moderate to high traffic areas and significant truck traffic.
	Avoid snow removal operation. Post with signs to restrict the use of sand, salt, and other deicing chemicals typically associated with snow cleaning activities.

[1]Please refer to the new draft State Underground Injection Control Rule, 2005.

Design Storm Storage Volume	Highly variable; depends upon regulatory requirements. Typically design for storm water runoff volume produced in the tributary watershed by the 6-month, 24-hour duration storm event.
Drainage Time for Design Storm	Minimum: 12 hours.
	Maximum: 72 hours.
	Recommended: 24 hours.
Construction	Excavate and grade with light equipment with tracks or oversized tires to prevent soil compaction.
	As needed, divert storm water runoff away from planned pavement area before and during construction.
	A typical porous pavement cross-section consists of the following layers: 1) porous asphalt course, 2-4 inches thick; 2) filter aggregate course; 3) reservoir course of 1.5-3-inches of washed rock; and 4) filter fabric
Porous Pavement Placement	Paving temperature: 240º - 260º F.
	Minimum air temperature: 50º F.
	Compact with one or two passes of a 10-ton roller.
	Prevent any vehicular traffic on pavement for at least two days.
Pretreatment	Pretreatment recommended to treat runoff from off-site areas. For example, place a 25-foot wide vegetative filter strip around the perimeter of the porous pavement where drainage flows onto the pavement surface.

Reference #18

Green Roofs

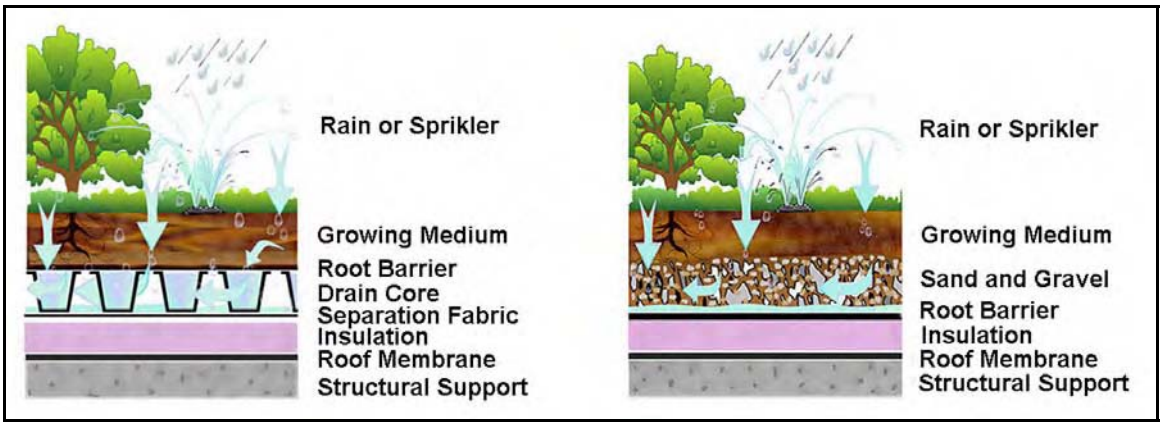
Green roof applications can be appropriate for some commercial and multi-family residential lots where the buildings occupy a large portion of the site. A layer of absorbent soil on the top of building retains rainfall and allows it to evaporate or transpire from the rooftop vegetation. The runoff from a green roof passes through the absorbent soil layer to an underdrain layer (there is no surface runoff), and therefore, peak runoff rates are attenuated. Green roofs provide multiple benefits such as attenuation of heat island effects which help to save on the energy cost of the building and sound reduction.

Green roofs are classed into two categories:

extensive green roofs; shallow soil layer of 3 to 7-inch
20-34 lb/square feet weight

intensive green roofs; thick soil layer of 8-inch to 8-foot
80-150 lb/square feet weight

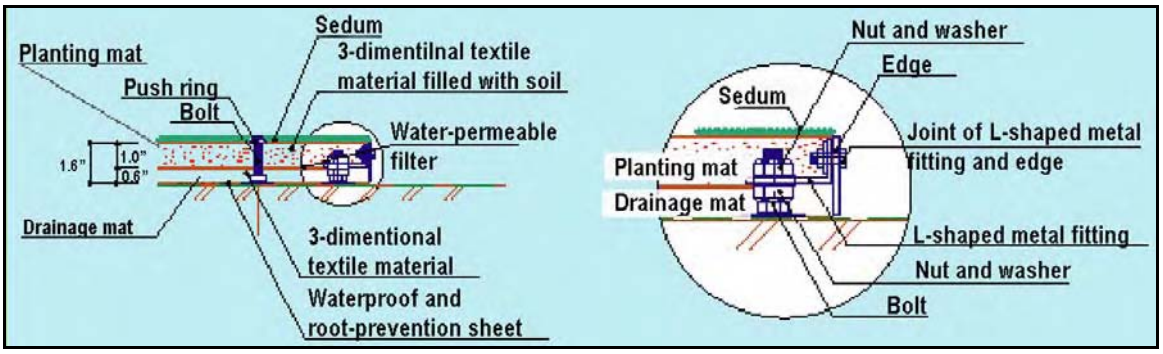
Recently, new technologies have made green roofs lighter to reduce the additional cost of supporting structure of the building. Figure C.3 shows typical green roof profiles.



Reference #19

Figure C.3 – Green Roof Profile

As the least weight green roof, sedum roof has been tested at many locations. Sedum is dry-tolerant plant that can grow with a thin soil layer (one to two-inch). It reduces the weight of green roof five to eight lb/square feet, eliminating the need for additional structural support. Figure C.4 shows sedum roof profiles and details.



Reference #20

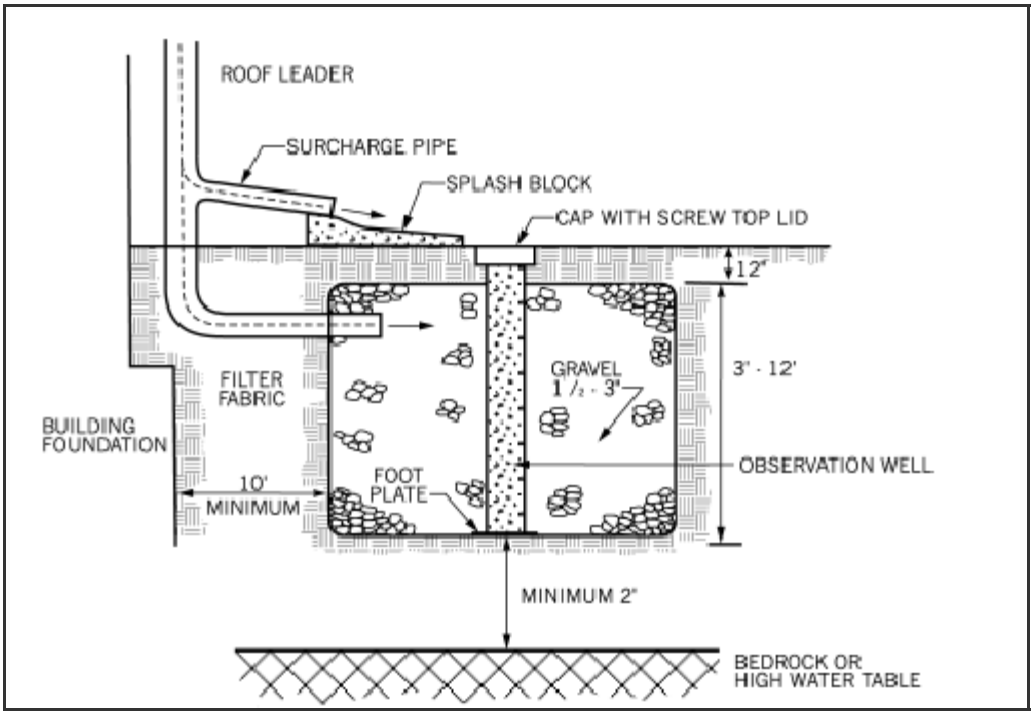
Figure C.4 – Sedum Roof Profile and Detail

Studies show that about one-foot of soil depth is needed to achieve the maximum reduction in runoff rate from prolonged winter storms. However, significant reduction in runoff rates from short intense storms that occur during dry weather periods can be achieved with as little as four inches of soil depth.

The City of Portland gives new green roofs the same credit as forest cover, allowing a curve number of 48 for roof gardens (intensive green roof) and a curve number of 61 for Eco-Roof (extensive green roof). In Germany, 3-inch green roofs have been found to be cost effective, and appreciable runoff will not begin until rainfall amounts exceed 0.6 inch.

Infiltration Facilities – Dry Well

Dry wells are small, excavated trenches backfilled with aggregate. They function as infiltration systems and are often used to control runoff from building rooftops. Dry well designs can be modified to act as catch basins, where they both collect and infiltrate direct surface runoff. Figure C.5 shows a typical detail of a dry well.



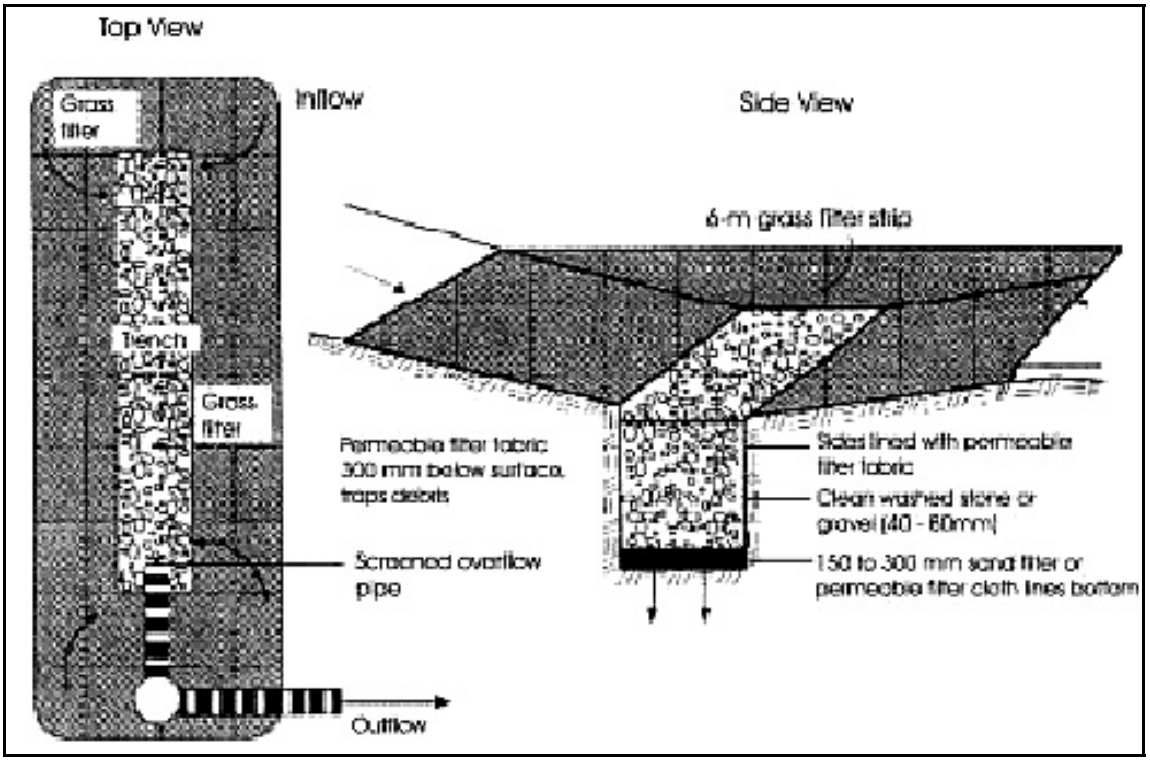
Reference #7

Figure C.5 – Typical Dry Well Section

Infiltration Facilities – Infiltration Trench

An infiltration trench is a shallow excavated trench that has been backfilled with coarse stone aggregate. It can be an underground reservoir or subsurface basin (Figures C.6 and C.7). Stormwater runoff is diverted into the trench and is stored until it can be infiltrated into the soil, usually over a period of several days. Infiltration trenches are a good design option in sandy soils where the depth to the maximum wet-season water table or hardpan is greater than three to six-feet.

(Note: The new draft of the Washington State Underground Injection Control Rule has specific design recommendations for dry wells based on soil types and risk of aquifer contamination.)



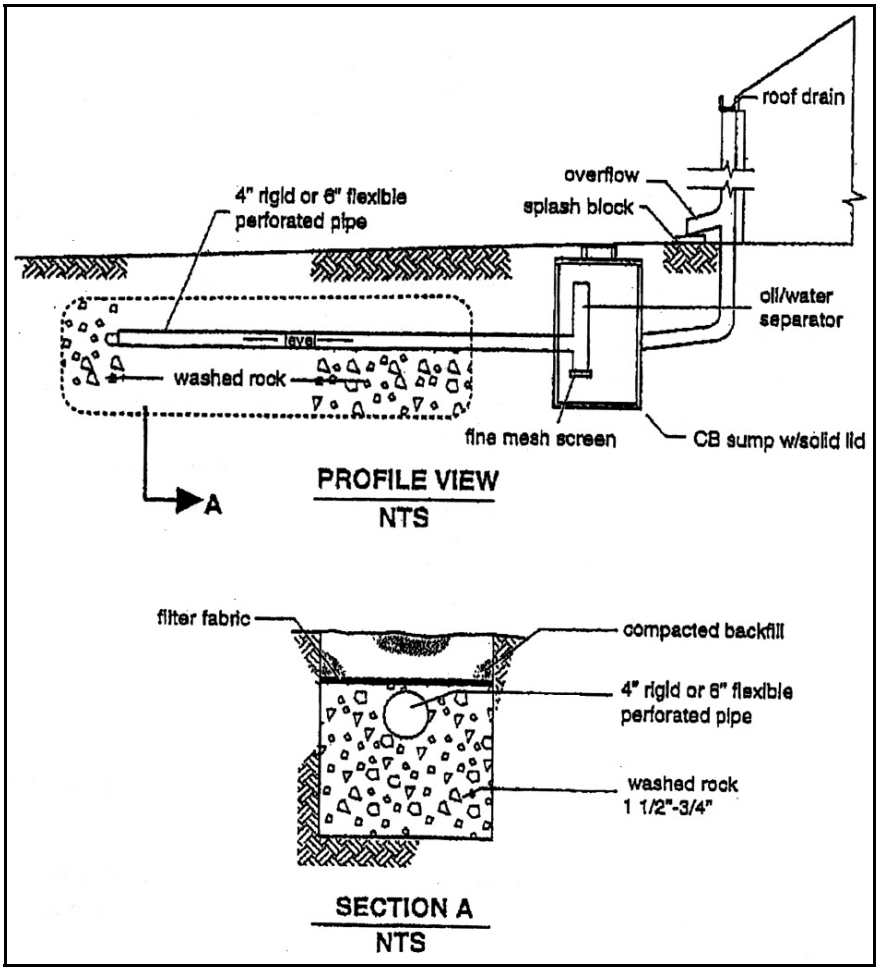
Reference #21

Figure C.6 – Subsurface Infiltration Trench

Bioretention

Bioretention is a water quality and water quantity control practice. It uses the chemical, biological, and physical properties of plants, microbes, and soils for removal of pollutants from stormwater runoff. Bioretention typically is used to treat small (0.25-1.0 acre), highly impervious surfaces such as parking lots and commercial areas. It is designed to contain an average annual storm event of about 0.5 – 0.7 inches of rainfall (Reference #21).

Bioretention consists of grass buffer strips (pretreatment area), ponded area, planting soil, sand bed, organic layer (mulch), and vegetation. A conceptual illustration for a bioretention area is presented in Figure C.8. The bioretention area design provides infiltration and water storage for uptake by vegetation.



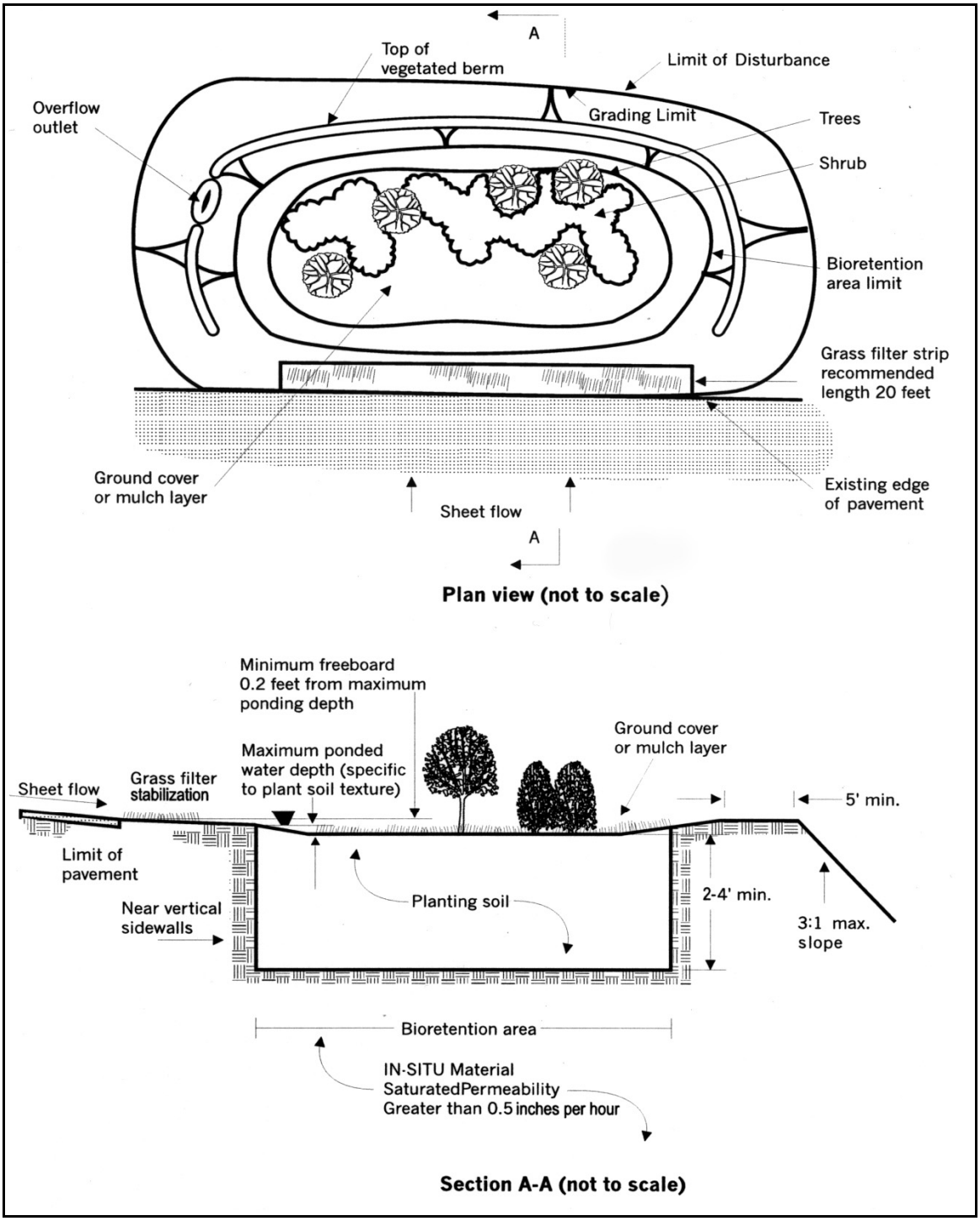
Reference #16

Figure C.7 – Underground Infiltration Trench

The surface of the planting soil is depressed to allow for ponding of runoff. Collected runoff is infiltrated through a surface organic layer of mulch and/or a ground cover to the planting soil. The runoff is stored in the planting soil where it is discharged over a period of days to the native soil underlying the bioretention area.

Bioretention areas should be designed as an off-line treatment system. In off-line systems, the "first flush", which is the most contaminated sheet flow, is retained, and larger flows are bypassed into the normal storm drain system. Such a design prevents the first flush from being washed out by higher discharges associated with on-line systems.

Bioretention has many potential side benefits other than water quality treatment. Plantings can improve the aesthetic value of the site as well as providing ecological value, such as improved habitat for small animals, shade, privacy screens, and wind breaks.



Reference #7

Figure C.8 – Plan View and Section of Bioretention Area

Cost reduction is another benefit of bioretention facilities. In Prince George's County, Maryland, a case study demonstrated that bioretention can be an economical alternative for

providing treatment for the first half-inch of runoff from commercial and residential sites. For example, the total estimated cost of a water quality treatment facility for an office building was reduced from $174,000 with oil-grit separators to $111,600 with a bioretention area. For other office building sites, evaluated, bioretention practices reduced the amount of storm drainpipe from 800 to 230 feet.

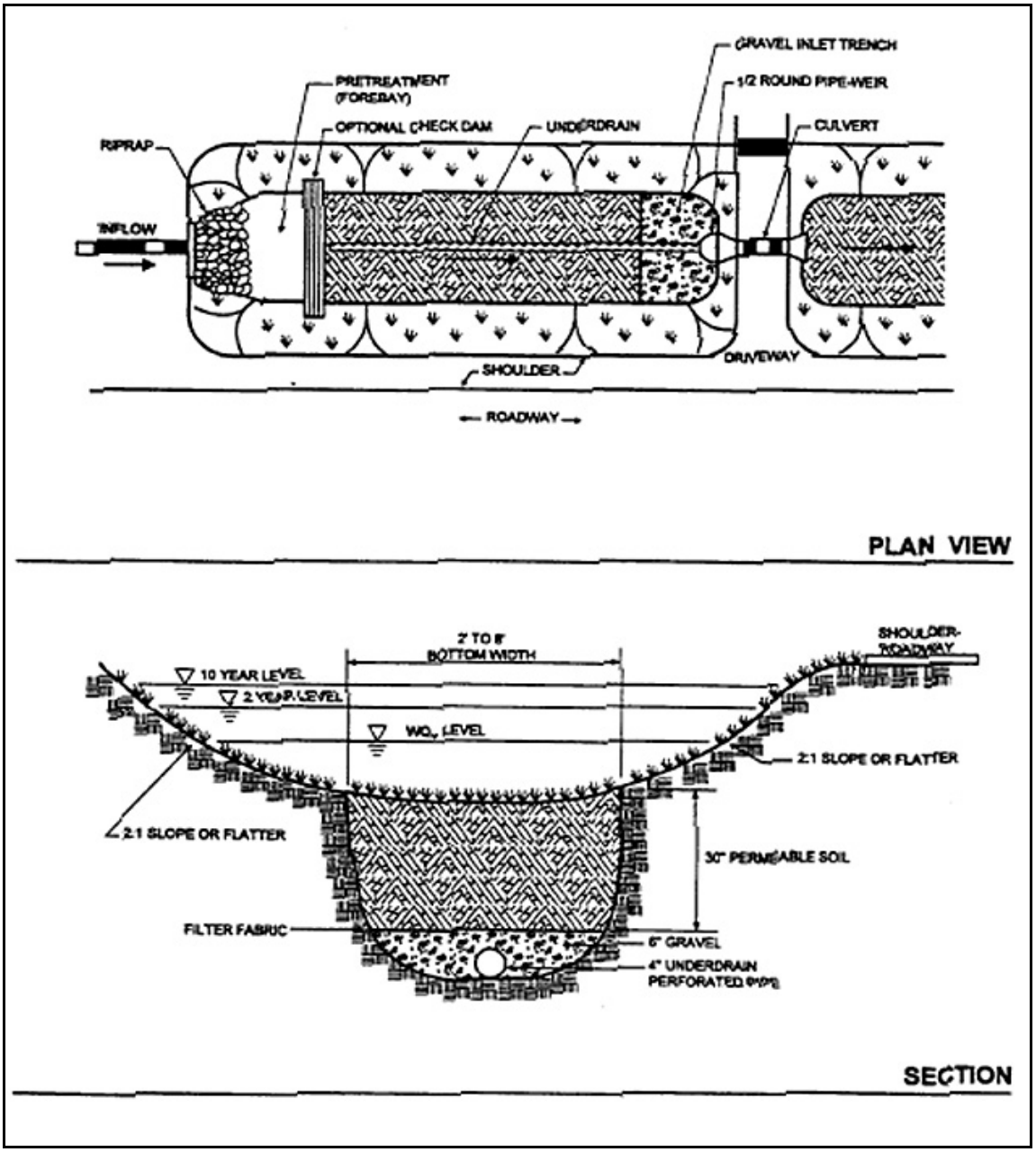
Grass Swale

Grass swales provide a series of vegetated open channels that are designed specifically to treat and attenuate stormwater runoff. They are best applied on a relatively small scale (generally less than five acres of impervious surface). There are many design variations including dry swales, wet swales, and biofiltration swales. These systems work well along roadways, driveways, and parking lots.

Dry swales are similar in design to bioretention areas. They typically have a sand/soil mix layer that meets minimum permeability required at the bottom of the channel. An underdrain system is also installed under the soil bed. Typically, the underdrain system is created by a gravel layer which encases a perforated pipe. Stormwater treated by the soil bed flows into the underdrain, which conveys treated stormwater back to the storm conveyance system (Figure C.9).

Wet swales intersect the groundwater and behave like a linear wetland cell. This design variation incorporates a shallow permanent pool and wetland vegetation to provide stormwater treatment. One disadvantage to the wet swale is that shallow standing water in the swale can cause public nuisance by providing mosquito breeding habitat.

A biofiltration swale is similar to a dry swale. It is more specifically designed for the treatment of stormwater. The primary pollutant removal mechanisms are filtration by grass blades which enhance sedimentation, trapping, and adhesion of pollutants to the grass and thatch. Biofiltration swales generally do not effectively remove dissolved pollutants. Maintaining dense vegetation is the key to its effectiveness. Therefore, a swale should receive a minimum of six-hours of sunlight daily during the summer months for healthy grass growth. A swale must dry between storms to maintain vegetation in good condition. For permanent saturated soil conditions, a wet biofiltration swale should be installed. Because typical grass dies when soil saturation exceeds two weeks, vegetation specifically adapted to saturated soil conditions should be used.



Reference #1

Figure C.9 – Plan View and Section of Dry Swale

Grass filter strips are vegetated areas intended to treat sheet flow from adjacent impervious areas. Filter strips function by reducing runoff velocities and filtering sediment and other pollutants. With proper maintenance, filter strips can provide relatively high pollutant removal. Grass filter strips require a relatively large amount of space, typically equal to the impervious area they treat. The land requirements for this practice can be a critical drawback in urban environments, where land prices are high. (Reference #1)

Storage

Rain barrels and cisterns are low-cost, effective, and easily maintainable storage units applicable to both residential and commercial/industrial site. Rain barrels operate by retaining a predetermined volume of rooftop runoff. In general, cisterns have a larger capacity and are installed either on rooftop or underground. Washington State Department of Ecology's stormwater design manual suggests that cisterns should provide at least 1,000 gallons of storage to have any significant hydrologic effect.

Costs and Benefits

Conventional and LID stormwater management costs are difficult to compare, because "marginal costs" are rarely defined for either approach. Some case studies and pilot programs show at least a 25 to 30 percent reduction in costs associated with site development, stormwater fees, and maintenance for residential developments that use LID strategies. These savings are achieved by reductions in clearing, grading, pipes, ponds, inlets, curbs, and paving. However, many LID projects have not been fully assessed in the long run due to its early stage in implementation. Some of this basic information is also lacking for conventional stormwater management as well. For instance, the costs to retrofit and repair an entire pipe system after 50 or 60 years are rarely estimated for conventional management. (Reference #8)

In addition, costs are site specific. Each project will be unique based on the site's soil conditions, topography, existing vegetation, land availability, etc. Some commonly seen cost benefits of LID projects include the following:

1. Multi-functionality—In many projects, LID was originally designed as a landscaped feature before its functionality as a stormwater control was introduced. In these situations, the landscaping and construction costs for stormwater have not been included and financially appear to be free. Additionally, the cost of maintaining the landscaped areas is typically included in the project cost and not in the cost of the stormwater system.
2. Lower lifecycle costs—It is important to take into account not just the initial capital costs but also those over the structure's lifetime, which can include operation, repair, maintenance, and decommissioning. Many LID techniques are self-perpetuating, easily repairable, or can be left as natural areas at the end of their functional lifetime, while conventional facilities may require high costs to take out of commission, repair, maintain, and/or replace.
3. Reduced off-site costs—Since LID addresses stormwater trunkline conveyance at its source, it is unlikely to incur major off-site costs in the form of conveyance network or outfalls. Most conventional techniques will require an off-site conveyance network to

collect the stormwater from the on-site system, resulting in additional project costs for the enhancement of downstream systems as urban areas expand.

4. Functional use of open space land—LID practices, such as bioretention, can usually be designed as part of the development's open space. Unlike large detention ponds, if these multifunctional LID practices are distributed throughout set-aside open space or previously designated landscaped land, they can contribute to a more park-like and community-friendly setting without incurring any additional costs for land allocation to the drainage system.

LID techniques will become less expensive over time, as a growing number of competing LID practitioners drive down prices and the technology becomes standard. Roofscapes Inc. expects that overall cost of green roof systems to decline by about 25 percent over the next couple of years (Reference #12).

Currently, costs of each LID technique are estimated as follows:

- Green roof; $5.6 to $14 /square feet[2]
- Absorbent landscaping/Bioretention; $2.3 to $6.5 /square feet[3]
- Dry swale (80 percent bioretention area): $1.8/square feet to $5.2/square feet (Reference #1)
- Porous pavement: $2 to $3 /square feet (conventional asphalt costs $0.5 to $1/square feet)
- Infiltration facilities : $2.8/square feet to $16/square feet
- Manually constructed cisterns (reinforced concrete, size of 3,000 gallons): $1,000

Summary: Applicability of LID to Mason County

Due to its natural setting, there will be many opportunities to use LID designs for the management of surface water runoff as the land within Mason County continue to develop. Table C.8 summarizes the applicability of the five major practices of LID design briefly discussed in the above literature review.

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[2] Extensive roofs are in the lower range, and intensive roofs are in the higher range. A pilot project in the City of White Rock, BC, which has a four-inch deep soil layer, costs about $8.4/square feet than a conventional impervious roof. (Reference #5)

[3] Sites with six-inch deep absorbent soil layer are in the lower range, and sites with 1.5-foot deep absorbent soil layer in the higher range.

Table C.8 Potential Applicability of LID Practices within Mason County		
LID Practice	Examples	Applicability to Mason County
Impervious Surface Control	Porous Pavement Green Roofs	- Could be incorporated into any building design. - Could be incorporated into any building design.
Infiltration Facilities	Dry Well Infiltration Trench	- Recommended for rooftop runoff, provides some attenuation of storms and some infiltration. - Recommended for conveyance, provides infiltration and some detention
Semi-Natural Conveyance System	Bioretention Grass Swale/Bioswale Filter Strips	- Include with landscaping where possible. - Good for small site attenuation and treatment. - Good for parking lots.
Storage	Cistern Rain Barrel	- Of limited use (unless of a large scale). - Could be used for some dry season watering
Landscaping	Effective Grading Use of Plants	- Of limited stormwater benefit unless of a large scale. - Recommend incorporating LID into landscape and green space areas to save costs and provide natural aesthetic look to the site.

In general, LID strategies can be beneficial and are recommended for future development within Mason County. The greatest attraction of the LID in surface water management design is the ability to better mimic some of the naturally occurring drainage systems. As development occurs, LID strategies could be used to simulate these natural systems.

The challenge for the Mason County land owners is to determine which LID strategies should be used and where should they be located. LID designs typically require land, and typically are more costly than conventional drainage designs. Unless they can be incorporated into required landscape and open-space areas, the use of the conventional regional detention and treatment systems may still be the best way for a land owners or developers to optimize the amount of land available for new construction. Clearly a

reasonable tradeoff will need to be made between costs, availability of land, and the cost and ability to mitigate environmental impacts as development within Mason County continues.

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Appendix D — Capital Project Construction Cost Estimates

Hoodsport RAC Capital Improvement Project		Project Cost
# 1	N. North Hill Drainage Improvements	$ 185,000
# 2	N. Schoolhouse Hill Road Ditch Improvements	$ 121,000
# 3	Replace Half-Pipe with 18-inch Diameter Culvert	$ 56,000
# 4	Filterra Device for WQ Retrofit (retrofits 0.8 ac)	$ 61,000
Total Cost of 6-year CIP Program		$ 423,000

PLANNING LEVEL PROJECT COST OPINION

PROJECT: **N. North Hill Drainage Improvements** **CHECK BY:**
Project ID: **# 1**
BY: **lcr** **DATE:** **1/28/2008**

ITEM NO.	ITEM	QUANTITY	UNIT	UNIT PRICE	AMOUNT
Construction Elements					
1	DITCH EXCAVATION INCL HAUL	260	CY	$ 25.00	$ 6,500
2	SAWCUTTING	940	LF	$ 4.00	$ 3,760
3	SCHEDULE A CULVERT PIPE 18 IN. DIAM.	351	LF	$ 45.00	$ 15,795
4	SCHEDULE A CULVERT PIPE 24 IN. DIAM.	118	LF	$ 50.00	$ 5,900
5	HMA CL.1/2 IN. PG 64-22 (4-inches)	80	TON	$ 150.00	$ 12,000
6	CRUSHED SURFACING TOP COURSE (4-inches)	80	TON	$ 35.00	$ 2,800
7	CRUSHED SURFACING BASE COURSE	100	TON	$ 55.00	$ 5,500
8	SHORING OR EXTRA EXCAVATION CLASS B	2,020	SF	$ 1.00	$ 2,020
9	SEEDING AND FERTILIZING	1.0	AC	$ 3,000.00	$ 3,000
10	TEMPORARY BYPASS	1	LS	$ 4,000.00	$ 4,000
				Subtotal Construction Elements	**$ 61,275**
Required Ancillary Items					
11	DEWATERING		0%		$ -
12	EROSION & SEDIMENTATION CONTROL		10%	(see note 3)	$ 6,128
13	TRAFFIC CONTROL		5%	(see note 4)	$ 3,064
14	CONTINGENCY		30%		$ 18,383
				Subtotal Ancillary	$ 27,574
				Subtotal Construction + Ancillary	**$ 88,849**
Mobilization					
15	MOBILIZATION		10%		$ 8,885
				Subtotal Construction + Ancillary + Mobilization	**$ 97,734**
Tax/Engineering/Management/Permitting					
16	STATE SALES TAX		8.3%		$ 8,112
17	ENGINEERING/LEGAL/ADMIN		50%		$ 48,867
18	CONSTRUCTION MANAGEMENT		20%		$ 19,547
19	PERMITTING		10%		$ 9,773
20	LAND AND RIGHT OF WAY		0%		$ -
				Subtotal	$ 86,299
				Subtotal Construction + Ancillary + Mobilization + Tax/Engineering/Management/Permitting	**$ 184,032**
2007 Dollars				**Total Estimated Project Cost (Rounded)**	**$ 185,000**

Notes:

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2. The order-of-magnitude cost opinion has been prepared for guidance in project evaluation from the information available at the time of preparation and for the assumptions stated. The final costs of the project will depend on actual labor and material.
3. Increase percentage markup if work is in or immediately adjacent to flowing or standing water, steep slope, and/or other erosion-prone conditions.
4. Increase percentage markup if work is in or immediately adjacent to secondary, arterial, or other high-volume road or temporarily closes a roadway.
5. Land Acquisition unit costs include Administrative Costs and Condemnation.

CIP#1 - N. North Hill Drainage Improvements Quantity Calculation Sheet	Calculated Values User Input Values **For use in estimate**

Ditch Excavation (N. North Hill, N Baskin Ln., and Olympic Ave.)

length	3,000	ft	**SUM**	
width (3.5' deep V ditch with 2:1 sides)	14	ft	**260**	**CY**
depth of excavation (2-in)	0.17	ft		
Seeding and Fertilizing Ditch by hand	0.96	acre	**1**	**AC**

Culvert Replacements

North Hill Road Culvert Inventory (provided by Mason Co.)

	Road #	Milepost	Diameter (feet) Existing	Diameter (feet) Proposed	Length
	45650	0	1	1.5	161
SUM 18-in Pipe (LF)	45650	0.02	1	1.5	30
351	45650	0.068	1	1.5	44
	45650	0.103	1	1.5	48
SUM 24-in Pipe (LF)	45650	0.14	1	1.5	68
118	45650	0.14	1.5	2	73
	45650	0.266	1.5	2	45

Paved Trench Repair	Paved	Paved			
Pipe Excavation					
pipe dia (ID)	1.5	2.0	*ft*		
pipe dia (OD) = 1.2*ID	1.8	2.4	*ft*		
trench width = (1.5 x ID) + 18"	3.8	4.5	*ft*		
street repair width = trench width + 2'	5.8	6.5	*ft*		
average depth to pipe invert	3.5	4.0	*ft, (assumes 2-ft cover)*		
trench length	351	118	*ft*		
Pavement Disturbance Width	5.8	6.5	*ft*		
trench backfill					
total trench depth (to bottom of bedding)	4.2	4.7	*ft*		
depth of trench that is pipe zone bedding	2.8	3.4	*ft, (OD + 6" above + 6" below)*		
depth of trench that is pavement restoration	0.67	0.67	*ft, (depth of HMA + depth of CSTC)*		
Depth of Trench CSBC backfill	0.7	0.6	*ft, (assumes no native for backfill)*		
*Volume CF (W*L*D_csbc)*	*899*	*336*	*CF*		
Volume (1.85ton/cy) TON	62	24	*TON*	**SUM**	
Volume +10%	68	26	*TON*	**100**	**Ton CSBC**
Pavement Repair					
Pavement Disturbance Width	5.8	6.5	*ft*		
Trench Length	351	118	*ft*		
HMA (4" thick)	673	256	*CF*		
	25	9	*CY*		
assume 2.05 ton/cy	*52*	*20*	*TON*	**SUM**	
Volume +10%	57	22	*TON*	**80**	**TON HMA**
CSTC (4" thick)	673	256	CF		
	25	9	CY		
assume 1.85 ton/cy	*47*	*18*	*TON*	**SUM**	
Volume +10%	52	20	*TON*	**80**	**TON CSTC**
shoring				**SUM**	
trench depth x trench length	1460	560	*SF*	**2,020**	**SF**
Sawcutting				**SUM**	
Two times the length of paved trench	702	236	*LF*	**940**	**LF**

PLANNING LEVEL PROJECT COST OPINION

PROJECT: **N. Schoolhouse Hill Road Ditch Improvements** **CHECK BY:**
Project ID: **# 2**
BY: **lcr** **DATE:** **1/29/2008**

ITEM NO.	ITEM	QUANTITY	UNIT	UNIT PRICE	AMOUNT
Construction Elements					
1	DITCH EXCAVATION INCL HAUL	910	CY	$ 25.00	$ 22,750
2	SAWCUTTING	240	LF	$ 4.00	$ 960
3	SCHEDULE A CULVERT PIPE 18 IN. DIAM.	120	LF	$ 45.00	$ 5,400
4	HMA CL.1/2 IN. PG 64-22 (4-inches)	20	TON	$ 150.00	$ 3,000
5	CRUSHED SURFACING TOP COURSE (4-inches)	20	TON	$ 35.00	$ 700
6	CRUSHED SURFACING BASE COURSE	30	TON	$ 55.00	$ 1,650
7	SHORING OR EXTRA EXCAVATION CLASS B	500	SF	$ 1.00	$ 500
8	SEEDING AND FERTILIZING	0.4	AC	$ 3,000.00	$ 1,200
9	TEMPORARY BYPASS	1	LS	$ 4,000.00	$ 4,000
				Subtotal Construction Elements	**$ 40,160**
Required Ancillary Items					
10	DEWATERING		0%		$ -
11	EROSION & SEDIMENTATION CONTROL		10%	(see note 3)	$ 4,016
12	TRAFFIC CONTROL		5%	(see note 4)	$ 2,008
13	CONTINGENCY		30%		$ 12,048
				Subtotal Ancillary	$ 18,072
				Subtotal Construction + Ancillary	**$ 58,232**
Mobilization					
14	MOBILIZATION		10%		$ 5,823
				Subtotal Construction + Ancillary + Mobilization	**$ 64,055**
Tax/Engineering/Management/Permitting					
15	STATE SALES TAX		8.3%		$ 5,317
16	ENGINEERING/LEGAL/ADMIN		50%		$ 32,028
17	CONSTRUCTION MANAGEMENT		20%		$ 12,811
18	PERMITTING		10%		$ 6,406
19	LAND AND RIGHT OF WAY		0%		$ -
				Subtotal	$ 56,561
				Subtotal Construction + Ancillary + Mobilization + Tax/Engineering/Management/Permitting	**$ 120,616**
2007 Dollars				**Total Estimated Project Cost (Rounded)**	**$ 121,000**

Notes:

1. The above cost opinion is in 2007 dollars and does not include future escalation, financing, or O&M costs.
2. The order-of-magnitude cost opinion has been prepared for guidance in project evaluation from the information available at the time of preparation and for the assumptions stated. The final costs of the project will depend on actual labor and material
3. Increase percentage markup if work is in or immediately adjacent to flowing or standing water, steep slope, and/or other erosion-prone conditions.
4. Increase percentage markup if work is in or immediately adjacent to secondary, arterial, or other high-volume road or temporarily closes a roadway.
5. Land Acquisition unit costs include Administrative Costs and Condemnation.

CIP#2 - N. Schoolhouse Hill Road Ditch Improvements Quantity Calculation Sheet	Calculated Values User Input Values **For use in estimate**

Ditch Excavation (N. Schoolhouse Hill Road - south side only)				
length	1,000	*ft*	**SUM**	
half of width (3.5' deep V ditch with 2:1 sides)	7	*ft*	**910**	**CY**
depth of excavation	3.50	*ft*		
Seeding and Fertilizing Ditch by hand	0.32	*acre*	**0.4**	**AC**
Culvert Replacements				
Number of Driveways on south side	10	*each*	**SUM 18-in Pipe**	
Estimated driveway width	12	*ft*	**120**	**LF**

Paved Trench Repair	Paved			
Pipe Excavation				
pipe dia (ID)	1.5	*ft*		
pipe dia (OD) = 1.2*ID	1.8	*ft*		
trench width = (1.5 x ID) + 18"	3.8	*ft*		
street repair width = trench width + 2'	5.8	*ft*		
average depth to pipe invert	3.5	*ft, (assumes 2-ft cover)*		
trench length	120	*ft*		
Pavement Disturbance Width	5.8	*ft*		
trench backfill				
total trench depth (to bottom of bedding)	4.2	*ft*		
depth of trench that is pipe zone bedding	2.8	*ft, (OD + 6" above + 6" below)*		
depth of trench that is pavement restoration	0.67	*ft, (depth of HMA + depth of CSTC)*		
Depth of Trench CSBC backfill	0.7	*ft, (assumes no native for backfill)*		
*Volume CF (W*L*D_csbc)*	*308*	*CF*		
Volume (1.85ton/cy) TON	22	*TON*	**SUM**	
Volume +10%	24	*TON*	**30**	**Ton CSBC**
Pavement Repair				
Pavement Disturbance Width	5.8	*ft*		
Trench Length	120	*ft*		
HMA (4" thick)	230	*CF*		
	9	*CY*		
assume 2.05 ton/cy	*18*	*TON*	**SUM**	
Volume +10%	20	*TON*	**20**	**TON HMA**
CSTC (4" thick)	230	CF		
	9	CY		
assume 1.85 ton/cy	*16*	*TON*	**SUM**	
Volume +10%	18	*TON*	**20**	**TON CSTC**
shoring			**SUM**	
trench depth x trench length	500	*SF*	**500**	**SF**
Sawcutting			**SUM**	
Two times the length of paved trench	240	*LF*	**240**	**LF**

PLANNING LEVEL PROJECT COST OPINION

PROJECT: **Replace Half-Pipe with 18-inch Diameter Culvert** **CHECK BY:**
Project ID: **# 3**
BY: **lcr** **DATE:** **1/29/2008**

ITEM NO.	ITEM	QUANTITY	UNIT	UNIT PRICE	AMOUNT
Construction Elements					
1	SCHEDULE A CULVERT PIPE 18 IN. DIAM.	200	LF	$ 45.00	$ 9,000
2	CRUSHED SURFACING BASE COURSE	80	TON	$ 55.00	$ 4,400
3	SHORING OR EXTRA EXCAVATION CLASS B	830	SF	$ 1.00	$ 830
4	SEEDING AND FERTILIZING	0.1	AC	$ 3,000.00	$ 300
5	TEMPORARY BYPASS	1	LS	$ 4,000.00	$ 4,000
				Subtotal Construction Elements	**$ 18,530**
Required Ancillary Items					
6	DEWATERING		0%		$ -
7	EROSION & SEDIMENTATION CONTROL		10%	(see note 3)	$ 1,853
8	TRAFFIC CONTROL		5%	(see note 4)	$ 927
9	CONTINGENCY		30%		$ 5,559
				Subtotal Ancillary	$ 8,339
				Subtotal Construction + Ancillary	**$ 26,869**
Mobilization					
10	MOBILIZATION		10%		$ 2,687
				Subtotal Construction + Ancillary + Mobilization	**$ 29,555**
Tax/Engineering/Management/Permitting					
11	STATE SALES TAX		8.3%		$ 2,453
12	ENGINEERING/LEGAL/ADMIN		50%		$ 14,778
13	CONSTRUCTION MANAGEMENT		20%		$ 5,911
14	PERMITTING		10%		$ 2,956
15	LAND AND RIGHT OF WAY		0%		$ -
				Subtotal	$ 26,097
				Subtotal Construction + Ancillary + Mobilization + Tax/Engineering/Management/Permitting	**$ 55,653**
2007 Dollars				**Total Estimated Project Cost (Rounded)**	**$ 56,000**

Notes:

1. The above cost opinion is in 2007 dollars and does not include future escalation, financing, or O&M costs.
2. The order-of-magnitude cost opinion has been prepared for guidance in project evaluation from the information available at the time of preparation and for the assumptions stated. The final costs of the project will depend on actual labor and material
3. Increase percentage markup if work is in or immediately adjacent to flowing or standing water, steep slope, and/or other erosion-prone conditions.
4. Increase percentage markup if work is in or immediately adjacent to secondary, arterial, or other high-volume road or temporarily closes a roadway.
5. Land Acquisition unit costs include Administrative Costs and Condemnation.

CIP#3 - Half-Pipe from Lake Cushman Road to Finch Creek Quantity Calculation Sheet	Calculated Values User Input Values **For use in estimate**

Seeding and Fertilizing Ditch by hand	0.09	acre, (200' x 20')		**0.1**	**AC**

Culvert Replacements

Estimated length of pipe	**200**	**LF**

Paved Trench Repair	Unpaved				
Pipe Excavation					
pipe dia (ID)	1.5	*ft*			
pipe dia (OD) = 1.2*ID	1.8	*ft*			
trench width = (1.5 x ID) + 18"	3.8	*ft*			
street repair width = trench width + 2'	0.0	*ft*			
average depth to pipe invert	3.5	*ft, (assumes 2-ft cover)*			
trench length	200	*ft*			
Pavement Disturbance Width	0.0	*ft*			
trench backfill					
total trench depth (to bottom of bedding)	4.2	*ft*			
depth of trench that is pipe zone bedding	2.8	*ft, (OD + 6" above + 6" below)*			
depth of trench that is pavement restoration	0.00	*ft, (depth of HMA + depth of CSTC)*			
Depth of Trench CSBC backfill	1.4	*ft, (assumes no native for backfill)*			
*Volume CF (W*L*D_csbc)*	*1,013*	*CF*			
Volume (1.85ton/cy) TON	70	*TON*	**SUM**		
Volume +10%	77	*TON*		**80**	**Ton CSBC**
Pavement Repair					
Pavement Disturbance Width	0.0	*ft*			
Trench Length	200	*ft*			
HMA (4" thick)	0	*CF*			
	0	*CY*			
assume 2.05 ton/cy	*0*	*TON*	**SUM**		
Volume +10%	0	*TON*		**-**	**TON HMA**
CSTC (4" thick)	0	CF			
	0	CY			
assume 1.85 ton/cy	*0*	*TON*	**SUM**		
Volume +10%	0	*TON*		**-**	**TON CSTC**
shoring			**SUM**		
trench depth x trench length	830	*SF*		**830**	**SF**
Sawcutting			**SUM**		
Two times the length of paved trench	-	*LF*		**-**	**LF**

PLANNING LEVEL PROJECT COST OPINION

PROJECT: **Filterra Device for WQ Retrofit (retrofits 0.8 ac)** **CHECK BY:**
Project ID: **# 4**
BY: **lcr** **DATE:** **1/29/2008**

ITEM NO.	ITEM	QUANTITY	UNIT	UNIT PRICE	AMOUNT
Construction Elements					
1	FILTERRA WQ TREATMENT DEVICE	2	EA	$ 10,000.00	$ 20,000
				Subtotal Construction Elements	**$ 20,000**
Required Ancillary Items					
2	DEWATERING		0%		$ -
3	EROSION & SEDIMENTATION CONTROL		10%	(see note 3)	$ 2,000
4	TRAFFIC CONTROL		5%	(see note 4)	$ 1,000
5	CONTINGENCY		30%		$ 6,000
				Subtotal Ancillary	$ 9,000
				Subtotal Construction + Ancillary	**$ 29,000**
Mobilization					
6	MOBILIZATION		10%		$ 2,900
				Subtotal Construction + Ancillary + Mobilization	**$ 31,900**
Tax/Engineering/Management/Permitting					
7	STATE SALES TAX		8.3%		$ 2,648
8	ENGINEERING/LEGAL/ADMIN		50%		$ 15,950
9	CONSTRUCTION MANAGEMENT		20%		$ 6,380
10	PERMITTING		10%		$ 3,190
11	LAND AND RIGHT OF WAY		0%		$ -
				Subtotal	$ 28,168
				Subtotal Construction + Ancillary + Mobilization + Tax/Engineering/Management/Permitting	**$ 60,068**
2007 Dollars				**Total Estimated Project Cost (Rounded)**	**$ 61,000**

Notes:

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2. The order-of-magnitude cost opinion has been prepared for guidance in project evaluation from the information available at the time of preparation and for the assumptions stated. The final costs of the project will depend on actual labor and material
3. Increase percentage markup if work is in or immediately adjacent to flowing or standing water, steep slope, and/or other erosion-prone conditions.
4. Increase percentage markup if work is in or immediately adjacent to secondary, arterial, or other high-volume road or temporarily closes a roadway.
5. Land Acquisition unit costs include Administrative Costs and Condemnation.

Unit prices were selected based on the prices shown at http://www.wsdot.wa.gov/biz/contaa/uba/. When a range of prices were provided by WSDOT, prices for a similar quantity were selected.

CLEARING AND GRUBBING	$	0.50	SF	($20,000/ACRE FOR 0.22 ACRE)
DITCH EXCAVATION INCL HAUL	$	25.00	CY	
SAWCUTTING	$	4.00	LF	
SCHEDULE A STORM SEWER PIPE 12 IN. DIAM.	$	40	LF	
SCHEDULE A CULVERT PIPE 18 IN. DIAM.	$	45	LF	
SCHEDULE A CULVERT PIPE 24 IN. DIAM.	$	50	LF	
TESTING STORM SEWER PIPE	$	2	LF	
HMA CL.1/2 IN. PG 64-22 (5-inches)	$	150	TON	
CRUSHED SURFACING TOP COURSE (4-inches)	$	35	TON	
CRUSHED SURFACING BASE COURSE	$	55	TON	
CATCHBASIN TYPE 1L	$	1,600	EA	
MANHOLE TYPE 2, 48 IN. DIAM.	$	3,000	EA	
CONNECT TO EXISTING STRUCTURE	$	1,000	EA	
SHORING OR EXTRA EXCAVATION CLASS B	$	1.00	SF	
SEEDING AND FERTILIZING	$	3,000	AC	
FILTERRA WQ TREATMENT DEVICE	$	10,000	EA	