BIRCH BAY

COMPREHENSIVE STORMWATER PLAN

PREPARED FOR

WHATCOM COUNTY WASHINGTON

PREPARED BY

CH2MHILL

July 2006

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Comprehensive Stormwater Plan

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Acronyms and Abbreviations

AKART	all known, available, and reasonable technology
BMPs	best management practices
CAC	Citizens Advisory Committee
CAO	Critical Areas Ordinance
CCTV	closed-circuit television
CFR	Code of Federal Regulations
CIP	Capital Improvement Program
CRIS	County Road Inventory System
DO	dissolved oxygen
DOH	Washington State Department of Health
Ecology	Washington Department of Ecology
EIS	environmental impact statement
ERUs	equivalent residential units
ESA	Endangered Species Act
FC	fecal coliform colonies
FCZD	flood control zone district
ft^2	square feet
FTE	full time equivalent
G.O.	General obligation
GPS	Global Positioning System
HB	House Bill
LID	low-impact development
LIDs	local improvement districts
LWD	large woody debris
M&O	Maintenance and Operations
MEP	maximum extent practicable
mg/L	milligrams per liter

ml	milliliters
MRC	Whatcom County Marine Resource Committee
MRSC	Municipal Research & Services Center
NPDES	National Pollutant Discharge Elimination System
NSEA	Nooksack Salmon Enhancement Association
NWIFC	Northwest Indian Fisheries Commission
O&M	operation and maintenance
PIE	Public Involvement and Education
PWTF	Public Works Trust Fund
RCW	Revised Code of Washington
REET	Real estate excise tax
ROW	right-of way
SDC	system development charge
SFRs	single-family residences
SMP	Shoreline Management Program
SRF	State Revolving Fund
SWMP	Stormwater Management Program [or Plan]
SWPPP	Stormwater Pollution Prevention Plan
TSS	total suspended solids
UGA	urban growth area
ULIDs	utility local improvement districts
USC	United States Code
WAC	Washington Administrative Code
WCC	Whatcom County Code
WDFW	Washington Department of Fish and Wildlife
WDNR	Washington State Department of Natural Resources
WRIA	Water Resource Inventory Area

Glossary

Best management practices (BMPs) - Structural or nonstructural methods to prevent or reduce the movement of sediment, nutrients, pesticides, or other pollutants from the land to surface or groundwater.

Capital improvement program (CIP) – An infrastructure planning tool for a municipality, county, or other government entity. The CIP often contains a listing of the infrastructure projects planned for a defined period of time into the future.

Fecal coliform bacteria – Microorganisms that live in large numbers in the intestines of warm-blooded animals that aid in the digestion of food. The presence of fecal coliform bacteria in aquatic environments indicates that the water has been contaminated with the fecal material of humans or other animals.

Impervious surface – Ground or rooftop surface that is paved or otherwise impermeable to water.

Large woody debris (LWD) – Felled or fallen vegetation (often trees) that accumulate near and within a stream or river that aid in the habitat diversity of a waterbody.

Low-impact development (LID) – The term for a series of measures whose overall goal is to reduce the negative effects of urbanization and development, including increased impervious surface, that lead to a hydrologic regime altered from the natural state.

National Pollutant Discharge Elimination System (NPDES) - A national permit program that controls water pollution by regulating point sources that discharge pollutants into waters of the United States. In most cases, the permit program is administered by the State.

Non-point source pollution – The pollution that is picked up by stormwater runoff as it makes it way through the watershed to the receiving water body.

Riparian – Relating to the bank of a natural watercourse such as a river or tidewater.

Special service district – A limited-purpose local government entity, separate from a city, town, or county government, that performs a single function. Special service districts are generally created through the County legislative authority to meet a specific need of the local community, such as a new or higher level of service.

Funding Mechanisms

Additional funding will be needed to address the stormwater issues raised by Birch Bay citizens. New funds will allow the County to protect public health and safety, meet public expectations, and address regulatory requirements while preparing a long-term strategy for operating surface water management programs.

Stormwater Funding Mechanisms

- Establishing a sub flood control zone district with authority to levy fees and charges.
- Introducing stormwater service rates and charges, and associated policies that include incentives and development financing.
- Complete a public involvement program prior to implementation of the surface water fee.
- Exploring the availability of Whatcom County funding, as well as federal, state, and other grant funding sources, and pursuing suitable options.

Several alternatives are available for funding stormwater management programs. To secure adequate funding, Birch Bay decisionmakers should incorporate a combination of mechanisms that consider both immediate and long-term needs. Any funding plan should also be guided by broad goals, such as customer acceptability, defensibility, revenue sufficiency and stability, equity, administrative ease, and consistency/compatibility with local policies, practices, and long-term strategies. It should include public education and involvement to help ensure ultimate support and success. Additional analysis and public debate are needed before adoption of any funding mechanism.

For More Information

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Birch Bay, looking southwest toward Point Whitehorn and the San Juan Islands beyond.

BIRCH BAY

Executive Summary

Introduction

Birch Bay, Washington, is located about 20 miles north of Bellingham in Whatcom County. This vibrant community and recreational destination includes a shallow, crescent-shaped bay containing cobble and sand beaches and expansive tide flats. The beach in Birch Bay is a very popular recreation area with many activities including swimming, fishing, boating, admiring flora and fauna, strolling the tide flats, and shellfish harvesting. The bay has extensive shellfish beds and recreational shellfish harvesting. The 194-acre Birch Bay State Park provides public access to these resources. Whatcom County Parks manages other public access points to the water. Terrell Creek is the predominant freshwater system in the Birch Bay watershed, draining approximately 17 square miles.

Birch Bay is currently experiencing increasing flooding and erosion, declining water quality, and loss of aquatic habitat as a result of increasing growth and development in the region.

Goal of the Birch Bay Comprehensive Stormwater Plan

The primary goal of this plan is to enable Birch Bay residents to reach agreement on a stormwater management plan that sustains the lifestyle and restores the aquatic resources of Birch Bay under the pressure of increasing growth and development.

This comprehensive stormwater plan addresses these issues and provides guidance on addressing or preventing future problems that may arise as growth continues.

In 2002, the Birch Bay Community Plan Steering Committee completed a community plan for the Birch Bay Urban Growth Area (UGA) and surrounding area. The Birch Bay Community Plan was adopted as a Sub Area Plan of the Whatcom County Comprehensive Plan in 2004. The plan includes the community's vision for accommodating future growth in the area, including the recommendation to develop a stormwater plan. This comprehensive stormwater plan has been developed in response to the Birch Bay Sub Area Plan action item.

Regulations Affecting Surface Water Management

Chapter 2 of this plan discusses stormwater regulatory requirements and compliance issues in Birch Bay. Relevant regulations include the Endangered Species Act (ESA), the Clean Water Act National Pollutant Discharge Elimination System (NPDES), and several Whatcom County ordinances, plans, and standards, such as the Whatcom County Comprehensive Plan, the update to Whatcom County's Shoreline Management Program (currently underway), the Birch Bay Sub Area Plan, the Whatcom County Zoning Ordinance, and the Whatcom County Development Standards. The County plans, programs, and ordinances influence and provide guidance for the development of a stormwater management program in Birch Bay.

As part of the preparation of this plan, a gap analysis was conducted to identify areas in Whatcom County regulations, ordinances, programs, and plans where improvements are needed to meet the regulatory requirements of the NPDES stormwater permit and other State requirements. The detailed recommendations produced by the gap analysis are presented in Chapter 2.

Surface Water Issues in Birch Bay

Several types of surface water problems have occurred recently in the Birch Bay area. The most publicized problem is the decline in the water quality of Birch Bay itself.

In July 2003, Birch Bay was added to the Washington State Department of Health's list of "threatened" shellfish harvesting areas. This status indicates a downward trend in water quality and was given as part of the Department of

Cottonwood Beach outfall, January 2006.

Rogers Slough, looking toward its outlet to Birch Bay, January 2006.

Health's Early Warning System. The Early Warning System is intended to identify areas that may be on the verge of failing public health standards or that show deteriorating water quality based on high fecal coliform levels. Although now removed, the threatened status for the shellfish resources of Birch Bay is a "wake-up call" for residents, planners, and policymakers in addition to commercial and recreational shellfish harvesters. This surface water problem highlights the need for regional stormwater planning efforts.

Public Involvement

This Birch Bay Comprehensive Stormwater Plan has benefited from significant public involvement. The Citizens Advisory Committee (CAC) has worked through identification of problems, potential solutions, and possible funding sources for the elements described in this plan. A public workshop was well attended and was vital to the development of an all-inclusive plan.

Besides declining water quality in Birch Bay, several other types of surface water problems occur in the area. Localized drainage issues, including flooding and erosion/sedimentation, have developed or worsened in several neighborhoods. Aquatic habitat in wetlands, freshwater creeks, and the saltwater bay has been lost. Surface water quality of local freshwater bodies has also declined. These issues are generally the result of historical and recent development in the area. The problems have been made worse by the greater impervious surface and non-point source pollution that accompanies increasing development.

Solutions to Surface Water Problems

The potential solutions to the identified water quantity, water quality, habitat, and policy issues can be divided into two categories: programmatic (non-structural) and capital (structural). Several of the surface water problems identified in Birch Bay can be addressed with construction projects suitable for the Whatcom County Stormwater Capital Improvement Program (CIP), and others can be solved with stormwater management programmatic actions.

Programmatic alternatives have the benefit of often being strategic rather than reactionary. Instead of fixing a single problem with a structural solution, programmatic alternatives often address several existing problems and are effective at preventing future problems. Potential programmatic solutions as part of a county-wide or Birch Bay stormwater management program are discussed in Chapter 4. Whatcom County has previously implemented most or all of these recommendations at one time or another in various locations in the county. Therefore, most of these actions could be implemented as an extension of existing activities or programs.

Programmatic Solutions

- Complaint response
- Inspections and illicit connections
- Spill response
- Maintenance and operations (M&O)
- Education
- Monitoring
- Regulatory and policy changes
- Record-keeping and annual reporting
- Identifying a watershed keeper
- Administration
- Implementation of mandatory low-impact development (LID) measures

Capital Improvement Projects

1. Birch Bay Drive roadway improvements
2. Drainage improvements, Cottonwood Neighborhood
3. Drainage improvements, Shintaffer Road at Richmond park
4. Lower Terrell Creek improvements for water quality benefits
5. Drainage improvements, Birch Point, various locations
6. Terrell Creek culvert at Grandview Road
7. Drainage improvements, Rogers Slough at Birch Bay Drive

Capital improvement projects would solve many of the drainage problems in the Birch Bay area, and could also be used to improve water quality and aquatic habitat. Several of these projects have been recommended for the Whatcom County CIP. Historically, decisions on drainage-related infrastructure projects have been made one at a time without the benefit of master planning to address several other problems or plans in the area. With the implementation of this stormwater plan, decisions can be made and projects can be planned, implemented, and prioritized based on the rating of that problem compared to others that have already been identified. Recommended capital projects are discussed in detail in Chapter 4.

1 Introduction and Background

Birch Bay is a beachfront community about 20 miles north of Bellingham, Washington. The shallow bay and tide flats provide recreational opportunities for residents and visitors alike. The extensive shellfish beds and shoreline are primary attractions. The Birch Bay watershed is experiencing increasing growth, and planning efforts need to keep pace with the development. The purpose of this Birch Bay Comprehensive Stormwater Plan is to provide guidance on current stormwater issues while providing a mechanism to deal with future problems as they arise.

1.1 Goals and Objectives of this Birch Bay Comprehensive Stormwater Plan

This section describes the goals and measurable objectives for this Birch Bay Comprehensive Stormwater Plan.

1.1.1 Goals

The goal of this plan is to enable Birch Bay residents to reach agreement on a stormwater management plan that sustains the lifestyle and restores the aquatic resources of Birch Bay under the pressure of increasing growth and development.

1.1.2 Objectives and Performance Measures

Table 1-1 lists the objectives of this plan and the corresponding performance measures. Several individual measures can be used to quantify or qualify performance for any one individual objective. There are other measures of performance that may not be listed here.

One set of objectives are that stormwater discharges should not cause or contribute to a violation of Washington State's Surface Water Quality Standards (Chapter 173-201A WAC), groundwater quality standards (Chapter 173-200 WAC), sediment management standards (Chapter 173-204 WAC), or human-health-based criteria in the National Toxics Rule (40 CFR Part 131.36).

1.2 Previous Planning Efforts in Birch Bay

Because Birch Bay is an unincorporated area, comprehensive planning is the responsibility of Whatcom County. Past comprehensive planning efforts included the *Birch Bay Comprehensive Plan* (Whatcom County, 1977), the *Blaine-Birch Bay Sub-Area Plan* (Whatcom County, 1987), the *Birch Bay Community Plan* (Sub Area Plan) (Kask Consulting, 2002), and the *Whatcom County Comprehensive Plan* (Whatcom County, 2005).

In 2004, the Birch Bay Community Plan Steering Committee completed a community plan for the Birch Bay Urban Growth Area (UGA) and surrounding area. This Birch Bay Community Plan (Sub Area Plan) was adopted as a Sub Area of the Whatcom County Comprehensive Plan in 2004. The plan includes the community's vision on accommodating future growth in the area.

TABLE 1-1. OBJECTIVES AND PERFORMANCE MEASURES

Objective	Corresponding Measure of Performance
Drainage, Flooding, and Erosion:	
Identify drainage, flooding, and erosion issues throughout the planning area and prioritize these issues	Consensus on prioritized list of current drainage, flooding, and erosion issues
Take action to resolve priority drainage, flooding, and erosion issues to the extent possible with available funds or acceptable future funding levels	Reduction in magnitude and frequency of drainage issues, flooding, and erosion. Funding obtained to implement high-priority projects.
Identify public versus private issues	Identification of what makes a public issue vs. what makes a private issue
Water Quality:	
Identify sources of coliform bacteria and other stormwater pollutants	Results of field identification efforts and data from source tracing, monitoring, etc. indicate source(s) of bacteria
Identify opportunities to eliminate or reduce sources of bacteria that lead to shellfish restrictions/closures Eliminate or reduce other stormwater pollutants such as nutrients	Programs are implemented to address these issues; monitoring data used to measure performance after implementation of programs Meet Washington State's Surface Water Quality Standards (Chapter 173-201A WAC), Ground Water Quality Standards (Chapter 173-200 WAC), Sediment Management Standards (Chapter 173-204 WAC), and human-health-based criteria in the National Toxics Rule (40 CFR Part 131.36)
Identify sources of fine sediment and soil reaching beaches; identify opportunities to mimic historical levels	Mitigation of unnatural sediment transport processes
Aquatic Habitat:	
Identify key shellfish, stream, and wetland habitats	Inventory of aquatic habitat resources is completed
Outline opportunities to sustain and improve shellfish habitat, salmon habitat, and wetland habitat	Develop action items and programmatic and structural alternatives
Maintain and protect natural areas including riparian zones, wetlands, and beachfront by discouraging development in these areas	Measure/map remaining natural areas, including wetlands and undeveloped beachfront area Documented changes in regulations, ordinances, and policies that discourage development in critical areas
Community Planning:	
Minimize additional impervious surface by reducing width of streets, encouraging smaller building footprints, etc.	All new projects implement LID concepts to the maximum extent possible
Funding:	
Identify, explain, and evaluate alternative funding mechanisms	Knowledge of all stakeholders on alternative funding mechanisms
Ensure recommended funding alternative is adequate, fair and equitable	General agreement among residents and Whatcom County on recommended funding alternative
Outline action steps and responsibilities for implementation of recommended funding alternative	Implementation of an adequate funding alternative

TABLE 1-1. OBJECTIVES AND PERFORMANCE MEASURES

Objective	Corresponding Measure of Performance
Management of Stormwater System:	
Identify level of service and service delivery options; evaluate and outline preferred alternative	Agreement on preferred alternative for Stormwater Management Program (SWMP)
Establish a mechanism for ongoing citizen review and comment on system performance and priorities	Implementation of forum for citizen review and comment
Outline action steps and responsibilities for implementing the recommendations of this plan	Consensus on procedures and responsibilities for plan implementation

The purpose of the *Whatcom County Comprehensive Plan* (2005) was to establish a framework of goals, policies, and action items for growth planning in both the UGAs and rural areas of Whatcom County. The most recent updates were made to the *Whatcom County Comprehensive Plan* in January 2005.

Development of the *Whatcom County Comprehensive Water Resources Plan* commenced in October 1998. This plan, dated 1999 and updated in 2000 and 2001, outlines Whatcom County's vision and goals in regard to water resources issues. Major goals and objectives outlined in the plan pertain to water supply, fish/shellfish, surface water management, groundwater management, and coordinated planning and management.

1.3 Public Involvement in Birch Bay Comprehensive Stormwater Plan Development

The public has been a vital part of the development of this Birch Bay Comprehensive Stormwater Plan. Several public involvement activities were held, including public workshops and presentations to and discussions with the Citizens Advisory Committee (CAC).

The first public workshop (Workshop #1) was conducted on October 1, 2005. The goal of this workshop was to gain an understanding of interests, goals, context, and issues with surface water, and to receive citizen input on surface water problems in the watershed. Residents were divided into groups by neighborhood and were given the task of identifying locations and severity of surface water problems.

Local area residents provided information on surface water problems both at Workshop #1 and via email and other correspondence during the weeks and months following.

Monthly CAC meetings provided opportunities for public involvement in plan development. Committee input was requested on assembled data and on potential alternative solutions.

A second public workshop (Workshop #2) will be held to receive public input on a draft version of this plan. The emphasis of the final workshop will be to present the findings and recommendations for review and comment.

Public hearings will be held by the County council as part of the Council consideration process for the Birch Bay Comprehensive Stormwater Plan.

2 Regulatory Requirements and Planning Documents

Birch Bay is a rapidly growing community that is experiencing increasing flooding and erosion, declining water quality, and loss of aquatic habitat. Historically, Birch Bay has been primarily a recreational beach community. The citizens of Birch Bay have completed a Comprehensive Land Use Plan that called for low-impact development (LID) and a stormwater plan to protect their lifestyle, activities, and aquatic resources while accommodating the anticipated growth. This Comprehensive Stormwater Plan has been prepared to achieve those goals.

This section identifies compliance requirements for Birch Bay under the National Pollutant Discharge Elimination System (NPDES) and the Endangered Species Act (ESA) in the context of currently implemented Whatcom County programs, policies, and regulations in and around Birch Bay.

With respect to NPDES requirements, Whatcom County is a required permittee under the Washington State Department of Ecology (Ecology) NPDES Phase II permit, along with Cowlitz, Kitsap, Thurston, and Skagit counties. Birch Bay is not required to be covered in the County's permit because Birch Bay is not defined as an urban area by the U.S. Census Bureau. However, Whatcom County's future population growth estimates for Birch Bay indicate that the area may meet or exceed this urban area criterion in the next 5 to 10 years. Therefore, it is prudent for Whatcom County to adopt the same stormwater management program in Birch Bay UGA as is required by the County's NPDES Phase II permit.

The City of Ferndale, located just south of the Birch Bay area, is a Phase II city. Currently, the City of Blaine and the area within the Birch Bay UGA are not individual permittees under Phase II. However, because the City of Blaine's UGA and the UGA of Birch Bay share a boundary, it is possible that Blaine and Birch Bay together may be covered under NPDES Phase II in the future.

This section discusses how Whatcom County's stormwater management program addresses the NPDES Phase II requirements, specifically for the Birch Bay area. It presents an NPDES regulatory gap analysis report describing deficiencies in the County's approach according to NPDES requirements. Potential additions to the Whatcom County Stormwater Management Program are recommended.

With respect to ESA requirements, Terrell Creek is the largest and most productive stream in the Birch Bay Watershed. Terrell Creek supports coho and chum salmon but not Chinook. Steelhead and cutthroat trout also may use the creek. Other streams in the watershed are much smaller and support few or no salmon. Therefore, the ESA is not a significant regulatory driver in Birch Bay, and analysis of ESA requirements is not included here.

This section describes the regulatory requirements of the current NPDES permit, presents a gap analysis with respect to the NPDES requirements, identifies State of Washington requirements, and makes recommendations for revising County regulations, ordinances, programs, or plans to address the requirements identified in the gap analysis.

Note that the scope of this analysis was limited largely to the use of existing review materials. This analysis has been substantially expanded beyond those materials, but the analysis is still somewhat limited.

2.1 Relevant Whatcom County Ordinances, Plans, Programs, and Standards

In 2005, a number of activities were completed in Whatcom County such as the adoption of the Critical Areas Ordinance (CAO) and Water Resource Inventory Area (WRIA) 1 Watershed Management and Salmon Recovery plans. These and other Whatcom County ordinances, plans, programs, and standards have different levels of influence on stormwater management in Whatcom County and Birch Bay. Following is a list of ordinances, plans, and programs whose policies collectively affect stormwater management in Birch Bay:

- Whatcom County Comprehensive Plan (2005)
- Whatcom County Development Standards (2002)
  - Design standards for roads and drainage
- Birch Bay Sub Area Plan (2002)
- Update to Parks and Recreation Open Space Plan (2006)
- Subdivision Ordinance, WCC Title 21
- Zoning Ordinance, WCC Title 20
  - Stormwater Special District (WCC 20.80.636)
  - Water Resource Special Management Area (WCC 20.80.735)
- Washington State Department of Ecology's NPDES Phase II Stormwater Regulations
- Whatcom County Critical Areas Ordinance, Whatcom County Code (WCC) Chapter 16.16 (2005)
- Update to County's Shoreline Management Program, WCC Title 23 (underway)
- WRIA 1 Watershed Management Project Plan
- WRIA 1 Salmon Recovery Plan
- Comprehensive Flood Hazard Management Plan
- River & Flood Repair and Maintenance Program
- Lake Whatcom Management Program
- Drayton Harbor Shellfish Closure Response Strategy
- Portage Bay Shellfish Closure Response Strategy
- Marine Resources Committee Annual Project List
- 6-Year Road Program

The plans influence and provide guidance to development of a stormwater management program in Birch Bay. The ordinances and development standards control development and provide potential protection of the existing Birch Bay environment (natural, social and economic) with new development.

The Shoreline Master Program and the CAO regulate development of aquatic areas such as lakes, wetlands, streams, and marine waters. They require buffers for new development from aquatic resources. The Zoning Ordinance (WCC Title 20) also includes requirements for setbacks that

protect aquatic resources. The CAO does not require use of LID techniques, but does allow some buffer reduction if LID is used where appropriate.

The Birch Bay watershed has been designated as a stormwater special district by the County Zoning Ordinance, WCC 20.80.635. The Zoning Ordinance requires use of stormwater BMPs in stormwater special districts. However, the stormwater special district requirements under WCC 20.80.636 do not specifically require the use of LID techniques. The special district provisions do require implementation of permanent stormwater BMPs, which could result in management measures that qualify as LID techniques. Because of this, new development in the watershed has not been required to maximize LID techniques. Development and adoption of an LID ordinance should be considered. Whatcom County may wish to use Ecology's NPDES Phase II permit Minimum Requirement #5 as a means for evaluating LID techniques and performance. In addition, care should be taken to apply LID techniques appropriate for the project location. For instance, infiltration along coastal bluffs may not be appropriate.

Birch Bay was designated as a Water Resource Special Management Area in February 2005. Existing provisions of the Water Resource Special Management Area requirements that have not been applied within the Birch Bay watershed to date include, "tree canopy area retention". Retention of existing trees on both public and private property is a key citizen concern.

Chapter 2 of the Whatcom County Development Standards (Whatcom County, 2002) covers stormwater management throughout Whatcom County. Section 221 of Chapter 2 covers the Stormwater Special District Standards that apply to Birch Bay. As this section is written, an applicant has the option of using either the same requirements that were in the 1996 Whatcom County Development Standards or the most recent version of Ecology's *Stormwater Management Manual for Western Washington* (2005). The 1996 Development Standards refer to the 1992 Ecology manual, rather than the updated 2005 Ecology manual. Generally, applicants opt for the lesser 1996 Development Standards when developing a comprehensive stormwater management plan for a new development or re-development covered by the standards. Whatcom County should adopt the 2005 Ecology manual.

The Ecology manual requires detention and treatment of stormwater for most developments. The manual recommends the use of a continuous simulation model such as Hydrological Simulation Program—Fortran (HSPF) or Ecology's own version of HSPF, WWHM2. The 1992 version of the manual allows the use of the Santa Barbara Urban Hydrograph (SBUH) model with a correction factor. The Ecology model is available and easy to use. The 2005 version of the Ecology model no longer allows the use of the SBUH. Whatcom County still allows use of the SBUH model.

Stormwater design and design review require detailed technical knowledge and thorough analysis. There are many assumptions that must be checked. For example, a developer must estimate the size of future houses and amount of impervious surface on lots. This affects the size of the stormwater detention and treatment facilities. Over the years, the size of new homes has increased greatly, yet many developers still use old estimates with lower impervious areas. This means that stormwater facilities may be too small to provide the expected benefits.

The Road Standards chapter (Chapter 5) of the Whatcom County Development Standards (May 2004) includes provisions for road widths within Stormwater Special Districts. Section 505.U of these standards states that "developers shall work with design professionals to reduce stormwater runoff by presenting low-impact alternatives to the standard road design" and that "the County Engineer shall review low-impact alternatives to the standard road design…as warranted to

reduce stormwater runoff in the [stormwater] special district areas." Drawings contained within the development standards show recommendations for road widths depending on average daily traffic volumes. Whatcom County should increase the implementation of reduced-width roadway designs by increasing implementation and enforcement of this requirement.

2.2 NPDES Phase II Regulatory Requirements and Gap Analysis

2.2.1 NPDES Phase II Requirements

The NPDES Phase II Draft Permit dated 2/16/06 was used for the regulatory gap analysis. The six minimum requirements under Section S5 in the previous Phase II permit were consolidated into five minimum requirements in the new permit. The new permit has the same requirement categories, but two of the requirements were combined into one. In the new draft permit, the fourth requirement, "Controlling Runoff from New Development, Redevelopment and Construction Sites," includes the performance measures covered in two different requirements in the old permit. The following five requirements are included in Section S5 of the new NPDES Phase II Draft Permit issued by Ecology on 2/16/06 (Ecology, 2006):

1. Public Education and Outreach
2. Public Involvement and Participation
3. Illicit Discharge Detection and Elimination (includes requirement for inventory)
4. Controlling Runoff From New Development, Redevelopment, and Construction Sites
5. Pollution Prevention and Operations and Maintenance for Municipal Operations

Each of these five NPDES Phase II requirements are described by a set of minimum performance measures outlined in the permit. Each of the performance measures are addressed individually in this gap analysis for the Birch Bay area. Table 2-1 at the end of this chapter contains additional detail on these requirements.

Other requirements of the permit include the following:

- Develop and implement a Stormwater Management Program (SWMP)
- Report any monitoring studies
- Assess effectiveness of BMPs and any changes needed
- Prepare a plan for future comprehensive long-term monitoring program
- Submit a detailed annual report on the status of SWMP implementation

Each of these is described in more detail in Table 2-1.

The Clean Water Act requires stormwater treatment by permittees to the maximum extent practicable (MEP). Washington State law requires all known, available and reasonable treatment (AKART). Ecology has determined that MEP is equivalent to AKART and that compliance with the Ecology *Stormwater Management Manual* is AKART.

2.2.2 NPDES Phase II Gap Analysis

Table 2-1 contains an outline of the NPDES Phase II requirements and corresponding performance measures along with the county regulations, ordinances, programs, or plans and any Birch Bay programs or plans that address each performance measure. Table 2-1 also contains a

listing of potential improvements to Whatcom County programs, plans, or policies that would address the identified gap.

2.3 State of Washington Requirements and Gap Analysis

There are several other State of Washington requirements other than NPDES Phase II that address surface water management and/or stormwater. These include the Growth Management Act, Shorelines Management Act, State Environmental Policy Act, the *Puget Sound Water Quality Management Plan* (Puget Sound Water Quality Action Team, 2000), and many others. For example, the Growth Management Act requires:

- "(1) A land use element… Where applicable, the land use element shall review drainage, flooding, and stormwater run-off in the area and nearby jurisdictions and provide guidance for corrective actions to mitigate or cleanse those discharges that pollute water of the state…"
- "(5) Rural element… (c) Measures governing rural development. The rural element shall include measures that apply to rural development and protect the rural character of the area… (iv) Protecting critical areas…and surface water and ground water resources…). Section .030(15) states " 'Rural character' refers to the patterns of land use… (g) That are consistent with the protection of natural surface water flows and ground water and surface water recharge and discharge areas."

Compliance with the Phase II NPDES requirements will achieve compliance with most of the other state regulations relevant to stormwater, as the NPDES Phase II requirements generally cover topics mentioned in these other State of Washington documents with at least one exception. The above language from the Growth Management Act would require retention of forest cover and limitations on impervious surfaces to provide "protection of natural surface water flows". This is addressed in the requirements for forest retention in the County regulations designating Birch Bay as a Water Resource Special Management Area. A thorough gap analysis has not been conducted on all of the other State of Washington requirements as part of the Birch Bay Comprehensive Stormwater Plan.

A new bill related to septic systems, House Bill (HB) 1458, has been passed by the Washington State Legislature. HB 1458 requires local health authorities to identify and correct failing septic systems by 2012. The provisions adopted under HB 1458 apply within "marine recovery areas" to be defined by the local health officer in the 12 counties bordering Puget Sound. Marine recovery areas are to be proposed "…where existing on-site sewage disposal systems are a significant factor contributing to concerns associated with: a) Shellfish growing areas that have been threatened or downgraded by the department under chapter 69.30 RCW; b) Marine waters that are listed by the Department of Ecology under section 303(d) of the federal clean water act (33 USC Sec. 1251 et seq.) for low-dissolved oxygen or fecal coliform; or c) Marine waters where nitrogen has been identified as a contaminant of concern by the local health officer…" The requirements of HB 1458 constitute a regulatory gap that will need to be addressed.

2.4 Recommendations Based on Gap Analysis

Gaps were identified between regulatory requirements of the NPDES Phase II permit and other State of Washington requirements, and Whatcom County regulations, ordinances, programs, and

plans. The following recommendations are made to meet requirements identified by the gap analyses:

- Adopt and require compliance with the 2005 version of the Ecology *Stormwater Management Manual*.
- Develop a program to inspect and require correction of inadequate septic systems per the requirements of HB 1458.
- Conduct a survey of the average amount of impervious surface on new construction projects in the last 1 to 3 years. Require that new development applications use the results as an estimate for calculating stormwater hydrographs and sizing facilities, or limit impervious surface on individual lots through building permits to the amount of impervious surface identified in the original permit application for subdivision. Encourage smaller lot sizes and shared open space.
- Require the maximum potential infiltration on development sites. Require amended soils to increase infiltration and detention of stormwater. Require pervious pavement with suitable base materials for infiltration for walkways, patios, driveways, and residential streets.
- Enforce Chapter 5 Section 505 U of the Whatcom County Development Standards to reduce pavement widths on residential streets. Whatcom County should increase the implementation of reduced-width roadway designs by increasing implementation and enforcement of this requirement.
- Implement the same stormwater management program in the Birch Bay UGA as is required by Whatcom County's NPDES Phase II stormwater permit to address the gaps outlined in Table 2-1. Table 2-1 contains a listing of sections in this plan with recommendations to address the various requirements of the NPDES Phase II permit.

TABLE 2-1. NPDES PHASE II REQUIREMENTS AND CORRESPONDING WHATCOM COUNTY REGULATIONS, PLANS, AND PROGRAMS

NPDES Phase II Requirements[a]	Minimum Performance Measures Associated with NPDES Phase II Requirements[a]	Applicable County Regulation or Program	Potential Improvement to Whatcom County Programs, Plans, or Policies	Sections in this Plan with Recommendations to Address This Requirement
1. Public Education and Outreach [Education programs aimed at residents, businesses, industrials, elected officials, policy makers, planning staff and other employees of the Permittee to reduce or eliminate behaviors and practices that cause or contribute to adverse stormwater impacts.]	a.) Implement or participate in an education and outreach program targeting a minimum of two [of these eight] audiences: i. Awareness by the general public of the need of improving water quality, reducing impervious surfaces, and protecting the existing and designated uses of waters of the state and the potential impacts caused by stormwater discharges. ii. Awareness of natural yard care techniques among homeowners, the general public, landscape professionals, and property managers. iii. Awareness by homeowners, general public, landscape professionals and property managers of the need to protect water quality by reducing purchase of and properly storing, using and disposing of pesticides, fertilizers, and other chemicals. iv. Awareness by homeowners, general public, landscape professionals and property managers of the need to protect water quality by reducing purchase of and properly storing, using and disposing of automotive chemicals, hazardous cleaning supplies, and other hazardous materials. v. Use of technical standards to develop stormwater site plans and erosion control plans by engineers, construction contractors, developers, development review staff, and land use planners, Use of BMPs to mitigate quality and quantity of runoff from development sites. vi. Understanding of the use of low-impact development (LID) among engineers, contractors, developers, architects, landscape architects, realtors and potential home buyers. vii. Awareness by small businesses and the general public about impacts of illicit discharges. viii. Involvement by the general public in environmental stewardship activities to increase awareness of the importance of water quality and mitigate, reduce, or eliminate adverse impacts of stormwater runoff.	ii. Lake-Friendly Gardening Kit. (Whatcom Co. Water Resources, Washington State University Whatcom County Cooperative Extension, Lake Whatcom Management Program) Geared towards homeowners living in the Lake Whatcom watershed. http://lakewhatcom.wsu.edu/gardenkit/INDEX.HTML iii. WCC Chapter 16.32, establishing regulations for fertilizer application on residential lawns and public properties within the Lake Whatcom Watershed. v. *Whatcom County Development Standards,* dated August 1996, *Chapter 2: Stormwater Management* (revised Sept. 11, 2002); Part 2, Temporary Erosion and Sediment Control; Part 3, Permanent Stormwater Management (Section 219, Technical Requirements). viii. The public is involved in stewardship activities such volunteer activities for Nooksack Salmon Enhancement Association (NSEA) or the Chums of Terrell Creek. The Whatcom County Water Resources Public Involvement and Education (PIE) program implements programs in watershed planning, management of Lake Whatcom, and recovery of endangered and threatened fish species. The PIE program led the development of a newsletter (*Watershed News*) about the WRIA 1 Watershed Management Project, a countywide watershed planning effort. Whatcom County Health Department http://www3.doh.wa.gov/here/materials/CRA_Detail.aspx?ID=358 WSU Cooperative Extension http://whatcomshellfish.wsu.edu/Drayton/	Additional education on natural yard care techniques, especially for homeowners, landscapers, and property managers. Reducing purchase of and properly storing, using, and disposing of automotive chemicals, hazardous cleaning supplies, and other hazardous materials; education and spill prevention efforts. Increasing involvement in environmental stewardship activities – reach out to children, students, adults, and visitors. See Chapter 5	5.2.2.5 Education

TABLE 2-1. NPDES PHASE II REQUIREMENTS AND CORRESPONDING WHATCOM COUNTY REGULATIONS, PLANS, AND PROGRAMS

NPDES Phase II Requirements[a]	Minimum Performance Measures Associated with NPDES Phase II Requirements[a]	Applicable County Regulation or Program	Potential Improvement to Whatcom County Programs, Plans, or Policies	Sections in this Plan with Recommendations to Address This Requirement
	b.) Implement or participate in an effort to measure understanding and adoption of the targeted behaviors among the targeted audiences. The resulting measurements shall be used to direct education and outreach resources most effectively as well as to evaluate changes in adoption of the targeted behaviors.		Develop on-going program action.	5.2.2.5 Education
	c.) Track and maintain records of public education and outreach activities.		Develop on-going program action.	5.2.2.8 Record-Keeping and Annual Reporting
2. Public Involvement and Participation [On-going opportunities for public involvement through advisory councils, watershed committees, etc.]	a.) Create opportunities for the public to participate in the decision-making process involving the development, implementation, and update of the Permittee's entire Stormwater Management Plan (SWMP). Each Permittee must develop and implement a process for consideration of public comments on their SWMP.	The Citizens Advisory Committee of Birch Bay. The Birch Bay Comprehensive Stormwater Plan adoption process will include public notification, public workshops and hearings.	Implement public participation plan.	5.2.2.5 Education
	b.) Each Permittee must make their SWMP, the annual report required under S9.A, and all other submittals required by this Permit, available to the public.	Reports and plans are posted on the county website. Follow links from county homepage: http://www.co.whatcom.wa.us.	Create opportunities for on-going public involvement.	5.2.2.9 Watershed Keeper
3. Illicit Discharge Detection and Elimination [On-going program to detect, remove, and prevent illicit connections, discharges, and improper disposal, including spills, into the MS4. Full implementation of an illicit discharge and elimination program]	a.) A storm sewer system map shall be developed no later than 4 years from the effective date of this permit. These maps should be periodically updated.	Whatcom County is currently inventorying all drainage structures, such as culverts, catch basins, and manholes using Global Positioning System (GPS). Inventory of the Lake Whatcom Watershed, as the highest priority, will occur first. There are 28 basins to inventory. The next highest priority is the Lake Samish basin. (http://www.co.whatcom.wa.us/publicworks/maintenance/surface.jsp)	Complete for Birch Bay.	5.2.2.2 Inspections and Illicit Connections
	b.) Develop and implement an ordinance or other regulatory mechanism to effectively prohibit non-stormwater, illegal discharges, and/or dumping into the Permittee's municipal separate storm sewer system to the maximum extent allowable under State and Federal law.		Develop and implement.	5.2.2.7 Regulations
	c.) Develop and implement an ongoing program to detect and address non-stormwater discharges, spills, illicit connections and illegal dumping into the Permittee's municipal separate storm sewer system.	Public Works, Solid waste division, performs public education (brochures, classroom presentations, household newsletters [84,000 homes]), performs litter pickup for illegal dump cleanups, and organizes Adopt-a-Road programs; garbage pickup and disposal is contracted for the Birch Bay area; yard waste disposal is available for City of Bellingham residents (over 5,300 tons collected in 2004).	Develop and implement.	5.2.2.2 Inspections and Illicit Connections

TABLE 2-1. NPDES PHASE II REQUIREMENTS AND CORRESPONDING WHATCOM COUNTY REGULATIONS, PLANS, AND PROGRAMS

NPDES Phase II Requirements[a]	Minimum Performance Measures Associated with NPDES Phase II Requirements[a]	Applicable County Regulation or Program	Potential Improvement to Whatcom County Programs, Plans, or Policies	Sections in this Plan with Recommendations to Address This Requirement
	d.) Permittees shall inform public employees, businesses, and the general public of hazards associated with illegal discharges and improper disposal of waste.	Partially implemented in other Whatcom County watersheds.	Develop and disseminate.	5.2.2.5 Education
	e.) Adopt and implement procedures for program evaluation and assessment, including the tracking number and type of spills or illicit discharges identified; inspections made; and any feedback received from public education efforts.		Develop and implement.	5.2.2.8 Record-Keeping and Annual Reporting
	f.) Provide appropriate training for municipal field staff on the identification and reporting of illicit discharges into MS4s.		Develop and implement.	5.2.2.5 Education
4. Controlling Runoff from New Development, Redevelopment and Construction Sites [Develop, implement, and enforce a program to reduce pollutants in stormwater runoff to MS4 from new development, redevelopment, and construction site activities. This applies to all sites 1 acre or less, including those projects less than 1 acre part of a larger projects and including roads.]	a.) The program shall include an ordinance or other enforceable mechanism that addresses the runoff from new development, redevelopment, and construction site projects.	*Whatcom County Development Standards, Chapter 2: Stormwater Management*, dated August 1996, revised September 2002. WCC 20.80.635 designates the Birch Bay Watershed as a Stormwater Special District. WCC 20.80.636 requires the use of permanent on-site stormwater quantity and quality facilities on all lots less than 5 acres where new development or redevelopment increases impervious surfaces by 500 ft^2 or more. *Whatcom County Development Standards, Chapter 2 Section 221: Stormwater Special District Standards,* dated May 2002. WCC 20.80.735 designates the Birch Bay watershed as a Water Resource Special Management Area. This requires enhanced erosion and sedimentation control.	Update to adopt 2005 Ecology manual.	5.2.2.7 Regulations
	b.) The program shall include a permitting process with plan review, inspection and enforcement capability to meet the standards listed for both private and public projects, using qualified personnel. At a minimum, this program shall be applied to all sites that disturb a land area 1 acre or greater, including projects less than one acre that are part of a larger common plan of the development or sale.	Whatcom County "Watersheds" Planners and Inspectors conduct the review of private and public permits, conduct Erosion and Sedimentation Control BMP inspections, conduct field education, and coordinate on enforcement actions, etc. within the regulatory Birch Bay watershed. Inspection of water quality violations is provided by Ecology. County inspectors work closely with Ecology inspectors. County inspectors inspect BMPs at the start of a project and periodic inspections occur until the project is complete. Correction notices are often issued and penalty assessments are issued as well.	Enhance the County inspection program with adequate staffing to reduce noncompliance with BMP requirements and water quality violations.	5.2.2.7 Regulations

TABLE 2-1. NPDES PHASE II REQUIREMENTS AND CORRESPONDING WHATCOM COUNTY REGULATIONS, PLANS, AND PROGRAMS

NPDES Phase II Requirements[a]	Minimum Performance Measures Associated with NPDES Phase II Requirements[a]	Applicable County Regulation or Program	Potential Improvement to Whatcom County Programs, Plans, or Policies	Sections in this Plan with Recommendations to Address This Requirement
	c.) The program shall include provisions to ensure adequate long-term operation and maintenance (O&M) of post-construction stormwater facilities and BMPs that are permitted and constructed pursuant to (b) above.	*Whatcom County Development Standards,* dated September 2002; *Chapter 2: Stormwater Management*; *Section 220: Maintenance of Stormwater Facilities* Site owners are required to inspect annually and maintain as appropriate. The County has no routine inspection program for maintenance. Residential facilities are unlikely to be maintained without formal County inspection program. A penalty for failing to maintain would require a complaint and demonstration that lack of maintenance of such a facility by the responsible party is in violation of a permit condition. In such cases, enforcement action may be pursued by the applicable County department/division (i.e., Public Works – Engineering). Penalties do not appear to be common occurrences.	Expand the County inspection program to ensure maintenance. Increase inspections and expand enforcement efforts.	5.2.2.4 Maintenance and Operations
	d.) The program shall include a procedure for keeping records of inspections and enforcement actions by staff, including inspection reports, warning letters, notices of violations, and other enforcement records. Records of maintenance inspections and maintenance activities shall be maintained. Permittees shall keep records of all projects disturbing more than 1 acre, and all projects of any size that are part of a common plan of development or sale that is greater than one acre that are approved after the effective date of this permit.	The County currently uses a permit tracking system to document inspections, enforcement actions, etc. associated with a permit action.	Enhance tracking and reporting function to ensure maintenance is conducted adequately.	5.2.2.8 Record-Keeping and Annual Reporting
	e.) The program shall make available copies of the "Notice of Intent for Construction Activity" and/or copies of the "Notice of Intent for Industrial Activity" to representatives of proposed new development and redevelopment. Permittees will continue to enforce local ordinances controlling runoff form sites that are also covered by stormwater permits issued by Ecology.	In place.	None.	Not included in this plan. This is implemented by the Planning and Development Services Department
	f.) The Permittee shall ensure that all staff responsible for implementing the program to Control Stormwater Runoff from New Development, Redevelopment, and Construction Sites, including permitting, plan review, construction site inspections, and enforcement, are trained to conduct these activities. Follow-up training shall be provided as needed to address changes in procedures, techniques, or staffing. Permittees shall document and maintain records of the training provided and the staff trained.		Develop and fund program.	5.2.2.5 Education

TABLE 2-1. NPDES PHASE II REQUIREMENTS AND CORRESPONDING WHATCOM COUNTY REGULATIONS, PLANS, AND PROGRAMS

NPDES Phase II Requirements[a]	Minimum Performance Measures Associated with NPDES Phase II Requirements[a]	Applicable County Regulation or Program	Potential Improvement to Whatcom County Programs, Plans, or Policies	Sections in this Plan with Recommendations to Address This Requirement
5. Pollution Prevention and Operation and Maintenance for Municipal Operations [Develop and implement an O&M program that includes training and has the ultimate goal of preventing or reducing pollutant runoff from municipal operations.]	a.) Adoption of maintenance standards that are as protective, or more protective, of facility function as those specified in Chapter 4 of Volume V of the 2005 *Stormwater Management Manual for Western Washington.*		Develop and fund program.	5.2.2.7 Regulations
	b.) Annual Inspection of all municipally owned or operated permanent stormwater treatment and flow control facilities and taking appropriate maintenance actions in accordance with the adopted maintenance standards.	Updating the Maintenance and Operations (M&O) Surface Drainage Program occurs regularly for changes made by the National Marine Fisheries Service, Ecology, and Washington Department of Fish and Wildlife (WDFW) on water quality and ESA issues. Other activities include checking drainage structures (ditches, culverts, catch basins, and manholes) to make sure that they are in good working condition. There are approximately 3,000 culverts in Whatcom County inventoried into the County Road Inventory System (CRIS), with many requiring cleaning, reset, or replacement (replacement usually requires an upgrade in order to meet the standards of the WDFW fish passage program. Catch basins can also require replacement because of failure or being undersized (restricting flow), and many need annual maintenance for debris removal and cleaning.	Expand program to include annual maintenance.	5.2.2.4 Maintenance and Operations
	c.) Spot checks of potentially damaged permanent treatment and flow control facilities (other than catch basins) after major storm events.	Not currently done.	Fund and train appropriate staff to make inspections.	5.2.2.4 Maintenance and Operations
	d.) Inspection of catch basins and inlets owned or operated by the Permittee at least once before the end of the permit term. Clean catch basins if the inspection indicates cleaning is needed to comply with maintenance standards established in the 2005 *Stormwater Management Manual for Western Washington*. Decant water shall be disposed of in accordance with Appendix 5 *Street Waste Disposal*.	Activities include checking drainage structures (ditches, culverts, catch basins, and manholes) to make sure that they are in good working condition. There are approximately 3,000 culverts in Whatcom County inventoried into the CRIS, with many requiring cleaning, reset, or replacement (replacement usually requires an upgrade in order to meet the standards of the WDFW fish passage program. Catch basins can also require replacement because of failure or being undersized (restricting flow), and many need annual maintenance for debris removal and cleaning.	Fund and train staff to inspect all facilities.	5.2.2.4 Maintenance and Operations
	e.) Compliance with the inspection requirements in a, b, c, and d above shall be determined by the presence of an established inspection program designed to inspect all sites and achieving inspection of 95 percent of all sites.			-
	f.) Establishment and implementation of practices to reduce stormwater impacts associated with runoff from streets, parking lots, roads or highways owned or maintained by the Permittee, and road maintenance activities conducted by the Permittee.	No program in Birch Bay.	Develop and fund program.	5.2.2.4 Maintenance and Operations

TABLE 2-1. NPDES PHASE II REQUIREMENTS AND CORRESPONDING WHATCOM COUNTY REGULATIONS, PLANS, AND PROGRAMS

NPDES Phase II Requirements[a]	Minimum Performance Measures Associated with NPDES Phase II Requirements[a]	Applicable County Regulation or Program	Potential Improvement to Whatcom County Programs, Plans, or Policies	Sections in this Plan with Recommendations to Address This Requirement
	g.) Establishment and implementation of policies and procedures to reduce pollutants in discharges from all lands owned or maintained by the Permittee and subject to this Permit, including but not limited to: parks, open space, road right-of-way, maintenance yards, and at stormwater treatment and flow control facilities.	No program in place for existing facilities.	Develop and fund program.	5.2.2.4 Maintenance and Operations
	h.) Develop and implement an on-going training program for appropriate employees of the Permittee whose construction, operations or maintenance job functions may impact stormwater quality.		Develop and fund program.	5.2.2.5 Education
	i.) Development and implementation of a Stormwater Pollution Prevention Plan (SWPPP) for all heavy equipment maintenance or storage yards, and material storage facilities owned or operated by the Permittee in areas subject to this permit that are not required to have coverage under the Industrial Stormwater General Permit.	No facilities in Birch Bay.	None.	None in watershed.
	j.) Records of inspections and maintenance or repair activities conducted by the Permittee shall be maintained in accordance with S9.		Develop and fund program.	5.2.2.8 Record-Keeping and Annual Reporting

[a]The Ecology NPDES Phase II permit is currently in draft form dated 2/15/06. This draft version was used for this analysis.

3 Birch Bay Watershed Characteristics and Conditions Assessment

3.1 Watershed Characteristics

This report is one element of an overall comprehensive stormwater plan for the watersheds of Birch Bay. Birch Bay is a rapidly growing community that is experiencing increasing flooding and erosion, declining water quality, and loss of aquatic habitat. Historically, Birch Bay has been primarily a recreational beach community. The citizens of Birch Bay completed a comprehensive land use plan that called for low-impact development and a stormwater plan to protect their lifestyle and aquatic resources while accommodating the anticipated growth. This plan will recommend measures to do that.

This report includes a basic description of the watershed, aquatic resources and land use of the Birch Bay area.

3.1.1 Watershed Description

Birch Bay, Washington, is located about 20 miles north of Bellingham, Washington, in Whatcom County. This vibrant community and recreational destination includes a shallow crescent-shaped bay approximately 2.5 miles wide containing cobble and sand beaches and expansive tide flats. The Birch Bay watershed (the area that drains into the bay) is approximately 17,255 acres (27 square miles) (Figure 3-1).

Dominant natural features of the Birch Bay area are the 12 miles of Puget Sound shoreline and the 194-acre Birch Bay State Park. The beach in Birch Bay is a very popular recreation area with extensive shellfish beds and recreational shellfish harvesting. Birch Bay State Park has 8,255 feet of saltwater shoreline in Birch Bay and 14,923 feet of freshwater and saltwater marsh shoreline on Terrell Creek. Terrell Creek flows from its source in Lake Terrell to its outlet in Birch Bay 8.7 miles away. Other creek drainages exist in the watershed, though Terrell Creek is by far the largest.

Daily average temperatures in Birch Bay vary from 62°F in July and August to 30°F in December and January. The area receives on average less than 6 inches of precipitation per month during December and January and just over 1 inch of precipitation in July and August. The area receives approximately 35 inches of precipitation annually.

Four or more cycles of glacial advance and retreat over the last 2.5 million years have shaped the topography and geology of western Whatcom County. The most recent glacial event ended approximately 12,000 years ago. Each time the glaciers advanced, the underlying sediments were compacted. The glacial ice was approximately 6,000 feet thick in the area. The weight of the ice compacted the underlying material and created a hard-packed material called glacial till. This glacial till has low permeability – approximately one inch per month. Drainage is poor and wetlands are common in flat areas consisting of glacial till. The southern portion of the Birch Bay area consists of glacial till. The northern portion of the Birch Bay area consists of marine sediments that were deposited when the area was under water.

The current topography of the Birch Bay area is a result of a diverse geologic history. The northern and southern extents of the watershed at Birch Point and Point Whitehorn, respectively, are the highest points in the watershed. The highest point in the Point Whitehorn area is approximately 150 feet above mean tide level and the highest point in the Birch Point area is approximately 250 feet above mean tide level. Steep bluffs exist along the shoreline of Birch Point and Point Whitehorn that are susceptible to erosion from wave action and stormwater runoff. The central inland portions of the watershed are relatively flat.

As with the rest of the Puget Sound, Birch Bay experiences diurnal tidal changes with two local high and two local low tides per 24-hour day. The mean diurnal tide range is 9.15 feet between mean higher high tide and mean lower low tide. This significant difference between high tide and low tide yields large areas of tidal flats that stretch up to a mile out into the bay depending on tidal changes.

3.1.2 Watershed Drainage Basins

Several different drainages discharge to Birch Bay through open channels, culverts, pipes, and tide gates. Figure 3-1 shows the locations and sizes of the 12 drainage sub-basins delineated as part of this plan. Table 3-1 lists the names of these 12 sub-basins and their contributing areas.

TABLE 3-1. BIRCH BAY WATERSHED DRAINAGE SUB-BASINS

Subbasin	Area (acres)
Birch Point, north	951
Birch Point, south	1,167
Rogers Slough	473
Shintaffer	890
Cottonwood	95
Hillsdale	463
Central Reaches	237
Central Uplands	716
Terrell Creek, lower	1,677
Terrell Creek, upper	8,362
Fingalson (drains to Terrell Creek)	1,037
Point Whitehorn	809
TOTAL	**17,255**

FIGURE 3-1

Birch Bay Watershed

File Path: \\simba\proj\WhatcomWaCountyOf\335334\GIS\MapDocuments\Watershed.mxd, Date: March 1, 2006 8:50:50 AM

The predominant freshwater drainage in the Birch Bay area is the 8.7-mile-long Terrell Creek system that begins at Lake Terrell in the southeastern portion of the Birch Bay watershed. This drainage covers approximately 17 square miles (11,077 acres). The outlet of Terrell Creek is an open channel located along the Birch Bay shoreline north of Alderson Road. The Fingalson sub-basin contributes 1,037 acres to the total acreage of Terrell Creek, and the Lower Terrell Creek sub-basin contributes 1,677 acres (Table 3-1). The remaining 8,362 acres is within the Terrell Creek sub-basin.

3.1.2.1 Birch Point North

The Birch Point North sub-basin consists of the area within the Birch Bay watershed that drains to the north of the point. The upper reaches of this sub-basin are on Trillium Corporation property. Development is centered mainly along Birch Point Road that runs along the coastline. The edge of the sub-basin along the shoreline is mostly made up of bluffs.

3.1.2.2 Birch Point South

The Birch Point South sub-basin includes the area of Birch Point that drains south and east of the point. Most of the northern reaches of this sub-basin are on Trillium property. Development is mainly within Birch Bay Village in the lower reaches of the sub-basin. Much of this sub-basin drains to Birch Bay through the Birch Bay Village Marina. The remaining portion of the sub-basin drains through various small ditches and channels out to Birch Bay to the west of Birch Bay Village. The shoreline of this sub-basin is mainly beach with some bluff along the western shoreline.

3.1.2.3 Rogers Slough

Rogers Slough is located to the west of Cottonwood Beach on the eastern edge of Birch Bay Village. A tide gate controls the outlet of this sub-basin that drains some of Birch Bay Village and a portion of undeveloped area to the north of Birch Point Road. Development has been concentrated within Birch Bay Village, although new development is planned for the area north of Birch Point Road. The northern extent of this sub-basin has not been well-defined because of the difficulties associated with drainage pattern delineation.

3.1.2.4 Shintaffer

The Shintaffer sub-basin was named for the main street that runs north-south through the center. Portions of the golf course at Semiahmoo are within this sub-basin as well as other areas north of Lincoln Road and east of Shintaffer Road. The northern extent of this sub-basin has not been well-defined. A large portion of the runoff from this sub-basin is conveyed in ditches along Shintaffer Road and through culverts and pipes through the Richmond Park Subdivision and then through an open channel finally discharging to Birch Bay through a piped outfall. The densest development in this sub-basin is located along Birch Bay and in the subdivisions along Shintaffer Road.

3.1.2.5 Cottonwood

The upper portion of the Cottonwood sub-basin consists of the open area to the west of Harbor View Road north of Anderson Road and south of Lincoln Road. The lower part of this sub-basin along Birch Bay is of a higher density zoning than the upper potion of the watershed. Drainage from the upper area is conveyed through a ditch and culvert across Anderson Road into a wooded area. According to local residents, this used to be a seasonal creek that now flows year-round.

The outlets of this system are two outfalls near Cedar Road along Birch Bay. These two outfalls are hydraulically connected with one acting as the relief for the other. There is another drainage that starts in the wetlands north of Harborview. The runoff from this area flows in pipes and discharges to the outlet at the intersection of Beach Way and Birch Bay Drive.

3.1.2.6 Hillsdale

The Hillsdale sub-basin includes the area within the Birch Bay watershed to the east of Harbor View Road. The eastern edge of the sub-basin is east of Blaine Road. Development is concentrated in the area along Birch Bay.

3.1.2.7 Central Reaches

This sub-basin consists of the area on either side of Birch Bay–Lynden Road stretching to the east nearly to Blaine Road past the fire station. The Central Reaches sub-basin includes area that is residential and area that is commercial and very little area that is not developed. The outlets for drainage from this sub-basin are two outfall pipes along Birch Bay shown on Figure 3-1.

3.1.2.8 Central Uplands

The Central Uplands sub-basin is low-lying and flat with an extensive ditched drainage network. A large portion of this sub-basin is covered with residential and commercial development along with the golf course and the Sunset Farm Equestrian Center. Development is centered along Birch Bay.

3.1.2.9 Terrell Creek, Lower

The Lower Terrell Creek sub-basin encompasses the area draining to the stretch of Terrell Creek along Birch Bay from Birch Bay State Park to the outlet. More than half of this area discharges through a series of outfall pipes along the length of the creek. The remainder is conveyed to Birch Bay through the open channel flowing west along Lora Lane and discharges at the mouth of Terrell Creek through a tide gate. This unnamed creek along Lora Lane could potentially provide enhanced habitat for fish if the tide gate were removed.

The upper portions of this drainage sub-basin are much less developed than the lower portions along Birch Bay. The area east of Blaine Road is currently less developed than the remainder of the sub-basin.

3.1.2.10 Terrell Creek, Upper

The Upper Terrell Creek sub-basin extends further east than any other sub-basin in the Birch Bay Watershed, nearly 8 miles. The predominant feature of the sub-basin is Lake Terrell, located in the southeastern portion of the sub-basin. The dam at the outlet of Lake Terrell controls the flow in Terrell Creek. The upper reaches of the sub-basin are mainly rural residential. A portion of the Cherry Point Refinery facility operated by BP Corporation lies within the Upper Terrell Creek sub-basin. Portions of the Cherry Point Refinery, including on-site ponds, discharge through a permitted deep water outfall into the salt water and not to Terrell Creek. For the most part, development has been concentrated within the lower reaches of the creek. Birch Bay State Park is located along Birch Bay where Terrell Creek turns and flows along the shoreline behind the beach berm.

3.1.2.11 Fingalson

The Fingalson sub-basin is a part of the Terrell Creek drainage. Fingalson Creek intercepts Terrell Creek near Kickerville Road between Pleasant Valley Road and Grandview Road. This sub-basin is less developed than the other sub-basins with most of the area in rural residential land use.

3.1.2.12 Point Whitehorn

The Point Whitehorn sub-basin consists of the area draining to the bay stretching from the western edge of Birch Bay State Park around the point to well within the Cherry Point Major/Port Industrial UGA. Much of the southern portion of the sub-basin is within the Cherry Point Major/Port Industrial UGA, the western boundary of which is Koehn Road. The northern part of the sub-basin contains residential development along Whitehorn Way and Grandview Road. The central part of the sub-basin is on Trillium property.

3.2 Conditions Assessment

A conditions assessment of natural resources, the built environment, and existing regulatory environment in the Birch Bay is presented in this section. The existing condition of natural resources in the Birch Bay area is a product of the natural processes, historical and current land use, patterns of development, and regulatory environment in the area. The existing condition of the built environment is also a product of the natural processes, historical and current land use, regulatory environment, and the history of investment in and maintenance of infrastructure such as roads, sewers, water systems, pipes, ditches, and ponds. These factors together have affected the current conditions within the Birch Bay area.

3.2.1 Natural Resources

The Birch Bay area has large numbers of fish, shellfish, marine birds, raptors, and other wildlife. Fish, shellfish, birds, and other wildlife use the wetlands, shorelines, creeks, and terrestrial areas as well as Birch Bay itself for refuge and rearing purposes. The near-shore marine waters provide rearing habitat for many species of fish, including the Pacific herring. The Terrell Creek watershed provides habitat for fish and wildlife including salmon and trout. Several species of waterfowl and raptors find habitat opportunities in Birch Bay. The northern bald eagle and the great blue heron are present.

The following sections describe the existing condition of the shorelines, shore lands, and near-shore marine waters of Birch Bay. The freshwater ecosystems of Terrell Creek and Lake Terrell are also covered here, as are wetlands watershed-wide.

3.2.1.1 Marine Waters

Birch Bay and associated salt marshes, beaches, and mud flats provide habitats that play a vital role in the health of the local environment. These habitats are spawning, rearing, and feeding grounds for a wide variety of marine and terrestrial life. Juvenile and adult fish, birds, and shellfish inhabit the waters of Birch Bay. Birch Bay is a shallow bay estuary with exposed tide flats stretching up to a mile under extreme low tides. This shoreline also provides recreational opportunities for local residents and visitors; it is one of the largest and most productive clamming areas in the state of Washington. Birch Bay supports large numbers of shellfish in its warm, nutrient-rich tide flats. Native clams are a key ecological resource in Whatcom County.

The harvest of shellfish safe for public consumption is directly linked to surface water quality in the terrestrial areas discharging to the marine waters supporting these shellfish populations. An important indicator of water quality for shellfish harvesting is bacterial contamination. The source of bacteria of concern to people (fecal bacteria) can be animal waste or human sewage. In general, potential sources of fecal bacterial include municipal sewage treatment plants, on-site sewage systems such as septic systems, broken sewage conveyance pipes, waste discharge from boat tanks, farm animals, pets, and wildlife.

In July 2003, Birch Bay was added to the Washington State Department of Health's (DOH) list of "threatened" shellfish harvesting areas. This status as "threatened" indicates a downward trend in water quality. Birch Bay was given this "threatened" status along with 19 other shellfish areas in the state. This status was given as part of the DOH's Early Warning System. The Early Warning System is intended to identify areas that are potentially on the verge of failing public health standards or that have currently deteriorating water quality based on fecal coliform levels.

The DOH classifies shellfish-growing areas on the basis of surveys that include assessments of water quality and pollution sources. The presence of fecal coliform bacteria is used as the primary indicator of water quality. In classifying each shellfish-growing area, DOH analyzes the 30 most recent samples taken from each sampling station located in and around the shellfish harvest area. The samples at each station must meet a two-part standard for water quality. The geometric mean of the samples cannot exceed 14 fecal coliform colonies per 100 milliliters of water (fc/100 ml), and no more than 10 percent of the samples can exceed 43 fc/100 ml (that is, the 90^{th} percentile of all samples should be less than 43 fc/100 ml). Table 3-2 lists these standards for both freshwater and marine waters. Samples must be taken six times a year. In most cases, several individual sampling stations exist over the harvesting area.

TABLE 3-2. FECAL COLIFORM WATER QUALITY STANDARDS FOR SHELLFISH

Class of Water	Part 1	Part 2
Freshwater – Class A	Fecal coliform are not to exceed a geometric mean of 100 organisms per 100 ml	Not more than 10% of the samples are to exceed 200 organisms per 100 ml
Marine Water – class AA and Class A	Fecal coliform are not to exceed a geometric mean of 14 organisms per 100 ml	Not more than 10% of the samples are to exceed 43 organisms per 100 ml

Washington State DOH uses the four following classifications when determining the status of commercial shellfish growing areas in the state: Approved, Conditionally Approved, Restricted, and Prohibited. An Approved status means that the standards have been met for shellfish harvest. A Conditionally Approved status means that there are specific predictable events such as wet-weather events that can cause an area to exceed water quality standards. The area is approved for harvest unless an event occurs. A Restricted status is given to an area that does not meet the standards but where pollution sources are limited and generally predictable. A Prohibited status means that an area is unable to meet the standards and has pollution sources that are unpredictable and abundant.

In 1995, all commercial shellfish beds in Drayton Harbor (to the north of Birch Bay) and Portage Bay (south of Birch Bay near Bellingham) were specified as Prohibited to harvest due to issues with non-point source pollution. Since 1995, resources have been dedicated to improving water

quality in Drayton Harbor with the goal of reopening the shellfish beds to commercial harvest. In May of 2004, 575 acres of Drayton Harbor were upgraded to Conditionally Approved.

The Whatcom County Water Resources Plan (1999, updated in 2001) quotes the Washington State DOH as having identified six significant or potentially significant pollution sources contributing to the degraded water quality in Drayton Harbor that led to the closure of shellfish beds there. These are:

1) Failing on-site septic systems on or near the harbor shoreline and creeks,

2) City of Blaine sewage treatment facilities and bypasses,

3) Stormwater runoff,

4) Blaine and Semiahmoo marinas,

5) Agricultural practices in California and Dakota watersheds, and

6) Fish processing wastewater.

The January 1995 reclassification of the shellfish beds in Drayton Harbor attributed the pollution to these six sources (Meriwether, 1995). The types of potentially significant sources identified in Drayton Harbor may also be sources of pollution in the Birch Bay watershed, including failing septic systems, leaking wastewater collection pipes, stormwater runoff, marinas, and agricultural practices. Note that the wastewater treatment plant outfall for Birch Bay is outside the bay and discharges in deep water (deeper than Birch Bay) in an area with strong currents. The strong currents result in rapid dispersal and dilution. Thus, the outfall is unlikely to be a significant source of bacteria in the bay but can not be discounted completely.

In the 2004 Annual Inventory of Commercial and Recreational Shellfish Areas of Washington State (DOH, 2005), pollution status was tallied and compared between nearly 100 commercial growing areas in Puget Sound for the year ending in December 2004. To determine pollution status, 90th percentiles were calculated for all sampling dates in 2004. The 90th percentiles were sorted into three categories: Good (0-30 coliform/100 ml), fair (31-43 coliform/100 ml), and bad (above 43 coliform/100 ml). Status was determined as percent of 90th percentiles falling into each category (good, fair, or bad). Birch Bay had one site with a 90th percentile that was rated “fair” and one site with a 90th percentile that was rated “bad” out of the 10 stations monitored. The remaining eight sites were rated, “good”. This 2004 Annual Inventory (DOH, 2005) was the first to show any sites within Birch Bay as having less than a “good” status. These 2004 annual results are in contrast to the Annual Inventories of 2001, 2002, and 2003 (DOH, 2002; DOH, 2003; and DOH, 2004), that show all sites within Birch Bay as rated, “good”.

The Washington State DOH has historically encouraged shellfish harvesters to stay a minimum of 50 feet from the stormwater outfall pipe located near the south end of the beach within Birch Bay County Park approximately 1/3 of a mile north of the Terrell Creek outlet. DOH conducted an outfall inventory in 1994 that lead to this warning. A second outfall inventory is planned for December 2006. Other “hot spots” for bacteria contamination are near the mouth of Birch Bay Village Marina and near the outlet of Terrell Creek.

The Whatcom County Marine Resource Committee (MRC) has conducted clam inventories along Birch Bay since 2004. In the summer of 2004, the MRC coordinated clam surveys in Birch Bay with the help of local volunteers. In 2005, surveys focused on Point Whitehorn and Birch Point. These surveys provided information about the types, numbers, and sizes of clams found in these

areas. Until now, there has been limited species-specific population data available. The information gathered through these surveys will be used to formulate a plan to protect shellfish areas in the future. In addition, these data will be used to help identify potential clam enhancement and restoration sites.

The MRC will be conducting water quality sampling at several sites in Birch Bay over a one-year period starting in 2006. Sites will be sampled monthly for flow and fecal coliform bacteria with the help of local volunteers.

Nutrient dynamics in Birch Bay are dominated by oceanic nutrient inputs from the Georgia Straits. Circulation patterns within Birch Bay and terrestrial and fluvial inputs from several small streams and Terrell Creek also affect nutrient cycling. Areas of intensive nutrient cycling and/or retention include freshwater and estuarine wetlands along the lower reaches of Terrell Creek, as well as the extensive intertidal sand and mud flats in Birch Bay (Whatcom County, 2006). Loss of estuarine and freshwater tidal wetlands along the northern shore of Birch Bay and to the west of Birch Bay State Park has reduced the capacity and opportunity for nutrient retention and cycling in wetlands.

Marine waters are generally well mixed in the marine reaches due to the exposure of the shoreline, even within the relatively low-energy and semi-enclosed waters of Birch Bay. The areas of weakest circulation occur in the southeastern corner of Birch Bay near the state park; this area is more susceptible to elevated nutrient levels than other locations within the watershed (Whatcom County, 2006).

3.2.1.2 Marine Shoreline

The shoreline stretching from the south at Point Whitehorn to Birch Point at the north is a "Shoreline of Statewide Significance", the only marine shoreline in Whatcom County with this designation (Kask Consulting, 2002). This designation applies to the area from the extreme low tide line to the ordinary high water mark. Tidelands, adjacent uplands, and associated wetlands are included. All salt waters in Whatcom County lying seaward from the line of extreme low tide are also "Shorelines of Statewide Significance" per RCW 90.58.030.

A series of bulkheads, rip-rap revetments, and groins have been constructed along the shoreline to maintain beach widths and to protect development and infrastructure along the shoreline. Because of this, the sediment budget and sediment transport processes that contribute to Birch Bay's beaches have been highly disturbed (Phillip Williams & Associates, 2002).

The principal sediment sources are the eroding headlands of Birch Point and Point Whitehorn (Phillip Williams & Associates, 2002). These "feeder" bluffs are a source of sand, gravel, and cobbles for the Birch Bay beaches. The shoreline sediment sources and paths of transport have been disrupted by development in Birch Bay.

3.2.1.3 Wetlands

Wetlands are an invaluable part of the water cycle as they contribute to aquifer recharge, provide groundwater storage, provide floodwater detention, and act as large-scale biofilters for pollutant removal. The loss of wetlands in developed and developing areas may increase pathogen loading, where numerous onsite septic systems occur. Wetlands also provide key fish and wildlife habitat.

A large portion of land in the southern part of the Birch Bay watershed supports wetlands that provide large amounts of surface water storage. These areas could be important for attenuating

storm flows in areas with limited infiltration/recharge potential. Loss of wetlands in the Birch Bay area has been due to many factors, such as development and re-configuration of the natural drainage network. This re-configuration was performed for flood control purposes and to drain areas for other land uses such as development.

The Birch Bay Community Plan (Kask Consulting, 2002), also known as the Birch Bay Sub Area Plan, included an inventory of wetlands for all areas within the Birch Bay planning area. This was strictly a planning-level survey intended to provide a general delineation of existing wetlands in the Birch Bay area. Existing wetlands were classified using the Cowardin Scientific Classification System. With this system, each wetland category is based on connection to other water bodies, type and density of vegetation present, and other factors. According to the wetlands inventory, approximately 1,250 acres of the approximately 8,700 acres (14 percent) included in the planning area for the Birch Bay Sub Area Plan are covered by wetlands.

3.2.1.4 Terrell Creek

The Terrell Creek drainage area is a significant part of the Birch Bay ecosystem. The Terrell Creek watershed provides habitat for large numbers of fish, birds, and other wildlife. Terrell Creek supports a variety of native fish species such as cutthroat trout and coho salmon. Numbers have declined in the past 50 years, mostly due to habitat degradation. Chum and coho were once found in great numbers within Terrell Creek. The Terrell Creek marsh is one of the few remaining saltwater/freshwater estuaries in northern Puget Sound. The north end of Birch Bay State Park is a natural game sanctuary providing refuge for smaller birds, migratory waterfowl, northern bald eagles, and great blue herons.

Terrell Creek begins at the outlet of Lake Terrell in the southeastern corner of the Birch Bay watershed. The stream meanders in a northwesterly direction for 2 miles and is joined by Fingalson Creek from the east. Fingalson Creek is fed by a natural spring in the upper reaches of that sub-watershed. The main stem of Terrell Creek flows west for 3 miles before entering Birch Bay State Park. The creek flows through the state park then makes an abrupt turn to the north and flows along the beach. The last 2 miles of Terrell Creek follow the shoreline from Birch Bay State Park north to the outlet north of Alderson Road.

Floodplains are an important hydrologic mechanism in Terrell Creek, which has a wide floodplain and associated riparian wetlands. Past development and current development has altered the floodplain dramatically by confining certain reaches of Terrell Creek and by altering the natural hydrologic regime.

The lower reach of Terrell Creek between Birch Bay State Park and the outlet of the creek into Birch Bay is confined to its current location. Historically, Terrell Creek meandered back and forth through the watershed and found its own path to Birch Bay. As development increased and infrastructure was constructed, this path became permanently fixed in its current position as a result of human intervention. Historical dredging was reportedly conducted in this lower reach.

Much of the Terrell Creek riparian zone has been converted to non-forest cover. Most of the remaining cover is scrub-shrub and deciduous and mixed forest stands. No significant conifer stands remain on the stream. The lack of conifer stands prevents recruitment of large woody debris (LWD) into Terrell Creek. The Nooksack Salmon Enhancement Association has begun an evaluation of current conditions in and around Terrell Creek. NSEA uses a smolt trap to count young salmon leaving the creek during the spring months. This smolt trap has been placed about one mile upstream from the mouth of Terrell Creek within Birch Bay State Park at the same

location from March to June each year since 2000. When this smolt trap is in use, it is checked twice per day. Since the smolt trap was first installed, many species of fish were discovered. Many coho and some steelhead smolts were discovered in the trap, including several wild (non-hatchery) coho. Many non-salmonids were also found, including yellow perch, pumpkinseed, starry flounders, and sculpins, some of which are stocked for sport fishing in Lake Terrell.

According to the *Catalog of Washington Streams and Salmon Utilization*, Volume 1 (WDFW, 1975), Terrell Creek provided fair to good populations of coho plus some chum salmon. This catalog describes how all but the lower 1.5 miles of creek present good pool-riffle stream character with small-gravel bottom and considerable sand in many areas with a few gravel-rubble stretches. The catalog also describes how cover ranges from sparse to moderate with low brush or overhanging grass along cleared land sections. Lastly, the catalog describes how smaller tributaries with intermittent flow present similar features.

Data available from StreamNet (2006) and gathered by the WDFW indicate distribution and activity of coho salmon in all reaches of Terrell Creek. In addition to coho, StreamNet recognizes the presence of winter steelhead in Terrell Creek. This dataset was last updated in June of 2005.

Chinook are known to use the estuarine portion of Terrell Creek, and the creek is presumed to be used for juvenile foraging and possibly rearing during migration to sea (Whatcom County, 2006 referencing NWIFC 2004; Whatcom County, 2005). Sea-run and resident cutthroat trout are known to use Terrell Creek, and winter steelhead are presumed to use Terrell Creek (NWIFC 2004, Whatcom County, 2005).

NSEA has completed fish habitat assessments, including water quality and flow measurements, to determine fish habitat conditions. These efforts yielded a list of concerns. First, the riparian areas both upstream and downstream from the Jackson Road Bridge were in need of significant physical restoration efforts. Secondly, several barriers to fish passage needed attention. These include culverts at Grandview and Blaine roads. Third, these efforts highlighted the need for a plan to manage flow rates in Terrell Creek during the dry periods of the year using flow regulation at the outlet of Lake Terrell.

Low summer flows reduce available juvenile rearing habitat during summer months. In addition, when flows are low, connections to wetlands and beaver ponds are nonexistent. These low flow conditions may also be accompanied by poor water quality and elevated temperatures. Outlet flows from Lake Terrell could be adjusted to prevent summer flows from reaching critical levels.

A number of projects have begun with the goal of improving riparian and in-stream habitat. Invasive reed canary grass has been removed and native vegetation has been planted along the banks of the creek. Large woody debris has been placed at various locations along a 2,500-foot stretch of the creek. This large woody debris provides diversity in flow quantity and velocity necessary for good salmon habitat. Salmon find refuge in slow-moving areas behind large woody debris and take advantage of the fast-moving flow between the obstructions.

Projects have also begun to restore fish passage at various locations along the length of Terrell Creek. Culverts are a common type of fish barrier. Existing culverts can be replaced with new structures that allow for fish passage under varying flow conditions. The first culvert creating a barrier for fish under certain flow conditions is the culvert at Blaine Road (SR 548). The Washington State Department of Transportation plans to replace this culvert. Another culvert, located at Grandview Road, is situated high enough above the creek bed that all fish passage is

impossible. Either this culvert would have to be replaced or the channel downstream from the culvert would have to be built up in elevation to allow for fish passage through the existing culvert. Lastly, the dam at the outlet of Lake Terrell prohibits fish passage into the lake. Several smaller streams discharge to Lake Terrell that may provide good spawning habitat if they were accessible to fish.

BP Corporation has performed wetland enhancement work on their property along Terrell Creek at Cherry Point Refinery.

Local citizen groups and volunteers have been an integral part of the monitoring, enhancement, and restoration projects in the Terrell Creek watershed. The Terrell Creek Stream Stewards conduct work parties to remove invasive vegetation and plant trees and shrubs, monitor stretches of Terrell Creek for fish use, and educate other members of the community on the importance of environmental responsibility. A subgroup of the Terrell Creek Stream Stewards, the Chums of Terrell Creek, have been involved in such projects as restoration work on the stretch of Terrell Creek on WDFW property downstream on Jackson Road.

Both the Washington Department of Ecology and NSEA have performed water quality sampling at different sites in Terrell Creek and along Birch Bay beaches. Ecology sampled monthly for fecal coliform and other pollutants in Terrell Creek at the Jackson Road bridge monthly from the fall of 2001 through the fall of 2002. In addition to fecal coliform, samples were analyzed for temperature, dissolved oxygen, turbidity, conductivity, ammonia, nitrogen as NO_2 and NO_3, nitrogen as NH_3, and total and dissolved phosphorus. Data for fecal coliform ranged from 3 coliform /100 ml to 470 coliform/100 ml. Of these samples, only two exceeded the Freshwater Class A Part 1 criteria of 100 coliform /100 ml. These two samples exceeding criteria were taken on 7/23/02 and 9/16/02. The temperature ranged from 2°C on 3/18/02 to 15°C on 7/22/02 at this Jackson Road site. All of the temperature data were below the aquatic life temperature criterion of 16°C for salmon and trout spawning, core rearing, and migration (Ecology, 2003). Dissolved oxygen ranged from 12.9 milligrams per liter (mg/L) on 3/18/02 to 1.2 mg/L on 6/18/02, with seven of the twelve samples taken at or below the freshwater water quality criteria of 9.5 mg/L. The dissolved oxygen samples that were below criteria represent all samples taken during the months of May through November.

NSEA has conducted water quality sampling in the creek and on Birch Bay beaches since May 2004. NSEA has conducted weekly sampling at five sites within the creek since May 2004 and added two additional creek sites to this protocol in late August of 2005. NSEA has measured the samples from the creek sites for temperature, pH, dissolved oxygen, and conductivity. In addition, NSEA has taken monthly fecal coliform samples at two sites along the beach in Birch Bay from November 2004 through the spring of 2005 and at the five creek sites from November 2004 to the present.

Weekly temperature data from May 2004 through November 2004 are shown in Figure 3-2 for the seven sites in Terrell Creek. The water quality criterion for temperature of 16.5°C is also shown. Most of the data taken between the months of June and October exceeded the criterion. A similar pattern is evident for dissolved oxygen as well, with most samples reading below the criterion of 9.5 mg/L for the months of June through November (Figure 3-3).

Fecal coliform data taken from November 2004 through September of 2005 ranged from non-detect (<2 coliform/100 ml) to 600 coliform/100 ml. One of the 10 samples taken at Site 1 (Lake Terrell outfall) was above the criterion of 100 coliform/100 ml (350 coliform/100 ml in January of 2005). All samples taken from all sites on that date were above the criterion and ranged from

FIGURE 3-2. TEMPERATURE DATA FROM SITES ALONG TERRELL CREEK FROM MAY 2004 THROUGH NOVEMBER 2005

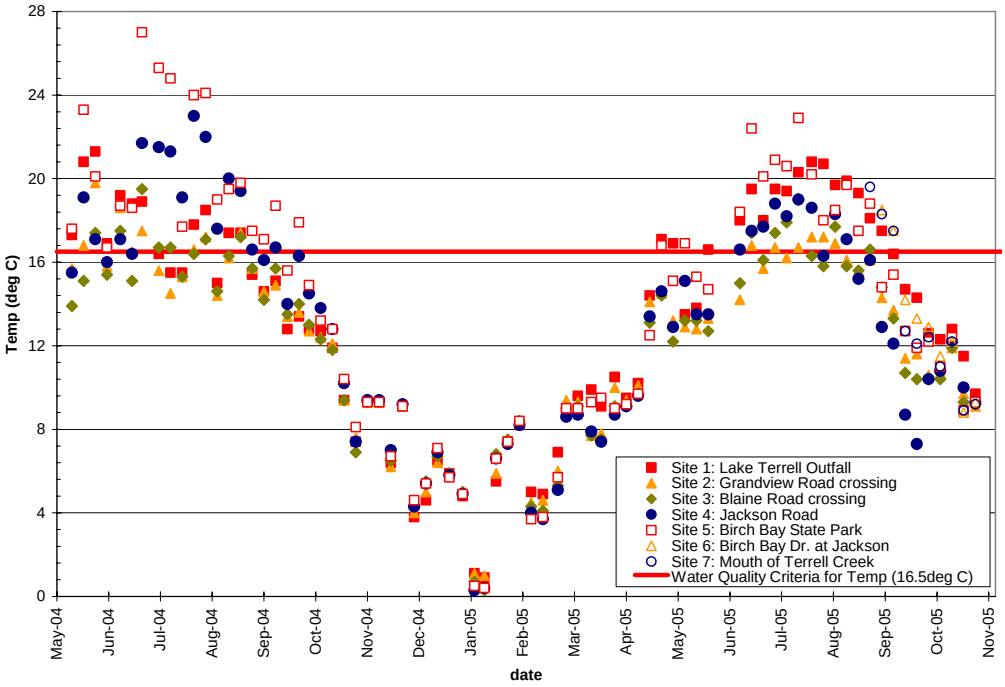
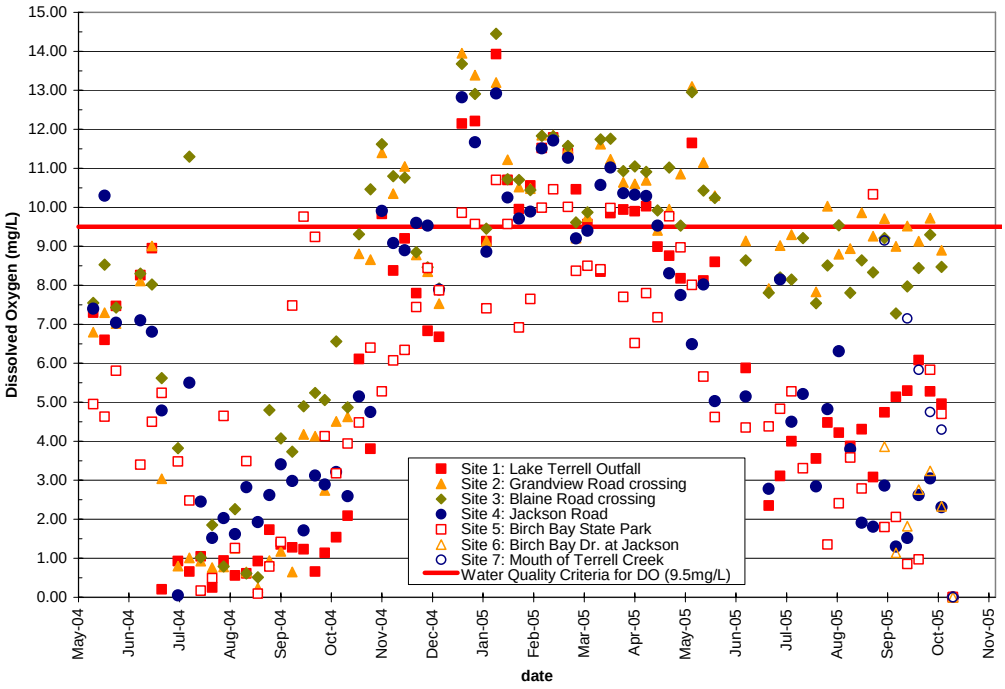


FIGURE 3-3. DISSOLVED OXYGEN DATA FROM SITES ALONG TERRELL CREEK FROM MAY 2004 THROUGH NOVEMBER 2005



Note: Data in Figures 3-2 and 3-3 received from Nooksack Salmon Enhancement Association via personal communication on 11/4/05.

340 to 600 coliform/100 ml. For the entire sampling period, four out of the ten samples taken at each of the Sites 2, 5, and 6 were above the criterion, six of the ten samples taken at Site 3 were above the criterion, and two of the ten samples taken at Site 4 were above the criterion. Overall, 21 of 60 samples taken for fecal coliform during this period were above the criterion of 100 coliform/100 ml.

In addition to water quality monitoring, NSEA has performed flow monitoring on Terrell Creek. Interns for NSEA from Western Washington University have set up flow rating curves at sites along Terrell Creek in preparation for flow monitoring activities. These locations are the dam at Lake Terrell, Grandview Road, Blaine Road, and Birch Bay. When water quality measurements are taken, staff gage readings are also recorded and corresponding flow rate information is calculated using the rating curves developed individually for each site.

NSEA and local community groups have made efforts to re-introduce chum to the waters of Terrell Creek because chum tend to be more tolerant of lower flows than coho. Chum eggs were fertilized and developed in a remote site incubator, then placed in Terrell Creek in January of 2005. Some chum have shown up in the smolt trap placed a mile upstream from the mouth of Terrell Creek within Birch Bay State Park. Juvenile chum leave streams and enter saltwater quicker than coho do. Coho tend to reside in freshwater streams for at least a year before entering the salt water. It is anticipated that chum, once they enter the saltwater, would return from the saltwater within a 3- to 5-year period to spawn. Results of this introduction of chum into the waters of Terrell Creek will not be evident until this 3- to 5-year period begins in January of 2008.

3.2.1.5 Lake Terrell

Four dairy farms purchased in the 1940s by the Department of Game became the 1,500-acre Lake Terrell unit and surrounding area. The farms were acquired for the purpose of producing and harvesting wild game. The area is now managed by the Department of Fish and Wildlife for waterfowl habitat restoration and preservation and to provide recreational opportunities.

Lake Terrell is located along the Pacific Flyway, which is the route of migrating waterfowl to/from British Columbia and areas farther north. Lake Terrell is a food source and resting place for migrating waterfowl. In addition, Lake Terrell supports a year-round population of birds and ducks. The lake itself provides habitat for bass and spiny-ray fish as well as rainbow and cutthroat trout. The surrounding habitat types include wetlands, grasslands, and upland mixed forest (Washington Department of Fish and Wildlife, 1998).

3.2.2 Built Environment

3.2.2.1 Population

The population of the Birch Bay community was recorded as approximately 4,900 people in the year 2000 census reflecting an 87 percent growth rate from the 1990 census. According to the same census, slightly more than 50 percent of the 5,100 housing units in Birch Bay were for seasonal or part-time use. By 2022, Birch Bay is expected to grow to over 9,600 people with over 4,100 full-time housing units and approximately the same number of seasonal or part-time housing units (Whatcom County, 2005).

These population numbers are for the Birch Bay Census Designated Place. The boundaries of this area are similar to those of the planning area for the Birch Bay Sub Area Plan. However, the northern portion of the Birch Point area and the Drayton Harbor area were excluded from the

Birch Bay Community planning area because those areas are within the UGA of the City of Blaine.

3.2.2.2 Neighborhoods

The planning area included in the Birch Bay Community Plan was split into ten different neighborhoods: Birch Point, Birch Bay Village, Cottonwood, Hillsdale, Central Reaches, Central Uplands, Terrell Creek, State Park Reach, West Cherry Point, and Point Whitehorn. An eleventh neighborhood, Lake Terrell, was added to this Stormwater Comprehensive Plan to incorporate the upper Terrell Creek watershed outside of the planning area boundary of the Birch Bay Community Plan. Figure 3-4 shows these neighborhoods. A breakdown of the acreage within each neighborhood is included in Table 3-3.

TABLE 3-3. BIRCH BAY COMMUNITY PLAN NEIGHBORHOODS

Neighborhood	Area (acres)
Birch Point	721
Birch Bay Village	444
Central Reaches	397
Central Uplands	2,275
Cottonwood	622
Hillsdale	812
Point Whitehorn	546
State Park Reach	688
Terrell Creek	1,300
West Cherry Point	894
Lake Terrell	8,000
TOTAL	**16,699**

FIGURE 3-4

Birch Bay Neighborhoods

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3.2.2.3 Land Use

Based on percentage, the Birch Bay area is one of the fastest growing areas in the state. Rapid home building is occurring, with condominiums and single-family residences built along the shoreline and throughout the area. The northern and central portions of Birch Bay have already been developed with residential homes and some commercial structures.

Birch Bay comprehensive planning is the responsibility of Whatcom County because Birch Bay is an unincorporated community. The Whatcom County Comprehensive Plan (2005) designates four UGAs in the general vicinity of Birch Bay: the Birch Bay UGA, the Cherry Point Major/Port Industrial UGA, City of Blaine UGA, and the City of Ferndale UGA. The only UGA designated for the unincorporated community of Birch Bay is the Birch Bay UGA. The northern border of the Birch Bay UGA is adjacent to the City of Blaine UGA (Figure 3-5). The Blaine UGA encompasses all of the area north of Lincoln Road except for a tract of land on either side of a stream north of Lincoln Road. The western and northern boundaries of the Cherry Point UGA are defined as Koehn Road to the west and Grandview Road and Terrell Creek to the north.

Certain neighborhoods were not included within the adopted Birch Bay UGA to protect steep slopes and public resources. Birch Point and portions of Point Whitehorn were removed to protect wetlands and potential landslide areas.

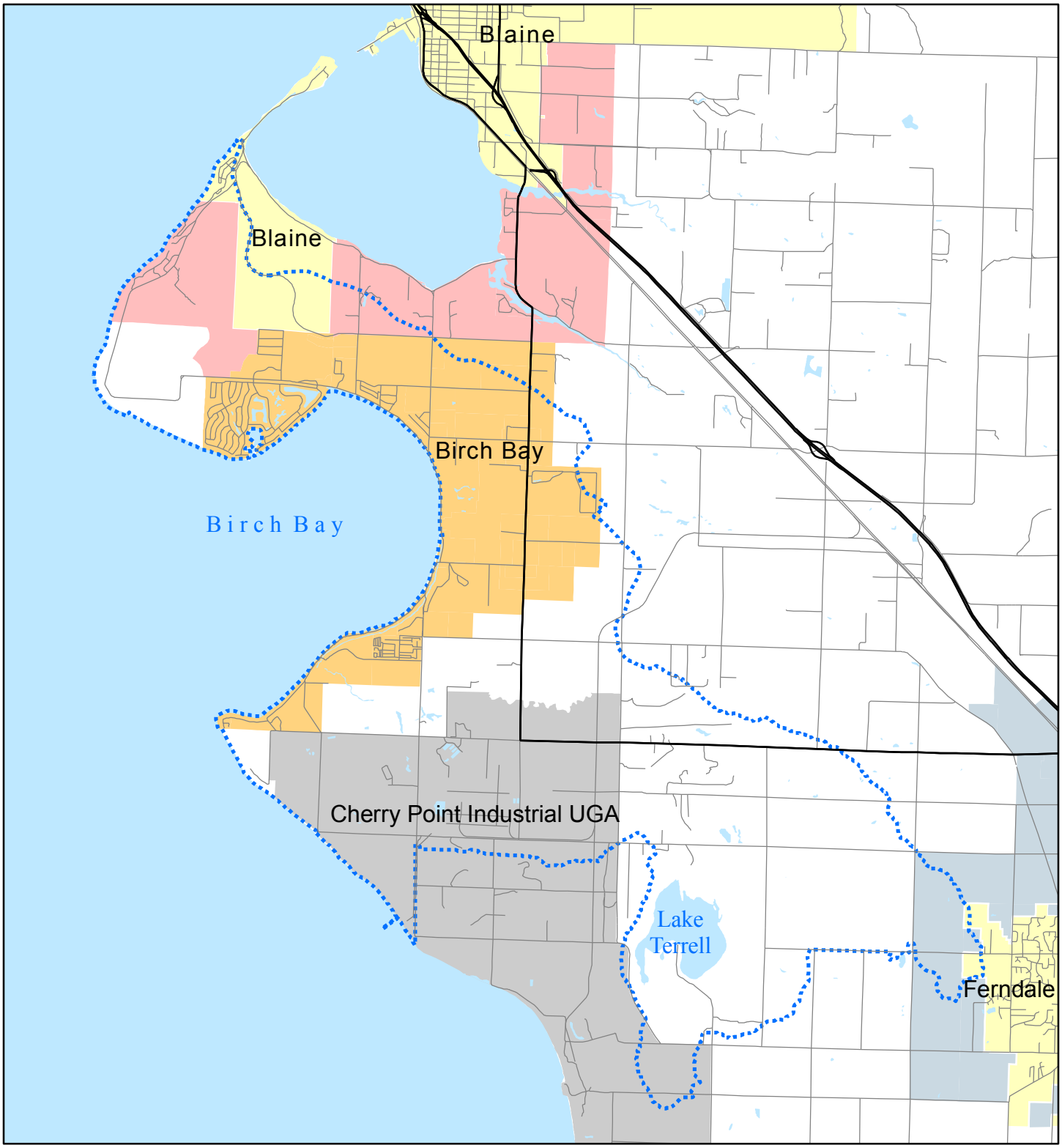
Most of the tidelands in Birch Bay are privately owned except areas at Birch Bay State Park and the areas owned by Whatcom County. This is in contrast to Drayton Harbor, where the City of Blaine owns much of the tidelands. Historically, Birch Bay tidelands have been accessible to the public.

Two major land owners in the Birch Bay area are Trillium Corporation and BP Corporation. Trillium owns a great deal of land inland of Birch Point and inland of Point Whitehorn. The BP Cherry Point Facility is located in the southeastern part of the Birch Bay watershed.

The Cherry Point UGA contains approximately 7,000 acres of industrial land and is currently the site of three major industrial facilities, including two oil refineries and an aluminum smelter. These facilities cover about 4,100 acres of the total area within the Cherry Point UGA.

The Cherry Point shoreline is part of the area that provides spawning habitat for Pacific herring. In September 2003, the Washington State Department of Natural Resources (WDNR) accepted the recommendation that Cherry Point be further evaluated for Aquatic Reserve status. A supplemental environmental impact statement (EIS) is currently being prepared for the proposed reserve. The proposed reserve extends from the southern boundary of Birch Bay State Park to the northern border of the Lummi Indian Nation Reservation, including the Cherry Point shoreline. The site excludes the current leases (BP, Intalco, ConocoPhillips shipping piers) and one proposed lease (Gateway Pacific Terminal site).

Existing development has been located primarily along the shoreline on Birch Bay Drive and along the major roads and highways between the shoreline and Interstate 5. Most future development along the shoreline will be re-development of existing structures.



City
Urban Growth Area - Blaine
Urban Growth Area - Birch Bay
Urban Growth Area - Ferndale
Cherry Point Port/Industrial Urban Growth Area
Birch Bay Watershed

N

0 0.5 1 Miles

FIGURE 3-5

Urban Growth Areas in Birch Bay Area

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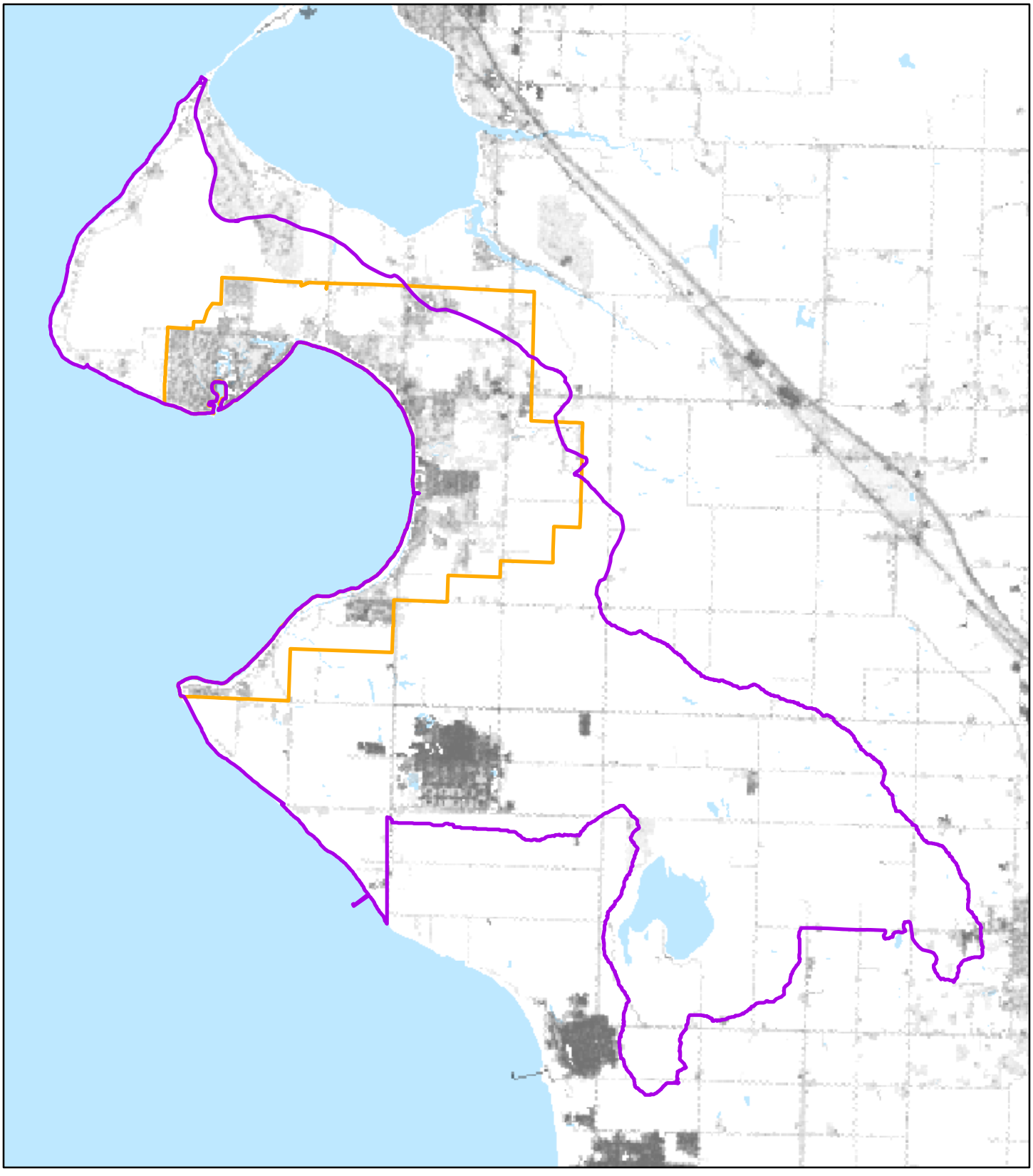
According to the Birch Bay Community Plan (Kask Consulting, 2002), nine different Whatcom County zoning designations are present in the Birch Bay area. These include the following:

- UR-4 (Urban Residential, maximum of four dwelling units/acre)
- URM-6 (Urban Residential, maximum of six dwelling units/acre)
- NC (Neighborhood Commercial, small concentrated land areas intended for retail sales of convenience goods and services within neighborhoods)
- GC (General Commercial, allows development of most commercial establishments, also allows single-family and multi-family development)
- RC (Resort Commercial, accommodates single-family and multi-family dwelling units, mobile home and RV parks, hotels, motels, and time-share condominiums; also some retail development)
- R-5A (Rural Residential, minimum lot size of 5 acres per dwelling unit with minimal commercial activities)
- R-10A (Rural Residential, minimum lot size of 10 acres per dwelling unit with minimal commercial activities)
- LII (Low Impact Industrial, services and associated distribution, manufacture, and assembly of finished products)
- HII (Heavy Impact Industrial, production, distribution, and changing the form of raw materials)

The areas containing the BP Cherry Point property are mainly HII and LII. The areas along Birch Point, Birch Bay Village, and north are mainly UR-4. The areas to the east and inland are mainly R-10A and R-5A. The sections of Birch Bay directly along the shoreline are mainly RC with some URM-6 mixed in.

Of the 8,343 acres within the Birch Bay Community Plan Planning Area, 3,447 acres (41 percent) are urban residential (UR-4 and URM-6), 438 (5 percent) are commercial (NC, RC, and GC), 2,747 acres (33 percent) are rural residential (R-5A and R-10A), and 1,711 acres (21 percent) are zoned industrial (LII or HII).

Figure 3-6 shows impervious surface coverage for the Birch Bay Area. The inventory of impervious surface was done by 30-meter grids with each cell shaded according to the total percent imperviousness. Impervious surface is concentrated along the beach and within the industrial areas. The locations of the greatest amount of impervious surface correspond with the locations of greatest zoning density. Generally, impervious surface increases with development density. Tools like LID measures can be used to mitigate the negative impacts of this relationship.



Legend

Watershed

Urban Growth Area - Birch Bay

Built Impervious Surfaces Draft (NOAA C-CAP 2004)

% Impervious

100

0

N

0 0.5 1 2 Miles

FIGURE 3-6

Impervious Surface in Birch Bay

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3.2.2.4 Drainage Network

The Birch Bay built drainage network consists of ditches, culverts, catch basins, detention ponds, and tide gates. Major outlets and outfalls and locations of tide gates are shown on Figure 3-1. Implementation of this drainage infrastructure has significantly altered the natural hydrology of the area.

Three main tide gates have been identified in Birch Bay. These are located in Rogers Slough east of Birch Bay Village, at the outlet of the creek along Lora Lane near the mouth of Terrell Creek, and at the intersection of Morrison and Wooldridge near where Jackson Road meets Birch Bay Drive (Figure 3-1).

The existing drainage network in the Birch Bay area is a product of the development history of the area. Many of the drainage ditches were developed years ago to dry out wetlands to allow a limited amount of development such as beach-front cottages or agriculture. The removal of forest and the increase in impervious surfaces with development beyond this initial minimal level have increased both the volume and the peak rate of runoff in the watershed. The capacity of existing drainage ditches and other drainage infrastructure may not be adequate to convey these higher flows. Removal of flood storage areas and constriction of natural drainages by filling and construction of culverts and tide gates have reduced the ability of some areas to drain and has caused water to back up. As a result, localized flooding has increased in certain areas.

Construction of roadways and roadside ditches has altered the surface and subsurface flow. Subsurface flow in the upper portion of soil is intercepted by roadside ditches and is conveyed more quickly and in more concentrated amounts than if the roadway and roadside ditches had not been there. This is most evident in areas such as Birch Point and Point Whitehorn, where surface flow is conveyed in cross-culverts and roadside ditches and then flows towards Birch Bay in concentrated flow streams that may promote erosion and stability problems.

The expectations of the drainage network have also changed with changing population and land use in Birch Bay. Historically, periodic flooding and other drainage issues may have occurred during the winter seasons when seasonal visitors were not in residence. Areas that experienced localized flooding issues in the winter months were dry by the time seasonal residents returned after the winter months. As property values have increased and the area has housed more year-round residents, a greater number of citizens and a greater amount of property have been affected by drainage-related issues. Incoming residents may be accustomed to drainage services provided in cities and therefore may have lower tolerances for drainage-related issues. While the existing drainage network may have been adequate for a seasonally-based beach-front community, the evolving demands for drainage service and response cannot be met with this system.

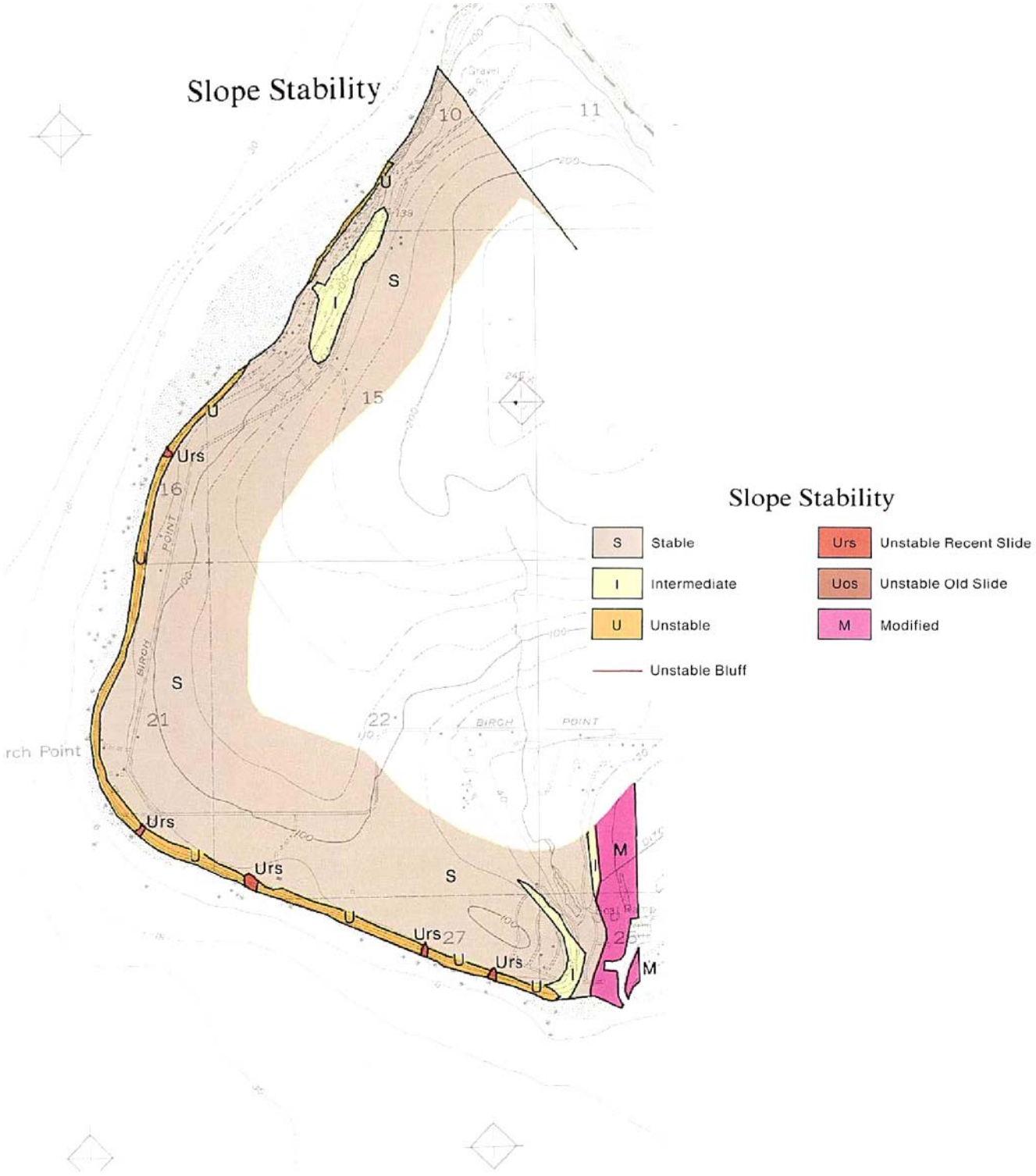
3.2.2.5 Slope Stability and Landslide Hazards

Slope stability is a problem all across the bluffs of Birch Point and Point Whitehorn. Natural processes may have been accelerated by increased runoff velocities and volume due to removal of vegetation, the installation of septic tank drainfields, and the construction of impervious surfaces and channelized ditches. Increases in subsurface flows can affect slope stability and can increase landslide hazards.

Land use activities in contributing areas have impacts on subsurface flows. Removal of vegetation may have increased the subsurface flows in the area. An increase in subsurface flow has been reported by certain Point Whitehorn and Birch Point residents living along the edge of the steep slopes who state that they have witnessed increased seepage and groundwater flow

underneath their homes and out the sides of the slopes. Increases and changes in subsurface flow can affect the rate of slope movement and increase the risk of landslide action.

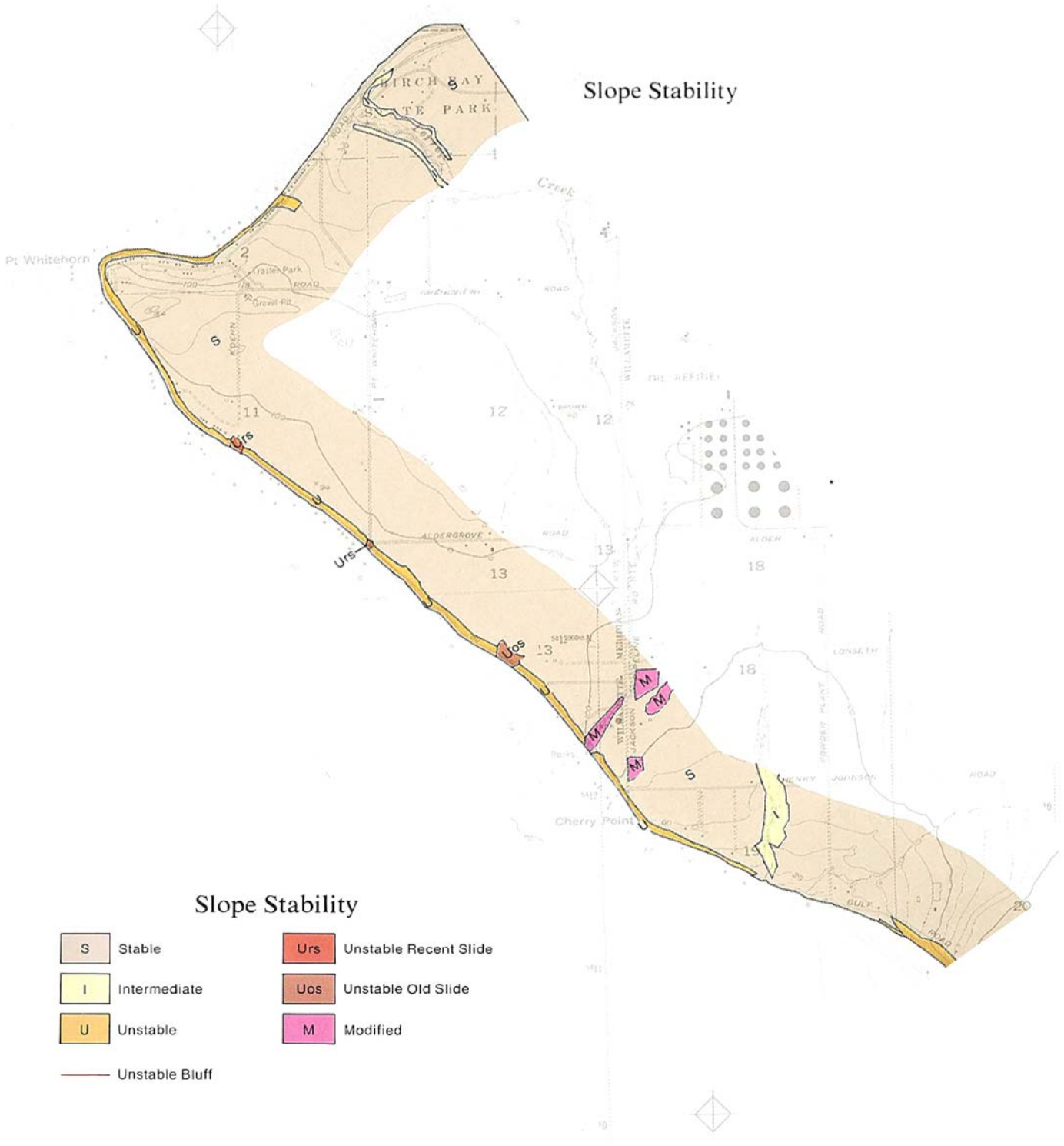
The Coastal Zone Atlas for Whatcom County (Ecology, 1979) shows the entire shoreline areas of Birch Point and Point Whitehorn as unstable. The maps show five recent slide areas along Birch Point and two recent slide areas along Point Whitehorn as of 1978. These maps show that slides are not new on either Birch Point or Point Whitehorn. Figure 3-7 shows the slope stability assessment for Birch Point and Figure 3-8 shows the stability assessment for Point Whitehorn from the 1978 Coastal Zone Atlas.



Source: Washington Department of Ecology. 1978. *1978 Coastal Zone Atlas of Washington. Volume 1: Whatcom County*.

FIGURE 3-7

Slope Stability Assessment for Birch Point from the 1978 Coastal Zone Atlas of Washington



Source: Washington Department of Ecology. 1978. *1978 Coastal Zone Atlas of Washington. Volume 1: Whatcom County*.

FIGURE 3-8

Slope Stability Assessment for Point Whitehorn from the 1978 Coastal Zone Atlas of Washington

4 Surface Water Issues and Problems Identified in Birch Bay

4.1 Introduction

Birch Bay is a rapidly growing community that is experiencing increasing stormwater drainage problems, declining water quality, and loss of aquatic habitat. Water quantity problems include erosion, flooding, slope instability, and sedimentation. Water quality concerns involve mainly fecal coliform bacteria and other pollutants from point and non-point sources. Aquatic habitat degradation is caused mainly by physical alterations through development. This chapter describes the drainage problems, water quality problems, and problems with aquatic habitat identified in Birch Bay.

4.2 Sources of Data

Surface water issues and problems were identified by collecting information from a variety of sources, including the following:

- Information from the Washington Department of Ecology, Whatcom County, the Birch Bay Steering Committee, the Washington State Department of Health, and the Nooksack Salmon Enhancement Association.
- Studies and reports from previous work conducted in and around the Birch Bay area, including:
  - *Point Whitehorn to Birch Bay State Park Shoreline Reach Analysis*, Whatcom County, Washington, Final Report (Coastal Geologic Services, 2003).
  - *Birch Bay Shoreline Improvement Plan and Conceptual Design*, Draft Report (Philip Williams and Associates, 2002).
  - *Birch Bay Community Plan (Sub Area Plan)*, Birch Bay Community Plan Steering Committee (Kask Consulting, 2002).
- Citizens Workshop #1: a workshop conducted with local area residents to identify problem areas or issues of concern. (A memorandum summarizing this workshop is included in Appendix A.)
- Correspondence from local area residents reporting continuous issues/problems or wet-weather-specific problems.
- Field visits conducted by Whatcom County, CH2M HILL, and local area residents.

Lists of problems identified in the Citizens' Workshop #1, during field work efforts, by residents and others via correspondence in the weeks and months following Workshop #1, and those problems identified in previous studies and historical information were combined into a master

list presented in Table 4-1. Details of identified problems are included in technical memorandums attached to this plan (Appendix A and Appendix B).

4.3 Description of Problem Types

The following general types of stormwater management issues were identified:

- Water quantity
- Water quality
- Aquatic habitat

Erosion and flooding are examples of water quantity issues. Bluff erosion and slope stability issues are often created by increased volume and velocity of runoff and therefore are included as water quantity issues.

Water quality issues may include point source pollution, such as stormwater runoff containing a large concentration of suspended sediment discharging from a construction site, or non-point source pollution such as fecal contamination from domestic animals, birds, and/or wildlife.

Aquatic habitat in local streams, wetlands, and near-shore areas is often physically altered by new development. These physical alterations may include decreased access to habitat due to road culverts or channelized sections of creek, each of which is problematic. Habitat can also be physically altered by changes in stream flow as a result of land clearing and an increase in impervious surfaces due to buildings and paving.

In addition to the water quantity, water quality, and aquatic habitat problem types, several problems identified by citizens refer to policy and planning issues or generally relate to new development.

4.4 Identified Surface Water Issues and Problems

A total of 27 different water quantity problems were identified by citizens, by field investigations, by conversations with other stakeholders, or by historical studies. Sixteen water quality problems and six aquatic habitat problems were also identified. These 49 problems are all described in detail in Appendices B and C. Figure 4-1 shows the locations of the water quantity, water quality, and habitat problems identified in the Birch Bay area. Several problems pertaining to policy and planning issues were omitted from Figure 4-1 as they did not pertain to a specific location.

These original 49 identified problems were grouped by type (water quantity, water quality, and habitat). Several of these were consolidated based on similar locations, causes, symptoms, and potential solutions, and the list was reduced to 41 individual problems. Of the 41 problems, 19 are strictly water quantity problems (primarily drainage and erosion), 13 are water quality problems, and 5 are habitat-related. Three additional problems are both water quantity and water quality related, and one problem is water quality and habitat related. Table 4-1 contains a listing of these 41 problems.

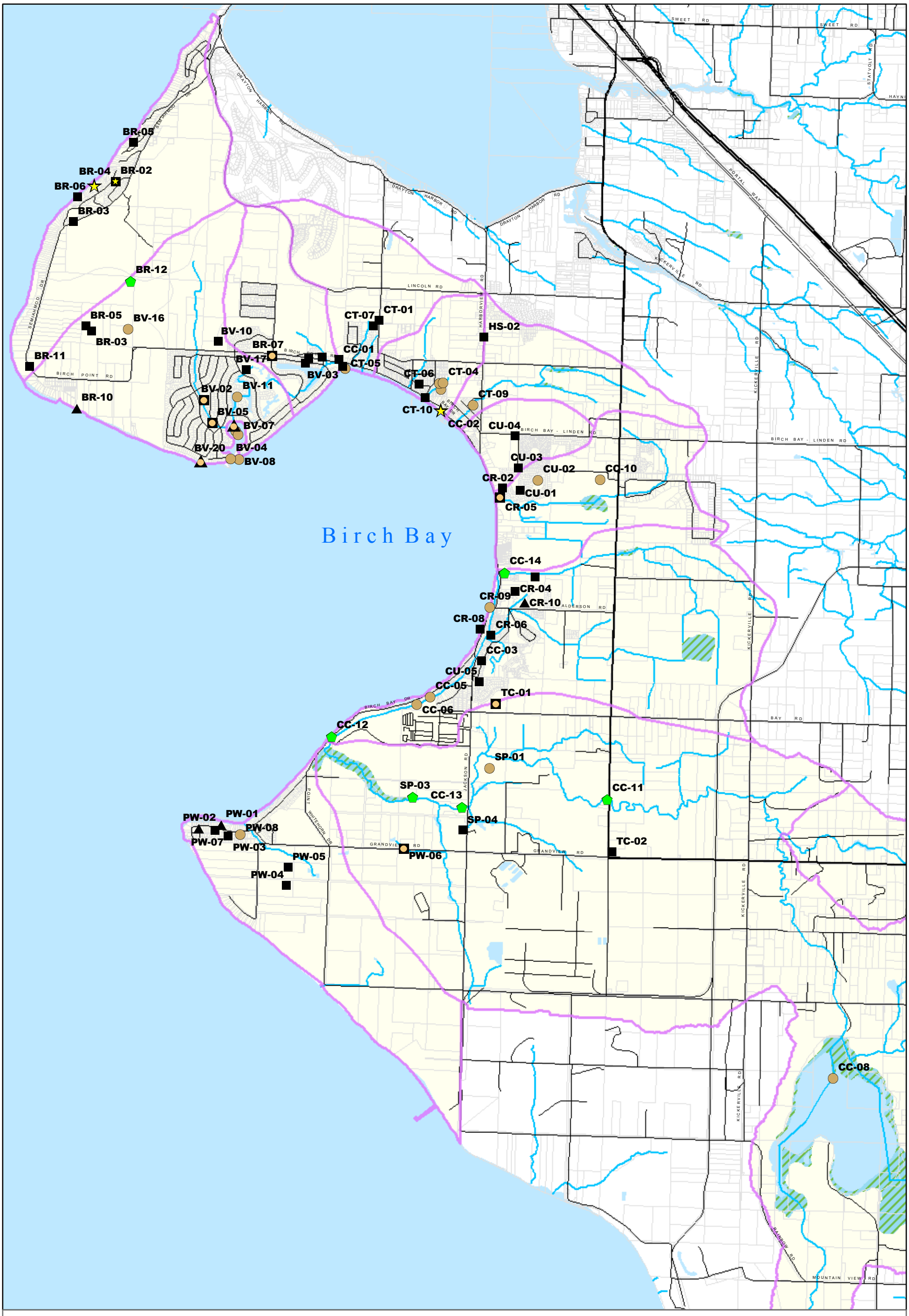


FIGURE 4-1

Locations of Identified Problems within the Birch Bay Area

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TABLE 4-1. IDENTIFIED PROBLEMS AND ISSUES RATED AND RANKED

						Types of Potential Solutions				
							Non-Structural (programmatic solution)			
Rank	Score[a]	Name[b]	Other Related Problems	Description	Type of Problem	Structural (potential capital solution)	Education, Public Involvement	Inspection & Enforcement (for drainage & water quality)	M&O[c]	Regulatory and Policy
1	37.7	CC-02	CC-02	Roadway erosion issues on Birch Bay Drive, several locations	drainage or erosion/stability	♦				
2	36.0	BR-10	BR-10	Slope Stability/erosion in Birch Point area	drainage or erosion/stability		♦	♦		♦
3	35.8	CC-04	CC-04	Potential for septic systems to be failing in Birch Bay area	water quality		♦	♦		♦
4	35.1	CT-01	CT-07	Flooding issues along Shintaffer, north side of Richmond Park Subdivision	drainage or erosion/stability	♦			♦	
4	35.1	CT-06	CT-10; CU-01	Flooding issues behind two outfalls at Cedar Rd. and Cottonwood Beach	drainage or erosion/stability	♦			♦	
6	34.8	CC-12	CC-05	Confined reach of Terrell Creek in lower part along beach - low dissolved oxygen (DO) and high temp	water quality, habitat	♦				
7	34.5	CC-05	CC-06	Water quality issues, Terrell Creek - algae, low DO, high temp, etc.	water quality		♦	♦		♦
8	33.8	BV-04	BV-04	Fecal coliform issues, Birch Bay - as sampled by DOH; shellfish beds threatened	water quality		♦	♦		♦
9	33.5	CC-13	CC-13	Degraded physical habitat in Terrell Creek	habitat		♦			♦
10	32.7	CR-06	CR-06	Tide gate and culvert blockage - N. Morrison	drainage or erosion/stability				♦	♦
11	32.5	SP-01	SP-01	Presence of large numbers of ducks and birds, Birch Bay State Park	water quality		♦			♦
11	32.5	CC-08	CC-08	Presence of large numbers of ducks and birds, Lake Terrell	water quality		♦			♦
11	32.5	SP-03	SP-03	Low summer flows in Terrell Creek	habitat					♦
14	31.7	PW-03	BV-16; PW-04; PW-05; PW-07	Tree loss throughout Birch Bay watershed (sediment transport, drainage issues)	drainage or erosion/stability, water quality		♦	♦		♦
15	31.4	PW-06	BR-04; CT-02; CT-03; CT-04; CT-09; CU-02	Drainage conveyance issues, yard debris and trash accumulate and block inlets/outlets	drainage or erosion/stability		♦	♦	♦	♦

TABLE 4-1. IDENTIFIED PROBLEMS AND ISSUES RATED AND RANKED

						Types of Potential Solutions				
							Non-Structural (programmatic solution)			
Rank	Score[a]	Name[b]	Other Related Problems	Description	Type of Problem	Structural (potential capital solution)	Education, Public Involvement	Inspection & Enforcement (for drainage & water quality)	M&O[c]	Regulatory and Policy
16	31.0	BR-02	BR-03; BR-04; BR-05; BR-06; BR-11	Drainage/flooding in Birch Point area (Cary Ln, Semiahmoo Dr, Normar Pl, Semiahmoo Rds.)	drainage or erosion/stability	♦	♦	♦	♦	♦
17	30.8	BV-02	BV-05; BV-10; BV-11; BR-07	Water quality of ponds, stream, marina at Birch Bay Village	water quality		♦	♦		♦
17	30.8	CC-11	CC-11	Fish passage blockages at Blaine and Grandview Road culverts	habitat	♦				
19	29.8	CT-05	CT-05	Presence of large numbers of Canada geese throughout watershed	water quality		♦			
20	29.3	BV-01	BV-02	Drainage/flooding Issues behind Rogers Slough (eastern portion of Birch Bay Village plus roadside ditches, excess runoff)	drainage or erosion/stability	♦			♦	♦
21	29.0	CC-01	CC-01	Tree and material accumulation at Rogers Slough and Cottonwood Beach	drainage or erosion/stability				♦	
22	28.8	CR-05	CR-05	Water quality at outfalls, much algae present at outfall near beach	water quality		♦	♦		♦
23	27.8	CU-05	TC-01	Retention pond overflow at Bay Crest (quality and quantity)	drainage or erosion/stability, water quality			♦	♦	♦
24	27.1	PW-01	PW-02; PW-03	Drainage, slope stability/erosion, and subsidence issues in Point Whitehorn Area	drainage or erosion/stability		♦	♦		♦
25	26.8	CR-09	CR-09	Presence of dogs, problematic if waste isn't removed, near Terrell Creek and other places	water quality		♦			♦
25	26.8	CC-10	CC-10	Use of County Equestrian Center, potential water quality issue if rules aren't followed re: waste	water quality		♦	♦		♦
27	25.8	BR-12	BR-12	Protect existing wetlands	habitat					♦
28	23.7	TC-02	TC-02	Drainage issues at intersection of Blaine and Grandview Rds.	drainage or erosion/stability	♦			♦	
29	23.1	CC-14	CC-14	Tide gates block potential fish habitat (Lora Lane tide gate to Terrell Creek)	habitat	♦			♦	♦
30	22.0	CR-03	CR-04	Drainage issues at Pine Drive, etc. behind tide gate at Lora Lane	drainage or erosion/stability					♦

TABLE 4-1. IDENTIFIED PROBLEMS AND ISSUES RATED AND RANKED

						Types of Potential Solutions				
							Non-Structural (programmatic solution)			
Rank	Score[a]	Name[b]	Other Related Problems	Description	Type of Problem	Structural (potential capital solution)	Education, Public Involvement	Inspection & Enforcement (for drainage & water quality)	M&O[c]	Regulatory and Policy
30	22.0	CU-03	CU-04	Retention pond overflow at Sealinks	drainage or erosion/stability	♦		♦		♦
32	21.2	BV-20	BV-12	Erosion issues at Birch Bay Village beach and bluff	drainage or erosion/stability, water quality		♦			♦
33	21.1	CC-09	CC-09	Presence of animals on properties near drainages to Terrell Creek and Birch Bay	water quality		♦			♦
34	20.8	SP-04	SP-04	Outfall blocked at Terrell Creek near Jackson Road	drainage or erosion/stability				♦	
35	18.7	CR-02	CR-05	Drainage issues near Mariners Cove	drainage or erosion/stability	♦			♦	
35	18.7	CC-03	CC-03	Drainage issues in yards along Wooldridge	drainage or erosion/stability				♦	
35	18.7	CR-08	CR-08	Flooding at Alderson Rd. at extreme high tide and winds	drainage or erosion/stability	♦				
38	18.3	HS-02	HS-02	Ditch overwhelmed at Harborview Rd.	drainage or erosion/stability				♦	
39	17.7	PW-08	PW-08	Potential use of herbicides/pesticides and other chemicals	water quality		♦	♦		♦
40	16.3	CC-07	CC-07	Mud tracked out of worksite	water quality		♦	♦		♦
41	11.7	CR-10	CR-10	Slope stability on hillside east along Alderson Road	drainage or erosion/stability		♦	♦		♦

[a] See section 4.5 for an explanation of this score.
[b] Problem name is original name given during problem identification process; Letters such as CT refer to the neighborhood in which the problem was identified. The number following the letters is the unique identifier for problems identified within that neighborhood and does not signify rating or ranking.
[c] M&O = maintenance and operations

4.4.1 Water Quantity Problems

Water quantity challenges in the Birch Bay watershed can be categorized in three groups:

- **Low-lying areas along the beach:** There are extensive low and flat areas behind the natural dune of the beach. Even without development, these areas were likely inundated during extreme high tides and high wind conditions. Many of the areas that now have homes and roads were once large, natural wetlands. Development has increased runoff and in some cases may have blocked natural flow paths.
- **New development:** The watershed is experiencing rapid development, particularly near the beach. New development is increasing the peak flow rate and volume of runoff even with on-site detention, resulting in increased downstream flooding and erosion. Existing standards and review procedures may need to be improved to reduce the impacts of new development.
- **Bluff erosion:** There are examples of slides all along the bluffs at both the south and north ends of Birch Bay. Beach erosion and slides along bluffs are natural events, but their occurrence may be accelerated by stormwater that is routed over the bluffs or if additional water is infiltrated into the ground near the bluffs from either stormwater or septic tank drain fields.

Many of the problems identified by citizens may be problems caused by individual property owners affecting themselves or other individual property owners. Such problems are often not the responsibility of the government but the responsibility of the individual property owners to resolve. For example, a property owner that routes rooftop runoff over the edge of the bluff would be responsible for removing the cause and repairing any damage to their own property.

Localized flooding problems are a primary water quantity concern of Birch Bay residents. Bluff erosion and hillside stability are also important and relevant concerns.

4.4.2 Water Quality Problems

Water quality challenges in the Birch Bay watershed can be categorized in two groups:

- **Activities of residents:** The majority of water quality problems reported by the citizens are due to activities of residents. This underscores the need for extensive and focused education of the local residents.
- **New construction:** Several water quality problems are related to new construction. This indicates that regulations should be stronger or more strictly enforced.

Additional descriptions of water quality issues are available in Appendix B. For example, coliform bacteria monitoring in Birch Bay has resulted in the listing in 2003 of the bay by the Washington DOH as “Threatened” for closure to recreational shellfish harvesting.

Residents of Birch Bay are concerned with the composition of stormwater runoff entering Birch Bay.

4.4.3 Aquatic Habitat Problems

The streams, wetlands, and near-shore marine waters in the Birch Bay area provide aquatic habitat for birds, fish, and shellfish. Residents of Birch Bay are concerned about the preservation of existing aquatic habitat and the restoration of habitat previously lost.

Key aquatic habitat issues in Birch Bay include fish passage and loss of wetlands. Additional habitat issues are described in Appendix B. For example, stream monitoring data show that the low summer flows near the mouth of Terrell Creek may stress or kill juvenile salmon and trout.

4.4.4 Policy / Planning Issues

Several issues were identified by citizens and others that do not relate to a site-specific water quantity, water quality, or aquatic habitat issue, but have more to do with how relevant policies and plans are created and carried out. These include:

- Citizens expressed concern about stormwater quantity and quality issues surrounding new development projects and how these new projects will influence existing conditions.
- Citizens stressed the importance of working with the City of Blaine on regional stormwater planning and possible stormwater detention projects.
- Citizens questioned the current water quality complaint system. Issues were the lines of communication and the process of enforcement.
- Citizens are concerned about the increase in impervious surface created by new development.
- Citizens expressed interest in LID for new development and re-development.
- Citizens are concerned about the rate of tree loss on public and private property.

4.5 Prioritization of Issues and Problems

Each individual water quantity, water quality, and habitat issue on the comprehensive list was rated against several criteria. These criteria reflect the goals and action items outlined in both the *Whatcom County Comprehensive Plan* (Whatcom County, 2005) and the *Birch Bay Sub-Area Plan* (Kask Consulting, 2002). The goals of the *Birch Bay Sub-Area Plan* include the following:

- Goal SW1: To protect water resources and natural drainage systems by controlling the quality and quantity of stormwater runoff.
- Goal SW2: To implement stormwater management policies and strategies which recognize the value of wetland areas in solving stormwater problems
- Goal SW3: To implement ongoing monitoring of stormwater so that fresh and salt water quality problems can be identified early on.

The goals of the *Whatcom County Comprehensive Plan* include the following:

- Goal 11E: Protect and enhance water quality and promote sustainable and efficient use of water resources.
- Goal 11F: Protect and enhance Whatcom County's surface water and groundwater quality and quantity for current and future generations.
- Goal 11G: Protect water resources and natural drainage systems by controlling the quality and quantity of stormwater runoff.

The specific criteria used to rate each surface water issue are related to impacts on people or the environment, or are related to the frequency of occurrence. The criteria used are shown in Table 4-2.

TABLE 4-2. PROBLEM RATING CRITERIA

Category (relative weight)	**Criteria (relative weight)**
People (total of 50%)	Health and safety (20%)
	Property (personal property (10%), public property (10%), magnitude of problem (10%)) (total of 30%)
Environment (total of 40%)	Shellfish resources (10%) Water quality (10%) Habitat (10%) Water quantity (hillside stability, erosion) (10%)
Frequency (total of 10%)	Frequency of occurrence (10%)

Health and safety is a primary concern in Birch Bay. Therefore, it has the highest individual weight of all the individual criteria at 20 percent. Cumulatively, “property” accounts for more at 30 percent, but personal property, public property, and problem magnitude each are only 10 percent individually.

A total score was assigned to each problem based on the relative weight of each criterion. Once this process was completed, the surface water problems were ranked according to that total score.

Table 4-1 shows the ranking of the 41 surface water problems according to the criteria used. A brief description of the problem is given as well as the type of problem (water quantity, water quality, or habitat). There is a good distribution of problem types throughout the list.

Figure 4-2 shows the portion of the score for each problem that is attributed to people, the environment, or frequency of occurrence. This allows for a comparison between problems that are priorities because of the potential effect(s) on people versus problems that are priorities for their effect(s) on the environment. The frequency of occurrence indicates how often a problem occurs and how that metric influenced the rating and ranking of the problem.

The prioritized list of surface water issues and problems was used to formulate the list of structural (capital project) and programmatic alternatives recommended in this Birch Bay Comprehensive Stormwater Plan.

Future problems and issues that may arise after the formulation of this plan can be rated according to this same set of criteria. This will allow for an ongoing prioritization of issues and problems.

FIGURE 4-2. RANKED SCORES, SUMMARY BY CONTRIBUTING FACTOR

5 Alternatives

5.1 Introduction

The citizens of Birch Bay completed the Birch Bay Sub-Area Plan which included a comprehensive land use plan that called for low-impact development and a stormwater plan to protect their lifestyle and aquatic resources while accommodating the anticipated growth in the community. This Comprehensive Stormwater Plan recommends measures to do that.

Water quantity, water quality, and habitat issues identified within Birch Bay were outlined and prioritized in Chapter 4. The identified problems were prioritized using criteria reflecting the goals and action items outlined in both the Whatcom County Comprehensive Plan and the Birch Bay Sub-Area Plan. Some prioritized problems have structural (capital project) solutions, while others have programmatic solutions, and several problems have both programmatic and structural solutions. Stormwater management programmatic actions should be addressed in a Stormwater Management Program. Capital project solutions should become part of the Whatcom County Capital Improvement Program.

5.2 Stormwater Management Program

Potential solutions to Birch Bay's stormwater problems were divided into actions that would not involve construction or acquisition, collectively referred to as programmatic approaches, and actions that would require capital projects and would be listed in the Capital Improvement Program (CIP). The programmatic alternatives have the benefit of often being strategic rather than reactionary. Instead of fixing a single problem with a structural solution, programmatic alternatives often address a series of existing problems and are effective at preventing future problems. The combination of programmatic actions and capital improvements comprise the Stormwater Management Program (SWMP). Currently, there is no formalized SWMP within Whatcom County. However, many current Whatcom County programs do address stormwater issues and therefore have been acting as an informal SWMP.

5.2.1 Summary of Issues that Require a Programmatic Approach

5.2.1.1 Regulatory Requirements and Guidance

Ecology's draft Phase II NPDES municipal stormwater permit lists programmatic solutions for permittees. Although Birch Bay is not subject to an NPDES permit at this time, it will likely be covered in the future. The list of solutions included in the Phase II permit is a good reference. Solutions listed in the permit include:

1. Public Education and Outreach
2. Public Involvement and Participation
3. Illicit Discharge Detection and Elimination (includes requirement for inventory of the drainage system)
4. Controlling Runoff From New Development, Redevelopment, and Construction Sites

5. Pollution Prevention and Operations and Maintenance for Municipal Operations

Each of these five NPDES Phase II requirements is implemented by a set of minimum performance measures outlined in the permit. These performance measures are described in Chapter 2.

Other requirements of the NPDES Phase II permit include:

- Develop and implement a stormwater management program
- Report any monitoring studies
- Assess effectiveness of best management practices (BMPs) and any changes needed
- Prepare a plan for future comprehensive long-term monitoring program, and
- Submit a detailed annual report of the status of SWMP implementation to Ecology

5.2.1.2 Water Quality

The primary water quality concern in Birch Bay is coliform bacteria in the bay. The Washington State Department of Health monitors bacteria in the bay and has previously listed Birch Bay as threatened for restricted shellfish harvesting. There are several potential sources of bacteria in Birch Bay. These include:

- The conveyance and treatment system belonging to the Birch Bay Water and Sewer District
- Dogs and cats
- Livestock
- Commercial sources
- Recreational vehicles and trailers
- Marina
- Wildlife
- Waterfowl (ducks and geese)
- Onsite septic systems
- People

Each of these is discussed below.

The conveyance and treatment system belonging to the Birch Bay Water and Sewer District. The district has an existing permit for operation of the treatment plant and collection system. The treatment plant outfall discharges to deep water outside of Birch Bay and is an unlikely source of bacteria in the bay. However, drift cells on a flood tide do come around Point Whitehorn so this deep-water outfall should not be eliminated as a potential source of bacteria within Birch Bay. Because all collection systems have a potential for leaks and infiltration, the district should have an ongoing program to detect and correct leaks and infiltration.

Dogs and cats. Dogs, cats, and other outdoor pets are a likely source of fecal bacteria, particularly near or on the beaches and streams. RNA source tracing in other locations regularly identifies cats and dogs as sources of bacteria. A program of education regarding picking up waste from dogs and cats is recommended. Signs and free bags and waste receptacles along the beach should be provided.

Livestock. There are no large commercial livestock operations within the watershed. There are a few hobby farms with livestock. The County should coordinate with the Conservation District to work with these owners to develop appropriate manure management practices.

Industrial sources. No potential industrial sources of bacteria have been identified within the watershed.

Recreational vehicles and trailers, commercial trailer parks. There are large numbers of recreational vehicles and trailers in the watershed, particularly during the summer months. An inventory of holding tank dump sites and their use should be conducted. Routine, unannounced inspections of trailer parks should be conducted to detect trailers that are not connected to sanitary sewers. An educational program should be implemented for the commercial and public parks. Counters should be installed on pump-out stations to determine frequency of use.

Marina. High coliform counts have been detected at the mouth of the marina. The County should work with the marina operators to develop an inspection program to assure that the discharge valves for holding tanks in the boats are closed. A review of the marina's pump-out station should be conducted to assure ease of use and proper function. If feasible, a counter should be added to the pump-out station to determine the level of use. An education program for boat owners should be developed and implemented. Volunteers among the boat owners should be identified to promote proper management among other boat owners. Water quality sampling could be conducted on the lakes and streams discharging to the marina as well as in the mouth of the marina itself to determine the source(s) of bacteria.

Wildlife. Large concentrations of birds occur in several locations in the watershed. In general, these are naturally occurring and are not a concern as a bacterial source. In a few places, birds concentrate because of particular human actions and should be discouraged. Geese are particularly attracted to large areas of open grass. These include the State Park and Birch Bay Village. The best deterrent is to replace the grass areas with native shrubs, particularly along bodies of water. Waterfowl prefer to have open sight lines, so a border of shrubs along the grass would also discourage them. Active programs of trained goose-control dogs may be employed to discourage geese from congregating. This approach has been successful in parks in other areas of the state. A program of signage to explain the issue and prohibit feeding of ducks and geese should be deployed.

Birch Bay Village has implemented a program to trap and remove adult geese and collect eggs from goose nests. Residents indicate that the program has been effective in reducing the numbers of geese in the village.

Onsite septic systems. The County should implement a program to test on-site septic systems and require corrections as appropriate. This approach has been successful in Portage Bay.

Results of fecal coliform sampling by Washington DOH at locations within Birch Bay led to a "threatened" status for shellfish beds in the area. A "threatened" status is given to an area that shows declining water quality. No source tracing has been preformed to determine if fecal coliform detected in Birch Bay samples is of human or animal origin. However, a study

performed for Drayton Harbor to the north of Birch Bay points to several potential sources of fecal coliform in that watershed, including failing septic systems (Meriwether, 1995).

A new bill has been passed by the Legislature related to septic systems. HB 1458 requires local health authorities to identify and correct failing septic systems by 2012.

Existing data can be used to create an accurate inventory of users connected to the sewers of the Birch Bay Water and Sewer District. Water users who are not connected to the sewer are served by onsite septic. Suspect areas can be investigated using such techniques as dye tracing, appearance of wet soils, lush vegetation surrounding systems, odor, or visible discharges. The County should enact requirements for owners to inspect systems and make corrections as needed.

People. Large numbers of people visit Birch Bay, particularly in the beach area. Public restrooms should be readily available and well maintained.

5.2.1.3 Water Quantity, Drainage, and Erosion

There are several areas in the Birch Bay watershed that have drainage problems. Most of these are large puddles that form occasionally and sometimes cover all or a portion of a roadway.

5.2.1.3.1 Bluff Erosion

Coastal bluff erosion is a natural process but may have been accelerated by human activity. The Coastal Zone Atlas for Whatcom County (Ecology, 1979) shows the entire shoreline areas of Birch Point and Point Whitehorn as unstable and shows five recent slide areas along Birch Point and two recent slide areas along Point Whitehorn as of 1978. Slides and bluff erosion are not new to the Birch Bay area.

The departments of Ecology and Natural Resources both have information available on proper management practices near coastal bluffs to reduce risks of slides. The Department of Ecology has published several guides for Puget Sound coastal and bluff property owners. These include:

- *Slope Stabilization and Erosion Control Using Vegetation, a Manual of Practice for Coastal Property Owners* (Ecology, 1993a)
- *Vegetation Management: A Guide for Puget Sound Bluff Property Owners* (Ecology, 1993b)
- *Surface Water and Groundwater on Coastal Bluffs: A Guide for Puget Sound Property Owners* (Ecology, 1995)

These manuals describe techniques used for minimizing the negative affects that surface water and groundwater mismanagement can have on the natural processes of landslides and erosion. *Surface Water and Groundwater on Coastal Bluffs* (Ecology, 1995) provides coastal property owners with general information concerning the management of water on coastal slopes. The publication describes the relationship between coastal geology, water, and slope stability. Techniques for evaluating site drainage and potential drainage control are presented within the publication. The other two resources, *Slope Stabilization and Erosion Control Using Vegetation* (Ecology, 1993a) and *Vegetation Management* (Ecology, 1993b) provide coastal property owners with basic information concerning the nature and use of slope planting techniques to manage soil erosion and shallow land movements. These three documents and others can help land owners minimize the risk of slide hazards.

The County should:

- Develop and implement a program of education for property owners in areas of coastal bluffs.
- Work with the Trillium Corporation to identify problems and solutions related to discharges from the Trillium property and conveyance to the beach as a condition of development approval.

5.2.1.3.2 Drainage

Development alters the natural hydrologic regime of an area. The initial clearing of vegetation yields the most significant alteration in hydrologic patterns. Once this initial clearing occurs, impervious surface coverage and hydrologic channelization that come with development exacerbate the problem. LID measures can mitigate these negative effects of development. Appendix D of this plan contains a review of the feasibility and potential effectiveness of LID measures within the Birch Bay watershed. For this review, the Low Impact Feasibility Evaluator (LIFE™) model was used to evaluate the effectiveness of LID measures in one development currently planned for Birch Bay.

LIFE™ model results indicate large reductions in peak flow rates generated by the 2-year, 10-year, and 100-year 24-hour events. The peak flow rates are reduced by 69 percent or more between the "Traditional Development" and "Development with LID" scenarios for each of three storm events run through the LIFE™ model. This study was performed based on one planned development of approximately 34 acres. It is likely that LID measures implemented to the scale and density as modeled with the LIFE™ model in this study would have comparable results elsewhere in the watershed. Detailed results of the LID review are contained in Appendix D.

Current Whatcom County regulations and requirements could be updated to reflect requirements for LID in new and redevelopment situations. For instance, a certain depth (such as 12 inches) of amended soils could be required on all pervious surfaces in new developments. Requirements could be set up to promote LID.

For the implementation of LID measures to truly be feasible in the Birch Bay area, the demand for "green" homes and LID must be known to developers and regulators alike. Developers would be more likely to incorporate LID measures into future developments if they are marketable and therefore more cost-effective.

5.2.1.4 Aquatic Habitat

There are ongoing programs to protect and restore aquatic habitat along Terrell Creek and the beach. These programs, which are largely volunteer, should be supported by the County and other agencies. In addition to the physical improvements made by the volunteers, the programs provide education to the volunteers and their circle of contacts.

5.2.2 Recommendations for Programmatic Solutions

5.2.2.1 Complaint Response

The public should be provided with a single number to call with complaints regarding drainage, erosion, or water quality issues. The County should place signs along the beach and key tributary locations providing the contact information to report water issues. Public works staff should be trained to collect appropriate information, track calls by type and location, and notify appropriate personnel to determine response. Staff should respond to all complaints within 24 hours even if just to acknowledge receipt of the complaint. A follow-up system should be in place to address

and resolve complaints or explain why complaints are not addressed. Complaint records should be periodically reviewed to identify "hot spots," and proactive solutions should be developed for them.

5.2.2.2 Inspections and Illicit Connections

An inventory of the drainage system in the Birch Bay watershed should be completed. All outfalls should be identified. An inspection program to detect and eliminate illicit connections to the stormwater system should be developed and implemented.

A semi-annual inspection of the tide gates and other drainage structures along the beach should be established.

A program should be established to inspect private drainage facilities such as stormwater ponds annually. This program will require a significant element of education with property owners. Many do not understand their systems or their importance and the need for maintenance.

The County should conduct inspections of existing and new development for adherence to existing Whatcom County regulations, including those for tight-line drainage along slopes.

The County should inspect pump-out facilities and coordinate with marina owners to develop a system of inspecting all boats in the marina. Boats should be inspected to assure that Y valves are closed and waste is not discharged to the water.

The County should conduct periodic inspections of RVs and trailers to ensure that there are no discharge pipes from holding tanks discharging sewage to ditches or streams.

The Birch Bay Water and Sewer District should sustain an annual inspection program to detect and eliminate infiltration and leakages in their pipe system. This may include dye tests.

The Whatcom County Health Department recommends that homeowners have their septic tank and drainfield inspected yearly and septic tank pumped once every 3 to 5 years. The Public Works Department should coordinate with the Health Department to develop a program of on-site sewage system inspections at least once every 5 years. Some warning signs of a failure are:

- Odors, surfacing sewage, soggy spots with lush green grass growth in the drainfield or septic tank area.
- Plumbing or septic tank backups
- Slow-draining fixtures
- Gurgling sounds in the plumbing system

Information regarding improper discharges to the stormwater system should be provided to community groups. If citizens notice suspicious pipes discharging to a ditch or stream they should contact public works. Similarly if citizens notice odors, sheens, colors, or turbidity, they should contact the Public Works Department. (Note that this will require discussion and training for Public Works staff.)

5.2.2.3 Spill Response

Supplies of absorbents and booms should be available on all maintenance trucks belonging to the Public Works Department and the Birch Bay Water and Sewer District as well as on all fire trucks. Crews should be trained in noticing and responding to spills.

5.2.2.4 Maintenance and Operations

At present, most public maintenance activity is limited to roads within the watershed. Road maintenance is conducted as necessary and appropriate to maintain road functions. It is funded by the road fund and taxes. Occasionally, additional maintenance related to the drainage system is conducted upon request or in emergency situations.

The drainage system primarily consists of roadside ditches and culverts throughout the watershed. There are also several tide gates and many surface water detention facilities. The roadside ditches and culverts are maintained by the County as needed to protect the roadway and to provide a safe transportation facility. The ditch and culvert system should continue to be maintained by the road program. Work orders generated by the inspections should be implemented. The drainage system should be evaluated to identify opportunities to enhance treatment, infiltration, and detention. The opportunities should be evaluated and prioritized. High priority retrofit projects should be funded and implemented.

There is currently no entity responsible for maintaining the tide gates. When requested, the County has occasionally cleaned or repaired the tide gates and other drainage facilities outside the road right-of-way. Responsibility and a funding source for tide gate maintenance and repair should be clarified.

Detention pond maintenance is the responsibility of the private property owner. Experience in multiple jurisdictions has shown that private detention ponds are rarely maintained by private parties without a public inspection program and a legal requirement to do so. The County should establish a program of annual inspection of private drainage detention and treatment facilities and a mechanism to require maintenance. Alternatively, the County should assume the responsibility for maintenance of residential facilities.

Maintenance and operations are also discussed in a separate technical memorandum attached as Appendix C to this plan.

5.2.2.5 Education

Most of the stormwater issues in the Birch Bay Watershed are caused by the everyday actions of the people that live in or visit the watershed. Changing behavior patterns would be far more effective than capital programs. The first step in changing behavior patterns is to increase the understanding of the need for the change and the specific actions that individuals can take. This requires an education program for commercial property owners, maintenance crews, homeowners' associations, livestock owners, pet owners, boat owners, RV owners, and visitors.

Because of the high levels of short-term summer visitors, it is important to develop educational actions that are onsite at the beach. These would be interpretive panels and displays related to people and pet waste management practices, care of habitat, and other topics.

A list of recommended educational topics and actions includes:

- Manure and erosion management for livestock owners conducted by Whatcom Conservation District. Funding would be needed for one-on-one visits and technical assistance. This would apply to any non-commercial "hobby farms" that are in the area.
- Support for local environmentally focused volunteer organizations including the Watershed Masters/Beach Watchers program and the Marine Resources Committee. Funding would be needed for developing education materials, lab tests for volunteer monitoring activities, a small grants program, and staff time.
- Support for community activities such as volunteer clean-up and native plant days and waterfront celebrations or festivals. Funding would be needed for staff time and display materials.
- Regular articles and advertisements in the local Birch Bay newspaper. Funding would be needed for staff time.
- Display materials for festivals and other special events.
- Information on stormwater management on the County website, http://www.co.whatcom.wa.us/.
- Septic system maintenance information.
- Lawn and garden care, nutrient and pesticide management – adapt the Lake Whatcom "watershed kit" for Birch Bay and make it available in the community.
- Work with local schools to provide teaching materials and opportunities for water quality related actions.
- Provide technical assistance to citizen organizations, developers, and commercial property owners.
- Provide training to maintenance and permit review staff.
- Work with the State Park, Birch Bay Village, and other land owners to develop plans and implement alternatives to large grass areas to discourage waterfowl.
- Provide training information to coastal bluff property owners regarding proper management of drainage, on-site sewage systems, and vegetation..
- Create display boards and fliers for campgrounds and trailer parks.
- Provide signs and brochures for boat owners in marina. Coordinate volunteer education and inspection program. Coordinate with Marina staff.
- Provide information to homeowner associations regarding proper maintenance of drainage systems.

Whatcom County has previously implemented most or all of these recommendations at one time or another in various locations in the county. Therefore, these actions could be implemented as an extension of the responsibilities of staff. Existing materials could be used or modified for Birch Bay as needed rather than developed from new. Refer to Table 5-1 for a list of specific needs for educational actions and their costs.

TABLE 5-1. PROPOSED BIRCH BAY WATERSHED EDUCATION PROGRAM

Issue or Potential Pollutant Source	Audience	Message	Media	Existing County Resource	Additional County resources needed	One-time Cost of additional need ($)	Annual Cost of additional need ($)[a]
Wastewater conveyance system	Birch Bay W&S District	Inspect pipes for leaks	Personal contact with staff	none	Minimal time of existing County staff, $30,000 one-time inspection costs to W&S District from existing revenues	30,000	x
Dogs and cats	Pet owners	Confine pets, pick up waste	General community education media, provide signs and free "mutt mitts" along beach.	one-time grant, expired	Small grants program	15,000	x
Livestock	Owners	Keep manure out of stream, protect soil	Manure and erosion management conducted by Cooperative Extension	"Tips Handbook for Small Farms"	One-on-one contacts by Whatcom Conservation District	15,000	5,000
Commercial sources	Owners and operators	Awareness, source control	Brochures, inspections, individual contact if problems noticed	none	Watershed keeper, 0.5 FTE		50,000
Recreational vehicles and trailers	Owners and operators	Use dump station	Display boards and fliers for campgrounds and trailer parks	none	Materials and installation	25,000	x
Marina	Owners and staff	Awareness, close Y valves, use pump station	Signs, inspections, coordination with marina staff and volunteers	none	Watershed keeper	10,000	x
Wildlife	General public	Focus on human-induced issues	General community education media	none	Watershed keeper	-	-
Waterfowl (ducks and geese)	Property owners and beach visitors	Modify, grass areas, don't feed	Work with the State Park, Birch Bay Village, and other land owners to develop plans and implement alternatives to large grass areas to discourage waterfowl	none	Watershed keeper	x	x

TABLE 5-1. PROPOSED BIRCH BAY WATERSHED EDUCATION PROGRAM

Issue or Potential Pollutant Source	Audience	Message	Media	Existing County Resource	Additional County resources needed	One-time Cost of additional need ($)	Annual Cost of additional need ($)[a]
Onsite septic systems	Property owners	Clean, maintain, test and repair systems	Septic system maintenance	Health Department has brochures	Watershed keeper	-	x
People	Beach visitors	Use public restrooms	Signs along beach	none	Materials and installation	20,000	-
Improperly maintained detention facilities	Homeowners associations	Maintain detention ponds and conveyances	Brochures, inspections, individual contact if problems noticed	none	Watershed keeper	-	x
New development	Developers, developer engineers, County plan reviewers, inspectors and maintenance staff	Technical issues and solutions, critical factors affecting performance	Provide technical assistance to citizen organizations, developers, and staff. Formal training programs for staff and private engineers.	none	Develop training materials, staff time for technical assistance, provide training. Initial cost to develop materials and provide one round of training: $50,000. Annual cost to provide training: watershed keeper and staff.	50,000	x
Road maintenance	Road maintenance staff and managers	Awareness of issues, how to identify problems, BMPs for maintenance	Provide training to maintenance and permit review staff	none	Watershed keeper	x	x
General	Residents and visitors	Awareness of issues and specific measures that individuals can do	Support local environmentally focused volunteer organizations including the Watershed Masters / Beach Watchers program	none	Watershed keeper, small grants program: $20,000	x	20,000
			Support community activities such as volunteer clean-up and native	none	Watershed keeper,	x	x

TABLE 5-1. PROPOSED BIRCH BAY WATERSHED EDUCATION PROGRAM

Issue or Potential Pollutant Source	Audience	Message	Media	Existing County Resource	Additional County resources needed	One-time Cost of additional need ($)	Annual Cost of additional need ($)[a]
			plant days and waterfront celebrations or festivals		small grants program		
			Regular articles and advertisements in the local Birch Bay newspaper	none	Watershed keeper	x	x
			Display materials for festivals and other special events	none	Watershed keeper	x	x
			Maintain internet information	none	Watershed keeper	x	x
			Septic system maintenance	none	Watershed keeper	x	x
			Lawn and garden care, nutrient and pesticide management – adapt the Lake Whatcom “watershed kit” for Birch Bay and make available. Refine "stormwater checklist for your lot"	none	Watershed keeper	x	x
			Work with local schools to provide teaching materials and opportunities for water quality related actions	none	Watershed keeper, small grants program	x	x
			Provide technical assistance to citizen organizations, developers, and commercial property owners	none	Watershed keeper	x	x
Coastal Bluff Erosion	Coastal bluff property owners	Sustain native vegetation, connect to sewer, convey stormwater safely to beach	Provide training information to coastal bluff property owners regarding proper management of drainage, on-site sewage systems and vegetation	none, Island County has appropriate printed materials for property	Watershed keeper, $3,000 for printing materials	3,000	x

TABLE 5-1. PROPOSED BIRCH BAY WATERSHED EDUCATION PROGRAM

Issue or Potential Pollutant Source	Audience	Message	Media	Existing County Resource	Additional County resources needed	One-time Cost of additional need ($)	Annual Cost of additional need ($)[a]
				owners			
TOTAL						**168,000**	**75,000**

[a] x = provided by 0.3 FTE of watershed keeper staff position

Note that costs for small grant program are listed only once.

5.2.2.6 Monitoring

In accordance with the NPDES permit conditions, a coordinated monitoring program should be developed. Since the primary water quality issue in the watershed is coliform bacteria, monitoring should be focused on that. The Department of Health monitors bacteria in the shellfish harvesting areas of the bay. There is no systematic monitoring program for the individual sources of bacteria. There have been reports that algae growth has increased in the bay. This may indicate that nutrients have increased.

Monitoring programs should include three elements:

- Compliance monitoring: were the program actions implemented (inspections, education)?
- Effectiveness: did the actions achieve objectives (reduce or eliminate bacterial sources)?
- Validation: did the objectives achieve goal (unrestricted shellfish harvesting)?

The first and most important question to resolve is how the monitoring information would be used to adapt management actions. The monitoring program should be long-term to identify trends. A work group should be formed in the County to answer this question and plan a monitoring program accordingly. The monitoring program should be adjusted periodically to increase its value but care should be taken to sustain a program in a consistent format so that data can be compared and trends identified.

The County has monitoring programs established in other watersheds and already has knowledgeable staff. Professionals from Whatcom County or a third-party consultant may be required to conduct some of the sampling of stormwater discharges to Birch Bay. Using professionals to collect samples or to coordinate sampling events could provide more consistent and reliable water sampling results. However, the program should include an element for volunteer training and coordination that would minimize monitoring hours spent by Whatcom County staff.

A stormwater monitoring program that includes both sampling and visual monitoring can be used for multiple purposes to better protect water quality. Much of the key monitoring may be visual indicators such as oil sheens, surveys of bird and pet concentrations, and discolored stormwater or stormwater with high turbidity. Volunteers can perform visual monitoring as well as most water quality sampling activities.

County staff should coordinate with the DOH to develop a program to monitor septic systems.

The County currently coordinates an annual clam survey. A vegetation survey should be added at the same time to identify potential increases in algae over time. If increases in algae are identified, water quality samples should be taken to test for nutrients. If high concentrations of nutrients are found, additional investigations should be made to find the source. Likely sources of excessive nutrients include golf courses, onsite sewer systems, and large livestock or bird populations.

The Nooksack Salmon Enhancement Association has begun an evaluation of current conditions in and around Terrell Creek. NSEA uses a smolt trap to count young salmon leaving the creek during the spring months. This smolt trap has been placed about one mile upstream from the mouth of Terrell Creek within Birch Bay State Park from March to June each year since 2000. When this smolt trap is in use, it is checked twice per day. Since the smolt trap was first installed,

many species of fish were discovered. NSEA has completed fish habitat assessments, including water quality and flow measurements, to determine fish habitat conditions.

Future habitat assessments should include the stretch of open channel along Lora Lane behind the tide gate to determine if this stretch would provide beneficial fish habitat. The fish habitat potential would have to be weighed against the benefits of the existing tide gate.

Following adoption of the stormwater plan, the County should require an annual review of implementation of the recommended actions (compliance monitoring). This could be incorporated with the annual budget review process. At the same time staff should present a list of specific potential bacterial sources identified and whether or not they were reduced or eliminated (effectiveness monitoring). The annual review should include a summary of DOH annual monitoring of coliform in Birch Bay and an analysis of implications for the effectiveness of the programs.

Refer to Table 5-2 for a list of specific needs for monitoring actions and their costs.

TABLE 5-2. PROPOSED BIRCH BAY STORMWATER MONITORING PROGRAM

Common Pollutants of Concern and Other Issues	Typical Sources	Indicator or parameter	Monitoring Approach				Existing County Resource	Additional County Resources Needed	One-time Cost of Additional Need	Annual Cost of Additional Need
			Targeting and Phasing	Frequency	Staff	Volunteers				
Human pathogens such as cholera, salmonella,	Septic systems, boats, trailers and motor homes, leaking sewers, people outdoors	Coliform bacteria or optical brighteners	Coliform counts at stormwater outfalls first, then upstream of problem areas to source. Pilot-test RNA source tracing and optical brighteners, then expand to additional locations as appropriate.	Monthly, random days	Organize and train volunteers to collect samples, manage laboratory testing and data management	Available to help collect samples	Knowledgeable staff but limited availability	Watershed keeper, 0.2 FTE. Consultant and laboratory assistance to conduct pilot tests.	$100,000	$20,000
Total Suspended Solids (TSS)	Construction, stream channel erosion, landslides, roadside ditches, soil erosion from yards and fields, brake and tire wear, dust, pavement wear, road sanding	TSS	Regular visual inspections to identify locations with frequent problems	Monthly, random days	Organize and train volunteers to conduct visual inspections	Available to provide visual monitoring	Knowledgeable staff but limited availability	Watershed keeper	0	x

TABLE 5-2. PROPOSED BIRCH BAY STORMWATER MONITORING PROGRAM

Common Pollutants of Concern and Other Issues	Typical Sources	Indicator or parameter	Monitoring Approach				Existing County Resource	Additional County Resources Needed	One-time Cost of Additional Need	Annual Cost of Additional Need
			Targeting and Phasing	Frequency	Staff	Volunteers				
Turbidity	Construction, stream channel erosion, landslides, roadside ditches, soil erosion from yards and fields, brake and tire wear, dust, pavement wear, road sanding,	Turbidity	Regular visual inspections to identify locations with frequent problems	Monthly, random days	Organize and train volunteers to conduct visual inspections	Available to provide visual monitoring	Knowledgeable staff but limited availability	Watershed keeper	0	x
Nutrients	Detergents and fertilizers, failing septic systems or leaking wastewater systems	Total and dissolved phosphorus, nitrogen. Visual indicators include excessive algae growth and vegetation transects on beach.	Regular visual inspections to identify locations with frequent problems, transects on beach	Annual	Organize and train volunteers to conduct visual inspections	Available to provide visual monitoring	Knowledgeable staff but limited availability	Watershed keeper	0	x
Hydrocarbons	Vehicle exhaust, leaks and drips	Visual indicators include oil sheen on surface	Regular visual inspections to identify locations	Monthly, random days	Organize and train volunteers to conduct visual	Available to provide visual monitoring	Knowledgeable staff but limited availability	Watershed keeper	0	x

TABLE 5-2. PROPOSED BIRCH BAY STORMWATER MONITORING PROGRAM

Common Pollutants of Concern and Other Issues	Typical Sources	Indicator or parameter	Monitoring Approach				Existing County Resource	Additional County Resources Needed	One-time Cost of Additional Need	Annual Cost of Additional Need
			Targeting and Phasing	Frequency	Staff	Volunteers				
		water	with frequent problems		inspections					
Heavy metals	Brake and tire wear, pipe leaks	Total and dissolved zinc and copper	No monitoring proposed						0	x
Healthy clam populations	Multiple factors include pollutants, disease, over-harvesting, exotic species competition, silt, temperature, natural predators	Species diversity and abundance	Volunteer transects combined with vegetation surveys	Annual	Organize and train volunteers to conduct visual inspections	Available to provide visual monitoring	Knowledgeable staff but limited availability	Watershed keeper	$500	x
Data management								0.1 FTE	0	$10,000
Overall coordination								watershed keeper	0	x
Total Cost									$100,500	$30,000

x = cost of watershed keeper shown only once

5.2.2.7 Regulations

The County should:

- Adopt and enforce the 2005 version of the Ecology Stormwater Management Manual for Western Washington (Ecology, 2005) and update County Development Standards for stormwater management in response.
- Adopt a LID ordinance that includes requirements for infiltration and reduced impervious surface. Small lots and shared open space should be encouraged. Remove any regulatory barriers to this, including allocating appropriate resources to ensure enforcement. Apply LID regulations in a way that makes sense given variations in site conditions (for instance, along steep slopes and on coastal bluffs).
- Prohibit discharge of pollutants to the stormwater system.
- Adopt requirements for annual inspections and corrections for septic systems.
- Create a Shellfish Protection District that comprises the Birch Bay watershed to increase awareness of the resource.

County maintenance staff indicated that permit review staff do not normally check with Public Works maintenance crews to determine if there are drainage issues near proposed developments. Existing drainage problems can be made worse by additional development, or they could often be resolved by the new development if the design engineers are aware of the issue. New development should not be allowed to make existing drainage problems worse. It would be helpful to identify a mechanism to check with road maintenance staff about existing drainage problems when reviewing permit applications.

Additional recommendations for additions and modifications to regulations are discussed in Chapter 2.

5.2.2.8 Record-Keeping and Annual Reporting

The draft NPDES permit requires keeping records of all activities. These include:

- SWMP development and implementation
- Annual report of SWMP effectiveness
- Number of inspections
- Enforcement actions
- Education activities

5.2.2.9 Watershed Keeper

Many of the needs for Birch Bay could be addressed by having a staff person dedicated to the water quality, quantity, and habitat issues of the watershed. Many jurisdictions have identified these staff as watershed keepers. This is the person that residents know to call and that coordinates all of the activities of the watershed. Approximately one half-time (0.5 full-time-equivalent [FTE]) person is needed to provide the education and coordination of related activities

in the watershed. Approximately 20 percent of a full-time person (0.2 FTE) is needed to conduct or coordinate monitoring activity in the watershed.

5.2.2.10 Administration

The SWMP program recommendations will require additional administration costs and personnel. One staff person should act as a "watershed keeper" or similar designation. As an initial effort to establish the education program, approximately 50 percent of a FTE person should be adequate. A permanent and dedicated funding source should be found.

5.2.3 Summary of Programmatic Recommendations

The programmatic action recommendations are summarized in Table 5-3.

TABLE 5-3. NEEDS ADDRESSED BY PROGRAMMATIC RECOMMENDATIONS

Program Element	Needs Addressed		
	Water Quality	Drainage and Erosion	Aquatic Habitat
Complaint Response	♦	♦	♦
Drainage Inspections and Illicit Connections	♦	♦	
Spill Response	♦		
Maintenance and Operations	♦	♦	
Education	♦	♦	♦
Monitoring	♦	♦	♦
Regulatory Changes	♦	♦	♦
Record Keeping	♦	♦	♦
Watershed Keeper	♦	♦	♦
Administration			

5.3 Projects Recommended for Capital Improvement Program

Projects recommended for the Whatcom County CIP are structural, not programmatic, in nature. Twelve different stormwater problems were identified as having potential structural solutions. The six ranked at the top are recommended here. Additional details of each project are included in the technical memorandum and fact sheets included in Appendix E.

One top-ranked problem, erosion of the Birch Bay Drive road surface, will be addressed in a future Whatcom County project (CC-02) that is already in the planning stages. Therefore, it was eliminated from this CIP prioritization analysis.

5.3.1 Descriptions of Priority Capital Projects

5.3.1.1 Drainage Improvements, Cottonwood Neighborhood (CT-06)

Stormwater runoff for a large portion of the Cottonwood Neighborhood is conveyed through an open channel through the County Park and into a closed-pipe system consisting of a pipe leading to a structure that diverts the flow into two different outfalls along Cottonwood Beach. Flooding occurs in the yards along Birch Bay Drive close to the system outlets. Development is expected to continue in the upstream portions of the drainage basin. This system must be capable of handling any additional flows due to these new developments. The failing system is on private property and was constructed by private property owners.

Solutions involving full trenching and pipe re-route/replacement would be the most cost-intensive potential alternatives. Installation of cast-in-place lining in the northernmost outlet pipe and replacement of outfall structures on both the outlet pipes appear to be the most cost-effective structural options.

Additional analysis of the system and the flows is needed followed by design and construction of improvements. Additional analysis may include a hydrologic and hydraulic model of the system. Further hydrologic study would allow designers to quantify the contributing area and corresponding design flows through the system. The hydraulics of the system should be analyzed to determine current head losses and other flow characteristics when the system is running at capacity. Site investigation techniques such as closed-circuit television (CCTV) pipe inspections, dye-testing, surveys, etc., should be used to further characterize the system before a preferred solution is implemented.

5.3.1.2 Drainage Improvements, Shintaffer at Richmond Park (CT-01)

The drainage ditch flowing south along the west side of Shintaffer Road conveys runoff from a large area west of Shintaffer. The ditch along the west side of Shintaffer flows through two 90-degree bends from the drainage ditch along Shintaffer towards the Richmond Park Subdivision. Runoff is then conveyed in ditches and culverts through the subdivision before discharging to a creek system through a ravine flowing to the south towards Birch Bay. The creek enters a culvert under Birch Bay Drive, and then enters Birch Bay within Rogers Slough.

Yards in the Richmond Park Subdivision are submerged during heavy rains as the system backs up. Residents near the creek below the Richmond Park subdivision have experienced erosion and slope degradation in back yards along the ravine.

Preliminary development plans for the open area to the north and west of the Richmond Park Subdivision indicate that runoff from most of that area will be re-routed away from the current outlet through the subdivision. A new conveyance will be constructed to Birch Bay for those flows. Approximately 1.5 acres of the currently contributing area will then drain through the subdivision. This will remove most of the peak flows that currently cause problems in the Richmond Park subdivision.

Due to these preliminary development plans, the preferred solution is to promote this re-routing of flows and to maximize the current conveyance capacity of the system. The existing drainage ditches along the east side of Shintaffer Road should be re-graded to provide positive drainage and maintained. The drainage system through the Richmond Park Subdivision should also be inspected and maintained as needed.

Additional analysis of the system and the flows may be needed to assess the long-term affects this hydrologic regime may have on the erosion and slope degradation occurring in the backyards along the ravine downstream of the Richmond Park Subdivision. The preferred solution should incorporate the potential impacts that future development will have on the hydrologic regime of this system.

5.3.1.3 Lower Terrell Creek Improvements for Water Quality Benefits (CC-12)

It is natural for a coastal stream to move in the direction of long-shore drift. Then, during large storm events the creek would cut through to a new, more direct outlet to salt water and the process starts over. As development in Birch Bay proceeded, sections of Terrell Creek were confined and the creek no longer was allowed to find a natural course. Terrell Creek has low dissolved oxygen levels and high temperatures due to upstream activities within the watershed plus the confined nature of its path that limits circulation.

One alternative under this project would involve a feasibility analysis plus the design and construction of a more direct outlet for Terrell Creek. However, this alternative may be more harmful than it is helpful, as the current configuration of Terrell Creek includes an extensive estuarine area that provides habitat for several species of fish, birds, and waterfowl. Though conditions in Terrell Creek under the current alignment aren't ideal, realigning the mouth of the creek has the potential to negatively affect the current habitat conditions in the creek.

Because of this constraint, the preferred solution for this project is to improve water quality conditions within Terrell Creek through programmatic solutions such as source control efforts rather than structural means. These programmatic solutions are described earlier in this chapter. An intensive program of tree planting is included to provide shade.

Programmatic solutions would provide more benefit for less cost (both financial and environmental) than would the structural solution. A concept-level cost estimate for the structural alternative of re-aligning Terrell Creek is close to $2 million, including construction costs (plus 50 percent contingency) and soft costs (permitting, legal costs of 30 percent of construction costs, and engineering study/design costs of an additional 30 percent). The high costs for permitting and engineering study/design reflect the specific issues of a construction project along a shoreline and within a salmon-bearing stream such as Terrell Creek.

5.3.1.4 Drainage Improvements, Birch Point, Various Locations (BR-02)

The natural hydrology in the Birch Point area has been altered due to past development. Construction of roadways, roadside ditches, and homes has altered the surface and subsurface flow. Loss of vegetation has increased volumes of runoff and peak flows. Surface flow is conveyed in cross-culverts and roadside ditches, and then flows towards Birch Bay in concentrated flow streams that may contribute to erosion and stability problems at the bluff.

Several localized surface drainage issues have been identified in the Birch Point Area. This project would involve addressing these issues by increasing the capacity of these drainages in a manner consistent with BMPs for active landslide areas. The most immediate need is for proper conveyance of drainage from upstream contributing areas. This project would involve the design and construction of tight-line (closed-pipe) drainage at the edge of the slope then down the slope. This setup would be repeated up to three additional times depending on location and magnitude of runoff flows from upstream areas.

The preferred solution is the structural alternative of constructing tight-line drainage from the edge of the bluff (including steep slopes) and down to the beach. This solution could be applied at any or all of the specific identified surface runoff outlets from upstream property.

Several of the problem spots may be addressed with structural projects such as drainage re-routes and capacity increases. However, these capital project solutions should be performed concurrently with programmatic solutions such as public education on proper drainage techniques, stricter requirements on addition of impervious surface and tree removal, increased inspection and enforcement of land clearing and drainage requirements, and the implementation of projects such as LID that have the potential for limiting runoff from upstream areas. Infiltration should not be encouraged within 300 feet of the bluffs due to the potential to increase slides. These programmatic solutions are addressed earlier in this chapter. These programmatic solutions will address sub-surface flow and erosion/stability issues around Birch Point that are not specifically addressed with this structural surface runoff improvement project.

If slides along the bluff continue, residents should consider formation of a local improvement district to finance installation of sewers. Homeowners should inspect their own property and route their drainage away from the bluff, or build their own conveyance to the beach.

5.3.1.5 Terrell Creek Culvert at Grandview Road (CC-11)

The Grandview Road crossing of Terrell Creek is currently a fish passage barrier under low-flow conditions. The culvert is situated high enough above the creek bed that any fish passage is impossible under low flows.

The preferred solution is the replacement of the existing culvert with a box culvert to allow for year-round fish passage under all flow regimes.

5.3.1.6 Drainage Improvements, Rogers Slough at Birch Bay Drive (BV-01)

Drainage ditches discharging to Rogers Slough back up behind the tide gate under high tide and/or wet weather conditions. When these ditches overflow, backyard flooding occurs in the homes within Birch Bay Village that have back yards along Birch Point Road. Ditches also back up along the north side of Birch Point Road.

Much of this area may be at or just above high tide level. During wet periods, runoff will back up behind the existing tide gate until the tide recedes and this runoff can discharge through the gate. Note that the flooded areas are low and historically are likely to have been wet even before homes and roads were built in the area.

More frequent removal of dead trees from Rogers Slough may help alleviate the drainage problems. A biological review of this activity should be conducted to determine potential impacts. An analysis of coastal processes should also be completed to determine if it would provide long-term benefit.

A detailed study of the area and the problem should be conducted as part of the preferred solution. A survey would yield detailed elevations of homes, yards, roadways, drainage ditches, pipes, and the tide gate in relation to tidal elevations within Rogers Slough. Further hydrologic study would allow designers to quantify the contributing area and corresponding design flows through the system. In addition, the formulation of a hydrologic model would enable planners to determine adequate detention requirements for future developments. This may include increased

detention requirements for any additional developments planned for the contributing area that would exceed the current detention capabilities of the existing system.

Drainage ditches, culverts, and pipes may be upgraded to maximize conveyance capacity. The tide gate may be replaced, depending on the results of the initial study. As an initial estimate, this preferred structural solution (if required, depending on results of detailed study) would cost $425,000, including construction costs plus 50 percent contingency and soft costs (permitting, engineering/design, etc.) of 30 percent.

Any capital project should be coordinated with updated operations and maintenance procedures and plans associated with tide gates and tide gate operation. In addition, any updates to planning requirements and requirements on LID and other source control should be made with this problem and project in mind.

5.3.2 Summary of Action Recommendations

- Pursue capital projects to address water quantity, water quality, and habitat issues
- Implement programmatic solutions along with capital projects to optimize success

5.4 Estimated Costs of Programmatic and Structural Alternatives

Tables 5-4, 5-5, and 5-6 summarize the costs of the programmatic and structural alternatives.

TABLE 5-4. BIRCH BAY PROPOSED PROGRAM COSTS

Program Element	Actions	Existing County Resource	Additional County resources needed	One-time Cost of additional need ($)	Annual Cost of additional need ($)
Complaint Response	Develop organizational responsibility, train staff	Existing staff adequate, need direction and training	0.1 FTE time to plan and train	10,000	existing staff
Inspections and Illicit Connections	Develop and implement inspection program	none	0.1 FTE to plan, coordinate and implement		10,000
Spill Response	Provide materials, train staff	Existing staff	0.1 FTE once to provide training	10,000	5,000
Maintenance and Operations	See Maintenance and Operations Section		0.5 FTE	-	50,000
Education	See Table 5-1	Knowledgeable staff but limited availability	Watershed Keeper 0.5 FTE	168,000	75,000

TABLE 5-4. BIRCH BAY PROPOSED PROGRAM COSTS

Program Element	Actions	Existing County Resource	Additional County resources needed	One-time Cost of additional need ($)	Annual Cost of additional need ($)
Monitoring	See Table 5-2	Knowledgeable staff but limited availability	Watershed Keeper 0.2 FTE	100,500	30,000
Regulatory	Revise existing regulations	Knowledgeable staff but limited availability	0.5 FTE one time	50,000	-
Record Keeping and Annual Reporting		Knowledgeable staff but limited availability	0.1 FTE	-	10,000
Administration	Develop, implement and manage billing system, manage overall program	Knowledgeable staff but limited availability	0.1 FTE Administrative Support, one time cost to implement billing system	150,000	10,000
Total				488,500	190,000

TABLE 5-5. PRIORITY CAPITAL PROJECTS FOR WHATCOM COUNTY CIP

Capital Project Name	Capital Project Description	Type of Problem (Drainage, Water Quality, or Habitat)	Concept-Level Cost Estimate of Preferred Capital Solution[a]
CC-02[b]	Birch Bay Drive Roadway Improvements *[Project already underway]*	Drainage or Erosion / Stability	--
CT-06	Drainage Improvements, Cottonwood Neighborhood	Drainage	$225,000
CT-01	Drainage Improvements, Shintaffer at Richmond Park	Drainage	$125,000
CC-12	Terrell Creek Improvements for Water Quality	Water Quality and Habitat	$50,000
BR-12	Drainage Improvements, Birch Point, Various Locations	Drainage	$250,000 for each individual location (up to 4 locations)
CC-11	Terrell Creek Culvert at Grandview Road	Habitat	$460,000
BV-01	Drainage Improvements, Rogers Slough at Birch Bay Drive	Drainage	$425,000

[a]Preliminary cost estimates include construction costs with +50% contingency and +25% for “soft” costs such as permitting and engineering/design.
[b]Birch Bay Drive Roadway Improvements are part of a project that is currently underway within Whatcom County. Therefore, this problem is not addressed in this analysis.

TABLE 5-6. SUMMARY OF ANNUAL FTES AND CASH OUTLAY

Program:	FTE			
	Watershed Keeper	**Technical or Management**	**Maintenance**	**Office or Financial**
Education	0.5			
Monitoring	0.2	0.1		
Complaint Response			x	
Inspection and Illicit Connections	0.1			
Spill Response			0.1	
Maintenance and Operations			0.5	
Regulatory				
Record Keeping and Annual Report	0.1			
Administration and Financial		0.1		0.1
TOTAL FTEs	**0.9**	**0.2**	**0.6**	**0.1**
Annual Cash Outlay:				
Conservation District			$5,000	
Spill Response Materials			$5,000	
Small Grant Program			$20,000	
TOTAL			$30,000	

6 Financial Analysis and Funding Recommendations

6.1 Introduction

Whatcom County currently has a county-wide flood control zone district (FCZD). The FCZD is funded by taxes on real property county-wide. Funds from the FCZD have been used primarily to address flooding issues along the Nooksack River. Several sub flood control zone districts have also been created to provide additional funding and focus on local flooding issues. Operations and maintenance for drainage in Birch Bay are currently funded primarily from the County's road fund. To date, the County has been able to provide a minimal level of drainage service with its existing road fund revenues; however, continued growth and increasing regulatory requirements (see Chapter 2 for description) necessitate additional funding.

Additional funding will allow the County to protect public health and safety, meet public expectations regarding surface water, and address the regulatory requirements of the state, the Clean Water Act, and the Endangered Species Act while preparing a long-term strategy for operating these programs. The goals of the recommended funding sources are focused on maximizing customer services and assuring that the charges are assessed in a manner that is credible, defensible, equitable, and administratively feasible.

This chapter presents a description of planning data, an evaluation of revenue needs and available financing mechanisms, a description of the storm and surface water utility user rate development, and a summary of recommendations. The planning data section includes the basis for the storm and surface water system impervious area and system growth projections. The proposed SWMP and CIP are described in Chapter 5 of this plan. Chapter 2 is an overview of the regulations and impacts to the SWMP. Section 6.3, Program Description and Revenue Needs, includes a more detailed description of the regulatory impacts and the cost of individual program elements. The evaluation of available financing mechanisms (Section 6.4) includes alternatives for funding operation and maintenance (O&M) and capital expenses. The surface water management user rate development section (6.5) includes a description of administrative policy considerations and a recommended storm and surface water utility rate structure.

6.2 Planning Data

6.2.1 Equivalent Residential Units

The recommended rate structure is based on the amount of impervious area of a property (discussed in Section 6.5). A property's surface water rate is defined by the number of equivalent residential units (ERUs) it contains. One ERU is equal to the impervious area of an average single-family residential unit. Impervious area for each non-single-family residential unit is defined in terms of ERUs. A flat rate per ERU can then be applied to all properties.

An ERU of 3,000 square feet (ft^2) of impervious area is used for this analysis (same as City of Bellingham). For planning purposes, ERUs for non-residential properties were estimated by

determining the total area of properties with similar existing types of land use (e.g., multi-residential, commercial, industrial, institutional, public, duplex, and other) and applying estimates of percent impervious area. The data were obtained from the County's GIS layers for land use, parcels, and impervious coverage (from satellite interpretation). As shown in Table 6-1, an estimate of 12,161 ERUs was identified in the Birch Bay watershed.

Note that these ERU totals are very preliminary numbers and they will likely change if additional analysis is performed before the final adoption of a rate. In addition, under provisions of the existing stormwater development regulations and development standards, duplexes have been treated the same as single family residential development. These ERU totals and their distribution among land uses could be revised based on a decision of how duplexes should be incorporated into the totals.

TABLE 6-1. SUMMARY OF EQUIVALENT RESIDENTIAL UNIT CALCULATION[A]

Land-Use	Total Area (ft^2)	% Impervious	Impervious Area (ft^2)	ERUs[b] (3000 ft^2)
Single Family Residential[c]	219,619,599	7	15,157,991	5,053
Multi-Residential[a]	40,710,212	11	4,300,505	1,434
Commercial[a]	29,130,800	32	9,273,965	3,091
Industrial[a]	94,112,722	17	15,579,232	5,193
Agricultural[a]	227,829,382	2	3,683,864	1,228
Forest[a]	48,068,729	1	307,801	103
Park[a]	38,763,953	3	1,187,100	396
TOTAL ERUs (excl. roadway)				**16,498**
TOTAL ROADWAY ERUs[d]	14,644,549	14	1,992,201	664
TOTAL ERUs (incl. Roadway)			36,324,667	**17,161**
Adjusted Total without BP (Cherry Point)				**12,161**
Water	12,153,477	0	36,272	**12**

[a]Source: Whatcom County GIS
[b]Source: Current City of Bellingham ERU
[c]Correlates well with census data from Birch Bay Subarea Plan
[d]ERUs are based on 30% of total impervious area, which assumes 30% of ROW impervious area will be billed.

6.2.2 Projected Service Area Growth

Population projections were obtained from the Birch Bay Sub Area Plan, which describes a year 2000 population for the census area 4,961 and a projected 2022 population of 9,619. This projected growth averages 4 percent over the 22-year period 2000 to 2022. Throughout this report, residential growth is projected to be 4 percent per year, and non-residential growth is projected to occur at the same rate as residential growth. No increase in the ERUs charged to the County's road fund and WSDOT is forecast.

6.3 Program Description and Revenue Needs

The purpose of this section is to summarize the recommended programmatic elements for the Birch Bay Surface Water Management Program. These are described more fully in Chapter 5. Program elements include the type of service to be offered and the level of effort for each service. Some of the program elements are necessary to meet various state and federal regulatory requirements and to meet public expectations, and some are recommended to meet the County's obligation to protect public health and safety. The following sections discuss public expectations for service and basic assumptions about the level of effort and costs of the SWMP.

6.3.1 Public Expectations for Surface Water Program

Independent of state and federal regulatory requirements, the community has expectations for management of the storm and surface water system by the County. At a minimum, citizens expect to be protected from flood hazards and water quality hazards. Until basic drainage and flooding problems are addressed, the citizens will not be interested in paying more for compliance with state and federal regulations. Thus, a top priority for any surface water program must be to protect citizens and property from flood and water quality related human health hazards. Once these basic issues are addressed, the citizens will be more interested in water quality impacts to fish, fish habitat, and community values such as aesthetics and education.

The completion of a comprehensive plan by the citizens of Birch Bay that called for a stormwater plan is a good example of local public expectations. This planning effort provides evidence to support an underlying assumption of this Stormwater Plan, that the citizens of Birch Bay place a relatively high value on environmental issues. This plan assumes therefore that the County's program must at least meet the requirements for the various state and federal regulations. The recommended alternative includes basic regulatory compliance and additional protection of water quality and aquatic habitat.

6.3.2 Program Elements and Level of Effort

Table 5-1 in Section 5 lists the recommended programmatic activities and their estimated costs. These costs are used for purposes of analysis in the following sections regarding finance.

6.4 Evaluation of Available Financing Mechanisms

This section reviews alternatives for financing the SWMP for the watersheds of Birch Bay. It begins with a review of special districts and stormwater utilities, which are entities that can be established to assume responsibility for funding and management of watershed programs. It then addresses specific mechanisms to fund or finance improvements to the system as well as its ongoing operations, including debt, grants, taxes, developer financing, fees, and charges. The section presents each alternative, identifies pros and cons, and closes with broad recommendations.

There are several mechanisms available to generate revenue targeted to specific services. These revenue source options have been created over time to provide services for specific local circumstances that do not get funded by counties because they are not county-wide issues. They have the advantage that they address local issues and are funded by those that are interested in the services. While citizens often resist increases in general taxes, they often support revenues that target specific services they want.

For a reference on funding stormwater programs, see:
http://www.nafsma.org/Guidance%20Manual%20Version%202X.pdf

6.4.1 Special Service Districts[1]

In Washington, special purpose districts (85.38 RCW) are limited-purpose local government entities, separate from a city, town, or county government. Generally they perform a single function, although some perform a limited number of functions not otherwise available from city or county governments. Special purpose districts are generally created through the county legislative authority to meet a specific need of the local community, such as a new or higher level of service. Once formed, many of the fiscal and administrative functions of special purpose districts are handled by the county government.

Most special purpose districts in Washington derive revenues from real property assessments and are taxing districts. Most have the power to impose taxes upon district property in proportion to property value, as opposed to obtaining revenue for public purposes in proportion to the benefits accruing to it. Some special districts (such as diking and drainage districts) are authorized to levy *benefit assessments*, which are charges to land owners based on the benefits their property receives from the project being funded with the proceeds of the assessment. Other special districts (such as flood control [86.09 RCW], flood control zone [RCW 86.15 RCW], and shellfish protection districts [90.72 RCW]) are authorized to *charge fees* directly for services. Revenues of special districts typically may be used for the ongoing operations and maintenance of facilities, as well as for capital costs. Whatcom County already has a county-wide flood control district, certain sub-flood control districts, and shellfish protection districts. Addition of a sub-flood control district for Birch Bay would be relatively straight-forward.

The Washington State legislature provides authority and specifies general procedures for the formation of special districts. The majority are formed by a resolution of or petition to the county legislative authority. Almost all formations require a formal public hearing to determine the need for the district, and in some instances a feasibility study is required. The formation generally requires an election to determine whether the majority of residents or landowners wish to form a district and pay taxes to receive the service.

Table 6-2 provides a summary of the different types of special districts in Washington of relevance to stormwater management. The table includes type of district, enabling statute and date it was created, purpose, formation, governance, and revenues.

[1] Portions of this section, and Table 6-2, were drawn from the Municipal Research & Services Center (MRSC), a non-profit, independent organization located in Seattle, Washington. Website: http://www.mrsc.org/index.aspx.

TABLE 6-2. SELECTED SPECIAL DISTRICTS AND A STORMWATER UTILITY IN WASHINGTON STATE AND THEIR KEY COMPONENTS

Type of District, Enabling Statute & Date Created	Purpose	Formation	Governance	Revenues
Diking District Ch. 85.05 RCW 1895	Straighten, widen, deepen, and improve all rivers, watercourses, or streams, construct diking system to protect land from overflow	Resolution or petition of 10 property owners; feasibility determination by county engineer; hearing; election pursuant to Ch. 85.38 RCW	Board of 3 elected commissioners	Special benefit assessments (based on the benefit to property rather than value of the property); bonds; participating counties/cities may appropriate funds for the district; participating cities may levy an assessment on property
Drainage District Ch. 85.06 RCW 1895	Establish drainage system	Same as Diking District	Board of 3 elected commissioners; consolidated districts could retain 5-member board	Same as Diking District
Flood Control District Ch. 86.09 RCW 1937	Protect life and property, preserve public health, and conserve and develop the natural resources; includes improvement, replacement, repair, or acquisition of works/ property to control floods	Same as Diking District; if less than 500 acres, petition of 50% of acreage	Board of 3 district commissioners, initially appointed; elected per Ch. 85.38 RCW (Special district creation and operation)	Special assessments (proportionate to benefits); fees and charges; bonds
Flood Control Zone District Ch. 86.15 RCW 1961	Undertake, operate, or maintain flood control projects/stormwater control projects of special benefit to specified areas of the county	Action of board or petition - 25% vote cast in proposed zone at last county general election; once established, the district may divide any or all of the zone into separately designated subzones, operated and legally established as a flood control zone district	Board of county commissioners; option to elect 3 zone supervisors if district of over 2,000 residents	Annual property tax (not to exceed fifty cents per $1000 assessed value); fees and charges; voluntary assessments; local improvement districts to finance capital projects that benefit only a portion of the district's area – with assessments proportionate to benefit property receives; bonds

TABLE 6-2. SELECTED SPECIAL DISTRICTS AND A STORMWATER UTILITY IN WASHINGTON STATE AND THEIR KEY COMPONENTS

Type of District, Enabling Statute & Date Created	Purpose	Formation	Governance	Revenues
Shellfish Protection District - "Clean Water District" Ch. 90.72 RCW 1985	Curb the loss of productive shellfish beds from nonpoint sources of pollution	Motion of county; election	County legislative authority	County tax revenues; fees and charges; priority for state water quality financial assistance to implement shellfish protection programs, including grants and loans
Stormwater Utility Ch. 36.89 RCW	Establish, acquire, develop, construct and improve open space, stormwater control facilities…	County legislative authority by resolution	County legislative authority	County legislative authority "by resolution for revenues by fixing rates and charges for the furnishing of service to those served or receiving benefits…from any storm water control facility or contributing to an increase of surface water runoff."

The value of special districts as a separate governmental form has been debated in many states. Critics question whether there are too many districts and whether they are accountable. Advocates favor providing focused services that respond to special needs and give local control. Some states, not including Washington, have created a uniform set of statutes to govern special districts and provide accountability.

Pros of special districts include that they:

- Concentrate on effectively providing limited services
- Are responsive to constituents, as districts are often geographically small with low population density
- Link those who pay to those who benefit (although not necessarily equitably)
- Offer the same "pros" as a stormwater utility when they are authorized to generate revenue through charges (as per Shellfish and Flood Control districts). These include:
  - Revenues generated are stable, and can increase with community growth and with rate hikes and special fees, allowing for stability of operations and maintenance, long-term planning, and improved ability to comply with NPDES regulations
  - Costs can be directly linked to benefits, enhancing equity.
  - They present a new source of funds, freeing up existing funding for other purposes.

- Bonds for capital improvements can be issued and repaid through revenues generated.

Cons of special districts include that they:

- Can result in too many units of government, with duplication of costs and weakened consolidated planning
- Tend to lack visibility, confusing residents regarding who is in charge
- Often have limited voter participation in the election of special district officers, detracting from their representative nature
- Entail added administrative complexity, where charges may be established (as per a stormwater utility)

Note that the County is required to form a shellfish protection district and develop a program to address causes of pollution if a shellfish harvesting area is closed or downgraded by the Department of Health as a result of water pollution. This happened in Whatcom County in Portage Bay and Drayton Harbor and a shellfish protection district was formed in each location.

Administratively, the simplest mechanism to fund the SWMP would be to increase the tax rate of the FCZD either county-wide or in the Birch Bay watershed. However, a rate system based on property value is generally less equitable (and therefore, more difficult to defend if challenged) than a system based on impervious surface. Impervious surface is directly related to the amount of runoff from a property. A high value property does not necessarily discharge more surface water or cause more impact than a property with less value.

6.4.2 Birch Bay Water and Sewer District

Water and sewer districts are authorized to provide stormwater service if they choose. An amendment to the district's general sewerage plan is required, followed by action to revise utility rates. Representatives of the Birch Bay Water and Sewer District have stated that the district has no interest in assuming responsibility for stormwater.

6.4.3 Stormwater Utility

Stormwater utilities (36.89 RCW) are a relatively recent development in municipal stormwater management, with the first established in Washington and Colorado in the early 1970s. A stormwater utility is an enterprise fund that can provide stable funding, through establishment of rates and charges, for stormwater operations and capital projects. Stormwater utilities generally have a variety of objectives, such as funding ongoing or improved maintenance and capital investments, improved flood management capacity and water quality prior to discharge, ecological preservation, as well as planning, education, and outreach.

Most stormwater utilities are designed to provide the majority of a community's stormwater funding, thereby offsetting other funding sources such as the General Fund. Stormwater utility charges are generally based on a user fee per unit of impervious surface area; thus, the amount of impervious surface area and the fee per unit are central factors in revenue generation. Other policy issues that will affect revenue generation include whether undeveloped as well as developed properties are charged, and whether the community charges itself for streets and other public properties.

Pros of a stormwater utility, with associated rates and charges, include:

- Revenues generated are stable, and can increase with community growth and with rate hikes and special fees, allowing for stability of operations and maintenance, long-term planning, and improved ability to comply with NPDES regulations.
- Costs can be directly linked to benefits, enhancing equity.
- They present a new source of funds, freeing up existing funding for other purposes.
- Bonds for capital improvements can be issued and repaid through revenues generated.

Cons of a stormwater utility include:

- They require a commitment of time, resources, and public acceptance to develop.
- They require billing and other administrative functions to operate.

6.4.4 Debt

6.4.4.1 Debt Issuance Repaid by Utility (or Special District) Revenues

6.4.4.1.1 Revenue Bonds

Storm and surface water utility revenue bonds may be backed by revenues of a stormwater utility (or revenue-generating special districts). Interest rates available for revenue bond debt fluctuate with market conditions. *Pros* of issuing revenue bonds include the ability to fund large capital projects where costs exceed available current revenues; they also maintain intergenerational equity. *Cons* of revenue bonds include interest costs, bond issuance costs, bond reserve requirements, and debt service coverage requirements – and the risk that projections for community growth and associated revenue generation may prove overly optimistic.

6.4.4.1.2 State Revolving Fund and Centennial Clean Water Fund

The Department of Ecology's Water Quality Program administers two major funding programs that provide low-interest loans for projects that protect and improve water quality in Washington State. These include the State Revolving Fund (SRF) and the Centennial Clean Water Fund (Centennial) loan program, for which projects that reduce nonpoint sources of water pollution are eligible. Loans are available for up to 100 percent of eligible project costs. Ecology provides financial hardship consideration for facility construction projects that would cause user fees to exceed 1.5 percent of the median household income in the local area. Hardship is addressed through variable interest rates, longer loan terms, partial grants, or a combination of all of these. Separate applications, in separate years, are required for pre-construction and construction funding. These loans are typically considered junior lien to revenue bonds. *Pros* of such loans include favorable financing and the hardship consideration; *cons* include debt-related costs.

6.4.4.1.3 Public Works Trust Fund

The Washington State Department of Community, Trade, and Economic Development administers Public Works Trust Fund (PWTF) loans. PWTF funding may be used for the repair, replacement, or improvement of existing storm and surface water facilities. The interest rate depends on the amount of local financial participation. The construction loan term is 20 years, and loan repayments consist of equal principal payments in years 2 through 20 and interest payments on the unpaid principal. PWTF loans are typically considered junior lien to revenue bonds. *Pros* of such loans include favorable financing; *cons* include debt-related costs.

6.4.4.2 Debt Issuance Repaid by Assessments or Taxes

6.4.4.2.1 General Obligation Bonds

General obligation (G.O.) bonds are backed by the taxing power of the County. *Pros* include that G.O. bonds typically offer lower interest rates than revenue bonds. On the *cons* side, use of G.O. bonds is less common than revenue bonds in utility systems where rate revenues are collected, as G.O. bonds impinge on the borrowing capacity and may affect the bond rating of the County, compete with other projects for which no specific revenue source is available, and may require voter approval. G.O. bonds repaid through property tax assessments may result in distributional inequities, as the cost of a project may not be paid by its beneficiaries.

6.4.4.2.2 Utility Local Improvement Districts

Another potential source of funds for improvements comes through formation of local improvement districts (LIDs). This involves an assessment made against the properties benefiting from the improvements. Utility local improvement districts (ULIDs) are also backed by the revenues of the utility. This type of financing is most commonly applied to extensions of facilities into previously undeveloped areas. *Pros* include distributional equity, the ability to avoid interest costs via early payment of assessments, and the ability of grant funding and/or assessment deferral for low-income and/or low-income senior property owners. *Cons* include that ULIDs are often difficult to form, because the process may be stopped if owners of 40 percent of the property within the ULID boundary protest its formation.

6.4.5 Grant Programs

Assorted federal and state grants for stormwater projects are available. Grant funding is highly competitive, so it should be factored into stormwater capital or financial plans with contingency considerations, in case it does not materialize. The *pros* of grant funding include the infusion of external funding for community benefit; the *cons* include the uncertainty of funding and that it is typically earmarked for specific uses – which may or may not include priority needs. Administrative costs for grant applications and reporting may be high relative to other available funding.

6.4.6 Developer Financing and Latecomers Agreements

Developers may be required, by policy, to cover costs associated with the construction of stormwater system improvements, particularly within new plats. Developer extensions in public rights-of-way would then be deeded to the County upon completion. The County may choose to require, in some cases, construction of oversized conveyance and detention facilities to serve future upstream extensions beyond the development. In these cases, the County may, by policy, reimburse the developer either through direct financial participation or latecomers' agreements. These agreements provide up to 10 years or more for developers to receive payment from future developed properties that receive benefit from the developer-financed improvements. *Pros* of such financing include the equity of linking project costs with users; *cons* may include the lack of direct County or utility control of such projects.

6.4.7 Taxes and Other County Funds

Taxes, including sales tax, fuel tax, and *ad valorem* property tax, may be used to fund stormwater systems. These revenue sources are fully committed to other uses. Therefore, another County service would need to be cut to provide additional funding for Birch Bay surface water issues. *Pros* include a stable source of funding and relative administrative simplicity of collecting the

funds. *Cons* include the difficulty of gaining public support, and inequities due to the disconnect between costs and benefits.

Use of other County funds for stormwater capital, operations, and maintenance costs presents *pros* such as relative administrative simplicity; *cons* include lack of distributional equity and potential fluctuations in the level of funding due to competition with other County priorities.

6.4.8 System Development Charges

A system development charge (SDC) is a one-time fee payable by new development. SDC revenue can be used to finance growth-related capital improvements, including improvements for stormwater systems, and to repay debt service on projects on which the SDC is based. SDC revenue cannot be used to fund O&M expenses. *Pros* are that with SDCs, "growth pays for growth," reducing rate impacts on existing customers, who have already invested in the system; this is particularly advantageous in a municipality undergoing rapid growth. *Cons* are that SDC revenues are not guaranteed and have potential economic development impacts.

6.4.9 Miscellaneous Charges and Fees

Other fees may be established to cover costs for specific services. Examples include:

- **Permit review and inspection fees** designed to recover all or a portion of the costs to review development plans and inspect projects under construction, to assure compliance.
- **Special service fees,** which recover the costs of services performed for specific clients, as opposed to the entire service area. This may include annual inspections of onsite detention systems, discharge monitoring, water quality enforcement investigations, and similar specialized activities which have evolved with the expansion of regulatory requirements.

Pros of such fees include that they can enhance equity, whereby those benefiting from the service pay for it. *Cons* include that such fees are not guaranteed revenue, and can fluctuate.

6.4.10 Public Support

Creation of any new revenue source generates opposition. To create public support for a new revenue source, it is imperative to provide a thorough public education program and an opportunity for community dialogue. Public education must clearly explain the need for additional revenue, the specific services that will be provided, and why the fee is fair (provides equity among property owners). The need in Birch Bay can likely be understood by property owners because of rapid growth, the recognition of the value of the shellfish resource, and local drainage issues. Chapter 7 provides a description of a public involvement program.

6.4.11 Governance

Creation of a new funding source can be independent of the question of governance. For example, a sub-flood control zone may be governed by the County Council or by an independent board that could be appointed or elected separately. Another option would be for the Council to appoint an advisory board that would recommend the annual priorities for the program.

Communities often want to see more accountability and to have more control over provision of services. There may be a perception that a county is too large to address the specific needs of the local community. Provision of a structure to address specific community priorities can address the issue.

The fees collected in Birch Bay must be used to provide services to the area (Birch Bay watershed) that generates the revenue. Therefore, the issue of local control may be somewhat reduced, particularly if there is a good public education program to explain the proposed services.

Provision of local control creates the potential for a conflict between the local area and the County at large. For example, if a local community decides to spend all of the revenue on drainage problems, certain regulatory requirements to address water quality might not be addressed. That could create a problem for the County and inequity between local communities in the County. A separate governing board may also increase costs because some of the administrative functions would be duplicated.

6.4.12 Service Delivery

Similar to governance, the creation of a revenue source does not obligate any particular organization to provide the service, as long as the service is provided. For example, the County Public Works Department could provide the service, or the County might be able to contract with the Whatcom Conservation District, the City of Blaine or Ferndale, the Birch Bay Water and Sewer District, or a private company to provide some or all of the services.

There may be certain efficiencies within the County because it already has staff and equipment that do similar or identical work. This might be balanced by cost savings of reduced travel time and local knowledge of another organization.

Contracting with a separate entity creates the potential for conflicts with other County programs or services. For example, a technical recommendation by a separate entity may conflict with County policies or recommendations.

6.4.13 Implementation

Implementation generally requires the following steps:

1. Develop and implement a public education and citizen participation program.
2. Develop a plan of the services to be provided.
3. Develop a rate structure (defining specifically who pays, how much), and select the legal authority for the revenue mechanism.
4. Adopt an ordinance to create the revenue mechanism.
5. Adopt an ordinance to set the rates.
6. Develop the billing system in cooperation with the County treasurer (for the billing format) and the County assessor (for property data).
7. Send the billings and train staff (including all those who answer phones in the treasurer's office, public works, and Executive and Council offices) on how to properly respond to telephone calls and answer basic questions.

6.4.14 Recommendations

There are many alternatives for funding stormwater management programs. To secure adequate funding, Birch Bay decisionmakers should incorporate a combination of mechanisms that take into consideration both immediate and long-term needs. Any funding plan should also be guided by broad goals, such as customer acceptability, defensibility, revenue sufficiency and stability,

equity, administrative ease, and consistency/compatibility with local policies, practices, and long-term strategies. It should include public education and involvement to help ensure ultimate support and success.

Although originally written to address different issues, the laws for stormwater utilities and those for flood control zone districts have been amended and now there is very little difference in the process for formation, the potential revenue-generating mechanism, or the type of services that can be provided by these two types of entities. Each can be formed by the County Council, each can provide a broad range of drainage and flooding related services, and each can generate revenue through assessed valuations, benefits received, or contributions to the need for services. A Flood Control Zone District can assess taxes or utility fees while a stormwater utility is limited to service fees.

Additional funding is needed to address the issues raised by citizens and addressed in this Comprehensive Stormwater Plan for Birch Bay. Additional analysis and public debate are needed before adoption. Stormwater funding mechanisms for Birch Bay should include a combination of:

1. Establishing a sub-flood control zone district with authority to levy fees and charges.
2. Introducing stormwater service rates and charges, and associated policies that include incentives and development financing.
3. Exploring the availability of County funding, as well as federal, state, and other grant funding sources, and pursuing suitable options.

A sub-flood control zone district is recommended because additional revenues are needed and Whatcom County residents and County staff are familiar with the concept. Administration by County staff for creation, billing, financial tracking, and operations would be consistent with other areas of the County and therefore easier.

Billing for the sub-flood control district should be based on the percent of impervious surface on a property as this is directly related to the amount of runoff created on the property. The amount of runoff is directly related to the need for stormwater services. A flat rate for single-family residences should be established to simplify and reduce the costs of the billing system.

The recommendations are to provide revenue sources which by themselves do not result in the need for more staff or changes in the County organizational structure.

Additional discussion is recommended among County departments, legal council, and citizens to evaluate the recommendations and the assumptions listed above. Further refinement of the recommendations and more specific information are needed. For instance, the boundaries of Birch Bay Watershed are hydrological rather than political. The watershed boundaries include part of the Blaine UGA to the north and a small part of the Ferndale UGA to the east. A more detailed survey of the Birch Bay Watershed is needed to finalize actual watershed boundaries for funding purposes.

6.5 Sub-Flood Control Zone District Rate Development

6.5.1 Administrative Policy Considerations

6.5.1.1 Issue: How Should Single-Family Residences and Duplexes Be Charged?

6.5.1.1.1 Background

The basic approach to establishing a surface water rate in this analysis is based on impervious area. Single-family residences (SFRs), of which there are approximately 5,000 within the Birch Bay watershed, contain variable amounts of impervious area. Applying a single amount of impervious area, and therefore a uniform storm and surface water rate, to every single-family residence is an industry standard. This is done to minimize the administrative complexity associated with defining and maintaining records of impervious areas for each household in the watershed. For purposes of this plan, an ERU is defined as 3,000 square feet of impervious area.

6.5.1.1.2 Recommendation

Adopt a single surface water rate for all single-family residences and duplexes. The County may wish to consider adopting a duplex surface water rate if subsequent evaluation of duplexes indicates that they usually contain a greater amount of impervious area than a typical single-family residence.

6.5.1.2 Issue: How Should Properties Other Than Single-Family Residences and Duplexes Be Charged?

6.5.1.2.1 Background

Properties other than single-family residences would include multi-unit residential, commercial, industrial, and institutional properties. Some utilities choose to charge these areas based on total impervious area, that is, establishing a stormwater rate in terms of an ERU and defining, for each non-SFR property, the number of ERUs based on impervious area. This alternative generally balances equity and administrative complexity. Some utilities also base storm and surface water rates on the intensity of development expressed as percent of the parcel that is impervious. This method recognizes a finding by some utilities that, for a given impervious square footage, a smaller parcel (higher % impervious) has higher runoff volumes than a larger parcel (lower % impervious).

6.5.1.2.2 Recommendation

Because of the desire to minimize administrative complexity wherever feasible, base surface water rates for non-SFR and duplex properties on impervious area.

6.5.1.3 Issue: Should Pervious Areas Be Charged?

6.5.1.3.1 Background

Pervious areas include forested areas, pastures, or landscaped open spaces that do not have paving or rooftops and have 0 percent impervious area.

Undeveloped land is a property classification that may or may not be charged. If the property is in its natural state (e.g., forested) then it does not contribute to changes in stream flow or water quality or habitat degradation. However, if the land has been developed (changed from its natural state, e.g., agricultural use, golf course, athletic field), then it contributes to changes in stream flows and degradation of water quality and aquatic habitat. Although the site is still pervious, the change in site conditions has likely changed the amount of natural infiltration and evaporation

and transpiration processes, thus increasing the amount of runoff and the degradation of water quality (e.g., sediment loading). If landscaped, the site is likely contributing water quality pollutants in the form of nutrients and pesticides. Parks and cemeteries typically have parking, buildings, and walkways associated with them. The impervious areas within them are thus likely to be subject to the surface water rate. Therefore, these areas are minimal and would generate minimal impacts and minimal revenues for the County overall. Addition of pervious areas to a billing structure raises administrative complexities considerably, because the amount of pervious area for a residential customer would need determination, and the policy of establishing a single rate for single-family residences would need review. Further, because the amount of runoff from pervious areas is less than from impervious areas, a cost-allocation between impervious and pervious areas would typically be completed to establish a pervious storm and surface water rate. Finally, there may be less public acceptance of a storm and surface water rate for pervious areas.

6.5.1.3.2 Recommendation

Charge parcels of pervious area with altered vegetation for surface water service. Apply a flat rate equivalent to one ERU per month per parcel (the same as the SFR rate). Provide an exemption for areas that remain in native forest cover and parcels entirely covered by wetlands.

6.5.1.4 Issue: Should Road Rights-of-Way Be Billed?

6.5.1.4.1 Background:

Road rights-of-way contain large areas of impervious surfaces for streets, sidewalks, and parking. These areas are likely to be large sources of impervious surfaces and therefore large contributors to changes in stream flows and increased streambank erosion and the largest contributor of pollutants to stormwater in the watershed. Ditches associated with roads intercept groundwater and accelerate the velocity of surface water as it moves toward the bay. This increases total surface discharge and peak flows that cause erosion and flooding. These impacts cannot be fully mitigated.

The County road fund currently pays for maintenance and upgrade of the streets. This includes limited maintenance and repair of the streets' drainage system and street sweeping. The need for the drainage system is caused by the need to drain water from street surfaces for public safety of motorists. However, the existing street storm drainage system also conveys runoff from private property.

Since the street funds pay for maintenance of the streets' drainage system there is an issue of whether or not the streets should also be subject to the surface water rate.

RCW 90.03.525 states that counties are authorized to charge the Washington State Department of Transportation for storm and surface water services, at a rate equal to 30 percent of that for comparable real property, and only if the County's streets are also billed. Thus, not billing the County's streets would prevent the County from billing state highways and would result in a loss of revenue to the watershed. Yet, state highways contribute to the watershed's stormwater runoff and pollutants.

Billing the streets creates administrative costs to create the billings and collect the funds. Some persons could view billing the streets as simply shuffling revenues from one pot to another, resulting in increased administrative costs overall. Others point out that not billing roads amounts to a subsidy of automobile use, which is contrary to the goals of surface water management and creates inequity in the rate system.

6.5.1.4.2 Recommendation

Bill County roads and WSDOT highways for storm and surface water services.

6.5.1.5 Issue: Should the Surface Water Revenue be Used to Fund Street Sweeping?

6.5.1.5.1 Background

Street sweeping removes large material from the street surfaces. If not picked up by street sweepers, such large material is typically trapped by catch basin grates or catch basins. The majority of pollutants in stormwater are either dissolved or attached to fine particles and are not collected by conventional street sweepers. Thus, street sweeping with conventional street sweepers provides no measurable benefit to water quality. During a brief period in the fall of each year, leaves can collect on catch basin grates and block them causing street flooding. During this period of time, street sweeping can provide a benefit to the public by removing leaves from catch basin grates and preventing localized flooding. Since the street drainage systems are necessary to provide street drainage, the question remains of why the surface water program should pay for street sweeping. Arguably, a small portion of the costs of street sweeping with conventional street sweepers could be justified for funding by the surface water program.

High-efficiency vacuum type sweepers are now available that pick up fine particles. They have been demonstrated to provide significant benefits to water quality. These units can reduce the annual loading of pollutants from the street system by up to 50 percent. If the goal of the County's street sweeping program is to reduce pollution in stormwater, the County should purchase one of these units. These units are particularly beneficial in industrial and commercial areas and on streets with high traffic volumes where pollutant loadings are higher. The unit could be shared with other watersheds with special water quality sensitivities such as Drayton Harbor or Lake Whatcom.

6.5.1.5.2 Recommendation

The County's road fund should continue funding conventional street sweeping expenses. The surface water revenues should reimburse the road fund for the purchase, operation, and maintenance costs of the proposed high-efficiency street sweeper at such time as this can be justified for multiple watersheds.

6.5.1.6 Issue: Should a Rate Credit Be Offered To Owners of Onsite Drainage Facilities That Meet Current Code Requirements?

6.5.1.6.1 Background

New developments are required to incorporate stormwater treatment and detention facilities to partially mitigate the impacts of the development. As a result, new development has an added expense and creates less impact overall to the County's resources. Owners of property with stormwater facilities believe that they should pay less than owners of properties that have no on-site stormwater facilities, and allowing this credit may increase support for the utility fee.

Onsite stormwater facilities can not completely mitigate the impacts of development. Conveyance facilities are still required, and County programs are still needed to compensate for cumulative impacts of existing and new development. Even new facilities require inspection and water quality monitoring, and education is still needed. Thus, a fee is justified and equitable even for new development with onsite stormwater mitigation facilities.

6.5.1.6.2 Recommendation

At this time, no rate reduction should be offered to owners of properties with an onsite stormwater facility.

6.5.1.7 Issue: Should Differential Rates Be Applied To Address Water Quality Issues?

6.5.1.7.1 Background

A portion of the rate will be used for providing services related to water quality. It is possible to quantify the services related to water quality and identify that portion of the utility rate that is due to water quality services. Certain portions of the watershed or certain land uses within the watershed may require more water quality related services. Those portions of the watershed could have a higher rate based on the increased demand for water quality services.

Creating such a proportionate billing system would create additional administrative costs to develop the rate and track expenditures by category and area. Costs related solely to water quality services are difficult to differentiate from water quantity and aquatic habitat services. Benefits associated with water quality services are also difficult to quantify and very little data are available on this subject.

6.5.1.7.2 Recommendation

Because of administrative complexity concerns, do not adopt differential rates to address water quality issues. Include the cost of water quality services in the basic rate without identifying a proportionate share. Do not differentiate the cost of water quality services from water quantity or aquatic habitat related services.

6.5.1.8 Issue: Should Geographically Differentiated Rates Be Applied if Capital Project Expenses Are Distributed Unequally Throughout the Watershed?

6.5.1.8.1 Background

Some areas of the watershed may require more capital improvements than other areas to address flooding, water quality, or aquatic habitat issues. It is possible to quantify these costs by area and charge some areas more than others to pay for the capital facilities needed to address the respective area. While the demand for capital facilities may be related to the development within the basin, it may also be due to other factors such as when the development occurred and the level of existing infrastructure available to serve certain areas. For example, it may not be fair to charge some areas more just because they have been historically under-served by capital facilities and now require more.

Creating a proportionate billing system would also create additional administrative costs to develop the rate and track expenditures by category and area.

6.5.1.8.2 Recommendation

Do not apply a differential rate based on capital improvement needs.

6.5.1.9 Issue: Should Direct Discharges to Birch Bay Receive a Rate Reduction?

6.5.1.9.1 Background

Properties that discharge directly to Birch Bay have no impact to streams. The reasoning follows that since the property owner is not “using” the system, then the property owner should not have to pay; however, all property owners share in the benefits of a surface water program which provides cleaner water and improves and enhances habitat in the watershed’s streams and lakes

and in Birch Bay. In addition, through direct discharge to the bay the runoff from the site may not be treated and may still create water quality impacts and the need for water quality services.

6.5.1.9.2 Recommendation

At this time, no rate reduction should be offered to owners of properties that discharge directly to Birch Bay. In the future, they should receive the same rate discount, if any, that properties with functioning onsite stormwater detention facilities receive.

6.5.1.10 Issue: Should Low-income Seniors Receive a Rate Reduction?

6.5.1.10.1 Background

Low-income seniors may find additional rates and charges create a financial hardship due to fixed incomes. Imposing additional fees on low-income seniors may generate public opposition to the overall program. Low-income seniors are unlikely to own large properties that create disproportionate impacts to the stormwater system. However, tracking incomes and granting reductions will create an additional administrative cost to the County. The County already has a program offering property tax reductions to low-income seniors.

Properties owned by low-income seniors create the same impacts and demand for services as other comparable properties. The decision to grant exemptions is primarily a social policy issue.

6.5.1.10.2 Recommendation

At this time, no rate reduction is anticipated. This matter should be brought before the County Council for further review.

6.5.1.11 Issue: Should Tax-Exempt Properties Receive an Exemption or Reduction in the Stormwater Rates?

6.5.1.11.1 Background

Some owners of tax-exempt properties, such as public or private schools and churches, will not understand the distinction between taxes and utility rates and may believe that they are exempt from the utility rates. These properties impose demands on the stormwater system, and therefore should be required to pay the utility fee like other users of the system. Granting a credit would violate the fundamental basis of the utility fee, which is a user-based fee. Schools and churches generally have large parking areas and large areas of impervious surfaces. Because of this, they create high peak runoff rates and volumes during storm events. As a result, they place particularly high demand on drainage systems and cause significant degradation of streams and other aquatic habitat. However, schools sometimes provide educational services related to water quality and aquatic resources.

6.5.1.11.2 Recommendation

Do not provide a rate exemption or reduction for tax-exempt properties. Do not provide a rate reduction for schools unless a demonstrated benefit and cost savings to the County can be established.

6.5.1.12 Issue: How Should the County Address Account Delinquencies?

6.5.1.12.1 Background

Based on the experience of other utilities, a small percentage of properties can be expected to become delinquent on stormwater utility payments. This creates an issue for the County. If owners are allowed not to pay, it creates an unfair situation for those that do pay. Options for enforcing collections include foreclosing on the property or terminating utility services for the

property. Terminating stormwater service to an individual property may not be feasible or effective in inducing payment of the rate. Foreclosing on the property can be expensive and time-consuming for the County.

6.5.1.12.2 Recommendation

If neither taxes nor utility fees are paid, the County should foreclose on the property to collect taxes and utility fees. If partial payments are received, the payments should be applied to the utility bills first and any extra should be applied to the taxes. Then, if necessary, the property can be foreclosed to collect the taxes due.

6.5.2 Surface Water Rate Projection

The following draft financial plan was prepared to estimate the rates needed to fund the recommended SWMP through 2012. This draft financial plan is based on the system planning data (ERUs and system growth projections) shown in Section 6.2, revenue requirements described in Chapter 5, and fiscal policy decisions discussed in Section 6.4. In addition to the maintenance and operations (M&O) and capital revenue requirements described in Chapter 5, surface water rate revenue will be subject to a 1.5 percent state tax.

Tables 6-3 and 6-4 show program expense projections and capita improvement plan costs.

Table 6-5 shows the projected surface water rate through 2012 and a calculation of projected rate revenue from single-family residences, other non-residential accounts, County right-of way (ROW), and WSDOT ROW. The projected monthly surface water rate of $7.00 per ERU would be applicable for purposes of this analysis for January 1, 2007, through 2012. As shown in the table, approximately $1,000,000 of revenue would be generated annually in the watershed with a rate of $7.00 per month per ERU.

Table 6-6 is a 6-year cash flow projection, showing sources and uses of surface water funds. Sources of funds include beginning year reserve balances, surface water rate revenue, permit fees, SDCs, and interest income. Real estate excise tax (REET) revenues are not shown. Table 6-6 includes revenues to illustrate the sources of funds used to cover surface water operating and capital expenses.

Uses of funds in Table 6-6 include operation and maintenance expenses, County and state taxes, capital projects, and end year fund balances. The projected 2012 ending fund balance is approximately $1,537,545, which exceeds the proposed reserve balance policy of exceeding three months of operation and maintenance expenses and one-half the average capital improvement budget. Based on this preliminary analysis a lower rate would be feasible or additional capital projects could be completed.

Prior to implementing a surface water rate, it is assumed that the County will identify impervious areas for each non-residential customer. The financial plan should be revised as these impervious areas for non-SFR customers are defined and as the proposed SWMP is refined.

For purposes of this preliminary analysis only, a single rate source was assumed. If a shellfish Protection District is also adopted it would not change the overall amount of revenue available or the overall expenses.

TABLE 6-3. PROGRAM EXPENSE PROJECTIONS

	Projected 2007	Projected 2008	Projected 2009	Projected 2010	Projected 2011	Projected 2012	Total
Administration							
Financial Management	$10,000	$10,300	$10,609	$10,927	$11,255	$11,593	$64,684
Rate Reviews	$0	$0	$0	$0	$0	$0	$0
Oversight/Coordination	$20,000	$20,600	$21,218	$21,855	$22,510	$23,185	$129,368
Billing	$160,000	$10,300	$10,609	$10,927	$11,255	$11,593	$214,684
Regulatory							
Inspection and Enforcement (funded by permit fees)	$0	$0	$0	$0	$0	$0	$0
Source Control	$0	$0	$0	$0	$0	$0	$0
Monitoring	$130,500	$30,900	$31,827	$32,782	$33,765	$34,778	$294,552
Record keeping and annual reports	$10,000	$10,300	$10,609	$10,927	$11,255	$11,593	$64,684
Revise existing regulations (funded by existing sources)	$0	$0	$0	$0	$0	$0	$0
Illicit Connections	$10,000	$10,300	$10,609	$10,927	$11,255	$11,593	$64,684
Operation and Maintenance							
Operations	$20,000	$20,600	$21,218	$21,855	$22,510	$23,185	$129,368
Street Sweeping	$0	$0	$0	$0	$0	$0	$0
Ditch and culvert cleaning and repair	$50,000	$51,500	$53,045	$54,636	$56,275	$57,964	$323,420
Complaint Response	$20,000	$10,300	$10,609	$10,927	$11,255	$11,593	$74,684
Emergency Response	$15,000	$5,150	$5,305	$5,464	$5,628	$5,796	$42,342
Capital Project Review	$0	$0	$0	$0	$0	$0	$0
Planning							
Update Plan	$0	$50,000		$50,000		$0	$100,000
Inventories	$0	$0	$0	$0	$0	$0	$0
Mapping	$0	$0	$0	$0	$0	$0	$0
Management Zones	$0	$0	$0	$0	$0	$0	$0

TABLE 6-3. PROGRAM EXPENSE PROJECTIONS

	Projected 2007	Projected 2008	Projected 2009	Projected 2010	Projected 2011	Projected 2012	Total
Biological Evaluation	$0	$0	$0	$0	$0	$0	$0
Public Involvement and Education	$243,000	$77,250	$79,568	$81,955	$84,413	$86,946	$653,131
							$2,155,602
Total Non-Capital Cost	**$688,500**	**$307,500**	**$265,225**	**$323,182**	**$281,377**	**$289,819**	**$2,155,602**

Note: Some expenses shown beginning in 2007 may in fact be phased in between 2007 and 2009.

TABLE 6-4. CAPITAL IMPROVEMENT PLAN - NOT ADJUSTED FOR INFLATION

Project	Dollar Basis	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
CC-02 Birch Bay Drive Roadway Improvements	2006 $	$0									
CT-06 Drainage Improvements, Cottonwood neighborhood	2006 $					$125,000	$100,000				
Stormwater Inventory Program	2006 $	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
CT-01 Drainage Improvements, Shintaffer at Richmond Park	2006 $						$125,000				
CC-12 Terrell Creek Improvements for Water Quality	2006 $	$50,000									
BR-12 Drainage Improvements, Birch Point	2006 $	$50,000	$150,000		$50,000	$150,000	$215,000				
CC-11 Terrell Creek Culvert at Grandview Road	2006 $	$0					$460,000				
BV-01 Drainage Improvements, Rogers Slough at Birch Bay Drive	2006 $	$0	$50,000	$200,000	$175,000						
Future identified CIP	2006 $	$0	$0	$0	$250,000	$250,000	$250,000				
Total		**$100,000**	**$200,000**	**$200,000**	**$475,000**	**$525,000**	**$1,150,000**	**$0**	**$0**	**$0**	**$0**

TABLE 6-5. PROJECTED RATE SCHEDULE AND RATE REVENUE

	2007	2008	2009	2010	2011	2012
Monthly Rate, $/ERU	$7.00	$7.00	$7.00	$7.00	$7.00	$7.00
Rate Revenue:						
Single-Family Residences	$425,000	$442,000	$459,680	$478,067	$497,190	$517,077
Non-SFR, Excluding Rights-of-Way	$540,000	$561,600	$584,064	$607,427	$631,724	$656,993
County ROW	$55,775	$58,006	$60,326	$62,739	$65,249	$67,859
WSDOT ROW	$0	$0	$0	$0	$0	$0
Projected Annual Rate Revenue	$1,020,775	$1,061,606	$1,104,070	$1,148,233	$1,194,162	$1,241,929

TABLE 6-6. SIX-YEAR CASH FLOW PROJECTION

	2007	2008	2009	2010	2011	2012
Sources of Funds:						
Beginning Balance	$0	$190,095	$701,585	$1,297,378	$1,603,939	$1,947,793
Stormwater Rate Revenue	$1,020,775	$1,061,606	$1,104,070	$1,148,233	$1,194,162	$1,241,929
Permit Fees	$0	$0	$0	$0	$0	$0
SDC Revenue	$0	$0	$0	$0	$0	$0
Real Estate Excise Tax	$0	$0	$0	$0	$0	$0
Interest Income	$15,312	$15,771	$16,244	$16,731	$17,233	$17,750
Total Sources of Funds	$1,036,087	$1,267,472	$1,821,900	$2,462,343	$2,815,334	$3,207,472
Uses of Funds:						
Non-Capital Expenses	$688,500	$307,500	$265,225	$323,182	$281,377	$289,819
Capital Projects	$100,000	$200,000	$200,000	$475,000	$525,000	$1,150,000
Utility 9.5% Tax	$30	$0	$0	$0	$0	$0
State 1.5% Tax	$57,492	$58,386	$59,296	$60,222	$61,165	$62,124
Debt Service	$0	$0	$0	$0	$0	$0
Ending Fund Balance	$195,095	$701,585	$1,297,378	$1,603,939	$1,947,793	$1,705,529
Total Uses of Funds	$1,036,087	$1,267,472	$1,821,900	$2,462,343	$2,815,334	$3,207,472

6.6 Summary of Recommendations

The following recommendations are offered to assist the County in implementing the topics discussed in this section:

- Adopt a sub flood control zone rate to provide revenues to cover the surface water program.
- Complete a public involvement program prior to implementation of the surface water rate.
- Prior to implementing a surface water rate, identify the specific properties that would receive the largest surface water bills, and notify these properties of the key components and milestones of the public involvement program.
- Discuss with the County Council the feasibility of providing a rate reduction for low-income seniors.
- Adopt permit fees that recover the County's expenses associated with permitting, reviewing, and inspection of new development.
- Pursue low-interest loans, such as those from the Public Works Trust Fund and Ecology State Revolving Fund program for eligible capital projects.
- Consider adopting a formal policy dedicating a portion of the County's REET revenues to storm drainage capital projects.
- Prior to implementation of a surface water rate, the County should determine the impervious areas associated with non-SFR properties in order to accurately bill these properties.

7 Recommendations

Several recommendations are made within this Birch Bay Comprehensive Stormwater Plan, summarized below.

7.1 Programmatic Solutions

A Stormwater Management Plan (SWMP) should include the following programmatic elements:

- **Complaint Response:** The public should be provided with a single number to call with complaints regarding drainage, erosion, or water quality issues.
- **Inspections and Identification of Illicit Connections:** An inspection program to detect and eliminate illicit connections should be developed and implemented.
- **Spill Response:** Spill kits should be placed on service vehicles and staff trained in how to identify spills.
- **Regulatory and Policy:**
  - The Stormwater Special District Requirements under WCC 20.80.636 do not specifically require the use of LID techniques. Because of this, new development in the watershed has not been required to maximize LID techniques. Development and adoption of an LID ordinance should be considered.
  - Update Whatcom County Development Standards to meet requirements in 2005 Ecology *Stormwater Manual for Western Washington.* Conduct thorough design review to ensure minimal impacts. Adopt requirements for infiltration and reduced impervious surface and remove regulatory barriers to this.
  - Implement programs and policies to gain compliance with NPDES Phase II. (Birch Bay is not currently required to be covered by the permit, although Whatcom County is.)
  - Encourage local health authorities to identify and correct failing septic systems according to recent legislation. (HB 1458 requires local health authorities to identify and correct failing septic systems by 2012.)
  - Prohibit discharge of pollutants to the stormwater system.
- **Maintenance and Operations:**
  - Conduct inspections and enforcement on existing private developments for proper maintenance of stormwater facilities (detention ponds and treatment) as well as County road drainage systems.
  - Establish maintenance standards according to Chapter 2 of Volume IV of the *Stormwater Management Manual for Western Washington* (Ecology, 2005).
  - Establish maintenance program to ensure inspection and maintenance frequency suggested in the NPDES Phase II Draft permit.

  - Document all inspections and maintenance activities. A database should be created/kept showing all historical maintenance and rehabilitation/repair activities conducted at a site or on a specific drainage infrastructure element.
  - Upgrade M&O equipment and increase drainage crews as necessary to meet increasing maintenance demands.

- **Education:** Educate residents and staff on proper practices to reduce discharge of pollutants to the stormwater system; change behavior patterns by increasing understanding of cause and effect of actions taken.
- **Public Involvement**: Involve residents in watershed activities to promote water quality, source controls, etc.
- **Monitoring**: In accordance with the NPDES permit conditions, develop a coordinated monitoring program. Since the primary water quality issue in the watershed is coliform bacteria, monitoring should be focused on that.
- **Record-Keeping and Annual Reporting**: The NPDES Phase II draft permit requires keeping records of all activities, including SWMP development and implementation, number of inspections and enforcement actions, and educational activities.

Whatcom County has previously implemented most or all of these recommendations at one time or another in various locations in the county. Therefore, these actions could be implemented as an extension of existing activities or programs.

Significant resources should be dedicated to identification of sources of bacteria contamination in Birch Bay that has led to shellfish restrictions. The following actions should be undertaken:

- Inspect pump-out facilities and coordinate with marina owners to develop a system of inspecting all boats in the marina. Boats should be inspected to assure that discharge valves for holding tanks are closed and waste is not discharged to the water.
- Conduct periodic inspections of trailers and RVs to require proper disposal of holding tank wastes.
- The Birch Bay Water and Sewer District should sustain an annual inspection program to detect and eliminate exfiltration and leakages from their pipe system. This may include dye tests.
- The Whatcom County Health Department recommends that homeowners have their septic tank and drainfield inspected yearly and septic tank pumped once every 3 to 5 years. The Public Works Department should coordinate with the Health Department to develop a program of onsite sewage system inspections at least once every 5 years.

7.2 Structural (Capital) Solutions

The structural projects outlined in this Birch Bay Comprehensive Stormwater Management Plan should be included in the 6-year Whatcom County Capital Improvement Program. These projects include the following:

- Drainage Improvements, Cottonwood Neighborhood

- Drainage Improvements, Shintaffer at Richmond Park
- Terrell Creek Improvements for Water Quality
- Drainage Improvements, Birch Point, Various Locations
- Terrell Creek Culvert at Grandview Road
- Drainage Improvements, Rogers Slough at Birch Bay Drive

7.3 Funding

Chapter 6 discussed funding mechanisms and projected needs. The recommendations outlined in Chapter 6 are summarized here:

- Adopt a sub flood control zone rate to provide revenues to cover the surface water program discussed in Chapter 5.
- Complete a public involvement program prior to implementation of the surface water fee.
- Prior to implementing a surface water fee, identify the specific properties that would receive the largest surface water bills, and notify these properties of the key components and milestones of the public involvement program.
- Discuss with the County Council the feasibility of providing a rate reduction for low-income seniors.
- Adopt permit fees that recover the County's expenses associated with permitting, reviewing, and inspection of new development.
- Pursue low-interest loans, such as those from the Public Works Trust Fund and Ecology State Revolving Fund program, for eligible capital projects.
- Consider adopting a formal policy dedicating a portion of the County's REET revenues to storm drainage capital projects.
- Prior to implementation of a surface water rate, the County should determine the impervious areas associated with non-SFR properties in order to accurately bill these properties.

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Appendix A

Birch Bay Comprehensive Stormwater Plan, Summary of Public Workshop 1

PREPARED FOR: Roland Middleton, Whatcom County

PREPARED BY: Bill Derry, CH2M HILL
Amy Engstrom, CH2M HILL

DATE: January 5, 2006

On October 1, 2005, Whatcom County held a public workshop to solicit input on stormwater quantity and quality problems in the Birch Bay area for a Comprehensive Stormwater Plan. This Workshop Summary presents the workshop agenda, summarizes the comments made during the workshop, and identifies actions to be taken during preparation of the Comprehensive Stormwater Plan to address the stormwater problems identified in the workshop.

Workshop 1 Agenda

9:00 Introductions, purpose, emergency exits, review agenda

9:05 Background presentation

Overall goal of stormwater plan

Premise of beachfront lifestyle

High shellfish and stream value

Growth

Expected product

Overall plan schedule

9:20 Small group "mind map" exercise to define issues by neighborhood,

Explain exercise and rules of brainstorming

9:50 Discuss results at table and identify key issues for each category (water quantity, water quality, habitat and others)

10:10 Neighborhood groups report to whole group

10:40 Break

10:50 Science background presentation

11:05 Neighborhood groups identify specific list of opportunities; how far is your neighborhood willing to go to protect streams and shellfish? (Reduce density, replace forest, increase stream, wetland and shoreline buffers, cluster development, leash laws, confine cats, confine livestock, others?)

11:50 Next steps

Committee meetings

Community field work

Technical studies

Develop draft plan

Public workshop

12:00 Adjourn

Replace chairs and clean-up

Workshop participants filled out comment forms at the meeting and submitted email comments afterward. Workshop participants were residents of the following neighborhoods:

- Birch Point
- Birch Bay Village
- Hillsdale
- Central Reaches
- Central Uplands
- Point Whitehorn
- Cottonwood Reach
- Terrell Creek
- State Park Reach
- Lake Terrell

The neighborhood of West Cherry Point will also be covered in the stormwater plan, but no residents of this neighborhood submitted comments. There are no residences within the West Cherry Point area.

Summary of Comments

This section summarizes the problem statements submitted by the workshop participants and some additional issues identified by reviewing maps of the area. The problems from the workshop related to both water quantity and water quality issues. Several specific comments were made that pertained to localized water quantity issues, including lack of conveyance capacity in the existing drainage system and erosion caused by excessive stormwater runoff velocities and volumes. Other comments pertained to water quality issues such as high numbers of waterfowl and the application of pesticides on large tracts of land. Lack of stormwater conveyance capacity was the most common type of problem

identified, followed by inappropriate stormwater management causing erosion and sedimentation. A complete catalog of the comments received is provided in Table 1.

Next Steps

This list of problems identified during the public workshop will provide a starting point for field investigations. Problems will be documented in greater detail, and locations will be verified. This list may be expanded during field efforts as other related and unrelated problems and concerns are identified. As the list of identified problems grows, efforts will be made to group problems by common cause or type of cause in order to build a solid set of alternatives to alleviate the problem(s).

TABLE 1
Problems Identified at Public Workshop

Problem No.	New Development	Habitat	Water Quality	Drainage, Flooding	Site, Ditch Erosion	Bluff Erosion, Stability	Streambank Erosion	Policy and Planning Issue	Problem Description
Birch Point									
BR-01	x		x						Horizons is putting a regional stormwater detention system. Quantity – no percolation. Quality – needs improvement.
BR-02				x	x				Cory Lane ditches are full. Piping system is overwhelmed. Flooding over Oertel Drive occurred prior to clear cuts (2004) and after and may continue. Road is eroding.
BR-03				x					Trillium clearcut has resulted in greater stormwater runoff into Semiahmoo Bay. Retention ponds may help, but lower piping may not be adjusted.
BR-04					x				Residents are clear-cutting high banks and cutting paths for water access, disposing yard waste into ditches and water.
BR-05	x x x x			x x ? ?					Management of clearcuts and subsequent clearcuts has impacted hydrology of Birch Point: – Water migrates in new ways and greater quantities – Water is under the vapor barriers beneath houses – Retention ponds release to ditches on Semiahmoo Drive, then to drain pipes and to salt water.
BR-06				x					Glacial marine drift blocks water flow, creates surficial aquifers, a challenge to water management.

TABLE 1
Problems Identified at Public Workshop

Problem No.	New Development	Habitat	Water Quality	Drainage, Flooding	Site, Ditch Erosion	Bluff Erosion, Stability	Streambank Erosion	Policy and Planning Issue	Problem Description
BR-07			x	x					Impacts to Birch Bay Village (BBV) by water coming from Birch Point: – Golf course flooded with overflow from Birch Pt Rd and Selder Rd – Water quality of lakes in BBV
BR-08								x	Need regional stormwater detention working with Blaine.
BR-09								x	Expand the plan to cover area all the way to City of Blaine border.
BR-10						x			(identified from workshop map) Slope stability all along Birch Point.
BR-11								x	(identified from workshop map) What ROW does County have/own? Could this be a regional outfall opportunity?
BR-12		x							(identified from workshop map) Pockets of existing wetlands must be protected.
Birch Bay Village									
BV-01				x					Rogers Slough health/condition is of great concern. Present drainage into slough from slopes above is problematic. The proposed new housing project off Selder Rd should not be allowed to drain into the slough, but should drain directly to the bay.
BV-02		x	x						Beaver pond – impacted by Skeenaway BBV continual auto repair, suspect leaks of oil and/or fuels; habitat destroyed by flooding
BV-03				x					There is major flooding with winter storms – big ponds of standing water form, deep enough and wide enough

TABLE 1
Problems Identified at Public Workshop

Problem No.	New Development	Habitat	Water Quality	Drainage, Flooding	Site, Ditch Erosion	Bluff Erosion, Stability	Streambank Erosion	Policy and Planning Issue	Problem Description
									for many ducks.
BV-04			x						Water samples have contained high levels of fecal coliform at mouth of marina
BV-05			x						The stream in Birch Bay Village has increased water flow that is very muddy.
BV-06			x						Muddy water and pollution from lakes is draining into BBV marina. Water from lakes and marina should be tested for fecal material and pollutants.
BV-07			x						Sediment in the bottom of the marina indicates extensive flow of muddy water over time.
BV-08			x						Creosoted logs collect on BBV beaches and pollute the bay.
BV-09								x	New development will reduce rainwater percolating into the ground and increase stormwater runoff into Birch Bay.
BV-10		x		x					There are several contamination sources from upper levels in connection with clay soil that doesn't allow absorption, with heavy runoff in winter months.
BV-11		x							There are algae blooms in ponds/lakes from geese fecal matter and fertilizer.
BV-12						x			Movement of sediment from tides in bay impacts marina.
BV-13	x							x	Coordinate long and short term planning for Highlands as they develop around BBV

TABLE 1
Problems Identified at Public Workshop

Problem No.	New Development	Habitat	Water Quality	Drainage, Flooding	Site, Ditch Erosion	Bluff Erosion, Stability	Streambank Erosion	Policy and Planning Issue	Problem Description
BV-14				x					Flooding has increased in last 5 years.
BV-15				x					Village recommends reroute along Birch Pt Rd with new culvert under Birch Pt Rd Loop to alleviate flooding
BV-16	x		x						(identified from workshop map) Large burn piles from Trillium clearcut input phosphorus/ash to runoff.
BV-17				x					(identified from workshop map) Identified several areas of flooding.
BV-18				x					(identified from workshop map) Identified locations of cross culverts in BBV.
BV-19	x								(identified from map) Identified proposed development.
BV-20						x			Tide is eroding beach at BBV bluff
Hillsdale									
HS-01				x					Drainage into Birch Bay starts 2 miles north at Lincoln Rd; soils appear to be very shallow layer of sand and loam over heavy clay. Indigenous growth is critical to slowing surface velocity; retention ponds may not be as effective.
HS-02				x					In the winter of 2003-2004, Harborview Rd frontage ditch overflowed for the first time in 23 years.
Cottonwood Reach									
CT-01				x					Several photos were supplied showing examples of flooding and drainage concerns in this neighborhood
CT-02			x						Yard waste dumped into the ditch.

TABLE 1
Problems Identified at Public Workshop

Problem No.	New Development	Habitat	Water Quality	Drainage, Flooding	Site, Ditch Erosion	Bluff Erosion, Stability	Streambank Erosion	Policy and Planning Issue	Problem Description
CT-03			x						Yard waste put into old wood catch basin.
CT-04			x	x					Manholes on the culverts at old wooden catch basin are not cleaned out.
CT-05			x x x						– Large numbers of Canada geese are present late summer through winter, leaving lots of fecal matter – Increasing numbers of brant are present in early spring – Neighbors park on beach berm – Residents throw yard waste into bay – Invasive species of grasses are now on the tide flats – coming from the BBV marina?
CT-06				x					Water is coming off the hill (Fern Lane) behind Halverson Lane. The County did some ditch work on Fern a couple of years ago but properties below are still having lots of water, especially after hard rains. The hill is pretty much solid clay, so the water seeps down through the layers like little streams.
CT-07				x					Drainage ditch along Shintaffer diverts through two 90-degree turns through Richmond Park. A wetland also feeds into this drainage. Area near the park backs up during significant rain – the excess water backs up onto homes and overflows

TABLE 1
Problems Identified at Public Workshop

Problem No.	New Development	Habitat	Water Quality	Drainage, Flooding	Site, Ditch Erosion	Bluff Erosion, Stability	Streambank Erosion	Policy and Planning Issue	Problem Description
									drainage areas within the park.
CT-08	x								The hillside is being engineered for stormwater from Horizons. Call Craig Parkinson at David Evans Assoc. 647-7151.
CT-09			x						(identified from workshop map) Yard waste areas
CT-10				x					(identified from workshop map) Areas of flooding because of broken culvert/pipe
Central Reaches									
CR-01				x					Broken flood gate needs repair/replacement.
CR-02			x	x					Units are flooded with heavy runoff in winter. There are only 11 people that live there during winter – why is stormwater mixing with sewer?
CR-03				x					Runoff from Seabreeze (?) through pipe down to Lora Lane.
CR-04				x					Retention pond overflows.
CR-05			x						– Large pipe drains onto beach, lots of algae. Where is water coming from? Nutrients? – Sewer backs up into bottom units when it rains. – Bank in back of Mariners Cove seeps water. New condos going in on top of bank.
CR-06				x					Culvert became blocked in 2002, causing flooding of low area toward Alderson. Standing water remains for weeks.
CR-07	x								New construction impacts.
CR-08				x					Where Alderson Rd ends at Beach

TABLE 1
Problems Identified at Public Workshop

Problem No.	New Development	Habitat	Water Quality	Drainage, Flooding	Site, Ditch Erosion	Bluff Erosion, Stability	Streambank Erosion	Policy and Planning Issue	Problem Description
									and Birch Bay Drive, when extreme high tides meet the creek at the road, it causes flooding.
CR-09			x						RV housing 6 dogs is parked on bank of Terrell Creek south of bridge at Alderson Rd.
CR-10						x			East, uphill, on Alderson Rd from Birch Bay Drive, hill is severely destabilized (many cracks indicating slippage)
CR-11								x x x x	Governance: – Enforcement! – Lines of communication, how to file a complaint – Tree retention, limits on impervious surface – Willingness of County to accept new ideas – developers are discouraged from using low-impact development (LID) for road construction
Central Uplands									
CU-01				x					Lack of regular maintenance leads to periodic flooding emergencies
CU-02			x						Lack of golf course maintenance; rumors are that trash has been dumped in the unmaintained golf course ponds.
CU-03	x			x					Pond overflows onto Sealinks Drive at entrance gate to Sealinks, flows west on North Golf Course Drive flooding cul de sac.
CU-04				x					Pipe drains the entire area all the way

TABLE 1
Problems Identified at Public Workshop

Problem No.	New Development	Habitat	Water Quality	Drainage, Flooding	Site, Ditch Erosion	Bluff Erosion, Stability	Streambank Erosion	Policy and Planning Issue	Problem Description
									back to the fire house near Blaine Rd. (?)
CU-05	x			x					Three storm ponds reach capacity early in the season. Pond on the corner of Bay and Jackson flows into tributary to Terrell Creek on south side of bay. The other 2 ponds flow into ditch along Key St that empties into ditch on Jackson. Culvert takes water under Jackson and directly to Terrell Creek.
Terrell Creek									
TC-01			x	x					Muddy/silty stormwater drainage from site. Retention ponds should be monitored to make sure they are operating properly.
TC-02				x					Flooding
TC-03			x						BP discharges stormwater to Terrell Creek
State Park Reach									
SP-01			x						Animals may be degrading water quality (Ducks on northern edge of park).
SP-02			x x x x x						– Chlorine from emptying pool and hot tubs drains into Terrell Creek – Fertilizers – Weed killers – Motor oil – Are the two outfalls filtered before emptying into Terrell Creek?
SP-03		x							Creek flow needs to be increased in summer.
SP-04				x					Outfall needs to be checked.

TABLE 1
Problems Identified at Public Workshop

Problem No.	New Development	Habitat	Water Quality	Drainage, Flooding	Site, Ditch Erosion	Bluff Erosion, Stability	Streambank Erosion	Policy and Planning Issue	Problem Description
Point Whitehorn									
PW-01						x			Slides, ground subsidence along edge of point; slides along the cliffs – at least 11 over the past few years. Large historic slide occurred on Celia Dr after sewer lines installed in the 1980s. Numerous since then.
PW-02						x			Several sites of changing steepness slopes or sinking of land around homes on edge of cliff.
PW-03				x					Drainage pipes not uniformly connected to curtain drains. Several houses have standing water in front after rains. There is a lot of seepage along Whitehorn Way.
PW-04				x					Impacts of massive tree loss – old Trillium property had numerous trees and wetlands, now are fields. Water is pooling.
PW-05				x					Point Whitehorn had a small lake, a stream, and a gravel pit that are no longer apparent but contribute to runoff problems.
PW-06			x	x					Ditch is used as garbage and yard waste dump. Blocks the ditch.
PW-07				x					Permitting problem: new building permit calls for onsite downspout management and the use of a bioswale to manage runoff instead of tight-line drainage; swale will overflow in a heavy rain.
PW-08			x						Broad use of herbicides and other chemicals near drainage to bay.
Lake Terrell									

TABLE 1
Problems Identified at Public Workshop

Problem No.	New Development	Habitat	Water Quality	Drainage, Flooding	Site, Ditch Erosion	Bluff Erosion, Stability	Streambank Erosion	Policy and Planning Issue	Problem Description
LT-01								x	BP has done wetland enhancement work along Terrell Creek and has stormwater data that may be useful. (info from Melissa Stoddard at BP Environmental Group, 371-1500)
LT-02	x								Subdivisions of property have increased greatly in the past 5 years along SR 548 and near Lake Terrell.
West Cherry Point									
--									No comments/problems submitted.

Appendix B

Birch Bay Comprehensive Stormwater Plan, Problem/Issue Identification

PREPARED FOR: Roland Middleton, Whatcom County

PREPARED BY: Bill Derry, CH2M HILL
Amy Engstrom, CH2M HILL

DATE: July 7, 2006

Introduction

This technical memorandum is one element of an overall Comprehensive Stormwater Plan for the watersheds of Birch Bay. Birch Bay is a rapidly growing community that is experiencing increasing flooding and erosion, declining water quality, and loss of aquatic habitat. Historically, Birch Bay has been primarily a recreational beach community. The citizens of Birch Bay completed a Comprehensive Land Use Plan that called for low-impact development (LID) and a Stormwater Plan to protect their lifestyle and aquatic resources while accommodating the anticipated growth. This Comprehensive Stormwater Plan recommends measures to achieve these goals.

The problem/issue identification task involves identifying drainage problems, water quality problems, and problems with aquatic habitat. Drainage problems can include erosion, flooding, and sedimentation. Water quality concerns revolve mainly around fecal coliform bacteria from point and nonpoint sources. Aquatic habitat degradation can be caused by physical alteration through development or other means.

Sources of Data

The following sources of information were used to identify stormwater issues and problems in the Birch Bay area:

- Information from the Washington Department of Ecology (Ecology), Whatcom County, The Birch Bay Steering Committee, the Washington State Department of Health (DOH), and the Nooksack Salmon Enhancement Association (NSEA)
- Studies and reports from previous work conducted in and around the Birch Bay area, including:
  - *Point Whitehorn to Birch Bay State Park Shoreline Reach Analysis, Whatcom County, Washington, Final Report* (Coastal Geologic Services, 2003)
  - *Birch Bay Shoreline Improvement Plan and Conceptual Design, Draft Report* (Philip Williams and Associates, 2002)
  - *Birch Bay Sub-Area Plan, Birch Bay Community Plan Steering Committee* (Kask Consulting, 2004)

- Public Workshop 1, which provided a detailed list of problems identified by local area residents (a workshop summary is provided in Appendix A)
- Correspondence from local area residents reporting continuous issues/problems or wet-weather-specific problems
- Field visits conducted by Whatcom County, CH2M HILL, and local area residents

Lists of problems identified in Public Workshop 1, during field work efforts, and by residents and others via correspondence in the weeks and months following Public Workshop 1, along with problems identified in previous studies and historical information, were combined into a master list included in this memorandum.

Description of Problem Types

The following types of stormwater management issues are identified in this memorandum:

- Water quantity
- Water quality
- Aquatic habitat

Drainage and flooding are examples of water quantity issues. Bluff erosion and stability issues are often caused by increased volume and velocity of runoff and are therefore included as water quantity issues.

Water quality issues may include point source pollution such as stormwater runoff containing a large concentration of suspended sediment discharging from a construction site, or nonpoint source pollution sources such as large numbers of pets, birds, and/or wildlife.

Aquatic habitat in local streams, wetlands, and nearshore areas can be physically altered. These physical alterations could include limited access due to road culverts or channelized sections of creek, each of which is problematic. Habitat can be physically altered by changes in stream flow as a result of clearing and the construction of impervious surfaces.

In addition to the water quantity, water quality, and aquatic habitat problem types, several problems identified by citizens refer to policy and planning issues or generally relate to new development. These problems are also discussed here.

Problems Identified

A total of 27 different water quantity problems were identified by citizens, through field investigations, through conversations with others, or in historical studies. Sixteen water quality problems and six aquatic habitat problems were also identified. Tables 1, 2, and 3 contain a summary of water quantity, water quality, and aquatic habitat problems identified in the Birch Bay area.

The water quality problems are identified in this memorandum by sets of codes: one set for problems the Public Workshop, and another set for problems identified either during field work activities or via correspondence from residents after the workshop. For the workshop-

identified problems, the comment codes are associated with the neighborhood in which the problem was identified. Many of the problems identified during Public Workshop 1 overlapped with or were also identified in field work efforts, or were reported as being problematic during wet-weather events experienced in the months following Workshop 1. Therefore, many of the problems listed in Tables 1, 2, and 3 have more than one comment code listed. For simplicity, the problems listed in the text below are referred to by only one code, the Workshop 1 code shown in bold in Tables 1, 2, and 3, as listed in the tables. The numbering system associated with the code should not be taken as an attempt to prioritize or rank the problems. Not all of the problems identified by the citizens have been extensively investigated, and some of the suggested causes may be inaccurate or incomplete.

For the problems identified either during field work activities or via correspondence from residents after the workshop, the assigned code is in the format CC-01. The neighborhood code for Birch Point is BR. The codes for Birch Bay Village, Hillsdale, and Cottonwood are BV, HS, and CT, respectively. The code for the Central Reaches is CR and the codes for the Central Uplands, Terrell Creek, and State Park Reach neighborhoods are CU, TC, and SP. The code for Point Whitehorn is PW and the code for Lake Terrell is LT.

The identified problems are discussed in the subsections below, grouped in the following categories:

- Water quantity problems
- Water quality problems
- Aquatic habitat problems
- Policy/planning issues

Water Quantity Problems

Water quantity challenges in the Birch Bay watershed can be categorized primarily in three groups, as follows:

- Low lying areas along the beach: There are extensive low and flat areas behind the natural dune of the beach. Even without development, these areas were likely inundated during extreme high tides and high wind conditions. Many of the areas that now have homes and roads were once large, natural wetlands. Development has increased runoff and in some cases may have blocked natural flow paths.

- New development: The watershed is experiencing rapid development particularly near the beach. New development is increasing the peak rate and volume of runoff even with onsite detention, resulting in increased downstream flooding and erosion. Existing standards and/or review procedures may need to be improved to reduce the impacts of new development.

- Bluff erosion: There are examples of slides all along the bluffs at both the south and north ends of Birch Bay. Beach erosion and slides along bluffs are natural events, but their occurrence may be accelerated by stormwater that is routed over the bluffs or if additional water is infiltrated near the bluffs from either stormwater or septic tank drainfields.

Many of the problems identified by citizens may be problems caused by individual property owners affecting themselves or other individual property owners. Such problems are often not the responsibility of the government but the responsibility of the individual property owners to resolve. For example, a property owner who routes rooftop runoff over the edge of the bluff would be responsible for the cause of and resolution to any damage to their own property.

Localized flooding problems are a primary water quantity concern of Birch Bay residents. Bluff erosion and hillside stability are also important and relevant concerns. Table 1 contains a listing of the 27 individual problems identified within the Birch Bay area pertaining to drainage, flooding and/or slope erosion/stability issues. Each of these problems is described here.

Water Quantity Problems Identified from the Literature

No water quantity problems were identified from the literature.

Water Quantity Problems Identified by Citizens

BR-02

Drainage issues have been reported along Semiahmoo Drive and across much of the Birch Point area. The ditches along Cary Lane tend to fill with material that then reduces conveyance capacity. The capacity of the stormwater conveyance system was exceeded in both December 2004 and January 2006. The outfall pipe at 8741 Oertel Drive became plugged and blew out at the lower end in December 2004, most likely because of accumulated debris.

The ditch along the southern section of Oertel drive has filled in over a several-year period, which diminishes conveyance capacity. Residents are clear-cutting high banks and cutting paths for water access; Recently, Whatcom County Department of Public Works has cleared out and deepened the channel, which has helped the problem.

In December 2004, water was reported underneath the vapor barrier at the home at 8710 Oertel Drive. There have been no other reports of this occurring.

The natural hydrology in the Birch Point area has been altered such that now stormwater runoff is conveyed through culverts and ditches. Loss of vegetation has increased volumes of runoff and peak flows. Ditch construction has channelized the system and promoted higher runoff velocities and greater volumes of runoff. Roadside ditches intercept both surface water and subsurface flow (groundwater) all along their length, adding volume to the drainage flows. Ditches also accelerate velocities of runoff because they are straight and relatively smooth. Figures 1 and 2 show examples of the current drainage infrastructure across and near the roads in the Birch Point area.

The subsurface geology of the area consists of clay and hard-packed marine sediments. Infiltration capacity is limited because of this. Drainage issues are therefore more pronounced because the soil is less forgiving. This is true throughout the Birch Bay area, but particularly in the northern half where marine soils predominate.

BR-03

A low point exists in road and ditch system near 8621 Semiahmoo Drive near the bend in the road. Two detention ponds (one from the north, one from the south) overflow to the County road ditches here. The ditches converge at this location and flow through a culvert into a ditch along the south property line of 8621 Semiahmoo Drive.

In December 2004, these ditches were overwhelmed and the outflow pipe was destroyed. Trillium Corporation and the Washington State Department of Natural Resources (DNR) replaced the outfall pipe with 24-inchplastic pipe. The resident built a concrete collector to channel flow to the outfall. January 2006, the problem happened again. Many cubic yards of material were eroded away during this event.

BR-05

Increased flows and velocity cause drainage problems along Normar Place off of Semiahmoo Drive. A ditch/outfall pipe is located along the south property line of a homeowner living along Normar Place. The ditch has eroded and sent rocks and mud down the half-pipe into the junction box. The box plugged up and caused a geyser effect (December 2004). The ditch/open channel outfall along the south property line was overwhelmed. The resident placed sandbags to prevent major damage.

This drainage begins at detention ponds on upslope Trillium property that flow into road ditches, and then through a cross-culvert under Semiahmoo Drive and down to the outfall ditch.

Drainage problems have occurred at Hogan Drive, a street with 5 or 6 homes just north of Normar Place along Semiahmoo Drive. Home owners have reported stormwater runoff from County Road ditches that has overtopped the road and flowed down to the homes. Residents have noted that the frequency of these drainage issues has increased. This area is not connected via roadside ditches to the detention ponds on Trillium property.

BR-11

Near the Semiahmoo Drive and Birch Point Road intersection, two detention ponds from Trillium Property flow south in a County road ditch to a cross-culvert under the road. During events in 2004 and 2005, the ditches overflowed and covered the roadway. Residents reported nearly a foot of water over roadway during each of these events.

David Evans and Associates has been investigating each of the drainage courses from the Trillium property to the beach to identify potential capacity, erosion, and slope stability issues. Information will be incorporated when it becomes available.

BR-10

Slope stability is a problem all across the bluffs of Birch Point. Natural processes have been accelerated by increased runoff velocities and volume due to removal of vegetation, the installation of septic tank drain fields, and the construction of impervious surfaces and channelized ditches. Construction of roadways and roadside ditches has altered the surface and subsurface flow. Subsurface flow in the upper portion of soil is intercepted by roadside ditches and is conveyed more quickly and in more concentrated amounts than if the roadway and roadside ditches had not been there. Surface flow is conveyed in cross-culverts and roadside ditches, then flows towards Birch Bay in concentrated flow streams that promote erosion and stability problems.

The westernmost portion of the area at and north of Birch Point itself is a geologically unique area. This portion of Birch Point is a groundwater recharge area where the overlying area is not perched and therefore contributes surface water to the shallow and deep groundwater flow. Land use activities in this contributing area have a great impact on the subsurface flows. Removal of trees and tree stumps has increased the subsurface flows in the area. This increase in subsurface flow has been experienced by residents living along the edge of the steep slopes, who have witnessed increased seepage and groundwater flow underneath their homes and out the sides of the slopes. Increases and changes in subsurface flow can affect the rate of slope movement and increase the risk of landslide action.

BV-01

Drainage ditches discharging to Rogers Slough back up behind the tide gate under high tide and/or wet weather conditions. When these ditches overflow, backyard flooding will occur in the homes within Birch Bay Village that have backyards along Birch Point Road. Ditches also back up along the north side of Birch Point Road. Figure 3 and Figure 4 show the full ditches on both sides of the road on a dry day during January 2006.

Questions have arisen on who is responsible for operations and maintenance of tide gates in the Birch Bay area, including this tide gate near Rogers Slough. Property ownership and locations of street rights-of-way need to be determined, as do operations and maintenance responsibilities for tide gates.

CC-01

Trees and other debris build up within and along the shore of Rogers Slough due to wave action and nearshore currents. Residents have stated that this material prevents adequate drainage and contributes to the localized flooding issues. According to residents, the County had just recently cleared away this material (in early March 2006), which has allowed for more timely drainage of the area. Residents say that this clearing would need to be performed on a regular basis, possibly yearly, to prevent future issues.

Trees and other debris also accumulate on Birch Bay Village beaches and on Cottonwood Beach, also because of natural wave action and nearshore currents.

BV-02

According to residents, drainage issues occur within Birch Bay Village during larger wet-weather events that occur under already-saturated conditions, mainly in the winter. Big ponds of standing water have been reported at various locations within Birch Bay Village.

BV-20

Citizens have reported that the beach at Birch Bay Village Bluff is eroding. It is possible that this is due to wave and rainfall erosion, tidal fluctuations, and naturally occurring sediment transport with the currents. It is also possible that this has been accelerated by human activity.

HS-02

In the winter of 2003-2004, the frontage ditch along Harborview Road overflowed for the first time in 23 years. This may have been due to lack of maintenance, with materials blocking ditch and culvert outlets. Residents have reported flow conveyance a problem if maintenance not performed.

CT-01

The drainage ditch flowing south along the West side of Shintaffer Road conveys runoff from a large area that stretches west and north of Lincoln Road. The ditch along the west side of Shintaffer flows through two 90-degree bends that divert the runoff from the drainage ditch along Shintaffer (off to the left in the picture) towards the Richmond Park Subdivision. Yards in the subdivision are submerged during heavy rains as the system backs up. Figure 5 shows the view to the north across the northern edge of the Richmond Park Subdivision and into the field. Figure 6 shows the drainage ditch along Shintaffer Road across the road from the Richmond Park Subdivision under flooded conditions.

After flowing through the Richmond Park subdivision, the drainage enters an open channel creek system that flows southward towards Birch Bay. The creek runs underneath Fawn Crescent and alongside Deer Creek Trail, two streets in the neighborhood with access from Birch Bay Drive. The system enters a culvert underneath Birch Bay Drive, then enters the bay. The culvert is approximately 400 feet to the east of the tide gate at Rogers Slough and about 300 feet to the west of the intersection of Shintaffer Road and Birch Bay Drive. Rogers Slough is the outlet point of the culvert and outfall. Several hundred feet of slough separate the outlet of this culvert from the primary drainage path in the central part of the slough.

The culverts through the subdivision appear to be undersized for the flows that enter the system. However, simply increasing the size of these culverts will not solve the problem. The open channel creek system downstream of the subdivision is in a ravine with situated homes close together that may be negatively impacted if runoff flow rates and volumes are increased.

Localized drainage issues have also been reported in the lots on the east side of Shintaffer. The ditch along the east side of Shintaffer drains the area east of Shintaffer Road and south of Lincoln Road and flows south along Shintaffer then enters Birch Bay. Adequate drainage is no longer achieved out of the ditch along Shintaffer on the east side of the street. Runoff backs up within the ditch and drains slowly out to the south along the east side of the street.

According to Whatcom County Maintenance and Operations (M&O) staff, no cross culverts connect the west and east sides of Shintaffer near the Richmond Park subdivision. However, the drainage issues on the different sides of the street may be related hydrologically.

CT-06

Flooding problems occur in the Cottonwood subbasin that discharges to Birch Bay along Birch Bay Drive near Cedar Road. Recent documented occurrences were on 1/11/06 and 1/29/06. The runoff from a large contributing area flows through a culvert under Anderson Road, in an open channel through the County-owned park, then in a pipe and through a diversion structure leading to two outfalls discharging to Birch Bay at Cottonwood Beach.

Two different outfalls provide the outlet for this area. These two different outfall pipes receive flow from the same location: a single diversion structure that channels runoff into the two outfalls from a single entry point. This diversion structure is no more than a “hole” that has one incoming pipe and two outgoing outfall pipes. This hole is located behind the home at 8208 Birch Bay Drive. The hole receives flow through a culvert and pipe system that flows underneath Cedar Road from an upstream open channel creek system. Residents

report that the creek drainage leading to these two outfalls was once a seasonal creek that now flows year-round.

Of the two different outfall pipes, one pipe heads to the west into Birch Bay along a County easement to the south of the residence at 8208 Birch Bay Drive. The second pipe (to the north of the first) flows west into Birch Bay through private property to the north of the residence at 8210 Birch Bay Drive. This second pipe exits the hole slightly higher than the first, acting as a relief system for the first outfall. This second outfall pipe is concrete and reportedly in multiple pieces along its length.

When the outfall pipe(s) are clogged or otherwise blocked or under extreme high tide conditions, the hydraulic head builds up and may create a backwater condition in the closed-pipe system. Figure 7 shows the hammerhead-type outlet structure of the northern outfall, and Figure 8 shows flooding that has occurred in the area. According to local residents, the lack of regular maintenance may lead to periodic flooding emergencies throughout Birch Bay. In both the January 2006 cases, the outfall had been obstructed by accumulated material that contributed to the drainage issues.

Since the more northern outlet pipe is in pieces, stormwater runoff may be exfiltrating into the surrounding soil. Yard flooding in the area may be the result of this exfiltration. Drains from the houses on both sides tie into this northern outfall pipe. The neighbor to the north at 8212 Birch Bay Drive has a drain tying into this outfall pipe with a flap gate on it to prevent backflow. The resident to the south at 8210 Birch Bay Drive has a perforated pipe leading to the pipe. The resident at 8214 also has a yard drain leading into this same pipe.

These areas along Birch Bay are at low elevation and are near sea level during extreme high tides combined with periods of high winds. Much of this area sits behind and lower than the area right at the shoreline. This "dune effect" may cause drainage issues as the water pools in the lower areas behind the beach berm. In addition, it is also possible that these areas have subsided due to compaction from development and from the removal of natural processes that add sediment and organic matter to the soils. Further analysis is needed to clarify this. Poor drainage conditions exist in this area. Overland flow occurs here because of increased impervious areas and existing development in low areas. Infiltration is also limited due to soils.

During storms and/or high tide conditions, subsurface flow could be a factor in yard flooding. The soil cover in this area contains sand and larger beach cobbles yielding high subsurface flow rates. If groundwater levels are near the surface, there is nowhere for stormwater runoff to go.

CC-02

Citizens have reported erosion of roadway and supporting material at two to three locations along Birch Bay Drive to the south of Cottonwood Beach. In at least one of these locations, the actual road surface has been affected. Pedestrians and bikers can no longer use the side of the road without being in a lane of traffic.

CR-02

Residents have reported that the parking area of the Mariners Cove Condominiums is flooded during the wet season. One large pipe drains to Birch Bay from this area, and the parking lot itself appears to be lower in elevation than the occasional extremely high tide.

Residents have also reported that sewer backups are a problem during rain events in the lower units of the Mariners Cove Condominiums.

CR-03

The area to the south and east of the Leisure Park is low-lying and flat and is part of the sub-basin draining to the ditch along Lora Lane. This ditch then discharges through the tide gate to Terrell Creek and on to Birch Bay. The yards of homes along Pine Drive are routinely full of runoff. Figure 9 shows the view looking east along the ditch along Lora Lane, with the Leisure Park on the left side of the picture. The tide gate to the mouth of Terrell Creek is just west of where the picture was taken (behind the photographer). Figure 10 shows the general low-lying area draining to the drainage ditch and the proximity of several homes in relation to the low-lying area. Figure 11 shows the area to the east and upstream of the home in Figure 10, taken looking to the northwest towards the drainage ditch and tide gate to Terrell Creek. The Birch Bay Subarea Plan Update (Kask Consulting, 2004) indicates that a large portion of this low-lying area is classified as wetlands. Much of the development in this area most likely occurred in areas that were originally wetlands.

Questions have arisen on who is responsible for operations and maintenance of tide gates in the Birch Bay area, including this tide gate. Property ownership and locations of street rights-of-way need to be determined, as do operations and maintenance responsibilities for tide gates.

CR-04

Citizens identified the location of a retention pond overflow in the open area to the south and east of the drainage issues along Pine Drive. This exacerbates the existing flooding due to the low elevations during high tides. Detention ponds in the low-lying areas as currently designed may have little or no value as mitigation for flooding in these areas if any portion of the storage is below the water level in the surrounding area during or following rainfall and/or high tide events.

CR-06

The culvert and tide gate at the corner of Wooldridge and Morrison often becomes blocked and causes road and yard flooding in the area. Water is often present over the roadway. Figure 12 shows the accumulated trash and other material propping open the tide gate during a site visit on 1/4/06. Figure 13 shows the culvert behind the tide gate under flooded conditions on 1/6/06. Because the tide gate was propped open and the picture was taken near the time of the high tide, the flooding shown may represent the approximate natural high tide level that day.

Questions have arisen on who is responsible for operations and maintenance of tide gates in the Birch Bay area, including this tide gate. Property ownership and locations of street rights-of-way need to be determined, as do operations and maintenance responsibilities for tide gates.

CR-08

Residents have reported flooding at the intersection of Alderson Road and Birch Bay Drive corresponding to extreme high tides. Water has been over the roadway.

CR-10

According to local residents, the hill east from Birch Bay Drive just north of and in view from Alderson Road is severely destabilized. Citizens have identified areas of slippage in the hillside.

The generally high water table and saturated nature of the soils during wet weather may have affected ground settling.

CU-03

According to local residents, the retention pond within Latitude 49 overflows into Sealinks Drive at the entrance gate to Sealinks. This drainage then flows west on North Golf Course Drive towards Birch Bay and causes localized drainage issues when the conveyance capacity of the stormwater system is exceeded.

CU-05

According to local residents, the three retention ponds in the Bay Crest Development reach capacity quickly. One pond near Bay and Jackson flows into a tributary to Terrell Creek. The other two ponds discharge to a ditch on Key Street, then to a ditch on Jackson that flows north to Terrell Creek. According to local residents, the discharge from all three ponds has been muddy and/or silty at various times in the past.

CC-03

Yard flooding has been reported along Wooldridge just north of Jackson. This has been documented with photographs taken by local residents. Figure 14 shows an example of this flooding.

TC-02

Street flooding has been reported by local residents at the intersection of Blaine and Grandview Roads in the Terrell Creek area.

SP-04

According to citizen reports, the outfall south of the Jackson Road Bridge needs to be maintained more frequently. The outfall gets clogged easily.

PW-01

Various seeps exist all along the shoreline from the tip of Point Whitehorn to the north end of Birch Bay State Park (Coastal Geologic Services, 2003). According to local residents, the most significant seep is near the state park. Slides and ground subsidence exists at various locations along the edge of the point and along the cliffs. Seepage has been occurring all along Whitehorn Way. Seeps, subsidence, and slides are natural processes, but they may be accelerated by changing drainage patterns due to development and roadway construction.

Slides have occurred along Point Whitehorn just as they have along Birch Point on the north side of Birch Bay. Several of these slides have been documented in the last few years, including one in January of 2005 and another in February 2006 at the same location in the area of the 6900 block of Holeman Avenue.

PW-03

The hydrology and drainage of the upper portion of the Point Whitehorn area has been modified because of development, road construction, and tree loss on the Trillium property. Clearing and grading have changed the hydrology, and runoff is now pooling.

Residents have reported standing water in yards in the Point Whitehorn neighborhood after rains. Local residents have reported that drainage pipes are not uniformly connected to curtain drains in the Point Whitehorn area. (A curtain drain is a type of subsurface drainage system that can be used to drain shallow water tables or perched saturated zones and is similar to a French drain, perimeter drain, or underdrain.) Residents have reported that a new building permit calls for onsite downspout management and bioswales to be used to manage runoff instead of tight-line drainage. Existing swales overflow in heavy rains.

PW-06

Yard waste and garbage can accumulate in roadside ditches and within other stormwater conveyance infrastructure. Yard waste dumped into ditches and near catch basins blocks runoff conveyance.

Residents have reported grass clippings in the ditch along Grandview in the Point Whitehorn neighborhood and at several locations near Cottonwood Beach. This prevents the proper conveyance of stormwater runoff. Yard waste disposal occurs near and within waterways between Birch Bay Village and Beach Way. This may occur here or may occur elsewhere and material is transported here. Residents have reported that yard waste and/or other trash has been dumped into ponds at Sealinks golf course.

Depending on the type of material disposed of, this could be affecting water quality as well as water quantity.

Water Quantity Problems Identified During Field Visits by County Staff and Consultant

No additional water quantity problems were identified during field visits. Water quantity problems identified in previous studies and by citizens were investigated.

TABLE 1
Water Quantity Problems Identified

Problem Type	Code from Public Workshop (PW) 1 (if applicable)	Description	Neighbor-hood	Location
Drainage, Flooding and Erosion/Stability	**BR-02** (also BR-04, BR-06)	Cary Lane ditches are full, piping system is overwhelmed; December 2004 and January 2006 documented dates Oertel Drive, December 2004, an outfall pipe at 8741 Oertel Drive became plugged and blew out at the lower end near the outlet. This most likely occurred because of accumulated debris. Resident repaired at own expense.	Birch Point	Oertel Drive off of Semiahmoo Dr. on Birch Point Cary Lane, off of Semiahmoo Dr. on Birch Point
Drainage, Flooding	**BR-03**	A low point exists in road and ditch system near 8621 Semiahmoo Drive. The ditches converge at this location and flow through a culvert into a ditch along the south property line of 8621 Semiahmoo Drive. In December 2004, ditches were overwhelmed and the outflow pipe was destroyed. Trillium Corp. and Washington State DNR replaced outfall pipe with 24”plastic pipe. Resident built concrete collector to channel flow to outfall. January 2006, the problem happened again. Many cubic yards of material were eroded away during this event	Birch Point	Semiahmoo Drive
Drainage, Flooding	**BR-05**	Increased flows and velocity cause drainage problems along Normar Place off of Semiahmoo Drive. The ditch eroded and sent rocks and mud down the half pipe into the junction box. The box plugged up and caused a geyser effect (December 2004). The ditch/open channel outfall along the south property line was overwhelmed. Resident placed sandbags to prevent major damage. The source of this drainage is detention ponds on upslope Trillium property that flow into road ditches, and then through a cross-culvert under Semiahmoo Drive and down to the outfall ditch.	Birch Point	Normar Place off of Semiahmoo Dr. on Birch Point
Drainage, Flooding	**BR-11**	Semiahmoo Drive and Birch Point Road intersection, two detention ponds from Trillium Property flow south in county road ditch to a cross-culvert under road. During events in 2004 and 2005, the ditches overflowed and covered the roadway with water. Residents reported nearly a foot of water over roadway during each of these events.	Birch Point	Semiahmoo Drive and Birch Point Road

TABLE 1
Water Quantity Problems Identified

Problem Type	Code from Public Workshop (PW) 1 (if applicable)	Description	Neighbor-hood	Location
Bluff Erosion, Stability	**BR-10**	Slope stability is a problem all across Birch Point. Residents along the high bluff areas of Semiahmoo Drive have reported ongoing slippage and erosion. Increased subsurface flow from Groundwater Recharge Area, special consideration for unique geologic area	Birch Point	Throughout Birch Point area
Drainage, Flooding	**BV-01**	Ditches leading to Rogers Slough back up under high tides and/or heavy rains, cause flooding in backyards along Birch Point Rd and Salish Rd. within Birch Bay Village; *[culvert re-route proposed by Birch Bay Village along Birch Point Rd under Birch Pt. Loop to alleviate flooding]*	Birch Bay Village	Birch Point Rd. and Birch Point Rd. Loop near Birch Bay Village
Drainage	Not reported at Workshop 1; therefore, named **CC-01** (also BV-08)	Trees and other material accumulate within Rogers Slough. Drainage is an issue when this material is present and is not removed frequently. Material also accumulates along Cottonwood Beach.	Birch Bay Village, Cottonwood	East of Birch Bay Village, Rogers Slough Cottonwood Beach
Drainage, Flooding	**BV-02** (also BV-03; BV-05; BV-10; BV-14; BV-17; BV-18; BR-07)	Major flooding with winter storms, big ponds of standing water within Birch Bay Village; stream in Village has increased in flow	Birch Bay Village	Birch Bay Village
Bluff Erosion / Stability	**BV-20**	Eroding beach and bluffs at Birch Bay Village	Birch Bay Village	Beach at Birch Bay Village
Drainage, Flooding	**HS-02**	Residents have reported flow conveyance a problem if maintenance not performed. In the winter of 2003-2004, Harborview Rd frontage ditch overflowed for the first time in 23 years, possibly due to maintenance Issues	Hillsdale	Harborview Road
Drainage, Flooding	**CT-01** (CT-07)	Drainage ditch along Shintaffer Rd. diverts through two 90° bends then through Richmond Park subdivision; conveys runoff from large area, excess backs up into driveways and backyards	Cottonwood Reach	Richmond Park subdivision along Shintaffer Rd. south of Lincoln Rd.

TABLE 1
Water Quantity Problems Identified

Problem Type	Code from Public Workshop (PW) 1 (if applicable)	Description	Neighbor-hood	Location
Drainage, Flooding	**CT-06** (also CT-10 and CU-01)	Flooding in yards of 17 homes during 1/29/06 event associated with blocked outfalls along Cottonwood Beach including hammerhead outfall near Cedar Rd. Yard flooding also documented on 1/11/06 (8200 Birch Bay Drive). As head increases, geysering may occur in upstream pipe.	Cottonwood Reach, Central Uplands	Cedar and Birch Bay Drive
Erosion, Stability	not reported at PW#1, therefore named **CC-02**	Citizens have reported erosion of roadway and supporting material at several locations along Birch Bay Drive to the south of Cottonwood Beach. Near at least one of these locations, the actual road surface has been affected. Pedestrians and bikers can no longer use the side of the road without being in a lane of traffic.	Cottonwood Reach	Cottonwood Beach and south
Drainage, Flooding	**CR-02** (also CR-05)	Mariners Cove yards are flooded with heavy runoff in wet season; backs up when it rains; single large pipe drains to beach	Central Reaches	Mariners Cove along Birch Bay Drive
Drainage, Flooding	**CR-03**	Low-lying area, backyards and homes are flooded during wetter months in Pine Drive area	Central Reaches	Outlet along Lora Lane and Birch Bay Drive; Pine Drive
Drainage, Flooding	**CR-04**	The retention pond overflows in the open area to the east of the units along Birch Bay drive just south of the Terrell Creek outlet near Lora Lane.	Central Reaches	Behind units along Birch Bay Drive, south of Terrell Cr. outlet
Drainage, Flooding	**CR-06**	Culvert blocked; standing water for weeks in low areas; often problems with water over roadway; also standing water on N. Morrison, which is the portion of the roadway not maintained by county)	Central Reaches	Corner of Wooldridge and Morrison
Drainage, Flooding	**CR-08**	Flooding occurs corresponding to extreme high tides	Central Reaches	Alderson Rd. at Birch Bay Drive
Bluff Erosion /Stability	**CR-10**	Citizens state that the hill just north of Alderson Rd. near Birch Bay Drive has signs of slippage.	Central Reaches	East on Alderson Rd. from Birch Bay Drive
Drainage, Flooding	**CU-03** (also CU-04)	Latitude 49 drainage pond overflows onto Sealinks Drive at entrance gate to Sealinks, flows west on N. Golf Course Dr. towards Bay	Central Uplands	Sealinks Dr. at entrance gate to Sealinks

TABLE 1
Water Quantity Problems Identified

Problem Type	Code from Public Workshop (PW) 1 (if applicable)	Description	Neighbor-hood	Location
Drainage, Flooding	**CU-05** (also TC-01)	Three retention ponds in Bay Crest Development reach capacity quickly; One pond near Bay and Jackson flows into tributary to Terrell Cr.; Two other ponds flow into ditch on Key Street to ditch on Jackson, north to Terrell Cr.; Discharge from all three ponds is muddy/silty;	Central Uplands	Key Street, corner of Bay and Jackson;
Drainage, Flooding	Not reported at Workshop 1; therefore, named **CC-03**	Yard flooding along Wooldridge just north of Jackson (documented with photographs taken 1/6/06 and 1/10/06)	Central Uplands	Corner of Jackson and Wooldridge
Drainage, Flooding	**TC-02**	Flooding of intersection of Blaine and Grandview Roads	Terrell Creek	Intersection of Blaine and Grandview Roads
Drainage, Flooding	**SP-04**	Outfall south of Jackson Rd. Bridge needs to be checked. It gets clogged or blocked easily.	State Park Reach	Jackson Rd and Terrell Creek
Drainage, Flooding Bluff Erosion /Stability	**PW-01** (also PW-02)	Slides, ground subsidence along edge of point and sides along cliffs; Seeps all along shore from tip of Pt. Whitehorn to north end of State Park – most significant one is near State Park; significant seepage along Whitehorn Way	Point Whitehorn	Point Whitehorn along point and cliffs
Drainage, Flooding	**PW-03** (also PW-04, PW-05; PW-07)	Tree loss on Trillium property has changed hydrology, as has residential development; water is now pooling; Former lake, stream, and gravel pit have changed hydrology; drainage is now an issue Several houses have standing water in front after rains; existing swales overflow in heavy rains Drainage pipes not uniformly connected to curtain drains; Citizens' comments: new building permit calls for onsite downspout management and bioswales used to manage runoff instead of tight-line drainage.	Point Whitehorn	Whitehorn Way; Trillium property to the south of Whitehorn Way

TABLE 1
Water Quantity Problems Identified

Problem Type	Code from Public Workshop (PW) 1 (if applicable)	Description	Neighbor-hood	Location
Drainage, Flooding	**PW-06** (also BR-04; CT-02; CT-03; CT-04; CT-09; CU-02; PW-06)	Yard waste and garbage blocks stormwater conveyance in ditch and catch basins; contributes to drainage problems Yard waste disposal occurs near and within waterways between Birch Bay Village and Beach Way along Birch Bay shoreline. This may occur here or may occur elsewhere and material is transported here.	Point Whitehorn, Cottonwood and others	Grandview Road, Maple and Cedar Streets off of Beach Way; Birch Bay shoreline between Birch Bay Village and Beach Way

FIGURE 1
Channelized Stormwater Flow along Semiahmoo Drive in Birch Point Area

FIGURE 2
Modifications made to Channelized Stormwater Flow along Semiahmoo Drive in Birch Point Area

FIGURE 3
Flooded drainage ditch along the south side of Birch Point Road to the west of Rogers Slough

FIGURE 4
Flooded drainage ditch along the north side of Birch Point Road to the west of Rogers Slough

FIGURE 5
The drainage channel downstream of the two 90-degree bends entering the Richmond Park Subdivision, looking north

FIGURE 6
The full drainage ditch along Shintaffer Drive looking south

FIGURE 7
Outfall along Birch Bay Drive near Cedar

FIGURE 8
Flooding that occurred in January, 2006 along the 8200 block of Birch Bay Drive

FIGURE 9
Looking east along the drainage ditch behind the tide gate at Lora Lane discharging to the mouth of Terrell Creek. The Leisure Park is shown on the left of the picture. Portions of the area to the right of the drainage ditch are classified as wetlands.

FIGURE 10
Low-lying area upstream of the drainage ditch shown in Figure 9. Note ponding water. Portions of this area are classified as a wetland.

FIGURE 11
Area behind (to the east of) homes shown in Figure 11, shown looking northwest. Portions of this area are classified as a wetland.

FIGURE 12
Material accumulated within the tide gate and culvert at the Corner of Wooldridge and Morrison, 01/04/06.

FIGURE 13
Flooded Ditch on the NE Corner of Wooldridge and Morrison behind tide gate, January 2006

FIGURE 14
Flooding along Wooldridge just north of Jackson, January 2006

Water Quality Problems

Water quality challenges in the Birch Bay watershed can be categorized into the following two primary groups:

- Many of water quality problems reported by the citizens are due to activities of residents. This underscores the need for extensive and focused education of the local residents.
- Several water quality problems are related to new construction. This indicates that regulations should be stronger or more carefully enforced.

Additional descriptions of water quality issues are available in the following sections. For example, coliform bacteria monitoring in Birch Bay has resulted in the listing in 2003 of the bay by the Washington Department of Health (DOH) as "Threatened" for closure to recreational shellfish harvesting.

Residents of Birch Bay are concerned with the composition of stormwater runoff entering Birch Bay. Table 2 contains a listing of the 16 individual problems identified within the Birch Bay area pertaining to water quality. Each of these problems is described here.

Water Quality Problems Identified from the Literature

CC-04

Pollution from failing septic systems is recognized as a source of pollution. The January 1995 reclassification of the shellfish beds in Drayton Harbor attributed the pollution to six sources, including failing septic systems (Meriwether, 1995). The presence of failing septic systems has not been confirmed in Birch Bay. However, it is a possibility that failing septic systems are contributing to declining water quality in Birch Bay.

Washington State Senate House Bill 1458 requiring local health authorities to identify and correct failing septic systems by 2012 passed the Washington State Senate on 2/28/06. This bill builds off of the recent DOH regulations requiring that Puget Sound counties develop plans that outline how they will manage onsite septic systems.

CC-05

Terrell Creek has low dissolved oxygen levels and high temperatures. Dissolved oxygen concentrations below criteria and temperatures above criteria have been recorded during water quality monitoring activities by both NSEA and Ecology (Rachel Vasak, NSEA, personal communication, 11/4/05). Other water quality parameters are also problematic along the length of the creek. Residents have reported algal blooms in several locations in the lower confined reaches of Terrell Creek.

At one time, Terrell Creek followed a natural path through the area. It is natural for a coastal stream to move in the direction of longshore drift and, occasionally during a large storm event, to cut through to a new, more direct outlet to salt water. Then the drift process starts over. As development in Birch Bay proceeded, sections of Terrell Creek were confined and the creek no longer was allowed to find a natural course. Current patterns of development permanently set the location of Terrell Creek. Currently, Terrell Creek follows the beach shoreline from the state park to its outlet.

This entire stretch along with a large portion of the creek within the state park is tidally influenced. The Terrell Creek marsh (within Birch Bay State Park) is one of the few remaining saltwater/freshwater estuaries in northern Puget Sound. The north end of Birch Bay State Park is a natural game sanctuary providing refuge for smaller birds, migratory waterfowl, American bald eagles, and the great blue heron.

The lower confined reaches of Terrell Creek are affected by tidal changes that may cause stagnant conditions under periods of high tide. The reaches of Terrell Creek between Birch Bay State Park and the outlet of the creek into Birch Bay have had measured low dissolved oxygen levels and higher temperatures. This has led to fish kills.

Water Quality Problems Identified by Citizens

BV-04

Water quality problems have been experienced within the marine waters of Birch Bay at a variety of locations. DOH monitors 10 stations throughout the bay for fecal coliform. Results of this coliform monitoring in Birch Bay have resulted in the listing of the bay by DOH as "Threatened" for closure to recreational shellfish harvesting as of July 2003.

BV-02

The water quality within the lakes and stream in Birch Bay Village is problematic. Pollutants entering these bodies of water may include nutrients, fertilizers, sediment, petroleum products from vehicle use, and waste material from ducks and birds. Algae blooms occur seasonally. In addition, these inputs into the marina may carry amounts of suspended sediment.

Large volumes of sediment coat the bottom of the Birch Bay marina. This material may enter the marina via the large volumes of "muddy" water discharging to the marina from the waterways within Birch Bay Village.

BV-12

Residents have reported that tidal currents have eroded the beach at bluffs at Birch Bay Village. It is not clear whether this is a natural event or a result of human disturbance. Although there have been multiple slides in the last few years, no information has been found that indicates whether the rate of beach erosion has changed over time. The movement of this material may affect the Birch Bay Village marina.

BV-16

The Trillium clear cut area along Birch Point may contribute pollutants to Birch Bay. These pollutants could include suspended sediment as well as others.

CT-05

Large numbers of Canada geese are present in late summer through winter. These geese leave wastes behind.

CR-05

Large amounts of algae are present near the large outfall pipe along the beach near Mariners Cove Condominiums. This may indicate excessive nutrients in the runoff. In addition, sewer backups associated with rain events have been reported by residents in the bottom units of the Mariners Cove Condominiums. Localized flooding occurs in this area associated with rain events.

CR-09
Many dogs are present at the residence(s) near the bank of Terrell Creek close to Alderson Road and Birch Bay Drive.

TC-01
Muddy and silty stormwater discharge has been reported from the Bay Crest development site.

SP-01
Large numbers of ducks and/or birds congregate on the north edge of the park. These ducks and birds leave waste behind.

PW-08
The use of herbicides and other chemicals has been reported by residents in the Point Whitehorn area. There is no specific information on location or amount of use. There are also no details on whether this is causing problems.

Water Quality Problems Identified During Field Visits by County Staff and the Consultant

CC-07
Mud has been tracked out of worksite by large trucks and other vehicles. This material coats the roadway for a distance away from the site entrance. This site is along the east-west road just south of Lake Terrell and is most likely a gravel pit or some other related operation.

CC-08
Large numbers of birds and geese populate Lake Terrell, leaving waste behind.

CC-09
Animals kept on properties may still have access to drainage ditches and depressions that eventually discharge to waterways and Birch Bay, as shown in Figure 15.

CC-10
The Sunset Farm Equestrian Center along Birch Road may be a source of animal waste material. Posted rules require users to remove animal waste from graveled area. However, regulations may not be followed. This 70-acre park is managed by Whatcom County Parks and Recreation. Figure 16 shows the Sunset Farm Equestrian Center.

TABLE 2
Water Quality Problems Identified

Problem Type	Code from Public Workshop (PW) 1 (if applicable)	Description	Neighbor-hood	Location
Water Quality Problems Identified in the Literature				
Water Quality	Not reported at PW 1; named **CC-04**	Potential for failing septic systems in Birch Bay area based on presence of failing septic systems in Drayton Harbor watershed contributing to shellfish harvesting closures there.	Birch Bay	Regional
Water Quality	Not reported at PW 1; named **CC-05 (also CC-06)**	Low dissolved oxygen concentrations and high temperatures in many reaches of Terrell Creek, most notably in the lower reaches within the last 1.5 miles of the creek outlet to Birch Bay. Other water quality parameters are also problematic. Algal blooms observed by citizens in the lower confined reaches of Terrell Creek may indicate excessive nutrient inputs and poor flushing leading to low dissolved oxygen levels.	Central	Terrell Creek near mouth
Water Quality Problems Identified by Citizens				
Water Quality	**BV-04** (also BV-06)	Water quality in Bitch Bay is problematic; high levels of coliform in various locations sampled by DOH.	Birch Bay	Birch Bay
Water Quality	**BV-02** (also BV-05; BV-07; BV-10; BV-11; BR-07)	Water quality of lakes and stream in Birch Bay Village is problematic; pollutants may include nutrients, fertilizers, sediment, petroleum products from vehicles; algae blooms and fecal matter from ducks/birds. Also, suspended sediment is a problem. Large amount of sediment at bottom of marina could be coming from flow of surface water into marina.	Birch Bay Village	Lakes and stream within Birch Bay Village; Birch Bay Village Marina
Water Quality	**BV-12** (also BV-20)	Beach at Birch Bay Village is eroding, as is Birch Bay Village Bluff; movement of sediment in bay may impact marina - requires more frequent dredging.	Birch Bay Village	Beach at Birch Bay Village
Water Quality	**BV-16**	Clear cut area contributes pollutants to runoff, especially suspended sediment.	Birch Point	Clear cut area on Birch Point

TABLE 2
Water Quality Problems Identified

Problem Type	Code from Public Workshop (PW) 1 (if applicable)	Description	Neighbor-hood	Location
Water Quality	**CT-05**	Large numbers of Canada geese present in late summer into winter, leave waste matter behind.	Cottonwood Reach	Between Birch Bay Village and Beach Way, Cottonwood Beach
Water Quality	**CR-05**	Lots of algae present near large pipe outfall along beach may indicate excessive nutrients in runoff.	Central Reaches	Along Beach near Mariners Cove condos
Water Quality	**CR-09**	Presence of many dogs on properties near bank of Terrell Creek may be contributing to coliform bacteria and nutrient inputs into Terrell Creek.	Central Reaches	Alderson and Birch Bay Drive
Water Quality	**TC-01**	Muddy/silty stormwater drainage from Bay Crest Development Site.	Terrell Creek	Bay Crest Development
Water Quality	**SP-01**	Large numbers of ducks/birds on north edge of park may be contributing to water quality problems.	State Park Reach	Within Terrell Creek
Water Quality	**PW-08**	Residents observed use of herbicides and other chemicals (?) observed in close proximity to drainage to bay. May also occur elsewhere in watershed.	Point Whitehorn, others	area-wide
Water Quality Problems Identified by County Staff and Consultant During Field Visit				
Water Quality	Not reported at PW 1; named **CC-07**	Mud tracked out of site by truck tires; material all over roadway; possibly a gravel pit or some other similar operation.	Lake Terrell	Just south of Lake Terrell along east-west road
Water Quality	Not reported at PW 1; named **CC-08**	Large numbers of birds and geese populate Lake Terrell, leave waste behind.	Lake Terrell	Lake Terrell and associated waterways
Water Quality	Not reported at PW 1; named **CC-09**	Animals kept on properties but have access to drainage ditches and depressions that discharge to channels that eventually discharge to Birch Bay.	Central Uplands	Locations throughout Birch Bay watershed

TABLE 2
Water Quality Problems Identified

Problem Type	Code from Public Workshop (PW) 1 (if applicable)	Description	Neighbor-hood	Location
Water Quality	Not reported at PW 1; named **CC-10**	The Sunset Farm Equestrian Center along Birch Road may be a source of animal waste material. Posted rules require users to remove animal waste from graveled area. This emphasizes the need for education and enforcement.	Central Uplands	West Side of Blaine Road south of Lynden Rd.

FIGURE 15
Presence of sheep near drainages to Birch Bay

FIGURE 16
Horse use areas at Sunset Farm Equestrian Center

Aquatic Habitat Problems

The streams, wetlands, and near shore marine waters in the Birch Bay area provide aquatic habitat for birds, fish, and shellfish. Residents of Birch Bay are concerned with the preservation of existing aquatic habitat and the restoration of habitat previously lost.

Key aquatic habitat issues in Birch Bay include fish passage and loss of wetlands. Additional habitat issues are described in following sections summarizing existing literature. For example, there are data that show that the low summer flows near the mouth of Terrell Creek may stress or kill juvenile salmon and trout. Table 3 contains a listing of the six individual problems identified within the Birch Bay area pertaining to aquatic habitat degradation and/or preservation.

Aquatic Habitat Problems Identified from the Literature

CC-11

At various locations along its course, Terrell Creek flows through culverts associated with road crossings. At least two of these have been built in a way that prevents fish passage.

The first culvert creating a barrier for fish under certain flow conditions is the culvert at Blaine Road. The Washington State Department of Transportation (WSDOT) currently has plans to replace this culvert. Another culvert, located at Grandview Road, is situated high enough above the creek bed that any fish passage is impossible. Either this culvert would have to be replaced, or the channel downstream from the culvert would have to be built up in elevation to allow for fish passage through the existing culvert (Rachel Vasak, NSEA, personal communication, 11/4/05).

The dam at the outlet of Lake Terrell also prohibits fish passage into the lake. Several smaller streams discharge to Lake Terrell that may provide good spawning habitat if they were accessible to fish.

CC-12

At one time, Terrell Creek followed a natural path through the area. It is natural for a coastal stream to move in the direction of longshore drift and, occasionally during a large storm event, to cut through to a new, more direct outlet to salt water. Then the drift process starts over. As development in Birch Bay proceeded, sections of Terrell Creek were confined and the creek no longer was allowed to find a natural course. Current patterns of development permanently set the location of Terrell Creek. Currently, Terrell Creek follows the beach shoreline from the state park to its outlet near Lora Lane.

This entire stretch along with a large portion of the creek within the State Park is tidally influenced. The Terrell Creek marsh (within Birch Bay State Park) is one of the few remaining saltwater/freshwater estuaries in northern Puget Sound. The north end of Birch Bay State Park is a natural game sanctuary providing refuge for smaller birds, migratory waterfowl, American bald eagles, and the great blue heron.

The stretch of Terrell Creek between the State Park and the outlet near Lora Lane is a confined reach that prevents the creek from achieving a natural pathway. The lower confined reaches of Terrell Creek between Birch Bay State Park and the outlet of the creek

into Birch Bay have low dissolved oxygen levels and higher temperatures. The lower reaches of Terrell Creek are affected by tidal changes that may cause stagnant conditions under periods of high tide. Dissolved oxygen concentrations below criteria and temperatures above criteria have been recorded during water quality monitoring activities by both NSEA and Ecology (Rachel Vasak, NSEA, personal communication, 11/4/05).

Aquatic Habitat Problems Identified by Citizens

SP-03

Terrell Creek flows are generally too low during the summer season. Low summer flows reduce available juvenile rearing habitat. In addition, when flows are low, connections to wetlands and beaver ponds are nonexistent. These low flow conditions may also be accompanied by poor water quality and elevated temperatures. Outlet flows from Lake Terrell could be adjusted to prevent summer flows from reaching critical levels. During the summer of 2005, flow rates were kept near or above approximately 100 cubic feet per second (cfs). This appeared to have helped the situation considerably.

BR-12

Pockets of natural areas exist on Trillium property in the Birch Point area. Some of these areas are designated as wetlands on the maps within the Whatcom County Comprehensive Plan (Whatcom County, 2005). Local residents insist that these should be protected as habitat for birds and other wildlife.

Aquatic Habitat Problems Identified During Field Visits by County Staff and Consultant

CC-13

Terrell Creek contains degraded instream and riparian habitat both upstream and downstream from the Jackson Road Bridge. A number of projects have begun with the goal of improving riparian and instream habitat. Invasive reed canarygrass has been removed, and native vegetation has been planted along the banks of the creek. Large woody debris has been placed at various locations along a 2,500-foot stretch of the creek. This large woody debris provides hydraulic diversity and improves salmon habitat. However successful these projects have been, there is room for improvement in the instream and riparian habitat.

CC-14

Tide gates may prevent access for fish to suitable habitat. The tide gate located near the mouth of Terrell Creek that blocks the drainage along Lora Lane by the Leisure Park is an example. The Birch Bay Steering Committee has held discussions on the benefits and the potential negative consequences of the use of tide gates. These will have to be weighed against the potential benefits of using the area behind the tide gate as fish habitat. Habitat surveys would have to be performed in areas behind tide gates to assess the benefits of use for fish.

TABLE 3
Aquatic Habitat Problems Identified

Problem Type	Code from Public Workshop (PW) 1 (if applicable)	Description	Neighbor-hood	Location
Aquatic Habitat Problems Identified in the Literature				
Fish Passage Blockage	Not reported at PW 1, named **CC-11**	Culverts under roadways prevent fish blockage. These culverts are at the Blaine Rd. and Grandview Rd crossings over Terrell Creek.	Terrell Creek	Various locations along Terrell Creek
Habitat Preservation	Not reported at PW 1, named **CC-12**	The stretch of Terrell Creek between the State Park and the outlet near Lora Lane is a confined reach that prevents the creek from achieving a natural pathway. This stretch of the creek backs up during high tides, creating stagnant conditions with low dissolved oxygen for fish.	Terrell Creek	Terrell Creek near outlet, downstream of Birch Bay State Park
Aquatic Habitat Problems Identified by Citizens				
Habitat Preservation	**SP-03**	Terrell Creek flow has not been maintained during summer months, levels are too low and temperatures are too high. However, during the summer of 2005, a minimum of 100 cfs was maintained in the creek (Rachel Vasek of NSEA, personal communication on 11/4/05). This showed positive benefits.	State Park Reach	Entire stretch of Terrell Creek
Habitat Preservation	**BR-12**	Pockets of existing wetlands should be protected as habitat for birds and other wildlife.	Birch Point	Birch Point
Aquatic Habitat Problems Identified by County Staff and Consultant During Field Visit				
Habitat Restoration	Not reported at PW 1, named **CC-13**	Terrell Creek contains degraded instream and riparian habitat both upstream and downstream from the Jackson Road Bridge.	Terrell Creek	Terrell Creek near the Jackson Road bridge
Fish Passage Blockage	Not reported at PW 1, named **CC-14**	Tide gates may prevent access for fish to suitable habitat. The tide gate located near the mouth of Terrell Creek that blocks the drainage along Lora Lane by the Leisure Park is an example.	Cottonwood Reach, others	Near mouth of Terrell Creek; other areas with tide gates

Policy / Planning Issues

Several issues were identified by citizens and others that do not relate to a site-specific water quantity, water quality, or aquatic habitat issue, but have more to do with how policies and plans are created and carried out. These are outlined in this section.

- Citizens expressed concern about stormwater quantity and quality issues surrounding new development projects and how these new projects will influence existing conditions.
- Citizens stressed the importance of working with the City of Blaine on regional stormwater planning and possible stormwater detention projects.
- Citizens questioned the current water quality complaint system. Issues were the lines of communication and the process of enforcement.
- Citizens are concerned about the increase in impervious surface created by new development.
- Citizens expressed interest in LID for new development and redevelopment.
- Citizens are concerned about the rate of tree loss on public and private property.

Summary

Water Quantity

Water quantity challenges in the Birch Bay watershed can be categorized in the following three main groups:

- **Low-lying areas along the beach**: There are extensive low and flat areas behind the natural dune of the beach. Even without development, these areas were likely inundated during extreme high tides and high wind conditions. Many of the areas that now have homes and roads were once large, natural wetlands. Development has increased runoff and in some cases may have blocked natural flow paths.
- **New development:** The watershed is experiencing rapid development, particularly near the beach. New development is increasing the peak rate and volume of runoff even with onsite detention resulting in increased downstream flooding and erosion. Existing standards and, or review procedures may need to be improved to reduce the impacts of new development.
- **Bluff erosion**: There are examples of slides all along the bluffs at both the south and north ends of Birch Bay. Beach erosion and slides along bluffs are natural events, but their occurrence may be accelerated by stormwater that is routed over the bluffs or if additional water is infiltrated near the bluffs from either stormwater or septic tank drain fields.

Many of the problems identified by citizens may be problems caused by individual property owners affecting themselves or other individual property owners. Such problems are often not the responsibility of the government, but the responsibility of the individual property owners to resolve. For example, a property owner who routes rooftop runoff over the edge

of the bluff would be responsible for the cause of and resolution to any damage to their own property.

Water Quality

Water quality challenges in the Birch Bay watershed can be categorized in two main groups, as follows:

- **Activities of residents**: The majority of water quality problems reported by the citizens are due to activities of residents. This underscores the need for extensive and focused education of the local residents.
- **New construction**: The occurrence of water quality problems related to new construction indicates that regulations should be stronger or more carefully enforced.

In addition, existing literature identifies other water quality issues identified. For example, coliform bacteria monitoring in Birch Bay has resulted in the listing in 2003 of the Bay by the Washington DOH as "Threatened" for closure to recreational shellfish harvesting.

Aquatic Habitat

Key aquatic habitat issues in Birch Bay include fish passage and loss of wetlands. In addition, water quality issues are identified in existing literature, such as data showing that the low summer flows near the mouth of Terrell Creek may stress or kill juvenile salmon and trout.

Policy / Planning

Citizens are concerned about the potential effects of new development on existing water quantity and water quality conditions. Key issues in Birch Bay include the rate of impervious surface increase and the rate of tree loss due to new and redevelopment.

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Appendix C

Birch Bay Comprehensive Stormwater Plan, Maintenance and Operations Strategy Review

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DATE: July 7, 2006

Introduction

This memorandum is one element of an overall Comprehensive Stormwater Plan for the watersheds of Birch Bay. Birch Bay is a rapidly growing community that is experiencing increasing flooding and erosion, declining water quality, and loss of aquatic habitat. Historically, Birch Bay has been primarily a recreational beach community. The citizens of Birch Bay completed a Comprehensive Land Use Plan that called for low-impact development (LID) and a Stormwater Plan to protect their lifestyle and aquatic resources while accommodating the anticipated growth. This Comprehensive Maintenance Plan recommends measures to achieve these goals.

This memorandum evaluates current Whatcom County Maintenance and Operations (M&O) procedures and programs as they relate to the Birch Bay area. In addition, this memorandum provides recommendations for Whatcom County's M&O program that define levels of service, costs, and implementation approaches.

Sources of Information

The following sources of information were used to identify M&O procedures, methods, and programs applicable to the Birch Bay area:

- Conversations with Whatcom County Drainage M&O staff
- Whatcom County Development Standards, Chapter 2, Stormwater Management: Section 220, Maintenance of Stormwater Facilities, and Section 221, Stormwater Special District Standards
- Whatcom County Comprehensive Plan (2005)
- Washington State Department of Ecology (Ecology) *Stormwater Management Manual for Western Washington* (2005)
- National Pollutant Discharge Elimination System (NPDES) and Washington State Waste Discharge General Permit for Discharges from Small Municipal Separate Storm Sewers in Western Washington (Phase II NPDES Stormwater Draft Permit) dated 2/15/06

Maintenance of stormwater facilities is called for in the Whatcom County Comprehensive Plan, Chapter 11, Environment (Whatcom County, 2005):

- Goal 11G: Protect water resources and natural drainage systems by controlling the quality and quantity of stormwater runoff.
  - Policy 11G-7: Establish, as a high priority, a stormwater maintenance program which assures that stormwater systems function at or near design capacity.
- Goal 11M: Protect and enhance shellfish habitat in commercial and recreational areas in order to ensure a productive resource base for long-term use.
  - Policy 11M-9: Modify current roadside ditch maintenance procedures to protect water quality.
- Action Plan: Environment
  - Develop a comprehensive stormwater management program designed to manage runoff from public facilities and industrial, commercial, and urban residential areas including streets and roads in compliance with NPDES requirements….
  - At a minimum, the components of this program shall include: … - programs for operation and maintenance of storm drains, detention systems, ditches and culverts…

Stormwater System Description

Whatcom County stormwater facilities include retention and detention facilities as well as the storm sewer conveyance system of storm sewer pipe, ditches, catch basins, and other structures. Whatcom County is currently engaged in an effort to inventory drainage infrastructure starting with priority watersheds and gradually incorporating the entire county into the database.

Stormwater facilities within the Birch Bay watershed consist of the following:

- Catch basins or related structures
- Public stormwater retention/detention facilities
- Private stormwater retention/detention facilities
- Culverts
- Outfalls
- Tide gates
- Open ditches
- Stormwater conveyance pipe

Existing Whatcom County Maintenance and Operations Program

Responsibility for Maintenance

Public Facilities

Responsibility for maintenance and operations of publicly owned and operated surface drainage facilities within Whatcom County lies with the Whatcom County M&O Division. M&O of roadways, structures, traffic, vegetation, and surface drainage infrastructure are all the responsibility of this division. The Surface Drainage Management Division within the M&O Division handles surface drainage maintenance.

The Road Standards section of the Whatcom County Development Standards (Chapter 5, Road Standards) outlines guidelines for maintenance of culverts under driveways. These standards state that "Maintenance of driveway approaches, including stormwater culverts, shall be the responsibility of the owner(s) whose properties they serve."

Private Facilities

Whatcom County Development Standards outline responsibilities for stormwater maintenance of private facilities (Section 220, Maintenance of Stormwater Facilities). General Provisions are outlined and include minimum standards for maintenance of stormwater facilities, minimum requirements for a maintenance plan and for frequency of inspection, and financial responsibility for inspection, maintenance, operation, and repair of stormwater systems.

These general provisions call for a frequency of inspection as outlined in the Maintenance Plan submitted with the development application, as follows:

- Stormwater facilities are to be inspected annually and cleared of debris, sediment, and vegetation.
- Grass swales and other bio-filters are to be inspected annually and mowed or replaced as necessary.
- Inspection and cleaning of catch basins and manholes are required annually, and inspection is required after major storm events for cleaning of sediment accumulation if the depth of the deposits is greater than one-third the depth from the basin to the invert of the lowest pipe into or out of the basin.
- Flow control facilities should be inspected annually and during major storms, inspected every 2 years for accumulated sediment that exceeds 10 percent of the designed pond depth, and inspected annually for any deterioration threatening the structural integrity of the facility.

The Development Standards specify that property owners are financially responsible for the inspection, maintenance, operation, or repair of stormwater systems not specifically accepted by the County through the development process. In addition, financial responsibility includes reimbursing Whatcom County for its costs to perform routine inspections to verify compliance, as described in the Maintenance Plan submitted with the

development application. The owner should maintain appropriate records of all inspection and maintenance activities. Whatcom County is authorized to inspect all stormwater systems to determine compliance with the provisions of the Maintenance Plan submitted with the development application.

Section 220 of the development standards describes the M&O of County-maintained privately owned facilities. Whatcom County may assume maintenance responsibility of a stormwater system if it is in the County's best interest to do so. If Whatcom County decides to assume responsibility, the County shall assume maintenance after the expiration of a 2-year period during which the owner has performed maintenance.

If Whatcom County does not assume maintenance responsibility at the end of the 2-year period, the owner of the private system must arrange for the occupants or owners of the subject property to assume maintenance consistent with the Maintenance Plan submitted with the development plan.

Maintenance Standards and Frequency of Maintenance

Whatcom County M&O crews plan to inspect each catch basin in the Birch Bay area at least twice per year. Roadside ditches are maintained on an as-needed basis, with maintenance efforts concentrated in the summer season with the cutting down and removal of vegetation, and in the winter season with removal of accumulated material that may prevent conveyance.

Several stormwater structures frequently need maintenance attention and are attended to by maintenance crews more frequently than others in the system. For instance, several culverts in the Birch Bay area tend to plug up with accumulated material such as grass clippings and trash.

Documentation of Inspections and Maintenance Activities/Database Management

Drainage crews know the system well and are familiar with the culverts, catch basins, ditches, and other facilities that frequently cause problems. However, no formal documentation process is in effect for Whatcom County. Much of this currently rests with the individual M&O crew members and supervisors who have a wealth of knowledge on how the drainage system works throughout the county.

Response to Customer Inquiries & Complaints

Drainage complaints are directed to the M&O drainage division at Whatcom County. When the complaint is received, a work order is generated and handed over to the drainage crew supervisor for scheduling. The problem is then addressed by the drainage crews. According to Whatcom County M&O staff, up to 50 drainage-related calls have been received per day on busier (wetter) days in the last few years. Complaints are prioritized based on severity.

Costs of Drainage Maintenance and Operations Activities

Limited information is available on the costs per unit to maintain and operate drainage infrastructure elements within Whatcom County. Table 1 includes costs for M&O activities from different jurisdictions. Data from Seattle Public Utilities and King County were used. These data represent costs per unit for various M&O activities conducted in large

jurisdictions with relatively short distances between structures. These cost estimates may be underestimating the true cost to perform these activities in Whatcom County, where much of the county is of low density. However, these numbers provide an order-of-magnitude estimate for the cost associated with several M&O activities that are performed within Whatcom County and Birch Bay.

TABLE 1
Drainage M&O Activities

Type of Structure	Activity	Cost per Unit[a]
Drainage Pipes	Jet Rod (for debris)	$2.07/ linear foot (LF)
	Machine Rod (roots)	$0.90/ LF
	Hydrocut (debris and roots)	$1.07 / LF
Culverts	Clean Culvert	$15 / each (EA)
	Hand Clean Culvert	$ 50 / EA
Catch Basins	Inspect Catch basin	$7.00 EA
	Clean Catch Basin	$45.10 EA
Drainage Ditches	Inspect Ditch	$0.25 / LF
	Perform Ditch Maintenance	$1.50 / LF
Facilities (ponds, tanks, vaults)	Inspect Retention/Detention Pond	$300.00 / EA

[a] Costs were derived from both Seattle Public Utilities and King County data. Unit costs for Seattle Public Utilities were based on activities conducted during 2004 and the first three quarters of 2005. Unit costs for King County were based on budget and performance for the years 1999 and 2000 with adjustments to 2005 dollars. Stated costs are estimates and do not include costs of transportation/disposal of waste materials from catch basins, ditches, and other facilities.

Published Guidelines for Maintenance and Operations

NPDES Phase II Stormwater Permit

Whatcom County is an NPDES Phase II jurisdiction (Ecology, 2006a). Currently, Birch Bay is not covered under the NPDES Phase II permit because Birch Bay is not deemed an Urbanized Area by the U.S. Census Bureau. In Washington State, census-defined Urbanized Areas do not line up with city and county boundaries and Urban Growth Areas (UGAs) established by the State's Growth Management Act (GMA). There are requirements for M&O of stormwater systems in the Draft NPDES Phase II Permit for Western Washington. The permit outlines the following performance measures for the M&O program:

a) **Adoption of maintenance standards** that are as protective, or more protective, of facility function as those specified in Chapter 4 of Volume V of the 2005 *Stormwater Management Manual for Western Washington.*

b) **Annual inspection** of all municipally owned or operated permanent stormwater treatment and flow control facilities and taking appropriate maintenance actions in accordance with the adopted maintenance standards.

c) **Spot checks of potentially damaged permanent treatment and flow control facilities** (other than catch basins) **after major** (greater than 24-hour 10-year recurrence interval rainfall) **storm events**

d) **Inspection of catch basins and inlets** owned or operated by the Permittee **at least once before the end of the permit term**. **Clean catch basins if the inspection indicates cleaning is needed** to comply with maintenance standards established in the 2005 *Stormwater Management Manual for Western Washington*.

e) Compliance with the inspection requirements in a, b, c, and d above shall be determined by the presence of an **established inspection program** designed to inspect all sites and achieving inspection of 95 percent of all sites.

f) Establishment and implementation of **practices to reduce stormwater impacts associated with runoff from streets, parking lots, roads, or highways** owned or maintained by the Permittee, and road maintenance activities conducted by the Permittee.

g) Establishment and implementation of policies and procedures to **reduce pollutants in discharges from all lands owned or maintained by the Permittee** and subject to this Permit, including but not limited to parks, open space, road right-of-way, and maintenance yards, and at stormwater treatment and flow control facilities.

h) Develop and implement an **on-going training program** for appropriate employees of the Permittee whose construction, operations, or maintenance job functions may impact stormwater quality.

i) Development and implementation of a **Stormwater Pollution Prevention Plan (SWPPP) for all heavy equipment maintenance or storage** yards, and material storage facilities owned or operated by the Permittee in areas subject to this permit that are not required to have coverage under the Industrial Stormwater General Permit.

j) **Records of inspections and maintenance or repair activities** conducted by the Permittee shall be maintained in accordance with S9 [Reporting Requirements].

Although Birch Bay is currently not a Phase II area, the M&O procedures and practices outlined in the Phase II permit are helpful in formulating a beneficial M&O program.

Stormwater Management Manual for Western Washington

Maintenance standards are described in the *Stormwater Management Manual for Western Washington* (Ecology, 2005). Chapter 2 of Volume IV of the Ecology manual specifies the following best management practices (BMPs)for **maintenance of stormwater drainage and treatment systems**:

- Inspect and clean treatment BMPs, conveyance systems, and catch basins as needed, and determine whether improvements in M&O are needed.
- Promptly repair any deterioration threatening the structural integrity of the facilities. These include replacement of clean-out gates, catch basin lids, and rock in emergency spillways.

- Ensure that storm sewer capacities are not exceeded and that heavy sediment discharges to the sewer system are prevented.
- Regularly removed debris and sludge from BMPs used for peak-rate control, treatment, and so forth; discharge to a sanitary sewer if approved by the sewer authority, or truck to a local or state government approved disposal site.
- Clean catch basins when the depth of deposits reaches 60 percent of the sump depth as measured from the bottom of basin to the invert of the lowest pipe into or out of the basin. However, in no case should there be less than 6 inches clearance from the debris surface to the invert of the lowest pipe…. Where these catch basins are part of a stormwater collection and treatment system, the system owner/operator may choose to concentrate maintenance efforts on downstream control devices as part of a systems approach.
- Clean woody debris in a catch basin as frequently as needed to ensure proper operation of the catch basin.
- Port warning signs—"Dump no Waste – Drains to Ground Water," "Streams", "Lakes"—or emboss on or adjacent to all storm drain inlets where practical.
- Disposal of sediments and liquids from the catch basins must comply with "Recommendations for Management of Street Wastes" described in Appendix IV-G of this Ecology manual.

The Ecology manual also outlines appropriate BMPs for **maintenance of roadside ditches**. These are the following (Ecology, 2005), also in Volume IV Chapter 2:

- Inspect roadside ditches regularly, as needed, to identify sediment accumulation and localized erosion.
- Clean ditches on a regular basis, as needed. Ditches should be kept free of rubbish and debris.
- Vegetation in ditches often prevents erosion and cleanses runoff waters. Remove vegetation only when flow is blocked or excess sediments have accumulated. Conduct ditch maintenance (e.g., seeding) in late spring and/or early fall, where possible. This allows vegetative cover to re-establish by the next wet season, thereby minimizing erosion of the ditch as well as making the ditch effective as a biofilter.
- In the area between the edge of the pavement and the bottom of the ditch, commonly known as the "bare earth zone," use grass vegetation wherever possible. Vegetation should be established from the edge of the pavement, if possible, or at least from the top of the slope of the ditch.
- Diversion ditches on top of cut slopes that are constructed to prevent slope erosion by intercepting surface drainage must be maintained to retain their diversion shape and capability.
- Ditch cleanings are not to be left on the roadway surfaces. Sweep dirt and debris remaining on the pavement at the completion of ditch cleaning operations.

- Roadside ditch cleanings not contaminated by spills or other releases and not associated with a stormwater treatment system, such as a bioswale, may be screened to remove litter and separated into soil and vegetative matter. The soil fraction may be handled as "clean soils," and the vegetative matter can be composted or disposed of in a municipal waste landfill.
- Roadside ditch cleanings contaminated by spills or other releases known or suspected to contain dangerous waste must be handled following Dangerous Waste Regulations unless testing determines it is not a dangerous waste.
- Examine culverts on a regular basis for scour and sedimentation at the inlet and outlet, and repair as necessary. Give priority to culverts conveying perennial and/or salmon-bearing streams, and culverts near streams in areas of high sediment load, such as those near subdivisions during construction.

The Ecology manual also outlines **maintenance needs for specific types of stormwater treatment facilities** (Section 4.6 of Volume V of the Ecology manual). These standards in Section 4.6 of Volume V are a tool for determining maintenance needs for stormwater facilities. The facility-specific standards outline types of potential defects, conditions of those defects that indicate maintenance is needed, and the results that are expected once maintenance is performed. Facility-specific standards are outlined for the following types of facilities (Ecology, 2005):

1. Detention Ponds
2. Infiltration Pond or Other Structure Promoting Infiltration
3. Closed Detention Systems (tanks/vaults)
4. Control Structure/Flow Restrictor
5. Catch Basins
6. Debris Barriers (ex: trash racks)
7. Energy Dissipaters
8. Typical Biofiltration Swale
9. Wet Biofiltration Swale
10. Filter Strips
11. Wetponds
12. Wetvaults
13. Sand Filters (above ground/open)
14. Sand Filters (below ground/enclosed)
15. StormFilter™ (media filters)
16. Baffle Oil/Water Separators
17. Coalescing Plate Oil/Water Separators
18. Catch Basin Inserts

Recommended Level of Maintenance and Operations Service for Whatcom County

Proper maintenance of stormwater facilities is necessary to ensure continued functionality. Setting standards for maintenance is an important element of a stormwater M&O program,

as is documentation. This section describes the recommended level of service for the M&O program in Whatcom County for Birch Bay.

Responsibility for Maintenance

Because surface water maintenance and roads maintenance are performed by two separate divisions in Whatcom County, it is conceivable that surface water maintenance can be performed by the County outside of the road right-of-way. For instance, tide gates located outside of the road right-of-way could be maintained by Whatcom County surface water maintenance crews.

Often, Whatcom County has taken over the maintenance of a structure such as a tide gate because the precedent has already been set for them to do so, and not because they own or installed the tide gate or other stormwater facility or structure. Efforts should be made to delineate what is and is not the responsibility of the County to maintain.

Whatcom County development standards outline the responsibilities of private developers for M&O of stormwater facilities on developed (and developing) properties. During at least the first 2 years after construction, the private developer is responsible for the maintenance of the facilities. After this time, however, Whatcom County can choose whether or not to accept the responsibility of M&O on the property. Whatcom County should review this practice to determine its effectiveness at long-term M&O of these structures. In addition, the drainage M&O crews should be made aware of which facilities are and are not the specific maintenance responsibility of the County. Accurate and updated lists and databases should be kept.

Whatcom County should exert its right to inspect new development sites and recently developed sites for compliance with the M&O plan for stormwater management submitted by the developer with the site development plan. These inspections and any corresponding enforcement actions may help alleviate drainage and water quality issues potentially caused by lack of maintenance of private facilities. These inspections could be scheduled quarterly or at some reasonable interval to ensure compliance. The Ecology manual outlines maintenance needs for specific types of stormwater treatment facilities (Section 4.6 of Volume V of the Ecology manual). These standards in Section 4.6 of Volume V should be used as a tool for determining maintenance needs for these private stormwater facilities. The facility-specific standards outline types of potential defects, conditions of those defects that indicate maintenance is needed, and the results that are expected once maintenance is performed. Current staffing levels may not be adequate for this pursuit**.** Once a level of service is identified, the county should adjust crew size accordingly.

Maintenance Standards

It is recommended that Whatcom County follow the maintenance standards in Chapter 2 of Volume IV of the Stormwater Management Manual for Western Washington (Ecology, 2005). The following list summarizes these standards:

- Inspect and clean catch basins and conveyance systems (including roadside ditches) as needed, and use the opportunity to determine whether improvements in M&O are needed. Note whether capacity has been exceeded or heavy sediment discharges have occurred. Use the following procedures:

  - Clean catch basins when the depth of the deposits reaches 60 percent of the sump depth as measured from the bottom of the basin to the invert of the lowest pipe in or out; if woody debris accumulates, clean as frequently as necessary to ensure proper operation.
  - Keep ditches free of rubbish and debris; conduct vegetation maintenance (e.g., seeding) in late spring or early fall, where possible; promote vegetation where possible; conduct proper handling of ditch cleanings.

- Inspect and clean treatment facilities, as needed, and use the opportunity to determine whether improvements in M&O are needed. Note whether capacity has been exceeded or heavy sediment discharges have occurred. Debris should be regularly removed from surface basins used for either peak-rate control or stormwater treatment; dispose of wastes properly.
- Identify any deterioration threatening structural integrity of facilities and immediately repair (examples: replacement of clean-out gates, catch basin lids, and rock in emergency spillways).
- Determine maintenance needs for specific types of drainage facilities as outlined in Section 4.6 of Volume V of the Ecology Manual (Ecology, 2005).

Frequency of Maintenance

Maintenance frequency describes how often a maintenance function must be performed. Conducting systematic maintenance is important to ensure that stormwater facilities function as designed. Preventive maintenance has the potential to reduce reactive-type emergency work orders. Preventive maintenance in the form of inspections and cleanings should be performed according to the schedule outlined in the NPDES Phase II permit requirements and the Ecology manual. The NPDES Phase II permit outlines the following performance measures related to frequency of maintenance:

- Annual inspection of all municipally owned or operated permanent stormwater treatment and flow control facilities; appropriate maintenance actions in accordance with the adopted maintenance standards
- Established inspection (and enforcement) program for privately owned facilities on an annual or semi-annual basis
- Spot checks of potentially damaged permanent treatment and flow control facilities (other than catch basins) after major storm events (10-year, 24-hour, for example)
- Established inspection (and cleaning) program for catch basins, inlets, and roadside ditches

Documentation of Inspections and Maintenance Activities/Database Management

Each facility or individual component of the surface water drainage system should be documented and given a unique name or code (an ID). Often, a series of numbers is used with a letter identifier indicating the type of facility or asset (such as CB for catch basin or P

for pipe). This database of surface drainage assets and facilities can be tied to the geographic information system (GIS) system for graphical interfacing.

All inspections and maintenance activates on surface water facilities should be documented. Information such as time, date, location, type of facility, reason for visit, and weather conditions should all be recorded. This information will be helpful for assessing the long-term maintenance needs of an individual surface water facility and for formulating a proactive and preventative maintenance plan rather than a reactive one.

A centralized database should be created that allows for information associated with any one facility or asset to be pulled up with little effort. Maintenance history, age, condition, and so forth of this asset would all be tied to the unique ID of the asset. Any work performed on the asset could be tracked in this manner.

A comprehensive recording and database management system can be used as a tool for scheduling M&O activities. Keeping track of resources and assets will allow for the prioritization of M&O activities based on information for each asset in the database such as maintenance history and complaint log. The use of resources can be optimized.

Additional Resources

As drainage infrastructure ages, more resources should be dedicated to its upkeep. Existing facilities that may be at or beyond design life should be inspected to determine whether repair or replacement/upgrade is necessary. Many assets that are currently part of the drainage infrastructure system may be undersized or otherwise not able to convey current demands because they were originally sized for pre-development or less developed conditions. This may become more of a problem as Whatcom County continues to grow quickly.

Tools such as an electronic database will allow Whatcom County to be more proactive and less reactive in their M&O program. A planned inspection program can be used to target aging infrastructure and other portions of the drainage system that are often problematic. Repair and rehabilitation activities can be prioritized based on age and risk of failure of any asset in the system.

As Whatcom County continues to grow in population, maintenance demands will increase. Equipment should be replaced and/or upgraded according to these increasing demands. New technologies should be implemented where possible to increase effectiveness. Hiring additional drainage M&O field personnel would also increase M&O capabilities.

References

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Appendix D

Birch Bay Comprehensive Stormwater Plan, Low Impact Development Feasibility and Effectiveness Review

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Introduction

This memorandum is one element of an overall Comprehensive Stormwater Plan for the watersheds of Birch Bay. Birch Bay is a rapidly growing community that is experiencing increasing flooding and erosion, declining water quality, and loss of aquatic habitat. Historically, Birch Bay has been primarily a recreational beach community. The citizens of Birch Bay completed a Comprehensive Land Use Plan that called for low-impact development (LID) and a Stormwater Plan to protect their lifestyle and aquatic resources while accommodating the anticipated growth. This Comprehensive Stormwater Plan will recommend measures to achieve these goals.

This memorandum describes types of LID measures that have been implemented successfully in Western Washington. Factors affecting success of LID measures are also discussed. The current regulatory environment in Whatcom County is discussed as it pertains to the implementation of LID measures. This memorandum also discusses the feasibility and potential benefits of implementing LID measures throughout the Birch Bay Watershed. The Low Impact Feasibility Evaluator (LIFE™) Model was used to evaluate the effectiveness of LID measures in one planned development. Results from this modeling effort are used to discuss the feasibility and potential effectiveness of implementing LID measures basinwide.

Overview of Low-Impact Development

LID is a stormwater management and land development strategy applied at the parcel and subdivision scale that emphasizes conservation and use of onsite natural features integrated with engineered, small-scale hydrologic controls to more closely mimic predevelopment hydrologic functions (Puget Sound Action Team, 2005). LID promotes reduction of stormwater runoff volume through mechanisms such as vegetative filtration, retention, and infiltration. LID measures are implemented at or near the source where surface runoff is generated. Several types of LID measures exist, including amended soils, biofiltration and bioretention swales, rain gardens, reductions in impervious surface, and pervious pavement.

A biofiltration swale is a long, gently sloped ditch or depression designed to treat stormwater as it flows through the swale. Bioretention swales possess specially constructed bottoms and side slopes with engineered soils, which encourage infiltration of stormwater runoff flowing through the swale. These swales often convey stormwater along the edge of a road. However, they can also be used as local depressions that retain stormwater on the site (sometimes referred to as rain gardens).

Rain gardens are vegetated depressions intended to promote infiltration. Runoff is channeled into a rain garden that may or may not have an outlet for overflow once the infiltration capacity of the rain garden has been reached.

Pervious pavement is an open-graded pavement that allows rainwater to pass through the road or sidewalk and infiltrate into the soils beneath rather than contribute to stormwater runoff. Reducing the width (and therefore total area) of paved surface for roadways and driveways can also be an effective LID technique.

LID measures can yield both water quantity and water quality benefits. Grass swales can reduce runoff velocity and act as infiltration devices to reduce peak flowrates and runoff volumes. They can also act as biofilters to remove pollutants from runoff. Pollutants are removed by sedimentation, but also by infiltration, biofiltration, and adsorption. In a literature review conducted by the U.S. Environmental Protection Agency (EPA), bioretention areas were found to be effective in reducing runoff volume and in treating the first portion of the storm before reaching infiltration capacity of the swale (EPA, 2000). Several studies included in this literature review also showed good removal efficiencies for both metals and nutrients, ranging from 50 to 90 percent for total copper, lead, and zinc and up to 80 percent for total phosphorus and total nitrogen. Generally speaking, the removal of metals was found to be directly related to the removal rate of total suspended solids.

Performance of bioretention swales is dependent upon channel length and longitudinal slope. Slopes greater than 3 to 4 percent require the use of check dams to slow the flows and allow for greater infiltration (EPA, 2000). Generally, biofiltration swales are most appropriate for smaller drainage areas with mildly sloping topography (Center for Watershed Protection, 1998). The soils on the swale bottoms and sides are amended with sand and organic matter to encourage infiltration. Amended soil mixes are capable of achieving an infiltration rate of up to 2 inches per hour.

Potential Effectiveness of LID Measures within the Birch Bay Watershed

Estimates of the effectiveness of LID measures can be made using measured data from existing LID sites, or effectiveness can be extrapolated from studies performed in other locations. However, due to the unique topography, geology, and hydrology of the Birch Bay Area, it was necessary to perform a study on LID effectiveness based on Birch Bay soil and hydrologic conditions.

To best characterize the density, character, and pattern of development in Birch Bay, the site plans for a development currently proposed for the area were used in the formulation of the

study. Preliminary site plans and stormwater drainage plans from the Horizons at Semiahmoo Project were used to assess the feasibility and effectiveness of LID measures in the Birch Bay area.

CH2M HILL's Low Impact Feasibility Evaluation (LIFE™) model was used to assess the potential effectiveness of LID measures within Birch Bay. The LIFE™ Model is a hydrologic simulation tool that was developed to evaluate the performance of various LID techniques such as bioretention, infiltration systems, rainwater capture/reuse systems, and green roofs. The LIFE™ model has been used to test the performance of LID techniques for different land uses, rainfall patterns, and soil characteristics. Attachment 1 to this memorandum contains a detailed description of LIFE™ Model capabilities and setup.

The preliminary site plans for the Horizons at Semiahmoo Project indicate that various LID measures such as rain gardens, reduced pavement widths, and sand filters are already planned for this project. For the purposes of this study, the LIFE™ Model was set up with all LID measures removed to accurately portray the hydrologic conditions of a traditional development scenario. This traditional development scenario was run through the LIFE™ Model in order to quantify the "traditional" development conditions.

LID measures of rain gardens, reduced pavement widths, pervious pavement, and amended soils were then added to the LIFE™ Model Setup. Model results from the scenario of Development with LID were compared to the Traditional Development scenario.

LIFE™ Model Setup

The LIFE™ Model was used as both a continuous and single event model. The continuous simulation was used to estimate the total annual reduction in runoff volume and peak flow from LID measures. The precipitation data used in the model were from the National Climatic Data Center (NCDC) gage at Bellingham International Airport. Average annual rainfall for the areas is approximately 35 inches per year. The pan evaporation data input to the model was obtained from Puyallup, Washington, the closest station with a long-term record of pan evaporation data. Continuous rainfall data from the year 2001 were used to calculate total annual runoff and annual pollutant loads because the rainfall for this year was 36.03 inches and was close to the long-term average rainfall. The model was run in one-hour time steps over the one-year timeframe modeled.

The 2-year, 10-year, and 100-year 24-hour events were run through the model to estimate the difference in required detention volume with implementation of LID measures. The single storm event model used the same setup as the continuous event model except using the SCS Type 1A precipitation distribution. The 24-hour precipitation amounts for the 2-year 24-hour, 10-year 24-hour, and 100-year 24-hour events were 2.1 inches, 3.1 inches, and 4.5 inches, respectively.

The soils of the Horizons at Semiahmoo Development consist of Birch Bay, Blainegate, Everett, and Whitehorn Soils representing soil classes 14, 15, 28, and 184, respectively. Everett soils are soil Type B, Birch Bay soils are soil Type C, and Blainegate and Whitehorn soils are soil type D (*Whatcom County Soil Survey Report* [NRCS, May 1992]). Nearly all of the area under the proposed development consists of the Type D soils of Whitehorn and

Blainegate. The infiltration rate of the subsurface soil was assumed to be 0.05 inch per hour for Hydrological Type D soil.

The LIFE™ Model was set up according to the two different scenarios: Traditional Development, and Development with LID. The lot size and total number of lots did not change between the scenarios of Traditional Development and Development with LID. The total width of the road right-of-way did not differ between scenarios, but the distribution of pervious versus impervious surface did change. The scenario with LID had rain gardens and pervious landscaping. This decreased the total percentage of impervious surface in the right-of-way for this scenario. Rain gardens were placed along the sides of the minor access roads where possible, depending on driveway and intersection locations. Pervious pavement was used in the scenario with LID measures for all driveways plus all minor access roads with less than 3 percent longitudinal slope. All pervious areas were modeled as having amended soils in the top 12 inches of the soil column versus the 4 inches of native fill for the Traditional Development scenario. This assumption of 4 inches of native fill present in the Traditional Development scenario represents an estimate of the total depth of topsoil present. In many cases, depth of top soil is less than this. Table 1 summarizes these input parameters for the LIFE™ Model Scenarios.

TABLE 1
Input Parameters for the LIFE™ Model

Input Parameter	Traditional Development	Development with LID	Difference
Lots	Number of lots, lot type, and lot size as specified in project plan The imperviousness of each lot is approximately 25%, including driveway and rooftop	Number of lots, lot type, and lot size as specified in project plan The imperviousness of each lot is approximately 25%, including driveway and rooftop	No difference
Road Width	Width as specified in project plan, but with impervious surface from back of sidewalk to back of sidewalk	Width as specified in project plan, but with rain gardens and pervious landscaping	Rain gardens and pervious landscaping instead of full width of impervious roadway surface
Bioretention (Rain Gardens)	No rain gardens	Rain gardens on all minor access roads	Rain garden length equal to approximately 30% of minor access road length
Pervious Pavement	No pervious pavement	Pervious pavement for all minor access roads with a slope less than 3% and for all driveways and sidewalks	Impervious area converted to pervious pavement
Soil	All pervious surface consists of native soil (4 inches of native fill)	Amended soil instead of native soil for all pervious surface within each lot	Pervious surface within each lot consists of top layer of 12 inches of amended soil instead of native soil
Rooftop and	Sheet flow across lot	Sheet flow across lot	No difference

TABLE 1
Input Parameters for the LIFE™ Model

Input Parameter	Traditional Development	Development with LID	Difference
Driveway Runoff	pervious area before entering street storm drainage system	pervious area before entering street storm drainage system	

Subbasin objects were set up according to the land use of each individual subbasin within the project area. The development was divided into 11 subbasin areas based on the proposed grading and the storm drainage layout provided by the developer. Total modeled area is 33.8 acres. Under the LID scenario, the impervious surface area is reduced by 8 percent compared with the Traditional Development scenario. The area breakdown of each subbasin object is shown in Table 2.

TABLE 2
Characteristics of Sub-basin Areas in the LIFE™ Model

		Impervious Area (%)	
LIFE™ Model Catchment	**Total Area (acres)**	**Traditional Development**	**Development with LID**
B1	1.9	58%	58%
B2	4.8	37%	36%
C1	1.6	34%	30%
C2	4.3	40%	32%
D1	6.7	43%	38%
EN	2.5	41%	38%
ES	2.7	37%	37%
F1	1.7	46%	38%
F2	4.6	38%	35%
G	1.8	39%	39%
H	1.2	45%	33%
TOTAL	**33.8**		

LIFE™ Model Results

Once potential locations for LID were identified as described in the previous section, the LIFE™ Model was used to evaluate the potential reduction in stormwater volume and peak flow using LID measures. The model was used to quantify the peak flow and volume reductions attributable to the LID measures as well as the change in required detention volume.

Continuous Model

LIFE™ Model results from the continuous model setup show that, on an annual basis, only a relatively small fraction of the total rainfall becomes surface runoff. Results indicate that 17 percent of annual precipitation runs off under the Traditional Development scenario. The remainder infiltrates or is evaporated (Table 3).

TABLE 3
LIFE™ Model Results for Continuous Simulation Under Traditional Development and Development with LID Measures Scenarios

	Traditional Development	Development with LID	Difference	Difference (%)
Runoff Volume				
Volume of Infiltration (cubic feet [ft^3]/yr) (acre-feet/year)	2,049,552 (47.1)	1,769,967 (40.6)	-279,585 (-6.4)	-13.6%
Volume of Evapotranspiration plus Volume of Storage within Soil Column (ft^3/yr) (acre-feet/year)	1,602,530 (36.8)	2,452,579 (56.3)	+850,049 (+19.5)	+53.0%
Volume of Runoff[a] (ft^3/yr) (acre-feet/year)	768,583 (17.6)	198,119 (4.5)	-570,464 (-13.1)	-74.2%
Runoff Rate				
Peak Rate of Runoff from Largest Storm of the Year[b] (cubic feet per second)	5.5	1.9	-3.6	-65.5%

[a]Total annual rainfall volume in the 33.8 acres modeled area in 2001: 4,420,665 ft^3 (101.5 acre-ft).
[b]The peak rate of runoff is from the largest storm over the modeled year of 2001. This largest storm is approximately equal to the 1-year 24-hour event.

Under the Development with LID scenario, total surface runoff volume in the modeled area reduces from 17.4 to 4.5 percent of annual precipitation volume. This translates into a 74 percent reduction in total runoff volume from the modeled area (Table 3). The volumes that would have otherwise become surface runoff either infiltrate or evapotranspire.

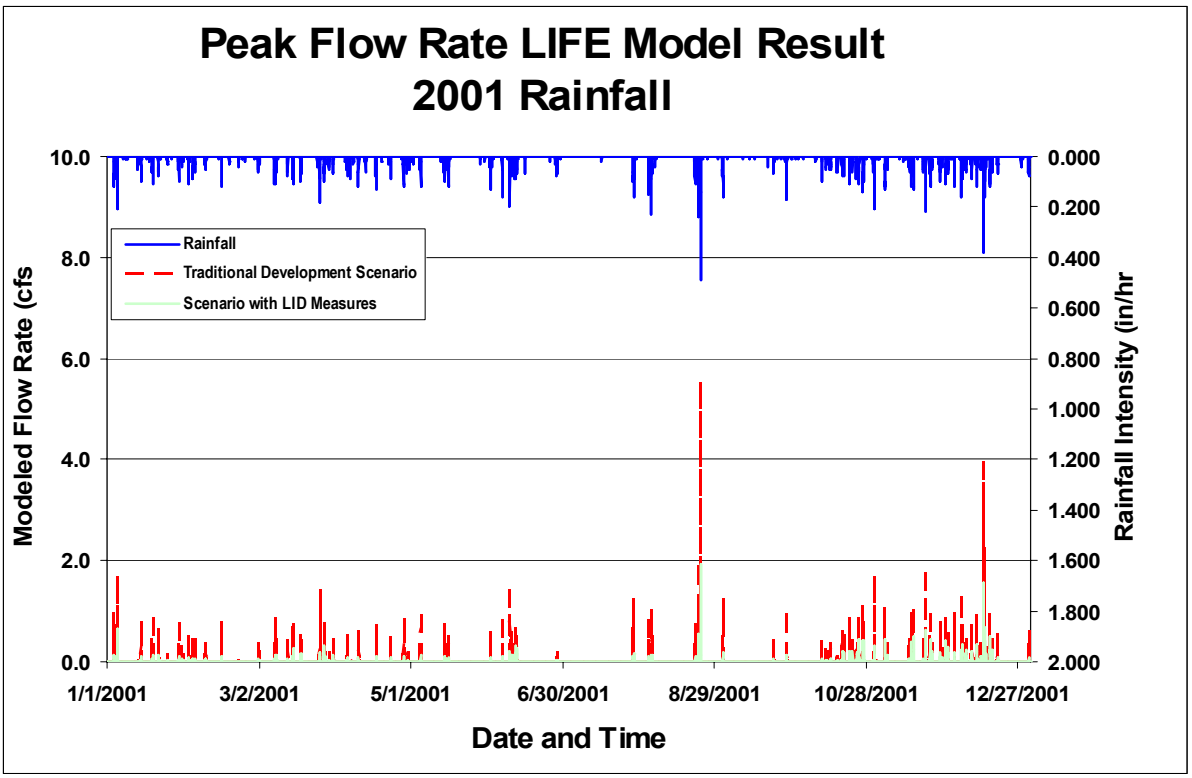
The reduction of runoff volume and peak flow rate is due to the decrease in total impervious area, the storage volume in the swales, the installation of pervious pavement, and the amended soils on the lawn of each lot. The reduction is mainly from the amended soils used for the pervious area with each lot, representing 49 percent of the total site area. The LIFE™ Model results show that the storage volume available within the soil column, especially within the 12 inches of amended soils, is contributing to the reduction in runoff volume.

The estimates for evapotranspiration also include the volume of storage available in the soil column. This value is significant due to the 12 inches of amended soils. The quantity of water retained in the soil in the LID scenario is much more than in the Traditional Development scenario.

The underlying soil is Hydrological Group D, so the infiltration of the runoff is limited. The performance of the rain garden is sensitive to infiltration conditions, which can vary considerably from one location to the next. The storage volume on the surface and within the soil is the main benefit that a rain garden provides.

LID measures also yield a reduction in peak rate of runoff over the year. Under the Traditional Development scenario, the peak rate of runoff from the largest event of the year (approximately equal to the 1-year 24-hour event) was 5.5 cubic feet per second (cfs) (see Table 3). With LID measures, the peak runoff rate from this event was 1.9 cfs. This is a reduction in peak runoff rate of nearly 66 percent. Figure 1 shows the hydrographs under both the Traditional Development and Development with LID scenarios.

FIGURE 1
LIFE™ Model Output Hydrographs for Continuous Model for both Modeled Scenarios



Single Event Model

The LIFE™ Model was run using the 2-year, 10-year, and 100-year 24-hour design storm events of 2.1, 3.1, and 4.5 inches. Three different scenarios were modeled: the predevelopment condition, the traditional development condition, and the LID development condition. Table 4 shows the results of these model runs in terms of peak event flowrates and required detention volumes.

TABLE 4
LIFE™ Model Results for Continuous Simulation Under Pre-Development, Traditional Development, and LID Development Conditions

	Pre-Development	Traditional Development	LID Development	Difference	Difference (%)
Peak flowrate (cfs)					
2-year 24-hour event	0.02	3.40	1.07	2.33	-68.5%
10-year 24-hour event	2.1	35.7	6.8	28.9	-81.0%
100-year 24-hour event	11.9	49.2	15.2	34.0	-69.1%
Required Detention Volume (ft^3)					
2-year 24-hour event[a]	--	--	--	--	--
10-year 24-hour event	--	131,214	6,630	124,584	-94.9%
100-year 24-hour event	--	174,136	19,789	154,347	-88.6%

[a]The 2-year 24-hour event did not produce enough runoff volume to perform the detention volume portion of this study.

The LIFE™ Model results indicate large reductions in peak flowrates generated by the 2-year, 10-year, and 100-year 24-hour events. The peak flowrates are reduced by 69 percent or more between the Traditional Development and Development with LID scenarios for each of three storm events run through the LIFE™ Model. Figure 2 shows the hydrographs corresponding to the 100-year 24-hour event for pre-development conditions and the two development scenarios of Traditional Development and Development with LID. Figure 2 shows hydrographs both upstream and downstream from the detention ponds modeled for both the Traditional Development and Development with LID scenarios.

These event-specific results from the LIFE™ Model indicate that implementing LID in a development could reduce the required detention volume for a development by about 88 percent based on the 100-year event.

Effects of LID on a Subbasin Scale

To demonstrate the cumulative impacts of implementing LID basinwide, results from the modeled development of 33.8 acres were applied several times within the same subbasin. The Horizons at Semiahmoo Project is sited within the Rogers Slough subbasin. This development covers approximately 33.8 acres (7.1 percent) of the 473-acre (0.74 square mile) subbasin. The modeled development was "copied" fourteen times over the sub-basin.

The implementation of LID reduces both total runoff volume and peak runoff rate. To quantify the reduction in total annual runoff volume over the entire sub-basin, the volume reduction in the 33.8 acres was multiplied by fourteen to represent the annual volume reduction in the 473 acres. (Routing and hydrograph timing does not affect volume reduction, only flowrate.) A total runoff volume reduction of 7,986,496 cubic feet

(183.3 acre-feet) could be expected on an annual basis from a 473-acre watershed if LID measures were implemented subbasin wide. This represents an annual reduction of 74.2 percent, the same as that for the individual development (Table 5).

FIGURE 2
LIFE™ Model Output Hydrograph for the 100-year 24-hour event for all Modeled Scenarios

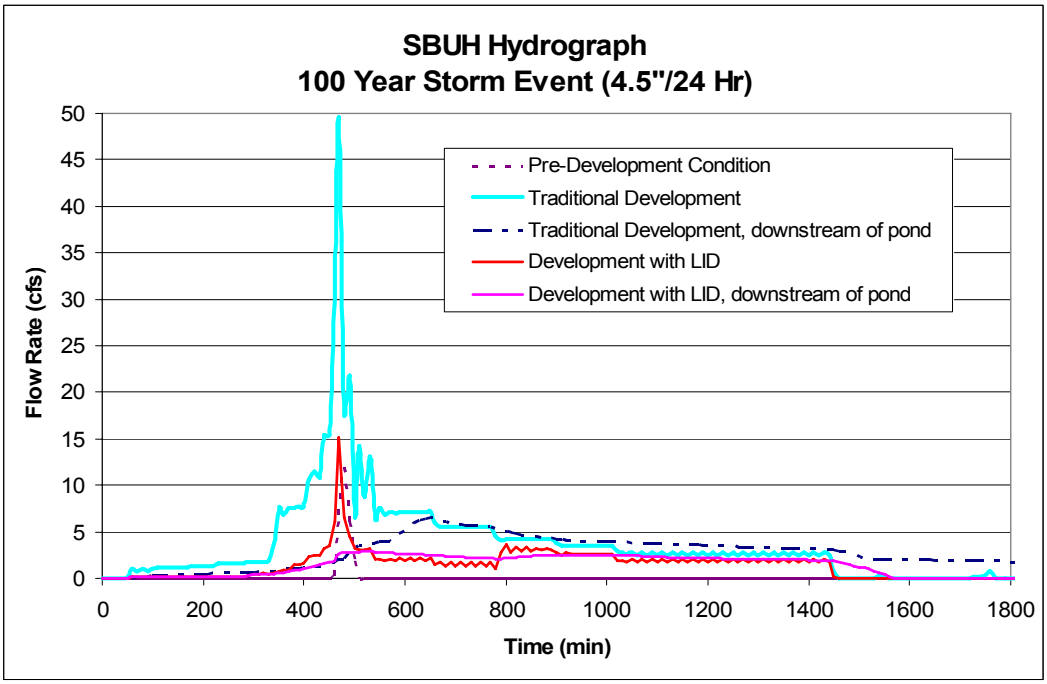


TABLE 5
Effects of LID Implementation Subbasin Wide

	Traditional Development	Development with LID Measures	Difference	Difference (%)
Peak flowrate (cfs)[a]				
10-year 24-hour event	29.7	28.2	-1.5	-5.1%
100-year 24-hour event	91.4	83.1	-8.3	-9.1%
Volume (ft^3)[b]				
Annual Volume of Runoff (ft^3/yr) (acre-ft/yr)	10,760,162 (247.0)	2,773,666 (63.7)	7,986,496 (183.3)	-74.2%

[a] Estimated peak flowrate reduction due to LID subbasin wide was determined by modeling the appropriate routing (and timing) depending on development location in subbasin.
[b] Estimated volume reduction due to LID subbasin wide was determined by applying modeled development over entire subbasin and adding up the total volume.
Note: The subbasin is approximately 473 acres; the modeled basin of 33.8 acres was applied 14 times over the subbasin.

To quantify the reduction in peak flowrate from the subbasin, the appropriate routing and timing are applied. Peak flowrate is affected by how long it takes runoff to reach the outlet point from different areas of the watershed. The 33.8-acre development was applied

14 times throughout the subbasin. The timing of each contributing hydrograph was determined based on soil, slope, and channel conditions. This was done for each of 14 contributing developments within the subbasin. Hydrographs for each of the contributing areas were combined to form a cumulative hydrograph for both the 10-year 24-hour and the 100-year 24-hour events. The peak flow reduction for the 10-year 24-hour event is approximately 5percent, and the peak flow reduction for the 100-year 24-hour event is approximately 9percent. These peak flow reduction percentages are less than those for the individual developments because of the effects of timing and routing between all the contributing areas. These percent reductions in peak flowrate are minimal. However, they only represent the reduction in the highest flowrate. These numbers do not reflect the reduction in the duration of high flowrates because of the significant volume reduction. With LID measures, the reduction in peak flowrate is not large. However, the length of time that these higher flows are occurring is much less.

Opportunities and Constraints for LID Implementation in the Birch Bay Area

LIFE™ Model results indicate that LID measures would be effective at reducing total annual runoff volumes and maximum annual peak flowrates in Birch Bay. This study was performed based on one planned development of approximately 34 acres. It is likely that LID measures implemented to the scale and density as modeled with the LIFE™ Model in this study would have comparable results elsewhere in the watershed.

Implementing LID measures subbasin wide would yield reductions in annual runoff volume proportional to those from modeling the 33.8-acre Horizons development. Subbasin wide implementation of LID could yield 5percent and 9percent reductions in peak flowrate from the 10-year 24-hour and 100-year 24-hour events, respectively. These reductions in peak flowrate may be minimal, but the corresponding reduction in duration of high flows is significant. These reductions could have significant positive impacts on downstream receiving water bodies.

The feasibility of using individual types of LID measures would have to be analyzed based on conditions in the immediate area of any planned project. For instance, biofiltration swales are not effective along slopes greater than about 8 percent, and pervious pavement has similar limitations on its use.

Current Whatcom County regulations and requirements could be updated to reflect requirements for LID in new and redevelopment situations. For instance, a certain depth (such as 12 inches) of amended soils could be required on all pervious surfaces in new developments. Requirements could be set up to promote LID.

These event-specific results from the LIFE™ Model indicate that implementing LID in a development could reduce the required detention volume for a development by about 88 percent based on the 100-year event. These results have political and regulatory implications. Detention requirements for new development could be amended to allow "credits" to developers for the implementation of LID measures in the form of reduced detention requirements.

Reducing the detention volume requirements by exactly the reduction in runoff volume due to LID would be risky. Detention volume requirements could be reduced based on some fraction of the total runoff volume reduction due to LID. Implementing a safety factor of perhaps 50 or 100 percent would be more appropriate, because it would allow for potential system malfunctions, design overestimates, or maintenance issues that may cause problems with the system.

Implementing LID measures provides an opportunity to go above and beyond current development practices. Translating all the benefits of LID into reduced detention requirements would only address runoff to current regulatory levels rather than exceeding them in an environmentally beneficial manner. "Credits" of reduction in detention requirements could be given to developers who implement LID, but at a more conservative level.

For the implementation of LID measures to truly be feasible in the Birch Bay area, the demand for "green" homes and LID must be known to developers and regulators alike. Developers would be more likely to incorporate LID measures into future developments if they are marketable and therefore more cost-effective.

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Attachment 1: LIFE™ Model Overview

CH2M HILL's Low Impact Feasibility Evaluation (LIFE™) model is a hydrologic simulation tool that was developed to evaluate the performance of various LID techniques (e.g., bioretention, infiltration systems, rainwater capture/reuse systems, green roofs). The LIFE™ model has been used to test the performance of LID techniques for different land uses, rainfall patterns, and soil characteristics. The LIFE™ model enables site level analysis of spatially distributed stormwater source controls (i.e., LID). This is its primary advantage over other hydrologic models.

The LIFE™ model provides a continuous simulation of the runoff and infiltration from a development (or redevelopment) area, or from a watershed (or subcatchment) with multiple land uses, given the following inputs:

- *Continuous rainfall data* (typically in time increments of one hour or less) and *evapotranspiration data* (daily), typically for a time period of one year or more. Evapotranspiration (ET) can also be calculated from temperature data.
- *Site design parameters and land cover characteristics* for each land use type being modeled (e.g., road width, rooftop coverage, surface parking coverage, population density).
- *Information on LID techniques* that are applied for each land use type, including:
  - Extent of source control application (e.g., percent of road and percent of building lots with certain types of source controls)
  - Source control design parameters (e.g., area and depth of infiltration facilities, soil depth for green roofs or absorbent landscaping, volume of rainwater reuse cisterns)
- *Soils information, including:*
  - Surface soil parameters (e.g., maximum water content, vegetation rooting depth)
  - Subsurface soil parameters (e.g., saturated hydraulic conductivity)

The model has seen numerous applications both in the United States and Canada. The model has been used for the development of two master-planned communities in the Vancouver, British Columbia area. It has been used for redevelopment projects in Idaho, North Carolina, and Virginia. It is being used for site characterization project in Prince George County, Maryland. It is also being used by the Tennessee Valley Authority to evaluate best management practices (BMPs) for new development.

There have been several applications of the LIFE™ Model in Western Washington. The model was applied to a 70-acre urban basin (Venema Creek) in Seattle in support of the City of Seattle's Natural Drainage System Program, whose early SEAStreet Project has gained national recognition for retro-fitting LID measures in an urban area. The LIFE™ model results demonstrated that intensive application of enhanced bioretention swales in the lower portion of the basin was capable of providing water quality treatment for the 6-month storm and reducing runoff to forested conditions for flows up to the 2-year storm event

(CH2M HILL, 2004a). That project is currently under design by the City of Seattle. In a study conducted for the Puget Sound Action Team, the LIFE™ Model was used to evaluate the capability of LID measures in meeting the state's flow control (detention) requirements for a series of prototypical residential and commercial developments (CH2M HILL, 2004b). The study determined that, under favorable conditions (infiltrative soils, and relatively less rainfall due to the Olympic rain shadow), LID measures alone could fulfill flow control requirements. In the remainder of cases, LID measures would significantly reduce the detention requirements of a project.

The LIFE™ model runs on an object-oriented dynamic simulation software platform called Extend. LIFE™ models are developed as a series of interconnected objects that represent different surface types within the modeled area. This modeled area can be any scale, but LIFE™ is particularly well suited for site-level analysis.

The following types of objects govern the hydrologic simulations within LIFE™:

- **Global objects**, which store information that can be accessed by all other objects within the model (e.g., rainfall data).
- **Physical objects,** which simulate the various components of the physical landscape (including impervious surfaces, pervious surfaces, and stormwater control facilities).
- **Flow routing objects**, which perform overland flow routing and simple channel routing using a kinematic wave approach

Each of these objects is described further in the following subsections.

Global Objects

Every LIFE™ model must have an object that defines environmental conditions, and will typically also have an object that stores data on the hydrologic properties of the various soil types within the modeled area.

The LIFE™ continuous simulation hydrologic model runs for a user-defined time period using a user-defined time step (typically 15 minutes to 1 hour). In order for the LIFE™ model to run, continuous rainfall data and ET data must be input to the global *environmental conditions* object. Rainfall data should be obtained from the nearest tipping bucket rainfall gauge to the project site. ET data can either be estimated directly based on pan evaporation data (if available), or calculated from daily minimum and maximum temperature data using a modified Penman-Monteith equation. If ET data is calculated from temperature, the latitude and elevation of the climate station are required as model inputs.

A reduction factor will typically be applied to the pan evaporation data to derive ET values because the former is substantially higher than the latter.

Physical Objects

The heart of the LIFE™ model simulations is the objects that represent the various components of the physical landscape, including LID techniques. The various types of physical objects used by the LIFE™ model are described below.

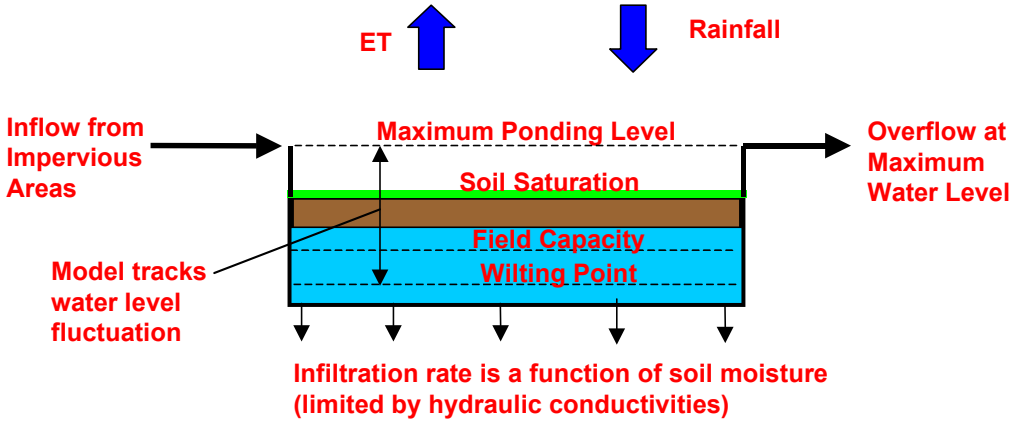
Impervious Surface Objects

Impervious surface objects are used to simulate noninfiltrating surfaces within the modeled area (e.g., rooftops, driveways, roads, sidewalks). These objects must be given an area and a runoff coefficient that defines the fraction of rainfall that becomes runoff from the surface. These objects must be connected to a *rainfall* object that passes in rainfall data from the global *environmental conditions* object. For models of LID scenarios, runoff output from an *impervious surface* object would typically be connected as inflow to a *pervious surface* object (see below); for example, to simulate capture of roadway runoff by a bioretention swale dispersion of rooftop runoff over part of the adjacent lawn area.

Pervious Surface Objects

Pervious surface objects are used to simulate all surfaces within the modeled area that are covered by soil (or other growing media), including various types of pervious surfaces (e.g., lawns, landscaped areas, forest) and many types of stormwater source control facilities (e.g., bioretention cells, swales, green roofs, planter boxes). These objects must be connected to a *rainfall* object and an *ET* object, which pass in rainfall and ET data from the global *environmental conditions* object. An areas and a series of hydrologic properties must be defined for each *pervious surface* object.

Simulating of the movement of water through pervious surface objects is at the heart of most LIFE™ model simulations. This process is described in more detail in the following chart.



Soil depth is the assumed size of the soil "reservoir." Water flows into this 'reservoir' from direct rainfall and inflow from other objects (e.g., impervious surface runoff). If the rate of input exceeds the saturated hydraulic conductivity (SHC) of the surface soil, the excess becomes surface runoff. When the soil moisture is between wilting point and field capacity, water loss occurs through ET only. When the soil moisture is between field capacity and maximum water content (e.g., between 30 and 50 percent water content for the above swale), water will infiltrate out of the soil layer (in addition to ET losses). The rate of infiltration varies linearly between field capacity (where the rate is zero) and maximum water content. The slope of this line is governed by the soil water half-life (SWHL) value

selected (slope = $1\text{-}e^{(-0.69 \times \text{time step})/\text{SWHL}}$). This value is typically selected so that the predicted infiltration rate at soil saturation is equivalent to the SHC of the surface soil. The rate of infiltration can never exceed the SHC of the surface or subsurface soil, and the subsurface SHC is often much less than the surface SHC. Therefore, **saturated hydraulic conductivity of the subsurface soil tends to govern long-term infiltration rates in the LIFE™ model simulations.** Surface runoff occurs when the surface soil reservoir is full (saturated soil plus any allowable ponding depth exceeded).

Note that a certain percentage of the infiltrated water can be assumed to emerge to the surface runoff as interflow (thus contributing to the modeled flow hydrographs), and the rest would be "lost" to deep groundwater.

Media Infiltration

Media infiltration objects are used to simulate infiltrating areas that behave as simple storage reservoirs, such as gravel infiltration trenches, pervious paving with reservoir base course, infiltration chambers, and bioretention underdrain layers. These objects may be connected to a *rainfall* object (if there is rainfall input) and may be connected to an *ET* object (if there is any evaporation assumed). An area must be defined for each *pervious surface* object along with the following hydrologic properties:

- **Retention depth**, which is the average depth from the bottom of the facility to the overflow level.
- **Void space ratio**, which is the fraction of the total media volume available for water storage (e.g., typically between 0.3 and 0.4 for gravel).
- **Saturated hydraulic conductivity (subsurface)**, which governs the maximum rate that water can move out of the media into the underlying soil.
- **Saturated hydraulic conductivity (media infiltration)**, which governs the maximum rate that water can move through the media. This does not tend to be a limiting factor and is typically assumed to be very large.
- **ET multiplier,** which is the multiplication factor that is applied to the reference ET data (or pan evaporation data) contained in the global environmental conditions object to determine evaporation losses during each time step (may be zero).

Media infiltration objects operate very similarly to a simple reservoir model, with inflow defined by the connected objects (e.g., rainfall, impervious surface runoff, infiltration from overlying bioretention cell or swale), outflow defined by the infiltration rate (subsurface SHC), and storage capacity defined by the above dimensions (area x retention depth x void space ratio).

Flow Routing Objects

The physical objects described above produce volume outputs (i.e., runoff and infiltration volumes per time increment), which can be expressed as average flowrates. *Flow routing* objects can be placed at any level within a LIFE™ model to perform overland flow routing or simple channel routing using a kinematic wave approach. These objects require only an inflow connection (runoff volume to be routed) and the following inputs:

- **Total contributing area**, which is the assumed area over which flow occurs (overland flow area or channel area)
- **Average width of flow path**
- **Average slope of flow path**
- **Manning's roughness coefficient (n) for flow path**
- **Initial depression storage** (storage characteristics are best defined by adjusting the retention properties of the physical objects; therefore, this parameter is often set to zero)
- **Convergence criterion** for flow continuity iteration (typically a very small number)

For each time step, *flow routing* objects convert runoff volumes to flowrates by combining Manning's equation with a flow continuity equation—the same kinematic wave approach used by other common hydrologic models (e.g., SWMM, MOUSE). Flow depth is initially estimated by dividing input runoff volume by total area. Manning's equation is combined with a flow continuity equation (i.e., flow in = flow out plus change in storage) to provide a differential equation that can be solved iteratively. Flow is then calculated using Manning's equation.

Appendix E

Birch Bay Comprehensive Stormwater Plan, Priority Capital Projects

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DATE: July 7, 2006

Introduction

This memorandum is one element of an overall Comprehensive Stormwater Plan for the watersheds of Birch Bay. Birch Bay is a rapidly growing community that is experiencing increasing flooding and erosion, declining water quality, and loss of aquatic habitat. Historically, Birch Bay has been primarily a recreational beach community. The citizens of Birch Bay completed a Comprehensive Land Use Plan that called for low-impact development (LID) and a Stormwater Plan to protect their lifestyle and aquatic resources while accommodating the anticipated growth. This Comprehensive Stormwater Plan recommends measures to achieve these goals.

Water quantity, water quality, and habitat issues identified within Birch Bay were outlined and prioritized in Chapter 3, Surface Water Issues and Problems, of the Birch Bay Stormwater Plan. This prioritization of problems was performed using criteria reflecting the goals and action items outlined in both the Whatcom County Comprehensive Plan and the Birch Bay Sub-Area Plan. Several of these identified problems can be addressed with structural solutions. These structural (nonprogrammatic) projects may be suitable candidates for the Whatcom County Capital Improvements Program (CIP).

This memorandum identifies and prioritizes projects for inclusion in a 6-year Whatcom County Stormwater CIP for Birch Bay. Estimated capital costs, maintenance costs, and potential funding sources are outlined for each proposed CIP project. Attached fact sheets provide detailed information for each proposed project.

Identification of Potential Capital Projects

Potential solutions have been identified for each water quantity, water quality, and habitat problem identified in the Birch Bay area. Chapter 4, Alternatives, of the Birch Bay Stormwater Plan describes what type(s) of solution(s) would be appropriate for each identified problem. Solutions can range from structural solutions such as enlarging or rerouting a drainage pipe to nonstructural (programmatic) solutions such as increasing maintenance or public education. Problems can be addressed by several types of solutions, often by combinations of solutions. Twelve of the identified issues in Birch Bay call for some degree of capital (structural) project as a solution, either as a stand-alone CIP project or paired with a nonstructural solution such as increased maintenance, public education, inspection, or enforcement.

Not all of the problems identified in this process can or should be addressed. Of the problems identified as having CIP solutions, five were ranked in the bottom half of all the 41 water quality, water quantity, and habitat problems identified initially. These problems were rated lower than other problems, indicating they are relatively less important than other problems. Also, many of these problems can be addressed by programmatic solutions such as increased M&O or more frequent inspection and enforcement rather than CIP projects.

After prioritization and elimination, seven problems remain. Table 1 at the end of this memorandum contains a listing of the seven priority problems that may be addressed with a CIP project.

Descriptions of Priority Capital Projects

This section contains a brief description of the identified problem and a corresponding description of alternative and preferred solutions. Each project has been given a name along with the original problem code. Additional details of each project are included in the attached fact sheets, one for each proposed project. Figure 1 shows the location of each project.

Birch Bay Drive Roadway Improvements (CC-02)

Erosion of the Birch Bay Drive road surface will be addressed in a future Whatcom County project already in the planning stages. Therefore, this problem was eliminated from this CIP prioritization analysis. Additional description or analysis is not provided here.

Drainage Improvements, Cottonwood Neighborhood (CT-06)

Problem Description

The runoff from a large contributing area flows through a culvert under Anderson Road, in an open channel through the County-owned park, then into a pipe/culvert system leading to a single diversion structure that splits into two outfalls discharging to Birch Bay at Cottonwood Beach. The diversion structure is located behind the home at 8208 Birch Bay Drive.

Two different outfalls provide the outlet for this area. These two different outfall pipes receive flow from the same location: a single diversion structure, or "hole," that channels runoff into the two outfalls from a single entry point. This hole, located behind the home at 8208 Birch Bay Drive, receives flow through a culvert and pipe system that flows underneath Cedar Road from an upstream open channel creek system. This pipe from the open channel creek system to the hole may be located underneath the trailer home just to the north of Cedar Road to the southeast of the hole.

Of the two different outfall pipes, one pipe heads to the west into Birch Bay along a County easement to the south of the residence at 8208 Birch Bay Drive. The second pipe (to the north of the first) flows west into Birch Bay through private property to the north of the residence at 8210 Birch Bay Drive. This second pipe exits the "hole" (described above) slightly higher than the first, acting as a relief system for the first outfall. This second outfall pipe is concrete and reportedly in multiple pieces along its length.

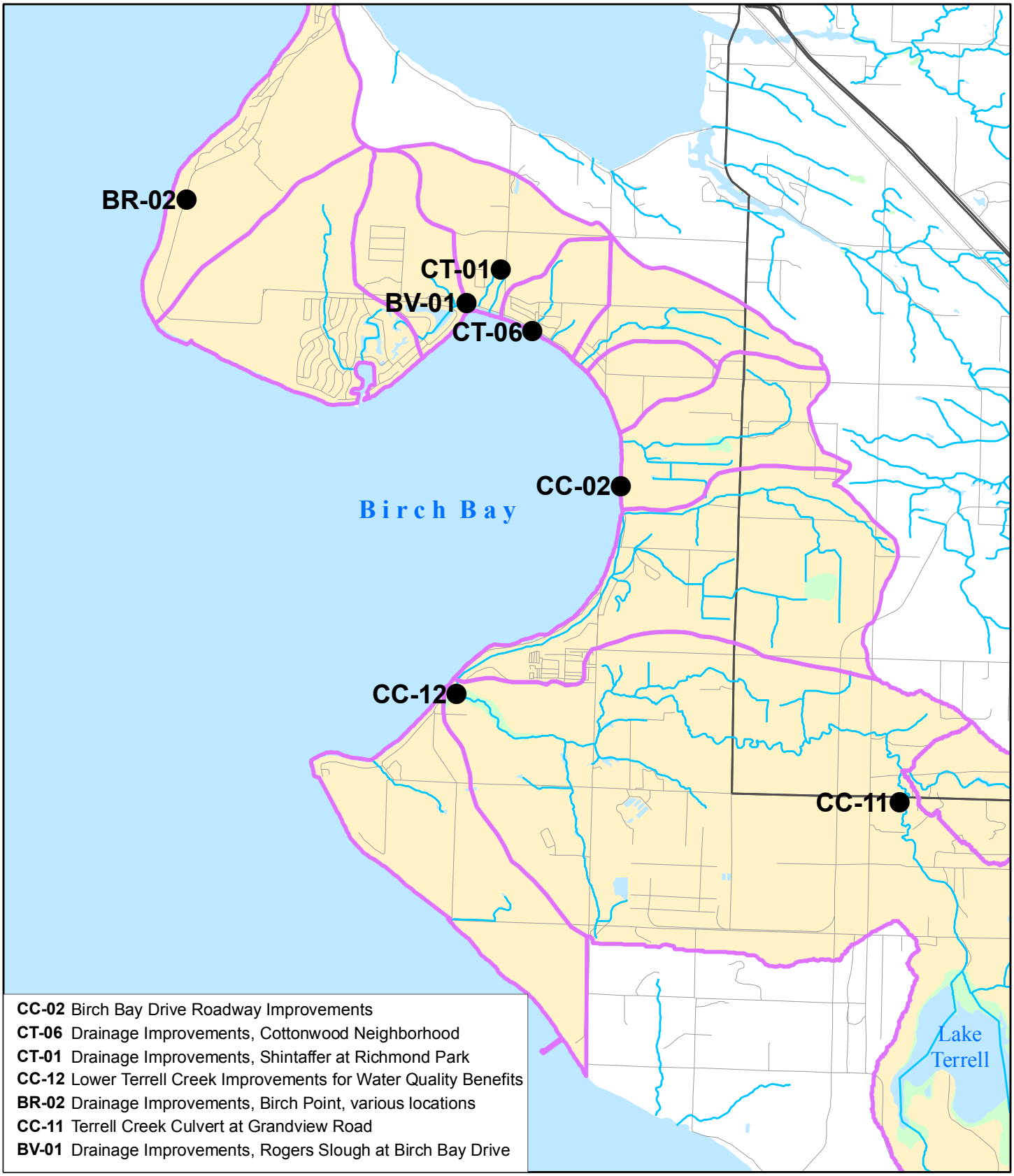

FIGURE 1
Priority Capital Projects

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Drains from houses on both sides tie into the northern outfall pipe. The neighbor to the north at 8212 Birch Bay Drive has a drain tying into this outfall pipe with a flap gate on it to prevent backflow. The neighbor to the south at 8210 Birch Bay Drive has a perforated pipe leading to the pipe. The resident at 8214 also has a yard drain leading into this same pipe.

Because the more northerly outlet pipe is in pieces, stormwater runoff may be exfiltrating into the surrounding soil. Yard flooding in the area may be the result of this exfiltration combined with a high groundwater table. Sand and beach cobbles are part of the soil mix in the area. This material has a high transmissivity that allows for rapid changes in groundwater levels with the season and perhaps with tidal fluctuations. If groundwater levels are near the surface, there is nowhere for stormwater runoff to go. Movement of sand along the beach periodically blocks the outlet and causes backwater conditions in the pipes. This condition is made worse under high tide and high landward wind conditions.

The yard at 8212 Birch Bay Drive periodically floods, as do yards to the north and south. If the outlet pipe becomes blocked with beach material and high groundwater levels exist, any stormwater runoff will have nowhere to go and will cause yard flooding in the area. The gaps in the concrete pipe (northern outfall) allow for exfiltration from the outfall pipe, plus saturated ground conditions prevent infiltration.

The runoff from the contributing area can overwhelm the system. As development continues in the upper portion of the watershed, runoff volumes and peak flowrates may increase. A preferred solution should incorporate the potential impacts that future development will have on the hydrologic regime of this system.

The owner/resident at 8212 stated that this drainage system was built by the former owner of the property. This portion of the system is on private property and is therefore a private system. Although the County may have taken responsibility thus far for maintenance, they may not be under obligation to perform such maintenance activities or to provide for improvements to the system.

Potential Alternatives

One solution to this problem is to reroute the outlet of the system west along Cedar Road under Birch Bay Drive to Birch Bay. This alternative would require construction of a new inlet structure with a trash grate, installation of several hundred feet of buried pipe, and construction of a new outfall out to Birch Bay. Portions of the existing system could not be abandoned because the system would still have to provide drainage for the cluster of homes down the hill from the new inlet. Permit requirements and construction requirements for constructing a new outfall would be significant.

A second solution would be to create an open channel instead of a piped system. The open channel portion of the current system would be extended down to Birch Bay. The inlet of the current closed-pipe system would be abandoned.

A third solution would be to re-route all flows through the southernmost outfall pipe, the outlet that flows through the County easement to the south of 8208 Birch Bay Drive. This pipe would have to be dug up and replaced with a larger diameter pipe, and the outfall structure would have to be improved. However, this alternative solution would not require the construction of a new outlet structure.

A fourth potential solution would involve installing a cast-in-place lining in one or both of the outlet pipes. The outlet pipe flowing west through private property between 8212 and 8210 Birch Bay Drive has reportedly broken into sections, with gaps in between as surrounding soils have settled. This condition may allow exfiltration of runoff into the surrounding soil, thereby increasing flooding potential. Lining this drainage pipe would prevent stormwater runoff from upstream from exfiltrating into the surrounding soil. Any flooding that would then take place in the surrounding yards would be the result of local drainage issues rather than from upstream. Infiltration could also be occurring into the pipe, depending on conditions both inside and outside the pipe. More information should be gathered to determine whether the existing system currently benefits from the exfiltration/infiltration situation. The system may be currently operating as a French drain. Like any other alternative that involves accessing this northernmost outlet pipe system, this alternative would require an easement for construction and maintenance access because it is on private property.

A fourth potential solution is to replace existing outlet structures with types that self-clean or are less prone to clogging. The existing system drains better if material is not clogging the outlets. Installation of self-cleaning outlet structures may alleviate some of the drainage issues by maintaining the design conveyance capacity of the structure. A duckbill-type outlet structure is one potential type. Any additional outlet structure would have its own set of expected head losses through the system. Detailed analysis should be performed to determine design constraints of the existing system to avoid increased flooding and backwater conditions.

An additional solution would be to fill in the yards to raise the ground elevation. This may also help alleviate yard flooding.

Preferred Solution

The solutions involving full trenching and pipe rerouting/replacement would be the most cost-intensive potential alternatives. Installation of cast-in-place lining in the northernmost outlet pipe and replacement of outfall structures on both the outlet pipes appear to be the most cost-effective structural options.

Additional analysis of the system and the flows is needed, followed by design and construction of improvements. Additional analysis may include a hydrologic and hydraulic model of the system. Further hydrologic study would allow designers to quantify the contributing area and corresponding design flows through the system. The hydraulics of the system should be analyzed to determine current head losses and other flow characteristics when the system is running at capacity. Site investigation techniques such as closed-circuit television (CCTV) pipe inspections, dye-testing, and/or survey should be used to further characterize the system before a preferred solution is implemented.

The concept-level cost estimate for this preferred solution is $225,000, including construction costs (plus 50 percent contingency) and soft costs (such as permitting, engineering/design) of 30 percent.

Drainage Improvements, Shintaffer Road at Richmond Park (CT-01)

Problem Description

The drainage ditch flowing south along the West side of Shintaffer Road conveys runoff from a large area that stretches west and north of Lincoln Road. The ditch along the west side of Shintaffer Road flows through two 90-degree bends that divert the runoff from the drainage ditch along Shintaffer Road towards the Richmond Park Subdivision. Yards in the subdivision are submerged during heavy rains as the system backs up. Runoff is then conveyed in ditches and culverts through the subdivision before discharging to an open channel/creek system and flowing to the south towards Birch Bay. The flow enters a culvert under Birch Bay Drive, then enters Birch Bay within Rogers Slough.

At the location of the two 90-degree flow diversions, runoff backs up behind the seemingly undersized culvert system in the subdivision. Yards and driveways are inundated with water. Because more development is planned for the open area to the north of the existing Richmond Park subdivision, this drainage problem has the potential to become worse. In addition, lots to the east of Shintaffer Road across the street from the Richmond Park subdivision have also had drainage issues recently, even though there are reportedly no cross-culverts across Shintaffer in that area.

After flowing through the Richmond Park Subdivision, the drainage enters an open channel creek system that flows southward towards Birch Bay. The creek crosses Fawn Crescent and then alongside Deer Creek Trail, two streets in the neighborhood with access from Birch Bay Drive. The system enters a culvert underneath Birch Bay Drive, then enters the bay.

It is not clear what the original flow path was before development of the Richmond Park Subdivision and other developments in the area. Residents have reported that an original outlet may have been through a creek system flowing south and discharging to Birch Bay somewhere between Shintaffer Road and the existing creek system by Fawn Crescent and Deer Creek Trail. Currently, this is not an outlet for the system. Runoff from a small portion of the contributing area could have originally flowed to Birch Bay along Shintaffer Road.

The culverts through the subdivision appear to be undersized for the flows that enter the system. However, simply increasing the size of these culverts will not solve the problem and will cause harm to downstream properties. The open channel creek system downstream from the subdivision is in a ravine with homes close together that are currently experiencing erosion and slope stability problems. This problem could worsen if runoff flow rates and volumes are increased.

The roadside ditches along Shintaffer Road are large and appear to have been designed to convey large amounts of flow. The ditches to the south of the pipe diversion appear to be sized to handle the flow that is currently diverted through the subdivision. However, a detailed site investigation and possibly hydrologic modeling would indicate whether flow diversions down Shintaffer or other route are feasible and indeed the preferred alternative.

Preliminary development plans for the open area to the north and west of the Richmond Park Subdivision indicate that runoff from most of that area will be rerouted away from the current outlet through the subdivision. Approximately 1.5 acres of the currently contributing area will then drain through the subdivision.

Potential Alternatives

One alternative is to increase the capacity of the culverts through the Richmond Park subdivision to alleviate flooding in the area. However, this action would yield higher peak flows downstream. These higher peak flows could potentially increase slope erosion and stream bed incision occurring within the ravine and creek system.

Another alternative would be to redistribute flows between the current drainage path through the Richmond Park subdivision and the drainage ditches along the west side of Shintaffer Road. These drainage ditches are relatively large and appear to have a capacity greater than the ditch and culvert system through the Richmond Park subdivision. However, the capacity of these ditches would have to be analyzed before any flows are rerouted. A third potential flow path could be identified through detailed site investigation. The area indicated by residents to be the original outlet of the system has been identified as a potential third flow path.

A third alternative is to create a detention facility in the upstream portions of the contributing area. This facility could accept flows from a portion of the area currently contributing to the ditch and culvert system through the Richmond Park subdivision. This detention facility or a portion of it could be a required part of any future development planned for that area (above and beyond their site-specific requirements), or it could be implemented by Whatcom County, and capacity could be "sold back" to the developers through a system development charge.

Because of the preliminary development plans for rerouting runoff from the open area, a potential solution is to promote this re-routing of flows and to maximize the current conveyance capacity of the system. The existing drainage ditches along the east side of Shintaffer Road should be re-formed and maintained. The drainage system through the Richmond Park Subdivision should also be inspected and maintained.

Additional analysis of the system and the flows may be needed to assess the long-term affects this hydrologic regime may have on the erosion and slope degradation occurring in the backyards along the ravine downstream of the Richmond Park Subdivision. The preferred solution should incorporate the potential impacts that future development will have on the hydrologic regime of this system.

Preferred Solution

Because of the preliminary development plans for rerouting flows, the preferred solution is to promote the rerouting of flows and to maximize the current conveyance capacity of the system. The existing drainage ditches along the east side of Shintaffer Road should be re-formed and maintained. The drainage system through the Richmond Park Subdivision should also be inspected and maintained.

Additional analysis of the system and the flows may be needed to assess the long-term affects this hydrologic regime may have on the erosion and slope degradation occurring in the backyards along the ravine downstream of the Richmond Park subdivision. The preferred solution should incorporate the potential impacts that future development will have on the hydrologic regime of this system.

The concept-level cost estimate for this preferred solution is $125,000, including construction costs plus 50 percent contingency and soft costs (e.g., permitting, engineering/design) of 30 percent.

Lower Terrell Creek Improvements for Water Quality Benefits (CC-12)

Problem Description

Terrell Creek has low dissolved oxygen levels and high temperatures. Dissolved oxygen concentrations below criteria and temperatures above criteria have been recorded during water quality monitoring activities by both the Nooksack Salmon Enhancement Association (NSEA) and the Washington State Department of Ecology (Ecology). Other water quality parameters are also problematic along the length of the creek.

At one time, Terrell Creek followed a natural path through the area. It is natural for a coastal stream to move in the direction of longshore drift. Occasionally, during a large storm event, the creek would cut through to a new, more direct outlet to salt water, and the drift process started over. As development in Birch Bay proceeded, sections of Terrell Creek were confined and the creek no longer was allowed to find a natural course. Current patterns of development permanently set the location of Terrell Creek. Currently, Terrell Creek follows the beach shoreline from Birch Bay State Park to the outlet.

This entire stretch along with a large portion of the creek within the state park is tidally influenced. The Terrell Creek marsh (within Birch Bay State Park) is one of the few remaining saltwater/freshwater estuaries in northern Puget Sound. The north end of the state park is a natural game sanctuary providing refuge for smaller birds, migratory waterfowl, American bald eagles, and the great blue heron.

The lower confined reaches of Terrell Creek are affected by tidal changes that may cause stagnant conditions under periods of low stream flow and warm weather. The reaches of Terrell Creek between Birch Bay State Park and the outlet of the creek into Birch Bay have had measured low dissolved oxygen levels and higher temperatures. This has led to fish kills.

Potential Alternatives

A potential programmatic solution to the low dissolved oxygen problem in Terrell Creek is to reduce the input of nutrients and organic matter from the watershed. Excessive nutrient inputs yield algal blooms that have significant impacts on dissolved oxygen levels in the water column. Organic matter uses up the available oxygen in decomposition processes. A second programmatic solution is to plant trees at various points along the length of the creek to increase shade and therefore reduce temperatures.

One structural alternative is to relocate the mouth of the creek to provide a more direct path to Birch Bay. This would allow Terrell Creek to "find" its natural pathway to Birch Bay, responding to natural process. A feasibility study would be required for both the creek realignment and for the most appropriate use for the current pathway of Terrell Creek from Birch Bay State Park to the current mouth. This would eliminate extensive fish, bird, and other wildlife habitat in and along the existing channel.

The benefits of a more direct pathway for Terrell Creek would have to be weighed against current habitat use and other factors. Currently, much of the lower reaches of Terrell Creek are tidally influenced and provide estuarine habitat for several species of birds and waterfowl. Realignment of the creek may negatively affect current habitat conditions. In addition, the tidal influence (and corresponding backwater conditions under high tide) may be propagated

upstream with the creek realignment. This may have negative impacts on upstream people and properties.

Another solution would be to aerate the water in known problem areas to increase the dissolved oxygen content. This solution is expensive, and it is not a sustainable alternative. Permitting would be difficult because it does not address the cause of the problem, only the symptoms.

Preferred Solution

Poor water quality conditions in Terrell Creek should be addressed by programmatic solutions such as source control efforts instead of by the structural alternative of realigning the mouth of the creek. Details of these programmatic solutions are included in Chapter 4, Alternatives, of the Birch Bay Stormwater Plan.

The structural alternative may have more of a negative impact than a positive one. Although conditions in Terrell Creek under the current alignment are not ideal, realigning the mouth of the creek has the potential to negatively affect the current habitat conditions in the creek. Programmatic solutions would provide more benefit for less cost (both financial and environmental) than would this structural solution. A concept-level cost estimate for the structural alternative of re-aligning Terrell Creek is close to $2 million, including construction costs (plus 50 percent contingency) and soft costs (including permitting and legal costs) of 30 percent of construction costs and engineering study/design at an additional 30 percent. These higher costs for permitting and engineering study/design reflect the specific issues of a construction project along a shoreline and within a salmon-bearing stream such as Terrell Creek.

Planting trees along the length of Terrell Creek would increase shade and therefore reduce temperatures. A concept-level cost estimate for this preferred solution is $50,000.

Drainage Improvements, Birch Point, Various Locations (BR-02)

Problem Description

The natural hydrology in the Birch Point area has been altered such that stormwater runoff is now conveyed through culverts and ditches. Surface flow is conveyed towards Birch Bay in concentrated flow streams that may contribute to erosion and stability problems at the point of discharge. Ditches accelerate velocities of runoff because they are straight and relatively smooth. Ditch construction has channelized the system and promoted higher runoff velocities and greater volumes of runoff.

Construction of roadways and roadside ditches has altered the surface and subsurface flow throughout Birch Point. Subsurface flow in the upper portion of soil is intercepted by roadside ditches and is conveyed more quickly and in more concentrated amounts than if the roadway and roadside ditches had not been there. By intercepting horizontal flow and removing water from shallow soils, roadside ditches reduce the amount of water moving across private properties toward the bluff.

The subsurface geology of the area consists of clay and hard-packed marine sediments. Infiltration capacity is limited because of this. Drainage issues are therefore more pronounced

because the soil is less forgiving. This is true throughout the Birch Bay area but particularly in the northern half where marine soils predominate.

Specific surface drainage problems identified in the Birch Point area are as follows:

- Oertel Drive ditch overwhelmed, loss of capacity due to accumulated material; residents have cut paths for water access.
- 8621 Semiahmoo Drive drainage ditches overwhelmed, low point in roadway.
- Normar Place, erosion of ditch and surrounding material during storm, plugged up outlet and overwhelmed system.
- Ditches along Cary Lane
- Localized road flooding at the Semiahmoo Drive and Birch Point Road intersection.

Slope stability is a problem all across the bluffs of Birch Point. Natural processes have been accelerated by increased runoff velocities and volume due to removal of vegetation, the installation of septic tank drain fields, and the construction of impervious surfaces and channelized ditches.

The westernmost portion of the area at and north of Birch Point itself is a geologically unique area. This portion of Birch Point is a groundwater recharge area where the overlying area is not perched and therefore contributes surface water to the shallow and deep groundwater flow. Land use activities in this contributing area have a great impact on the subsurface flows. Removal of trees and tree stumps may have increased the subsurface flows in the area. This increase in subsurface flow has been experienced by residents living along the edge of the steep slopes, and the residents have witnessed increased seepage and groundwater flow underneath their homes and out the sides of the slopes. Increases and changes in subsurface flow can affect the rate of slope movement and may increase the risk of landslide action.

Potential Alternatives

A structural alternative to this set of problems is for improvements in the conveyance of runoff from upstream contributing areas. This project would involve the design and construction of tight-line drainage from an upstream contributing area across a road to the edge of the slope, then down the slope. This setup would be repeated up to three additional times depending on location and magnitude of runoff flows from upstream areas. David Evans and Associates have identified each specific surface runoff outlet from Trillium Property. This inventory should be incorporated into the design/engineering of any drainage improvements.

Programmatic solutions include public education on proper drainage techniques, stricter requirements on addition of impervious surface and tree removal, increased inspection and enforcement of land clearing and drainage requirements, and implementation of projects such as LID that have the potential for limiting runoff.

Preferred Solution

The preferred solution is the structural alternative of constructing tight-line drainage from the edge of the bluff (including steep slopes) and down to the beach. This solution could be applied at any or all of the specific identified surface runoff outlets from upstream property.

Several of these problem spots may be addressed with structural projects such as drainage reroutes and capacity increases. However, these capital project solutions should be performed concurrently with programmatic solutions such as public education on proper drainage techniques, stricter requirements on addition of impervious surface and tree removal, increased inspection and enforcement of land clearing and drainage requirements, and implementation of projects such as LID that have the potential for limiting runoff. These programmatic solutions are addressed Chapter 4, Alternatives, of the Birch Bay Stormwater Plan. These programmatic solutions will address subsurface flow and erosion/stability issues around Birch Point that are not specifically addressed with this structural surface runoff improvement project.

The concept-level cost estimate for this preferred solution is $250,000 for each location. This estimate includes construction costs plus 50 percent for contingency and 30 percent for soft costs (e.g., permitting, engineering/design). Addressing four locations is estimated to cost $1,000,000.

Terrell Creek Culvert at Grandview Road (CC-11)

Problem Description

The Grandview Road crossing of Terrell Creek is currently a fish passage barrier under low-flow conditions. The culvert is situated high enough above the creek bed that any fish passage under low flows is impossible. Either this culvert would have to be replaced or the channel downstream from the culvert would have to be built up in elevation to allow for fish passage through the existing culvert. (The culvert at Blaine Road is also a fish passage barrier along Terrell Creek. However, the culvert at Blaine Road is currently slated for replacement by the Washington Department of Transportation and is therefore not addressed here.)

Potential Alternatives

One potential alternative is the installation of a series of weirs downstream from the existing culvert to increase the elevation of the stream bed. This could allow passage of fish during all flow regimes including low flow. However, the most direct approach to this problem would be the installation of a fish-friendly culvert such as a box culvert that would allow passage under low flow conditions.

Preferred Solution

The preferred solution is the replacement of the existing culvert with a box culvert to allow for year-round fish passage under all flow regimes.

The concept-level cost estimate for this preferred solution is $460,000, including construction costs plus 50 percent contingency and soft costs (e.g., permitting, engineering/design) of 30 percent.

Drainage Improvements, Rogers Slough at Birch Bay Drive (BV-01)

Problem Description

Drainage ditches discharging to Rogers Slough back up behind the tide gate under high tide and/or wet weather conditions. When these ditches overflow, backyard flooding occurs in the homes within Birch Bay Village that have backyards along Birch Point Road. Ditches also back up along the north side of Birch Point Road.

Much of this area may be at or just above high tide level. During wet periods, runoff will back up behind the existing tide gate until the tide recedes and this runoff can discharge through the gate. However, this drainage is prevented by a nonfunctioning tide gate, or an excess of runoff into the system, or lack of maintenance of the tide gate. Accumulated material within Rogers Slough also may prevent adequate drainage from the system. Note that the flooded areas are low and historically are likely to have been wet even before homes and roads were built in the area. It may be appropriate to prevent further home construction in wet areas.

Potential Alternatives

Potential solutions include structural and programmatic alternatives. Structural alternatives consist of improvements to the drainage system or filling yards that experience the flooding. Improvements to the drainage system may include a reconfiguration of the existing tide gate, drainage ditches, and cross-culverts in the area. For example, Birch Bay Village representatives have proposed a culvert reroute along Birch Point Road under the Birch Point Loop to alleviate flooding.

The alternative of filling in portions of the area that are below high tide level would have permitting difficulties and may not alleviate the problems.

Material such as trees tend to accumulate within Rogers Slough and prevent adequate drainage. Therefore, increasing frequency of maintenance as a programmatic method may alleviate some of the flooding.

The preferred solution should incorporate the potential impacts that future development will have on the hydrologic regime of this system.

Preferred Solution

Accumulated material such as trees should be removed from Rogers Slough more frequently to help alleviate the drainage problems. This programmatic solution is addressed Chapter 4, Alternatives, of the Birch Bay Stormwater Plan.

A detailed study of the area and the problem should be conducted as part of the preferred solution. A survey would yield detailed elevations of homes, yards, roadways, drainage ditches, pipes, and the tide gate in relation to tidal elevations within Rogers Slough. Further hydrologic study would allow designers to quantify the contributing area and corresponding design flows through the system. In addition, the formulation of a hydrologic model would enable planners to determine adequate detention requirements for future developments. This may include increased detention requirements for any additional developments planned for the contributing area that would exceed the current detention capabilities of the existing system.

Drainage ditches, culverts, and pipes may be upgraded to maximize conveyance capacity. The tide gate may be replaced, depending on the results of the initial study. As an initial estimate, this preferred structural solution (if required, depending on results of detailed study) would cost $425,000, including construction costs plus 50 percent contingency and soft costs (e.g., permitting, engineering/design) of 30 percent.

Any capital project should be coordinated with updated M&O procedures and plans associated with tide gates and tide gate operation. In addition, any updates to planning requirements and

requirements on LID and other source control should be made with this problem and project in mind as it relates to new development in the area.

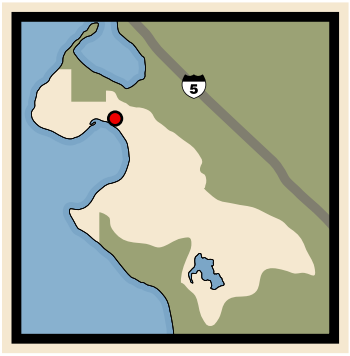
TABLE 1
Priority Capital Projects for Whatcom County CIP

Capital Project Name (Rank)	Capital Project Description	Recom-mended Capital Project?	Problem Rank (out of 41)	Problem Description	Type of Problem (Drainage, Water Quality, or Habitat)	Concept-Level Cost Estimate of Preferred Capital Solution[a]
CC-02 (1)[b]	Birch Bay Drive Roadway Improvements (project already underway)[b]	NO	1	Erosion of material supporting roadway of Birch Bay Drive	Drainage or Erosion / Stability	--
CT-06 (2)	Drainage Improvements, Cottonwood Neighborhood	YES	4	Drainage/flooding issues at Cedar and Birch Bay Drive at Cottonwood Beach; discharging through two outfalls along beach	Drainage	$225,000
CT-01 (2)	Drainage Improvements, Shintaffer Road at Richmond Park	YES	4	Drainage/flooding Issues along Shintaffer Road along north side of Richmond Park subdivision	Drainage	$125,000
CC-12 (4)	Terrell Creek Improvements for Water Quality	YES	6	Terrell Creek Confined in lower reaches – poor water quality	Water Quality and Habitat	$50,000
BR-02 (5)	Drainage Improvements, Birch Point, Various Locations	YES	16	Drainage/flooding Issues, various places along Birch Point Area (Cary Lane, Semiahmoo Drive, Normar Place, Semiahmoo/Birch Point Roads)	Drainage	$250,000 for each individual location (up to four locations)
CC-11 (6)	Terrell Creek Culvert at Grandview Road	YES	17	Road Culvert as blockage to fish habitat, Blaine and Grandview Roads	Habitat	$460,000
BV-01 (7)	Drainage Improvements, Rogers Slough at Birch Bay Drive	YES	20	Drainage/flooding behind tide gate at Rogers Slough	Drainage	$425,000

[a] Preliminary cost estimates include construction costs with 50% contingency and 30% for "soft" costs such as permitting and engineering/design.
[b] Birch Bay Drive Roadway Improvements are part of a project that is currently underway within Whatcom County. Therefore, this problem is not addressed in this analysis.

Drainage Improvements, Cottonwood Neighborhood (CT-06)

CT-06



PROJECT DESCRIPTION

Stormwater runoff for a large portion of the Cottonwood Neighborhood is conveyed through the open channel through the County Park and into a closed-pipe system consisting of one pipe leading to a structure diverting flow to two different outfalls along Cottonwood Beach. Flooding occurs in the yards along Birch Bay Drive close to the system outlets. Development is expected to continue in the upstream portions of the drainage basin. This system must be capable of handling any additional flows due to these new developments. The failing system is on private property and was constructed by private property owners.

EXPECTED BENEFITS

Provide adequate drainage for contributing area

Decrease magnitude and frequency of flooding

Improve health and safety

DESIGN OBJECTIVES AND REQUIREMENTS

Increase capacity of system to convey runoff from contributing area

Create design that accommodates sand and other material that accumulates within outlets at beach

Maintain aesthetically-pleasing appearance of beachfront area

POTENTIAL ALTERNATIVES

Construct system re-route, requiring more than a hundred feet of new drainage pipe plus new outfall to Birch Bay

Re-route all flows to one outlet rather than two; increase capacity of existing outlet, requires construction of more than a hundred feet of larger diameter pipe, improved outfall structure

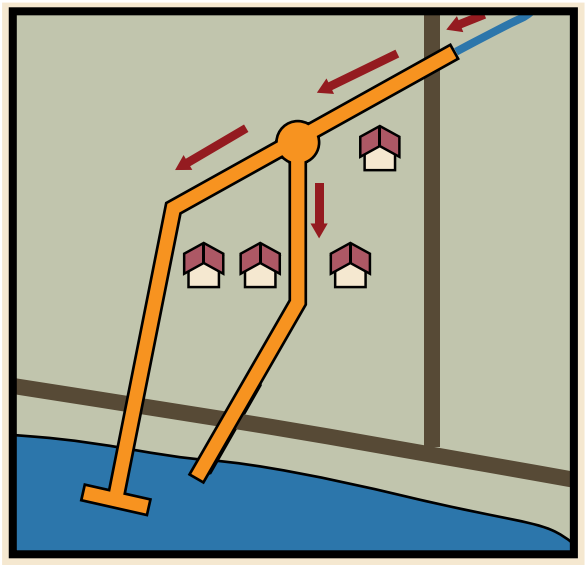
Install cast-in-place pipe liner in the northernmost outfall pipe

Upgrade current outfall structures (2) with types that prevent build-up of material and corresponding loss of conveyance capacity

Daylight closed-pipe system; extend open channel creek to Birch Bay

Fill in yards to alleviate flooding

Do nothing. The failing system is private



PREFERRED SOLUTION

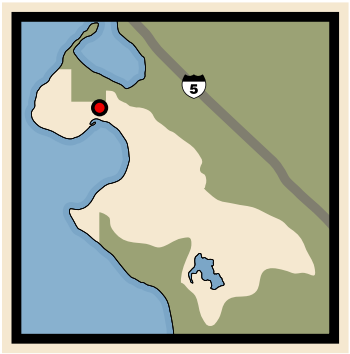
Installation of cast-in-place lining in the northernmost outlet pipe and replacement of outfall structures on both the outlet pipes, pending results from additional analysis/data review; improvements to inlet structures for safety

Perform additional analysis of system conditions and conveyance requirements, site investigation techniques such as CCTV, dye testing, and survey, hydrologic and hydraulic modeling

ESTIMATED COSTS *(concept-level only, with construction costs +50% contingency and soft costs of 25%, including permitting, engineering/design, etc.)*: $225,000

Drainage Improvements, Shintaffer at Richmond Park (CT-01)

CT-01



PROJECT DESCRIPTION

The drainage ditch flowing south along the West side of Shintaffer Road conveys runoff from a large area that stretches west and north of Lincoln Road. The ditch along the west side of Shintaffer flows through two 90-degree bends from the drainage ditch along Shintaffer towards the Richmond Park Subdivision. Runoff is then conveyed in ditches and culverts through the subdivision before discharging to a creek system through a ravine flowing to the south towards Birch Bay. The creek enters a culvert under Birch Bay Drive then enters Birch Bay within Rogers Slough. Yards in the Richmond Park Subdivision are submerged during heavy rains as the system backs up. Residents near the creek have experienced erosion and slope degradation in backyards along the ravine.

EXPECTED BENEFITS

Provide adequate drainage for contributing area

Decrease magnitude and frequency of flooding and erosion

Improve health and safety

Provide adequate storage within the upstream system

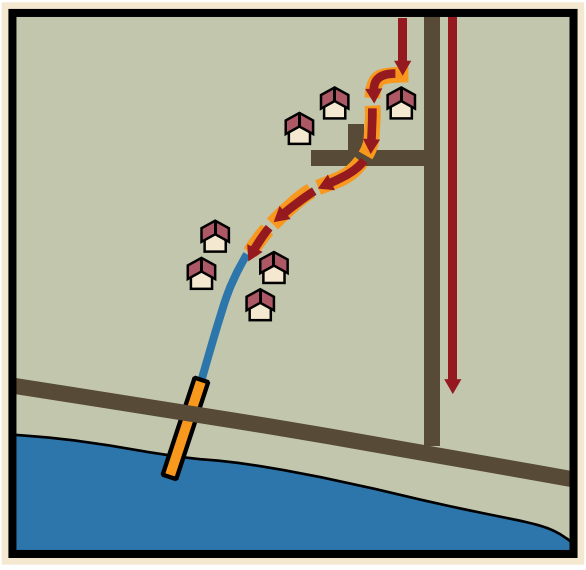
DESIGN OBJECTIVES AND REQUIREMENTS

Increase capability of system to convey runoff from contributing area

Minimize erosion of ravine and creek bank

Optimize allocation between ditches along Shintaffer and ditches in subdivision and other potential outlets

Maintain aesthetically-pleasing appearance of area



POTENTIAL ALTERNATIVES

Increase capacity of ditch and culvert system through Richmond Park Subdivision to convey runoff from contributing area

Optimize allocation between ditches along Shintaffer and ditches in subdivision and other potential outlets

Construct detention in upper portion of sub-basin

PREFERRED SOLUTION

Perform additional analysis of system conditions and conveyance requirements, site investigation including survey, hydrologic modeling

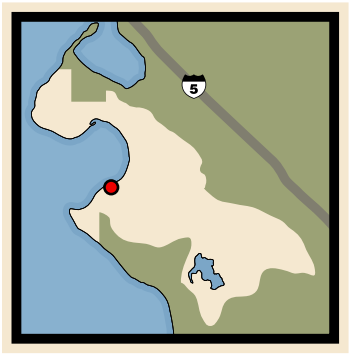
Re-allocate runoff to Richmond Park Subdivision, ditches along Shintaffer, and potential third flow path to Birch Bay

Provide detention in upstream portion of sub-basin, if necessary

ESTIMATED COSTS *(concept-level only, with construction costs +50% contingency and soft costs of 25%, including permitting, engineering/design, etc.)*: $450,000

Lower Terrell Creek Improvements for Water Quality Benefits (CC-12)

CC-12



PROJECT DESCRIPTION

At one time, Terrell Creek followed a natural path through the area. It is natural for a coastal stream to move in the direction of long-shore drift. Then, occasionally during a large storm event, the creek would cut through to a new more direct outlet to salt water and the process starts over. As development in Birch Bay proceeded, sections of Terrell Creek were confined and the creek no longer was allowed to find a natural course. Terrell Creek has low dissolved oxygen levels and high temperatures due to upstream activities within the watershed plus the confined nature of its path that limits circulation.

One alternative under this project would involve a feasibility analysis plus the design and construction of a more direct outlet for Terrell Creek. However, this alternative may be more harmful than it is helpful, as the current configuration of Terrell Creek includes an extensive estuarine area that provides habitat for several species of birds and waterfowl.

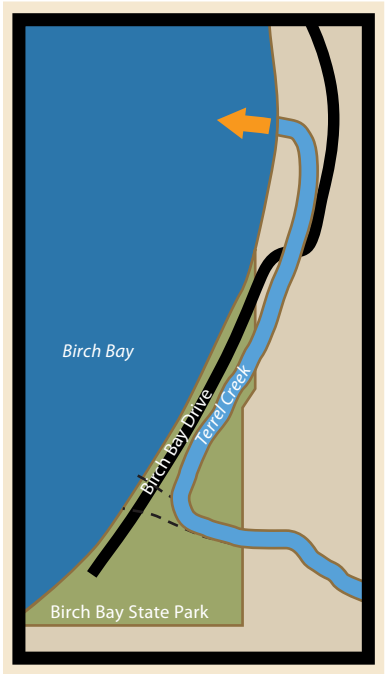
Because of this constraint, the preferred solution for this project is to improve water quality conditions within Terrell creek through programmatic rather than structural means. These programmatic solutions are described in Chapter 4 (Alternatives) of the Birch Bay Stormwater Plan.

EXPECTED BENEFITS

Increase in water movement to allow for higher dissolved oxygen content

Re-create natural conditions that are more suitable for fish

Alleviate current stagnant water conditions in lower confined reach of Terrell Creek



DESIGN OBJECTIVES AND REQUIREMENTS

Conduct assessment of benefits versus loss of current habitat and structure

Assess how project would affect hydraulic and geomorphic conditions

Preserve current uses by people and wildlife

Maintain aesthetically-pleasing appearance of area

POTENTIAL ALTERNATIVES

Conduct physical reconfiguration of creek path to more natural conditions; construct new outlet for Terrell Creek within Birch Bay State Park

Incorporate programmatic solutions such as source control efforts and tree plantings

Consider acquisition of ajoining properties

PREFERRED SOLUTION

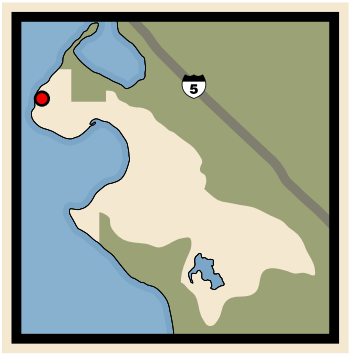
Address water quality problems by programmatic means; plant trees, increase source control efforts, education, evaluate acquisition

ESTIMATED COSTS *(concept-level only, with construction costs +50% contingency and soft costs of 25%, including permitting, engineering/design, etc.)*:

$50,000 for tree planning and aquatic habitat enhancement

Drainage Improvements, Birch Point, Various Locations (BR-02)

BR02



PROJECT DESCRIPTION

The natural hydrology in the Birch Point area has been altered due to past development. Construction of roadways, roadside ditches, and homes has altered the surface and sub-surface flow. Loss of vegetation has increased volumes of runoff and peak flows. Surface flow is conveyed in cross-culverts and roadside ditches then flows towards Birch Bay in concentrated flow streams that may contribute to erosion and stability problems at the bluff.

Several localized surface drainage issues have been identified in the Birch Point Area. This project would involve addressing these issues by increasing capacity of these drainages in a manner consistent with BMPs for active landslide areas. The most immediate need is for proper conveyance of drainage from upstream contributing areas. This project would involve the design and construction of tight-line drainage at the edge of the slope then down the slope. This setup would be repeated up to three additional times depending on location and magnitude of runoff flows from upstream areas.

EXPECTED BENEFITS

Provide adequate drainage for contributing area

Decrease magnitude and frequency of drainage problems

Improve safety by decreasing risk of propagating landslides due to inappropriate drainage practices

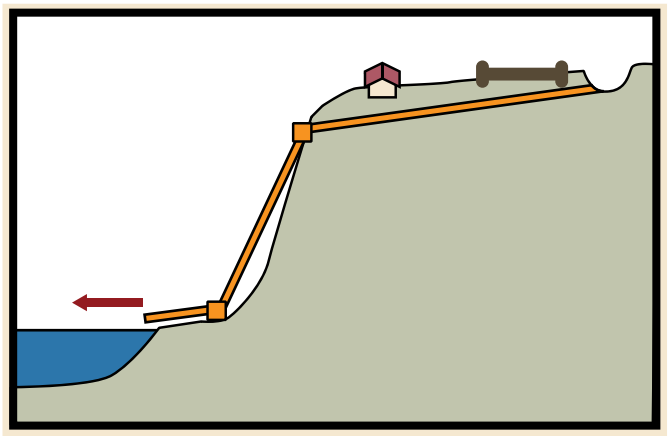
DESIGN OBJECTIVES AND REQUIREMENTS

Increase capability of system to convey runoff from contributing area

Minimize erosion of ravine and creek bank

Optimize allocation between ditches along Shintaffer and ditches in subdivision and other potential outlets

Maintain aesthetically-pleasing appearance of area



PREFERRED SOLUTION

Installation of tight-line drainage from upstream contributing properties to edge of bluff and over to water's edge

Coordination with programmatic (non-structural) alternatives such as public education on proper drainage techniques, stricter development/land clearing requirements, etc.

POTENTIAL ALTERNATIVES

Installation of adequate drainage from upstream contributing properties to edge of bluff and tight-linedto the water's edge

ESTIMATED COSTS *(concept-level only, with construction costs +50% contingency and soft costs of 25%, including permitting, engineering/design, etc.)*:

$250,000 for each site addressed, $1,000,000 for four sites

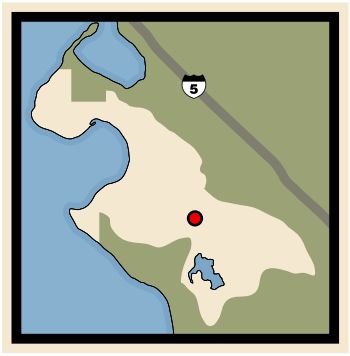
Terrell Creek Culvert at Grandview Road (CC-11)

CC-11

PROJECT DESCRIPTION

The Grandview Road crossing of Terrell Creek is currently a fish passage barrier under low flow conditions. The culvert is situated high enough above the creek bed that any fish passage is impossible under low flows.

The preferred alternative is the installation of a fish-friendly culvert such as a box culvert that would allow passage under low flow conditions.



EXPECTED BENEFITS

Provide opportunities for fish passage

Promote spawning in creek stretches upstream of Grandview Road

DESIGN OBJECTIVES AND REQUIREMENTS

Allow for fish passage in all seasons

Design culvert to achieve hydraulic capacity requirements

POTENTIAL ALTERNATIVES

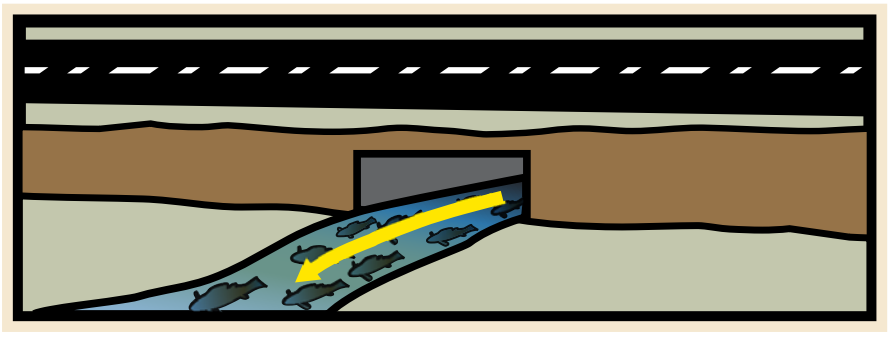
Installation of step-weirs to raise the elevation of the stream bed downstream of the Grandview Road culvert to allow for fish passage

Replacement of existing culvert under Grandview Road with "fish-friendly" culvert

PREFERRED SOLUTION

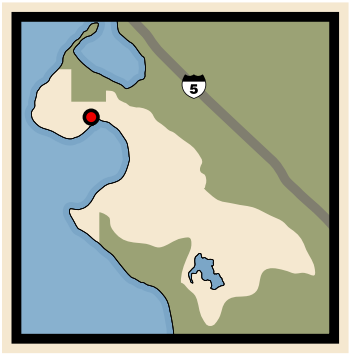
Replacement of existing culvert with "fish-friendly" culvert

ESTIMATED COSTS *(concept-level only, with construction costs +50% contingency and soft costs of 25%, including permitting, engineering/design, etc.)*: $460,000



Drainage Improvements, Rogers Slough at Birch Bay Drive (BV-01)

BV-01



PROJECT DESCRIPTION

Drainage ditches discharging to Rogers Slough back up behind the tide gate under high tide and/or wet weather conditions. When these ditches overflow, backyard flooding occurs in the homes within Birch Bay Village that have backyards along Birch Point Road. Ditches also back up along the north side of Birch Point Road. Much of this area may be at or just above high tide level. During wet periods, runoff will backup behind the existing tide gate until the tide recedes and this runoff can discharge through the gate. Note that the flooded areas are low and historically are likely to have been wet even before homes and roads were built in the area.

EXPECTED BENEFITS

Provide adequate drainage for contributing area

Decrease magnitude and frequency of flooding

Design Objectives and Requirements

DESIGN OBJECTIVES AND REQUIREMENTS

Increase capability of system to convey runoff from contributing area

Create design that accommodates material that accumulates in Rogers Slough and may block flow

Maintain aesthetically-pleasing appearance of area

POTENTIAL ALTERNATIVES

Construct drainage system improvements such as replacement of culverts, ditches, and other infrastructure

Fill in yards and other low spots that flood

Coordination with programmatic solution of increased maintenance – removal of logs other accumulated material within Rogers Slough

PREFERRED SOLUTION

Conduct site assessment study, including detailed survey of the area to assess elevations in relation to high tide; conduct hydrologic study to assess required capacity of current system

Perform improvements to drainage system and fill in yards and other low spots, pending results from site assessment study

ESTIMATED COSTS *(concept-level only, with construction costs +50% contingency and soft costs of 25%, including permitting, engineering/design, etc.)*:

$425,000