Technical Guidance Document

For Clearing and Grading
In Western Washington

washington state department of
community, trade and economic development

Cover Photo

This publication will help local governments develop best management practices for clearing and grading in their communities.

Photo/Steven Wright

Technical Guidance Document For Clearing and Grading In Western Washington

Washington State Department of Community, Trade and Economic Development

Juli Wilkerson, Director

Local Government Division

Nancy K. Ousley, Assistant Director

Growth Management Services

Leonard Bauer, AICP, Managing Director
Christine Parsons, AICP, Senior Planner
Rita R. Robison, AICP, Senior Planner
Jan Unwin, Office Support Supervisor
PO Box 42525
Olympia, Washington 98504-2525
(360) 725-3000 Fax (360) 753-2950
www.cted.wa.gov/growth

Consultant Team

David Sale, Sandra Davis, and Steven Wright
ECO Resource Group

May 2005

Table of Contents

Appendices

Table of Figures

Table of Tables

To obtain this publication in alternative format, please contact the
CTED ADA coordinator at:
PO Box 42525
Olympia, Washington 98504-2525
(360) 725-2652
(360) 753-1128 (Fax)

Acknowledgements

The Washington State Department of Community, Trade and Economic Development (CTED) wishes to thank the following people for their contributions to the quality of this document, either by providing us with references or information, or in reviewing and editing of this document or the Clearing and Grading Example Code. We have endeavoured to capture the intent of all of their comments, and value the time and effort that they have given to the project.

Harriett Beale	Puget Sound Water Quality Action Team
Steve Foley	King County Water and Land Resources Division
Drew Gangnes	Magnusson Klemencic
Tim Harris	Building Industry Association of Washington
Curtis Hinman	WSU Extension Pierce County
Jeff Killelea	Washington State Department of Ecology
James Lux	Lux Diversified
Tom McFarlane	City of Bellevue Department of Planning and Community Development
Ed O'Brien	Washington State Department of Ecology
Douglas Peters	Washington State Department of Community, Trade and Economic Development
Robin Rogers	Master Builders Association of King and Snohomish Counties
Kristen Sawin	Association of Washington Business
G.S. "Duke" Schaub	Associated General Contractors of Washington
Pat Schneider	Foster Pepper & Shefelman PLLC
Evan Sheffels	Senate Republican Caucus, Washington State Legislature
Senator Tim Sheldon	Washington State Legislature, 35th District
John Stuhlmiller	Washington State Farm Bureau
Michael Transue	Associated General Contractors of Washington
Jessica Ward	Associated Builders and Contractors of Western Washington
Greg Wingard	Waste Action Project
Bruce Wulkan	Puget Sound Water Quality Action Team

1. Introduction

This technical guidance document is intended to provide guidance and assistance to local jurisdictions in Western Washington seeking to prevent and control negative effects of clearing and grading on the environment and infrastructure. It provides supporting documentation regarding statutory and regulatory requirements and best management practices (BMPs) for land clearing and grading in Western Washington, as well as techniques to integrate requirements for stormwater management and low impact development (LID) into project and site plans and local ordinances.

The technical guidance sections of this document also support a Clearing and Grading Example Code (Example Code) included here as Appendix 1. This Example Code represents language and techniques to assist jurisdictions in Western Washington in adopting, updating, or amending clearing and grading, erosion and sedimentation, critical area, or forest protection codes or ordinances in response to growth management planning and Phase II National Pollution Discharge Elimination System (NPDES) stormwater permit requirements.

Chapters of this guidance document provide:

- A background discussion of clearing and grading management, how it is integrated with other planning efforts and legal requirements, and how to maximize the effectiveness of ordinances and codes.
- An overview of existing information on environmental impacts of land disturbance from clearing and grading.
- Documented practices to minimize or eliminate those impacts.

The information presented is drawn from a variety of sources including planning and technical documents and other literature on land development, clearing and grading, critical areas protection strategies, erosion and sedimentation control, site design, landscaping, and construction practices. The document conveys a range of practices and techniques used to prevent, control, minimize, or eliminate impacts of land development practices that relate to clearing and grading and construction stormwater management. It also suggests where LID practices might be integrated to afford the most opportunities and regulatory flexibility to local jurisdictions.

This technical guidance document is not a state regulation and is developed as an advisory document only. It has no independent regulatory authority and does not establish new environmental regulatory requirements. Nothing in this document is intended to supercede or amend the Washington State Department of Ecology's (Ecology) 2001 *Stormwater Management Manual for Western Washington* (SWMM) or the latest edition of the manual (see Section 1.6 for further considerations regarding this document).

1.1 Background

Clearing and grading activities that precede land development can impact landscape and infrastructure in a number of ways, including increased erosion and sedimentation, increased airborne dust, mobilization, and transport of contaminants, reduced slope stability, increased soil compaction, damage to sensitive and critical areas, disruption of existing hydrologic patterns, and negative impacts to fisheries and aquatic life (Corish, 1995 and Ecology, SWMM-II, 2001). However, since clearing and grading occurs early in the development process, planning and site management choices at this stage can also create opportunities to reduce negative short- and long-term effects of land development (Corish, 1995), as well as reduce costs of land clearing, maintenance, and management (Cahill and Horner, 1992), and restoration (Corish, 1995 and Ecology, SWMM-II, 2001). The potential effects of clearing and grading are discussed in more detail in Section 2, and BMPs and other techniques and opportunities for reducing these effects are discussed in Section 3.

The principal regulatory mechanism used by local jurisdictions to manage the effects of clearing and grading practices is through the adoption of local codes and ordinances. A number of jurisdictions in Washington have adopted either specific clearing and grading ordinances, or utilize stormwater management, tree protection and natural landscape or vegetation, stormwater ordinances, and critical areas ordinances to address land development impacts of clearing and grading. Most of these ordinances seek to minimize the impacts from land disturbance activities such as clearing vegetation, grading, and fill practices through a variety of strategies that seek to control the impacts of disturbance through methods such as temporary (and permanent) structural erosion and sediment controls (TESC). Strategies for controlling disturbances include construction site access control, stormwater detention, sediment trapping and filtration, fencing, conveyance channels, and other techniques. According to Corish (1995), 88 percent of regulations setting criteria for clearing and grading were structurally related.

Conventional stormwater management designs typically locate BMPs at the most downstream point of the site for end of pipe control. The discharge using conventional BMPs is set to match the predevelopment peak stormwater discharge rate. However, this approach only controls the maximum rate of runoff while allowing significant increases in runoff volume, frequency, and duration of runoff from the predevelopment conditions. These hydrologic alterations provide the mechanisms for further degradation of receiving waters (Coffman, 1998).

Engineered stormwater conveyance, treatment, and detention systems can reduce the impacts of development to water quality and hydrology, but they cannot replicate or restore the natural hydrologic functions of the watershed that existed before development, or remove sufficient pollutants to replicate the water quality of predevelopment conditions (O'Brien, 2001). Other primarily nonstructural methods that are used for erosion prevention are intended to reduce the cleared and graded "footprint" to preserve the natural landscape features. These include minimizing vegetation removal to preserve existing site vegetation (such as limits on tree removal or requiring percentages of cleared to uncleared land), limiting development on steep slopes, fitting building sites, roads, and utilities to natural gradients, clustering development, ensuring against soil compaction, and requiring revegetation. "Minimum disturbance/minimum maintenance" site development is one highly conservative approach in which clearing and grading are allowed only within a carefully prescribed building envelope that avoids creating new landscapes and avoids other nonpoint source impacts (Cahill and Horner, 1992).

A mitigation strategy that relies solely on structural BMPs will not maintain natural levels of ecological integrity (May and Horner, 2001). Through preservation of existing vegetation and natural gradients, minimization of clearing and grading, and proper construction site management, local jurisdictions can utilize what are often "missed opportunities" for preventing erosion (Corish, 1995).

Low Impact Development

Integrating prevention and low impact practices with structural controls should enhance the flexibility and effectiveness of local efforts to minimize the effects of clearing and grading. Low impact development (LID) principles and applications present a significant conceptual shift from a purely structural approach to conventional site development and stormwater management strategies, and can provide guidance for clearing and grading practices. LID is primarily a source reduction approach, and emphasizes protection and use of on-site natural features integrated with engineered, small-scale, dispersed controls to manage stormwater and maintain or restore predevelopment watershed hydrologic functions (Hinman, 2001 and PSAT, 2005). The goal for LID is to prevent measurable impacts to streams, lakes, wetlands, and other natural aquatic systems from commercial, residential, or industrial development sites (PSAT, 2005).

While general LID practices apply to many different circumstances, individual techniques need to be fitted to the specifics of each site and project; not all LID techniques are applicable to all development projects. Local governments will want to work closely with contractors, developers, and property owners to make sure that practices used are appropriate to the site and project.

Successful LID starts with understanding the natural hydrologic and topographic characteristics of a site and developing an integrated plan that responds to those specific site conditions. This can maximize the efficiency and value of the work required for development while reducing the potential negative impacts to the site's natural ability to support stormwater and soil retention and natural infiltration. LID strategies are "neither pro-development nor anti-development, … grounded on the positive notion that environmental balance can be maintained as new communities are developed throughout our watersheds, if basic principles are obeyed" (DDNR, 1997).

Effective LID practices start during the site assessment and design/development process, employ practices to mitigate clearing and grading and site development impacts, and provide site management and restoration guidance. Site clearing and grading can be an LID tool used to reduce site impacts and stormwater flow rates and achieve the four basic elements that constitute LID design:

- Conservation measures – Retain/restore vegetation cover, permeable soils, and natural features.
- Site planning – Minimization techniques for impacts to critical areas, soils, and impervious coverage.
- Distributed and integrated management practices – Handle stormwater in small-scale, redundant, and integrated practices that slow storm flows and time of concentration.
- Maintenance and education – Acceptance and long-term maintenance of LID systems in a community.

Important LID concepts that will inform clearing and grading practices and minimize impacts include using drainage/hydrology as a design element, defining development envelopes and protected areas, developing an integrated preliminary site plan, and understanding and taking advantage of site conditions. Site conditions can be used to enhance natural systems, reduce overall site construction impacts, and (potentially) reduce development and long-run maintenance costs. The following paragraphs briefly outline these concepts, but readers are encouraged to review the LID literature cited in the references and at the end of this section.

Use Drainage/Hydrology as a Design Element (Prince George's County, 1999)
LID site planning incorporates drainage/hydrology by carefully conducting hydrologic evaluations and reviewing spatial site layout options to understand and take advantage of site conditions. Hydrologic evaluation procedures can be used to minimize the LID runoff potential and to maintain the predevelopment time of concentration.

Define Development Envelope and Protected Areas (PSAT, 2005)
Site design should include a comprehensive inventory and assessment of on-site and adjacent off-site conditions. The assessment evaluates site hydrology, topography, soils, vegetation, and water features to identify how the site currently processes stormwater. Assessment of natural resources will produce a series of maps identifying streams, lakes, wetlands, buffers, steep slopes and other hazard areas, significant wildlife habitat areas, and permeable soils offering the best available infiltration potential.

Develop Integrated Preliminary Site Plan (PSAT, 2005)
Once the site conditions and opportunities for design are known, a site plan then aligns roads, lots, and structures, and implements construction practices to preserve and utilize these features to retain natural hydrologic function. Building sites, road layout, and stormwater infrastructure should be configured to minimize soil and vegetation disturbance and take advantage of a site's natural stormwater processing capabilities. Environmental conditions, local zoning, and development requirements can be integrated with the site assessment to delineate the development envelope (area to be developed) and the native vegetation and highly infiltrative soils to be protected from development.

Use Site Conditions to Minimize Impacts (Prince George's County, 1999 and PSAT, 2005)
Minimal disturbance techniques can be employed to reduce the limits of clearing and grading and minimize hydrologic impacts. Restricting ground disturbance by identifying the smallest possible area and clearly delineating it on the site and employing minimal disturbance techniques to limit these impacts will help to maintain the hydrological and ecological integrity of the site.

Specific LID Techniques for Clearing and Grading

LID techniques specifically related to minimizing site disturbance during clearing and grading fall into four categories (PSAT, 2005):

(1) Efficient site design

- Reduce the overall development envelope and maximize protection of native soils and vegetation with efficient road layout and cluster design.
- Retain natural topographic features that slow and store storm flows.
- Limit overall project cut and fill.
- Do not increase steep continuous slopes.
- Orient the long axis of buildings along contours to minimize cut and fill.
- Use minimal excavation foundation systems to minimize grading (see Minimal Excavation Foundation section, PSAT, 2005).
- Stagger floor levels in buildings to adjust to gradient changes.
- Limit clearing and grading disturbance to road, utility, building pad, landscape areas, and the minimum additional area needed to maneuver equipment (a 10-foot perimeter around the building site can provide adequate work space for most activities).
- Limit the number and extent of construction access roads, and locate access where future roads and utility corridors will be placed.

(2) Coordinated planning and activity among construction entities

- Begin clearing, grading, and heavy construction activity during lowest precipitation months and conclude by late fall when rainfall and associated soil compaction, erosion, and sediment yield from equipment activity increase. Late fall is also when conditions are most favorable for establishing vegetation.
- Plan efficient sequencing of construction phases to reduce equipment activity and potential damage to soil and vegetation protection areas.
- Establish and maintain erosion and sediment controls before or immediately after clearing and grading activity begins.
- Phase project to complete operations in one section of the site before clearing and grading the next. Project phasing is challenging when coordinating utility, road, and other activities (Corish, 1995). The greatest potential to implement and benefit from phasing will be on large projects where extensive exposed areas are difficult to stabilize over long periods.
- Map native soil and vegetation protection areas on all plans and delineate these areas on the site with appropriate fencing to protect soils and vegetation from clearing, grading, and construction damage. Fencing should be chain link and a minimum of four feet high. Silt fencing or compost berms may be necessary in addition to the chain link barrier for erosion control.
- Stockpile materials in areas designated for clearing and grading (avoid areas within the development envelope that are designated for bioretention or other bioretention areas).
- Stockpile and reuse excavated topsoil to amend disturbed areas.
- Cover small stockpiles of soil and seed larger piles for erosion control during wet months.
- Conduct a pre-construction inspection to determine that adequate barriers have been placed around vegetation protection areas and structural controls are implemented properly (Corish, 1995).

- Conduct routine inspections to verify that structural controls are maintained and are operating effectively throughout construction, and that soil structure and vegetation are maintained within protection areas.
- Conduct a final inspection to verify that revegetated areas are stabilized and that stormwater management systems are in place and functioning properly.

(3) Adequate training of personnel implementing project activities

- Install signs to identify limits of clearing and grading, and explain the use and management of the natural resource protection areas.
- Meet and walk property with equipment operators regularly to clarify construction boundaries, limits of disturbance, and construction activities.
- Require erosion and sediment control training for operators.

(4) Proper equipment

- Research in the agricultural setting indicates that ground contact pressure generally determines the potential for compaction in the upper 6-8 inches of soil while total axle load can influence compaction in the deeper subsoil layers. Vehicles with tracks or tires with axle loads exceeding 10 tons per axle can compact soils as deep as three feet. A majority of the total soil compaction (70-90 percent) can occur in the first pass with equipment (PSAT, 2005).

- To minimize the degree and depth of compaction, use equipment with the least ground pressure to accomplish tasks. For smaller projects, many activities can be completed with mini-track loaders that are more precise, require less area to operate, exert less contact pressure than equipment with deep lugged tires, and have lower total axle weight (PSAT, 2005).

In recent years, progressive local and state government surface water and resource managers, private consultants, scientists, and others have led the Puget Sound region in developing significant research and a growing number of applications of LID to demonstrate its adaptability and applicability to regional climate and soil conditions. The Puget Sound Action Team (PSAT) provides a number of resources, references, and examples at *www.psat.wa.gov/Programs/LID.htm*. The Washington State Department of Ecology's (Ecology) 2001 *Stormwater Management Manual for Western Washington* includes Volume 5, Chapter 5: On-Site Stormwater Management. Ecology is also leading a committee to increase the flow credits for LID practices that can reduce the size of stormwater ponds required to control stormwater flows from development projects. Research by the University of Washington Center for Water and Watershed Studies (*http://depts.washington.edu/cwws/*) and demonstration projects, workshops, and collaborative projects led by Washington State University Extension of Pierce County, as well as many developers, consultants, organizations, educators, and local and tribal government staff have moved the practice of LID forward rapidly in Western Washington.

The *Low Impact Development Technical Guidance Manual for Puget Sound* (PSAT, 2005) updates and provides local specifications for many of the practices in this guidance and includes information on new Ecology flow credits for LID techniques. See *www.psat.wa.gov/Programs/LID.htm* for more information on downloading or requesting a copy of this document.

1.2 Integration With Other Laws and Planning Efforts

Whatever approach a jurisdiction uses to prevent or control negative impacts from clearing and grading, it is important to ensure that any clearing and grading ordinances and practices are integrated with other laws and planning efforts. They include federal and state laws and regulations, streams and critical areas protection strategies, watershed plans, and local planning development regulations and zoning requirements.

A number of federal and state statutes and regulations set a framework for the management of clearing and grading practices, and are discussed in more detail in Appendix 2. Among the most directly relevant to the establishment of clearing and grading regulations are:

- The **Federal Clean Water Act** and its requirements for the regulation of stormwater discharges through NPDES construction and municipal permits provide a structure that will require close coordination of local actions with Ecology to ensure consistency of regulatory efforts.
- The **Endangered Species Act (ESA)** provides constraints on degradation of habitat for listed, threatened, and endangered species, in particular the effects of increased sedimentation on salmon and steelhead spawning habitat in streams.
- The **Washington State Growth Management Act (GMA)** seeks to minimize impacts from clearing and grading activities and limit soil disturbance activities by requiring local governments to address water quality and quantity in their planning and implementation considerations, including protecting designated critical areas (wetlands, fish and wildlife conservation areas, geologically unstable areas, frequently flooded areas, and critical aquifer recharge areas). All local governments in Washington state must designate and protect critical areas functions and values through the inclusion of the best available science (BAS). Criteria set out in WAC 365-195-900 through 365-195-925 create the framework for how counties and cities may use information that local, state, or federal natural resource agencies have determined represents the BAS and how to demonstrate that the best science was included in the development of critical area ordinances. The responsibility for including the BAS in the development and implementation of critical areas policies or regulations rests with the legislative authority of the county or city.
- The **Puget Sound Water Quality Management Plan** encourages communities in the Puget Sound basin to adopt ordinances implementing controls for new development and redevelopment, including measures for control of erosion, sedimentation, and other pollutants on construction sites.
- The **Shoreline Management Act of 1971 (SMA)** requires local jurisdictions to develop shoreline master programs (SMPs) and any clearing and grading regulations will need to be consistent with those plans and regulations. Shoreline Environment designations and development standards to protect shorelines under the locally adopted SMP should be consistent with provisions to protect critical areas, and thus will have relevance for clearing and grading practices.
- Under the **Forest Practices Act**, counties, cities, municipalities, or other local or regional governmental entities can adopt or enforce laws, ordinances, or regulations pertaining to land

use planning or zoning in forested areas provided that the lands have been or will be converted to a use other than commercial forest product production. The act provides that when a forest practice application is submitted under RCW 76.09.060 (Class IV General) which declares that some or all the lands will be converted to a use other than commercial timber production, the activity is subject to the provisions of the [jurisdiction]'s land disturbance regulations, and establishes when logging becomes a land disturbance activity.

It is important to consider the range of scales and cumulative effects of clearing and grading activities. Development regulations related to clearing and grading and erosion control typically focus on the constructed operational design of a project, controlled and diminished stormwater runoff, reduction of impervious surfaces, and required vegetated landscaping. While these factors may be attainable on large-scale development activities with engineered drainage plans, such as subdivisions and commercial projects, the measures may be beyond the ability of most single-family residential projects and homeowners. And yet, these smaller, single-family residential projects have a cumulative impact on a drainage basin that may be as great as that of the larger projects and result in large cumulative effects (Caine, 2001). Alternatives such as construction site phasing, which can limit mass grading, may only be appropriate for larger projects (greater than 25 acres). Individual clearing and grading or environmental sediment controls (ESC) plans would ideally take into account any applicable larger scale watershed processes (such as salmon recovery plans under ESA). At the same time, site level LID should be allowed and encouraged by jurisdictions as a component of watershed and regional land use practices (Mittelstadt, 2001). In addition, integrating clearing and grading with other planning and regulatory efforts can help promote the conservation of wildlife corridors and habitat continuity.

The integration of clearing and grading regulations with other ordinances and planning efforts will reduce duplication and costs and enhance the effectiveness of the regulations: the goal is not to duplicate, but to streamline and enhance the overall effectiveness of all the efforts. On a local scale this integration can be achieved through optimal use of initial site plans that consider the project as a whole, areas around the clearing area on the lot, and, where possible, nearby stream restoration or watershed plans.

While the nature of clearing and grading controls is to limit the negative environmental effects of these land development practices, these regulations are often seen as also restricting the options available for developers and contractors. Contractors have expressed concerns about ordinances shutting down work for extended periods of the year (due to wet season restrictions), increasing the costs of development, and lack of consistency across adjacent jurisdictions (correspondence from Jessica Ward, Associated General Contractors, July 15, 2004). There are regulatory and institutional barriers that act as impediments to LID as well (Hinman, 2001). Language in the Puget Sound Water Quality Management Plan that calls on all cities and counties in Puget Sound to "adopt ordinances that allow and encourage low impact development practices" is based on the understanding that current local policies and ordinances in the majority of jurisdictions in the basin effectively preclude the use of some innovative development and stormwater management practices. As local policies and ordinances are revised, barriers to implementing low impact development in the basin will gradually be removed (Wulkan, 2001).

1.3 Effectiveness of Ordinances

The effectiveness of codes and ordinances can vary. Several national surveys of local government programs in the 1990s, through interviews with experts and administrators, highlighted some problems that affect the quality and effectiveness of efforts to regulate clearing and grading (Corish, 1995 and CWP, 1997A). Responses noted that:

- Revegetation efforts were frequently unsuccessful.
- Sensitive areas and preserved trees were not adequately protected or even cleared.
- Cleared slopes were not adequately protected.
- Erosion and sediment controls were not adequately maintained.
- Practices prescribed in plans were never installed.
- Some BMPs installed correctly failed to perform.
- Lack of inspection occurred.
- Contractor cooperation was lacking.
- Lack of (agency) leadership.
- Lack of contractor knowledge.
- Inadequate formal training in ESC techniques.
- Wide variance in inspection frequency and effectiveness.
- Inadequate staffing.
- Funding problems for local ESC programs.

The failure of ordinances to adequately regulate clearing and grading points to factors necessary for the success of these regulatory efforts. These factors would include adequate staffing and funding of agency programs responsible for managing, inspecting, and enforcing clearing and grading projects; the ability to incorporate technological developments and learning from monitoring and inspections into ordinances; and education and training of staff, contractors, developers, and property owners. The following checklist contains a number of important questions to consider when developing clearing and grading ordinances.

A Checklist for Evaluating Local Clearing and Grading Ordinances

(Adapted from CWP, 1997, Table 40.2).

√ Has the ordinance considered revegetation within 15 days during growing season? – and mulch/straw stabilization in non-growing season?

√ Has it included any criteria to measure the success of revegetation efforts?

√ Has it considered clearly prohibiting clearing or grading within the 100-year floodplain, wetlands, stream buffers, and erodible soils?

√ Has it considered protecting the areas above the site with fencing or signs during construction?

√ Has it considered a minimum area of the site to remain uncleared?

√ Has it considered providing incentives to developers to minimize the extent of forest clearing? (e.g., footprinting)?

√ Has it considered special erosion control practices required when slopes exceed 10 to 15%?

√ Has it considered prohibiting clearing on slopes greater than 25%?

√ Has it considered phased construction on larger development sites to reduce the duration of soil exposure?

√ Has it considered any mechanism to minimize soil compaction during construction, especially near trees?

√ Has it considered provisions to conserve forests and protect individual trees during the construction process?

√ Has it considered measures to preserve existing topsoil?

√ Is a preconstruction walk through required to delineate the limits of disturbance?

√ Are performance bonds required to ensure proper compliance and successful revegetation?

Most of these issues can be evaluated and managed within a conceptual framework that might be of help to local jurisdictions thinking through the development of clearing and grading ordinances or policy, or even for those jurisdictions that would like to increase the effectiveness of existing programs. According to Daniels and Walker (2001), "effective policy":

- Is an adaptive process.
- Uses the most appropriate science and technology.
- Is implementable.
- Has low transaction costs.

In developing and amending regulations for clearing and grading practices, this means that

1. Both the regulatory structure (the local jurisdiction) and the development industry (contractors, developers, property owners) will need to be flexible enough to adapt practices and regulations to new information.
2. The practices used for preventing and controlling effects from clearing and grading will need to be monitored and reviewed to be sure they are appropriate and effective (through inspections and data collection) to define what is working and what is not, so changes can be made to improve the practices and regulations over time. Appropriate means more than just "state-of-the-art"; it also means that the practice used may depend on the site and other localized circumstances, and should be addressed in a site planning process.
3. To be effectively implemented, the ordinances should be grounded in practicality (what can be done in the local circumstances with available tools and techniques) and reasonableness (scientifically and economically sound). Ordinances must consider market forces, available technology, and environmental protection.
4. Both the short- and long-term costs of the ordinance and the practices used to prevent or control the effects of clearing and grading should be considered. This means not only up-front costs to developers and property owners, but also the costs to the jurisdiction of monitoring, enforcement, and regulation and maintenance of stormwater systems being impacted by development.

1.4 Education

A critical component to the success of land development ordinances lies in providing current information to property owners, developers, contractors, and builders on the appropriate techniques for preventing and minimizing impacts of clearing and grading. As noted in Section 1.2, the effectiveness of efforts to prevent, regulate, and control these impacts is undermined by lack of knowledge on how to apply or maintain BMPs, and on the lack of knowledge of the cost effectiveness of alternative approaches. In Puget Sound and other parts of Washington state, many developers and local governments are seeking to transition to low impact development stormwater practices. The developer and local public agency/authority must effectively communicate the benefits of LID as well as its maintenance responsibilities to potential and existing property owners. Property owners must also be educated about the necessity of not disturbing vegetation, compacting soils, or eliminating BMPs (Prince George's County, 1999). Conversely, local jurisdictional staff will benefit from establishing a productive, ongoing dialogue with scientists, engineers, and the development industry.

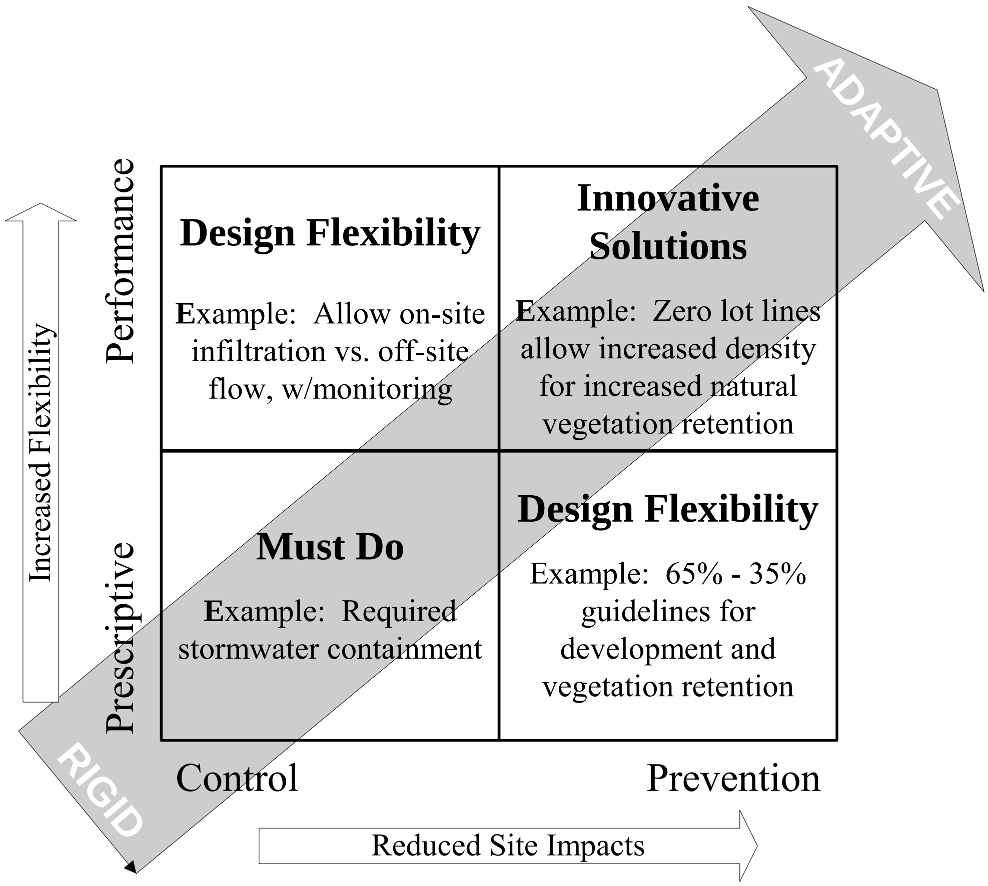
Another important education goal is to work with the building community as it undergoes a transition in modifying their construction techniques, sequencing land disturbance activities, undertaking on-site activities to reduce waste (*Built Green Handbook*, 2002), and tracking of excavated earth off site, in order to build a more sustainable community and protect environmental resources (Caine, 2001). Designers also need to know which construction practices are most problematic and know how to limit performance failures through better design and inspection (CWP, 1997C).

1.5 Prescriptive and Performance Management Approaches

A formative issue for local government planners and elected officials seeking to develop, revise, or implement clearing and grading regulations is the appropriate balance between prescriptive and performance approaches. Prescriptive approaches provide specific methods and techniques (such as BMPs) that must be followed, and are generally easier and less costly to enforce. Performance-based approaches specify what criteria must be met at different stages of the project, without specifying exactly how these must be met. Performance criteria could include, for example, acreage of natural vegetation left undisturbed, adherence to water quality standards (such as turbidity), success of revegetation efforts, and others. Performance-based standards require adequate review, approval, inspection, clear standards, and monitoring, all of which result in more up-front time to establish individual permit or project requirements, and may be more difficult to enforce. This could result in greater costs to both local government and individual developers. But performance-based standards would also allow for more flexibility in the permitting process and in the options for site development, which could result in cost savings for local governments and developers, result in creative new approaches, and benefit those LID approaches that are often held back by existing regulations. Any performance-based approaches must still follow the statutory requirements.

One alternative may be to use a prescriptive approach with performance incentives (Figure 1). Such an approach would appropriately balance control of clearing and grading impacts with prevention. Incentives should be built into such a system; resulting in faster project review times, more flexible permit conditions, or reduced or waived permit fees or bonds for projects that clearly show preventive techniques in site plans.

Figure 1. Matrix showing relation of regulatory and management choices for clearing and grading options



1.6 Considerations When Using This Document

This technical guidance document provides information for a comprehensive approach to managing clearing and grading activities that attempts to integrate clearing and grading with low impact development and stormwater management practices. It is intended to provide local jurisdictions with technical assistance when developing or updating their clearing and grading regulations. This technical guidance document is not a state regulation, and is developed as an advisory document only. It is intended to provide an example to local jurisdictions, developers, contractors, and others on different methods or ways to manage clearing and grading activities in compliance with applicable state and federal laws. This document has no independent regulatory authority and does not establish new environmental regulatory requirements.

The recommendations and approaches to clearing and grading practices presented here are meant to provide resources and guidance to local jurisdictions, but do not supercede or amend Ecology's 2001 *Stormwater Management Manual for Western Washington* (SWMM) or the latest edition of the manual. Ecology has stated its desire to have the Example Code and guidance be consistent with the likely permit conditions of the Construction Activities General

Permit that is expected to be issued in 2005. Although Ecology cannot guarantee what those permit conditions will be, it is Ecology's intent to incorporate much, if not all, of the text within the 12 "Construction Stormwater Pollution Prevention Plan (SWPPP) Elements" as published in the 2001 *Stormwater Management Manual for Western Washington*. Ecology also intends to reference the use of BMPs in the manual, or BMPs that provide equivalent pollution control, as acceptable approaches to achieve the intent of the elements.

Consistency among the Example Code, this technical guidance document, and the Ecology stormwater manuals and construction permit will help local jurisdictions take advantage of federal stormwater regulations aimed at reducing the permitting burden on local governments. These federal regulations allow construction sites between one and five acres to be regulated by "qualified" local programs as an alternative to obtaining coverage under an NPDES permit issued by Ecology. To be a "qualified" local program, a local government will have to develop or reference some compendium of BMPs that provide a similar level of pollution and flow control during construction as those BMPs in the Ecology manuals. The local government will have the burden of proof to demonstrate the equivalency of their documents.

Finally, this technical guidance document attempts to address issues of clearing and grading impacts and practices, and relate these to stormwater management and low impact development, in effect trying to bridge design, construction, and maintenance practices. CTED understands the limitations of this "bridging," and concerns include:

- The amount of clearing and grading on-site will be directly relevant to the design of the development, and yet clearing and grading contractors have little control over the design process.
- Many LID practices, aside from the minimization of vegetation removal and soil disruption, are post-construction, design-related solutions, and are thus not applicable solely to clearing and grading.
- Construction stormwater management BMPs are more broadly applicable than to just the clearing and grading phase of development, and some BMPs are not directly applicable to just clearing and grading.

We hope that this document will be read as an effort to clarify the relationships between clearing and grading, stormwater management, and low impact development, and thus to identify opportunities for integration. Used in this way, we believe this technical guidance document can suggest ways in which clearing and grading can be used as a tool for minimizing both the costs of development (to all parties) and the impacts on the environment, while reducing duplication of efforts.

2. Clearing and Grading Impacts

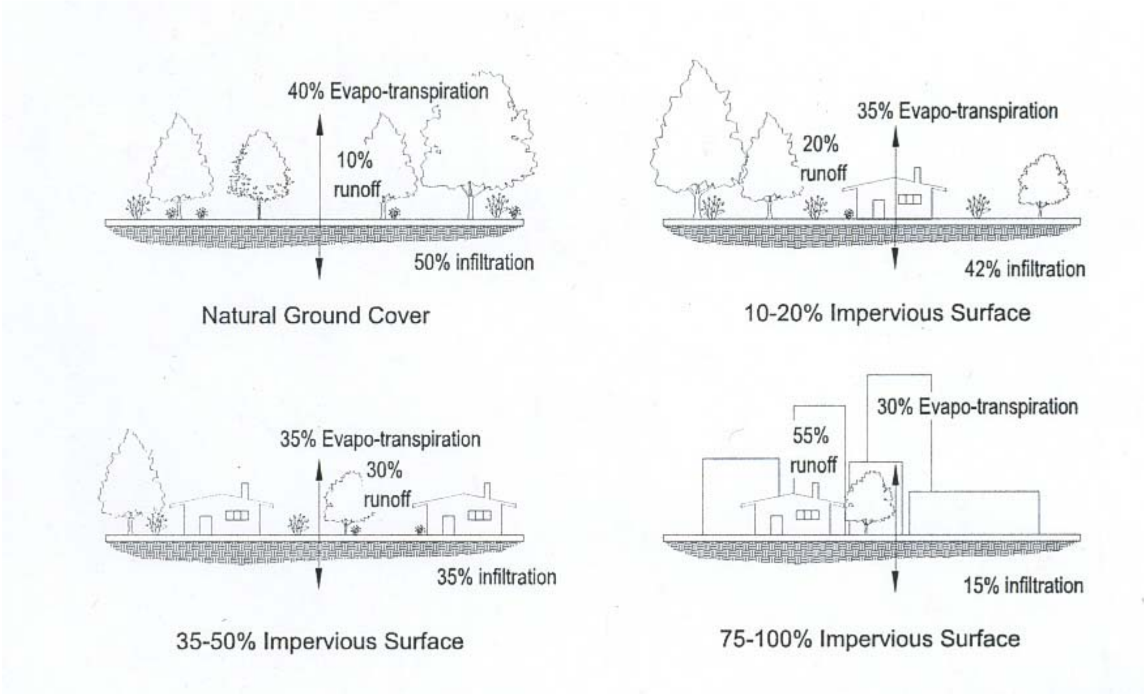
2.1 Environmental Concerns

Current development practices, including clearing of natural forest cover, grading of upper soil layers, and filling of depressional storage areas, result in a significant alteration of the watershed's natural hydrologic regime. Protecting native soil and vegetation and retaining hydrologic function during the clearing and grading phase presents one of the most significant challenges within the development process. Upper soil layers contain organic material, soil biota, and a structure favorable for storing and slowly conducting stormwater down gradient (PSAT, 2005). During the development process, both the forest cover and the highly absorbent upper soil layers (forest duff) tend to be removed. Clearing and grading exposes and compacts underlying subsoil with significantly different hydrologic characteristics (PSAT, 2005). In addition, natural areas are replaced with impervious surfaces (pavement, rooftops, and turf areas). Stormwater runoff tends to increase in proportion to increased imperviousness at the expense of infiltration, while at the same time evapotranspiration is also decreased. This shifts the hydrologic regime from a subsurface to surface-runoff-dominated system. As a result of this shift, streamflows tend to increase for a given storm event, the frequency of channel-forming flows increases, and the duration of high-flow events also increases (May et al., 1997).

Conventional stormwater conveyance systems are designed to collect, convey, and discharge runoff as efficiently as possible. The developed landscape is designed and constructed (cleared, graded, piped, and paved) with the intent to create a highly efficient drainage system to prevent on-site drainage problems, promote good drainage, and quickly convey runoff to a storm drain or stream. This efficient drainage system increases runoff volume, decreases ground water recharge, and changes the timing, frequency, and rate of discharge. Conventional site development because of efficient site drainage causes increased potential for flooding, water quality degradation, stream erosion, and the need to construct BMPs. Typical use of BMPs as an end of pipe treatment device reinforces and perpetuates the design of the efficient runoff collection and conveyance system (Coffman, 1998). This generally leads to rapid changes in stream channel morphology and the destruction of instream salmonid habitat due to the combined effects of higher peak flows and a longer duration of bankfull flow events. In addition, development can produce nonpoint source (NPS) pollution that tends to enter streams and wetlands along with stormwater runoff resulting in degraded water quality (May et al., 1997, from May and Horner, 2001).

As illustrated in Figure 2, urbanization and increased impervious areas greatly alter the predevelopment hydrology (EPA, 1993 and Booth and Reinelt, 1993). This increase in impervious areas has been directly linked to increases in impacts on receiving streams (Figure 2) by numerous investigators (including Booth and Reinelt, 1993; Horner et al., 1994; Klein, 1979; May, 1997; and Steedman, 1988). Research findings indicate that streams with a high level of "riparian integrity" have a greater potential for maintaining natural ecological conditions than do streams without a natural riparian corridor (May and Horner, 2001). In addition, streams with a riparian management zone (RMZ) that retains a high level of riparian integrity, in general, also have a higher level of ecological integrity than streams in watersheds where a structural BMP strategy is the primary mitigation strategy (May and Horner, 2001).

Figure 2. Impervious surface changes due to urbanization (From Prince George's County, Figure 2.6)



Erosion and Sedimentation

Soil erosion and the resulting sedimentation produced by clearing and grading impacts the environment by damaging aquatic and recreational resources as well as aesthetic qualities. Erosion and sedimentation can erode natural, nutrient rich topsoils making reestablishment of vegetation difficult, and often requiring soil amendments and fertilizer. Siltation fills culverts and storm drains, decreasing capacities and increasing flooding and maintenance frequency. Detention facilities fill rapidly with sediment, decreasing storage capacity and increasing flooding. Infiltration devices can become clogged and fail. Streams and harbors must be dredged more frequently to remove obstructions caused by sedimentation in order to restore navigability. Sediment in lakes builds more rapidly, reducing water depth, and shallow areas can become covered by aquatic plants, reducing usability. Phosphorus attached to soil particles increases nutrient loading, and can cause a change in the water pH, algal blooms, and oxygen depletion in lakes and streams that lead to eutrophication and fish kills. Water treatment for domestic uses becomes more difficult and costly. Eroded soil particles decrease the viability of macro-invertebrates and food-chain organisms, impair the feeding ability of aquatic animals, clog gill passages of fish, and reduce photosynthesis. Successful fish spawning is diminished by sediment-clogged gravel. Sedimentation following spawning can smother the eggs or young fry (Ecology, SWMM-II, 2001).

Soil Erosion

Rapid urbanization of forest and farmland in the Puget Sound basin has severely degraded soil capacity to absorb, filter, and store rainwater and support vigorous plant growth. Common development practices include removal of topsoil during grading and clearing, compaction of remaining soil, and planting into unimproved soil or shallow depths of poor quality imported topsoil. These conditions typically produce unhealthy plants that require excessive fertilizers and pesticides, further contaminating runoff.

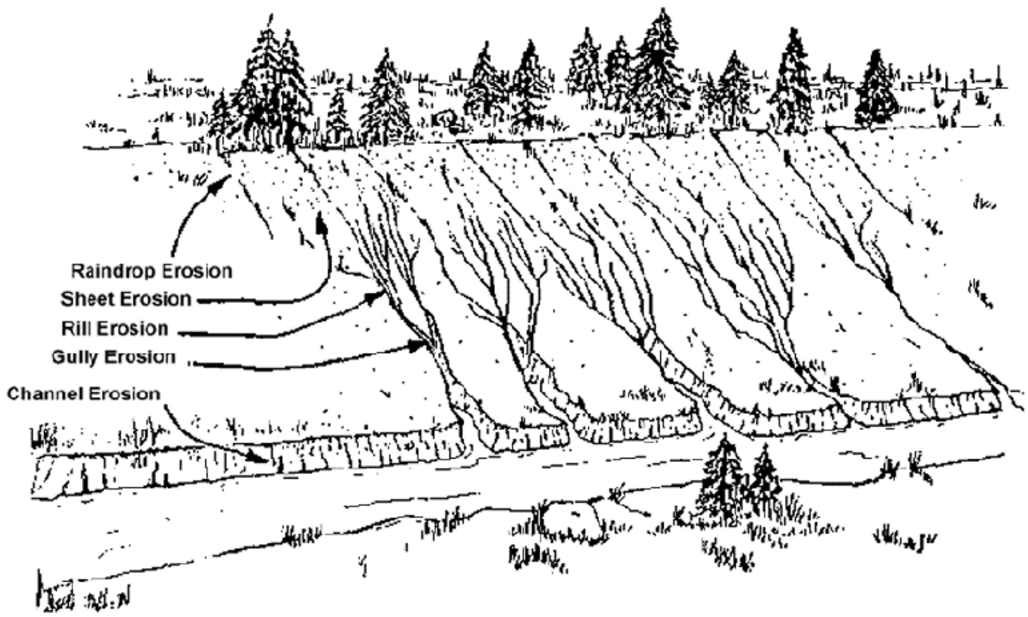
Soil erosion is the removal of soil from its original location, and in construction activities, is largely caused by the force of falling and flowing water. Erosion by water includes the following processes (see Figure 3):

- Raindrop Erosion – The direct impact of falling drops of rain on soil dislodges soil particles so that they can then be easily transported by runoff.
- Sheet Erosion – The removal of a layer of exposed soil by the action of raindrop splash and runoff, as water moves in broad sheets over the land and is not confined in small depressions.
- Rill and Gully Erosion – As runoff concentrates in rivulets, it cuts grooves called rills into the soil surface. If the flow of water is sufficient, rills may develop into larger gullies.
- Stream and Channel Erosion – Increased volume and velocity of runoff in an unprotected, confined channel may cause stream meander instability and scouring of significant portions of the stream or channel banks and bottom (Ecology, SWMM-II, 2001).

Soil erosion by wind creates a water quality problem when dust is blown into water. Dust control on paved streets using washdown waters, if not conducted properly, can also create water quality problems (Ecology, SWMM-II, 2001).

Protecting native soil and vegetation and retaining hydrologic function during the clearing and grading phase presents one of the most significant challenges within the development process. Upper soil layers contain organic material, soil biota, and a structure favorable for storing and slowly conducting stormwater down gradient; clearing and grading exposes and compacts underlying subsoil with significantly different hydrologic characteristics. On till soil, precipitation is rapidly converted to overland flow. On sites with native outwash soils and vegetation where surface and interflow are negligible, the increase in overland flow can be greater than till conditions if impervious areas are not minimized and soil structure is not protected for infiltration.

Figure 3. Types of soil erosion (From Ecology, SWMM-II, 2001)



Factors Influencing Erosion Potential

The erosion potential of soils can be readily determined using various models such as the Flaxman Method (Flaxman, 1972), or the Revised Universal Soil Loss Equation (RUSLE) (Ecology, SWMM-II, 2001).

The soil erosion potential of an area, including a construction site, is determined by four interrelated factors:

1. Soil characteristics.
2. Vegetative cover.
3. Topography.
4. Climate.

Collection, analysis, and use of detailed information specific to the construction site for each of these four factors can provide the basis for an effective construction stormwater management system (Ecology, SWMM-II, 2001).

The first three factors – soil characteristics, vegetative cover, and topography – are constant with respect to time until altered intentionally by construction. The designer, developer, and construction contractor should have a working knowledge about and control over these factors to provide high quality stormwater results. The fourth factor, climate, is predictable by season, historical record, and probability of occurrence. While predicting a rainfall event is not possible, many of the impacts of construction stormwater runoff can be minimized or avoided by planning appropriate seasonal construction activity and using properly designed BMPs (Ecology, SWMM-II, 2001).

1. Soil Characteristics

The vulnerability of soil to erode is determined by soil characteristics: particle size, organic content, soil structure, and soil permeability (Ecology, SWMM-II, 2001).

Particle Size: Soils that contain high proportions of silt and very fine sand are generally the most erodible and are easily detached and carried away. The erodibility of soil decreases as the percentage of clay or organic matter increases; clay acts as a binder and tends to limit erodibility. Most soils with high clay content are relatively resistant to detachment by rainfall and runoff. Once eroded, however, clays are easily suspended and settle out very slowly (Ecology, SWMM-II, 2001).

Organic Content: Organic matter creates a favorable soil structure, improving its stability and permeability. This increases infiltration capacity, delays the start of erosion, and reduces the amount of runoff (Ecology, SWMM-II, 2001).

The addition of organic matter increases infiltration rates (and, therefore, reduces surface flows and erodibility), water retention, pollution control, and pore space for oxygen (Ecology, SWMM-II, 2001).

Soil Structure: Organic matter, particle size, and gradation affect soil structure, which is the arrangement, orientation, and organization of particles. When the soil system is protected from compaction, the natural decomposition of plant debris on the surface maintains a healthy soil food web. The soil food web in turn maintains the porosity both on and below the surface (Ecology, SWMM-II, 2001).

Soil Permeability: Soil permeability refers to the ease with which water passes through a given soil. Well-drained and well-graded gravel and gravel mixtures with little or no silt are the least erodible soils. Their high permeability and infiltration capacity helps prevent or delay runoff (Ecology, SWMM-II, 2001).

By combining the soils information with information on the topography, drainage, and vegetation on the site, the planner can determine the critically erodible and sensitive areas that should be avoided if possible during construction.

2. Vegetative Cover

Vegetation provides a host of useful functions, which are vital to Conservation Design Techniques. These functions reflect the close connection between water quantity and water quality issues:

- Vegetation absorbs energy of falling rain, promoting infiltration, minimizing erosion, etc.
- Roots hold soil particles in place, preventing erosion.
- Vegetation (blades, stems, trunks, etc.) slows runoff velocity; as this velocity slows, not only is the erosive force reduced, but also sediment already entrapped will begin to settle out, as will other pollutants. Reduced velocity means increased opportunity for infiltration.

- Vegetation provides for a richer organic soil layer, which improves soil porosity and structure, maximizing the absorptive capacity of the soil and promoting infiltration, etc.
- Vegetation "consumes" many different types of stormwater-linked pollutants through uptake from the root zone. In addition to the positive effects on sediment and sediment-bound phosphorus, even solubilized nitrogen is taken up through a series of complex processes and transformations, as are some other metals and compounds (DDNR, 1997).

Erosion can be significantly reduced by limiting the removal of existing vegetation and by decreasing duration of soil exposure to rainfall events. Give special consideration to the preservation of existing vegetative cover on areas with a high potential for erosion such as erodible soils, steep slopes, drainage ways, and the banks of streams. When it is necessary to remove vegetation, such as for noxious weed eradication, revegetate these areas immediately (Ecology, SWMM-II, 2001). Where existing vegetation cannot be saved, the planner should consider staging of construction, temporary seeding, or temporary mulching.

3. Topography

The size, shape, and slope of a construction site influence the amount and rate of stormwater runoff. Each site's unique dimensions and characteristics provide both opportunities for and limitations on the use of specific control measures to protect vulnerable areas from high runoff amounts and rates. Slope length, steepness, and surface texture are key elements in determining the volume and velocity of runoff. As slope length and/or steepness increase, the rate of runoff and the potential for erosion increases. Slope orientation is also a factor in determining erosion potential. For example, a slope that faces south and contains drought soils may provide such poor growing conditions that vegetative cover will be difficult to re-establish (Ecology, SWMM-II, 2001).

4. Climate

Seasonal temperatures and the frequency, intensity, and duration of rainfall are fundamental factors in determining amounts of runoff. As the volume and the velocity of runoff increase, the likelihood of erosion increases. Where storms are frequent, intense, or of long duration, erosion risks are high. Seasonal changes in temperature, as well as variations in rainfall, help to define the period of the year when there is a high erosion risk. When precipitation falls as snow, no erosion occurs. In the spring, melting snow adds to the runoff, and erosion potential will be higher. If the ground is still partially frozen, infiltration capacity is reduced. Rain-on-snow events are common in Western Washington between 1,500 and 3,000-foot elevation. Western Washington is characterized in fall, winter, and spring by storms that are mild and long lasting. The fall and early winter events saturate the soil profile and fill stormwater detention ponds, increasing the amount of runoff leaving the construction site. Shorter-term, more intense storms occur in the summer. These storms can cause problems if adequate BMPs have not been installed on-site (Ecology, SWMM-II, 2001).

Sedimentation

Sedimentation of soil particles transported by water is accelerated in slower-moving, quiescent stretches of natural waterbodies or in treatment facilities such as sediment ponds and wetponds. Sedimentation occurs when the velocity of water in which soil particles are suspended is slowed for a sufficient time to allow particles to settle, and the settling rate is dependent on the soil particle size. Heavier particles, such as sand and gravel, can settle more rapidly than fine particles such as clay and silt. Sedimentation of clay soil particles is reduced due to clay's relatively low density and electro-charged surfaces, which discourage aggregation. The presence of clay particles in stormwater runoff can result in highly turbid water, which is not amenable to treatment by settling (Ecology, SWMM-II, 2001).

Turbidity is an optical property of water where suspended solid and dissolved materials such as silt, clay, and other organic and inorganic matter cause light to be scattered rather than transmitted in straight lines. Measurements of turbidity have been developed to quickly estimate the amount of sediment within a sample of water and to describe the effect of suspended solids blocking the transmission of light through a water body (Lloyd, 1987 and Bash et al., 2001). Turbidity is one of the water quality parameters included in the Water Quality Standards for Surface Waters in Washington State (see Chapter 173- 201A WAC). Turbidity is increased when erosion carries suspended sediment into receiving waters. Treating stormwater to reduce turbidity can be an expensive, difficult process with limited effectiveness. Any actions or prevention measures that reduce the volume of water needing treatment for turbidity are beneficial (Ecology, SWMM-II, 2001).

2.2 Costs Associated With Clearing and Grading

This guidance document does not attempt a cost-benefit analysis of clearing and grading management practices, but a discussion of some of the aspects of costs is included here to highlight the issues that are raised in the literature and by stakeholders.

Costs associated with clearing and grading include not only mitigation of the environmental effects noted above, but financial and opportunity costs and tradeoffs. Local jurisdictions must accommodate market forces as well as natural forces in regulatory approaches. The economic impact of excessive clearing and grading is often quantified in terms of the net load of sediment to water supply reservoirs and navigation channels. Water supply and treatment infrastructure is also affected (Corish, 1995). Sedimentation in salmon bearing streams and the resulting habitat loss and suffocation of eggs and fry can result in "takings" determinations that would result in restoration costs.

Costs from erosion and sedimentation impacts can be obvious or subtle. Some are difficult to quantify, such as the loss of aesthetic values or recreational opportunities. Restoration and management of a single lake can cost millions of dollars. Reductions in spawning habitat, and subsequent reduction in salmon and trout production, cause economic losses to sports fisheries and traditional Native American fisheries. The maintenance costs of manmade structures and harbors are readily quantifiable. Citizens pay repeatedly for these avoidable costs as city, county, state, and federal taxpayers. The costs to local jurisdictions for staffing permit offices and providing inspections will increase as more permits are requested and demand for inspections increase. Effective erosion and sediment control practices on construction sites can greatly reduce undesirable environmental impacts and costs (Ecology, SWMM-II, 2001).

Seasonal restrictions on clearing and grading activities can result in extra costs to contractors and developers. Some ordinances will effectively shut down all sitework and clearing and grading from three to six months of the year. This will impact the ability to find qualified contractors who are willing to work only part of the year and raise concerns over the limitations on the number of units of housing that can be constructed to meet demand (thus driving up housing costs) (correspondence from Jessica Ward, Associated General Contractors, July 15, 2004). Construction site phasing that limits mass grading may also increase upfront costs to developers (CWPP, 1997B).

LID measures result in less disturbance of the development area, result in conservation of natural features, and can be less cost intensive than traditional stormwater control mechanisms. Cost savings for control mechanisms are not only for construction, but also for long-term maintenance and life cycle cost considerations (Prince George's County, 1999). Clustering of dwellings, for example, reduces costs considerably through not only reduced land clearing, but reduced road construction (including curbing), reduced sidewalk construction, fewer street lights, less street tree planting/less landscaping, reduced sanitary sewer line and water line footage, reduced storm sewers, and reduced need for costly stormwater basin construction as well. An analysis indicates that total site development costs for a clustered 166-acre subdivision were 66 percent of total costs for a conventional non-clustered site plan with tremendous savings resulting from reduced grading, water and sewer line construction, and especially stormwater management.[1]

Prevention is a key to reducing the overall costs of development. It is much more cost-efficient to prevent pollutants from entering the stormwater than it is to remove the pollutants once they are in the system (Prince George's County, 1999).

---

[1] Based on James Frank's "The Costs of Alternative Development Patterns: A Review of the Literature" (1989) and the CH2MHILL/Chesapeake Bay Program's "Cost of Providing Government Services to Alternative Residential Patterns" (1993), costs of infrastructure (streets/roads, sewer and water lines, storm sewers and management systems, sidewalks) move from $10,200 per unit (1992 dollars) in a cluster at 5 units per acre to $33,700 per unit at 1 unit per acre (with an adjustment to 1996 dollars, the difference approaches $25,000 per unit). There are numerous studies from highly reputed organizations where significant (over 25 percent) cost savings are achieved with clustering when densities are relatively low (i.e., at 1 acre or larger lots; when base densities start out at half-acre or less, cost savings with clustering diminishes; see Land Ethics/Dodson Associates' Rappahannock Views 1994; National Association of Homebuilders Cost-Effective Site Planning – Single Family Development, 1986). In Northeastern Illinois Planning Commission's "Reducing Impacts of Urban Runoff," the NAHB 1986 study results are reviewed in detail.

Figure 4. Structural and non-structural BMP cost comparison (From Cahill and Horner, 1992)

Table 2. Comparison of total annualized costs. Structural and non-structural best management practices for new single-family development in "Coastal County" (Cahill and Associates, 1992).

BMP	Cost per cubic foot of stormwater	Construction cost (× 1,000)[1,2,3]	Construction cost amortized (× 1,000)	Indirect cost (× 1,000)[4]	BMP O&M cost (× 1,000)[5]	Design/study cost (× 1,000)[6]	Total annual cost (× 1,000)[7]
Minimum disturbance/ minimum maintenance	$0	$0	$0	$0	$110	$50	$160
Infiltration practices	$3	$3,000	$270	$200 - 650	$50	$60	$580
Constructed wetlands with harvesting	$5	$5,000	$450	$200 - 650	$500	$80	$1,230
Wet detention basins	$4	$4,000	$360	$200 - 650	$50	$60	$670
Dry detention basins	$3	$3,000	$270	$200 - 650	$80	$50	$600

1. Only the single-family residential component of Coastal County growth is considered in this comparison.
2. All stormwater systems are designed for three inches of storage per unit area of impervious surface.
3. The estimated storage requirement for the 10 developments assumed is 1 million cu ft stormwater.
4. Reflects the cost of growing grass, vegetation and landscaping, as well as the costs of lawn mowing, landscape trimmings, etc.
5. For non-structural, includes staff salaries and other elements of minimum disturbance/minimum maintenance program; for structural, includes maintenance and inspection, such as vacuuming and cleaning of porous pavement, harvesting macrophytes and algae, removal of sediment, etc.
6. Reflects the design of structural practices or background studies to institutionalize the minimum disturbance program.
7. Total columns 3, 4 (low range), 5, and 6.

Cahill and Horner (1992) provided a cost evaluation of structural and non-structural BMPs (Figure 4). Using minimum disturbance/minimum maintenance preventive BMPs reduces the need for temporary structural ESC controls and reduces maintenance costs for upkeep, while increasing the efficiency of reducing pollutants (Cahill and Horner, 1992 and Corish, 1995).

3. Practices

The benefit of careful planning and execution of site clearing and grading to the county or city agencies responsible for permitting, inspection, and compliance with local, state, and federal laws and regulations is often a reduction in inspection and oversight time, including time to inspect and approve mitigation and restoration efforts.

The U.S. Environmental Protection Agency's (EPA) Phase II Stormwater Rule allows the NPDES permitting authority (Washington State Department of Ecology) to include conditions in its Construction Stormwater NPDES General Permit that incorporate, by reference, qualifying local erosion and sediment control programs. In these jurisdictions, developers that comply with local erosion and sediment control program requirements would also be deemed in compliance with NPDES requirements without having to apply for and obtain coverage under Ecology's Construction Stormwater NPDES General Permit. The process for establishing qualifying local programs will be established in the revised Construction Stormwater NPDES General Permit in 2005.

3.1 Clearing and Grading Elements

The discussion of practices in Section 3 is organized around the 12 Construction Stormwater Pollution Prevention elements in the *Stormwater Management Manual for Western Washington* (Ecology, SWMM-II, 2001) for ease of comparison of local ordinances and regulations with Ecology standards, to aid in consistency of local ordinances with state and federal regulations, and for ease of reference. Proper adherence to these 12 elements of site development could also lead to a reduction in multiple jurisdictional permitting requirements. The following section does not include all important details of the minimum standards for stormwater management, but is intended as guidance for the examples of practices and standards that can be applied in minimizing the negative impacts of clearing and grading.

Site development projects all have several common construction steps. From the initial process of marking the limits of a site, to construction of temporary erosion and sediment control systems, maintenance of structures during construction, and site restoration, careful attention to each step can reduce project costs and impacts to adjacent properties, manmade storm drainage conveyance structures, streams and wetlands, and other local wildlife habitat areas.

The 12 elements provide a sequential and structural organization of practices for preventing, controlling, and managing clearing and grading issues, and they provide a framework for connecting and integrating low impact development practices. Linking these 12 elements together in practice and in the clearing and grading ordinance creates a strategy to minimize the impacts of site development on the site, adjacent properties, water quality, and wildlife habitat.

The elements are:

1. Mark Clearing Limits
2. Establish Construction Access
3. Control Flow Rates
4. Install Sediment Controls
5. Stabilize Soils
6. Protect Slopes
7. Protect Drain Inlets
8. Stabilize Channels And Outlets

9. Control Pollutants
10. Control Dewatering
11. Maintain BMPs
12. Manage the Project

Each of the elements are organized in the following manner to relate the clearing and grading issues with accepted BMPs, low impact development opportunities and preventive measures, and other design alternatives:

A. Description

This subsection describes what this element is about and how it relates to other elements and components of clearing and grading. The components include:

Site Management and Access
Clearing
Grading
Soil Protection
Sediment Control
Slopes – Hydrogeology
Maintenance of Natural Hydrologic Functions

Vegetation
- Removal
- Revegetation
  - Uplands
  - Riparian

Stormwater
- Control
- Retention

B. Element Criteria and Suggested BMPs (from Ecology, SWMM-II, 2001)

As in the Stormwater Management Manual, criteria that define minimum standards for each element are listed, followed by the identification of BMPs. For each BMP, only the Purpose and the Conditions of Use are included here: reference should be made to the appropriate manual for more specific details and relevant drawings.

C. Low Impact Development (if available)

This subsection provides a description of any LID or prevention techniques or practices that relate to the element under discussion, or to the phase of clearing and grading to which the element refers. These are intended to be applied in addition to and in the process of implementing the BMPs listed in subsection C. Drawings appropriate to related LID techniques mentioned in the text are included in Appendix 3.

References used in this section are from many areas of the country, but virtually all of the LID practices have applicability in Western Washington. For example, the national low impact development manual, *Low Impact Design Strategies: An Integrated Approach*, produced by Prince George's County, Maryland, for the EPA presents goals and principles for this technology and guidance on site planning, design practices, erosion and sediment control considerations, maintenance needs, and techniques for public outreach. Some of the specific LID techniques referenced in this document may need to be adjusted for local weather and site conditions; general LID approaches are intended to be broadly applicable in effect.

For more information on LID practices directly applicable to Western Washington, the Puget Sound Water Quality Action Team's *Low Impact Development Manual for Puget Sound* (2005) is now available on the PSAT Web site at *www.psat.wa.gov*.

D. <u>Examples of Design Alternatives (if available)</u>

This subsection provides examples of any design alternatives that can promote and provide opportunities for flexibility.

The Master Builders Association of King and Snohomish Counties has produced the Built Green Developer Program (June 2002), which identifies many strategies for reducing overall site impacts and operational costs to construction and development projects. The program utilizes a checklist and point scoring to help guide planning and implementation of the recommendations. Several of these suggestions are appropriate for clearing and grading technical solutions and are included throughout this section.

3.1.1 Mark Clearing Limits

A. Description

Marking clearing limits of any project is a critical first step for establishing proper control before any permanent and unrepairable damage is created by the proposed land disturbance activity. The objectives of this step are to minimize disturbance to protected areas, existing vegetation, adjacent properties, and existing facilities that are outside the area of disturbance. Marking the limits also allows the regulating permitter and permittee an opportunity to review on-site conditions and protections prior to the actual start of the land disturbance activity. Therefore, the regulating jurisdiction should establish consistent practices for the delineation of clearing and grading limits linked to permitted and exempted practices within their controlling ordinances.

Marking clearing limits means that prior to any clearing, grading, or grubbing activity the permittee will physically mark the extent of the area to be disturbed. Depending on the nature and size of the project this can range from very simple perimeter flagging (use lathe and survey tape, combined with painted marks on the ground) to extremely complex signage and fencing plans (installing steel post and chain link fence protection for critical habitat, trees, and buffer areas; using signage, flagging, and construction fencing to limit/control construction access and stock pile areas; and using perimeter fencing to protect the site from trespass as well as keep activity within approved boundaries).

Marking of clearing limits should also address monitoring of the construction activity to and from the site during clearing and grading to provide safe, temporary access across site to adjacent properties, revisions to pedestrian and bicycle routes, or transportation impacts. As part of the threshold identification, the jurisdictions should establish clear guidelines for the required use of construction activity and detour route signage, certified flaggers, off duty police, or other types of on-site traffic control. Clear guidelines should also be established for measures that will delineate and control unauthorized access to and from the site during nonconstruction hours. This type of site protection and transportation accommodation should also be included, if needed, as part of marking of clearing limits, and pre-construction site review prior to approving clearing and grading activities.

B. Element Criteria and Suggested BMPs

[Source: Ecology, SWMM-I, 2001 (2.5.2) and Ecology, SWMM-II, 2001 (3.2.3, 4.1, 4.2)]

Prior to beginning land disturbing activities, including clearing and grading, all clearing limits, sensitive areas and their buffers, and trees that are to be preserved within the construction area should be clearly marked, both in the field and on the plans, to prevent damage and off-site impacts. Plastic, metal, or stake wire fence may be used to mark the clearing limits.

BMP C101: Preserving Natural Vegetation

The purpose of preserving natural vegetation is to reduce erosion wherever practicable. Limiting site disturbance is the single most effective method for reducing erosion. For example, conifers can hold up to about 50 percent of all rain that falls during a storm. Up to 20-30 percent of this rain may never reach the ground but is taken up by the tree or evaporates. Another benefit is that the rain held in the tree can be released slowly to the ground after the storm.

Conditions of Use. Natural vegetation should be preserved on steep slopes, near perennial and intermittent watercourses or swales, and on building sites in wooded areas, or as required by local governments.

BMP C102: Buffer Zones

A buffer zone is an undisturbed area or strip of natural vegetation or an established suitable planting that will provide a living filter to reduce soil erosion and runoff velocities.

Conditions of Use. Natural buffer zones are used along streams, wetlands, and other bodies of water that need protection from erosion and sedimentation. Vegetative buffer zones can be used to protect natural swales and can be incorporated into the natural landscaping of an area. Critical areas buffer zones should not be used as sediment treatment areas. These areas shall remain completely undisturbed. The local permitting authority may expand the buffer widths temporarily to allow the use of the expanded area for removal of sediment.

BMP C103: High Visibility Plastic or Metal Fence

Fencing is intended to: (1) restrict clearing to approved limits; (2) prevent disturbance of sensitive areas, their buffers, and other areas required to be left undisturbed; (3) limit construction traffic to designated construction entrances or roads; and (4) protect areas where marking with survey tape may not provide adequate protection.

Conditions of Use. To establish clearing limits, plastic or metal fence may be used:

- At the boundary of sensitive areas, their buffers, and other areas required to be left uncleared.
- As necessary to control vehicle access to and on the site.

BMP C104: Stake and Wire Fence

Fencing is intended to: (1) restrict clearing to approved limits; (2) prevent disturbance of sensitive areas, their buffers, and other areas required to be left undisturbed; (3) limit construction traffic to designated construction entrances or roads; and (4) protect any areas where marking with survey tape may not provide adequate protection.

Conditions of Use. To establish clearing limits, stake or wire fence may be used:

- At the boundary of sensitive areas, their buffers, and other areas required to be left uncleared.
- As necessary, to control vehicle access to and on the site.

C. Low Impact Development

Site Assessment (PSAT, 2005)

Comprehensive inventory and assessment of on-site and adjacent off-site conditions are the initial steps for implementing low impact development. The inventory and assessment process will provide information necessary to implement the site planning and layout activities (examined in the next chapter) by identifying the current, and estimating the pre-disturbance conditions. Specifically, the assessment evaluates site hydrology, topography, soils, vegetation, and water features to identify how the site currently processes stormwater. The design then aligns roads, lots, and structures and implements construction practices to preserve and utilize these features to retain natural hydrologic function. In most cases, low impact development requires on-site inventory and assessment and cannot be properly planned and implemented through map reconnaissance alone.

Reduce Limits of Clearing and Grading (Prince George's County, 1999)

The limits of clearing and grading refer to the site area for the development. This development area will include all impervious areas such as roads, sidewalks, rooftops, and pervious areas such as graded lawn areas (these are not pervious unless specially designed to be) and open drainage systems. To minimize hydrologic impacts on existing site land cover, the area of development should be located in areas that are less sensitive to disturbance or have lower value in terms of hydrologic function (e.g., developing barren clay soils will have less hydrologic impact than development of forested sandy soils). At a minimum, areas of development should be placed outside of sensitive area buffers such as streams, floodplains, wetlands, and steep slopes. Where practical and possible, avoid developing and protect from impacts all areas with soils which have high infiltration rates to reduce net hydrologic site impacts.

D. Examples of Design Alternatives

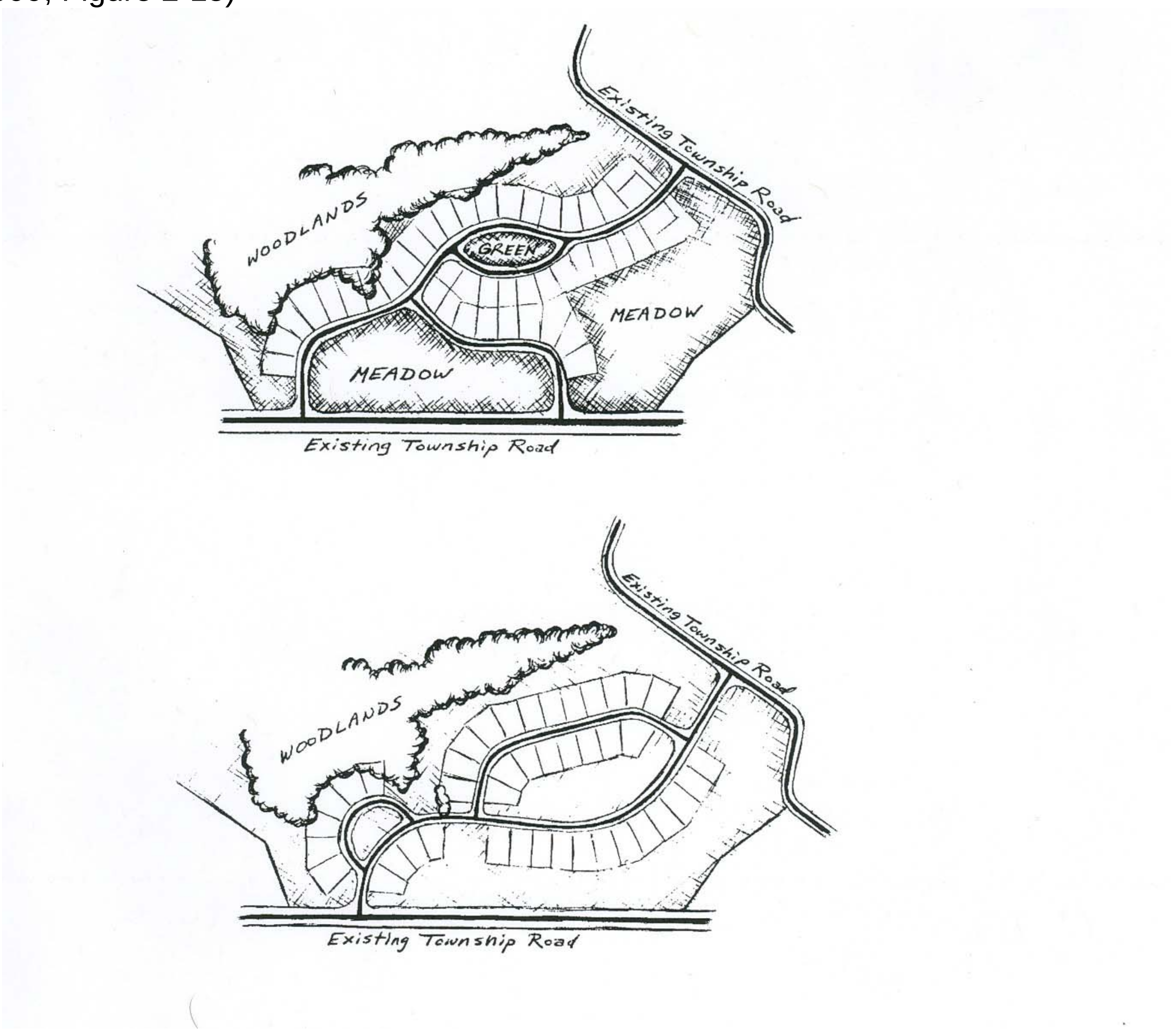
Preserve Usable Open Spaces (*Built Green Handbook*, 2002)

By design, natural areas offer many benefits including surface water management and flood control. Open space not only helps control stormwater runoff by increasing the amount of pervious surface available to absorb rainfall, it also serves to protect site ecosystems. Clearing and grading of forests and native vegetation at any site should be limited to the minimum amount needed to build lots, allow access to all utilities and site amenities including parks, and provide fire protection.

Site and Lot Vegetation (Prince George's County, 1999)

Revegetating graded areas, planting, or preserving existing vegetation can reduce the peak discharge rate by creating added surface roughness as well as providing for additional retention, reducing the surface water runoff volume, and increasing the travel time (Figure 5). Developers and engineers should connect vegetated buffer areas with existing vegetation or forested areas to gain retention/detention credit for runoff volume and peak rated reduction. This technique has the added benefit of providing habitat corridors while enhancing community aesthetics.

Figure 5. Site layouts with/without vegetation retention (From Prince George's County, 1999, Figure 2-15)



3.1.2 Establish Construction Access

A. Description

Unchecked access and egress to a construction site can cause or contribute to violations of water quality standards and can cause substantial damage to adjacent properties, existing utilities (including curb, gutters, and sidewalks, storm sewers and other buried utilities), public streets and open spaces, native vegetation, critical habitat areas, and temporary erosion and sediment control structures. Poorly delineated construction access leads to greater adjacent property impacts and erosion due to a wider area of disturbance. Establishing well-defined construction access routes is a critical component for reducing the potential damage of all of these effects.

Construction access must address impacts to existing utilities and infrastructure. Dust, noise, track-out, mud, overhanging trees and utility service lines, underground buried utilities, surface waters, drainage structures, and other facilities must be considered during the planning stage to minimize impacts. Delivery of and removal of material leads to heavy loads on unsupported soils, and unprotected utility crossings must also be addressed in the construction access plan. Limiting construction access to a single point (or a few for very large projects) also (1) allows for better control of adjacent property, neighborhood, traffic, and transportation impacts, (2) reduces construction costs, (3) reduces potential water quality impacts, and (4) allows for efficient oversight inspection of the access point and egress operations. Properly designed, installed, and maintained construction entrances and wheel wash systems can limit or significantly reduce the track-out of sediment from the construction site and prevent sedimentation on adjacent properties, surface waters, and public rights-of-way. Any sediment tracked off site onto roads must be removed in a timely manner by shoveling or street sweeping so that it does not contaminate stormwater.

B. Element Criteria and Suggested BMPs
[Source: Ecology, SWMM-I, 2001 (2.5.2) and Ecology, SWMM-II, 2001 (3.2.3, 4.1, 4.2)]

- Construction vehicle access and exit shall be limited to one route if possible, or two for linear projects such as roadways where one access is necessary for large equipment maneuvering.
- Access points shall be stabilized with quarry spalls or crushed rock to minimize the tracking of sediment onto public roads.
- Wheel wash or tire baths should be located on site, if applicable.
- Roads shall be cleaned thoroughly at the end of each day. Sediment shall be removed from roads by shoveling or pickup sweeping and shall be transported to a controlled sediment disposal area. Street washing will be allowed only after sediment is removed in this manner.
- Street wash wastewater shall be controlled by pumping back on site or otherwise be prevented from discharging into systems tributary to state surface waters.
- Construction access restoration shall be equal to or better than the preconstruction condition.

BMP C105: Stabilized Construction Entrance

Construction entrances are stabilized to reduce the amount of sediment transported onto paved roads by vehicles or equipment by constructing a stabilized pad of quarry spalls at entrances to construction sites.

Conditions of Use. Construction entrances shall be stabilized wherever traffic will be leaving a construction site and traveling on paved roads or other paved areas within 1,000 feet of the site. On large commercial, highway, and road projects, the designer should include enough extra materials in the contract to allow for additional stabilized entrances not shown in the initial Construction Stormwater Pollution Prevention Plan (SWPPP). It is difficult to determine exactly where access to these projects will take place; additional materials will enable the contractor to install them where needed.

BMP C106: Wheel Wash

Wheel washes reduce the amount of sediment transported onto paved roads by motor vehicles.

Conditions of Use. When a stabilized construction entrance (see BMP C105) is not preventing sediment from being tracked onto pavement:

- Wheel washing is generally an effective BMP when installed with careful attention to topography. For example, a wheel wash can be detrimental if installed at the top of a slope abutting a right-of-way where the water from the dripping truck can run unimpeded into the street.
- Pressure washing combined with an adequately sized and surfaced pad with direct drainage to a large 10-foot x 10-foot sump can be very effective.

BMP C107: Construction Road/Parking Area Stabilization

Stabilizing subdivision roads, parking areas, and other on-site vehicle transportation routes immediately after grading reduces erosion caused by construction traffic or runoff.

Conditions of Use

- Roads or parking areas shall be stabilized wherever they are constructed, whether permanent or temporary, for use by construction traffic.
- Fencing (see BMPs C103 and C104) shall be installed, if necessary, to limit the access of vehicles to only those roads and parking areas that are stabilized.

3.1.3 Control Flow Rates

A. Description

Controlling flow rates means regulating changes in conditions that alter the flow of stormwater from the site prior to, during, and after construction. Unregulated flows within a site can lead to substantial negative impacts on wetlands, habitats, aquifer and recharge areas, wildlife, adjacent neighbors' property, wells, septic fields, utilities, etc. Reducing vegetative cover generally increases stormwater overland flow rates; increase in runoff into existing storm drainage structures increases velocity of runoff, and leads to faster time of concentration for basins. These changes in natural or status quo flow rates often lead to flash flooding on a small scale, loss of topsoil, and potential damage to adjacent properties. Most accepted flow rate control methodology includes (1) no-net increase in off-site flow rates, (2) control of water to area of disturbance, and (3) use of check dams and modified structures to hold water and increase the time of concentration.

Many of these existing flow control practices use temporary holding ponds, infiltration sites, and constructed wetlands to handle the additional water surcharges from clearing and grading activities. Increased awareness of the potential threat of West Nile Virus and other new water borne diseases – and the potential impacts to human, bird, and equine populations – should lead to consideration of the type of structures approved for temporary and permanent flow controls.

B. Element Criteria and Suggested BMPs

[Source: Ecology, SWMM-I, 2001 (2.5.2) and Ecology, SWMM-II, 2001 (3.2.3, 4.1, 4.2)]. Refer also to Ecology, SWMM-III, 2001, Detention Facilities.

- Properties and waterways downstream from development sites shall be protected from erosion due to increases in the volume, velocity, and peak flow rate of stormwater runoff from the project site, as required by local plan approval authority.
- Downstream analysis is necessary if changes in off-site flows could impair or alter conveyance systems, streambanks, bed sediment, or aquatic habitat.
- Where necessary to comply with Minimum Requirement #7, stormwater detention facilities shall be constructed as one of the first steps in grading. Detention facilities shall be functional prior to construction of site improvements (e.g., impervious surfaces).
- The local permitting agency may require pond designs that provide additional or different stormwater flow control. This may be necessary to address local conditions or to protect properties and waterways downstream from erosion due to increases in the volume, velocity, and peak flow rate of stormwater runoff from the project site.
- If permanent infiltration ponds are used for flow control during construction, these facilities should be protected from siltation during the construction phase.

BMP C240: Sediment Trap

A sediment trap is a small temporary ponding area with a gravel outlet used to collect and store sediment from sites cleared and/or graded during construction. Sediment traps, along with other perimeter controls, shall be installed before any land disturbance takes place in the drainage area.

Conditions of Use. Prior to leaving a construction site, stormwater runoff must pass through a sediment pond or trap or other appropriate sediment removal BMP. Non-engineered sediment traps may be used on-site prior to an engineered sediment trap or sediment pond to provide additional sediment removal capacity.

The sediment trap is intended for use on sites (1) where the tributary drainage area is less than three acres, (2) with no unusual drainage features, and (3) with a projected build-out time of six months or less. It is a temporary measure (with a design life of approximately six months) and shall be maintained until the site area is permanently protected against erosion by vegetation and/or structures.

Sediment traps and ponds are only effective in removing sediment down to about the medium silt size fraction. Runoff with sediment of finer grades (fine silt and clay) will pass through untreated, emphasizing the need to control erosion to the maximum extent first.

Whenever possible, sediment-laden water shall be discharged into on-site, relatively level, vegetated areas (see BMP C234: Vegetated Strip). This is the only way to effectively remove fine particles from runoff unless chemical treatment or filtration is used. Discharge into vegetated areas can be particularly useful after initial treatment in a sediment trap or pond. The areas of release must be evaluated on a site-by-site basis in order to determine appropriate locations for and methods of releasing runoff. Vegetated wetlands shall not be used for this purpose. Frequently, it may be possible to pump water from the collection point at the downhill end of the site to an upslope vegetated area. Pumping shall only augment the treatment system, not replace it, because of the possibility of pump failure or runoff volume in excess of pump capacity.

All projects that are constructing permanent facilities for runoff quantity control should use the rough-graded or final-graded permanent facilities for traps and ponds. This includes combined facilities and infiltration facilities. When permanent facilities are used as temporary sedimentation facilities, the surface area requirement of a sediment trap or pond must be met. If the surface area requirements are larger than the surface area of the permanent facility, then the trap or pond shall be enlarged to comply with the surface area requirement. The permanent pond shall also be divided into two cells as required for sediment ponds. Either a permanent control structure or the temporary control structure (described in BMP C241: Temporary Sediment Pond) can be used. If a permanent control structure is used, it may be advisable to partially restrict the lower orifice with gravel to increase residence time while still allowing dewatering of the pond. A shut-off valve may be added to the control structure to allow complete retention of stormwater in emergency situations. In this case, an emergency overflow weir must be added.

A skimmer may be used for the sediment trap outlet if approved by the local permitting authority.

BMP C241: Temporary Sediment Pond

Sediment ponds remove sediment from runoff originating from disturbed areas of the site. Sediment ponds are typically designed to remove sediment no smaller than medium silt (0.02 mm). Consequently, they usually reduce turbidity only slightly.

Conditions of Use. Prior to leaving a construction site, stormwater runoff must pass through a sediment pond or other appropriate sediment removal BMP. A sediment pond shall be used where the contributing drainage area is three acres or more. Ponds must be used in conjunction with erosion control practices to reduce the amount of sediment flowing into the basin.

C. Low Impact Development

Low impact development emphasizes protection and use of on-site natural features integrated with engineered, small-scale, dispersed controls to manage stormwater and maintain or restore predevelopment watershed hydrologic functions (Hinman, 2001).

Low impact development strategies:

- Maintain predevelopment time of concentration by strategically routing flows to maintain travel time throughout the site, or increase infiltration to reduce flow.
- Apply distributed integrated management practices to treat, detain, retain, and infiltrate runoff to restore predevelopment conditions. These practices would include use of multifunctional open swales, bioswales, infiltration practices, bioretention (rain gardens), water capture (rain barrels), and depression storage in conservation areas.

The bioretention concept originated in Prince George's County, Maryland, in the early 1990s and is a principal tool for applying the low impact development design approach. The term bioretention was created to describe an integrated stormwater management practice that uses the chemical, biological, and physical properties of plants, microbes, and soils to remove, or retain, pollutants from stormwater runoff. Numerous designs have evolved from the original application; however, there are fundamental design characteristics that define bioretention across various settings.

Bioretention areas (also known as rain gardens) are:

- Shallow landscaped depressions with designed soil and plant complexes that receive stormwater from a small contributing area (specific sizing depends on soil characteristics surrounding the bioretention area and contributing land coverage type; however, bioretention cells are designed to manage storm flows on the scale of individual lots and up to approximately a one-half acre of impervious surface).
- Facilities designed to more closely mimic natural conditions where healthy soil structure and vegetation promote the infiltration, storage, and slow release of stormwater flows.
- Small-scale, dispersed facilities that are integrated into the site as a landscape amenity.
- A BMP designed as part of a larger LID approach (bioretention can be used as a stand alone-practice – for example, on an individual lot – however, best performance is achieved when integrated with other LID practices).

The term bioretention is used to describe various designs using soil and plant complexes to manage stormwater. The following terminology is used in this manual:

- Bioretention cells: shallow depressions with a designed planting soil mix and a variety of plant material including trees, shrubs, grasses, and/or other herbaceous plants. Bioretention cells may or may not have an under-drain and are not designed as a conveyance system.
- Bioretention swales: incorporate the same design features as bioretention cells; however, bioretention swales are designed as part of a conveyance system.
- Biodetention: facilities that disperse stormwater as sheet flow through plant and soil complexes (used on slopes, see sloped biodetention description below).

[See PSAT (2005), Section 6, for examples of bioretention applications and design guidelines].

D. Examples of Design Alternatives

Construct Stormwater Detention Facilities as a First Step in Grading. Construct all permanent stormwater detention/infiltration facilities as the first step in grading. This will ensure protection of water resources on the site and help avoid costly delays for water quality violations (*Built Green Handbook*, 2002). When permanent stormwater detention/infiltration facilities are used during the construction phase, the structure must, at a minimum, meet the design criteria for temporary sediment ponds. Permanent stormwater facilities should be protected from sedimentation during the construction phase using appropriate BMPs. Failure to do so may result in the structure being clogged with clays and other sediment that may reduce the infiltration rate and prevent the pond from functioning as designed. A pretreatment facility (sediment trap or pond) should be constructed and maintained in conjunction with the permanent facility to help prevent clogging (Ecology, SWMM II, 2001).

3.1.4 Install Sediment Controls

A. Description

This section relates to controlling sediment and preventing the deposition or discharge of sediment from sites under development where the existing vegetation and natural soil retention systems have been disturbed. Sediment controls include systems to manage stormwater and prevent the discharge of sediment from a site during storm conditions and during regular construction conditions (dust, vehicle track-out, dewatering operations, etc.). Sediment controls are generally temporary systems that are installed prior to clearing and grading, maintained and modified as needed during construction, and are replaced by permanent sediment controls. The permanent controls such as site restoration planting, terraces, sediment traps, and stormwater ponds prevent sedimentation after construction or site disturbance is complete.

B. Element Criteria and Suggested BMPs

[Source: Ecology, SWMM-I, 2001 (2.5.2) and Ecology, SWMM-II, 2001 (3.2.3, 4.1, 4.2)]

- The duff layer, native topsoil, and natural vegetation shall be retained in an undisturbed state to the maximum extent practicable.
- Prior to leaving a construction site or prior to discharge to an infiltration facility, stormwater runoff from disturbed areas shall pass through a sediment pond or other appropriate sediment removal BMP. Runoff from fully stabilized areas may be discharged without a sediment removal BMP, but must meet the low control performance standard of Element #3, Bullet #1. Full stabilization means concrete or asphalt paving; quarry spalls used as ditch lining; or the use of rolled erosion products, a bonded fiber matrix product, or vegetative cover in a manner that will fully prevent soil erosion. The local permitting authority shall inspect and approve areas fully stabilized by means other than pavement or quarry spalls.
- BMPs intended to trap sediment on site shall be constructed as one of the first steps in grading. These BMPs shall be functional before other land disturbing activities take place.
- Earthen structures such as dams, dikes, and diversions shall be seeded and mulched according to the timing indicated in Element #5.

- BMPs intended to trap sediment on site must be located in a manner to avoid interference with the movement of juvenile salmonids attempting to enter off-channel areas or drainages, often during nonstorm events, in response to rain event changes in stream elevation or wetted area.

BMP C230: Straw Bale Barrier

Straw bale barriers decrease the velocity of sheet flows and intercept and detain small amounts of sediment from disturbed areas of limited extent, preventing sediment from leaving the site. See Figure 4.18 in Ecology, SWMM-II, 2001 for details on straw bale barriers.

Conditions of Use

- Below disturbed areas subject to sheet and rill erosion are places straw bale barriers can be used.
- Straw bales are among the most used and least effective BMPs. The best use of a straw bale is hand spread on the site.
- Where the size of the drainage area is no greater than one-quarter acre per 100 feet of barrier length; the maximum slope length behind the barrier is 100 feet; and the maximum slope gradient behind the barrier is 2:1 are appropriate uses for straw bale barriers.
- Straw bale barriers should be used where effectiveness is required for less than three months.
- Under no circumstances should straw bale barriers be constructed in streams, channels, or ditches.
- Straw bale barriers should not be used where rock or hard surfaces prevent the full and uniform anchoring of the barrier.

BMP C231: Brush Barrier

The purpose of brush barriers is to reduce the transport of coarse sediment from a construction site by providing a temporary physical barrier to sediment and reducing the runoff velocities of overland flow.

Conditions of Use

- Brush barriers may be used downslope of all disturbed areas of less than one-quarter acre.
- Brush barriers are not intended to treat concentrated flows, nor are they intended to treat substantial amounts of overland flow. Any concentrated flows must be conveyed through the drainage system to a sediment pond. The only circumstance in which overland flow can be treated solely by a barrier, rather than by a sediment pond, is when the area draining to the barrier is small.
- Brush barriers should only be installed on contours.

BMP C232: Gravel Filter Berm

A gravel filter berm is constructed on rights-of-way or traffic areas within a construction site to retain sediment by using a filter berm of gravel or crushed rock.

Conditions of Use. A gravel filter berm is used where a temporary measure is needed to retain sediment from rights-of way or in traffic areas on construction sites.

BMP C233: Silt Fence

Use of a silt fence reduces the transport of coarse sediment from a construction site by providing a temporary physical barrier to sediment and reducing the runoff velocities of overland flow. (See 4.20 in Ecology, SWMM-II, 2001 for details on silt fence construction.)

Conditions of Use

- A silt fence may be used downslope of all disturbed areas.
- A silt fence is not intended to treat concentrated flows, nor is it intended to treat substantial amounts of overland flow. Any concentrated flows must be conveyed through the drainage system to a sediment pond. The only circumstance in which overland flow can be treated solely by a silt fence, rather than by a sediment pond, is when the area draining to the fence is one acre or less and flow rates are less than 0.5 cfs.
- Silt fences should not be constructed in streams or used in V-shaped ditches. They are not an adequate method of silt control for anything deeper than sheet or overland flow.

BMP C234: Vegetated Strip

Vegetated strips reduce the transport of coarse sediment from a construction site by providing a temporary physical barrier to sediment and reducing the runoff velocities of overland flow.

Conditions of Use

- Vegetated strips may be used downslope of all disturbed areas.
- Vegetated strips are not intended to treat concentrated flows, nor are they intended to treat substantial amounts of overland flow. Any concentrated flows must be conveyed through the drainage system to a sediment pond. The only circumstance in which overland flow can be treated solely by a strip, rather than by a sediment pond, is when the following criteria are met (see below):

Table 1. Criteria for use of vegetated strip rather than settling pond (From Ecology, SWMM-II, 2001, Table 4.11)

Vegetated Strips		
Average Slope	**Slope Percent**	**Flowpath Length**
1.5H:1V or less	67% or less	100 feet
2H:1V or less	50% or less	115 feet
4H:1V or less	25% or less	150 feet
6H:1V or less	16.7% or less	200 feet
10H:1V or less	10% or less	250 feet

BMP C235: Straw Wattles

Straw wattles are temporary erosion and sediment control barriers consisting of straw that is wrapped in biodegradable tubular plastic or similar encasing material. They reduce the velocity and can spread the flow of rill and sheet runoff and capture and retain sediment. Straw wattles are typically 8 to 10 inches in diameter and 25 to 30 feet in length. The wattles are placed in shallow trenches and staked along the contour of disturbed or newly constructed slopes. (See Figure 4.22 in Ecology, SWMM-II, 2001 for typical construction details.)

Conditions of Use

- Straw wattles are used on disturbed areas that require immediate erosion protection, on exposed soils during the period of short construction delays or over winter months, and on slopes requiring stabilization until permanent vegetation can be established.
- Straw wattles are effective for one to two seasons.
- If conditions are appropriate, wattles can be staked to the ground using willow cuttings for added revegetation.
- Rilling can occur beneath wattles if they are not properly entrenched, and water can pass between wattles if they are not tightly abutted together.

BMP C240: Sediment Trap

See Section 3.1.3 above for description.

BMP C241: Temporary Sediment Pond

See Section 3.1.3 above for description.

BMP C250: Construction Stormwater Chemical Treatment

Turbidity is difficult to control once fine particles are suspended in stormwater runoff from a construction site. Sediment ponds are effective at removing larger particulate matter by gravity settling, but are ineffective at removing smaller particulates such as clay and fine silt.

Sediment ponds are typically designed to remove sediment no smaller than medium silt (0.02 mm). Chemical treatment may be used to reduce the turbidity of stormwater runoff, but approved protocols, including correct dosage rates and monitoring, must be followed to ensure that the treated stormwater is not toxic to aquatic organisms.

Conditions of Use. Chemical treatment can reliably provide exceptional reductions of turbidity and associated pollutants. Very high turbidities can be reduced to levels comparable to what is found in streams during dry weather. Traditional BMPs used to control soil erosion and sediment loss from sites under development may not be adequate to ensure compliance with the water quality standard for turbidity in the receiving water. Chemical treatment may be required to protect streams from the impact of turbid stormwater discharges, especially when construction is to proceed through the wet season.

Formal written approval from Ecology and the local permitting authority is required for the use of chemical treatment regardless of site size. The intention to use chemical treatment shall be indicated on the Notice of Intent for coverage under the Construction Stormwater General Permit. Chemical treatment systems should be designed as part of the Construction SWPPP, not after the fact. Chemical treatment may be used to correct problem sites in limited circumstances with formal written approval from Ecology and the local permitting authority.

Note: Sites that propose to use anionic polyacrylamides to stabilize soils in accordance with BMP C126 do not have to obtain Ecology's approval.

The State Environmental Policy Act (SEPA) review authority must be notified at the application phase of the project review (or the time that the SEPA determination on the project is performed) that chemical treatment is proposed. If it is added after this stage, an addendum will be necessary and may result in project approval delay.

BMP C251: Construction Stormwater Filtration

Filtration removes sediment from runoff originating from disturbed areas of the site.

Conditions of Use. Traditional BMPs used to control soil erosion and sediment loss from sites under development may not be adequate to ensure compliance with the water quality standard for turbidity in the receiving water. Filtration may be used in conjunction with gravity settling to remove sediment as small as fine silt (0.5 μm). The reduction in turbidity will be dependent on the particle size distribution of the sediment in the stormwater. In some circumstances, sedimentation and filtration may achieve compliance with the water quality standard for turbidity.

Unlike chemical treatment, the use of construction stormwater filtration does not require approval from Ecology.

Filtration may also be used in conjunction with polymer treatment in a portable system to ensure capture of the flocculated solids.

C. Low Impact Development

Currently, the most frequently used approach to sediment control is simply to direct all surface runoff into a large sediment basin, which is later cleaned out and converted to a permanent stormwater management pond. Although this approach is arguably the simplest and lowest cost method to control sediment, it often fails to address the other principles described above and thus may not represent the best way to prevent and control sediment.

One of the underlying concepts of LID technology involves breaking up the drainage areas of a given site into very small catchment areas to disconnect hydraulically connected areas and to treat, disperse, and infiltrate runoff so as to provide opportunities to increase the time of concentration and thus reduce peak discharges. Accordingly, this approach will benefit sediment control efforts by diffusing surface flow into many directions and providing more flexibility in the use of a variety of sediment control practices. This approach will provide more opportunity to use silt fences and small structures to trap silt, and control small catchment areas generally below three acres in size. It will also allow more opportunity to integrate the use of vegetative buffers in sediment control. When bioretention practices are planned for stormwater management, they will need to comply with the BMP recommendations of the Ecology manual. When clearing and grading operations are complete, the accumulated silt can be removed and the bioretention cell can be installed. Also, no long-term controls are to be placed in use prior to completion of construction and permanent stabilization of all disturbed areas.

Inspection and Maintenance. The final important control step is to implement a thorough inspection and maintenance program. This step is vital to the success of an erosion and sediment control program. A site cannot be controlled effectively without thorough, periodic checks of all erosion and sediment control practices. When inspections reveal problems, modifications, repairs, cleaning, or other maintenance operations must be performed expeditiously. Particular attention must be paid to water-handling structures such as diversions, sediment traps, grade control structures, sediment basins, and areas being revegetated. Breaches in the structures or areas being revegetated must be repaired quickly, preferably before the next rainfall.

3.1.5 Stabilize Soils

A. Description

Stabilizing soils reduces sediment transport, dust, erosion, loss of topsoil, and other impacts that can threaten the long-term viability to restore the site, as well as posing potential impacts to adjacent sites. Key issues in effective erosion and sediment controls include: soil type and condition, slope conditions, existing vegetation upstream and downstream, time of year, weather protection, soils stockpiling, grading practices, and mechanical structures versus natural practices to reduce the impacts to exposed soils.

B. Element Criteria and Suggested BMPs
[Source: Ecology, SWMM-I, 2001 (2.5.2) and Ecology, SWMM-II, 2001 (3.2.3, 4.1, 4.2)]

- Exposed and unworked soils shall be stabilized by application of effective BMPs that protect the soil from the erosive forces of raindrops, flowing water, and wind.
- From October 1 through April 30, no soils shall remain exposed and unworked for more than two days. From May 1 to September 30, no soils shall remain exposed and unworked for more than seven days. This stabilization requirement applies to all soils on site, whether at final grade or not. These time limits may be adjusted by the local permitting authority if it can be shown that the average time between storm events justifies a different standard.
- Soils shall be stabilized at the end of the shift before a holiday or weekend if needed based on the weather forecast. Applicable practices include, but are not limited to, temporary and permanent seeding, sodding, mulching, plastic covering, erosion control fabrics and matting, soil application of polyacrylamide (PAM), the early application of gravel base on areas to be paved, and dust control.

- Selected soil stabilization measures shall be appropriate for the time of year, site conditions, estimated duration of use, and the water quality impacts that stabilization agents may have on downstream waters or ground water.
- Soil stockpiles must be stabilized and protected with sediment trapping measures.
- Linear construction activities – such as right-of-way and easement clearing, roadway development, pipelines, and trenching for utilities – shall be conducted to meet the soil stabilization requirement. Contractors shall install the bedding materials, roadbeds, structures, pipelines, or utilities and re-stabilize the disturbed soils so that:
  - From October 1 through April 30, no soils shall remain exposed and unworked for more than two days.
  - From May 1 to September 30, no soils shall remain exposed and unworked for more than seven days.

BMP C120: Temporary and Permanent Seeding

Seeding is intended to reduce erosion by stabilizing exposed soils. A well-established vegetative cover is one of the most effective methods of reducing erosion.

Conditions of Use

- Seeding may be used throughout the project on disturbed areas that have reached final grade or that will remain unworked for more than 30 days.
- Channels that will be vegetated should be installed before major earthwork and hydroseeded with a Bonded Fiber Matrix. The vegetation should be well established (i.e., 75 percent cover) before water is allowed to flow in the ditch. With channels that will have high flows, erosion control blankets should be installed over the hydroseed. If vegetation cannot be established from seed before water is allowed in the ditch, sod should be installed in the bottom of the ditch over hydromulch and blankets.
- Retention/detention ponds should be seeded as required.
- Mulch is required at all times because it protects seeds from heat, moisture loss, and transport due to runoff.
- All disturbed areas shall be reviewed in late August to early September and all seeding should be completed by the end of September. Otherwise, vegetation will not establish itself enough to provide more than average protection.
- At final site stabilization, all disturbed areas not otherwise vegetated or stabilized shall be seeded and mulched. Final stabilization means the completion of all soil disturbing activities at the site and the establishment of a permanent vegetative cover, or equivalent permanent stabilization measures (such as pavement, riprap, gabions, or geotextiles) which will prevent erosion.

BMP C121: Mulching

The purpose of mulching soils is to provide immediate temporary protection from erosion. Mulch also enhances plant establishment by (1) conserving moisture, (2) holding fertilizer, seed, and topsoil in place, and (3) moderating soil temperatures. There is an enormous variety of mulches that can be used. Only the most common types are discussed in this section.

Conditions of Use. As a temporary cover measure, mulch should be used on disturbed areas that require cover measures for less than 30 days.

- Mulch is used as a cover for seed during the wet season and during the hot summer months.
- Mulch is used during the wet season on slopes steeper than 3H:1V with more than 10 feet of vertical relief.
- Mulch may be applied at any time of the year and must be refreshed periodically.

BMP C122: Nets and Blankets

Erosion control nets and blankets are intended to prevent erosion and hold seed and mulch in place on steep slopes and in channels so that vegetation can become well established. In addition, some nets and blankets can be used to permanently reinforce turf to protect drainage ways during high flows. Nets (commonly called matting) are strands of material woven into an open, but high-tensile strength net (for example, coconut fiber matting). Blankets are strands of material that are not tightly woven, but instead form a layer of interlocking fibers, typically held together by a biodegradable or photodegradable netting (for example, excelsior or straw blankets). Blankets generally have lower tensile strength than nets, but cover the ground more completely. Coir (coconut fiber) fabric comes as both nets and blankets.

Conditions of Use. Erosion control nets and blankets should be used:

- To aid permanent vegetated stabilization of slopes 2H:1V or greater and with more than 10 feet of vertical relief.
- For drainage ditches and swales (highly recommended). The application of appropriate netting or blanket to drainage ditches and swales can protect bare soil from channelized runoff while vegetation is established. Nets and blankets also can capture a great deal of sediment due to their open, porous structure. Synthetic nets and blankets can be used to permanently stabilize channels and may provide a cost-effective, environmentally preferable alternative to riprap. One hundred percent synthetic blankets manufactured for use in ditches may be easily reused as temporary ditch liners.

Disadvantages of blankets include:

- Surface preparation is required.
- On slopes steeper than 2.5:1, blanket installers may need to be roped and harnessed for safety.
- They cost at least $4,000-6,000 per acre installed.

Advantages of blankets include:

- They can be installed without mobilizing special equipment.
- They can be installed by anyone with minimal training.
- They can be installed in stages or phases as the project progresses.
- Seed and fertilizer can be hand-placed by the installers as they progress down the slope.
- They can be installed in any weather.
- There are numerous types of blankets that can be designed with various parameters in mind. Those parameters include: fiber blend, mesh strength, longevity, biodegradability, cost, and availability.

BMP C123: Plastic Covering

Plastic covering provides immediate, short-term erosion protection to slopes and disturbed areas.

Conditions of Use

- Plastic covering may be used on disturbed areas that require cover measures for less than 30 days, except as stated below.
- Plastic is particularly useful for protecting cut and fill slopes and stockpiles. Note: The relatively rapid breakdown of most polyethylene sheeting makes it unsuitable for long-term (greater than six months) applications.
- Clear plastic sheeting can be used over newly-seeded areas to create a greenhouse effect and encourage grass growth if the hydroseed was installed too late in the season to establish 75 percent grass cover, or if the wet season started earlier than normal. Clear plastic should not be used for this purpose during the summer months because the resulting high temperatures can kill the grass.
- Due to rapid runoff caused by plastic sheeting, this method shall not be used upslope of areas that might be adversely impacted by concentrated runoff. Such areas include steep and/or unstable slopes.
- While plastic is inexpensive to purchase, the added cost of installation, maintenance, removal, and disposal make this an expensive material, up to $1.50-$2 per square yard.
- Whenever plastic is used to protect slopes, water collection measures must be installed at the base of the slope. These measures include plastic-covered berms, channels, and pipes used to covey clean rainwater away from bare soil and disturbed areas. At no time is clean runoff from a plastic covered slope to be mixed with dirty runoff from a project.
- Other uses for plastic include:
    1. Temporary ditch liner.
    2. Pond liner in temporary sediment pond.
    3. Liner for bermed, temporary fuel storage area if plastic is not reactive to the type of fuel being stored.
    4. Emergency slope protection during heavy rains.
    5. Temporary drainpipe (“elephant trunk”) used to direct water.

BMP C124: Sodding

The purpose of sodding is to establish permanent turf for immediate erosion protection and to stabilize drainage ways where concentrated overland flow will occur.

Conditions of Use. Sodding may be used in the following areas:

- Disturbed areas that require short-term or long-term cover.
- Disturbed areas that require immediate vegetative cover.
- All waterways that require vegetative lining. Waterways may also be seeded rather than sodded and protected with a net or blanket.

BMP C125: Topsoiling

Topsoiling provides a suitable growth medium for final site stabilization with vegetation. While not a permanent cover practice in itself, topsoiling is an integral component of providing permanent cover in those areas where there is an unsuitable soil surface for plant growth. Native soils and disturbed soils that have been organically amended not only retain much more stormwater, but they also serve as effective biofilters for urban pollutants and, by supporting more vigorous plant growth, reduce the water, fertilizer, and pesticides needed to support installed landscapes. Topsoil does not include any subsoils but only the material from the top several inches including organic debris.

Conditions of Use

- Native soils should be left undisturbed to the maximum extent practicable. Native soils disturbed during clearing and grading should be restored, to the maximum extent practicable, to a condition where moisture-holding capacity is equal to or better than the original site conditions. This criterion can be met by using on-site native topsoil, incorporating amendments into on-site soil, or importing blended topsoil.
- Topsoiling is a required procedure when establishing vegetation on shallow soils, and soils of critically low pH (high acid) levels.
- Stripping of existing, properly functioning soil system and vegetation for the purpose of topsoiling during construction is not acceptable. If an existing soil system is functioning properly, it shall be preserved in its undisturbed and uncompacted condition.
- Depending on where the topsoil comes from, or what vegetation was on site before disturbance, invasive plant seeds may be included and could cause problems for establishing native plants, landscaped areas, or grasses.
- Topsoil from the site will contain mycorrhizal bacteria that are necessary for healthy root growth and nutrient transfer. These native mycorrhiza are acclimated to the site and will provide optimum conditions for establishing grasses. Commercially available mycorrhiza products should be used when topsoil is brought in from off site.

BMP C126: Polyacrylamide for Soil Erosion Protection

Polyacrylamide (PAM) is used on construction sites to prevent soil erosion. Applying PAM to bare soil in advance of a rain event significantly reduces erosion and controls sediment in two ways. First, PAM increases the soil's available pore volume, thus increasing infiltration through flocculation and reducing the quantity of stormwater runoff. Second, it increases flocculation of suspended particles and aids in their deposition, thus reducing stormwater runoff turbidity and improving water quality.

Conditions of Use. PAM shall not be directly applied to water or allowed to enter a water body.

In areas that drain to a sediment pond, PAM can be applied to bare soil under the following conditions:

- During rough grading operations.
- In staging areas.

- On balanced cut and fill earthwork.
- On haul roads prior to placement of crushed rock surfacing.
- On compacted soil roadbase.
- On stockpiles.
- After final grade and before paving or final seeding and planting.
- In pit sites.
- On sites having a winter shut down. In the case of winter shut down, or where soil will remain unworked for several months, PAM should be used together with mulch.

Some PAMs are more toxic and carcinogenic than others. Only the most environmentally safe PAM products should be used.

The specific PAM copolymer formulation must be anionic. Cationic PAM shall not be used in any application because of known aquatic toxicity problems. Only the highest drinking water grade PAM, certified for compliance with ANSI/NSF Standard 60 for drinking water treatment, will be used for soil applications. Recent media attention and high interest in PAM has resulted in some entrepreneurial exploitation of the term "polymer." All PAM are polymers, but not all polymers are PAM, and not all PAM products comply with ANSI/NSF Standard 60. PAM use shall be reviewed and approved by the local permitting authority. The Washington State Department of Transportation (WSDOT) has listed approved PAM products on its Web page.

BMP C130: Surface Roughening

Surface roughening aids in the establishment of vegetative cover, reduces runoff velocity, increases infiltration, and provides for sediment trapping through the provision of a rough soil surface. Horizontal depressions are created by operating a tiller or other suitable equipment on the contour or by leaving slopes in a roughened condition by not fine grading them.

Conditions for Use

- All slopes steeper than 3:1 and greater than five vertical feet require surface roughening.
- Areas with grades steeper than 3:1 should be roughened to a depth of two to four inches prior to seeding.
- Areas that will not be stabilized immediately may be roughened to reduce runoff velocity until seeding takes place.
- Slopes with a stable rock face do not require roughening.
- Slopes where mowing is planned should not be excessively roughened.

BMP C131: Gradient Terraces

Gradient terraces reduce erosion damage by intercepting surface runoff and conducting it to a stable outlet at a non-erosive velocity.

Conditions of Use. Gradient terraces normally are limited to denuded land having a water erosion problem. They should not be constructed on deep sands or on soils that are too stony, steep, or shallow to permit practical and economical installation and maintenance. Gradient terraces may be used only where suitable outlets are or will be made available. (See Ecology, SWMM-II, 2001, Figure 4.8 for gradient terraces).

BMP C140: Dust Control

Dust control prevents wind transport of dust from disturbed soil surfaces onto roadways, drainage ways, and surface waters.

Conditions of Use. Dust control is used in areas (including roadways) subject to surface and air movement of dust where on-site and off-site impacts to roadways, drainage ways, or surface waters are likely.

BMP C180: Small Project Construction Stormwater Pollution Prevention

Small project construction stormwater pollution prevention is used to prevent the discharge of sediment and other pollutants to the maximum extent practicable from small construction projects.

Conditions of Use. For use on small construction projects, those adding or replacing less than 2,000 square feet of impervious surface or clearing less than 7,000 square feet.

C. Low Impact Development

An important principle is to apply soil erosion control practices on disturbed areas as a first line of defense against off-site damage. Control does not begin with the perimeter sediment trap or basin. It begins at the source of the sediment, the disturbed land area, and extends down to the control structure.

Soil stabilization practices include a variety of vegetative, chemical, and structural measures used to shield the soil from the impact of raindrops or to bind the soil in place, thus preventing it from being detached by surface runoff or wind erosion. Soil stabilization practices include the following:

- Temporary and permanent seeding.
- Topsoiling.
- Erosion control nets, blankets, and matting.
- Mulching.
- Surface roughening (e.g., stair-step grading, grooving, contour furrows, and tracking).
- Tree protection.

The use of mulch to achieve temporary stabilization is gaining increased attention and recognition. Ongoing research efforts are confirming the fact that mulching is a very effective method of reducing runoff as well as removing pollutants from runoff.

3.1.6 Protect Slopes

A. Description

The slope of underlying ground is one of the most important factors in soils erosion potential. "Protect slopes" implies that the ground in question is not flat, and, therefore, will have a minimal to significant chance of becoming unstable during clearing and grading activities. In the western areas of Washington, glaciated soils structures are common, and tend to exacerbate the negative effects of slope clearing during storm events. Therefore, protecting slopes prior to, during, and after construction is needed to protect all downstream properties, critical areas, streams, and wetlands. Since the term slopes implies anything from not flat to nearly vertical, the range of protection measure and inspection/oversight will require site-specific recommendations.

Retaining structures (existing and new rockeries and retaining walls) are a gray area in many ordinances. Some jurisdictions regulate these structures by requiring a building permit under the Washington State Building Code. The state building code is the International Building Code with amendments adopted by Washington state. A building permit may not cover clearing and grading for retaining structure installation and repair. Other jurisdictions create specific ordinances to address construction and improvement of these elements. In either case, the clearing and grading BMPs should be employed at a minimum to ensure that impacts for work on these structures does not impact neighboring properties.

B. Element Criteria and Suggested BMPs
[Source: Ecology, SWMM-I, 2001 (2.5.2) and Ecology, SWMM-II, 2001 (3.2.3, 4.1, 4.2)]

- Design, construct, and phase cut and fill slopes in a manner that will minimize erosion.
- Consider soil type and its potential for erosion.
- Reduce slope runoff velocities by reducing continuous length of slope with terracing and diversions, reduce slope steepness, and roughen slope surface.
- Divert upslope drainage and run-on waters with interceptors at top of slope. Stormwater from off site should be handled separately from stormwater generated on the site. Diversion of off-site stormwater around the site may be a viable option. Diverted flows shall be redirected to the natural drainage location at or before the property boundary.
- Contain downslope collected flows in pipes, slope drains, or protected channels. Check dams shall be used within channels that are cut down a slope.
- Provide drainage to remove ground water intersecting the slope surface of exposed soil areas.
- Excavated material shall be placed on the uphill side of trenches, consistent with safety and space considerations.
- Stabilize soils on slopes, as specified in Section 3.1.5, Stabilize Soils.

BMP C120: Temporary and Permanent Seeding

See Section 3.1.5 above for description.

BMP C130: Surface Roughening

See Section 3.1.5 above for description.

BMP C131: Gradient Terraces

See Section 3.1.5 above for description.

BMP C200: Interceptor Dike and Swale

Provide a ridge of compacted soil, or a ridge with an upslope swale, at the top or base of a disturbed slope or along the perimeter of a disturbed construction area to convey stormwater. Use the dike and/or swale to intercept the runoff from unprotected areas and direct it to areas where erosion can be controlled. This can prevent storm runoff from entering the work area or sediment-laden runoff from leaving the construction site.

Conditions of Use. Where the runoff from an exposed site or disturbed slope must be conveyed to an erosion control facility, which can safely convey the stormwater.

- Locate upslope of a construction site to prevent runoff from entering disturbed area.
- When placed horizontally across a disturbed slope, it reduces the amount and velocity of runoff flowing down the slope.
- Locate downslope to collect runoff from a disturbed area and direct it to a sediment basin.

BMP C201: Grass-Lined Channels

Grass-lined channels provide a channel with a vegetative lining for conveyance of runoff.

Conditions of Use. This practice applies to construction sites where concentrated runoff needs to be contained to prevent erosion or flooding.

- A vegetative lining can provide sufficient stability for the channel cross-section and at lower velocities of water (normally dependent on grade). This means that the channel slopes are generally less than 5 percent and space is available for a relatively large cross-section.
- Typical uses include roadside ditches, channels at property boundaries, outlets for diversions, and other channels and drainage ditches in low areas.
- Channels that will be vegetated should be installed before major earthwork and hydroseeded with a bonded fiber mulch (BFM). The vegetation should be well established (i.e., 75 percent cover) before water is allowed to flow in the ditch. With channels that will have high flows, erosion control blankets should be installed over the hydroseed. If vegetation cannot be established from seed before water is allowed in the ditch, sod should be installed in the bottom of the ditch in lieu of hydromulch and blankets.

BMP C204: Pipe Slope Drains

Pipe slope drains are used to convey stormwater anytime water needs to be diverted away from or over bare soil to prevent gullies, channel erosion, and saturation of slide-prone soils.

Conditions of Use. Pipe slope drains should be used when a temporary or permanent stormwater conveyance is needed to move the water down a steep slope to avoid erosion (Figure 4.11 in Ecology, SWMM-II, 2001). On highway projects, they should be used at bridge ends to collect runoff and pipe it to the base of the fill slopes along bridge approaches. These can be designed into a project and included as bid items. Another use on road projects is to collect runoff from pavement and pipe it away from side slopes. These are useful because there is generally a time lag between having the first lift of asphalt installed and the curbs, gutters, and permanent drainage installed. Used in conjunction with sand bags or other temporary diversion devices, these will prevent massive amounts of sediment from leaving a project. Water can be collected, channeled with sand bags, Triangular Silt Dikes, berms, or other material, and piped to temporary sediment ponds. Pipe slope drains can be:

- Connected to new catch basins and used temporarily until all permanent piping is installed.
- Used to drain water collected from aquifers exposed on cut slopes and take it to the base of the slope.
- Used to collect clean runoff from plastic sheeting and direct it away from exposed soil.
- Installed in conjunction with a silt fence to drain collected water to a controlled area.
- Used to divert small seasonal streams away from construction. They have been used successfully on culvert replacement and extension jobs. Large flex pipe can be used on larger streams during culvert removal, repair, or replacement.
- Connected to existing down spouts and roof drains and used to divert water away from work areas during building renovation, demolition, and construction projects. There are now several commercially available collectors that are attached to the pipe inlet and help prevent erosion at the inlet.

BMP C205: Subsurface Drains

Subsurface drains intercept, collect, and convey ground water to a satisfactory outlet, using a perforated pipe or conduit below the ground surface. Subsurface drains are also known as "french drains." The perforated pipe provides a dewatering mechanism to drain excessively wet soils, provide a stable base for construction, improve stability of structures with shallow foundations, or reduce hydrostatic pressure to improve slope stability.

Conditions of Use. Use subsurface drains when excessive water must be removed from the soil. The soil permeability, depth to water table, and impervious layers are all factors which may govern the use of subsurface drains.

BMP C206: Level Spreader

Level spreaders provide a temporary outlet for dikes and diversions consisting of an excavated depression constructed at zero grade across a slope. They convert concentrated runoff to sheet flow and release it onto areas stabilized by existing vegetation or an engineered filter strip.

Conditions of Use. Level spreaders are used when a concentrated flow of water needs to be dispersed over a large area with existing stable vegetation. Items to consider are:

1. What is the risk of erosion or damage if the flow may become concentrated?

2. Is an easement required if discharged to adjoining property?
3. Will most of the flow be ground water and not surface flow?
4. Is there an unstable area downstream that cannot accept additional ground water?

Use level spreaders only where the slopes are gentle, the water volume is relatively low, and the soil will adsorb most of the low flow events.

BMP C207: Check Dams

Construction of small dams across a swale or ditch reduces the velocity of concentrated flow and dissipates energy at the check dam.

Conditions of Use. Use check dams where temporary channels or permanent channels are not yet vegetated, channel lining is infeasible, and velocity checks are required.

- Check dams may not be placed in streams unless approved by the Washington Department of Fish and Wildlife. Check dams may not be placed in wetlands without approval from a permitting agency.
- Check dams shall not be placed below the expected backwater from any salmonid bearing water between October 1 and May 31 to ensure that there is no loss of high flow refuge habitat for overwintering juvenile salmonids and emergent salmonid fry.

BMP C208: Triangular Silt Dike (Geotextile-Encased Check Dam)

Triangular silt dikes may be used as check dams for perimeter protection, for temporary soil stockpile protection, for drop inlet protection, or as a temporary interceptor dike.

Conditions of Use

- May be used in place of straw bales for temporary check dams in ditches of any dimension.
- May be used on soil or pavement with adhesive or staples.

Triangular silt dikes have been used to build temporary:

- Sediment ponds.
- Diversion ditches.
- Concrete wash out facilities.
- Curbing.
- Water bars.
- Level spreaders.
- Berms.

C. Low Impact Development (Prince George's County, 1999)

Natural drainage patterns that exist on the site should be identified to plan around these critical areas where water will concentrate. Where possible, natural drainage ways should be used to convey runoff over and off the site to avoid the expense and the problems of constructing an artificial drainage system. These natural drainage ways should be protected with vegetative buffers whenever possible. Manmade ditches, diversions, and waterways will become part of the erosion problem if they are not properly stabilized. Care should also be taken to be sure that increased runoff from the site will not erode or flood the existing natural drainage system.

Ground cover is the most important factor in terms of preventing erosion. Any existing vegetation that can be saved will help prevent erosion. Vegetative cover shields the soil surface from raindrop impact while the root mass holds soil particles in place. Vegetation also can filter sediment from runoff. Thus, grass buffer strips can be used to remove sediment from surface runoff. Vegetation also slows the velocity of runoff and helps maintain the infiltration capacity of a soil. Trees and unique vegetation protect the soil as well as beautifying the site after construction. Where existing vegetation cannot be saved, the planner should consider staging of construction, temporary seeding, or temporary mulching.

D. Examples of Design Alternatives

Vegetated buffers are strips of vegetation, either natural or planted, around sensitive areas such as waterbodies, wetlands, woodlands, or highly erodible soils. In addition to protecting sensitive areas, vegetated strips help to reduce stormwater runoff impacts by trapping sediment and sediment-bound pollutants, providing some infiltration, and slowing and dispersing stormwater flows over a wide area.

Level Spreaders. A level spreader typically is an outlet designed to convert concentrated runoff to sheet flow and disperse it uniformly across a slope to prevent erosion. One type of level spreader is a shallow trench filled with crushed stone. The lower edge of the level spreader must be exactly level if the spreader is to work properly (Prince George’s County, 1999).

3.1.7 Protect Drain Inlets

A. Description

When stormwater leaves the on-site erosion and sediment control structures (installed to control the impacts of clearing and grading), it flows into the natural stream course or existing stormwater conveyance system. In all but the best conditions, there is generally some pollutants, sediments, and organic material remaining in the stormwater. Since this section relates primarily to stormwater conveyance systems, the type of inlet protections installed must handle soils, construction debris, rocks, oil, fuels, and other normal construction site debris so it does not become introduced into the storm drain system. TESC systems, monitoring, spill protection, and spill protection plans must be in place prior to permitting to ensure the proper response procedures are ready at the start of the work.

Protection of drain inlets creates a last line of defense to prevent stormwater contaminants from entering the storm drain system, so inlet protection BMPs should also be designed to handle situations where the existing flow and sediment control structures fail. And finally, construction activity and equipment is often heavy, and can block, crush, or slow the performance of existing systems, so measures need to be taken to avoid creating upstream and downstream flooding hazards when considering protection of drain inlets.

B. Element Criteria and Suggested BMPs

[Source: Ecology, SWMM-I, 2001 (2.5.2) and Ecology, SWMM-II, 2001 (3.2.3, 4.1, 4.2)]

- Storm drain inlets operable during construction shall be protected so that stormwater runoff does not enter the conveyance system without first being filtered or treated to remove sediment.
- Approach roads shall be kept clean. Sediment and street wash water shall not be allowed to enter storm drains without prior and adequate treatment unless treatment is provided before the storm drain discharges to waters of the state.
- Inlets should be inspected weekly at a minimum and daily during storm events. Inlet protection devices should be cleaned or removed and replaced before six inches of sediment can accumulate.

BMP C220: Storm Drain Inlet Protection

Storm drain inlet protection prevents coarse sediment from entering drainage systems prior to permanent stabilization of the disturbed area.

Conditions of Use. Storm drain inlets are to be made operational before permanent stabilization of the disturbed drainage area. Protection should be provided for all storm drain inlets downslope and within 500 feet of a disturbed or construction area, unless the runoff that enters the catch basin will be conveyed to a sediment pond or trap. Inlet protection may be used anywhere to protect the drainage system. It is likely that the drainage system will still require cleaning. The Stormwater Management Manual (Ecology, SWMM-II, 2001,Table 4.9) lists several options for inlet protection. All of the methods for storm drain inlet protection are prone to plugging and require a high frequency of maintenance. Drainage areas should be limited to one acre or less. Emergency overflows may be required where stormwater ponding would cause a hazard. If an emergency overflow is provided, additional end-of-pipe treatment may be required.

C. Low Impact Development

Flow Path. Increasing flow path of surface runoff increases infiltration and travel time. One of the goals of a LID site is to provide as much overland or sheet flow as allowed by local jurisdictional codes to increase the time it takes for rooftop and driveway runoff to reach open swale drainage systems. To accomplish this, the designer can direct rooftop and driveway runoff into bioretention facilities, infiltration trenches, dry wells, or cisterns that are strategically located to capture the runoff prior to its reaching the lawn. In addition, strategic lot grading can be designed to increase both the surface roughness and the travel length of the surface runoff (Prince George’s County, 1999).

D. Examples of Design Alternatives

Infiltration Trenches

An infiltration trench is an excavated trench that has been back-filled with stone to form a subsurface basin. Stormwater runoff is diverted into the trench and is stored until it can be infiltrated into the soil, usually over a period of several days. Infiltration trenches are very adaptable integrated management practices (IMPs), and the availability of many practical configurations makes them ideal for small urban drainage areas. They are most effective and have a longer life cycle when some form of pretreatment is included in their design. Pretreatment may include techniques like vegetated filter strips or grassed swales (Figures 6 and 7, Appendix 3). Care must be taken to avoid clogging of infiltration trenches, especially during site construction activities.[2] The key design considerations for the infiltration trench are summarized in Prince George's County (1999, Table 4-8). Detailed design guidance is provided in *Maryland Standards and Specifications for Infiltration Practices* (MDNR, 1984), *Maintenance of Stormwater Management Structures: A Departmental Summary* (MDE, 1986); and *Maryland Stormwater Design Manual* (MDE, 1998).

Table 2. Infiltration trench design considerations (From Prince George's County, 1999 – Table 4-8)

Design Storm	Determined by state or local agency. Local conditions may necessitate adjustment of the recommendations in the guidance document.
Soil Permeability	> 0.27 - 0.50 inches per hour
Depth	3 to 12 feet
Storage Time	Empty within 3 days
Backfill	Clean aggregate > 11/2", < 3", surrounded by engineering filter fabric
Runoff Filtering	
Outflow Structures	Overland flow path of surface runoff exceeding the capacity of the trench must be identified and evaluated. An overflow system leading to a stabilized channel or watercourse including measures to provide non-erosive flow conditions must be provided.
Observation Well	Well must be provided, 4" PVC on footplate, constructed flush with ground surface, cap with lock.
Hydrologic Design	Determined by state or local agency.
Water Quality	See Table 4.3 for performance data.
Maintenance	Periodic monitoring; quarterly during first year, annual thereafter.

[2] Infiltration trenches are intended to be a BMP to manage stormwater from the completed construction site. They could help reduce surface runoff during construction, but are likely to get clogged with sediment unless a sediment removal BMP is upstream of it.

3.1.8 Stabilize Channels and Outlets

A. Description

Channels, streams, ditches, and other storm drainage elements generally experience increased erosion (scouring, down-cutting, etc.) and siltation as a result of clearing and grading activities. Reducing or removing natural cover, changing surface grades, and concentrating flows of stormwater into point source releases tend to increase the energy transferred in runoff water and the frequency of inundations that natural and manmade channels must handle.

When the velocity of concentrated water flows increases, the water has more energy to lift and carry in a suspended state particles (silt, sand, and rocks) from the channel lining, resulting in increased turbidity (suspended solids), increased scouring (the act of pulling particles protecting the channel lining), and side- or down-cutting (changing the gradient or length of the channel to achieve a new "steady state" condition). The impacts to a channel or stream are often eroding banks and undercutting trees and vegetation, cutting through gravels and silt layers to expose bedrock, and increasing siltation (dropping of suspended materials) near the mouth of the stream.

It is necessary to stabilize channels and outlets to control these effects, and avoid impacting adjacent properties and natural stream habitats for vegetation and wildlife. Typical strategies include installing angular rock to dissipate and absorb much of the increased energy, restoring vegetation for channels, performing after grading, and armoring channels (with riprap, geo-fabrics, and concrete) to withstand the down-cutting and erosive nature of the increased flows or frequency. Understanding the hydrologic nature of the site and designing and developing ways to handle increased infiltration on site, retaining and utilizing more natural vegetation as energy dissipation prior to releasing the stormwater from the site, and reducing overall land disturbance are ways to reduce the cost and need for more structural control techniques.

B. Element Criteria and Suggested BMPs
[Source: Ecology, SWMM-I, 2001 (2.5.2) and Ecology, SWMM-II, 2001 (3.2.3, 4.1, 4.2)]

- Temporary on-site conveyance channels shall be designed, constructed, and stabilized to prevent erosion from the expected flow velocity of a two-year, 24-hour frequency storm for the developed condition.
- Stabilization, including armoring material, adequate to prevent erosion of outlets, adjacent streambanks, slopes, and downstream reaches, shall be provided at the outlets of all conveyance systems.

BMP C202: Channel Lining

Channel lining protects erodible channels by using either blankets or riprap.

Conditions of Use

- When natural soils or vegetated stabilized soils in a channel are not adequate to prevent channel erosion.

- When a permanent ditch or pipe system is to be installed and a temporary measure is needed.

In almost all cases, synthetic and organic coconut blankets are more effective than riprap for protecting channels from erosion. Blankets can be used with and without vegetation. Blanketed channels can be designed to handle any expected flow and longevity requirement. Some synthetic blankets have a predicted life span of 50 years or more, even in sunlight. Other reasons why blankets are better than rock include the availability of blankets over rock. In many areas of the state, rock is not easily obtainable or is very expensive to haul to a site. Blankets can be delivered anywhere. Rock requires the use of dump trucks to haul and heavy equipment to place. Blankets usually only require laborers with hand tools, and sometimes a backhoe. The Federal Highway Administration recommends not using flexible liners whenever the slope exceeds 10 percent or the shear stress exceeds 8 lbs/ft2.

BMP C209: Outlet Protection

Outlet protection prevents scour at conveyance outlets and minimizes the potential for downstream erosion by reducing the velocity of concentrated stormwater flows.

Conditions of Use. Outlet protection is required at the outlets of all ponds, pipes, ditches, or other conveyances, and where runoff is conveyed to a natural or manmade drainage feature such as a stream, wetland, lake, or ditch.

C. Low Impact Development (Prince George's County, 1999)

Minimize Directly Connected Impervious Areas. After the total site imperviousness has been minimized and a preliminary site plan has been developed, additional environmental benefits can be achieved and hydrologic impacts reduced by disconnecting the unavoidable impervious areas as much as possible. Strategies for accomplishing this include:
- Disconnecting roof drains and directing flows to vegetated areas.
- Directing flows from paved areas, such as driveways, to stabilized vegetated areas.
- Breaking up flow directions from large paved surfaces.
- Encouraging sheet flow through vegetated areas.
- Carefully locating impervious areas so that they drain to natural systems, vegetated buffers, natural resource areas, or infiltration zones/soils.

Modify/Increase Drainage Flow Paths. The time of concentration (Tc), in conjunction with the hydrologic site conditions, determines the peak discharge rate for a storm event. Site and infrastructure components that affect the time of concentration include:
- Travel distance (flow path).
- Slope of the ground surface and/or water surface.
- Surface roughness.
- Channel shape, pattern, and material components.

Techniques that can affect and control the Tc can be incorporated into the LID concept by managing flow and conveyance systems within the development site:

- Maximize overland sheet flow.
- Increase and lengthen flow paths.
- Lengthen and flatten site and lot slopes.
- Maximize use of open swale systems.
- Increase and augment site and lot vegetation.

Overland Sheet Flow. The site should be graded to maximize the overland sheet flow distance and to minimize disturbance of woodland along the post-development Tc flow path. This practice will increase travel times of the runoff and thus the time of concentration. Consequently, the peak discharge rate will be decreased. Flow velocity in areas that are graded to natural drainage patterns should be kept as low as possible to avoid soil erosion. Velocities in the range of two to five feet per second are generally recommended. Flows can be slowed by installing a level spreader along the upland ledge of the natural drainage way buffer, or creating a flat grassy area about 30 feet wide on the upland side of the buffer where runoff can spread out. This grassy area can be incorporated into the buffer itself. It may be unnecessary to set aside additional land to create this area.

D. Examples of Design Alternatives

Use Natural Drainage for Surface Runoff. As an alternative to structural gutters, pipes, and concrete swales for drainage and infiltration, use vegetated swales, wetlands, and small holding areas. Natural drainage flows can be simulated to slow stormwater and flow rates. A connected series of small-scale features works better than isolated ones. Benefits of incorporating constructed wetlands into a project include reduced infrastructure costs (achieved by using the wetlands for drainage), aesthetic appeal that can boost property values, and market differentiation that can increase sales (*Built Green Handbook*, 2002).

3.1.9 Control Pollutants

A. Description

Pollutants associated with clearing and grading activities come from natural sources (sand, silt, and clay), demolition of existing structures, and the operation of mechanical equipment on the site. The primary goal of controlling pollution during clearing and grading operations is to prevent pollutants from contaminating surface water, ground water, or soils. Both physical and managerial controls can be associated with avoiding introducing pollutants into the ground, stormwater, or adjacent properties during clearing and grading operations. Depending on the size of the project, permit controls can range from a simple checklist of procedures to requiring on-site health and safety officers and plans to ensure proper adherence with all agency pollution regulations.

B. Element Criteria and Suggested BMPs
[Source: Ecology, SWMM-I, 2001 (2.5.2) and Ecology, SWMM-II, 2001 (3.2.3, 4.1, 4.2)]. See also Ecology, SWMM-IV, 2001.

- All pollutants, including waste materials and demolition debris, that occur on site during construction shall be handled and disposed of in a manner that does not cause contamination of stormwater. Woody debris may be chopped and spread on site.
- Cover, containment, and protection from vandalism shall be provided for all chemicals, liquid products, petroleum products, and non-inert wastes present on the site (see Chapter 173-304 WAC for the definition of inert waste).
- Maintenance and repair of heavy equipment and vehicles involving oil changes, hydraulic system drain down, solvent and de-greasing cleaning operations, fuel tank drain down and removal, and other activities which may result in discharge or spillage of pollutants to the ground or into stormwater runoff must be conducted using spill prevention measures, such as drip pans. Contaminated surfaces shall be cleaned immediately following any discharge or spill incident. Emergency repairs may be performed on-site using temporary plastic placed beneath and, if raining, over the vehicle.
- Wheel wash or tire bath wastewater shall be discharged to a separate on-site treatment system or to the sanitary sewer.
- Application of agricultural chemicals including fertilizers and pesticides shall be conducted in a manner and at application rates that will not result in loss of chemical to stormwater runoff. Manufacturers' recommendations for application rates and procedures shall be followed.
- BMPs shall be used to prevent or treat contamination of stormwater runoff by pH modifying sources. These sources include bulk cement, cement kiln dust, fly ash, new concrete washing and curing waters, waste streams generated from concrete grinding and sawing, exposed aggregate processes, and concrete pumping and mixer washout waters.

BMP C151: Concrete Handling

Concrete work can generate process water and slurry that contain fine particles and high pH, both of which can violate water quality standards in the receiving water. This BMP is intended to minimize and eliminate concrete process water and slurry from entering waters of the state.

Conditions of Use. Any time concrete is used, these management practices shall be utilized. Concrete construction projects include, but are not limited to, the following:

- Curbs
- Sidewalks
- Roads
- Bridges
- Foundations
- Floors
- Runways

BMP C152: Sawcutting and Surfacing Pollution Prevention

Sawcutting and surfacing operations generate slurry and process water that contain fine particles and high pH (concrete cutting), both of which can violate the water quality standards in the receiving water. This BMP is intended to minimize and eliminate process water and slurry from entering waters of the state.

Conditions of Use. Anytime sawcutting or surfacing operations take place, these management practices shall be utilized. Sawcutting and surfacing operations include, but are not limited to, the following:

- Sawing
- Coring
- Grinding
- Roughening
- Hydro-demolition
- Bridge and road surfacing

C. Low Impact Development

LID IMPs are designed for on-site use. This approach integrates the lot with the natural environment and eliminates the need for large centralized parcels of land to control end-of-pipe runoff. The challenge of designing a low impact site is that the IMPs and site design strategies must provide quantity and quality control and enhancement, including:

- Ground water recharge through infiltration of runoff into the soil.
- Retention or detention of runoff for permanent storage or for later release.
- Pollutant settling and entrapment by conveying runoff slowly through vegetated swales and buffer strips.

Maximize use of natural processes within the soil mantle and the plant community. The soil mantle offers critical pollutant removal functions through physical processing (filtration), biological processing (various types of microbial action), and chemical processing (cation exchange capacity, other reactions). Plants similarly provide substantial pollutant uptake/removal potential through physical filtering, biological uptake of nutrients, and even various types of chemical interactions. Where something ends up is important. Pollution is often just a resource out of place – too much of a good thing in the wrong location. Natural processes can work effectively to minimize these types of pollution problems (DDNR, 1997).

Soils are very important for their ability to remove pollutants entrained in stormwater through a complex of physical, chemical, and biological mechanisms. Above all, the soil mantle must be understood to be a vast and complex system, a rich and diverse community of organisms – thousands, even millions of organisms per cubic inch – all of which have complex functions that can become the basis of impacts if damaged or destroyed, or become mechanisms for treatment if understood and properly utilized. The various types of processes which occur as the result of soil microbe action and the other essential elements of the soil community, when fully understood, can be utilized quite effectively for stormwater management purposes. Soil constitutes an extremely valuable resource. Documenting the complete array of these soil-based processes is a manual in itself. Soil microflora are abundant and diverse, including innumerable species of bacteria, fungi, actinomycetes, algae, and viruses. These species process organic material, certainly a stormwater-linked pollutant, as food and energy sources in different ways. Physically, particulate form pollutants are caught and filtered by the soil mantle as well. Many of the soil-based functions which are chemically oriented (adsorption, others) occur through the mechanisms of cation exchange[3] (CEC) driven by surface area of soil particles, among other factors. Such functions are especially important for their ability to remove soluble pollutants such as nutrients. Even in large particle sandy soils where surface area is low (72 sq cm per gram), significant pollutant reduction can occur through these chemical mechanisms (DDNR, 1997).

Pollutant removal potential often varies indirectly with permeability. For example, soils which are extremely sandy (large particle) can be expected to have excellent permeability. Yet CEC values may be borderline. In fact, extremely sandy soils may have such low CEC values that they should be deemed unacceptable certainly for any type of stormwater runoff which can be expected to be reasonably laden with nonpoint source pollutants, particulate or soluble. In no way should "hot spot" runoff from roads or fast food parking lots be cycled through sandy infiltration systems without being pretreated through some sort of filtering mechanism. Conversely, heavy clayey soils may have limited permeability, yet typically do an excellent job of removing a wide variety of pollutants through their high CEC ratings (DDNR, 1997).

3.1.10 Control Dewatering

A. Description

Construction activities, such as construction of piping systems and foundations, often require removal of ground water. Generally, this water is ground water or surface runoff that seeps or flows into an open excavation, where it must be removed by means of pumping, draining, or other means. The primary challenges of handling water removal from excavations are the likelihood that it is contaminated with sediment, petroleum, or other pollutants. Therefore typical dewatering operations require special handling to prevent the discharge of pollutants and control the rate of dewatering so downstream waterbodies, stream channels, and storm conveyance systems are not impacted.

B. Element Criteria and Suggested BMPs
[Source: Ecology, SWMM-I, 2001 (2.5.2) and Ecology, SWMM-II, 2001 (3.2.3, 4.1, 4.2)]

- Foundation, vault, and trench dewatering water shall be discharged into a controlled conveyance system prior to discharge to a sediment pond. Channels must be stabilized, as specified in Element #8.
- Clean, non-turbid dewatering water, such as well-point ground water, can be discharged to systems tributary and to state surface waters, as specified in Element #8, provided the dewatering flow does not cause erosion or flooding of receiving waters. These clean waters should not be routed through stormwater sediment ponds.
- Highly turbid or contaminated dewatering water from construction equipment operation, clamshell digging, concrete tremie pour, or work inside a cofferdam shall be handled separately from stormwater.

[3] Cation exchange capacity (CEC) is used as a measure of pollutant reduction potential.

- Other disposal options, depending on site constraints, may include:
  - Infiltration.
  - Transport off site in vehicle, such as a vacuum flush truck, for legal disposal in a manner that does not pollute state waters.
  - On-site treatment using chemical treatment or other suitable treatment technologies.
  - Sanitary sewer discharge with local sewer district approval.
  - Use of a sedimentation bag with outfall to a ditch or swale for small volumes of localized dewatering.

C. Low Impact Development

Bioretention is a practice to manage and treat stormwater runoff by using a conditioned planting soil bed and planting materials to filter runoff stored within a shallow depression. The bioretention concept was originally developed by the Prince George's County, Maryland, Department of Environmental Resources in the early 1990s as an alternative to traditional BMP structures (ETA, 1993). The method combines physical filtering and adsorption with biological processes. The system can include the following components, as illustrated in Figure 8, Appendix 3:

- A pretreatment filter strip of grass channel inlet area.
- A shallow surface water ponding area.
- A bioretention planting area.
- A soil zone, an underdrain system.
- An overflow outlet structure.

D. Examples of Design Alternatives

The major components of the bioretention system all require careful design considerations. These major components are summarized in Table 3. Detailed design guidance can be obtained from the Prince George's County Bioretention Manual (ETA, 1993).

Table 3. Bioretention design components

Pretreatment Area	Required where a significant volume of debris or suspended material is anticipated such as parking lots and commercial areas. Grass buffer strip or vegetated swale are commonly used pretreatment devices.
Ponding Area	Typically limited to a depth of 6 inches
Ground Cover Area	3 inches of mature mulch recommended
Planting Soil	Depth = 4 feet Soil mixtures include sand, loamy sand, and sandy loam Clay content £ 10%
In-situ Soil	Infiltration rate ³ 0.5 inches/hour w/o underdrains
Infiltration Rate	£ 0.5 inch/hour underdrain required
Plant Materials	Native species, minimum 3 species
Inlet and Outlet Controls	Non erosive flow velocities (0.5 ft/sec)
Maintenance	Routine landscape maintenance
Hydrologic Design	Determined by state or local agency

3.1.11 Maintain BMPs

A. Description

At the start of clearing and grading operations the permittee will have in place all best management practices, both structural and procedural. These BMPs are often the last line of defense against impacting adjacent properties, sensitive areas, and water resources. It is important that regular and consistent procedures for monitoring, repairing, and revising the BMPs are in place. These monitoring procedures should be part of the permit requirements. Removal and repair of the impacts of structural BMPs should also be included as a permit requirement.

B. Element Criteria and Suggested BMPs
[Source: Ecology, SWMM-I, 2001 (2.5.2) and Ecology, SWMM-II, 2001 (3.2.3, 4.1, 4.2)]

- Temporary and permanent erosion and sediment control BMPs shall be maintained and repaired as needed to ensure continued performance of their intended function. Maintenance and repair shall be conducted in accordance with BMPs.
- Sediment control BMPs shall be inspected weekly or after a runoff producing storm event during the dry season and daily during the wet season. The inspection frequency for stabilized, inactive sites shall be determined by the local permitting authority based on the level of soil stability and potential for adverse environmental impacts.
- Temporary erosion and sediment control BMPs shall be removed within 30 days after final site stabilization is achieved or after the temporary BMPs are no longer needed. Trapped sediment shall be removed or stabilized on site. Disturbed soil resulting from removal of BMPs or vegetation shall be permanently stabilized.

3.1.12 Manage the Project

A. Description

Good management of a project will employ BMPs that ensure the project is completed without causing negative impacts to surface water, ground water, on-site vegetation and soils, and adjacent properties. It will use techniques and BMPs that allow the staging, execution, and completion in the shortest amount of time possible, thereby reducing exposure and risk of severe weather that can result in stormwater contamination. And finally, it will maintain the highest possible measures of safety and control for both workers and unintended site visitors.

B. Element Criteria and Suggested BMPs
[Source: Ecology, SWMM-I, 2001 (2.5.2) and Ecology, SWMM-II, 2001 (3.2.3, 4.1, 4.2)]

Phasing of Construction Development: Projects shall be phased where feasible in order to prevent, to the maximum extent practicable, the transport of sediment from the development site during construction. Revegetation of exposed areas and maintenance of that vegetation shall be an integral part of the clearing activities for any phase. Clearing and grading activities for developments shall be permitted only if conducted pursuant to an approved site development plan (e.g., subdivision approval) that establishes permitted areas of clearing, grading, cutting, and filling. When establishing these permitted clearing and grading areas, consideration should be given to minimizing removal of existing trees and minimizing disturbance and compaction of native soils except as needed for building purposes. These permitted clearing and grading areas and any other areas required to preserve critical or sensitive areas, buffers, native growth protection easements, or tree retention areas, as may be required by local jurisdictions, shall be delineated on the site plans and the development site.

Seasonal Work Limitations: While the following seasonal limitations for clearing and grading are provided as guidance from the Stormwater Management Manual produced by the Ecology, in the development and implementation of codes, ordinances, and regulations, local jurisdictions need to customize for local weather and site conditions.

From October 1 through April 30, clearing, grading, and other soil disturbing activities shall only be permitted if shown to the satisfaction of the local permitting authority that the transport of sediment from the construction site to receiving waters will be prevented through a combination of the following:

1. Site conditions including existing vegetative coverage, slope, soil type, and proximity to receiving waters.
2. Limitations on activities and the extent of disturbed areas.
3. Proposed erosion and sediment control measures.

Based on the information provided and local weather conditions, the local permitting authority may expand or restrict the seasonal limitation on site disturbance.

The following activities are exempt from the seasonal clearing and grading limitations:

1. Routine maintenance and necessary repair of erosion and sediment control BMPs.
2. Routine maintenance of public facilities or existing utility structures that do not expose the soil or result in the removal of the vegetative cover to soil.
3. Activities where there is 100 percent infiltration of surface water runoff within the site in approved and installed erosion and sediment control facilities.

Coordination with Utilities and Other Contractors: The primary project proponent shall evaluate, with input from utilities and other contractors, the stormwater management requirements for the entire project, including the utilities, when preparing the Construction SWPPP.

Inspection and Monitoring: All BMPs shall be inspected, maintained, and repaired as needed to ensure continued performance of their intended function. A qualified erosion and sediment control specialist shall be identified in the Construction SWPPP and shall be on-site or on-call at all times. Certification may be through the Construction Site Erosion and Sediment Control Certification Program offered by the Washington State Department of Transportation/Associated General Contractors of Washington-Education Foundation, or any equivalent local or national certification and/or training program. Sampling and analysis of the stormwater discharges from a construction site may be necessary on a case-by-case basis to ensure compliance with standards. The local permitting authority may establish monitoring and reporting requirements when necessary. Whenever inspection and/or monitoring reveals that the BMPs identified in the Construction SWPPP are inadequate, due to the actual discharge of or potential to discharge a significant amount of any pollutant, the SWPPP shall be modified, as appropriate, in a timely manner.

Maintenance of the Construction SWPPP: The Construction SWPPP shall be retained on-site or within reasonable access to the site. The Construction SWPPP shall be modified whenever there is a significant change in the design, construction, operation, or maintenance of any BMP.

C. Low Impact Development (Prince George's County, 1999)

The following five basic steps govern the development and implementation of a sound erosion and sediment control plan for any land development activity.

- Step One: Planning. Plan the operation to fit the existing site features, including topography, soils, drainage ways, and natural vegetation.
- Step Two: Scheduling of Operations. Schedule grading and earthmoving operations to expose the smallest practical area of land for the shortest possible time. If possible, schedule land disturbance activities during dry seasons or periods.
- Step Three: Soil Erosion Control. Apply soil erosion prevention and control practices as a first line of defense against off-site damage.
- Step Four: Sediment Control. Apply sediment control practices as a second line of defense against off-site damage.
- Step Five: Maintenance. Implement a thorough inspection and maintenance program.

Scheduling of Operations. An important erosion and sediment control step is to expose the smallest practical area of land for the shortest possible time. The reason behind this step is rather simple – one acre of exposed land will yield less sediment than two acres of exposed land, and an area exposed for three months will yield less sediment than an area exposed for six months. The clearing, grubbing, and scalping of excessively large areas of land at one time is an unnecessary invitation to erosion and sediment problems.

These initial earth-disturbing activities should be kept to a bare minimum. On the areas where disturbance takes place, the site designer should consider staging of construction, temporary seeding, and/or temporary mulching as a technique to reduce erosion.

Staging of construction involves stabilizing one part of the site before disturbing another. In this way the entire site is not disturbed at once and the time without ground cover is minimized. Temporary seeding and mulching involves seeding or mulching areas that would otherwise lie open for long periods of time. The time of exposure is limited and, therefore, the erosion hazard is reduced.

Soil Erosion Control Practices. An important principle is to apply soil erosion control practices on disturbed areas as a first line of defense against off-site damage. Control does not begin with the perimeter sediment trap or basin. It begins at the source of the sediment, the disturbed land area, and extends down to the control structure. Soil particles become sediment when they are detached and moved from their initial resting place. This process, which is called erosion, is accomplished for the most part by the impact of falling raindrops and the energy exerted by moving water and wind, especially water. A reduction in the rate of soil erosion is achieved by controlling the vulnerability of the soil to erosion processes or the capability of moving water to detach soil particles. In humid regions this is accomplished through the use of soil stabilization and runoff control practices.

Soil stabilization practices include a variety of vegetative, chemical, and structural measures used to shield the soil from the impact of raindrops or to bind the soil in place, thus preventing it from being detached by surface runoff or wind erosion.

Inspection and Maintenance. The final important control step is to implement a thorough inspection and maintenance program. This step is vital to the success of an erosion and sediment control program. A site cannot be controlled effectively without thorough, periodic checks of all erosion and sediment control BMPs. When inspections reveal problems, modifications, repairs, cleaning, or other maintenance operations must be performed expeditiously. Particular attention must be paid to water-handling structures such as diversions, sediment traps, grade control structures, sediment basins, and areas being revegetated. Breaches in the structures or areas being revegetated must be repaired quickly, preferably before the next rainfall.

D. Examples of Design Alternatives

Phase grading. Phase construction so that no more than 40 percent of the site is disturbed at any one time to limit disturbance of the site and help decrease dust and erosion problems. In addition, phasing development to avoid grading during wetter months helps avoid storm related problems that can be quite costly, cause construction delays and stoppages, and damage public and private properties downstream (*Built Green Handbook*, 2002).

Construction Sequencing and Phasing (See CWP, 1997B). A part of the review process for development should include an explicit construction sequence. The sequence should be:

1. Install perimeter BMPs.
2. Clear building site, but retain as much vegetation as possible surrounding the building.
3. Excavate for foundation and utilities; if possible, consider pin piling of grade beam foundations to minimize site excavations.
4. Pour foundation and rough-in utilities.
5. Backfill foundation and establish final grades on the site.
6. Apply appropriate ground cover.
7. Frame and build structure(s) with clustering to preserve existing vegetative canopy and critical areas. This change will shift the focus of the developer from constructing the building and then doing the site to developing the site and then constructing the building. This is a thinking process that requires the builder/homeowner to think outside the box and capture the reality of a more cost-effective way to develop the landscape (Caine, 2001).

3.2 Site Restoration

Many of the BMPs from SWMM and LID recommendations touch on elements of site restoration. But most of these elements focus on mitigating the immediate impacts and effects of clearing and grading operations. An example is the SWMM BMPs for stabilizing soils (see section 4.3.5), which list several temporary measures and also identify permanent seeding and sodding of channels. These BMPs also need to include normal agronomic practices such as watering for rapid seed germination, good survival rates that results in healthy vegetation that provides erosion and sediment control and other water quality benefits. LID recommendation to utilize bioretention swales to increase infiltration and reduce runoff describe initial grading and planting strategies, but also do not often mention monitoring for viability after the project is complete. While these elements protect a site during and for a short period after the initial impacts are created, they often lack mechanisms for monitoring and ensuring (1) the long-term viability of the permanent stormwater control structures or (2) the health of replacement trees and vegetation or constructed wetlands and infiltration zones.

In contrast, the LID recommendation for limiting vegetation removal to the minimum possible to complete the work is by its nature a successful long-term site restoration strategy. "Retention of a wide, continuous riparian zone in forest cover or wetlands has been shown to be the BMP of greatest potential and versatility among those in current use" (May and Horner, 2001). This practice may also be the simplest to accomplish logistically, the least costly and, accordingly, the most cost effective. "In newly developing areas, riparian zones can be isolated from development, along with their associated streams, which are not going to be built over in any event" (May and Horner, 2001).

A failure of either the planted areas or the constructed control structures could manifest increased erosion, leading to potential property damage and ultimately become the responsibility of the jurisdiction to repair if there is no way to hold the initial constructor/permittee responsible. This level of site restoration guarantee may not be feasible for small sites, but is critical for large sites, where the impact of a large-scale failure in vegetation and permanent control protecting slopes or exposed soils can impact adjacent public and private properties, utilities, wetlands, and streams.

Jurisdictions should institute measures to ensure the health of site restoration (structural, revegetation, and reforestation) efforts for up to three years after the completion of a project. These measures might take the form of performance bonds or securities, insurance policies, pooling tree removal fees and fines into restoration funds, or other means to maximize the desire of the permittee to maintain conditions for success of all elements of the project. While this suggestion seems extreme, it often takes three years for the affects of large scale clearing and grading efforts to show within the remaining forest canopy, constructed wetlands, reseeded or resodded turf areas, and replanted natural areas. It also may take three years before a significant storm fully tests the permanent control measures constructed on the site.

4. Related References and Citations

Booth, D. and L. Reinelt. 1993. Consequences of Urbanization on Aquatic Systems – Measured Effects, Degradation Thresholds, and Corrective Strategies, pp. 545-550. In *Proceedings Watershed '93 A National Conference on Watershed Management*. March 21-24, 1993. Alexandria, Virginia.

Built Green Handbook. 2002. Built Green: A Green Developer Program for Green Communities. Master Builders Association of King and Snohomish Counties.

Cahill, T.H. and W.R. Horner. 1992. Structural and Nonstructural Best Management Practices for the Management of Non-Point Source Pollution in Coastal Waters: A Cost-Effectiveness Comparison. Trenton, New Jersey. Cahill Associates.

Caine, Ed. 2001. Snohomish County Experience with Low Impact Development and Its Integration with the Erosion Control Program. In proceedings of *Low Impact Development in Puget Sound, Innovative Stormwater Management Practices*. Puget Sound Water Quality Action Team, 2001.

Center for Watershed Protection (CWP), 1997A. Muddy Water In – Muddy Water Out? In Watershed Protection Techniques, 2(3): 393-403. CWP, Article 52, February 1997.

Center for Watershed Protection (CWP), 1997B. Practical Tips for Construction Site Phasing. In Watershed Protection Techniques, 2(3): 413-417. CWP, Technical Note No. 80, February 1997. Also found in Schueler, Thomas R. and Heather K. Holland, editors, *The Practice of Watershed Protection*. Center for Watershed Protection, Ellicott City, Maryland 21043). c2000. Article No. 54. See *www.cwp.org/pubs_download.htm*.

Center for Watershed Protection (CWP), 1997C. Construction Practices: The Good, the Bad, and the Ugly. In Watershed Protection Techniques, 1(3): 95-99. CWP, Article 60, February 1997.

Center for Watershed Protection (CWP), 1998. *Better Site Design: A Handbook for Changing Development Rules in Your Community*. Principle No. 19, pp. 143-149. Prepared by the CWP for the Site Planning Roundtable. August 1998. See *www.cwp.org/pubs_download.htm*.

Chesapeake Research Consortium (CRC). 1996. Design of Stormwater Filtering Systems. Prepared by the Center for Watershed Protection, Silver Spring, Maryland.

Coffman, Larry S., Michael L. Clar, and Neil Weinstein. 1998. New Low Impact Design: Site Planning and Design Techniques for Stormwater Management. In *Proceedings of the 1998 National Planning Conference*, AICP Press. *www.asu.edu/caed/proceedings98/Coffmn/coffmn.html*

Corish, Kathleen A. 1994. Clearing and Grading Guidance: A Guide to Improving Clearing and Grading Regulations Through Non-Structural Best Management Practices. Metropolitan Washington Council of Governments. Washington, D.C. 48 pp.

Corish, Kathleen A. 1995. Clearing and Grading Strategies for Urban Watersheds. Metropolitan Washington Council of Governments. Prepared for U.S. Environmental Protection Agency, Office of Wetlands, Oceans, and Watersheds, Grant #X-818188-01-6. December 1995.

Daniels, Steven E. and Gregg B. Walker. 2001. *Working Through Environmental Conflict: The Collaborative Learning Approach*. Praeger Publishers.

Delaware Department of Natural Resources (DDNR). 1997. Conservation Design for Stormwater Management: A Design Approach to Reduce Stormwater Impacts from Land Development and Achieve Multiple Objectives Related to Land Use. A Joint Effort Between the Delaware Department of Natural Resources and Environmental Control and The Environmental Management Center of the Brandywine Conservancy. September 1997.

Engineering Technologies Associates Inc. (ETA). *1993 Design Manual for Use of Bioretention in Stormwater Management*. Prepared for Prince George's County, Maryland, Department of Environmental Resources.

Flaxman, E. M. 1972. Predicting Sediment Yield in Western United States. Journal of the Hydraulic Division, American Society of Civil Engineers, 98:2073-2085.

Hinman, Curtis. 2001. Integrating and Implementing Low Impact Development in Pierce County Land Use Development Process. In proceedings of *Low Impact Development in Puget Sound, Innovative Stormwater Management Practices*. Puget Sound Water Quality Action Team, 2001.

Horner, R.R., J.J. Skupien, E.H. Livingston, and H.E. Shaver. 1994. Fundamentals of Urban Runoff Management: Technical and Institutional Issues. Terrene Institute, Washington, D.C.

Klein, R.D. 1979. Urbanization and Stream Quality Impairment. Water Resource Bulletin, 15(4): 948:903.

Maryland Department of Natural Resources (MDNR). 1984. Maryland Standards and Specifications for Infiltration Practices. Department of Natural Resources, Water Resources Administration, Stormwater Management Division.

Maryland Department of the Environment (MDE). 1998. Maryland Stormwater Design Manual. Prepared for Water Resources Administration, Maryland Department of the Environment, by the Center for Watershed Protection Inc., Environmental Quality Resources Inc., and Loiderman Associates Inc.

May, C.W., E.B. Welch, R.R. Horner, J.R. Karr, and B.W. Mar. 1997. Quality Indices for Urbanization in Puget Sound Lowland Streams. Prepared for Washington State Department of Ecology, by Department of Civil Engineering, University of Washington, Seattle, Washington.

May, Christopher W. and Richard R. Horner. 2001. Conventional Development: Cumulative Impacts, Limitations of the Mitigation-Based Stormwater Management Strategy and the Promise of Low Impact Development in the Pacific Northwest. In proceedings of *Low Impact Development in Puget Sound, Innovative Stormwater Management Practices*. Puget Sound Water Quality Action Team, 2001.

McDonald, David. 2001. Soils for Salmon: Integrating Stormwater, Water Supply and Solid Waste Issues in New Development and Existing Landscapes. Seattle Public Utilities. In proceedings of *Low Impact Development in Puget Sound, Innovative Stormwater Management Practices*. Puget Sound Water Quality Action Team, 2001.

Mittlestadt, Gillian. 2001. From Comp Plan to Site Plan: A Framework for Land-Use Planning That Supports Low Impact Development. In *Proceedings of Low Impact Development in Puget Sound, Innovative Stormwater Management Practices*. Puget Sound Water Quality Action Team, 2001.

O'Brien, Ed. 2001. Low Impact Development and the Department of Ecology's Stormwater Manual for Western Washington. In proceedings of *Low Impact Development in Puget Sound, Innovative Stormwater Management Practices*. Puget Sound Water Quality Action Team, 2001.

Parsons, Chris. 2001. Integrating LID Concepts with Growth Management Planning Efforts. In proceedings of *Low Impact Development in Puget Sound, Innovative Stormwater Management Practices*. Puget Sound Water Quality Action Team, 2001.

Prince George's County, 1999. *Low-Impact Development: An Integrated Environmental Design Approach*. Department of Environmental Resources, Prince George's County, Maryland. *www.goprincegeorgescounty.com/Government/AgencyIndex/DER/PPD/LID/LiDNatl.pdf*

Puget Sound Action Team. 2005. *Low Impact Development Technical Guidance Manual for Puget Sound*. Puget Sound Action Team in cooperation with Curtis Hinman (WSU Extension Pierce County) and the Washington State Department of Ecology, 2005.

Steedman, R.J. 1988. Modification and Assessment of an Index of Biotic Integrity to Quantify Stream Quality in Southern Ontario. Canadian Journal of Fisheries and Aquatic Science. 45:492-501.

U.S. Environmental Protection Agency (EPA). 1993. Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters. Publication 840-B-92-002. Washington, D.C.: EPA Office of Water.

Urban Land Institute (ULI). 1980. Village Homes, Project Reference File. The Urban Land Institute, Vol. 10 (April-June):8.

Washington State Department of Community, Trade and Economic Development (CTED). 2003. *Critical Areas Assistance Handbook: Protecting Critical Areas Within the Framework of the Washington Growth Management Act*. CTED. Olympia, Washington. November 2003.

Washington State Department of Ecology (Ecology). 2000. Construction Stormwater NPDES General Permit, October 4, 2000. Ecology. See for more information *www.ecy.wa.gov/programs/wq/stormwater/construction/index.html*.

Washington State Department of Ecology, SWMM-I. *Stormwater Management Manual for Western Washington. Volume I – Minimum Technical Requirements and Site Planning.* Prepared by Ecology, Water Quality Program. Publication No. 99-11 (A revised portion of Publication No. 91-75). August 2001.

Washington State Department of Ecology, SWMM-II. *Stormwater Management Manual for Western Washington. Volume II – Construction Stormwater Pollution Prevention.* Prepared by Ecology, Water Quality Program. Publication No. 99-12 (A revised portion of Publication No. 91-75). August 2001.

Washington State Department of Ecology, SWMM-III. *Stormwater Management Manual for Western Washington. Volume III – Hydrologic Analysis and Flow Control Design/BMPs.* Prepared by Ecology, Water Quality Program. Publication No. 99-13 (A revised portion of Publication No. 91-75). August 2001.

Washington State Department of Ecology, SWMM-IV. *Stormwater Management Manual for Western Washington. Volume IV – Source Control BMPs.* Prepared by Ecology, Water Quality Program. Publication No. 99-14 (A revised portion of Publication No. 91-75). August 2001.

Washington State Department of Ecology, SWMM-V. *Stormwater Management Manual for Western Washington. Volume V – Runoff Treatment BMPs.* Prepared by Ecology, Water Quality Program. Publication No. 99-15 (A revised portion of Publication No. 91-75). August 2001.

Wulkan, Bruce. 2001. Low Impact Development in the Puget Sound Water Quality Management Plan. In proceedings of *Low Impact Development in Puget Sound, Innovative Stormwater Management Practices*. Puget Sound Water Quality Action Team, 2001.

4.1 Some On-Line Resources

General

Center for Watershed Protection, Ellicott City, Maryland 21043. *www.cwp.org/*

Stormwater Guidance

Stormwater Management Manual, Volumes I-V
www.ecy.wa.gov/programs/wq/stormwater/index.html

Guidance Document for Applying for Ecology's General Permit to Discharge Stormwater Associated with CONSTRUCTION Activity
www.ecy.wa.gov/biblio/9937.html

Technical Documents

Guidelines for use of RUSLE (revised Universal Soil Loss Equations)
http://www.greenfix.com/Channel%20Web/pdfs/RUSLE%20Guidelines.pdf

Bioretention

www.goprincegeorgescounty.com/Government/AgencyIndex/DER/PPD/LID/bioretention_links.asp?h=20&s=&n=50&n1=160

Low Impact Development

Prince George's County Maryland Web site
www.goprincegeorgescounty.com/Government/AgencyIndex/DER/PPD/LID/lid_links.asp?h=20&s=&n=50&n1=160

Puget Sound Water Quality Action Team
www.psat.wa.gov/Programs/LID.htm

Appendices

Appendix 1: Clearing and Grading Example Code

Introduction

Clearing of vegetation and grading of soils for construction activities is known to affect the normal flow and infiltration of rainfall, potentially causing the loss of topsoil and sedimentation into our rivers and streams. Other impacts of land disturbance activities may be a loss of vegetation cover and forest canopy that results in increased runoff volumes and frequency, increased soil erosion, and the invasion of non-native plant species on the subject property, if it is not properly and promptly revegetated. Avoiding or minimizing the impacts of clearing and grading activities to adjacent and downstream public or private property and fish and wildlife habitat is one of the goals for regulating clearing and grading activities.

This Clearing and Grading Example Code (Example Code) is one example of a comprehensive approach to managing clearing and grading activities and is developed to provide local jurisdictions with an example they can use when developing or updating their clearing and grading regulations. The Example Code (and supporting technical guidance document) is not a state regulation. Instead, it is intended to provide an example to local jurisdictions, developers, contractors, and others of different methods or ways to regulate clearing and grading activities in compliance with applicable state and federal laws. The documents have no independent regulatory authority and do not establish new environmental regulatory requirements.

The Example Code has been developed by reviewing and integrating examples from other adopted city and county ordinances, resource information for clearing and grading provided on the Municipal Research & Services Center Web site, the Washington State Department of Community, Trade and Economic Development's (CTED) *Critical Areas Assistance Handbook* (2003), and the Washington State Department of Ecology's *Stormwater Management Manual for Western Washington* (2001). Specific Western Washington ordinances used in the development of this Example Code include the cities of Anacortes, Bellevue, Lake Forest Park, Redmond, and Olympia, and the counties of Jefferson, King, Whatcom, and Klickitat. As a result, the Example Code captures ways in which a number of different jurisdictions in Western Washington have approached various aspects of clearing and grading within their codes while leaving room for a jurisdiction to include local preferences. The Example Code and supporting technical guidance document emphasize the use of techniques to limit land disturbances from clearing and grading, and are designed to be adapted to local needs and conditions. Current law and regulations, where applicable, require project proponents to obtain a permit or approval prior to the clearing of vegetation or grading of soils prior to construction activity. Some of the performance standards in the Example Code may not be technically appropriate in all communities. In addition, the process by which building permits are granted may vary among communities. As a result, jurisdictions may choose to regulate clearing and grading through other ordinances or regulations. Neither the Example Code nor the technical guidance document is intended to represent a threshold below which a local jurisdiction cannot deviate. Nor is the Example Code meant to imply there is a single appropriate set of rules and principles for the regulation of clearing and grading activities.

The components of this Example Code have, therefore, been developed in modules that can be incorporated into existing regulations [such as regulations for erosion and sedimentation control (ESC), forest practices, critical area ordinances (CAO), or stormwater ordinances], enabling the user to choose various aspects that are appropriate to their local circumstances and regulatory needs. This approach provides maximum flexibility to assist jurisdictions in achieving their clearing and grading goals.

In order for local stormwater erosion control programs to be considered consistent with Washington State Department of Ecology's (Ecology) technical guidance, local jurisdictions must include statements that are similar to those in the *Stormwater Management Manual for Western Washington* or the latest edition of the manual in some enforceable rule or document. Ideally, stormwater management and maintenance should be integrated into site development standards and regulations. The Example Code provides an illustration of how clearing and grading ordinances can be used as part of a stormwater management program. Ecology can provide additional information and guidance on model ordinance language for stormwater regulations.

Under the Growth Management Act (GMA) (Chapter 36.70A RCW), development regulations, such as critical area ordinances, are designed to protect the function and values of wetlands, fish and wildlife habitat areas, frequently flooded areas, aquifer recharge areas, and steep slopes and serve as an important overlay when regulating land clearing activities. Integrating the appropriate critical area provisions to protect critical area functions into a clearing and grading ordinance will ensure consistency between critical areas' protection and land clearing and revegetation activities. No regulations for development setback or stream and wetland buffers are presented in this Example Code. Therefore, the development standards identified in adopted critical area ordinances should be referenced in this code, as appropriate.

For recommendations on appropriate development setbacks, vegetated buffer sizes, or other critical area protections for land development activities, consultation with the appropriate state agency, federal agency, or natural resource professional will ensure that protection of natural resources for wetlands, fish, wildlife, and community needs is achieved. [See CTED's *Critical Areas Assistance Handbook* (2003) for examples of critical areas protection standards and recommended buffers.]

While specific communities' needs may vary, there are a few elements that can help make a clearing and grading ordinance more effective, regardless of the more specific requirements:

- Reference to a specific technical manual.
- Clear enforcement measures.
- Flexibility to allow a process to change the plan in response to field conditions.
- Authority for inspectors from the local permitting authority to inspect construction sites at regular intervals, and particularly at points where the plan may need to be changed.
- Incorporating measures to protect natural resources and critical areas.
- A specific plan approval process, with guidelines on plan submission.

Clearing and grading is widely accepted as a necessary practice, but there are certain caveats to making even the most well crafted ordinance effective. First, communities need to have the staff and resources to enforce erosion and sediment control regulations (see the technical guidance document Section 1.3). In addition, any technical manuals referred to in the ordinance need to provide useful guidance on selecting effective clearing and grading and erosion and sediment control measures. Finally, educating contractors, engineers, and designers is important to successful implementation.

Chapter X.10

Purpose and General Provision

Chapter X.20
Definitions

Chapter X.30
Administration

Chapter X.40
Clearing and Grading Standards

X.40.140 Cut and Fill Slopes
X.40.150 Rockeries
X.40.160 Control of Other Pollutants
X.40.170 Dewatering Devices
X.40.180 Slash Removal
X.40.190 Revegetation
X.40.200 Construction Phasing
X.40.210 Seasonality – Temporary Restrictions
X.40.220 Maintenance
X.40.230 Ponds and Reservoirs
X.40.240 Site-Specific Requirements

Chapter X.50
Special Management Areas

X.50.010 Designation
X.50.020 Forested Lands in Urban Areas (Tree Retention and Replacement)
X.50.030 DNR Forest Practices Permit for Rural Areas
X.50.040 Conversion Option Harvest Plan
X.50.050 Six-Year Moratorium

Chapter X.60
Enforcement

X.60.010 Offense and Penalty
X.60.020 Length of Offense
X.60.030 Stop Work Orders and Corrective Actions
X.60.040 Notice of Penalty
X.60.050 Permit Revocation
X.60.060 Restoration or Mitigation
X.60.070 Appeals
X.60.080 Authority of Prosecuting Attorney

Chapter X.10 Purpose and General Provision

The Purpose and General Provision section allows the jurisdiction to establish the general framework within which the Clearing and Grading Ordinance will fit. Throughout this Example Code, authority is generally given to the "director" of the planning and community development department. Depending on the organization of the jurisdiction and department, authority may be placed with the administrator, manager, hearing examiner, or other individual or body charged with implementing these regulations.

X.10.010 Purposes

The Purposes section should include the major purposes for which the ordinance is being established. At a minimum, this section should include purposes pertaining to protecting or promoting the health, safety, and general welfare of the jurisdiction's citizens; implementing the comprehensive plan; protecting, preserving, or enhancing the natural environment and fish and wildlife habitats; and minimizing damage due to hazardous conditions. Additional relevant purposes may be added as deemed necessary by the jurisdiction. Finally, this section identifies that the purpose of this ordinance is to establish a review process for clearing and grading activities with greater potential for off-site impacts.

A. To promote the public health, safety, and general welfare of the citizens and protect public and private resources of the [jurisdiction] without preventing the reasonable use, development, and maintenance of land.

B. To avoid or minimize impacts of clearing and grading, as a component of land disturbance activities to adjacent and downstream public or private property.

C. To encourage site development on public and private property, including clearing, excavation, and filling in such a manner as to minimize hazards to life, health, and property.

D. To preserve and enhance the [jurisdiction] physical and aesthetic character by preventing untimely and indiscriminate removal or destruction of trees and ground cover.

E. To preserve, replace, or enhance the natural qualities of lands, watercourses, and aquatic resources; preserve and protect priority fish and wildlife habitats; minimize water quality degradation and the sedimentation of creeks, streams, ponds, lakes, wetlands, marine waters, and other water bodies; and preserve and enhance beneficial uses.

F. To minimize surface water runoff and diversion which may contribute to flooding.

G. To reduce siltation in the [jurisdiction] streams, lakes, storm sewer systems, and public roadside improvements.

H. To reduce the risk of slides and the creation of unstable building sites.

I. To promote building and site planning practices that are consistent with the [jurisdiction] natural topography, soils, and vegetative features while at the same time recognizing that certain factors such as disease, danger of fallings, proximity to existing and proposed structures and improvements, interference with utility services, protection of scenic views, and the realization of a reasonable enjoyment of property may require the removal of certain trees and ground cover.

J. To ensure prompt development, restoration, and replanting and effective erosion control of property after land clearing and grading.

K. To implement the goals and policies of the [jurisdiction] comprehensive plan.

L. To promote low impact development site planning and building practices that provide for managing surface water runoff on-site and are consistent with the [jurisdiction] natural topography, vegetation cover, and hydrology.

M. It is also the purpose of this code to establish a [jurisdiction] review process for larger, potentially more impactful, land disturbing projects to ensure these regulations are met.

X.10.020 Applicability

The Applicability section indicates the jurisdiction's intent to exercise its authority over all clearing and grading activities and establishes the scope of the ordinance by identifying the activities and geographic area to which the ordinance applies. The provisions of this ordinance should apply throughout the entire jurisdiction.

All clearing and grading activity within [jurisdiction] shall be subject to the provisions of this chapter. No clearing and grading approval shall be issued by the [jurisdiction] prior to the applicant's meeting the submittal requirements as set forth in these regulations and only when in compliance with federal, state, and local regulations.

X.10.030 Review Threshold Established

While all clearing and grading activities are subject to this ordinance, only activities that meet or exceed certain threshold criteria are subject to jurisdictional review. Clearly articulating what activities require a permit and what activities do not require a permit assists in providing predictability to all stakeholders.

The [jurisdiction] has determined that there is a threshold of clearing and grading activity where the likelihood of impact to land and resources is sufficiently high to require permit review and approval of the activity by the [director] prior to commencement. Threshold criteria contained in X.10.040 and X.10.050 shall be applied.

X.10.040 Clearing and Grading Activity Requiring Approval – Permit Required

This section provides specific details regarding the activities for which a Clearing and Grading Permit is required. Specific thresholds pertaining to clearing and grading activities should be included. Thresholds may be adjusted to correspond to local conditions or adjusted to respond to the predominant size of local lots. The thresholds below are representative of thresholds contained in the City of Olympia, the City of Bellevue, and Jefferson County's clearing and grading ordinances.

Clearing and grading approval is required for any project involving any of the following:

A. Any clearing, filling, excavation, or grading in a protected area, critical area, or critical area buffer.

B. Clearing and grading of 7,000 square feet or greater.

Refer to the Department of Ecology's Stormwater Management Manual for Western Washington (SWMM-I, 2001, Chapter 2.4 and 2.5). *Ecology recommends stormwater management review by local governments for land disturbances, including clearing and grading, of 7,000 square feet or greater. Currently, an NPDES permit is required for the clearing and grading of all lots of one acre and discharges to surface water.*

C. Fill and/or excavation of fifty (50) cubic yards or more, even if excavated material is used as fill on the same site. [Quantities of fill and excavation are separately calculated and then added together, even if excavated material is used as fill on the same site.]

D. Clearing or grading that will likely penetrate the ground water table, including the construction of ponds and reservoirs.

E. An excavation which is more than five (5) feet in depth or which creates a cut slope greater than five (5) feet in height and steeper than one and one-half units horizontal in one unit vertical (1.5:1).

F. Any re-grading or paving of an area used for stormwater retention or detention or as an existing drainage course.

G. Rockeries over four (4) feet in height as measured from the bottom of the base rock or block.

H. The cutting down or topping by more than one quarter of any trees that are required to be preserved by a city code, plat condition, or other requirement.

X.10.050 Exemptions

It is important to clearly state that although some activities may not require permit approval, they nevertheless must comply with certain minimum site requirements. The Exemptions section should also make it clear that activities resulting in conversions of forestland to uses other than commercial timber production are subject to local clearing and grading regulations. A basic assumption of this ordinance is that unless otherwise exempted by state or federal law, all activity is subject to the requirements of this ordinance. The exemptions below are representative of exemptions contained in the City of Olympia, the City of Bellevue, and Jefferson County's clearing and grading ordinances.

A. Forest practices regulated under RCW 76.09 are not governed by this ordinance. Activities involving conversion of land to uses other than commercial timber production are subject to [jurisdiction] clearing and grading or land disturbance regulations. (See technical guidance document, Appendix 2.)

B. Clearing and grading approval is not required for any of the following activities, provided that clearing and grading activity authorized to be undertaken without a formal approval shall be subject to the minimum requirements contained in X.040 of this ordinance:

1. Activity needed to place building foundations and retaining walls requiring an approval when in compliance with the Washington State Building Code. The

state building code is the International Building Code with amendments adopted by Washington state.

2. Land clearing, grading, filling, sandbagging, diking, ditching, or similar work during or after periods of extreme weather or other emergency conditions which have created situations such as toxic releases, flooding, or high fire danger that present an immediate danger to life or property.

3. Digging of individual graves in a permitted graveyard.

4. Refuse disposal sites controlled by other regulations.

5. Mining, quarrying, excavation, processing, or stockpiling of rock, sand, gravel, aggregate, or clay where established and provided for by law, provided such operations do not affect the lateral support or increase the stresses in or pressure upon any adjacent or contiguous property.

6. Agricultural crop management of existing and ongoing farmed areas as defined per RCW 84.34.020.

7. Routine landscape maintenance of existing landscaped areas on developed lots, including pruning, weeding, planting annuals, and other activities associated with maintaining an already established landscape. For lots developed prior to the adoption of [jurisdiction] critical areas regulations (critical areas regulations cited) with landscaping in what are now protected areas, routine landscape maintenance can occur without a Clearing and Grading Permit provided the soil level is not changed.

8. Routine drainage maintenance of existing, constructed stormwater drainage facilities located outside of a protected area, including, but not limited to, detention/retention ponds, wetponds, sediment ponds, constructed drainage swales, water quality treatment facilities, such as filtration systems, and regional storm facilities that are necessary to preserve the water quality treatment and flow control functions of the facility. This exemption does not apply to any expansion and/or modification to already excavated and constructed stormwater drainage facilities.

9. Roadway repairs and overlays within public street rights-of-way for the purpose of maintaining the pavement on existing paved roadways. This exemption does not apply to curbs, gutters, sidewalks, utilities, new traffic calming devices, new roadways, or the widening of the paved surface of existing roadways.

10. The removal of dead trees or of diseased or damaged trees which constitute a hazard to life or property.

C. An exemption from a Clearing and Grading Permit does not exempt the person doing the work from meeting all applicable codes of the [jurisdiction].

X.10.060 Authority

Throughout this Example Code, authority is generally given to the "director" of the planning and community development department. Depending on the organization of the jurisdiction and department, authority may be placed with the administrator, manager, hearing examiner, or other individual or body charged with implementing these regulations.

A. As provided herein, the [director] is given the authority to interpret and apply, and the responsibility to enforce this chapter to accomplish the stated purpose.

B. The [director] may withhold, condition, or deny development permits or activity approvals to ensure that the proposed action is consistent with this chapter.

X.10.070 Relationship to Other Codes, Regulations, and Practices

Some general provisions may already be in the adopted zoning code and may be referenced here rather than restated. Jurisdictions are encouraged to review clearing and grading permits concurrent with other permits such as shoreline development, critical areas, or Hydraulic Project Approval (HPA) permits and require applicants to submit a combined application of environmental information.

A. These clearing and grading regulations shall apply in addition to zoning and other regulations adopted by the [jurisdiction].

These regulations should include compliance with GMA requirements that cities and counties adopt development regulations which preclude land uses or development deemed incompatible with critical areas (RCW 36.70A.172).

B. These clearing and grading regulations shall apply concurrently with review conducted under the State Environmental Policy Act (SEPA), as locally adopted. Any conditions required pursuant to this chapter shall be included in the SEPA review and threshold determination.

C. In order to be in compliance with the provisions of this chapter, the applicant shall comply with the applicable engineering standards approved by the [director]. In addition, the applicant shall comply with those minimum requirements for temporary erosion and sedimentation control and associated best management practices set forth in the latest edition of Department of Ecology's *Stormwater Management Manual for Western Washington*, or an approved, equivalent manual.

In order for local stormwater erosion control programs to be considered consistent with Department of Ecology guidance, local jurisdictions must include statements that are similar to what is in the latest version of the Stormwater Management Manual for Western Washington *in some enforceable rule or document. Ecology may establish specific compliance targets in the General Permit for Construction Activities and the Municipal Stormwater General permits.*

D. Compliance with the provisions of this chapter does not constitute compliance with other federal, state, and local regulations and permit requirements that may be required. The responsibility for determining the existence and application of these requirements rests solely with the applicant; provided, that to the extent known, the [director] will inform the applicant of other agency requirements or permits that may apply to a site (for example, Shoreline Substantial Development permits, Critical Area and Resource Lands regulations, Hydraulic Permit Act permits, Section 106 of the National Historic Preservation Act, U.S. Army Corps of Engineers Section 404 permits, and National Pollution Discharge Elimination System permits). The applicant is responsible for complying with these requirements, apart from the process established in these regulations.

E. It is encouraged that, where appropriate, all clearing and grading activities within [jurisdiction] utilize principles of low impact development (LID) to reduce site impacts created by clearing and grading for land development.

Refer to Puget Sound Action Team's Web site [www.wa.gov/puget_sound] *to view a copy of the Low Impact Development Manual developed in partnership with Department of Ecology and WSU Extension Pierce County.*

X.10.080 Severability

A severability clause protects the jurisdiction from legal challenges in which a phrase, sentence, subsection, or section is found to be invalid. The severability clause allows the contested portion of the ordinance to be stricken without eliminating the balance of the document.

If any provision of this chapter, or its application to any person or circumstance, is found to be invalid for any reason, the remainder of this chapter or its application to any other person or circumstance shall not be affected.

Chapter X.20   Definitions

Applicant: The individual, partnership, association, or corporation applying for a permit to do work under this chapter, including the property owner, and any employee, agent, consultant, or contractor acting on behalf of the applicant, and any successor in interest.

Best Management or Development Practices (BM/DPs), **Best Management Practice (BMP):** The schedules of activities, prohibitions of practices, maintenance procedures, and structural and/or managerial practices, that when used singly or in combination, prevent or reduce the release of pollutants and other adverse impacts to waters of Washington state.

Other ordinances have added: "BMPs include, but are not limited to, structural solutions covered by the terms "best available technology" (BAT) and "all known available and reasonable methods of treatment" (AKART).

Bioretention: On-lot retention of stormwater through the use of vegetated depressions engineered to collect, store, and infiltrate runoff.

Buffer or Buffer Zone, **Buffer:** The zone contiguous with a sensitive area that is required for the continued maintenance, function, and structural stability of the sensitive area. The critical functions of a riparian buffer (those associated with an aquatic system) include shading, input of organic debris and coarse sediments, uptake of nutrients, stabilization of banks, interception of line sediments, overflow during high water events, protection from disturbance by humans and domestic animals, maintenance of wildlife habitat, and room for variation of aquatic system boundaries over time due to hydrologic or climatic effects. The critical functions of terrestrial buffers include protection of slope stability, attenuation of surface water flows from stormwater runoff and precipitation, and erosion control.

Building Site: Shall have the meaning set forth in __________Code, now or as hereafter amended.

Certified Erosion Control Specialist: An individual who has received training and is currently certified through an approved program to install, inspect, and maintain erosion and sediment control best management practices. (See: *http://www.cpesc.net/* for certification information.)

Clean Water Act (CWA): Federal Water Pollution Control Act enacted by Public Law 92-500, as amended by Public Laws 95-217,95-576, 96-483, and 97-117; USC 1251 et seq.

Clearing: Destruction and removal of vegetation by manual, mechanical, or chemical methods resulting in exposed soils.

Clearing Activity: Clearing that takes place on a single parcel of record or as part of a single project. A clearing activity will be considered to be complete when the site has been fully converted to its intended use and soil stabilization has been achieved through permanent measures.

Clearing and Grading Permit: The written permission of the director to the permittee to proceed with the act of clearing and grading within the provisions of this chapter. The Clearing and Grading Permit includes the associated approved plans and any conditions of approval as well as the permit form itself.

Cluster Development: Buildings concentrated in specific areas to minimize infrastructure and development costs while achieving the allowable density. This approach allows the preservation of natural open space for recreation, common open space, and preservation of environmentally sensitive features.

Colluvium or Colluvial Deposits: A soil deposit derived from downslope movement of material from other soil formations as the result of one or more small earth slides. These deposits are typically found on steep hillsides or at the base of slopes.

Conversion Option Harvest Plan (COHP): A voluntary plan developed by the landowner and approved by the [jurisdiction] prior to submittal to the Washington State Department of Natural Resources (DNR), indicating the limits of harvest areas, road locations, critical area buffers, and open space. The plan provides the landowner with the opportunity to log under a DNR Class II, III, or IV Special Permit without a [jurisdiction] development permit while maintaining the option to convert the land at a later date. Under this condition, the imposition of a six-year moratorium on future development may be waived.

Critical Area: Any area designated as a critical area pursuant to RCW 36.70A.170 and Chapter XX of [jurisdiction] Land Use Code.

Degradation: Degradation of an area includes, but is not limited to, impacts such as sedimentation, erosion, and loss of shading, light, and noise.

Design Storm: A prescribed hyetograph and total precipitation amount (for a specific duration recurrence frequency) used to estimate runoff for a hypothetical storm of interest or concern for the purposes of analyzing existing drainage, designing new drainage facilities, or assessing other impacts of a proposed project on the flow of surface water. (A hyetograph is a graph of percentages of total precipitation for a series of time steps representing the total time during which the precipitation occurs.)

Detention: The temporary storage of stormwater to control discharge rates, allow for infiltration, and improve water quality.

Development: Any activity that requires federal, state, or local approval for the use or modification of land or its resource. These activities include, but are not limited to, subdivision and short subdivisions; binding site plans; planned unit developments; variances; shoreline substantial development; clearing activity; excavation; embankment; fill and grade work; converting fallow land or undeveloped land to agricultural purposes;

activity conditionally allowed; building or construction; revocable encroachment permits; and septic approval.

Drainage Plan: A plan for receiving, handling, and transporting surface water or groundwater runoff within the site.

Drip Line Boundary: The circle that can be drawn on the ground below a tree directly under its outermost branch tips.

Dry Season: The months of May through September.

The definition of dry season can be adjusted to reflect regional differences in climate conditions.

Dry Well: Small excavated trenches filled with stone to control and infiltrate rooftop runoff.

Ecology: Washington State Department of Ecology.

Engineered Fill: Soil fill, which is wetted or dried to near its optimum moisture content, placed in lifts of 12 inches or less and each lift compacted to a minimum percent compaction as specified by a geotechnical engineer.

EPA: Environmental Protection Agency.

Erosion: The wearing away of the land surface by running water, wind, ice, or other geological agents, including such processes as gravitational creep. Also, the detachment and movement of soil or rock fragments by water, wind, ice, or gravity. The following terms are used to describe different types of water erosion:

- Accelerated erosion – Erosion much more rapid than normal or geologic erosion, primarily as a result of the influence of the activities of humans or, in some cases, of the animals or natural catastrophes that expose bare surfaces (e.g., fires).
- Geological erosion – The normal or natural erosion caused by geological processes acting over long geologic periods and resulting in the wearing away of mountains, building up of floodplains, coastal plains, etc. Synonymous with natural erosion.
- Gully erosion – The erosion process whereby water accumulates in narrow channels and, over short periods, removes the soil from this narrow area to considerable depths, ranging from one (1) to two (2) feet to as much as seventy-five (75) to one hundred (100) feet.
- Natural erosion – Wearing away of the earth's surface by water, ice, or other natural agents under natural environmental conditions of climate, vegetation, etc., undisturbed by humans. Synonymous with geological erosion.
- Normal erosion – The gradual erosion of land used by humans, which does not greatly exceed natural erosion.
- Rill erosion – Erosion processes in which numerous small channels only several inches deep are formed; occurs mainly on recently disturbed and exposed soils.
- Sheet erosion – The removal of a fairly uniform layer of soil from the land surface by runoff.

- Splash erosion – The spattering of small soil particles caused by the impact of raindrops on wet soils. The loosened and spattered particles may or may not be subsequently removed by surface runoff.

Erosion Control Plan: A plan indicating the specific measures and sequencing to be used for controlling sediment and erosion on a development site before, during, and after construction.

Excavation: The removal of material such as earth, sand, gravel, rock, or asphalt.

Fill: Earth, sand, gravel, rock, asphalt, or other solid material used to increase the ground surface elevation or to replace excavated material.

Filling: The act of placing fill material (earth, sand, gravel, rock, asphalt, or other solid material) on any soil surface, natural vegetative covering, or other fill material to raise the ground elevation or to replace excavated material.

Filter Strips: Bands of closely growing vegetation, usually grass, planted between pollution sources and downstream receiving waterbodies.

Fine-grained Soils: Any soil association that is classified in Hydrologic Soil groups C or D as mapped in the [jurisdiction] Soil Survey, or as determined by a qualified soil scientist.

Forest Practice: Any activity conducted on or directly pertaining to forest land and related to growing, harvesting, or processing timber (222-16 WAC); including, but not limited to: (1) road and trail construction; (2) fertilization; (3) prevention and suppression of diseases and insects; or (4) other activities which qualify as a use or development subject to the Forest Practices Act.

Geotechnical Engineer: A professional engineer currently registered in the state of Washington, qualified by reason of experience and education in the practice of geotechnical engineering, and designated by the owner as the geotechnical engineer of record for the project.

Grading: The movement of earth material through mechanical or other means to create the finished surface and contour of a project site.

Greenway: A linear open space; a corridor composed of natural vegetation. Greenways can be used to create connected networks of open space that include traditional parks and natural areas.

Ground Water: Water in a saturated zone or stratum beneath the land surface or a surface water body.

Habitat: An area or type of area that supports plant or animal life.

Hydrology: The science dealing with the waters of the earth, their distribution on the surface and underground, and the cycle involving evaporation, precipitation, flow to the seas, etc.

IMP: Integrated management practice. An LID practice or combination of practices that are the most effective and practicable (including technological, economic, and institutional considerations) means of controlling impacts to the predevelopment site hydrology.

Impervious Area: A hard surface area (e.g., parking lot or rooftop) that prevents or retards the entry of water into the soil, thus causing water to run off the surface in greater quantities and at an increased rate of flow.

Imperviousness Overlay Zoning: One form of the overlay zoning process. Environmental aspects of future imperviousness are estimated based on the future zoning build-out conditions. Estimated impacts are compared with watershed protection goals to determine the limit for total impervious surfaces in the watershed. Imperviousness overlay zoning areas are then used to define subdivision layout options that conform to the total imperviousness limit.

Incentive Zoning: Zoning that provides for give-and-take compromise on zoning restrictions, allowing for more flexibility to provide environmental protection. Incentive zoning allows a developer to exceed a zoning ordinance's limitations if the developer agrees to fulfill conditions specified in the ordinance. The developer may be allowed greater lot yields by a specified amount in exchange for providing open spaces within the development.

Infiltration: The downward movement of water from the land surface into the soil.

Land Disturbance Activity: Any activity that results in a change in the existing soil cover and/or the existing soil topography. Land disturbing activities include, but are not limited to, clearing, grading, filling, and excavation.

Landscaping or Landscaped Areas: Land that has been modified by altering soil levels and/or vegetation for aesthetic or practical purposes.

Landslide Deposit: A large mass of earth and/or rock that has moved physically downslope by gravity and broken into discrete fragments.

Level Spreader: An outlet designed to convert concentrated runoff to sheet flow and disperse it uniformly across a slope to prevent erosion.

Low Impact Development (LID): The integration of site ecological and environmental goals and requirements into all phases of urban planning and design from the individual residential lot level to the entire watershed. LID site planning incorporates drainage/hydrology by carefully conducting hydrologic evaluations and reviewing spatial site layout options. These procedures, incorporated into the site planning process early on (prior to permitting), aid with understanding and maximizing site conditions to reduce both total clearing and grading amounts and volumes, and on-site and off-site impacts.

Nonpoint Source Pollution: Pollution that enters a water body from diffuse origins on the watershed and does not result from discernible, confined, or discrete conveyances.

Modular Block Wall: A wall constructed of manufactured modular wall units acting as a protective facing for an exposed soil face or as a gravity retaining wall.

National Pollutant Discharge Elimination System (NPDES): The national program for issuing, modifying, revoking and reissuing, terminating, monitoring, and enforcing permits, and imposing and enforcing pretreatment requirements, under sections 307,402, 318, and 405 of the Federal Clean Water Act, for the discharge of pollutants to surface waters of the state from point sources. These permits are referred to as NPDES permits and, in Washington state, are administered by the Department of Ecology.

Open Space: Land set aside for public or private use within a development that is not built upon.

Overlay Districts: Zoning districts in which additional regulatory standards are superimposed on existing zoning. Overlay districts provide a method of placing special restrictions in addition to those required by basic zoning ordinances.

Performance Zoning: Establishes minimum criteria to be used when assessing whether a particular project is appropriate for a certain area; ensures that the end result adheres to an acceptable level of performance or compatibility. This type of zoning provides flexibility without the well-defined goals and rules found in conventional zoning.

Permanent Erosion Control: Permanent improvements, such as landscaping or drainage control structures, which cover the soil such that no erosion can occur.

Permeable: Soil or other material that allows the infiltration or passage of water or other liquids.

Permit: Unless noted otherwise, refers to the Clearing and Grading Permit; see Clearing and Grading Permit.

Permittee: The property owner to whom the Clearing and Grading Permit is issued. The property owner may be a person(s), partnership, association, or corporation.

Planned Unit Development (PUD) Zoning: A special classification authorized in some zoning ordinances, where a unit of land under control of a single developer may be used for a variety of uses and densities, subject to review and approval by the local governing body. The locations of the zones are usually decided on a case-by-case basis.

Potential Slide Block (Failure Envelope): The area near the surface of a slope between the toe of the slope and a line drawn upward at two (2) feet horizontal to one (1) foot vertical from the toe to the surface of the ground above the slope, or as otherwise determined by a geotechnical engineer.

Recharge Area: A land area in which surface water infiltrates the soil and reaches the zone of saturation or groundwater table.

Reinforced Fill or Reinforced Soil: Soil fill designed by an engineer that includes reinforcement consisting of metal or synthetic materials in bars, trips, grids, or sheets.

Retaining Wall: A wall designed to resist the lateral displacement of soil or other materials.

Riparian Area: Vegetated ecosystems along a water body through which energy, materials, and water pass. Riparian areas characteristically have a high water table and are subject to periodic flooding.

Rockery or Rock Wall: One or more courses of large rocks stacked near vertical in front of an exposed soil face to protect the soil face from erosion and sloughing. A rockery or rock wall is not considered a retaining wall.

Root Protection Zone (RPZ): A buffer, established by the jurisdiction that provides protection against root compaction or construction damage.

It is accepted by arborists that roots frequently extend past the drip line of a tree, and root protection should go past the drip line. While ordinances vary in how far past the drip line the root protection zone should extend, an accepted standard is that an effective root protection zone extends five (5) feet past the "drip line." Another accepted practice is that protective fencing should be installed around the perimeter of the drip line or root protection zone. The jurisdiction may also allow a determination by a certified arborist as to where the root protection zone needs be located.

Routine Landscape Maintenance: Pruning, weeding, planting annuals, mowing turf lawns, and other activities associated with maintaining an already established landscaped area. This definition does not include felling or topping of trees or removal of invasive plants resulting from lack of regular maintenance.

Runoff: Water from rain, melted snow, or irrigation that flows over the land surface.

Rural: Those lands located outside of an incorporated area or an established urban growth area (UGA) that are not resource lands of long-term significance and which are consistent with the Washington Growth Management Act.

SCS: U.S. Department of Agriculture Soil Conservation Service; renamed the Natural Resources Conservation Service (NRCS).

Sedimentation: The process of gravity-induced settling and deposition of fragmented rock, soil, or organic particles displaced, transported, and deposited by erosive water-based processes.

SEPA (State Environmental Policy Act): The Washington State Law, RCW 43.21C.020, intended to prevent or eliminate damage to the environment.

Significant Tree: As defined by the local jurisdiction, trees that have value for various reasons, such as size, age, historical significance, or ecological function or other reasons. (See tree.)

This definition is more general than most existing ordinances, in order to give maximum flexibility to the jurisdiction.

Site: A lot or parcel or a group of contiguous lots or parcels associated with a certain application, building or buildings, or other development.

Site Fingerprinting: Development approach that places development away from environmentally sensitive areas (wetlands, steep slopes, etc.), future open spaces, tree save areas, future restoration areas, and temporary and permanent vegetative forest buffer zones. Ground disturbance is confined to areas where structures, roads, and rights-of-way will exist after construction is complete.

Slide: The movement of a mass of rocks and/or earth down a slope.

Soil: Unaggregated or uncemented deposits of mineral and/or organic particles or fragments derived from the breakdown of massive rocks or decay of living matter.

Soil Erosion: The removal of soil from its original location by the action of water, ice, gravity, or wind.

Stormwater Management Manual for Western Washington (Manual): The technical manual prepared by Ecology for use by local governments and published in 2001 (or latest edition), or statewide revisions when they become available, that contain descriptions of and criteria for BMPs to prevent, control, or treat pollutants in stormwater.

Swale: An open drainage channel designed to detain or infiltrate stormwater runoff.

Tree: Any living woody plant having a sound structure and being in good health, characterized by one or more main stems or trunks and many branches, where the trunk diameter measures six (6) inches or greater for a conifer, and twelve (12) inches or greater for a deciduous tree, when measured at a height of four and one half (4½) feet from the ground level. (See significant tree.)

See ordinances from Olympia, Whatcom County, and Lake Forest Park.

Uncontrolled Fill: Fill which has been placed under unknown conditions or without any controls such as geotechnical inspection or monitoring.

Unstable Slopes: Those sloping areas of land that have in the past exhibited, are currently exhibiting, or will likely exhibit mass movement of earth.

USGS: U.S. Geological Survey, an agency within the Department of the Interior.

Vegetation Maintenance: Lawn maintenance, brush and tree pruning, and other normal land maintenance activities involving cutting, removal, or planting of vegetation by manual, mechanical, or chemical methods.

Wall Drain: A drainage system behind retaining walls, rockeries, rock walls, or modular block walls used to collect water moving through the soil or rock behind the wall or rockery.

Watershed: The topographic boundary within which water drains into a particular river, stream, wetland, or body of water.

Wetponds and Wetvaults: Drainage facilities for water quality treatment that contain permanent pools of water that are filled during the initial runoff from a storm event. They are designed to optimize water quality by providing retention time in order to settle out particles of fine sediment to which pollutants such as heavy metals absorb. They also allow biologic activity to occur that metabolizes nutrients and organic pollutants.

Wet Season: The definition of wet season should be adapted to reflect regional differences. For the west side of Washington state, this includes the rainy months from October 1 through April 30.

The definition of wet season can be adjusted to reflect regional differences in climate conditions. On the eastside of the state, it may reflect the period of time when the ground is frozen and there is runoff from the snow pack.

Zero-Lot-Line Development: A development option in which side yard restrictions are reduced and the building abuts a side lot line. Overall unit-lot densities are, therefore, increased. Zero-lot-line development can result in increased protection of natural resources, as well as reduction in requirements for road and sidewalk.

Chapter X.30 Administration

This section of the code pertains to the permit applications process and the conditions under which a permit shall be issued. It also illustrates how fees, permit approvals, the ability to proceed with clearing or grading activities, the expiration of permits, and penalty fees can be incorporated under this section.

X.30.010 Permit Application – Process and Submittal Requirements

The requirements listed below are representative of the cities of Anacortes, Lake Forest Park, Redmond, and Olympia's clearing and grading process and submittal requirements.

A. An application for a Clearing and Grading Permit shall be submitted on a form provided by the [jurisdiction]. Accompanying such form shall be a general plot plan, which shall minimally include the following information:

1. General vicinity map.

2. A site plan, drawn to scale (a recent survey and topographic map may be required for some projects) that includes streets, proposed access, existing and proposed structures, extent and location of proposed clearing and grading activities, major physical features of the property (i.e., streams, ravines, etc.) and sensitive areas on or near the site, drainage channels, sewer and water lines (if possible), and existing and proposed easements.

Local jurisdictions should be consistent in their requirements for clearing and grading site plans, and site plan requirements for larger construction projects.

3. Location and dimensions of buffer areas to be maintained or established, and location and description of proposed erosion-control devices or structures.

4. Location of all significant trees (as defined by the local jurisdiction) and identification of type and size. Designation of those trees to be removed and those to be protected.

5. Identification of areas to be revegetated and/or restored. Provide plant types and methods.

6. As determined at the discretion of the [director], other information as deemed appropriate to this chapter may be required in instances related to geological hazard, shoreline protection, stream protection, tree protection and replacement, or project scope.

B. Upon receipt of a clearing and grading application, the [director] or his/her designee shall confer with other [jurisdiction] personnel as may be appropriate, and make a decision within twenty (20) working days from the date of submission of a completed application, unless an extension is authorized by the applicant.

C. Approved plans shall not be amended without authorization of the [director] or his/her designee. The permit may be suspended or revoked by the [director] because of incorrect information supplied or any violation of the provisions of this chapter.

D. No work shall commence until a permit notice is posted by the [jurisdiction] on the subject site for a period of ten (10) days prior to commencement of grading activities.

Note: The timeframe for public notice or notification of pending development activities varies among jurisdictions. The 10-day period can be waived or changed depending on how public notice is provided by the jurisdiction.

E. An application penalty fee triple that assessed by Section X.60.010 shall be assessed for any grading or clearing conducted prior to issuance of a Clearing and Grading Permit required by this chapter.

F. If the grading involves 500 or more cubic yards, a SEPA (State Environmental Policy Act) review shall be required. Refer to Section X.30.020.

G. Grading in excess of 1000 cubic yards shall be performed in accordance with an approved erosion control and drainage plan prepared by a licensed professional engineer or certified erosion control specialist in the state of Washington.

1. An erosion control plan should include erosion and sedimentation control, a vegetation management plan, a landscape plan, a restoration plan, etc., including sequencing of construction and permanent measures.

2. A drainage plan drainage requirements, systems, and techniques must comply with the latest version of Ecology's *Stormwater Management Manual for Western Washington* and any local Surface Water Design Manual as adopted by the [jurisdiction].

X. 30.020 Conditions of Approval/Project Denial

This section outlines how approval for clearing and grading activities, and any conditions on that approval, will be administered.

A. The [director] may impose conditions on permit approval as needed to mitigate identified project impacts and shall deny permit applications that are inconsistent with the provisions of this chapter.

B. All clearing and grading projects shall be subject to the following conditions:

1. All clearing and grading, as a component of land disturbance projects, shall be subject to inspection by the [jurisdiction].

2. Prior written permission from the [director] shall be provided for modification of any plan.

3. The applicant shall maintain an up-to-date, approved copy of the plans on-site.

4. The applicant shall provide owner permission for the [jurisdiction] to enter the site for purposes of inspecting compliance with the plans, for performing any work necessary to bring the site into compliance with the plans, or for emergency corrective measures.

C. When a SEPA environmental checklist is required:

1. A determination of non-significance (DNS), a mitigated determination of non-significance (MDNS), or a determination of significance (DS) shall be issued by the [jurisdiction] environmental official prior to the issuance of a clearing and grading approval by the [director].

2. Provisions contained in the DNS, MDNS, or DS shall be considered when approving the clearing and grading activity and conditions of the approval shall not be less restrictive than those in the DNS, MDNS, or DS.

X. 30.030 Expiration of Applications and Permits

This section refers to the timing elements of clearing and grading, which should be established consistent with the jurisdiction's existing regulatory review process. The timeframes referenced below are based upon the cities of Bellevue and Olympia.

A. An application for clearing and grading approval will be canceled if an applicant fails, without reasonable justification, to respond to the [jurisdiction]'s written request for revisions or corrections within thirty (30) days. The [director] may extend the response period beyond thirty (30) days if the applicant provides and adheres to a reasonable schedule for submitting the full revisions.

B. When a permit is ready to be issued, the applicant shall be notified and must pick up the permit within sixty (60) days of notification or it shall be canceled.

C. Clearing and grading permits expire when:

1. The authorized work is not begun within six (6) months from the date of approval issuance.

2. Work is abandoned for over one-hundred-eighty (180) consecutive days.

3. If authorized work is performed in a consistent and progressive manner, the approval shall expire one (1) year from the date of issuance unless an alternate time frame is specified on the permit or an extension is granted.

4. Upon a showing of good cause, up to two (2), six (6) month extensions may be granted by the [director] provided that conditions that were relevant to issuance of the permit have not changed substantially and no material detriment to the public welfare will result from the extension.

X. 30.040 Inspections

Inspections are important component of local jurisdictions' monitoring of clearing and grading activities to ensure program goals are being met. This sections outlines the timing for inspections. Whenever possible, timing should be established consistent with the jurisdiction's existing regulatory review process. These stages were adapted from information provided by Municipal Research & Services Center's example of Darby Creek's Stormwater Management Strategies and Standards for New Development: Inspection Schedule for Clearing and Grading.

A. Each site shall be inspected as necessary to ensure that required sediment control measures are installed and effectively maintained in compliance with the permit requirements. Where applicable, the applicant must obtain inspection by the [jurisdiction] at the following stages:

Stage 1 - Following the installation of sediment control measures or practices and prior to any other clearing and grading activity, including during the construction of sediment traps or ponds.

Stage 2 - During rough grading, including hauling imported or waste materials.

Stage 3 - Upon completion of final grading, including the establishment of ground covers and planting, and installation of all landscaping.

B. The [director] shall specify inspection, testing, and monitoring requirements applicable to a given project prior to permit issuance. However, the [director] may require additional inspection, testing, monitoring, or professional analysis and recommendations when conditions exist that were not covered in the permit application documents or were not sufficiently known at the time of permit issuance.

C. The permittee must give the [jurisdiction] at least 24 hours of advance notice prior to needed inspections. Inspections will be scheduled for the next working day after receiving the request, except if the notice is received on Friday, the inspection will be scheduled for Tuesday.

D. Where applicable, inspections may be conducted by a certified erosion control specialist or licensed professional engineer who must file an inspection report with the [director].

Some jurisdictions permit inspections to be conducted by licensed professional engineers or certified erosion control specialists who have been approved by the jurisdiction to conduct clearing and grading inspections as their designated agent. (*See:* http://www.cpesc.net/.) *Following the completion of the inspection, these designated agents are required to submit inspection reports to the [director]. The time frame required to file the inspection report varies, but where a problem is noted, the report should be filed within 24 hours.*

X. 30.050 Appeal

Time limits for appeals should be consistent with other appeal processes.

Any person or persons aggrieved by any action of the [director] may, within fourteen (14) calendar days of such action, file a notice of appeal with the [hearing body] setting forth the reasons for such an appeal. The [hearing body] shall hear and determine the matter and may affirm, modify, or disaffirm the administrative decision within ninety (90) calendar days of the filing of notice of appeal.

X.30.060 Variance

Information regarding variances may be found in other sections of a local jurisdiction's code. However, if it is not, you would include this information here. Time limits for variances should generally be consistent with other adopted time limits, such as those for preliminary plats.

Variances from the standards of this ordinance may be authorized by the [director] in accordance with the procedures set forth in the [document] of the [jurisdiction] code. The [hearing body] shall review the request and make a written finding that the request meets or fails to meet the variance criteria.

A. **Variance Criteria.** A variance may be granted only if the applicant demonstrates that the requested action conforms to all of the criteria set forth as follows:

1. Special conditions and circumstances exist that are peculiar to the land, the lot, or something inherent in the land, and that are not applicable to other lands in the same district.

2. The special conditions and circumstances do not result from the actions of the applicant.

3. A literal interpretation of the provisions of this chapter would deprive the applicant of all reasonable economic uses and privileges permitted to other properties in the vicinity and zone of the subject property under the terms of this chapter, and the variance requested is the minimum necessary to provide the applicant with such rights.

4. Granting the variance requested will not confer on the applicant any special privilege that is denied by this chapter to other lands, structures, or buildings under similar circumstances.

5. The granting of the variance is consistent with the general purpose and intent of this chapter, and will not further degrade the functions or values of the property or otherwise be materially detrimental to the public welfare or injurious to the property or improvements in the vicinity of the subject property, or to the quality of waters of the state.

6. The decision to grant the variance includes the best available science and gives special consideration to conservation or protection measures necessary to preserve or enhance anadromous fish habitat.

7. The granting of the variance is consistent with the general purpose and intent of the [locally adopted comprehensive plan] and adopted development regulations.

B. **Conditions May Be Required.** In granting any variance, the [director] may prescribe such conditions and safeguards as are necessary to secure adequate protection of the property from adverse impacts, and to ensure conformity with this chapter.

C. **Time Limit.** The [director] shall prescribe a time limit within which the action for which the variance is required shall be begun, completed, or both. Failure to begin or complete such action within the established time limit shall void the variance.

D. **Burden of Proof.** The burden of proof shall be on the applicant to bring forth evidence in support of the application and upon which any decision has to be made on the application.

E. **Notice Requirements**. Proposals needing variances from clearing and grading regulations shall be subject to notice and public hearing requirements consistent with the requirements and limitations in Chapter 36.70B RCW. Notices and hearings for a project shall be consolidated and integrated with any environmental and permit review processes.

X. 30.070 Financial Assurance of Performance

Inclusion of financial assurance ensures compliance with the provisions of this chapter.

A. The [director] may require bonds in such form and amounts as may be deemed necessary to ensure that the work shall be completed in accordance with the permit. The property owner, or other person or agent in control of the property, if required, shall furnish bonds.

B. In lieu of a surety bond, the applicant may file a cash bond or instrument of credit with the [jurisdiction] in an amount equal to that which would be required in the surety bond.

C. To ensure proper performance and repair of degraded site conditions relating to the activity, financial assurance shall be required in an amount of 150 percent of the greater of either:

1. The estimated cost of constructing all erosion and sediment control measures or other BMPs specified in the approved plans.

2. The estimated cost, as determined by the [director], of monitoring BMP performance plus the estimated cost of designing and constructing any corrective work or mitigating measures that might be necessary to correct the effects on-site and off-site of inadequate or failed workmanship, materials or design.

X.30.080 Fees

Clearing and Grading Permit fees can be determined in a number of ways.

Fees shall be filed at a rate established by the [jurisdiction] and contained in the Unified Fee Schedule, [jurisdiction] __________ Code.

Application and Plan Review Fees. When a plan or other data are required to be submitted, plan review fees shall be paid at the time of submittal of plans and specifications for review. Plan review fees shall be set forth in [jurisdiction] __________ Code.

X.30.090 Responsibility to Have Permit

Every person working or directing work that requires a permit under this chapter must:

A. Have a copy of the permit before starting and during all phases of the work. The permit, approved plans, and applicable terms and conditions of approval shall be kept on site at all times.

B. Be familiar with and comply with the terms and conditions of the permit.

X.30.100 As-Built Plans

For clearing and grading undertaken to develop plat or short plat infrastructure, the permittee shall submit a copy of the as-built plans to the [director]. Such plan(s) shall be submitted prior to final approval.

X.30.110 Final Approval

The [director] shall give final approval that clearing and grading has been carried out in compliance with the permit once all work is completed per the permit.

Chapter X.40 Clearing and Grading Standards

The purpose of this section of the code is to provide general standards for all clearing and grading activities undertaken within a jurisdiction. This section is intended to apply to all clearing and grading activities including both activities that do not require formal approval by the jurisdiction and those that do require formal approval (X.10.040 and X.10.050, respectively). Site requirements can be both general and specific, as deemed appropriate by the jurisdiction to meet local conditions and site requirements, and should be described in any site plans. The jurisdiction may wish to incorporate any or all of the measures shown, or may wish to include additional requirements or greater detail within specific standards. (Sources, Olympia 16.48.080 and Redmond Ordinance 2218)

If a local jurisdiction wants to have an equivalent stormwater manual and a "qualified" local program, language for this chapter will need to incorporate sufficient detail (e.g., statements from the Ecology manual) or reference other local ordinances where the language exists, so that each of the following standards is enforceable.

Some of the standards contained in this section are referenced to Section 3 of the technical guidance document, which includes science-based examples, detailed descriptions, best management practices, and other guidance for jurisdictions to apply to clearing and grading regulations and low impact development practices within Western Washington.

X.40.010 Minimize Potential Impacts

All grading and clearing activities shall be conducted so as to minimize potential adverse effects of these activities on forested lands, surface water quality and quantity, groundwater recharge, fish and wildlife habitat, adjacent properties, and downstream drainage channels. Whenever possible, the permittee shall attempt to prevent impacts and minimize the clearing of naturally occurring vegetation, retain existing soils, and maintain the existing natural hydrological functions of the site. *(Similar to Olympia 16.48.080 A.1.-A.3)*

X.40.020 Stormwater Consistency of Standards

All standards under this code will be consistent with the latest version of the *Stormwater Management Manual for Western Washington* (Washington Ecology Water Quality Program).

X.40.030 Mark Clearing and Grading and Land Disturbance Limits

Prior to commencing activity, the applicant shall establish and mark on-site clearing and grading limits and other critical site features as appropriate.

In this section, the local jurisdiction can refer to site plans and other relevant permit application requirements. (See Technical Guidance Document, Section 3.1.1.)

X.40.040 Natural Features and Vegetation Retention

Wherever possible, vegetation, drainage, and other natural features of the site shall be preserved, and the grading and clearing should be performed in a manner that attempts to limit areas of impact to the building, road, and utility footprints. Groundcover and tree disturbance shall be minimized, and root zones shall be protected. Land disturbance activities shall be conducted so as to expose the smallest practical area to erosion for the least possible time. Projects shall be phased, where practical, to decrease exposed soils and minimize adverse impacts to natural features and vegetation resulting from land disturbance activities. No ground cover or trees which are within a minimum of fifteen (15) feet of the annual high water mark of creeks, streams, lakes, and other shoreline areas or within ten (10) feet of the top of the bank of the same shall be removed, nor shall any mechanical equipment operate in such areas, provided that conditions deemed by the [director] to constitute a public nuisance may be removed, and provided that a property owner shall not be prohibited from making landscaping improvements where such improvements are consistent with the aims of this section, and where the owner can convincingly demonstrate such consistency to the [director]. *(Portions from Olympia 16.48.080 A4 and similar to Redmond 15.24.080h)*

(See Technical Guidance Document, Section 3.1.1.)

X.40.050 Aesthetics

Land disturbance activity shall be undertaken in such a manner so as to preserve and enhance the [jurisdiction's] aesthetic character. Important landscape characteristics that define the aesthetic character, such as large landmark trees, important vegetation species, and unique landforms or other natural features shall be preserved to every extent practical. *(Similar to Olympia 16.48.080 A.5)*

Each jurisdiction should define in this code or others (referenced here) what constitutes the aesthetic character of the jurisdiction to make clear what specifically needs to be preserved and enhanced.

X.40.060 Site Containment

Erosion, sediment, and other impacts resulting from any clearing and grading activity shall be contained on the site. Containment of such impacts may require temporary erosion/ sedimentation control measures during and immediately following clearing and grading activities. The faces of slopes shall be prepared and maintained to control erosion. Check dams, riprap, plantings, terraces, diversion ditches, sedimentation ponds, straw bales, or other devices or methods shall be employed where necessary to control erosion and provide safety. Devices or procedures for erosion protection shall be initiated or installed as soon as possible during grading operations and shall be maintained in operable condition by the owner. *(Olympia 16.48.080 B.7)*

(See Technical Guidance Document, sections 3.1.3 through 3.1.10.)

X.40.070 Protection of Adjacent Properties

Adjacent and downstream properties, storm drain inlets, and the downstream natural and built drainage system shall be protected from sediment deposition and erosion by appropriate use of BMPs such as vegetative buffer strips, sediment barriers or filters, dikes or mulching, or by a combination of soil stabilization measures. If protection is inadequate and deposition occurs on the adjoining property, public right-of-way, or drainage system, the permittee shall immediately remove the deposited sediment and restore the affected area to its original condition. Downstream properties and waterways shall be protected from erosion and sedimentation during construction due to temporary increases in the volume, velocity, and peak flow rate of runoff from the site.

(See Technical Guidance Document, sections 3.1.4, 3.1.5, and 3.1.7.)

X.40.080 Construction Access

Construction vehicle access shall be, whenever feasible, limited to one route. A temporary access road shall be provided at all sites. Access surfaces shall be stabilized to minimize the tracking of sediment onto adjacent roads by utilizing appropriate BMPs. Other measures may be required at the discretion of the [director] in order to ensure that sediment is not tracked onto public streets by construction vehicles, or washed into storm drains. Sediment deposited on the paved right-of-way shall be removed in a manner that prevents it from entering the drainage system.

(See Technical Guidance Document, Section 3.1.2.)

X.40.090 Stabilization of Disturbed Areas

All exposed soil shall be stabilized by application of suitable BMPs and soil stabilization measures, including but not limited to sod or other vegetation, plastic covering, mulching, or application of base course(s) on areas to be paved. All BMPs shall be selected, designed, and maintained according to the approved manual by the [director]. From October 1 through April 30, no unworked soils shall remain exposed for more than two days. From May 1 through September 30, no unworked soil shall remain exposed for more than seven days. The [jurisdiction] may permit extension of these times or require reduction of these times based on current or projected weather conditions with prior approval of the [director]. *(Redmond 15.24.080 2e)*

(See Technical Guidance Document, sections 3.1.3 and 3.1.4.)

X.40.100 Dust Suppression

Dust from clearing, grading, and other construction activities shall be minimized at all times. Impervious surfaces on or near the construction area shall be swept, vacuumed, or otherwise maintained to suppress dust entrainment. Any dust suppressants used shall be approved by the [director]. Petrochemical dust suppressants are prohibited. Watering the site to suppress dust is also prohibited unless it can be done in a way that keeps sediment out of the drainage system.

(See Technical Guidance Document, Section 3.1.4)

X.40.110 Erosion and Sedimentation Control

The property owner shall design and implement erosion and sedimentation control BMPs appropriate to the scale of the project and necessary to prevent sediment from leaving the project site, including but not limited to, the standards and requirements described in this chapter, in the latest edition of Ecology's *Stormwater Management Manual for Western Washington*, or other codes and ordinances of [jurisdiction].

A. In addition to the measures in this and other codes and ordinances, the [director] may impose the following erosion control measures, or other additional measures, as appropriate for the project:

1. Performance monitoring to determine compliance with state water quality standards, or more stringent standards if adopted by the city.

2. Funding additional city inspection time, up to a full-time inspector.

3. Stopping work if necessary to control erosion and sedimentation.

4. Construction of additional siltation/sedimentation ponds.

(See Technical Guidance Document, Section 3.1.4.)

5. Use of a series of portable sedimentation tanks or temporary filter vaults.

(See Technical Guidance Document, Section 3.1.10.)

6. Use of high quality catch basin inserts to filter runoff.

7. Use of erosion control blankets, nets, or mats in addition to or in conjunction with straw mulch.

(See Technical Guidance Document, Section 3.1.4.)

B. The following additional requirement applies to projects that are not construction of an individual, single-family home:

1. Temporary on-site stormwater conveyance systems shall be designed, constructed, and stabilized to prevent erosion from leaving the the site and impacting properties, streams, and wetlands downstream of the clearing and grading activity. Stabilization measures shall be provided that comply with local BMPs at stormwater conveyance system outlets to prevent erosion of outlets, adjacent streambanks, slopes, and downstream reaches or properties.

2. If the initially implemented erosion and sedimentation BMPs do not adequately control erosion and sedimentation, additional BMPs shall be installed, including but not limited to the extraordinary BMPs described in subsection (A) of this section. It is the permittee's responsibility to ensure sediment does not leave the site in an amount that would violate applicable state, county, or city water quality standards. The [jurisdiction] has the authority to enforce state water quality standards, or, if adopted by the [jurisdiction], more stringent water quality standards.

C. The timing/sequencing requirements for implementing/removing erosion and sedimentation control measures are as follows:

1. The permittee must install the temporary erosion and sedimentation control BMPs prior to all other clearing, grading, or construction.

2. The permittee must remove all temporary erosion and sediment control BMPs within thirty (30) days after final site stabilization or after the BMP is no longer needed, per agreement of the [director]. Before removing such BMPs, the permittee must remove

trapped sediment or stabilize on-site. Any soils disturbed during sediment removal must be permanently stabilized by the permittee.

3. The permittee must complete the required permanent erosion control within seven (7) days of completed grading unless the weather is unsuitable for transplanting. In that case, the permittee must maintain temporary erosion control until permanent restoration can be completed. The period between work completion and final planting shall not exceed one year without written authorization from the [director].

X.40.120 Protection of Critical Areas

This section provides the policy direction that is consistent with the jurisdiction's Critical Area Ordinance.

The function and values of all critical areas, including all stream types, geologically unstable areas, critical aquifer recharge areas, frequently flooded areas, wetlands, and fish and wildlife conservation areas or habitats, and their critical areas buffers located on or adjacent to the site shall be protected from clearing and grading activities that result in sedimentation, erosion, and degradation. Such impacts shall be avoided by appropriate use of setbacks, erosion, and sediment control measures and other appropriate best development and management practices consistent with [jurisdiction] __________ Code (Critical Area Ordinance).

X.40.130 Avoidance of Hazards

Land disturbance activities shall not result in off-site physical damage, nor pose a danger or hazard to life or property. Neither shall such activities contribute to or create landslides, accelerated soil creep, or settlement of soils.

This ensures that land disturbance activities do not further destabilize a nearby potentially hazardous site.

X.40.140 Cut and Fill Slopes

If a local government wants to have an equivalent stormwater manual serve as a "qualified" local program through Ecology, they will have to incorporate the additional statements from the Ecology manual into another enforceable document.

Cut and fill slopes shall be designed and constructed in a manner that will minimize erosion. In addition, slopes shall be stabilized in accordance with the requirements of this section.
The applicant/permittee shall:

A. Submit a geotechnical report, prepared by a geotechnical engineer, when required pursuant to the [jurisdiction]'s Land Use Code including Critical Area Ordinance provisions for qualified professional reports or clearing and grading development standards. The clearing and grading development standards specify when a subsurface investigation is required and the level of investigation and information required in the report.

B. Minimize clearing and grading on slopes fifteen (15) percent or greater and meet any sensitive earth conditions performance standards set forth in (applicable standards).

(See Technical Guidance Document, Section 3.1.6.)

C. Comply with the Land Use Code restrictions applicable to slopes forty (40) percent or greater and to areas of colluvial or landslide deposit on slopes of fifteen (15) percent or greater.

(See Technical Guidance Document, Section 3.1.6.)

D. Limit the maximum gradient of artificial slopes to no steeper than 2:1 [two (2) feet of horizontal run to one (1) foot of vertical fall] unless a geotechnical engineering report and slope stability analysis is provided and shows that a factor of safety of at least 1.5 for static loads and 1.1 for pseudostatic loads can be met, as demonstrated per the methodology in the clearing and grading development standards.

E. Do no clearing, excavation, stockpiling, or filling on the potential slide block of an unstable or potentially unstable slope unless it is demonstrated to the [director]'s satisfaction that the activity would not increase the load, drainage, or erosion on the slope.

(See Technical Guidance Document, Section 3.1.6.)

F. Do no clearing, excavation, stockpiling, or filling on any unstable or potentially unstable areas (such as landslide deposits) unless it is demonstrated to the [director]'s satisfaction that the activity would not increase the risk of damage to adjacent property or natural resources or injury to persons.

G. Intercept any ground water, subsurface water, or surface water drainage encountered on a cut slope and discharge it at a location approved by the [director] in consultation with the [jurisdiction] utilities department.

(See Technical Guidance Document, Section 3.1.6.)

H. Follow the procedures and standards in the clearing and grading development standards related to slopes.

(See Technical Guidance Document, Section 3.1.6.)

I. Design and protect cut and fill slopes to minimize erosion.

(See Technical Guidance Document, Section 3.1.6.)

X.40.150 Rockeries

Rockeries may be used for erosion protection of cut or fill slopes. The primary function of a rockery is to protect the slope face from soil erosion and sloughing.

A. Rockeries used to protect uncontrolled fill slopes may be no higher than four (4) feet, as measured from the bottom of the base rock.

B. Rockeries used to protect cut slopes or reinforced or engineered fill slopes may be up to a maximum height of twelve (12) feet, as measured from the bottom of the base rock, with the approval of the [director]. Any rockery that is over four (4) feet high, as measured from the bottom of the base rock (cut slopes and reinforced or engineered fill slopes only) shall be designed by a geotechnical engineer.

C. A wall drain must be provided for all rockeries greater than four (4) feet in height as measured from the bottom of the base rock. The drains shall be installed in accordance with applicable standards from the Ecology *Stormwater Management Manual for Western Washington* (2001) or approved equivalent.

D. The procedures and requirements in the clearing and grading development standards related to rockery design and construction must be followed. If the rockery is within a property line setback, see also the height restrictions of [Land Use Code reference].

E. The geotechnical engineer must provide construction monitoring and/or testing as required by the permit conditions, and submit construction inspection reports to the department for all rockeries that require design by a geotechnical engineer. For each project, or phase of a project, the geotechnical engineer must provide a final letter or report summarizing the results of the construction monitoring for each rockery, verifying that the rockery construction meets the geotechnical recommendations and design guidelines. The final letter or report must be submitted to the department prior to the final clearing and grading inspection.

X.40.160 Control of Other Pollutants

The permittee must properly handle and dispose of other pollutants that are on-site during construction so as to avoid possible health risks or environmental contamination. Direct and indirect discharge of pollutants to the drainage system, critical areas, wetlands, streams, or any other adjacent properties is prohibited.

(See Technical Guidance Document, Section 3.1.9.)

X.40.170 Dewatering Devices

A. Foundation, vault, and trench dewatering water shall be discharged into a controlled conveyance system prior to discharge to a sediment pond. Channels must be stabilized (as specified in Element #8 of Ecology's *Stormwater Management Manual for Western Washington*, Volume 2).

B. Clean, non-turbid dewatering water, such as well-point ground water, can be discharged to systems tributary to state surface waters, as specified in Element #8, provided the dewatering flow does not cause erosion or flooding of receiving waters. These clean waters should not be routed through stormwater sediment ponds.

C. Highly turbid or contaminated dewatering water from construction equipment operation, clamshell digging, concrete tremie pour, or work inside a cofferdam shall be handled separately from stormwater.

D. Other disposal options, depending on site constraints, may include:

1. Infiltration.

2. Transport off site in a vehicle, such as a vacuum flush truck, for legal disposal in a manner that does not pollute state waters.

3. On-site treatment using chemical treatment or other suitable treatment technologies.

4. Sanitary sewer discharge with local sewer district approval.

5. Use of a sedimentation bag with outfall to a ditch or swale for small volumes of localized dewatering.

(See Technical Guidance Document, Section 3.1.10.)

X.40.180 Slash Removal

Slash from clearing shall preferably be chipped and spread across the site within one (1) year of project completion. If necessary, burning of slash may be permitted based on local regulatory, climatic, and site conditions.

X.40.190 Revegetation

The following time frames should be consistent with the exposed soil protection measures established in X.40.090. This section does not require immediate permanent revegetation, but does require that soil stabilization be maintained until the permanent revegetation measures are installed.

The site shall be revegetated and landscaped as soon as practical, in accordance with a revegetation plan, approved by the [director].

A. A permanent revegetation plan, utilizing vegetation that is known to have a high natural survival rate, shall be implemented consistent with the [jurisdiction] landscaping, tree protection and replacement, and permanent revegetation regulations.

The long-term success of a revegetation effort requires the use of plant material native to an area to ensure that long-term maintenance and irrigation will not be required. The director should approve the permanent revegetation plan to ensure that the types of plants being used will provide the intended goal.

B. Where permanent revegetation measures are not in place within seven (7) days in the dry season and two (2) days in the wet season, the permittee shall provide temporary revegetation or stabilization measures in accordance with the recommendations of the latest edition of Ecology's *Stormwater Management Manual for Western Washington*, and maintain such measures in good condition until the permanent revegetation measures are installed and inspected by the [jurisdiction].

1. Temporary revegetation during the dry season for all disturbed areas of the site (exposed and unworked) that are not covered by permanent improvements such as buildings, parking lots, and decks shall be hydro-seeded and irrigated within seven (7)

days until vegetation has been successfully established or the site otherwise revegetated or stabilized using straw mulch, or other approved methods on an interim basis.

2. Temporary revegetation during the wet season for disturbed areas of the site (exposed and unworked) that are not covered by permanent improvements such as buildings, parking lots, and decks shall be hydro-seeded, otherwise revegetated, or stabilized using plastic sheeting or other approved methods, on a temporary basis within two (2) days until vegetation has been successfully established.

This section ensures that any exposed and unworked soils are stabilized within seven (7) days in the dry season, and within two (2) days in the wet season consistent with Ecology's Stormwater Management Manual for Western Washington, Vol. 2.3.2*. The timing difference [seven (7) days versus two (2) days] reflects the greater erosion potential during the winter months.*

X.40.200 Construction Phasing

Staged construction is allowed only if each phase complies with the code, and if the [director] approves a phasing plan.

(See Technical Guidance Document, Section 3.1.12.)

X.40.210 Seasonality – Temporary Restrictions

Each jurisdiction should develop their own "risk" assessment criteria to be used by their plan reviewers to determine that the site will not transport sediment to surface waters during the wet season. This includes clearly defining slopes, soil types, etc. appropriate to the jurisdiction and local conditions.

Seasonality: Wet season (defined as the period from October 1 through April 30) clearing, grading, and other land disturbing activities may be approved by the [director] for proposals that have minimal disturbance of soils and are on sites with predominant soils that have low runoff potential, and are not hydraulically connected to sediment/erosion-sensitive features. The following criteria also apply:

A. Wet season clearing, grading, and other land disturbing activities may be approved provided an erosion and sediment control plan is prepared by a professional engineer that specifically identifies methods of erosion control for wet weather conditions to control erosion/sedimentation, surface water run off, and safeguard slope stability. In a situation where erosion or sediment is not contained on site, construction activity shall cease immediately and notification of the [director] shall be made within twenty-four (24) hours.

B. When approval is issued in the dry season (defined as the months of May through September), and work is allowed to continue in the wet season, the [jurisdiction] may require additional measures to limit erosion/sedimentation for slope stability. The [director] may prohibit land-disturbing activities during certain days of the wet season. Determinations shall be made on a site-specific basis and evaluation of the following:

1. Average existing slope on the site.

2. Quantity of proposed cut and/or fill.

3. Classification of the predominant soils and their erosion and runoff potential.

4. Hydraulic connection of the site to features that are sensitive to erosion impacts.

5. Storm events and periods of heavy precipitation.

C. If a clearing and grading approval is issued for work during the wet season and the [director] subsequently issues a "Stop Work" order or correction notice for insufficient erosion and sedimentation control, the approval will be suspended until the dry season, or until the [director] determines that weather conditions are favorable and effective erosion and sedimentation control is in place.

D. Certain activities are exempted from seasonal restrictions. (For a list of exemptions, see Ecology's *Stormwater Management Manual for Western Washington*, Construction SWPPP Element 12, Vol. II, pages 3-15.)

X.40.220 Maintenance

All temporary and permanent erosion and sedimentation control devices shall be maintained so that they function as intended until the site has been permanently stabilized and successfully revegetated, and the potential for on-site erosion has passed. Erosion control devices that are damaged or not working properly shall be returned to operating condition within twenty-four (24) hours of identifying they are not working properly or receiving notice from the [field inspector], or as otherwise directed by the [director].

(See Technical Guidance Document, Section 3.1.12.)

The permittee shall:

A. Regularly inspect (weekly or after any runoff producing storm event during the dry season, and daily including on weekends during the wet season) all temporary and permanent erosion and sedimentation BMPs and maintain them per the development standards so that they function as intended until the site has been permanently stabilized, and the potential for on-site erosion has passed.

B. Submit a schedule for operation and maintenance of all construction-related BMPs if the project is not an individual single-family home and involves more than 7,000 square feet of clearing and/or more than fifty (50) cubic yards of excavation and/or fill. The operation and maintenance schedule must identify the responsible parties and provide their day and evening phone numbers.

C. Return any BMPs that are damaged or not working properly to normal operating conditions as directed by the [inspector] or within twenty-four (24) hours of receiving notice from the [director]. BMPs that must be addressed include: stream buffers/setbacks, stormwater/pollutant protection, natural feature preservation/vegetation retention, critical area protection, setbacks/buffers, wetlands, fish habitat, avoidance of hazards, revegetation, erosion and sediment control, and permanent retention/detention facilities. The responsibility for maintaining site stability and maintenance objectives for buffer vegetation and permanent erosion, sedimentation, and runoff control structures for the original permit requirements is the responsibility of the property owner once the work is complete and final restoration measures have been installed as per the plans or approved permit requirements.

X.40.230 Ponds and Reservoirs

Grading and excavation to construct ponds and reservoirs shall:

A. Meet all applicable setbacks specified in this code, except for stormwater detention facilities authorized by the [director].

B. Maintain in-stream flows of natural drainage courses.

C. Protect adjacent property from damage.

X.40.240 Site-Specific Requirements

Additional, site-specific requirements may be established after a site visit by the [inspector]. These requirements shall be based on specific site conditions and are limited to additional temporary erosion and sedimentation control and the mitigation of hazardous or potentially hazardous conditions that pose a threat off site or habitat preservation.

This section provides the jurisdiction with some leeway in requiring additional measures on a site-specific basis.

Chapter X.50 Special Management Areas

X.50.010 Designation

The [jurisdiction] may designate Special Management Areas as deemed necessary to establish a more stringent standard for clearing and grading activity in highly valued water resource areas, environmentally sensitive areas, areas that exhibit clear evidence of degradation correlated to development, or areas where natural conditions are so unstable that clearing and grading activity could potentially result in hazardous conditions. Examples of potential Special Management Areas include critical areas, sensitive environmental features, hazardous areas, wellhead protection zones, etc.

The designation and conditions shall be so designated in the [jurisdiction]'s comprehensive plan prior to implementation of this section. Special Management Areas can be nominated for designation by [jurisdiction], landowners, and citizens interested in providing special consideration for clearing and grading activities as a part of the annual comprehensive plan amendment process [reference jurisdiction's code].

X.50.020 Forested Lands in Urban Areas (Tree Retention and Replacement)

The intent of this section is to support the retention of mature, high-value trees and other vegetation, where practicable. Based on empirical studies it is commonly accepted in planning and design fields, in comparative real estate value studies, in civil court damage, and in insurance claim cases that large trees increase the value of a property by as much as several thousand dollars. They also can reduce the overall energy use of adjacent buildings by shading and wind protection; provide urban wildlife habitat; and increase the aesthetic appeal of a street or community. The protection of significant trees is one measure that a jurisdiction can take to protect existing value of lands being developed or redeveloped. The trees that are included under this section should be identified at the site plan level and protected and maintained throughout the construction phase. (The tree protection standards are based upon the City of Redmond's tree protection practices.)

A. Tree Retention Criteria

Trees may be prioritized for retention based on the following criteria:

1. Trees which are unusual due to their size, age, or rarity, as defined by [jurisdiction].

2. Trees located in environmentally sensitive areas or critical areas.

3. Trees that offer visual screening and noise buffering for existing or anticipated incompatible land uses.

4. Trees which shelter other trees from strong winds or are part of a continuous and mutually dependent canopy.

5. Trees with significant habitat value such as snags or other vegetation as identified by a certified arborist or qualified wildlife biologist.

B. Fencing and Protection from Damage

Any trees or groups of trees to be retained shall have temporary fencing installed around the root protection zone. Fencing beyond the root protection zone may be required if a certified arborist or qualified biologist determines such additional protection is needed to protect the tree(s) from damage. Trees designated for retention shall not be damaged by scoring; ground surface level changes; compaction of soil; machines or other activity; attaching objects to trees; altering drainage; or any other manner that may cause damage of roots, trunks, or surrounding ground cover.

C. Field Verification

Any trees designated for retention shall be field verified by the [director] before land disturbance begins.

D. Tree Retention Requirements

No significant tree or stand of trees shall be removed without first obtaining the appropriate approval of the [director], in accordance with [jurisdiction] __________ Code.

E. Tree Replacement Requirements

For every tree meeting the criteria established under X50.020.A that is removed during a clearing or grading activity, the applicant shall replace trees in accordance with the provisions of the [jurisdiction] __________ Code. The time schedule for planting replacement trees shall be specified in the approved plan.

X.50.030 DNR Forest Practices Permit for Rural Areas

A landowner in a rural area shall have the option to log under a state Department of Natural Resources (DNR) Forest Practices Permit without a development permit or clearing and grading approval while maintaining the option to convert the land at a later date. It is also the purpose of this section to allow the landowner to seek a waiver from a six-year moratorium [see RCW 76.09.060(I)] when he/she mitigates the impact of damage caused by the activity.

X.50.040 Conversion Option Harvest Plan

When a forest practice application submitted under RCW 76.09.060 (Class IV General), which declares that some or all the lands will be converted to a use other than commercial timber production, the activity is subject to the provisions of the [jurisdiction]'s clearing and grading regulations.

A. A conversion option harvest plan (COHP) guidelines and application form shall be made available by the [jurisdiction].

B. A COHP must be submitted by the applicant, then reviewed and approved by the [jurisdiction] prior to submittal to the DNR in order for a moratorium waiver on development to be granted by the [director].

C. The [director] shall utilize the COHP to condition the forest practice in such a manner that the activity is in compliance with the [jurisdiction's] critical area and other environmental regulations, including wetland, stream, river, lake buffers, and protection from potential hazards.

D. A fee shall be established by the [jurisdiction] for the review of a COHP.

E. The COHP shall remain in effect until a development permit has been approved by the [director].

F. In the event of a transfer in ownership, the permit transfers with the land.

X.50.050 Six-Year Moratorium

A. Any property that has been cleared under a Class I, II, III, and IV Special Forest Practices Permit shall not be eligible for any development permit for a period of six (6) years from the issuing date of the Forest Practices Permit, consistent with provisions in Chapter 76.09.060 RCW. Provisions shall be made by the [jurisdiction] to record such a condition.

B. A waiver of the six-year moratorium may be granted by the [director] when a COHP is signed by the applicant and approved by the [director].

Chapter X.60 Enforcement

X.60.010 Offense and Penalty

This section clearly states what actions qualify as offenses under the provisions of this ordinance, as well as what penalties apply. Specific penalties will vary among communities and should reflect realistically enforceable penalties given the political realities of a jurisdiction.

A. Any person who engages in or is responsible for a clearing and grading activity, and (1) fails to obtain a Clearing and Grading Permit or approval when required pursuant to [jurisdiction's Clearing and Grading Code, Section XXX]; (2) fails to comply with any permit condition; or (3) fails to comply with the regulatory requirements of [jurisdiction's Clearing and Grading Code Section XXX] shall be guilty of a civil offense and may be fined a sum not to exceed one thousand dollars ($1,000) for the first offense. The amount fined shall be referred to as the penalty. Criteria for administratively determining the assessed penalty shall be established by [jurisdiction].

B. When a violation occurs in an area designated as a Special Management Area within the context of this chapter, the total fine assessed shall be increased to one hundred and fifty (150) percent of the standard violation fine set forth in this chapter.

X.60.020 Length of Offense

This provision clarifies that each day of violation of this ordinance amounts to a separate offense, and thus ensures that continued violations will be interpreted and understood to be multiple offenses, punishable by multiple penalties.

Each day or portion thereof of land disturbing activity in conjunction with any of the above violations shall constitute a separate offense. An offense shall begin on the date that a notice of violation has been issued.

X.60.030 Stop Work Orders and Corrective Actions

A. The [director] shall notify the permittee, or person doing the work, whenever the [director] determines that:

1. During the life of the permit, the project is causing problems related to earth and water resources, such as sediment leaving the site or entering the drainage system.

2. The act or intended act of clearing or grading has become or will constitute a hazard to life and limb, endangers property, or adversely affects the safety, use, or stability of a public way, drainage channel, street, or surface water.

3. Clearing and grading is occurring without a required permit.

4. The project is otherwise violating this chapter or the provisions of a permit issued under this chapter.

B. Initial notice per Subsection A of this section may be verbal. If verbal notice is given, it shall be followed by a written correction notice if compliance is not readily achieved. When issuing a written correction notice, the [director] shall serve it to the persons doing the work or causing the work to be done or post the notice on the site. Any written correction notice shall specify:

1. The work that must be done to correct the violation or abate the problem.

2. The amount of time that the permittee has to commence and complete the required work.

3. That, if the work is not commenced and completed within the time specified, the [jurisdiction] will use the proceeds of the abatement security device (if an abatement security device was provided for the project) to have the required work completed.

C. A written correction notice per Subsection B may include a stop work order, or a stop work order may be independently issued, whenever the continuation of work is likely to harm or pose a hazard to property, safety, or the downstream drainage system. In addition, a stop work order shall also be issued as specified in Subsection D.

1. In the stop work order, the [director] shall specify which work must stop (in order to prevent further damage). The [director] has the authority to stop all work on the site.

2. If a stop work order is issued, it shall be served (1) to the persons doing the work or causing the work to be done or (2) by posting the notice on the site.

D. Work suspended through a stop work order cannot resume until measures are in place to prevent a reoccurrence of the problem and until continued work is authorized in writing by the [director].

X.60.040 Notice of Penalty

A notice in writing shall impose the penalty provided in Section XXX, either by certified mail with return receipt requested, or by personal service to the person, incurring the penalty. The notice of penalty shall include the amount of the penalty imposed and shall describe the violation with reasonable particularity in ordering the act or acts constituting the violation or violations to cease and desist.

X.60.050 Permit Revocation

The [director] may revoke or suspend the Clearing and Grading Permit whenever:

A. The permittee requests such revocation or suspension.

B. The work does not proceed in accordance with the plans, as approved, or is not in compliance with the requirements of this chapter or other [jurisdiction] ordinances.

C. Entry upon the property for the purpose of investigation or inspection has been denied.

D. The permittee has made a misrepresentation of a material fact in applying for such permit.

E. The progress of the work indicates that the plan is or will be inadequate to protect the public, the adjoining property, the street, protected areas, the drainage system, or other utilities; or the work endangers or will endanger the public, the adjoining property, the street, protected areas, the drainage system, or other utilities.

F. The permit has not been acted upon or extended within the time allowed pursuant to __________ Code.

X.60.060 Restoration or Mitigation

This section is intended to ensure that areas disturbed through violations of this ordinance will either be restored or financially mitigated by the violator.

If the land disturbance activity has occurred on a site in violation of this chapter, prompt corrective action, restoration, or mitigation of the site shall be required when appropriate. If this provision is not complied with, the [jurisdiction] may restore or mitigate the site and charge the responsible person for the full cost of such an activity.

X.60.070 Appeals

Time limits for appeals should be consistent with other appeal processes.

A notice of violation issued pursuant to this section constitutes a determination from which an administrative appeal may be taken by the filing of a notice of appeal with the [jurisdiction] within fourteen (14) days of service of the notice of violation. Such appeals shall be heard by the [hearing body].

X.60.080 Authority of Prosecuting Attorney

This section ensures compliance with this ordinance by allowing the jurisdiction's attorney to act as deemed necessary.

The prosecuting attorney may enforce compliance with this ordinance by such injunctive, declaratory, or other actions as deemed necessary to ensure that violations are prevented, ceased, or abated.

Appendix 2: Relevant Federal and State Statutes, Regulations, and Guidance

Clearing and grading practices are affected by a number of different federal and state statutes, regulations, and guidance documents. These relate primarily to water quality and stormwater runoff, land use, protection of resource lands and critical areas, and protection of habitat for fish and wildlife and threatened and endangered species. Construction site stormwater runoff is regulated on the local level through ordinance and codes that follow guidance and requirements from the federal and state levels.

1.12 Federal

a. **Federal Clean Water Act (FCWA, 1972, and later modifications, 1977, 1981, and 1987)**
b. **National Pollutant Discharge Elimination System (NPDES) permit program**

The Federal Clean Water Act (FCWA, 1972, and later modifications, 1977, 1981, and 1987) established water quality goals for the navigable (surface) waters of the United States. One of the mechanisms for achieving the goals of the Clean Water Act is the NPDES permit program, administered by the U.S. Environmental Protection Agency (EPA). In 1987, Congress added section 402(p) to the Clean Water Act to establish a comprehensive framework for addressing municipal and industrial stormwater discharges under the NPDES permit program. The federal regulations require an NPDES permit for construction activities which will disturb five or more acres of land (Ecology, SWMM–II, 2001).

EPA has delegated responsibility to administer the NPDES permit program to the state of Washington (Ecology, SWMM-II, 2001). Regulations adopted by Washington state through the Department of Ecology include procedures for issuing permits (Chapter 173-220 WAC), water quality criteria for surface and ground waters (Chapters 173-201A and 200 WAC), and sediment management standards (Chapter 173-204 WAC). These regulations require that a permit be issued before discharge of wastewater to waters of the state is allowed. The regulations also establish the basis for effluent limitations and other requirements included in permits (Ecology, SWMM-II, 2001).

The first implementation phase of the 1987 Clean Water Act amendments (Phase I) also requires NPDES permits for municipal stormwater discharges from municipalities that:

- Have a separate storm sewer system that discharges to surface water or to drainage ditches that discharge to surface water.
- Have a population served by the storm sewer system that is greater than 100,000 people.

The Phase II regulation requires NPDES municipal stormwater permits for all municipalities within census urbanized areas.[4] For municipalities outside of census-urbanized areas, with a population exceeding 10,000 and a population density greater than 1,000 per square mile,

[4] Census urbanized areas are defined as a central place (or places) and the adjacent densely settled surrounding area that together have a minimum population of 50,000 and a minimum average density of 1,000 per square mile.

Ecology must develop criteria to determine whether an NPDES permit is necessary. Implementation of municipal stormwater programs through Phase II permits will be phased in by 2008 (Ecology, SWMM-II, 2001).

Both the Phase I and Phase II NPDES permit programs require permitted municipalities to adopt ordinances implementing controls for new development and redevelopment, including measures for control of erosion, sedimentation, and other pollutants on construction sites. Under the Phase I NPDES permit, these ordinances must include all of the Minimum Requirements contained in Volume I of the Stormwater Management Manual, or requirements determined by the Department of Ecology to be technically equivalent. Ecology expects to include similar requirements in the Phase II permit, which will be issued in 2005.

Regulatory Requirements (from the Construction Stormwater Management Manual, SWMM-2)

- Phase I municipal NPDES permits require large urban cities and counties to adopt ordinances implementing controls for new development and redevelopment, including measures for control of erosion, sedimentation, and other pollutants on construction sites.
- The Phase II NPDES municipal permit program will require many municipalities throughout the state to adopt ordinances implementing controls for new development and redevelopment, including measures for control of erosion, sedimentation, and other pollutants on construction sites.
- Construction projects must apply for coverage under the NPDES General Permit for Stormwater Associated with Construction Activities if the project results in the disturbance of five acres or more of land, including clearing, grading, and excavation activities, and the project discharges stormwater from the site into a surface water or discharge to a storm drain system that discharges to a surface water.
- Some construction projects may require an individual NPDES permit.
- Beginning in 2003, coverage under the General Permit will be required for construction sites that result in the disturbance of one acre or more of land (Ecology, SWMM-II, 2001).

Construction General Permit

Coverage under the Construction General Permit is required for any clearing, grading, or excavating that will disturb five acres or more of land area and that will discharge stormwater from the site into surface water(s), or into storm drainage systems that discharge to surface water. Parcels less than five acres in area that are part of a larger common plan of development totaling five acres or more are also required to obtain a permit (Ecology, 2000).[5] The federal permitting threshold dropped from five acres down to one acre on March 10, 2003. However,

[5] In many cases, a common plan of development or sale consists of many small construction projects. For example, an original common plan of development for a residential subdivision might lay out the streets, house lots, and areas for parks, schools, and commercial development that the developer plans to build or sell to others for development. All these areas would remain part of the common plan of development or sale until the intended construction occurs. See: *http://cfpub.epa.gov/npdes/stormwater/cgpfaqs.cfm#223*.

Washington state has not yet implemented the Phase II requirements. In 2005, Ecology will issue the permit for one to five acre sites.

The permit requires application of stabilization and structural practices to reduce the potential for erosion and the discharge of sediments from the site. The stabilization and structural practices cited in the permit are similar to the minimum requirements for sedimentation and erosion control in Volume I of the SWMM. The permit also requires construction sites within the Puget Sound basin to "select from BMPs described in Volume II of the most recent edition of Ecology's *Stormwater Management Manual for Western Washington* (SWMM) that has been available at least 120 days prior to the BMP selection." Sites outside the basin are required to select BMPs from the manual, from the *Erosion and Sediment Control Handbook*, by Goldman et al., or to select other appropriate BMPs. The permit also states that where Ecology has determined that the local government requirements for construction sites are at least as stringent as Ecology's, Ecology will accept compliance with the local requirements.

Construction activities that are not required to apply for coverage include:

- Construction activities that discharge stormwater only to the ground and have no point source discharge to surface water or a municipal storm sewer at any time during construction.
- Any part of a facility with a stormwater discharge resulting from remedial action under an order or consent decree.
- Any emergency construction activity required to protect public health and safety.
- Any construction activity for routine maintenance of existing facilities to maintain original line and grade or hydraulic capacity.

Facilities excluded from coverage include:

- Nonpoint source silvicultural activities.
- Construction projects that are federally owned or operated or are on tribal land, or discharge stormwater directly to tribal waters with EPA approved water quality standards.
- Stormwater discharges that originate from the site after construction has been completed and the site has undergone final stabilization. Final stabilization means the completion of all soil disturbing activities at the site and the establishment of a permanent vegetative cover.
- Equivalent permanent stabilization measures such as riprap, gabions, or geotextiles which will prevent erosion.
- Any facility covered under an existing NPDES Individual Permit or General Permit in which stormwater management or treatment requirements or both are included for all stormwater discharges associated with construction activity.

The EPA Phase II stormwater regulations require construction sites of one acre and larger to be covered by an NPDES permit, effective March 2003. (Note: In areas with a qualified local program, a developer would be covered by the General Permit, without applying for it). There is greater flexibility on options for implementing coverage for sites under five acres. Ecology has not determined how it will implement coverage for these small construction sites, but any strategy must require implementation of those BMPs necessary to protect the beneficial uses of surface water (Ecology, SWMM-II, 2001).

Nonpoint Source Pollution Control Plan

Separate and distinct from the CWA's NPDES permit program is section 319 of the CWA, concerned with nonpoint source pollution. Under 319, each state is required to develop and implement a Nonpoint Source Pollution Control Plan.[6] In addition, under Section 319, EPA provides grants to states to implement approved nonpoint management plans. Washington has developed its funding program three ways: the Department of Ecology uses a percentage of the 319 grant to fund staff to develop water cleanup plans; another percentage of funds goes to local governments, tribes, and special purpose districts to implement plans; and a smaller percent goes to other Washington state agencies to directly implement actions identified in Table 9.1 of Washington state's nonpoint plan.

c. Coastal Zone Act Reauthorization Amendments (CZARA)

The Coastal Zone Act Reauthorization Amendments (CZARA) address the impacts of nonpoint source pollution in coastal waters.[7] Section 6217 of the CZARA specifies that each state with an approved coastal zone management plan must develop a Nonpoint Pollution Control Program to cover construction activities on sites that result in disturbance of less than five acres (EPA, 1993 and Corish, 1995). Environmental Protection Agency (EPA) guidance required by CZARA [§6217(g)](EPA, 1993) addresses the reduction and control of erosion and sediment related to construction activities (Corish, 1995).

d. Endangered Species Act

The Endangered Species Act (ESA) is of concern for construction sites because of the potential adverse impacts to receiving waters from discharges of sediment, turbidity, or abnormal pH. Specific adverse impacts include:

- Suffocation of eggs or fry.
- Displacement and elimination of aquatic invertebrates utilized for food.
- Reduction in the biodiversity of aquatic invertebrates.
- Reduction of foraging abilities in turbid water.
- Irritation of gill tissue that can lead to disease or death.
- Filling of resting areas, feeding areas, or spawning gravels with sediment.

These impacts could be determined to be a take under ESA. The stranding of listed species behind erosion and sediment control features or the impairment of their access into certain areas

[6] Washington state chose to merge the federal requirements of CWA Section 319 and Section 6217 of CZARA under one planning process.

[7] CZARA only covers "the coastal nonpoint area" also called the "6217 management area." Under CZARA, states are required to establish this area based on guidance from NOAA and EPA. In previous submission of the state's CZARA plan in 1995 and 1996, the coastal zone was defined as 16 counties in Western Washington: Clallam, Island, Jefferson, King, Kitsap, Mason, Pierce, San Juan, Skagit, Snohomish, Thurston, and Whatcom in the Puget Sound region and Grays Harbor, Lewis, Pacific, and Wahkiakum along the Pacific Coast. This designation will remain essentially the same, except it will be based on the WRIAs rather than the counties. Thus, the 6217 management area is comprised of WRIAs 1-24.

due to the presence of erosion and sediment control features could also be determined to be a take under ESA (Ecology, SWMM-1, 2001).

Local jurisdictions should make sure that any clearing and grading ordinance, codes, or regulations are consistent and integrated with any local or regional efforts to address ESA, including watershed protection, critical areas protection, or stream restoration activities.

1.13 State

a. Washington State Growth Management Act (GMA) (WAC 365-195) (RCW 36.70A)

The planning goals of the GMA (RCW 36.70A.020) focus on issues such as urban growth, transportation, housing, and economic development, as well as natural resource lands conservation and environmental protection issues. The environmental planning goals specifically address critical areas including wetlands, critical aquifer recharge areas, fish and wildlife habitat, frequently flooded areas, and geologically hazardous areas. The GMA requires counties and cities to adopt development regulations, reflective of the best available science, that preclude land uses or development deemed incompatible with those critical areas (RCW 36.70A.172) (Parsons, 2001).

The GMA additionally requires all local governments to address water quality and quantity in their planning and implementation considerations, including the designation and protection of critical areas. The GMA seeks to minimize clearing and grading activities and limit soil disturbance activities. To be consistent with the requirements for critical areas, standards for clearing and grading should be adopted to regulate activities prior to site development approval. An option can be included to limit the percent of a site that can be cleared in keeping with low impact development site planning. Clearing and grading exemptions should not include project areas located within critical areas or buffers, even when the proposed alteration is for less than 50 cubic yards (CTED, 2003).

b. Washington State Environmental Policy Act (SEPA) (WAC 197-11)

The State Environmental Policy Act (SEPA), Chapter 43.21C RCW, was enacted in 1971 to ensure that governmental decisions are made with an understanding of their potential impacts on the natural and built environments. In growth management planning, SEPA review is triggered: (1) when a county or city proposes adoption of county-wide planning policies, comprehensive plans, subarea plans, or development regulations; and (2) when local governments process permit applications for projects that meet thresholds defined in SEPA.

Some communities adopted comprehensive plans under the GMA with detailed environmental impact statements (EIS) that project developers can use instead of individual environmental analyses. Other communities have less detailed EISs that will need to be supplemented for later actions.

Options remain for communities that did not combine growth management and SEPA. Subarea, transportation, sewer, water, stormwater, and other plans can produce better results than parcel-by-parcel, project-by-project environmental review. A number of communities have found the subarea – a neighborhood, industrial area, downtown, or highway corridor – provides the most "bang-for-the-buck" in striking a balance between protecting the environment and encouraging development.

It is recommended that locally adopted categorical exemptions from SEPA do not apply in designated critical areas pursuant to WAC 197-11-908. SEPA review procedures should rely first on critical areas review requirements to address environmental impacts. Local governments are encouraged to complete review under the critical areas regulations prior to making a threshold determination. Counties and cities may then make a determination that some or all of the environmental impacts of a project have been adequately addressed by critical areas regulations. SEPA and critical area review procedures should be evaluated to ensure project and environmental review procedures are integrated and not duplicative.

c. Shoreline Management Act of 1971 (SMA) (RCW 90.58)

Local jurisdictions required to develop shoreline master plans under SMA will need to ensure that any clearing and grading regulations are consistent with the plan. Shoreline Environment designations and development standards to protect shorelines under the locally adopted Shoreline Master Program (SMP) should be consistent with provisions to protect critical areas (CTED, 2003).

A Shoreline Substantial Development Permit (Shoreline Permit) is required for substantial development that occurs within 200 feet of the shoreline. This permit is required in addition to any land use permit (zoning, special use, or conditional use) that is required for the project. Substantial development is defined by state law (RCW 90.58.030) and generally includes any development that is valued at more than $2,500 or interferes with the normal public use of the surface waters. Some types of developments are exempt from shoreline permits such as constructing a single-family home or building a dock for your home. Being exempt from a permit, however, does not mean you are exempt from the development regulations.

d. The Puget Sound Water Quality Management Plan (Plan)

The Puget Sound Water Quality Management Plan is adopted by the Washington State Legislature under Chapter 90.71 RCW as the comprehensive plan to restore and protect the biological health and diversity of Puget Sound. It is also adopted by the Environmental Protection Agency as the Comprehensive Conservation and Management Plan for Puget Sound under the National Estuary Program. The plan calls upon local governments in the Puget Sound basin to adopt ordinances implementing controls for new development and redevelopment, including measures for control of erosion, sedimentation, and other pollutants on construction sites (Ecology, SWMM-II, 2001).

These ordinances must include all of the Minimum Requirements contained in Volume I of the Stormwater Management Manual, or requirements determined by the Department of Ecology (Ecology) to be technically equivalent. Minimum Requirement #2, Construction Stormwater Pollution Prevention, requires that new development and redevelopment projects address stormwater pollution prevention during construction. Construction projects must consider all of the 12 elements of construction stormwater pollution prevention and develop controls for all of the elements that pertain to the project site. Projects that add or replace 2,000 square feet or more of impervious surface or clear more than 7,000 square feet must prepare a construction stormwater pollution prevention plan (SWPPP) that is reviewed by the plan approval authority of the local government. The Construction SWPPP must contain sufficient information to satisfy the plan approval authority that the problems of pollution have been adequately addressed for the proposed project. Projects that add or replace less than 2,000 square feet of impervious surface or clearing projects of less than 7,000 square feet are not required to prepare a Construction SWPPP. However, these projects must consider all of the 12 elements of Construction Stormwater Pollution Prevention and develop controls for all elements that pertain to the project site.

Comprehensive stormwater management programs under the plan related to clearing and grading include:

- Stormwater Controls for New Development and Redevelopment – Local governments are directed to adopt ordinances that require the use of best management practices (BMPs) to control stormwater flows, provide treatment, and prevent erosion and sedimentation from all new development and redevelopment projects. They are also directed to adopt and require the use of Ecology's stormwater technical manual (or an approved alternative manual) to meet these objectives. All new development in the basin, particularly new development sited outside of urban growth areas, are to seek to achieve no net detrimental change in natural surface runoff and infiltration.
- Stormwater Site Plan Review – Local governments are directed to review new development and redevelopment projects to ensure that stormwater control measures are adequate and consistent with local requirements.
- Inspection of Construction Sites – Local governments are directed to regularly inspect construction sites and to adopt ordinances to ensure clear authority to inspect construction sites, to require maintenance of BMPs, and to enforce violations. They are also directed to provide local inspectors with training on erosion and sediment control practices.
- Low Impact Development Practices – Local governments are directed to adopt ordinances that allow and encourage low impact development practices. These are practices that infiltrate stormwater (using proper safeguards to protect ground water) on-site rather than collecting, conveying, and discharging stormwater off site. The goals of low impact development practices are to enhance overall habitat functions, reduce runoff, recharge aquifers, maintain historic in-stream flows, and reduce maintenance costs (Ecology, SWMM-I, 2001). The principles include: maintaining pre-developed, undisturbed stormwater flows; retaining native vegetation, soils, and other natural features to intercept, infiltrate, evaporate, and transpire stormwater; emphasizing a higher standard of soil quality in disturbed soils through the use of compost and other materials; clustering development and roads on sites; and reducing impervious surfaces.

Other elements of the comprehensive stormwater management program include:

- Maintenance of permanent facilities.
- Source control.

- Elicit discharges and water quality response.
- Identification and ranking of problems.

e. Best Available Science (WAC 365-195-900 through 925) (Chapter 36.70A.172 RCW)

All local governments in Washington state must designate and protect critical areas functions and values through the inclusion of the best available science (Chapter 36.70A.172 RCW). Criteria set out in WAC 365-195-900 through 365-195-925 create the framework for how counties and cities may use information that local, state, or federal natural resource agencies have determined represents the best available science and how to demonstrate that the best science was included in the development of critical area ordinances. The responsibility for including the best available science in the development and implementation of critical areas policies or regulations rests with the legislative authority of the county or city. However, when feasible, counties and cities should consult with a qualified scientific expert or team of qualified scientific experts to identify scientific information, determine the best available science, and assess its applicability to the relevant critical areas. The scientific expert or experts may rely on their professional judgment based on experience and training, but they should use the criteria set out in WAC 365-195-900 through 365-195-925 and any technical guidance provided by the department.

Characteristics of a valid scientific process. In the context of critical areas protection, a valid scientific process is one that produces reliable information useful in understanding the consequences of a local government's regulatory decisions and in developing critical areas policies and development regulations that will be effective in protecting the functions and values of critical areas. A valid scientific process is one that includes the following characteristics:

1. Peer review. The information has been critically reviewed by other persons who are qualified scientific experts in that scientific discipline. The criticism of the peer reviewers has been addressed by the proponents of the information. Publication in a refereed scientific journal usually indicates that the information has been appropriately peer-reviewed.

2. Methods. The methods that were used to obtain the information are clearly stated and able to be replicated. The methods are standardized in the pertinent scientific discipline or, if not, the methods have been appropriately peer-reviewed to ensure their reliability and validity.

3. Logical conclusions and reasonable inferences. The conclusions presented are based on reasonable assumptions supported by other studies and consistent with the general theory underlying the assumptions. The conclusions are logically and reasonably derived from the assumptions and supported by the data presented. Any gaps in information and inconsistencies with other pertinent scientific information are adequately explained.

4. Quantitative analysis. The data have been analyzed using appropriate statistical or quantitative methods.

5. Context. The information is placed in proper context. The assumptions, analytical techniques, data, and conclusions are appropriately framed with respect to the prevailing body of pertinent scientific knowledge.

6. References. The assumptions, analytical techniques, and conclusions are well referenced with citations to relevant, credible literature and other pertinent existing information.

The table below provides a general indication of the characteristics of a valid scientific process typically associated with common sources of scientific information.

Characteristics of a valid scientific process [from WAC 365-195-905 5(b)]

	CHARACTERISTICS					
Sources of Scientific Information	Peer review	Methods	Logical conclusions and reasonable inferences	Quantitative analysis	Context	References
A. Research. Research data collected and analyzed as part of a controlled experiment (or other appropriate methodology) to test a specific hypothesis.	**X**	**X**	**X**	**X**	**X**	**X**
B. Monitoring. Monitoring data collected periodically over time to determine a resource trend or evaluate a management program.		**X**	**X**	**Y**	**X**	**X**
C. Inventory. Inventory data collected from an entire population or population segment (e.g., individuals in a plant or animal species) or an entire ecosystem or ecosystem segment (e.g., the species in a particular wetland).		**X**	**X**	**Y**	**X**	**X**
D. Survey. Survey data collected from a statistical sample from a population or ecosystem.		**X**	**X**	**Y**	**X**	**X**
E. Modeling. Mathematical or symbolic simulation or representation of a natural system. Models generally are used to understand and explain occurrences that cannot be directly observed.	**X**	**X**	**X**	**X**	**X**	**X**
F. Assessment. Inspection and evaluation of site-specific information by a qualified scientific expert. An assessment		**X**	**X**		**X**	**X**

may or may not involve collection of new data.						
G. Synthesis. A comprehensive review and explanation of pertinent literature and other relevant existing knowledge by a qualified scientific expert.	X	X	X		X	X
H. Expert Opinion. Statement of a qualified scientific expert based on his or her best professional judgment and experience in the pertinent scientific discipline. The opinion may or may not be based on site-specific information.			X		X	X

f. Forest Practices (Chapter 76.09 RCW)

Under the Forest Practices Act counties, cities, municipalities, or other local or regional governmental entities can adopt or enforce laws, ordinances, or regulations pertaining to land use planning or zoning in forested areas provided that the lands have been or will be converted to a use other than commercial forest product production. The act provides that when a forest practice application is submitted under RCW 76.09.060 (Class IV General), which declares that some or all the lands will be converted to a use other than commercial timber production, the activity is subject to the provisions of the jurisdiction's land disturbance regulations, and establishes when logging becomes a land disturbance activity. A six-year moratorium is put into place following this application during which any property that has been cleared under a Class I, II, III, and IV Special Forest Practices Permit shall not be eligible for any development permit. This requires that a local jurisdiction must establish a six-year moratorium through a local ordinance if the jurisdiction decides to use the enabling language contained in RCW 76.09.060(3)(b)(I).

Forest Practices Rules, WAC 222-20-050, were modified to authorize local government entities to approve conversion option harvest plans (COHP) for certain Class II, Class III, and Class IV – Special Forest Practice applications. This allows a landowner to request the appropriate local government entity to approve a conversion option harvest plan and to maintain the option for conversion to a use other than commercial timber operation. If approved, this plan will release the landowner from the six-year moratorium on future development. This provision allows the landowner to harvest trees without development approval. However, the jurisdiction can review and condition the logging activity so that environmental health is not compromised when future development does take place, and the jurisdiction shall utilize the COHP to condition the forest practice in such a manner that the activity is in compliance with critical area and other environmental regulations, including wetland, stream, river, lake buffers, and protection from potential hazards.

Other Standards and Permit Requirements

Other regulations and permits may require the implementation of BMPs to control pollutants in construction site stormwater runoff. They include:

- Hydraulic Project Approval permits.

- Total maximum daily load (TMDLs) or water clean up plans.
- Contaminated site remediation agreements.
- Other local permits and approvals.

It is important that local jurisdictions carefully define what other standards are applicable within their area, and reference or include in the permitting process ways to effectively satisfy these requirements.

Hydraulic Project Approvals (HPAs)

Under Chapter 77.55 RCW, the Hydraulics Act, the Washington State Department of Fish and Wildlife has the authority to require actions when stormwater discharges related to a project would change the natural flow or bed of state waters. The implementing mechanism is the issuance of a Hydraulic Project Approval (HPA) permit. In exercising this authority, Fish and Wildlife may require:

- Compliance with the provisions of the latest edition of Ecology's Stormwater Management Manual.
- Application of more stringent requirements that they determine are necessary to meet their statutory obligations to protect fish and wildlife (Ecology, SWMM-I, 2001).

Requirements Identified Through Watershed/Basin Planning or Total Maximum Daily Loads

A number of the requirements of the latest edition of Ecology's Stormwater Management Manual can be superseded by the adoption of ordinances and rules to implement the recommendations of watershed plans or basin plans. Local governments may initiate their own watershed or basin planning processes to identify more stringent or alternative requirements. They may also choose to develop a watershed plan in accordance with the Watershed Management Act (Chapter 90.82 RCW) that includes the optional elements of water quality and habitat. They may also choose to develop a basin plan in accordance with Chapter 400-12 WAC. As long as the actions or requirements identified in those plans and implemented through local or state ordinances or rules comply with applicable state and federal statutes (e.g., the federal Clean Water Act and the Endangered Species Act), they can supersede the requirements in the Stormwater Management Manual. The decisions concerning whether such locally derived requirements comply with federal and state statutes rest with the regulatory agencies responsible for implementing those statutes (Ecology, SWMM-I, 2001), and local jurisdictions should take the initiative in ascertaining consistency and compliance in those cases.

A requirement of the Stormwater Management Manual can also be superseded or added to through the adoption of actions and requirements identified in a total maximum daily load (TMDL) plan that is approved by the EPA. However, it is likely that at least some TMDLs will require use of the BMPs in the manual (Ecology, SWMM-I, 2001).

Other Local Government Requirements

Stormwater discharges from construction sites must also comply with Washington state's surface water quality standards (Chapter 173-201A WAC), sediment management standards (Chapter 173-204 WAC), ground water quality standards (Chapter 173-200 WAC), and human health based criteria in the National Toxics Rule (Federal Register, Vol. 57, No. 246, December 22, 1992, pages 60848-60923) (Ecology, SWMM-I, 2001).

Local jurisdictions should also coordinate site planning and land development with the state building code and any adopted building codes and state building code modifications in their local area. This could relate specifically to vertical retaining structures such as rockeries and retaining walls and temporary shoring operations and site grading and restoration.

Appendix 3: Figures and Drawings

Figure 6. Examples of dry swale for infiltration (From Prince George's County, 1999, Figure 4-7)

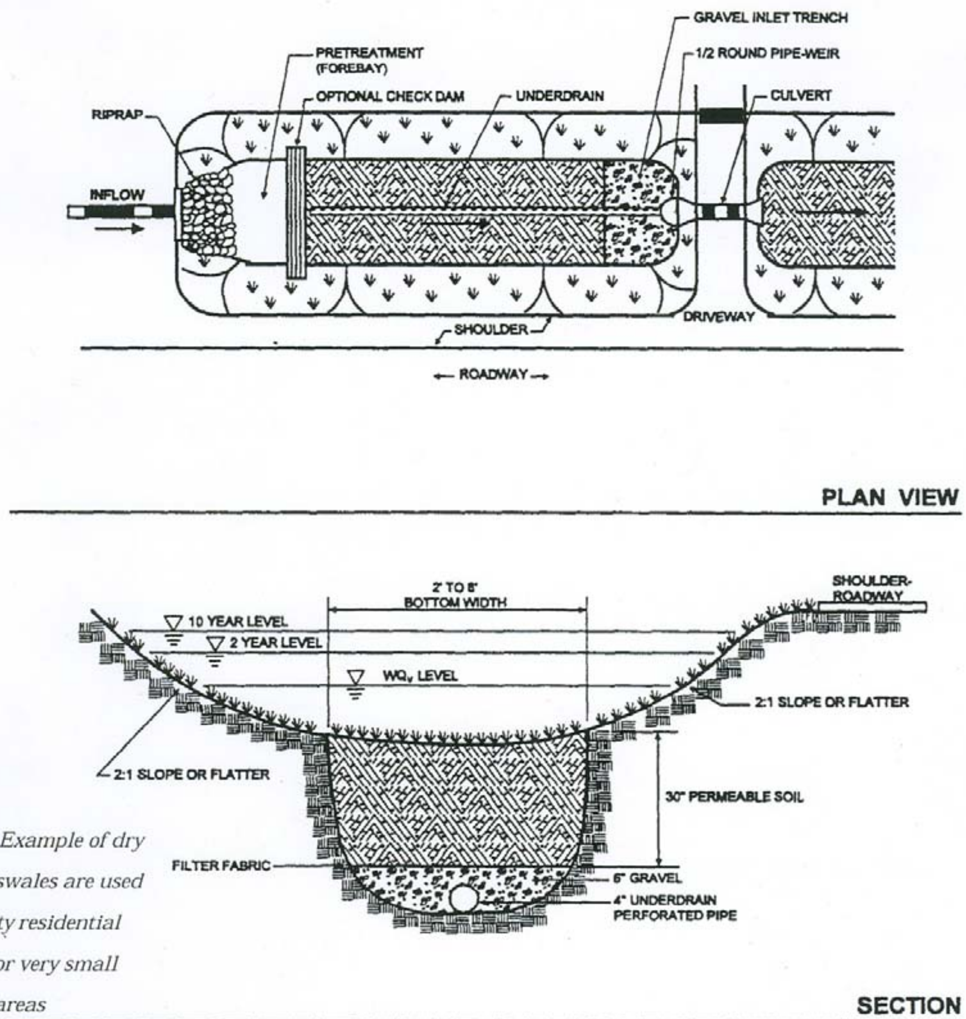


Figure 4-7. Example of dry swale. Dry swales are used at low density residential projects or for very small impervious areas

Figure 7. Examples of wet swale for infiltration (From Prince George's County, 1999, Figure 4-8)

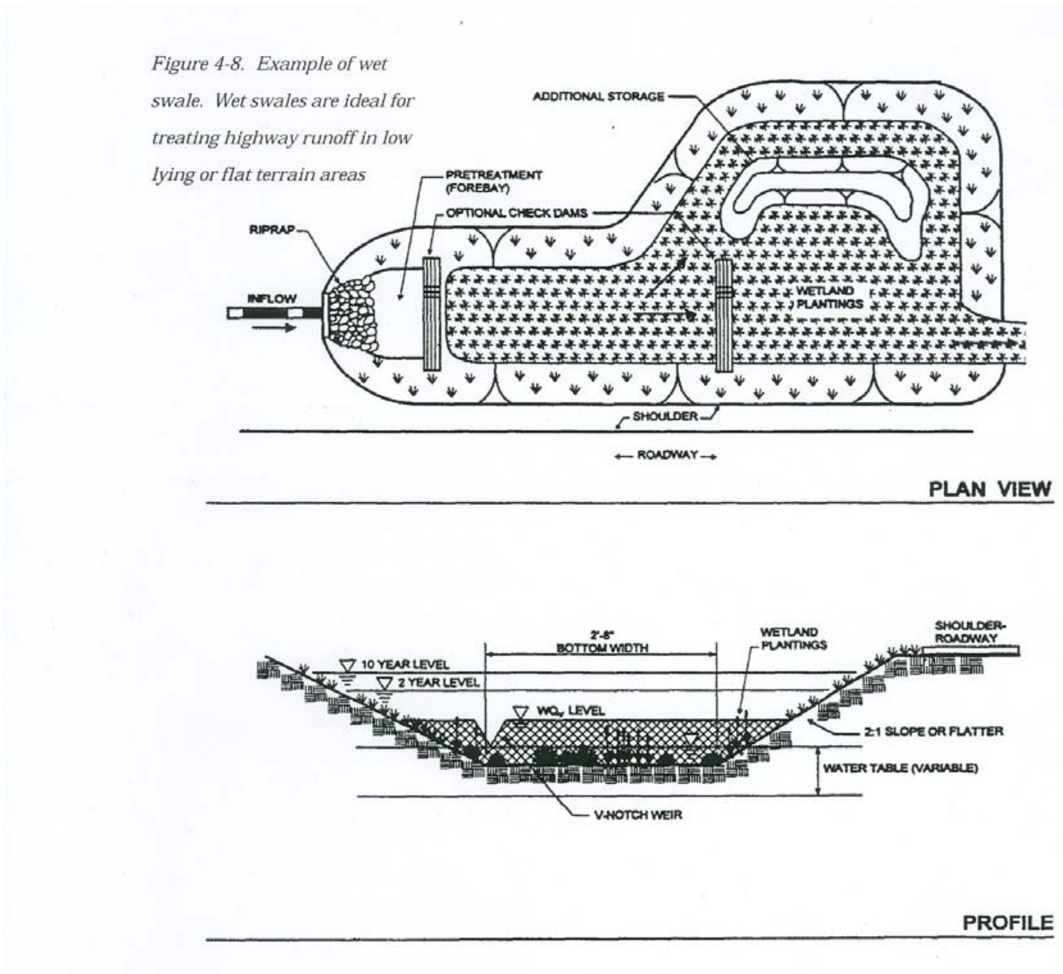
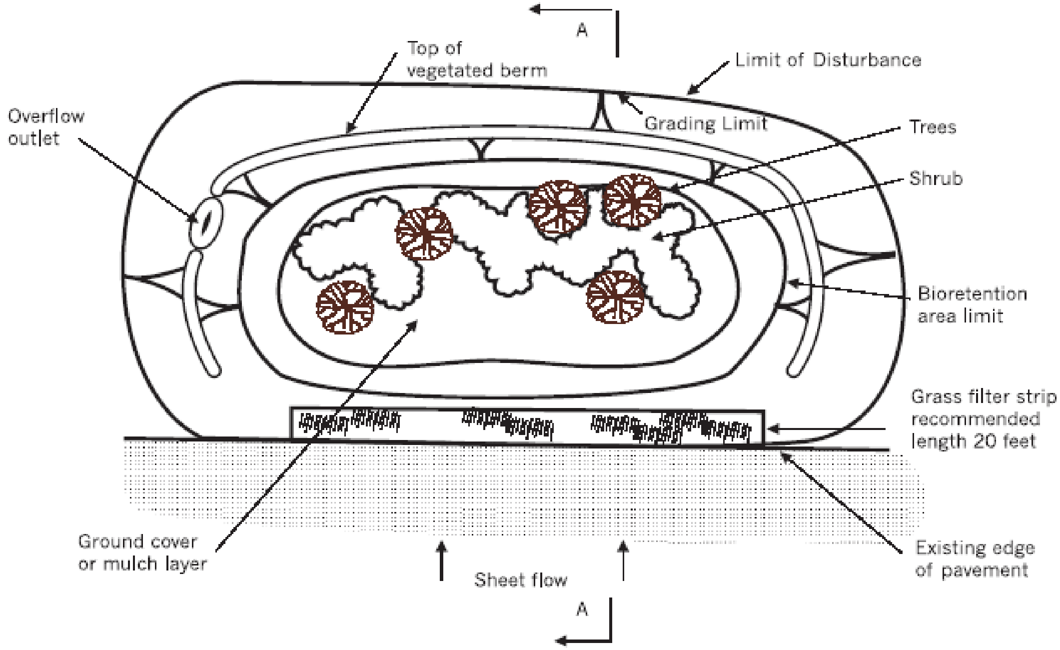
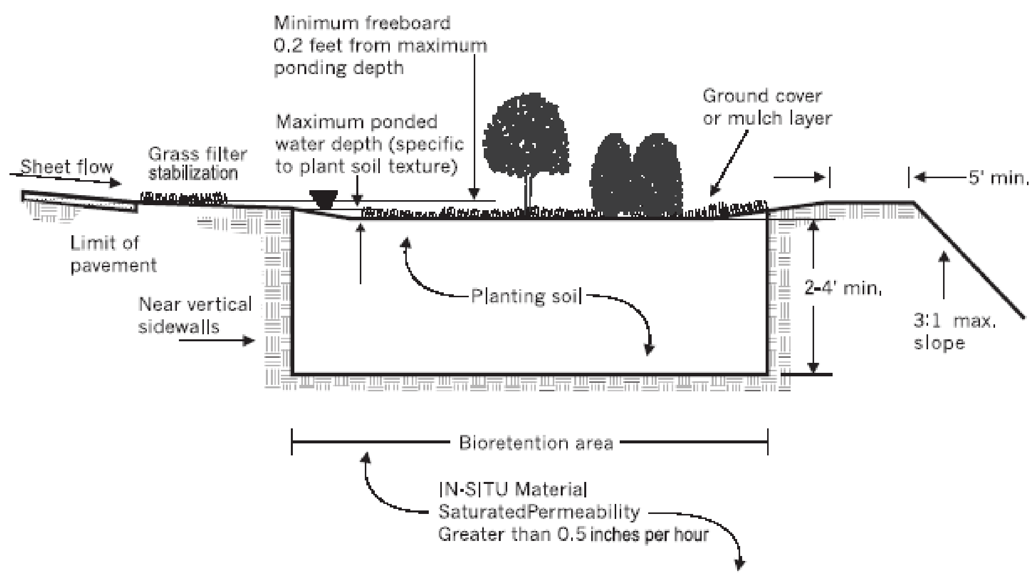


Figure 8. Example of a Bioretention Facility (From Prince George's County, 1999, Figure 4-3)



Plan view (not to scale)



Section A-A (not to scale)