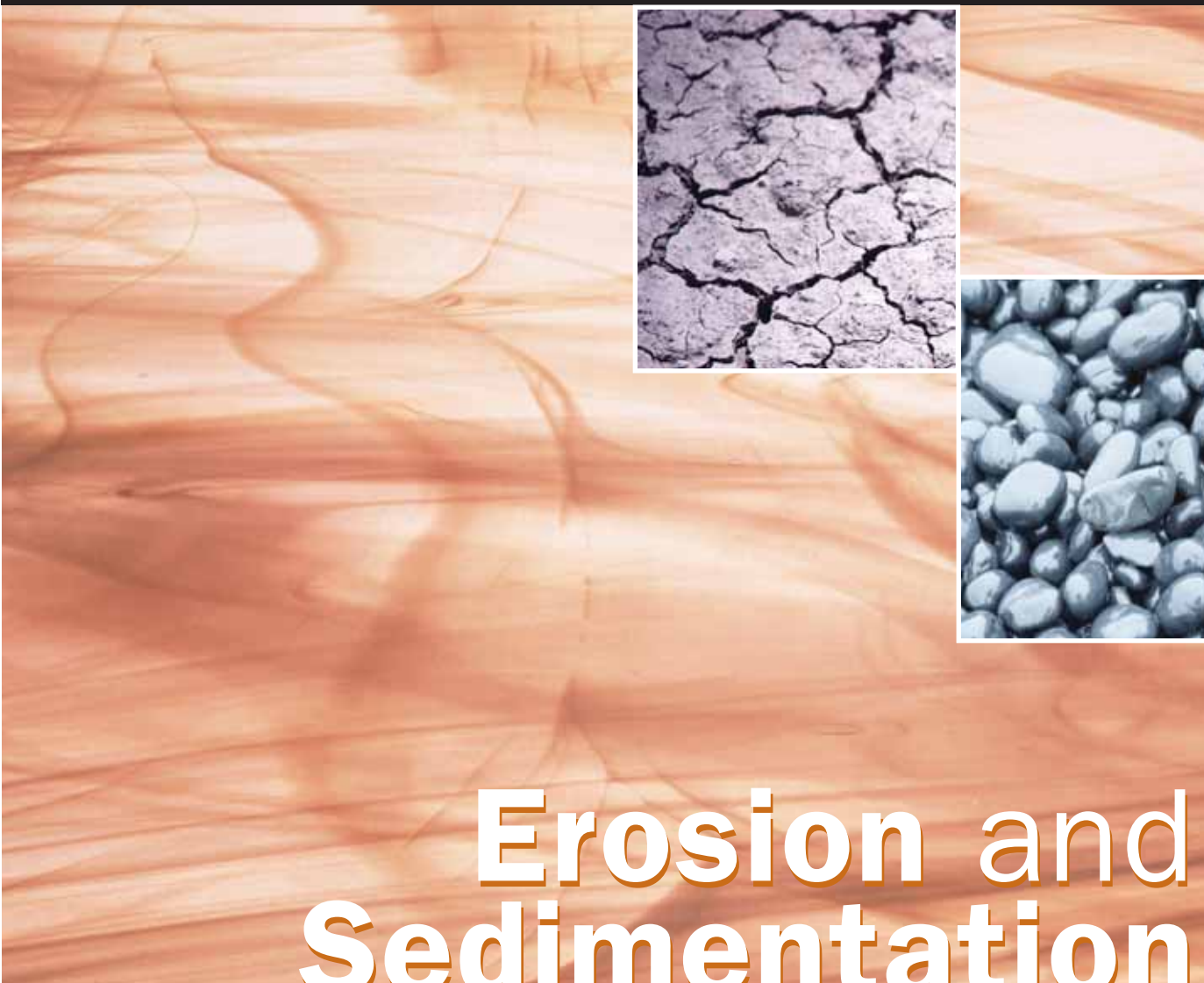
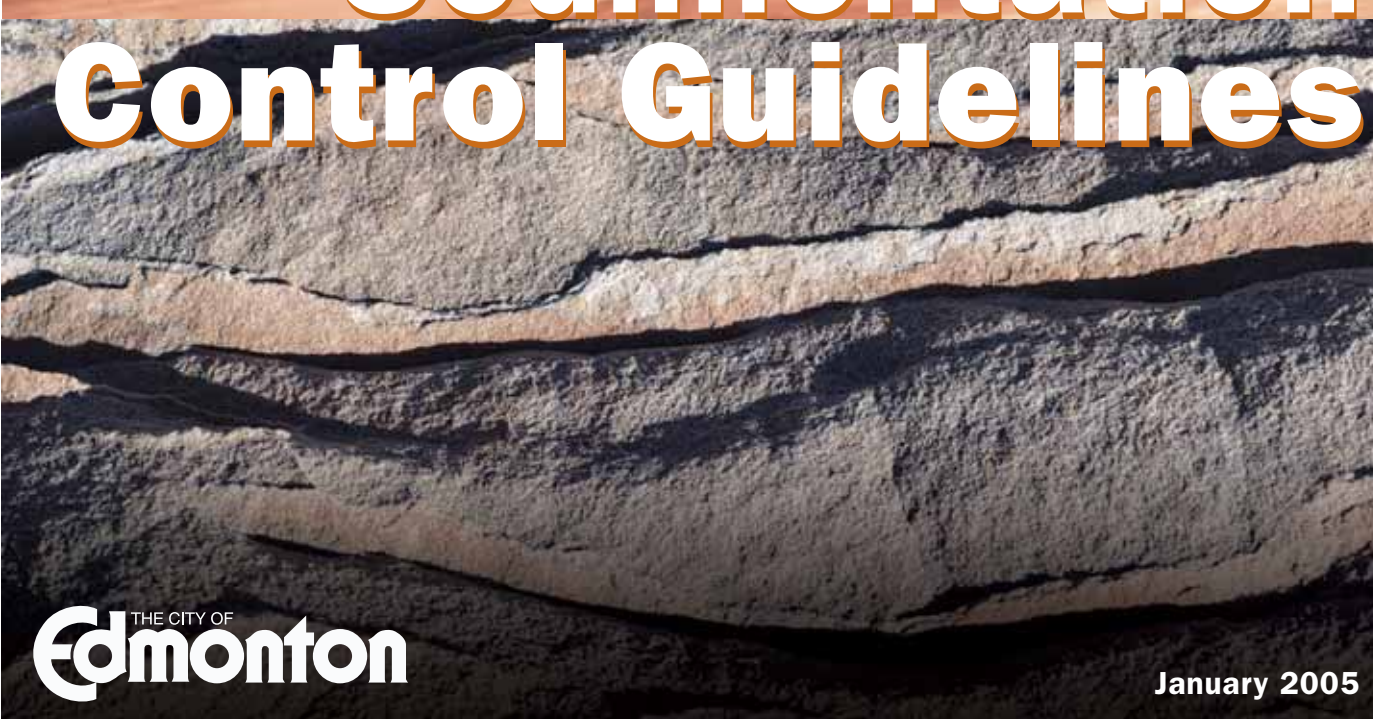


EDMONTON



Erosion and Sedimentation Control Guidelines



These Guidelines were prepared by Stantec Consulting Ltd. under contract to The City of Edmonton, Drainage Services. Guidance and direction for the development of these Guidelines was provided by the Drainage Services Working Group comprised of the following individuals:

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- Alberta Roadbuilders and Heavy Construction Association
- Alberta Sustainable Resource Development
- Alberta Transportation
- Consulting Engineers of Alberta
- Department of Fisheries and Oceans
- Canadian Coast Guard
- Environment Canada
- Strathcona County
- Urban Development Institute
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1.1 BACKGROUND

Erosion and sedimentation are naturally occurring processes involving the loosening, transport and deposition of soils. Erosion is the wearing away of soil materials, caused by the action of wind and water, through detachment and transport of materials from one location to another, usually at a lower elevation. Sedimentation is the deposition of soil particles previously held in suspension by flowing water. Stormwater runoff is part of the natural hydrological cycle, however, clearing, grading, and other activities that remove vegetation and compact the soil result in increased runoff. Excessive runoff causes gully erosion, increased streambank erosion, sedimentation, and flooding.

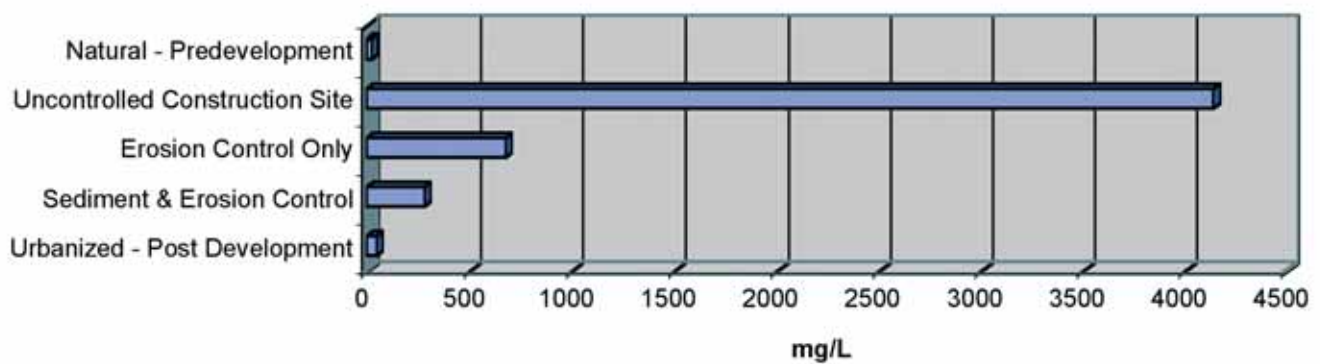
Construction activities can result in a rapid increase in erosion and sedimentation that, if left uncontrolled, can irreparably harm the environment. Construction activities can produce erosion at 200 to 400 times the rate of erosion from other land uses¹. Figure 1.1 provides a comparison of stormwater sediment concentration scenarios from pre-development to post-development. Sedimentation increases by orders of magnitude in the case of a construction site that has no erosion or sedimentation control.



1. Severe erosion and sedimentation

¹ International Erosion Control Association.

Figure 1.1: Stormwater Sediment Concentrations



Source: California Water Quality Control Board, San Francisco Bay Region, Erosion and Sediment Control Field Manual (3rd ed., 1999).

Erosion on a site is not always readily visible. Even if you do not see deposits of eroded soil on or near a site, erosion and sedimentation may be reducing the water quality downstream, damaging infrastructure and the environment, and making Edmonton's natural areas less desirable. Sedimentation of our

watercourses can negatively affect water supplies, infrastructure, flood control, fish habitat and fishing, navigation, and recreational activities. Sediment, along with adsorbed contaminants, is the largest contributor to non-point stormwater pollution.



2. Sediment plume at outfall

It is important that our water resources are protected from erosion of the land or pollution caused by construction activities and other harmful activities. The costs associated with these damages can be significant. Erosion and Sedimentation Control (ESC) techniques serve to minimize the negative impacts of urban development on:

- Public and private property
- Infrastructure
- Ecosystems and habitat
- Water quality
- Air quality

1.2 PURPOSE

The City of Edmonton, Drainage Services Branch (Drainage Services) recognizes the need to proactively address the issues of erosion and sedimentation, particularly with respect to new construction projects within the city.

The *Erosion and Sedimentation Control Guidelines* (Guidelines), and accompanying *Erosion and Sedimentation Control Field Manual* (Field Manual) have been prepared to assist owners, developers, consultants, contractors, and City departments and staff, including those of Drainage Services, in understanding ESC issues. These documents are intended as guidance for those involved in meeting the requirements of the City of Edmonton *Design and Construction Standards, Volume 3, Drainage* for ESC planning and measures.

Establishment of the Guidelines and Field Manual also meets a target identified under Drainage Services' Environmental Management System (EMS).

The Guidelines are intended to fulfill the following needs:

- Provide a consolidated statement of Drainage Services' policies and expectation regarding ESC
- Clarify the respective roles and responsibilities for ESC for Drainage Services, owners and developers, consultants and contractors
- Encourage awareness of and conformance with federal and provincial legislation and with municipal by-laws and standards related to ESC
- Improve communications among all parties responsible for ESC

- Assist parties in recognizing the causes of environmental damage and the various means of mitigating the risks, thereby reducing environmental impacts
- Promote consistency, quality and continual improvement in the standard of efforts to protect the environment

1.3 APPLICATION

The Guidelines and Field Manual come under the mandate of The City of Edmonton, Drainage Services.

The Guidelines and Field Manual have been developed with the specific intent of application to projects that are subject to **approval**² by Drainage Services of sewer and drainage system planning documents and engineering drawings by the City of Edmonton, Drainage Services associated with the private development process and Servicing Agreements, and to infrastructure design and construction undertaken by or on behalf of Drainage Services.

With respect to the private development process, the City of Edmonton *Design and Construction Standards, Volume 3, Drainage* stipulates that **ESC information** must be provided with the Area Master Plan, an **ESC strategy** must be developed during the Neighbourhood Design Report stage, and a more detailed **ESC Plan** must be prepared and submitted with the Detailed Engineering Drawings and implemented during pre-construction, construction and post construction phases. Taken together, these elements make up the Drainage Services **ESC Framework**. **Chapter 4.0 – Drainage Services ESC Framework** describes the requirements in detail.

Note however, that the Guidelines and Field Manual are also intended to provide guidance on the need for, and implementation of, ESC measures in association with all forms of development. Applicable projects include those in the following categories:

- “Greenfield” developments – includes new residential, commercial and industrial developments and expansion of existing developments that involve the disturbance of previously undisturbed areas.
- ‘Re-development’ projects – the redevelopment of previously developed areas that result in ground disturbance.
- ‘Rehabilitation and upgrading’ projects – the repair, upgrading or replacement of existing infrastructure that results in ground disturbance.

² As per the City of Edmonton Design and Construction Standards.

Where these projects involve a **sign-off**³ from Drainage Services, as appropriate there may be requirements for determination of ESC measures and preparation of an ESC plan, such requirements to be subject to the discretion of Drainage Services in accordance with operative policies at the time of submissions.

Those responsible for all projects and developments, regardless of requirements for approval or sign-off by Drainage Services, should at a minimum implement good housekeeping measures to manage erosion and sedimentation issues on-site. A discussion of good housekeeping practices is provided in **Chapter 7.0 – Erosion and Sedimentation Control Measures**.

ESC is ultimately the responsibility of the “owner” of the development, which can include a private developer, property owner, or the City of Edmonton. However, everyone involved in the project, including owners, developers, consultants, contractors, the City of Edmonton, and federal and provincial regulators play a role in protecting the environment through effective ESC.

1.4 ELEMENTS OF AN EFFECTIVE ESC PLAN

Preparation and implementation of an **ESC Plan** is one of the key components of the Drainage Services ESC Framework and is a crucial step in managing erosion and sedimentation. The ten elements of an effective ESC Plan are:

1. Phase Construction to Limit Soil Exposure
2. Minimize Needless Stripping and Grading
3. Stabilize Exposed Soils Immediately
4. Protect Waterways and Stabilize Drainage Ways
5. Protect Steep Slopes and Cuts
6. Install Perimeter Controls
7. Employ Advanced Sediment Settling Controls
8. Ensure Contractors are Trained in ESC Plan, Implementation, Inspections, Maintenance and Repairs
9. Adjust ESC Plan at Construction Site
10. Assess ESC Practices After Storms

Chapter 5.0 – Erosion and Sedimentation Control Plan provides further detail on these ten elements and additional guidance on ESC Plans.

1.5 STRIPPING AND GRADING

Pre-construction stripping and grading activities are often the most significant activities in a construction project that contribute to erosion and sedimentation. In some cases, owners/developers are undertaking stripping and grading activities one to two years or longer before construction of municipal improvements has commenced. The City of Edmonton currently does not require owners/developers to apply for a permit prior to undertaking stripping and grading of a site.⁴ However, owners/developers are strongly encouraged to plan for and time their stripping and grading operations such that the potential for erosion and sedimentation is minimized. Once stripping and grading of a site has begun, ESC measures should be implemented.⁵

Additional information on stripping and grading can be found in the following chapters: **Chapter 4.0 – Drainage Services Erosion and Sedimentation Control Framework**; **Chapter 5.0 – Erosion and Sedimentation Control Plans**; and **Chapter 7.0 – Erosion and Sedimentation Control Measures**.

1.6 USE OF THE GUIDELINES

The Guidelines are to be used as a reference source for the preparation of an ESC Plan and the management of erosion and sedimentation generally. **THE GUIDELINES ARE NOT INTENDED TO BE A DESIGN MANUAL.** They are intended to provide general direction and are not to be considered rigid requirements. They are not an exhaustive list of all possible ESC practices, products and devices. There are many other ESC measures in addition to those cited in this document that may be acceptable for use on a given project. New methods, products, techniques and solutions are continuously being developed. It is expected that qualified professionals, experienced in the design and use of the various ESC measures and best management practices, will prepare and implement the ESC Plan using current technology appropriate to site conditions and the potential for damage to the environment. Owners/developers, consultants, and contractors remain responsible for

³ For example, construction plans associated with major development and building permit applications referred by the Planning and Development Department.

⁴ The City may consider making stripping and grading a permitted activity in the future.

⁵ Note that stripping and grading activities that result in the conversion or loss of wetlands can lead to enforcement action by provincial or federal regulators under legislation such as the provincial *Public Lands Act* and *Water Act*, and federal *Fisheries Act*. Authorizations or approvals may be required from provincial or federal regulatory agencies prior to disturbing wetlands or other areas protected under environmental legislation. Additional information on these and other requirements can be found in *Chapter 2.0 – Regulatory Requirements*.

ensuring compliance with all applicable legislation and by-laws, and the terms and conditions of approvals, licences or permits.

The Guidelines and Field Manual will be reviewed on a regular basis and updated to incorporate and reflect knowledge and experience gained in the field, new research and technologies, and improved ESC practices, products and services. The goal of Drainage Services is to achieve continual improvement in ESC, thereby resulting in greater environmental protection and conservation of precious natural resources.

1.7 TRAINING

It is the responsibility of the owner/developer and its consultants and contractors to ensure that they are competent in all aspects of ESC design, installation, and maintenance and to stay current with new research and technologies. Opportunities to take ESC training courses arise on a fairly regular basis, and have been offered by the following organizations:

- Alberta Transportation
- Alberta Environment
- City of Calgary
- Consulting Engineers of Alberta
- Alberta Roadbuilders and Heavy Construction Association
- University of Alberta and other post-secondary institutions

These organizations can be contacted for information on upcoming courses. In addition, the International Erosion Control Association, a non-profit, member organization, provides training and information in erosion and sedimentation control. Additional information can be found on its website at: <http://www.ieca.org/>.

Certified Professional in Erosion and Sediment Control Inc. provides training and certification in erosion and sedimentation control. Certification can be beneficial to professionals involved in related design or construction work on a frequent basis. Additional information can be found on its website at: <http://www.cpesc.net/>.

1.8 TERMS AND ACRONYMS

A glossary of terms is included at the end of the Guidelines. The following acronyms are used throughout these Guidelines:

Acronym	Meaning
AAFRD	Alberta Agriculture, Food and Rural Development
AENV	Alberta Environment
AMP	Area Master Plan
ARP	Area Redevelopment Plan
BMPs	Best Management Practices
CCC	Construction Completion Certificate
CCG	Canadian Coast Guard
CEPA	<i>Canadian Environmental Protection Act, 1999</i>
CPESC	Certified Professional in Erosion and Sediment Control
DFO	Department of Fisheries and Oceans
EIA	Environmental Impact Assessment
EPEA	<i>Environmental Protection and Enhancement Act, R.S.A. 2000, c. E-12</i>
ESC	Erosion and Sedimentation Control
FAC	Final Acceptance Certificate
MGA	<i>Municipal Government Act, R.S.A. 2000, c. M-26</i>
NDR	Neighbourhood Design Report
PDR	Preliminary Drainage Report
PM	particulate matter
RUSLE	Revised Universal Soil-Loss Equation
s.	section (when used in reference to a legislative provision)
ss.	sections (when used in the plural in reference to legislative provisions)
USDA	United States Department of Agriculture
WEPP	Water Erosion Prediction Project

2.1 INTRODUCTION

If left unchecked, erosion and sedimentation can result in a variety of negative impacts to the environment, including loss of valuable topsoil, water quality degradation, harm to aquatic and vegetative species and habitat, and damage to adjacent land. Numerous federal, provincial, and municipal acts, regulations, bylaws, codes of practice, standards, and guidelines are applicable to urban development activities that result or could result in erosion, sedimentation and adverse effects on the environment. The following acts, regulations, and bylaws (as well as several standards, guidelines, and codes of practice) are reviewed in this chapter:

Federal

- *Fisheries Act*, R.S.C., 1985, c. F-14
- *Navigable Waters Protection Act*, R.S.C. 1985, c. 22
- *Migratory Birds Convention Act, 1994* (1994, c. 22)
 - *Migratory Birds Regulations*, C.R.C., c. 1035
- *Canadian Environmental Protection Act, 1999*, S.C. 1999, c. 33

Provincial

- *Environmental Protection and Enhancement Act*, R.S.A. 2000, c. E-12
 - *Release Reporting Regulation*, A.R. 117/93
 - *Wastewater and Storm Drainage Regulation*, A.R. 119/1993
- *Water Act*, R.S.A. 2000, c. W-3
 - *Water (Ministerial) Regulation*, A.R. 205/98
- *Soil Conservation Act*, R.S.A. 2000, c. S-15
- *Public Lands Act*, R.S.A. 2000, c. P-40

Municipal

- *Municipal Government Act*, R.S.A. 2000, c. M-26
- *Sewers Use Bylaw No. 9675*
- *Sewers Bylaw No. 9425*
- *Surface Drainage Bylaw No. 11501*
- *North Saskatchewan River Valley Area Redevelopment Plan Bylaw No. 7188*

NOTE: This chapter identifies the PRIMARY regulatory requirements that may apply to activities and projects that result in erosion and sedimentation. It is NOT exhaustive, and specific legal advice should be sought to ensure that all relevant legislation has been identified when a specific regulatory issue arises. This information is not offered, nor intended to be offered, as any form of legal advice.

2.2 FEDERAL

Current versions of all federal legislation, including those listed below, are available online from Justice Canada at: <http://laws.justice.gc.ca/en/index.html>.

2.2.1 Fisheries Act

The *Fisheries Act*, R.S.C., 1985, c. F-14, administered by the Department of Fisheries and Oceans Canada¹ (DFO), applies to all fishing zones, territorial seas and inland waters of Canada. The Act regulates the protection of fish and fish habitat, pollution prevention, the harvesting of fish, and the safe use of fish.

The definition of “fish” is broad and includes “(a) parts of fish, (b) shellfish, crustaceans, marine animals, and any parts of shellfish, crustaceans, or marine animals, and (c) the eggs, sperm, spawn, larvae, spat and juvenile stages of shellfish, crustaceans and marine animals” (s. 2). “Fish habitat” is defined as “spawning grounds and nursery, rearing, food supply and migration areas on which fish depend directly or indirectly in order to carry out their life processes” (s. 34(1)).

Section 32 contains a general prohibition against destroying fish by any means other than fishing unless authorized by the Minister or under regulations made under the Act.

Section 35(1) prohibits the carrying on of any work or undertaking that results in the harmful alteration, disruption or destruction of fish habitat (HADD) unless an authorization is obtained from DFO².

Section 36(3) prohibits any person from depositing or permitting the deposit of a “deleterious substance”³ of any type in water frequented by fish, or in any place under any conditions where the deleterious substance could enter such water. Silt and sediment are among the most common types of deleterious substances.

¹ Some of the enforcement provisions in the *Fisheries Act* are administered by Environment Canada.

² The requirement to obtain an authorization under the *Fisheries Act* triggers the requirement to undertake an environmental assessment under the *Canadian Environmental Assessment Act, 1992*, c. 37.

³ Defined in s. 34(1) to include “any substance that, if added to any water, would degrade or alter...the quality of that water”, or “any water that contains a substance in such quantity or concentration, or that has been so treated, processed or changed, by heat or other means, from a natural state that it would, if added to any other water, degrade or alter...the quality of that water” so that it is rendered or is likely to be rendered deleterious to fish or fish habitat.

There are regulations under the Act that allow the deposit of certain types and quantities of deleterious substances, and are primarily aimed at industries (e.g. chlor-alkali mercury effluent). Otherwise there is no provision in the Act that authorizes the discharge of a deleterious substance. Therefore, the release of any amount of silt or sediment is potentially a contravention of the Act.

Section 38(4) creates a duty to report the deposit of a deleterious substance. Where, “out of the normal course of events, there occurs a deposit of a deleterious substance in water frequented by fish or a serious and imminent danger thereof by reason of any condition, and where any damage or danger to fish habitat or fish or the use by man of fish results or may reasonably be expected to result...” it must be reported to an inspector by any person who:

- owns the deleterious substance or has charge, management or control thereof, or
- causes or contributes to the causation of the deposit or danger thereof.

Under s. 38(5), the same persons are also required to take all reasonable measures to prevent any deposit or to counteract, mitigate or remedy any adverse effects that result or may result from a deposit. Section 38(6) states that where a DFO inspector is satisfied on reasonable grounds that there is a deposit as per s. 38(4), and that immediate action is necessary in order to carry out any reasonable measures, he/she may take any such measures or direct that they be taken by any person referred to in s. 38(4). This can include entering and accessing any place, premises, vehicle or vessel, shutting down the project, installing erosion and sedimentation control measures, etc.

Contravention of the Act may result in maximum fines ranging up to \$200,000 or \$300,000 (depending on the offence) and/or six months imprisonment for summary offences, and up to \$1,000,000 and/or three years imprisonment for indictable offences. Where a contravention is committed or continued on more than one day, each day is considered a separate offence (s. 78.1). No one will be convicted of an offence under the Act if they exercised due diligence to prevent the commission of the offence, or reasonably and honestly believed in the existence of facts that, if true, would render their conduct innocent (s.78.6). See Section 2.6 for more discussion on due diligence.

2.2.2 Navigable Waters Protection Act

The *Navigable Waters Protection Act*, R.S.C. 1985, c. 22, administered by the Canadian Coast Guard (CCG), applies to all navigable waters and coastal areas across Canada. The purpose of the Act is to protect the public right of navigation in all navigable waters, and applies to in-stream work involving construction or placement in, on, over, under, through, or across any navigable water. “Navigable water” includes a canal and any other water created or altered as a result of the construction of any work. Navigability is determined by the CCG on a case-by-case basis.

Under sections 21 and 22 it is prohibited to throw or deposit into a navigable water any sawdust, edgings, slabs, bark, stone, gravel, earth, cinders, ashes or other material or rubbish that interferes with navigation. A person is liable to a fine not exceeding \$5,000 for contravening sections 21 or 22.

2.2.3 Migratory Birds Convention Act, 1994

The purpose of the *Migratory Birds Convention Act, 1994* (1994, c. 22) and the *Migratory Birds Regulations*, C.R.C., c. 1035 (Regulations) is to protect and preserve migratory birds and migratory bird habitats. The Act and Regulations apply to various:

- Migratory game birds, including ducks, geese, swan, cranes, shorebirds and pigeons
- Migratory insectivorous birds, including chickadees, cuckoos, hummingbirds, robins, swallows and woodpeckers
- Other migratory non-game birds, including gulls, herons, loons, and puffins

The complete list of migratory birds is contained in Schedule 1 to the Act. It is prohibited under s. 35 of the Regulations to deposit or permit to be deposited oil, oil wastes or any other substances harmful to migratory birds in any waters or any area frequented by migratory birds. Fines for summary offences range from a maximum of \$50,000 and/or six months in prison for an individual, and a maximum of \$100,000 for a corporation, and for indictable offences, to a maximum of \$100,000 and/or five years in prison for an individual, and a maximum of \$250,000 for a corporation (s. 13(1)). The fine amounts can double for subsequent offences (s. 13(2)). A person who commits or continues an offence on more than one day is liable for a separate offence for each day the offence is committed (s. 13(3)), and an offence involving each migratory bird or nest can be calculated as a separate offence (s. 13(4)).

2.2.4 Canadian Environmental Protection Act, 1999

The *Canadian Environmental Protection Act, 1999* (1999, c. 33) (CEPA), targets pollution prevention and protection of the environment, human life and health from the risks associated with toxic substances. Under s. 64, a substance is “toxic” if it is entering or may enter the environment in a quantity or concentration or under conditions that:

- have or may have an immediate or long-term harmful effect on the environment or its biological diversity,
- constitute or may constitute a danger to the environment on which life depends, or
- constitute or may constitute a danger in Canada to human life or health.

Once a substance is declared toxic, it is placed on the Toxic Substances List in Schedule 1 of CEPA. Particulate matter (PM) that is less than or equal to 10 microns is a toxic substance under CEPA. Wood burning, crop residues fires, and road dust can contribute to PM in the air. Under sections 95 to 99, where a toxic substance is released into the environment, any person who owns or has the charge, management or control of a substance, or causes or contributes to the release or increases the likelihood of the release, must report the release and take measures to prevent the release and remedy/mitigate the effects.

For a summary offence, the maximum penalty is a fine of not more than \$300,000 and/or imprisonment for not more than six months. For an indictable offence the maximum penalty is a fine of not more than \$1,000,000 and/or imprisonment for not more than three years (s. 272(2)). Where a contravention is committed or continued on more than one day, each day is considered a separate offence (s. 276).

2.3 PROVINCIAL

Current versions of all provincial acts, regulations and codes of practice, including those listed below, are available online from Alberta Queen’s Printer at: <http://www.qp.gov.ab.ca/index.cfm>.

2.3.1 Environmental Protection and Enhancement Act

The *Environmental Protection and Enhancement Act*, R.S.A. 2000, c. E-12 (EPEA), administered by Alberta Environment (AENV), supports and promotes the protection, enhancement and wise use of the environment. Under sections 108 and 109, it is prohibited to: (1) knowingly release or permit the release, or (2) release or permit the release, of a

substance into the environment in an amount, concentration or level or at a rate of release that:

- is in excess of an approval or a regulation, or
- causes or may cause a significant adverse effect.

“Substance” is defined in s. 1(mmm) and includes “any matter that is capable of becoming dispersed in the environment”, and can include silt and sediment. “Release” is defined in s. 1(hhh) and includes “to spill, discharge, dispose of, spray, inject, inoculate, abandon, deposit, leak, seep, pour, emit, empty, throw, dump, place, and exhaust”. Significant adverse effect is not defined in the Act, but “adverse effect” is defined as “impairment of or damage to the environment, human health or safety or property” (s. 1(b)).

Section 110(1) creates a duty to report a release that has caused, is causing or may cause an adverse effect on the environment. The person who releases or causes or permits the release must report it as soon as they know or ought to know of the release to:

- the Director (AENV),
- the owner of the substance,
- their employer,
- the person having control of the substance, and
- any other person who may be directly affected by the release.

The release must be reported in person or by telephone and must include the information in s. 111(1)(a) to (e). This must be followed up by a written report to AENV within seven days of the verbal report (unless the requirement for the written report has been waived by the Director). The written report must contain the information set out in s. 4(3) of the *Release Reporting Regulation*, A.R. 117/93. AENV’s *Release Reporting Guideline* (June 2001) provides additional details and guidance on release reporting requirements.

Section 110(3) puts the onus on employees of local authorities to report releases:

A police officer or employee of a local authority or other public authority who is informed of or who investigates a release of a substance into the environment that may cause, is causing or has caused an adverse effect shall immediately notify the Director of the release unless the police officer or employee has reasonable grounds to believe that it has been reported by another person.

2.0 REGULATORY REQUIREMENTS

In addition to reporting a release of a substance, the person responsible for a substance that may cause, is causing, or has caused an adverse effect must, as soon as they become aware or ought to have become aware of the release, take all reasonable measures to:

- repair, remedy and confine the effects of the substance,
- remove or otherwise dispose of the substance in such a manner as to effect maximum protection to human life, health and the environment, and
- restore the environment to a condition satisfactory to AENV.

Penalties under the Act range from \$50,000 to \$1,000,000 and/or up to two years imprisonment. Where a contravention is committed or continued on more than one day, each day is considered a separate offence (s. 231). Due diligence is a defence to most offences under EPEA and is established by proving on a balance of probabilities that the person took all reasonable steps to prevent the commission of the offence (s. 229).

2.3.1.1 Wastewater and Storm Drainage Regulation

The *Wastewater and Storm Drainage Regulation*, A.R. 119/1993 under EPEA sets out requirements for design and construction standards, substance release, extensions and replacements, and operation of municipal, industrial and privately owned wastewater systems and storm drainage systems. The Regulation adopts several codes of practice and standards, including the *Code of Practice for Wastewater Systems Using a Wastewater Lagoon*, *Code of Practice for Wastewater Systems Consisting Solely of a Wastewater Collection System*, and the *Standards and Guidelines for Municipal Waterworks, Wastewater and Storm Drainage Systems*.

Section 7 prohibits the use or disposal into a wastewater or storm drainage system a substance in an amount, concentration or level or rate of release that may:

- impair the integrity of the wastewater or storm drainage collection system,
- impair the operation or performance of a storm drainage treatment facility or wastewater treatment plant, or
- impair the quality of storm drainage or treated wastewater and the gases and sludge produced in the treatment process.

Penalties under the Regulation range from up to \$50,000 for an individual, and up to \$500,000 for a corporation.

2.3.1.2 Standards and Guidelines

AENV has developed several guidelines and standards related to stormwater management:

- *Municipal Policies and Procedures Manual* (April 2001) – Municipalities, in planning and implementing surface drainage, must adopt an integrated approach to stormwater management, beginning at the watershed and sub-watershed levels and extending to the subdivision/site plan level with emphasis on stormwater quality and best management practices (BMPs), both structural and non-structural. AENV has set a target for stormwater quality of a minimum 85% removal of total suspended solids (TSS) of particle size 75 mm or greater.
- *Stormwater Management Guidelines for the Province of Alberta* (January 1999) – These guidelines are intended to help municipalities, local authorities, consulting engineers, and developers in the planning and design of stormwater management systems in Alberta. They outline the objectives of stormwater management and the available methodologies and concepts for planning, design and operation of stormwater drainage systems.
- *Standards and Guidelines for Municipal Waterworks, Wastewater and Storm Drainage Systems* (December 1997) – This document sets out the minimum performance standards, design standards, design guidelines and operating and monitoring requirements and guidelines for these systems in Alberta municipalities.

Copies of AENV standards, guidelines, and other publications can be obtained by searching AENV's reports and publications web page:

<http://www3.gov.ab.ca/env/info/infocentre/publist.cfm>

2.3.2 Water Act

The *Water Act*, R.S.A. 2000, c. W-3 regulates the allocation, protection and conservation of water in the Province of Alberta and is administered by AENV. Under s. 36(1) an approval is required for the following activities:

- Placing, constructing, operating, maintaining, removing or disturbing works, maintaining, removing or disturbing ground, vegetation or other material, or carrying out any undertaking, including but not limited to groundwater exploration, in or on any land, water or water body that:

- alters, may alter or may become capable of altering the flow or level of water, whether temporarily or permanently, including but not limited to water in a water body, by any means, including drainage,
 - changes, may change or may become capable of changing the location of water or the direction or flow of water, including water in a water body, by drainage or otherwise,
 - causes, may cause or may become capable of causing the siltation of water or the erosion of any bed or shore of a water body, or
 - causes, may cause or may become capable of causing an effect on the aquatic environment.
- Altering the flow, direction of flow, or level of water or changing the location of water for the purposes of removing an ice jam, drainage, flood control, erosion control or channel realignment or for a similar purpose;
 - Drilling or reclaiming a water well or borehole; and
 - Anything defined as an activity in the regulations.

The *Water (Ministerial) Regulation*, A.R. 205/98, Schedule 1, lists activities that are exempt from the approval requirement. Included in this list is landscaping that is not in a watercourse, lake or wetland if the landscaping does not result in

- an adverse effect on the aquatic environment on any parcel of land, or
- any change in the flow or volume of water on an adjacent parcel of land.

The *Water Act* also regulates water consumption, whereby a licence is required under s. 49(1) to commence or continue a diversion of water for any purpose or to operate a works.

Penalties for offences under the *Water Act* range from \$50,000 to \$100,000 and/or two years imprisonment for an individual, and \$500,000 to \$1,000,000 for a corporation. An offender is liable for each day or part of a day that the offence occurs or continues (s. 145). For the “strict liability” offences, due diligence is a defence and is established by demonstrating that all reasonable steps have been taken to prevent the commission of the offence.

2.3.2.1 Codes of Practice

There are several Codes of Practice under the *Water Act*, including the *Code of Practice for Outfall Structures* (2003), the *Code of Practice for Watercourse Crossings* (2001), and the *Code of Practice for Pipelines and Telecommunications Lines Crossing a Water Body* (2001). Taking measures to prevent or control erosion and sedimentation when undertaking these activities are included in the typical requirements found in these codes. Individuals undertaking these types of activities should review the code of practice requirements and consult with AENV prior to commencing construction.

2.3.3 Public Lands Act

The *Public Lands Act*, R.S.A. 2000, c. P-40 applies to public land under the administration of the Minister of Sustainable Resource Development (s. 2(1)). This includes all naturally occurring bodies of water. With a few exceptions, title to the beds and shores of (a) all permanent and naturally occurring bodies of water, and (b) all naturally occurring rivers, streams, watercourses and lakes, is vested in the Crown in right of Alberta (s. 3). The extent of the Province’s ownership of the bed and shore is limited by the bank of the body of water (defined in s. 17(2) of the *Surveys Act*, R.S.A. 2000, c. S-26). This is the line along the upper limit of the bed and shore, formed by the normal, continuous action or presence of surface water on the land, that forms a natural boundary between the Crown owned bed and shore, and privately owned land. The location of the bank is not affected by occasional periods of drought or flooding. The ‘bed’ is the land on which the water sits, and the ‘shore’ is that part of the bed that is exposed when water levels are not at their normal fullest level.⁴

Approval is required prior to developing or modifying the beds, shores or banks of a body of water including, but not limited to:

- Any project (temporary or permanent) that involves the disturbance, modification, placement or removal of material on the bed, shores or banks of a body of water, including the infilling of a permanent and naturally occurring wetland
- Any commercial development (temporary or permanent)
- Re-alignment of a watercourse channel

⁴ This definition is taken from the Department of Sustainable Resource Development’s web site.

2.0 REGULATORY REQUIREMENTS

- Cutting or removal of vegetation on the shores or banks of a body of water
- Erosion protection works, retaining walls, groynes, breakwaters and causeways

Section 54 includes the following prohibited activities (unless authorized under the Act or any other applicable legislation): accumulation of waste material, debris, refuse or garbage on public land; injuriously affecting watershed capacity; disturbance that results or is likely to result in injury to the bed or shore of any river, stream, watercourse, lake or other body of water or land; and the creation of any condition on public land which is likely to result in soil erosion⁵.

Under section 59(2) the general penalty for an offence under the Act or the regulations is a fine not exceeding \$5,000 for each day or part of a day the offence occurs or continues. The Minister can issue an enforcement order under s. 59.1 ordering the person to do or refrain from doing anything, carry out any specified measures, and remedy the effects of the contravention.

2.3.4 Soil Conservation Act

The *Soil Conservation Act*, R.S.A. 2000, c. S-15 applies to all land within the Province of Alberta.⁶ Section 3 of the Act states:

Every landholder shall, in respect of the landholder's land, take appropriate measures

- (a) to prevent soil loss or deterioration from taking place, or
- (b) if soil loss or deterioration is taking place, to stop the loss or deterioration from continuing.

Landholder is defined in s. 1(c) as the occupant, or if there is no occupant, the owner of the land. If a landholder is not taking appropriate measures to prevent soil loss or deterioration, or stop it from continuing, a soil conservation officer appointed under the Act can serve a notice ordering the landholder or owner to take remedial measures, and if the measures are not carried out, may enter on the land and carry out the remedial measures set out in the order. The landholder/owner is then responsible

for paying for the expenses incurred in carrying out the remedial measures.

Section 15 of the Act provides the local authority of a municipality with the power to appoint one or more soil conservation officers for the municipality. Under s. 21 a local authority may, under a bylaw, prohibit the removal of topsoil from land, and require a permit for the removal of topsoil from land.

A person who contravenes s. 3 of the Act is liable to a fine of not more than \$500 for each day or part of the day the offence continues to a maximum fine of \$10,000. A person who fails to comply with a notice/order made by an officer, contravenes any other provision of the Act or regulations, or contravenes a bylaw made under s. 21, is liable to a fine of not more than \$5,000.

2.4 MUNICIPAL

The *Municipal Government Act*, R.S.A. 2000, c. M-26 (MGA) gives broad authority to municipalities to pass bylaws governing a variety of areas under municipal jurisdiction and control. Specifically, sections 7 and 8 of the MGA give Council the power to pass bylaws for municipal purposes including the safety, health and welfare of people and the protection of people and property, and public utilities, and to regulate or prohibit and provide for a system of licences, permits or approvals. The City also publishes standards and guidelines to provide more detailed information on specific municipal requirements. As well, municipalities have the direction, control and management of the rivers, streams, watercourses, lakes and other natural bodies of water within the municipality, including the air space above and the ground below (s. 60(1)).

The following City of Edmonton bylaws, standards and guidelines are applicable to the issue of erosion and sedimentation and their impacts on surface drainage, the storm drainage system, sewers systems, and stormwater management in Edmonton.

Copies of all City bylaws are available online at: <http://www.edmonton.ca/portal/server.pt> (click on "Bylaws").

⁵ Many of the activities that are regulated under the *Public Lands Act* are also regulated under the *Water Act*, R.S.A. 2000, c. W-3. See discussion under Section 2.2.2.

⁶ The *Soil Conservation Act* does not apply in respect of the use of "specified land" within the meaning of the *Environmental Protection and Enhancement Act*. "Specified land" is defined under s. 134(f) of EPEA. The definition specifically excludes "subdivided land that is used or intended to be used solely for residential purposes", and "any part of any unsubdivided land that is the site of a residence and the land used in connection with that residence solely for residential purposes". This type of land is therefore subject to the *Soils Conservation Act*. Specified land is further defined in s. 1(t) of the *Conservation and Reclamation Regulation*, A.R. 115/1993 and includes land that is being used or has been used or held for or in connection with a well, industrial pipeline, battery, oil production site, municipal pipeline, telecommunication systems or transmission line, mine, pit, quarry, borrow excavation, peat operation, roadway, exploration operation, railway, and plant. "Roadway" means a highway or road as defined in the *Public Highways Development Act*.

2.4.1 Sewers Use Bylaw No. 9675

The purpose of the *Sewers Use Bylaw No. 9675* is to regulate the release of matter to the City of Edmonton's sewerage system and watercourses and to levy sewer service charges for services provided (s. 1). "Release" means to directly or indirectly conduct matter to the sewerage system, wastewater treatment facility or watercourse by spilling, discharging, disposing of, abandoning, depositing, leaking, seeping, pouring, draining, emptying, or by any other means (s. 1(ooo)). "Matter" means any solid, liquid or gas (s. 2(ww)). "Sewerage system" is all City owned facilities for collection, storage, transportation and pumping of stormwater, clear-water wastes or wastewater, or any part thereof, and includes swales, ditches, channels and stormwater management facilities (s. 2(vvv)). "Watercourse" means:

- the bed and shore of a river, stream, lake, creek, lagoon, swamp, marsh or other natural body of water, or
- a canal, ditch, reservoir, stormwater management facility or other man-made surface feature,

whether it contains or conveys water continuously or intermittently.

Part III governs releases to the storm sewerage system and watercourses. Sections 10(1) and (2) contain a general prohibition against releasing or permitting the release of any matter or hazardous waste into a storm sewer, including any stormwater management facility, or watercourse. Section 10(3) allows the release of stormwater or subsurface water (other than from a remediation site or high potential contaminant release area) that does not contain a hazardous waste, a prohibited waste, or a restricted waste. Prohibited and restricted wastes are listed in Schedule A and C respectively, and include gravel, rock, sand, soil and straw.

Section 12(1) prohibits the release of stormwater runoff from private property (including a private stormwater management facility) to the North Saskatchewan River or to any canal, ditch, reservoir or other man-made surface water feature that drains into the North Saskatchewan River, from the upstream City limits to 125 metres downstream of the E.L. Smith Water Treatment Plant water supply intake. There are several exceptions listed in s. 12(2) (e.g., stormwater management facility is installed in accordance with the Sewers Bylaw, BMPs are followed, monitoring is provided, and releases are in compliance with this bylaw).

If a release of any matter prohibited under s. 10 does occur, s. 13(1) requires any person who releases or

permits the release to, immediately after becoming aware of the release, notify:

- the City Manager,
- the owner of the premises, and
- any other person who may be directly affected by the release

and to provide the City Manager with the information listed in s. 13(2). A written report must be submitted within seven (7) days of the release and include the information set out in s. 13(5).

Measures to confine, remedy and repair the effects of the release, and remove or otherwise dispose of the matter to minimize adverse effects must be taken by the person who released or permitted the release as soon as the person becomes aware or ought to have become aware of the release (s. 13(4)).

A person found guilty of an offence under the bylaw is liable to a fine not exceeding \$10,000 and to imprisonment for not more than six months for non-payment of the fine (s. 30).

2.4.2 Sewers Bylaw No. 9425

The purpose of the *Sewers Bylaw No. 9425* is to:

- regulate connections between private drainage services and the City of Edmonton sewerage system,
- regulate the use of stormwater management facilities,
- prevent damage or misuse of the sewerage system, and
- allow the collection of sanitary sewer trunk charges and other cost assessments.

Before commencing construction of any sewer or sewer service, a person must enter into a servicing agreement or contract with the City (s. 4(2)). Approval is required before a person can uncover, enter, make any connections with or opening into, use, alter, disturb or conduct work (except for removal of blockages) in any public sewer (s. 4(3)). Construction specifications for the sewerage system are determined by the City (s. 4(6)).

Under s. 4(8), no one may construct foundation or roof drainage systems, canals, ditches, reservoirs, stormwater management facilities, or other man-made surface features draining to the North Saskatchewan River, or any tributary or watercourse draining to the North Saskatchewan River, from the upstream City limits to 125 metres downstream of the E.L. Smith Water Treatment Plant intake unless:

- stormwater management facilities are designed and constructed to the satisfaction of the City Manager, and
- written approval is obtained from the City Manager.

When connection to a new or existing sewer service is required, a written request must be submitted to the City Manager including, but not limited to, a site mechanical and grading plan, including stormwater management controls and storage methods, and an assessment of the potential to release wastewater or stormwater to a sanitary, combined or storm sewerage system or watercourse in contravention of the Sewers Use Bylaw (s. 8).

The maximum penalty under the bylaw is a fine not exceeding \$10,000 and imprisonment for not more than six months for non-payment of the fine (s. 31).

2.4.3 Surface Drainage Bylaw No. 11501

The *Surface Drainage Bylaw No. 11501* regulates lot grading and surface drainage requirements within private and public lands (s. 1). Under s. 6, the City Manager is authorized to establish for any lot mentioned in s. 5 (land zoned commercial, industrial, multiple family, apartment, row housing, and urban services) a limited rate of release of stormwater including discharges into a public sewer and discharges to a ditch or surface drainage feature designated by the City Manager. Section 7 allows the City Manager to determine and specify the location of release of stormwater and subsurface drainage to a sewer service, an overland route, or a specific overflow point on or from a lot.

Part V provides restrictions affecting surface drainage. Under s. 11, no owner can permit roof drainage or pumped subsurface drainage from a building to be discharged:

- to a location where soil erosion would occur,
- to a location where the flow of water or accumulation of water would adversely affect or have the potential to adversely affect the stability of a slope or top of bank,
- to a location where the flow of water or accumulation of water would have a detrimental effect on a ravine or an environmentally sensitive area, or
- to a location or in such a way as to cause or have potential to cause a nuisance, hazard or damage.

Under s. 12 no person is permitted to alter the surface elevations or surface grades of any land such that it may cause or have potential to cause a nuisance, hazard or damage, or it may adversely affect the stability of a slope or top of bank.

Offences under the bylaw carry a maximum fine of \$10,000 and up to six months imprisonment for non-payment of the fine (s. 20).

2.4.4 North Saskatchewan River Valley Area Redevelopment Plan Bylaw No. 7188⁷

The North Saskatchewan River Valley Area Redevelopment Plan (ARP), adopted in 1985, defines a boundary for the river valley and ravine system, and a set of policies and development approval procedures for lands within this boundary. Most development activities proposed for lands within the ARP boundaries are subject to an environmental review process. Environmental reviews are undertaken by the proponent, reviewed through a technical circulation (including Drainage Services), and approved by the Planning and Development Department and/or City Council. There are three levels of environmental review: Initial Project Review, Environmental Screening, and Environmental Impact Assessment (EIA). An EIA report will describe the natural features, topography, special historic, archaeological and other aspects of the proposed development, to evaluate what impacts will result from the development and to define methods and action plans to minimize or mitigate the impacts. Erosion and sedimentation are among the types of potential impacts that may be addressed by an EIA. The level of detail of assessments at each planning stage is defined with respect to site-specific needs and concerns and detailed assessments may not be necessary for some areas. An EIA, if required, should be undertaken as early in the project planning stages as possible.

2.4.5 Standards, Guidelines and Policies

The City of Edmonton, Drainage Services has published several standards and guidelines related to stormwater management, conservation, and environmental protection.

⁷ This bylaw is not available online. A hard copy can be obtained by contacting the City of Edmonton, Office of the City Clerk.

2.4.5.1 Design and Construction Standards, Volume 3, Drainage

The *Design and Construction Standards, Volume 3, Drainage* (2003) include requirements related to all aspects of design and construction of drainage infrastructure/facilities including, but not limited to, planning and design studies, the storm drainage system, stormwater management facility design, lot grading and surface drainage design, detailed engineering drawings, as-built drawings, and project acceptance. Specific standards related to ESC are discussed in detail in **Chapter 4.0 – Drainage Services ESC Framework**. A copy of the Design and Construction Standards is available online at: <http://www.edmonton.ca/portal/server.pt> (click on “Agreements, Permits and Licences”, and “News, Reports and Publications”).

2.4.5.2 Guidelines for Stormwater Management Requirements for Individual Lot Developments

These guidelines, published in July 1987, require the control of allowable peak discharge rates for stormwater flows from developing or re-developing properties into the sewer system for most areas of the City. Stormwater runoff control is required only for lots greater than 0.16 ha (0.4 acres). Where peak stormwater runoff control is required, storm flows are to be restricted to 0.035 m³/s/ha, or 35 L/s/ha. Areas to which the requirement applies are shown in Exhibit 1 to the guidelines.

The guidelines include stormwater runoff control requirements for development in re-zoned higher density areas, when building an addition, and when servicing properties in the combined sewer areas of the City. The guidelines provide storage value determination calculations, outlet rate control requirements, and submission requirements for Drainage Services’ review and approval.

2.4.5.3 Conservation of Natural Sites in Edmonton’s Table Lands – City Policy C-467

This policy, approved by City Council in July 1995, encourages the voluntary conservation of natural sites (environmentally sensitive and significant natural areas) identified on Edmonton’s table lands⁸. The natural sites were identified in the Inventory of Environmentally Sensitive and Significant Natural Areas, City of Edmonton (1993) due to their ecological sensitivity or significance to Edmonton. The sites range from 2 to 50 hectares and contain features such as old growth forest, young woodlots, native prairie, rare plants and birds, sand dunes, and lakes.

The policy requires development proponents to provide information for “development proposals and strategies on Edmonton’s table lands, and any new development proposals and strategies or any major amendments to approved development proposals and strategies on substantially undeveloped lands within the City of Edmonton.” The policy requirements have been integrated into Area Structure Plans, Neighbourhood Area Structure Plans, Neighbourhood Structure Plans, and Servicing Concept Design Briefs.

The City has developed two guideline documents to assist development proponents in preparing natural site assessments/natural area management plans as required by the policy:

- Conservation of Natural Sites in Edmonton’s Table Lands, Draft Natural Site Assessment Guidelines – describes three stage process for natural site assessments – Stage 1: Preliminary Natural Site Assessment; Stage 2: Detailed Natural Site Assessment; Stage 3: Economic Assessment
- Guidebook for Preparing Natural Area Management Plans for Edmonton’s Environmentally Sensitive Area and Significant Natural Areas: A Working Draft Document (March 2003) – provides standardized template for developing management plans.

Natural area management plans identify environmental characteristics of a site, many of which may be relevant in determining potential erosion and sedimentation impacts, including wildlife, vegetation, bird and fish habitat, surface water quality and topography and soil.

2.4.5.4 City of Edmonton Release Reporting Guidelines

The City of Edmonton has developed its own *General Release Reporting Guidelines* (October 2003). The guidelines assist City employees in reporting environmental releases/spills. It applies in situations where a City employee is aware or made aware of a release, whether or not the release was caused by City of Edmonton employees, or was related to City of Edmonton operations. The guidelines provide guidance on what is a release/spill, procedures for reporting it, and forms that must be completed in the event of a release/spill.

2.5 SUMMARY TABLES

Table 2.1 below provides a general summary of the main legislative requirements related to erosion and sedimentation (Note: It does not include all of the requirements discussed in the text of this chapter).

⁸ Defined in s. 1.19 of policy document C-467 as “those suburban and agricultural lands, outside of the North Saskatchewan River Valley, which were annexed to the City of Edmonton in 1982.” Attachment A to the policy provides a map indicating this area.

Table 2.1: Summary of Primary Legislative Requirements

Legislation	Provision	Description
Federal		
Fisheries Act	s. 2	Definition of “fish”.
	s. 32	Prohibits destroying fish by any means other than fishing unless authorized by Minister or regulations.
	s. 35(1)	Prohibits carrying on any work or undertaking that results in HADD of fish habitat without an authorization.
	s. 36(3)	Prohibits deposit or permitting the deposit of a deleterious substance.
	s. 38(4)	Duty to report the deposit of a deleterious substance.
	s. 38(5)	Duty to take mitigative/remedial measures.
Navigable Waters Protection Act	s. 38(6)	Powers of DFO inspector.
	s. 21	Prohibits throwing or depositing any sawdust, edgings, slabs, bark or like rubbish into a navigable water if it is liable to interfere with navigation.
	s. 22	Prohibits throwing or depositing any stone, gravel, earth, cinders, ashes or other material or rubbish that is liable to sink to the bottom of a navigable water.
Migratory Birds Convention Act	Schedule 1	Lists migratory birds subject to Act.
Migratory Birds Regulations	s. 35	Prohibit deposit or permitting deposit of oil, oil wastes or any other substances harmful to migratory birds in any waters or any area frequented by migratory birds.
Canadian Environmental Protection Act, 1999	Schedule 1	Lists particulate matter less than or equal to 10 microns as a toxic substance.
Provincial	s. 64	Definition of “toxic substance”.
	ss. 95-99	Duty to report release of a toxic substance into environment.
	ss. 108 & 109	Prohibits knowingly releasing or permitting release, or releasing or permitting release of substance into the environment in amount, concentration or rate in excess of an approval or registration or that causes or may cause a significant adverse effect.
	s. 110(1)	Duty on person who releases or causes or permits the release to report release that has caused, is causing or may cause an adverse effect.
	s. 110(3)	Duty on police officers and employees of local authorities to report releases.
	s. 112	Duty to take measures to repair, remedy, confine, remove, dispose of substance and restore environment where release of substance may cause, is causing or has caused an adverse effect.
	s. 7	Prohibits use or disposal of substance into wastewater or storm drainage system that impairs the integrity of the system, operation of a treatment facility or plant, or quality of storm drainage or treated wastewater, gases and sludge.
	s. 36(1)	Approval required for activities listed in section.
	s. 49(1)	Licence required to divert water or to operate a works.

Legislation	Provision	Description
Public Lands Act	s. 54	Prohibits accumulation of waste material, debris, refuse or garbage on public land; injuriously affecting watershed capacity; injury to bed or shore of any river, stream, watercourse, lake or other water body or land; and soil erosion on public land.
Soil Conservation Act	s. 3	Requires landowner to take measures to prevent soil loss or deterioration from taking place, and/or to stop loss or deterioration from continuing.
Municipal		
Sewers Use Bylaw No. 9675	ss. 10(1) & (2)	Prohibits release or permitting release of any matter or hazardous waste into storm sewer, stormwater management facility or watercourse.
	s. 12	Prohibits release of stormwater runoff from private property to N. Sask. River, canal, ditch, reservoir or man-made surface water feature that drains into N. Sask. River from upstream city limits to 125 m. downstream of E.L. Smith Water Treatment Plant water supply intake.
	s. 13	Duty to report release of any matter prohibited under s. 10 and take measures to confine, remedy, repair, confine and/or dispose effects of release.
Sewers Bylaw No. 9425	s. 4(2)	Must enter into servicing agreement with City before commencing construction of sewer or sewer service.
	s. 4(3)	Approval required before person can uncover, enter, make any connections with or opening into, use, alter, disturb or conduct work (except remove blockages) in public sewer.
Surface Drainage Bylaw No. 11501	s. 11	Prohibits discharge of roof drainage or pumped subsurface drainage from building to location where soil erosion would occur.
	s. 12	Prohibits altering the surface elevations or surface grades of any land such that it may cause or have potential to cause a nuisance, hazard or damage, or it may adversely affect the stability of a slope or top of bank.
North Saskatchewan River Valley Area Redevelopment Plan Bylaw No. 7188		Requires environmental review for development activities proposed for lands within Area Redevelopment Plan boundaries (river valley and ravine system).

2.6 DUE DILIGENCE

As set out above, penalties for contravention under legislation can include large fines and prison sentences. Other consequences can include stop work orders, delays in projects, costs of remediation, damage to reputation, as well as contractual penalties and the cost of repairs of erosion on the site. Even though an activity may not be adjacent to a river or lake, sediment transported from a construction site can become a release and lead to prosecution of the owner, developer, contractor, consultant and/or the City. ***The cost of remediation of an area damaged by a release is always more expensive than the cost of preventing the release.***

Due diligence has been recognized as a defence for many environmental, or “strict liability”, offences. Exercising due diligence can prevent the occurrence of an offence altogether. Where an incident does occur and is investigated, the exercise of due diligence may avoid the laying of charges, and where charges are laid it may result in an acquittal or if convicted, may reduce the sentence.

The defence of due diligence was first recognized through the common law, established by the landmark decision of the Supreme Court of Canada in *R. v. Sault Ste. Marie*⁹. As the concept of a due diligence defence developed over the years through case law, federal and provincial legislators began codifying the defence. Today, there are many examples in environmental legislation where the defence of due diligence is expressly provided¹⁰.

Due diligence is established by proving on a balance of probabilities that one took all reasonable steps to prevent the commission of the offence, or reasonably and honestly believed in the existence of facts that, if true, would render their conduct innocent. Although due diligence can be used as a defence, it is not a guarantee of an acquittal and the onus is on the accused to prove their case.

What constitutes due diligence is case specific and the standard of care required to establish the defence depends on the facts of each case and the particular industry or activity involved. Typically the accused must show that it has a proper system to prevent incidents and has taken reasonable steps to ensure the effective operation of the system.

While it is difficult to provide a successful defence for blatant offenses, good records such as diaries, inspection and maintenance logs, minutes and photos can help in documenting a defense of “due diligence” when every reasonable care has been taken to prevent a release and an inadvertent release occurs. Records showing that a proper ESC plan was implemented, properly monitored and maintained can become invaluable under such circumstances. ***Chapter 5.0 – Erosion and Sedimentation Control Plan*** and ***Chapter 6.0 – Monitoring, Maintenance and Record Keeping*** of these Guidelines provide more details on the ESC Plan, record keeping and monitoring.

⁹ [1978] 85 D.L.R. (3d) 161.

¹⁰ See for example s. 229 of *EPEA* and s. 78.6 of the *Fisheries Act*.

The erosion and sedimentation process involves three basic stages: detachment, transport and deposition. Once a particle becomes detached it becomes sediment, and the transportation system controls where it will be deposited. ESC attempts to (i) prevent the particle from being detached, (ii) control the transport, and (iii) promote its deposition in locations on the construction site that will not harm the environment.

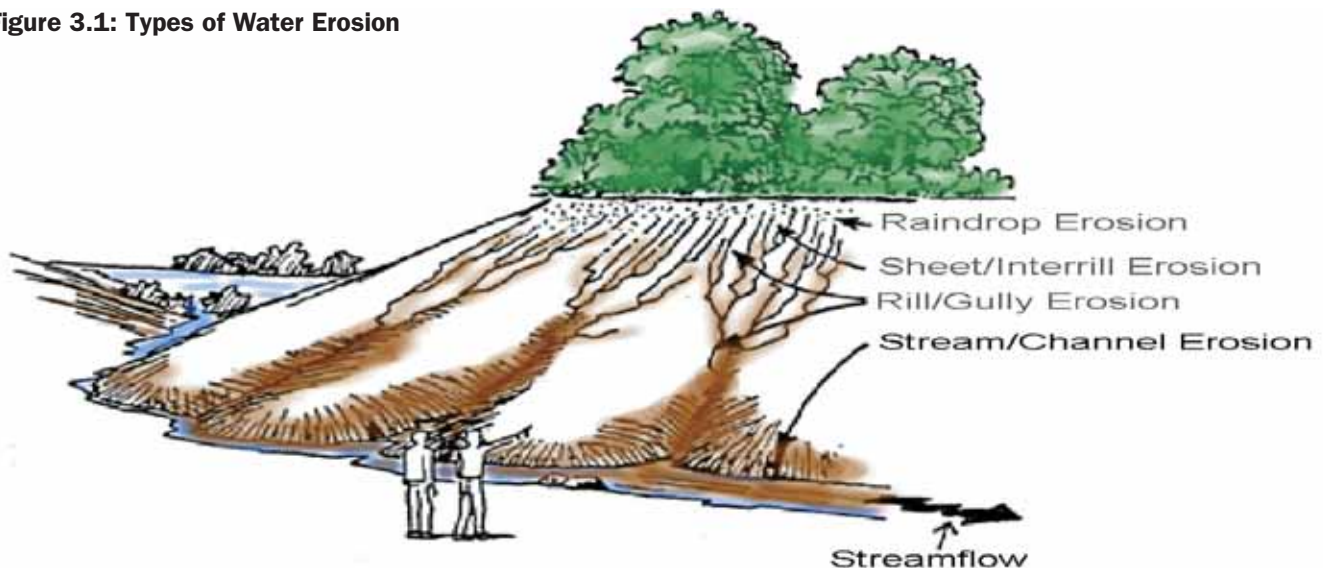
3.1 EROSION

There are several types of water erosion. Figure 3.1 shows the four types of water erosion described below:

- **Raindrop** – The direct impact of falling drops of rain on soil, causing the dislodging of soil particles so they can be easily transported by surface runoff.
- **Sheet/Interill** – Caused by the removal of a layer of exposed surface soil by the action of raindrop splash and runoff as water moves in broad sheets over the land.
- **Rill/Gully** – Grooves or rills cut into the soil surface as runoff flows and concentrates in rivulets. If water flow is great enough, rills will develop into larger gullies.
- **Stream/Channel** – Stream meander instability, scouring, and erosion of stream or channel banks and bottom caused by increased volume of runoff in an unprotected, confined channel.

Factors that influence erosion include the soil characteristics, soil cover (vegetation), topography and climate.

Figure 3.1: Types of Water Erosion



3.1.1 Soil Characteristics

Soil characteristics that are most likely to impact soil erodibility are particle size distribution and texture, permeability and organic matter content. Erodibility generally decreases as the plasticity (clay content) of the soil increases. Well-graded gravel and predominantly gravel mixtures with trace amounts of silt are the least erodible. In general, soil erodibility rating is as follows:¹

- **LOW:** heavy clay, clay, sandy clay, loamy sand, sand and topsoil
- **MEDIUM:** silty clay, silty clay loam, clay loam, sandy clay loam, and sandy loam
- **HIGH:** silty loam, loam, and silt

A soil's permeability is an indication of a soil's ability to absorb rainfall or surface runoff. A general relationship between soil permeability and precipitation runoff indicates that for the same amount of precipitation, runoff would be the highest on a clay soil, followed by a loamy clay, then a sand loam, with the least runoff on a sand and gravel soil.

Topsoil is generally less erodible because of higher levels of organic matter content, improving on permeability, soil moisture holding capacity, and improved soil structure and aggregate stability.

¹ Alberta Transportation, *Design Guidelines for Erosion and Sediment Control for Highways* (March 2003), Figure 4.2

3.1.2 Vegetative Cover

Vegetation is very effective as an erosion control measure due to its ability to:

- Shield the ground from direct rainfall impact
- Improve the soil permeability
- Reduce the runoff velocity
- Hold soil particles in place with its root structure

3.1.3 Topography

The length and gradient of a slope are key factors in terms of the amount of erosion that will occur. In addition, the slope shape (e.g., concave vs. convex) and aspect (e.g., north-facing vs. south-facing) affect the amount of erosion.

The gradient of a slope is a key factor in terms of increased potential for erosion. In general, doubling the slope gradient doubles the erosive factor. Slope length increases the potential for erosion because it increases the ability for concentrated flow channels to develop. Longer slopes collect more water, as such, the depth of sheet flow increases with a corresponding increase in tractive forces to erode the soil.

Concentrated runoff as opposed to sheet flow has a greater ability to scour and transport sediment and begin the formation of rills and gullies. Slope length is related to other topographic considerations such as basin shape. Even at the field scale, a small well-defined contributing area for surface runoff will lead to the rapid development of concentrated flow channels during a runoff event. The formation of concentrated flow channels during a runoff event will increase the erosion and sediment export in those areas.

3.1.4 Climate

Rainfall event duration and intensity impacts the potential for soil erosion. Section 13 of Volume 3 of the City's *Design and Construction Standards* provides storm design rainfall and runoff numbers for Edmonton. Rainfall events are also seasonal in that the potential for severe storms ("erosive rainfall") is highest in July, with June and August being slightly lower, and September being significantly lower.

Additional information on these factors and how to evaluate the potential for erosion can be found in texts on erosion and sedimentation control and in documents such as the Alberta Transportation *Design Guidelines for Erosion and Sediment Control for Highways* (March 2003), as amended.

Wind erosion can also create problems such as loss of material from stockpiles, dust problems on adjacent roads or developed areas and water quality problems

when the dust settles on water bodies. Many of the same principles and methods used to control water erosion can also be applied to wind erosion.

3.1.5 Erosion Modeling

RUSLE

The Revised Universal Soil-Loss Equation (RUSLE) was adapted from the Universal Soil Loss Equation (USLE) for agricultural lands and estimates long-term average annual rates of soil loss from construction sites. The RUSLE computes the average annual soil loss as follows:

$$A = R \times K \times L \times S \times C \times P$$

where:

A = annual soil loss (tonnes/ha/year)

R = rainfall factor (MJ/mm/ha/hr/yr)

K = soil erodibility factor (tonne hour/ MJ/mm)

L x S = slope length and steepness factors, respectively (dimensionless)

C = vegetation and management factor (dimensionless)

P = support practice factor (dimensionless)

Section 6.4 of Alberta Transportation's *Design Guidelines for Erosion and Sediment Control for Highways* (March 2003), as amended, provides a detailed description of how to determine the value of each of the factors.

RUSLE has a number of limitations in terms of predicting erosion from construction sites during storm events:

- Does not account for soil losses due to gully, wind or tillage erosion
- Provides long-term average soil loss rates, rather than precipitation event (storm event) estimates, the latter being when most erosion occurs at a construction site
- There are slope length and gradient limitations
- Does not provide watershed-scale sediment yields, and average watershed values are not appropriate for RUSLE factors
- May not be verified for the geographic area of concern

WEPP

Newer process-based field scale water erosion modeling has been developed by the United States Department of Agriculture (USDA), through the Water Erosion Prediction Project (WEPP). The WEPP model

is a continuous model that predicts event-based erosion as a result of rainfall and snowmelt. More information about WEPP can be found at <http://soils.ecn.purdue.edu/~wephtml/wepptut/jhtml/intro.html>.

Alberta Agriculture Food and Rural Development (AAFRD) has done extensive work with the WEPP model modifying the model's erodibility parameters (k_r , k_i and τ_c) for Alberta conditions by field testing representative soils throughout the province. AAFRD also conducted extensive evaluation of the model under Alberta climatic conditions using data from field scale runoff catchments.

The WEPP model is favourable in several respects, including:

- Has been adapted for Alberta soils
- Can model precipitation events (storm events)
- Can model Alberta slope length and gradient conditions
- Can produce catchment-scale sediment yields

3.2 TRANSPORT

Stormwater or wind carries the sediment from the location it was dislodged to where it is deposited. By controlling the transport one can direct the flow to the ESC measure to trap and deposit the sediment on site. By controlling the velocity and conditions of the stormwater, one can also reduce any additional erosion along the flow channel.



3. Sediment has been transported and deposited

3.3 SEDIMENTATION

Sedimentation is the deposition of soil particles transported and previously held in suspension by flowing water. Sedimentation occurs when the flow decreases to the point where particles can no longer be transported and settle out depending on their weight. Large particles, such as gravel and coarse sand, will settle out first, followed by fine sand, silt and clay fragments/particles.

There are a number of Best Management Practices (BMPs) designed to minimize sedimentation. Proper location, installation and maintenance of these facilities can remove a significant portion of the sediment from stormwater. In some cases flocculants or filtration aids can be added to assist in removing fine sediments. However, misapplication of flocculants or accidental spills can kill fish, and the potential risks of using flocculants must be considered.



4. Sedimentation of soil particles

3.4 EROSION POTENTIAL AND RISK ASSESSMENT

Two important steps involved in determining what ESC measures should be implemented on a site is to calculate the erosion potential of a site, and assess the risks of impacts to downstream receivers. These calculations will typically be done as part of the preparation of an ESC Plan. The requirements of the ESC Plan are discussed in greater detail in **Chapter 5.0 – Erosion and Sedimentation Control Plan**. The sections below discuss how to calculate erosion potential and undertake a risk assessment.

3.4.1 Erosion Potential

The erosion potential of a site is based on a number of factors, including:

- Slope gradient
- Slope length
- Soil erodibility

Soil gradients are measured perpendicular to the contours and computed as a percentage (vertical distance divided by the horizontal distance). For example, a 1:1(H:V) slope is a 100% slope. Based on the magnitudes, the slope gradient of a site can be classified as gentle, moderate or steep as per Table 3.1:

Table 3.1: Slope Gradient Calculation³

Slope (%)	Description
0 to 10	Gentle
10 to 15	Moderate
Over 15	Steep

The slope length is the distance from the crest to the toe, and can be grouped into two categories as shown in Table 3.2:

Table 3.2: Slope Length Calculation⁴

Length	Description
Under 70 m	Moderate
Over 70 m	Long

An assessment of erosion potential from sheet erosion can be determined based on the soil erodibility, the slope and length of the site. **The longer and steeper the slope, the greater the erosion potential.** It is noted that in storm events, concentrated flow channels can form on gentle slopes of less than 10% inclination. The slope gradient categories in Table 3.3 can be used as a guide for evaluating erosion potential:

Table 3.3: Erosion Potential Calculation¹

Topographic Classes		Soil Erodibility ²			EROSION POTENTIAL
Gradient	Length	Low	Medium	High	
Gentle	Moderate	Low	Low	Moderate	
	Long	Low	Moderate	High	
Moderate	Moderate	Low	Moderate	High	
	Long	Moderate	High	High	
Steep	Moderate	Moderate	High	High	
	Long	Moderate	High	High	

³ City of Calgary, *Guidelines for Erosion and Sediment Control*, February 2001, Section 4.4

⁴ See section 3.1.1 for soil erodibility rating

3.4.2 Risk Assessment

Once the erosion potential has been calculated, another factor is to determine the risk of impacts on downstream receivers ('receivers' can include water bodies or other environmentally sensitive areas, private property, etc.). The onus is on the owner/developer to identify downstream concerns. For example, is there existing storm infrastructure in the area and, if so, does it drain to a storm pond or directly to a storm outfall at a watercourse? Is there property downstream that could be impacted versus overland drainage to an undeveloped, vegetated area?

If the erosion potential is calculated as being low, and the risk of impact on downstream receivers is assessed as being negligible, good housekeeping measures on site will likely address the ESC requirements. As the erosion potential and risk increases, ESC measures need to be more carefully designed, constructed and monitored.

Calculating the erosion potential and undertaking a risk assessment provides important information and becomes part of the overall site assessment included in the ESC Plan. Table 3.4 can be used as a guide to determine the ESC requirements for a construction site.

Table 3.4: ESC Requirements & Downstream Receivers⁵

Erosion Potential	Impacts on Downstream Receivers	Minimum Degree of ESC Required
Low	Negligible	Good housekeeping measures required
	Yes	ESC measures required
Moderate to High	Negligible	ESC measures required
	Yes	More extensive ESC measures required

⁵ City of Calgary, Guidelines for Erosion and Sediment Control, February 2001, Section 4.6

4.1 INTRODUCTION

The Drainage Services ESC Framework is to ensure that land is being developed in an environmentally sound manner, and that owners and developers (whether they are public or private), and their consultants and contractors are addressing erosion and sedimentation and other environmental issues, beginning at the earliest possible stages of the development, and continuing throughout the construction and post-construction phases.

One of the ways this is achieved is through timely and effective planning and implementation of ESC measures. The City of Edmonton *Design and Construction Standards, Volume 3, Drainage* (2003) (*Design and Construction Standards*) provides for a detailed sewer and drainage planning, design and construction process, and includes requirements for owners/developers to address and plan for erosion and sedimentation control prior to the commencement of any land disturbance.

This chapter describes the Drainage Services ESC Framework with reference to the specific requirements set out in the City's *Design and Construction Standards*. Figure 4.1 provides a schematic of the ESC Framework, summarizing the various development stages and identifying when, and to what level, ESC issues must be addressed. The following sections of this chapter describe the framework in greater detail.

4.2 PLANNING AND DESIGN

There are various sewer and drainage design studies, plans and reports that are required throughout the planning process. Specific sewer and drainage servicing concerns are addressed at an increasing level of detail as the planning and development process proceeds and more detailed site-specific information becomes available. ESC issues must be addressed at various stages of the planning process.

4.2.1 Regional Master Plan

The Regional Master Plan is the overall drainage plan for the Edmonton area that defines the short, medium and long-term storm and sanitary sewer strategy. It is prepared and periodically updated by Drainage Services, and is a prerequisite to the General Municipal Plan for the City prepared under the MGA and approved by Council. The plan includes conceptual strategies for siting, sizing, preliminary layouts and designs of the storm and sanitary sewers.

Stormwater drainage planning at this level is formulated on the watershed concept and identifies conditions of drainage normally prevailing for runoff

events including rainfall and snow melt runoff. The Regional Master Plan addresses the environmental impact of stormwater and treated sewage effluents, to ensure the need for pollution abatement and protection of receiving waters. Appropriate control strategies are recommended.

4.2.2 Watershed Plan

Watershed Plans are required for any drainage basin either totally or only partly within the City boundary, including both areas proposed for development and those expected to remain undeveloped. They provide the conceptual framework for evolving the Area Master Plans formulated in conjunction with Area Structure Plans. Drainage Services will normally prepare the Watershed Plans.

The plan identifies the existing drainage and environmental constraints and defines options for management and development of alternatives. The analysis includes the use of stormwater management facilities for urban conditions as well as servicing concepts to be implemented during the transition stage from rural and undeveloped to fully developed conditions, as this process may take place over a long period of time.

The finished plan and staging recommendations are incorporated in a preliminary engineering report for approval and implementation by Drainage Services. At later design stages, drainage services for individual developments must be considered in the frame of the Watershed Plan.

4.2.3 Preliminary Drainage Report

For those areas where a Watershed Plan is not available, a private developer may prepare a Preliminary Drainage Report (PDR) to address storm drainage planning requirements as necessary to establish the framework and terms of reference for an Area Master Plan Study and preliminary environmental and hydrogeotechnical impact assessments. The PDR reviews existing data, identifies potential problems related to future drainage servicing and potential conflicts with other infrastructure plans, and proposes a conceptual plan for the orderly servicing of new developments. Drainage Services must approve the PDR terms of reference before an Area Master Plan is undertaken.

4.2.4 Area Master Plan

The Area Master Plan (AMP) proposes the optimum sewer and drainage service schemes that will meet the short and long-term servicing needs of the development area. In most cases, Drainage Services prepares the AMP when deemed necessary by

Drainage Services to accommodate area planning needs. In some cases, the owner/developer is responsible for having the AMP undertaken by a qualified engineering consultant. Drainage Services must approve the AMP terms of reference before the work is started.

The AMP must identify in general terms the drainage basin, proposed trunk storm sewers, the principal drainage patterns, and the approximate location of the major permanent structures. Depending on the particular development area circumstances, additional site-specific requirements may apply. These are determined on a case-by-case basis and can include an EIA (if discharging to natural watercourses or environmental reserve lands), and soils and groundwater investigation.

Erosion and Sedimentation Control

The AMP should address/identify the following ESC related information:

- The overall watershed and development in relation to it
- Details of watercourses and valley reaches, and typical cross-sections
- Description of natural storage and drainage, including bodies of water (wetlands) that may be subject to provincial ownership or jurisdiction, and which may or may not be impacted by a proposed development
- Identification of pre-development flows
- Topography
- Identification and proposed use of natural features
- Identification of areas on or adjacent to the site that are or may be susceptible to erosion
- Identification of off-site areas (e.g., downstream sites) that may be adversely affected by erosion and sedimentation coming from the site (e.g., water treatment plant intakes, sensitive fish habitat, undisturbed natural areas, particular wetlands, locations of historical or environmental significance, etc.)
- Where possible, identification of permanent ESC measures/BMPs

4.2.5 Neighbourhood Design Report

The Neighbourhood Design Report (NDR) defines the basis of detailed design of the principal components of the sanitary sewer and storm drainage infrastructure. A major objective of the NDR is to develop a staged implementation for the facilities. The NDR must identify all constraints to implementation of the facilities, including financial, design, hydrogeotechnical and construction approvals. The NDR must be prepared by the owner/developer, usually through its engineering consultant, for approval by Drainage Services.

Erosion and Sedimentation Control

The NDR must include a section outlining the **ESC Strategy** for the site. The ESC Strategy builds on the ESC information provided in the AMP and should include identification of:

- Preliminary and anticipated final contours
- The major components of the storm drainage system
- Potential off-site and/or downstream impacts
- An evaluation of areas susceptible to erosion
- All critical areas that require erosion protection and proposed measures for erosion control
- Details of proposed sedimentation control facilities
- Anticipated sediment loadings and sediment removal schedule
- Location, purpose and capacity of permanent BMPs and a conceptual plan for temporary BMPs
- Approximate limits of clearing and grading, buffer strips, vegetation to be retained, etc.
- **Timing/sequencing of stripping and grading activities (see discussion below)**
- Any unique challenges or approaches anticipated

Just-In-Time Stripping and Grading

Regarding stripping and grading, it is common practice for owners/developers to strip and grade land in some cases long before the primary construction activities commence on the site. Stripping and grading and other activities that remove vegetation greatly increase the potential for erosion and sedimentation, resulting in increased cost and environmental damage. Owners/developers should consider timing their stripping and grading activities to allow vegetation to remain in place for as long as possible prior to construction. Further discussion on stripping

and grading is included in Section 4.4 of this chapter and in **Chapter 5.0 – Erosion and Sedimentation Control Plan** and **Chapter 7.0 – Erosion and Sedimentation Control Measures**.

4.2.6 Detailed Engineering Drawings

Following the preparation of the NDR, and after obtaining Subdivision Approval for the development area, the next step in the process involves the preparation and submission of Detailed Engineering Drawings by the owner/developer (through its consultant). Section 20.0 of the *Design and Construction Standards* sets out the Engineering Drawings specifications.

At this stage, the owner/developer (or his/her delegate) is required to prepare and submit a detailed **ESC Plan**. An ESC Plan defines the temporary and permanent measures to be implemented throughout the construction and post-construction periods to mitigate any potential erosion and sedimentation problems both within the development and in downstream developments or areas.

The ESC Plan is to be submitted with the Detailed Engineering Drawings. **Note that Drainage Services' review of the ESC Plan serves as record of receipt, not approval of the Plan.**

The Plan is required to show both the temporary and permanent ESC measures/Best Management Practices (BMPs) for the development. Any revisions to the permanent BMPs must be approved as outlined in the *Design and Construction Standards*. Modifications to the temporary BMPs on the ESC Plan do not require the prior approval of Drainage Services, as the ESC Plan must be flexible to meet changing conditions and emergency situations. However, Drainage Services should be informed of the change(s) in a timely manner. Also, the flexibility to modify the ESC Plan should not be taken as entitlement to eliminate or fail to implement a satisfactory ESC Plan. **Chapter 5.0 – Erosion and Sedimentation Control Plan** sets out in detail the requirements for the ESC Plan.

4.3 SERVICING AGREEMENT

The Servicing Agreement between the City of Edmonton and the owner/developer sets out all the requirements related to the construction and installation of municipal improvements (e.g., storm and sanitary sewers, paved roads, sidewalks, curb and gutter, landscaping), including provisions related to Construction Completion Certificates and Final Acceptance Certificates. Construction must be carried out in accordance with the Agreement. The Agreement requires that the construction, installation and maintenance of municipal improvements must be done in accordance with the Engineering Drawings and Design and Construction Standards. Any site-specific ESC requirements stipulated by Drainage Services will be addressed in the Servicing Agreement.



5. Topsoil and vegetation removed in the previous year. Erosion and sedimentation occurred the following spring.

4.4 PRE-CONSTRUCTION – STRIPPING AND GRADING

Pre-construction stripping and grading activities are often the most significant activities in a construction project that contribute to erosion and sedimentation. In some cases, owners/developers are undertaking stripping and grading activities one to two years or longer before construction of municipal improvements has commenced. The City of Edmonton currently does not require owners/developers to apply for a permit prior to undertaking stripping and grading of a site. However, owners/developers are strongly encouraged to plan for and time their stripping and grading operations such that the potential for erosion and sedimentation is minimized. Once stripping and grading of a site has begun, ESC measures should be implemented (e.g., temporary seeding or mulches)³. The City may consider making stripping and grading a permitted activity in the future. See **Chapter 7.0 – Erosion and Sedimentation Control Measures** for a discussion of just-in-time stripping and grading BMPs.

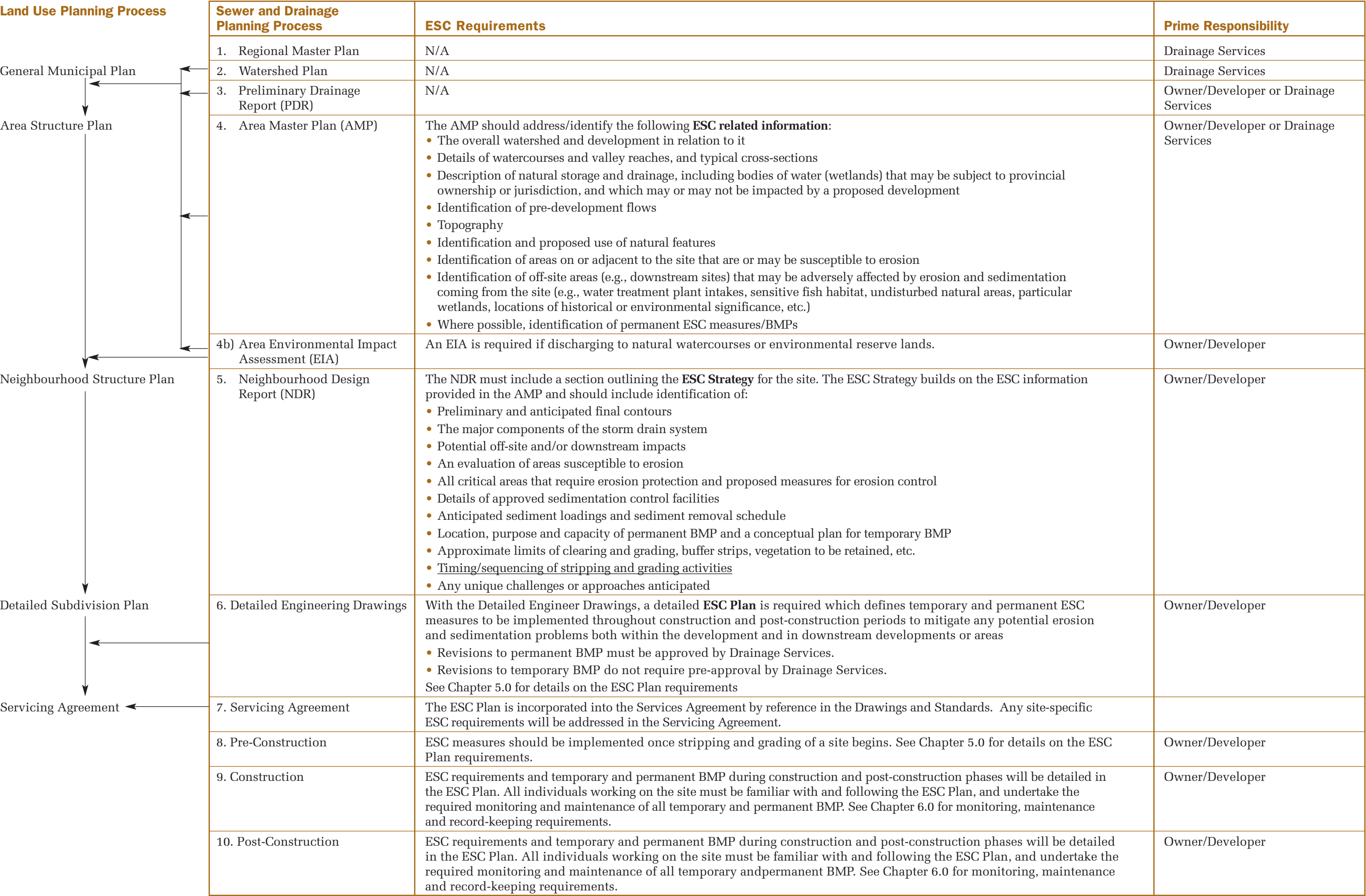
4.5 CONSTRUCTION AND POST-CONSTRUCTION

ESC requirements and temporary and permanent BMPs during the construction and post-construction phases will be detailed in the ESC Plan. The owner/developer, or his/her delegate, is responsible for ensuring that all individuals working on the site are familiar with and are following the ESC Plan, and undertaking the required monitoring and maintenance of all temporary and permanent BMPs at the site. **Chapter 6.0 – Monitoring, Maintenance and Record Keeping** sets out requirements and responsibilities for monitoring and maintenance of temporary and permanent BMPs from start of construction through post-construction.

As stated in Chapter 1.0, all projects and developments, regardless of requirements for approval or sign-off by Drainage Services, should at a minimum implement good housekeeping measures to manage erosion and sedimentation issues on-site. **Chapter 7.0 – Erosion and Sedimentation Control Measures** provides a discussion of good housekeeping practices.

³ Note that stripping and grading activities that result in the conversion or loss of wetlands can lead to enforcement action by provincial or federal regulators under legislation such as the provincial *Public Lands Act* and *Water Act*, and federal *Fisheries Act*. Authorizations or approvals may be required from provincial or federal regulatory agencies prior to disturbing wetlands or other areas protected under environmental legislation. Additional information on these and other requirements can be found in **Chapter 2.0 – Regulatory Requirements**.

Figure 4.1 Erosion and Sedimentation Control Framework



5.1 INTRODUCTION

In an urban environment, the objective of erosion and sedimentation control is to protect the environment, and in particular water bodies, from sediment and other pollutants. Effective erosion and sedimentation control can be achieved by careful attention to the following principles:

- Protect the land surface from erosion
- Manage runoff and keep velocities low
- Capture sediment on-site
- Integrate erosion and sedimentation control with the construction activities
- Inspect and maintain the erosion and sedimentation control measures/practices

ESC is most effectively addressed by controlling it at the source. **Erosion prevention is the most effective way to keep sediment out of a water body.** Proper planning can help reduce or prevent the problem and minimize the true cost of construction.

The ESC Plan is the document that describes who and what will control erosion, and when, where and how this will be done. The plan is the common link of communication between the owner/developer or his/her delegate (i.e. consultant), the contractor, and Drainage Services personnel. A thorough understanding of the ESC Plan is essential for proper implementation.

5.2 OBJECTIVES OF THE ESC PLAN

The ESC Plan needs to:

1. Minimize erosion and manage sediments based on site specific ESC measures
2. Adapt to varying field conditions
3. Clearly show the location and type of ESC measures/devices
4. Protect critical/environmentally sensitive areas

An ESC Plan needs to be well integrated with other environmental protection measures in order to be effective. The measures must address and integrate both temporary and permanent conditions.

5.3 PREPARING THE ESC PLAN

The ESC Plan must be stamped by a qualified Professional Engineer, a Landscape Architect, or a Certified Professional in Erosion and Sediment Control (CPESC). Individuals with other professional designations or experience in ESC, such as biologists, can prepare or assist in preparing the ESC Plan, but the Plan must carry the stamp of one of the three professionals listed above.

Ideally, the individual preparing the Plan will have experience in the design and installation of BMPs/ESC measures, and will seek input from personnel who have experience in the implementation and maintenance of BMPs/ESC measures, where appropriate, in order that the measures are integral to the project and effective for the site.

Key steps to developing an ESC Plan and selecting ESC measures include:

1. Site Assessment:
 - The topographic and climatic conditions of the site.
 - The potential for soil erosion at the site. Elements that define the potential for soil erosion are described in **Chapter 3.0 – Erosion, Transport and Sedimentation**, and include: slope gradient, slope length, and soil erodibility.
2. Risk Assessment – Establish the risk of impacts to downstream receivers, i.e., a description of downstream water uses, and the potential impacts of the project on these uses.
3. Evaluation of ESC Measures – The types of ESC measures should be selected based on the site assessment, risk assessment, and the details of the proposed project.

5.4 COMPONENTS OF THE ESC PLAN

ESC Plans submitted to Drainage Services should consist of three parts: (1) Report, (2) Drawings, and (3) Calculations.

5.4.1 Report

The report is a brief description of the overall strategy for ESC. It should summarize the aspects of the project that are important for erosion and sedimentation control and should include:

- A brief description of the proposed land-disturbing activities, existing site conditions and adjacent areas (such as creeks and buildings) that might be affected by the land disturbance
- A description of critical areas on the site – areas that have potential for serious erosion problems such as severe grades, highly erodible soils, and areas near wetlands or water bodies
- A construction schedule that includes the date stripping and grading will begin and the expected date of stabilization
- A brief description of the measures that will be used to minimize erosion and control sedimentation on the site, when they will be installed, and where they will be located
- An inspection and maintenance program, including frequency of inspection, reseeding, repair and reconstruction of damaged structures, cleanout and disposal of trapped sediment, duration of maintenance program, and final disposition of the measures when site work is complete
- Shutdown plans where construction activities are delayed for an extended period of time. ESC shutdown plans need to address ongoing maintenance and inspection issues
- An emergency response plan that identifies available short-term resources in terms of personnel, equipment, and ESC measures, and steps to be taken for incident reporting to regulatory authorities where discharge of sediment exceeds regulatory requirements
- Name and signature of person preparing the plan and professional stamp/designation

Special issues that may need to be addressed include:

Sensitive Area Protection

- Show on-site and off-site drainage basins that flow through the area
- Delineate major features such as the North Saskatchewan River, the top of bank or crest of the river valley and ravines and show the buffer or setback distances and all proposed protection measures
- Delineate all lakes, wetlands, impoundments, intermittent or continuous streams and show proposed protection measures
- Indicate any slopes greater than 20% on preliminary and final contours and show proposed protection measures for each stage of grading

Inlet Protection

- Show the storm drain system complete with size and location of storm drains, inlets, pipes, basins, etc.
- Provide diversions, where applicable, to divert clear water around disturbed areas
- Indicate where the stormwater discharges and what measures exist or will be installed to prevent erosion and dissipate the flow energy
- Show the location and type of all inlet sedimentation control BMPs

5.4.2 Drawings

Site Plan

The Site Plan should show:

- Existing and final site contours at an interval and scale sufficient for distinguishing runoff patterns before and after disturbance
- Existing vegetation, such as grassy areas or vegetative buffers, that may reduce erosion or off-site sedimentation
- Limits of clearing and grading
- Critical areas within or near the project area, such as streams, lakes, wetlands, highly erodible soils, public streets, and residences
- Locations and types of ESC measures, with dimensions
- A legend, if necessary

Detailed Drawings

- Detailed drawings of ESC structures and measures, showing dimensions, materials and other important details

5.4.3 Calculations

Calculations/specifications that may be required include:

- Design criteria and calculations such as design particle size for sediment basins and peak discharge for channel design and outlets
- Calculations to demonstrate the design sediment removal efficiency from the runoff from the site as a percentage
- Seeding or vegetative specifications
- Inspection and maintenance notes

Sedimentation Control

- Provide sediment traps for areas less than 2 hectares complete with design calculations
- Provide sediment basins for areas of 2 hectares or greater complete with design calculations
- Show any other storm water management facilities complete with operating conditions
- Provide pipe end treatments and flow control devices to prevent channel erosion

Utility Lines and Water Crossings

- Provide sediment traps for dewatering activities
- Provide details for all water crossings

A checklist can assist in ensuring that all the necessary elements of a comprehensive ESC Plan have been addressed. **Appendix A** provides a checklist of the minimum requirements for an ESC Plan.

The ESC Plan must be a stand-alone document that can be located on the construction site for use by site personnel, inspectors and regulators. As site work progresses, the ESC Plan should be modified by the consultant and/or contractor, in consultation with Drainage Services staff, to reflect changing conditions.

As stated in Chapter 4.0, the ESC Plan must be submitted to Drainage Services for all projects that require Drainage Services' approval or sign-off. Typically it will be submitted with the Detailed Engineering Drawings. **It is not the responsibility of Drainage Services to ensure that the ESC Plan is appropriate for the level of work suggested by the proposed project.** Drainage Services will review the plan only to determine if it meets the minimum standards set out in these Guidelines. The review checklist for Drainage Services personnel attached in **Appendix B** has been included for this purpose. It is the owner's/developer's responsibility, through his/her consultant and contractor to ensure that the plan and proposed ESC measures are appropriate for the proposed project. Drainage Services will indicate that the ESC Plan has been received for record, but their review does not constitute approval of the Plan.

5.5 ELEMENTS OF AN EFFECTIVE ESC PLAN

Table 5.1 outlines ten elements of an effective ESC Plan, representing a comprehensive and integrated approach for achieving environmental protection during construction. These elements should be kept in mind when planning a project, and preparing and implementing an ESC Plan.

5.0 EROSION AND SEDIMENTATION CONTROL PLAN

Table 5.1: Ten Elements of an Effective ESC Plan¹

Ten Elements of an Effective ESC Plan

ELEMENT	COMMENT
1. Phase Construction to Limit Soil Exposure	Large areas of grading should be avoided since this maximizes erosion potential. Construction phasing, where only a portion of the site is disturbed at one time, minimizes sediment load potential.
2. Minimize Needless Stripping and Grading	Areas of a development that do not require stripping and grading should not be cleared and graded, or these activities should be restricted. These include stream buffers, forest conservation areas, wetlands, springs, highly erodible soils, steep slopes and environmental areas.
3. Stabilize Exposed Soils Immediately	To provide soil stabilization, it is important to establish cover over the denuded area within a short period of time of the soils being exposed. Cover such as grass, mulch, erosion control blankets, hydroseeding, and plastic sheeting can be used to achieve this.
4. Protect Waterways and Stabilize Drainage Ways	Streams and waterways are particularly susceptible to sedimentation. Clearing adjacent to a waterway should not be done, and a silt fence should be installed along the perimeter of the buffer. Existing drainage ways should be identified, as these will likely be the major routes that eroded sediments will take to reach streams, rivers and storm sewers. Drainage ways are also prone to erosion due to the high velocity of runoff.
5. Protect Steep Slopes and Cuts	Steep slopes are the most highly erodible surfaces within construction sites. Steep slopes are generally defined with slopes of 6H:1V to 3H:1V or greater. Where possible, clearing and grading of steep slopes should be avoided. Otherwise, special techniques, such as uphill flow diversion and silt fencing, should be used to prevent uphill runoff from flowing down the slopes.
6. Install Perimeter Controls	Perimeter controls should be implemented at the edge of the construction site to retain or filter runoff before it leaves the site.
7. Employ Advanced Sediment Settling Controls	Even when the best ESC measures are employed, high concentrations of sediments may be discharged during larger storm events. Therefore, the ESC Plan should include some sediment traps or basins to allow captured sediments to settle out. To improve the trapping efficiency, these basins must be designed to incorporate features such as larger volumes, use of baffles, skimmers and other outlet devices, and multi-cell construction. Regular inspection and maintenance are also critical to the operation of these practices.
8. Ensure Contractors are Trained in ESC Plan, and Implementation, Inspections, Maintenance and Repairs	The most important element in the implementation of an ESC Plan is the training and experience of the contractors, as they are usually responsible for installation and maintenance of the measures. In the end, everyone is responsible for erosion and sedimentation control. Therefore, training and education is important for everyone, from the developer down to the homebuilder. Everyone is working towards the same goal of protecting our waterways.
9. Adjust ESC Plan at Construction Site	For an ESC Plan to be effective, it may have to be modified due to discrepancies between planned and as-built grades, weather conditions, altered drainage and unforeseen requirements. Regular inspections are needed to ensure that ESC controls are working properly. Inspections should be conducted at least once per week, and after heavy rainstorms or snowmelt events.
10. Assess ESC Practices After Storms	After a rainstorm, it is usually clear whether an ESC Plan worked or not. If the storm was unusually large or intense, it is likely that many of the controls will require repair, clean out, or reinforcement. A quick response to assess and correct damages of the controls is required.

¹Source: The City of Calgary, Wastewater & Drainage Urban Development, *Guidelines for Erosion & Sediment Control* (February 2001).

5.6 OTHER ESC PLAN CONSIDERATIONS

5.6.1 Plan Content/Design

The designer of the ESC Plan relies primarily on available data such as contour plans, soils data, geotechnical borehole logs, aerial photographs and site visits. Construction activities on site often reveal localized conditions that were not anticipated in the design. Changes in the construction sequence or weather conditions will also impact the ESC Plan. In some cases, the ESC Plan may address the initial and final phases of construction but not address interim construction phases with adequate temporary BMPs. A successful ESC program must encourage site personnel to recognize and react to potential changes as required.

Site personnel should coordinate with the designer before making any changes to be sure they understand the designer's intent and constraints. Always check special provisions and permit documents for unusual project conditions. Remember that the ultimate goal is to protect the environment, and not simply to follow the ESC Plan.

5.6.2 Critical Resources

Critical resources can include water treatment plant intakes, sensitive fish habitat, undisturbed natural areas, particular wetlands, locations of historical or environmental significance, etc. Sometimes the critical area is not on or adjacent to the construction site but may be connected to it by a drainage course or a piped system and is therefore subject to potential impact.

5.6.3 Difficult Site Conditions

Space limitations, poor site access, extreme topography, steep slopes, silty soils, concentrated flows, conflicts between permits and specifications, construction deadlines, severe weather, and proximity to critical resources are some examples of difficult site conditions.

Whatever the cause, accept that difficult situations happen. Be prepared to act and respond quickly. Every situation requires a different response. Creative thinking may be required to arrive at the best solution. Remember that timely attention to difficult situations will be very helpful in working through them.

5.6.4 Just-in-Time Stripping and Grading

The construction schedule can be a powerful BMP in the ESC Plan. When organizing the project, it may be possible to work portions of the site into phases. The clearing and stripping, then grading, followed by surface restoration can be done phase by phase, minimizing the amount of time that the bare soil is left exposed. This is sometimes called “just in time grading”. Phasing the stripping and grading activities in a construction project can be a key method of minimizing erosion and sedimentation problems.

5.6.5 Contractor Activities

The engineer and contractor need to consider the objectives of the ESC Plan with respect to the construction activities. Sometimes the contractor may have valuable experience and suggestions on how to address ESC issues. At other times established methods of carrying out construction activities may not meet the objectives of preventing erosion and controlling sedimentation. Consider the proposed approach and methods in light of achieving the desired goal as well as the economics.

The contractor must ensure that the sequence of installation of BMPs will minimize erosion and control sedimentation. If the contractor can demonstrate that substitute materials can provide the same level of protection then alternatives may be considered.

Cooperation and communication between the designer and contractor is key to the successful implementation of an ESC Plan. When these parties review the ESC Plan prior to the beginning of the work, and engage in regular and ongoing communication, it increases the chance that the ESC Plan will run smoothly and meet its goal.

5.6.6 Maintenance and Repair

Once the BMPs are installed and in operation, the job has just begun. Weather can change rapidly. Construction equipment or third parties can damage BMP installations. It is always cheaper to repair, make adjustments to, and maintain the BMP devices than it is to correct damage to the environment after a failure.

Some typical maintenance requirements are:

- Maintenance of sod includes adequate watering and replacement of dead patches.
- When erosion control blankets are used in place of sod, proper maintenance includes seeding, watering and restoration.
- Sedimentation basins should be cleaned when sediments fill the basin one-third to one half of its storage volume.

- Remove sediment from behind silt fences before the depth of sediment reaches one third of the height of the silt fence.
- Make all repairs promptly.

5.6.7 Quality of Workmanship

Many BMPs will not function effectively unless they are properly installed. Be aware of the specifications, drawings, and the manufacturer's recommendations for installation. Careful workmanship is the backbone in installing measures that will act together to protect a sensitive resource. Quality control is also needed in regular inspection and in the maintenance of BMPs to keep them fully functional. Lack of quality control can make the situation worse and lead to disastrous failures.

Some examples of the need for quality control are:

- A well-constructed sediment basin will capture runoff, trap sediment, and provide controlled discharge.
- Mulch that is spread evenly will protect the entire surface area from sheet and rill erosion.
- A properly installed silt fence will allow passage of water and trap sediment.
- Poor quality mulch, straw bales or seed can introduce weeds to the site.

Regardless of the cause, BMPs that are not working properly should be repaired quickly to prevent erosion and sedimentation problems. A BMP may not be working for one of the following reasons:

1. Incorrect design
2. BMP not suited for the function
3. BMP installed incorrectly
4. No maintenance
5. Changing site conditions
6. Changing demands for BMP
7. BMP installed out of sequence with construction activities

Additional information on ESC planning and BMPs can be found in the latest editions of Alberta Transportation's *Design Guidelines For Erosion and Sediment Control for Highways* (March 2003), the Department of Fisheries and Oceans *Land Development Guidelines for the Protection of Aquatic Habitat* (September 1993), and similar manuals.

Issues related to the monitoring and maintenance of ESC measures/BMPs are discussed in **Chapter 6.0 – Monitoring and Maintenance and Record Keeping**. Examples of common BMPs and discussion of good housekeeping measures is provided in **Chapter 7.0 – Erosion and Sedimentation Control Measures**.

6.1 MONITORING AND MAINTENANCE

Once a combination of ESC measures appropriate to the site has been selected, and construction is underway, it is crucial that their effectiveness is monitored, the necessary maintenance is carried out, and a contingency plan is prepared in the event of emergencies or failures. All temporary and permanent ESC measures must be inspected, maintained and repaired as needed to ensure continued performance.

The responsibility for monitoring and maintenance is primarily that of the owner/developer:

- Permanent BMPs/ESC Measures – The owner/developer is responsible for monitoring and maintaining all permanent BMPs until the FAC is issued; after FAC this responsibility is turned over to the City (Drainage Services). “Monitoring” of BMPs is conducted to determine whether the BMP is functioning as intended.
- Temporary BMPs/ESC Measures – The responsibility for monitoring and maintaining all temporary BMPs is that of the owner/developer until the measures are no longer required. The owner/developer is then responsible for removing them.

6.1.1 Monitoring and Inspections

Both permanent and temporary BMPs/ESC measures should be inspected at least once per week, and after heavy rainstorms or snowmelt events. All disturbed areas of the site, material storage areas, entrance and exit roads, and all ESC controls should be inspected. The measures must be in good operating condition until the area they protect has been completely stabilized and the construction activity complete.

Inspections tips:

- A coordinated grid on the ESC Plan will assist in describing the location of BMPs in preparing inspection reports
- The initial site inspection of the entire site should occur prior to start of construction to verify the location of the BMPs, record existing conditions and see if changes are needed to the ESC Plan
- Weekly inspections should cover all disturbed areas of the site, entrances, exits, all ESC measures and storage areas
- Inspection reports should note BMPs installed, maintenance or repairs required and completed, storm time, size and duration, and site conditions

- Monthly inspections of new vegetation should determine if additional measures are needed to support proper growth
- Supplemental inspections should occur when rain is forecast to see that the BMPs are in place and after a storm to verify they are still in good condition. In the case of a release or spill, additional inspections and reports are required (see note at end of chapter).

6.1.2 Maintenance and Repairs

A schedule of planned maintenance activity must be included with the ESC Plan and followed. When ESC measures are insufficient or not working properly, changes to the ESC Plan must be made to ensure continued compliance.

As discussed above, for permanent ESC measures, the responsibility for maintenance and repair is transferred from the developer/owner to the City following FAC. For temporary ESC measures, the owner/developer is responsible for their maintenance and repair until they are no longer needed.

Some measures such as silt fences and inlet protection devices will require periodic replacement and/or removal of accumulated sediment. Sediment basins (traps and ponds) will require periodic sediment removal when the design storage level is one third to half full. Damage or deficiencies to ESC measures should be corrected as soon as practicable after an inspection.

Sometimes projects are shut down prior to completion of the construction due to the end of the construction season, contractual disagreements or extended weather related delays. In these cases, the following steps should be taken:

- Protect and stabilize stockpiles
- Protect and stabilize exposed surfaces
- Protect critical resources
- Clean out all sediment ponds, basins and traps where sediment may have accumulated
- Install and maintain perimeter control measures
- Install and maintain runoff control measures
- Restrict public access to the site
- Continue inspections and maintenance of the site until construction starts up again

Remember that erosion and sedimentation may be severe during snowmelts and spring thaw. Provide protection in the fall.

Prior to project start up after an extended shutdown period, the site should be inspected prior to

commencing any construction, all sediment ponds, basins and traps should be cleaned out where sediment has accumulated, and any ESC measures that were damaged during the shutdown period should be repaired.

6.2 RECORD KEEPING

Good records such as diaries, inspection and maintenance reports, meeting minutes, and photos are crucial for documenting a defense of “due diligence” if an inadvertent release occurs and every reasonable care had been taken to prevent the release. Records showing that a proper ESC plan was implemented, properly monitored and maintained become invaluable under such circumstances and cannot be overstressed.

At a minimum, the owner/developer, or his/her delegate, must complete an inspection report of any maintenance, damages or deficiencies of ESC measures. An inspection should be undertaken, and report prepared, once per week and following heavy rainstorms or snowmelt events. The same document can be used to record maintenance and repairs undertaken following an inspection. It is the responsibility of the owner/developer, or designate, to prepare the inspection report. The inspection report must be signed by the owner's/developer's inspector. See **Appendix C** for a sample ESC inspection report.

The owner/developer (or his/her delegate) is not required to submit copies of inspection reports to Drainage Services, however, Drainage Services may, on a case-by-case basis, request to review copies of inspection reports and/or other ESC documents at the site to determine their existence and extent. Upon written request, the owner/developer or his designate must submit for Drainage Services' review copies of all documentation on the ESC Plan, its installation, operation and maintenance.

NOTE: Releases of silt, sediment and other harmful or deleterious substances can trigger reporting requirements under various pieces of federal and provincial legislation and municipal bylaws, such as the *Fisheries Act*, *Canadian Environmental Protection Act*, *Environmental Protection and Enhancement Act*, and the City of Edmonton *Sewers Use Bylaw, No. 9675*. In addition, the owner of the substance, or person who released the substance is typically required under the legislation to take all reasonable measures to contain and clean up the release and may be required to submit a written report. Refer to **Chapter 2.0 – Regulatory Requirements** for more information on release reporting requirements.

7.1 INTRODUCTION

ESC measures, or Best Management Practices (BMPs), are activities, practices, devices or combinations thereof that are designed to prevent or reduce the release of sediment and other pollutants into receiving water bodies or streams or other environmentally sensitive areas. They operate by preventing the detachment of soil particles, controlling the transport, or by facilitating sedimentation at controlled locations on the site.

On all applicable sites, the owner/developer, or his/her delegate, should employ the appropriate level of ESC measures in order to achieve sufficient erosion and sedimentation control. All areas of a site, even those rated as having low erosion potential with negligible impacts on downstream receivers (see Tables 3.3 and 3.4 in Chapter 3.0), will require at least good housekeeping measures.

7.2 BMP SELECTION

A large number of BMPs/ESC measures exist, and it is essential that the appropriate BMPs be selected for the application. The selection of BMPs should be based on the following:

- Site assessment, and risk assessment based on downstream receivers
- Project design requirements
- Construction requirements and limitations, including the construction season
- Permanent and temporary requirements
- Regulatory requirements
- Economic factors

Many of the BMPs may serve more than one purpose. Selection of BMPs will depend on the experience of the designer with respect to the above noted elements. In some situations, more than one ESC measure may be appropriate. To be effective they need to be properly installed in the correct place and maintained throughout the project. Often backup BMPs are required to protect critical resources should the primary BMP fail. A supply of materials is desirable to deal with emergencies. It is not intended that all BMPs be used on every job. The professional designing the ESC plan must evaluate and select which BMPs are suitable and most appropriate. New ESC measures are constantly being developed with changing technology, and designer innovation may result in new options.

Temporary BMPs

Temporary ESC measures are implemented during the construction phase and will ultimately be removed, or will naturally biodegrade or photo-degrade.

Temporary BMPs that are no longer required must be removed. The following guidelines provide a good approach to the temporary ESC plan.

1. Silt fences and fabrics can be used (they should not be used for perimeter control for the site's main drainage course, but are effective in other situations, e.g., sheet flow).
2. Sediment control basins should be installed to detain sediment-laden water.
3. Seeding and mulching should be done in stages and as soon as possible.
4. Use diversions to direct flow away from exposed soil areas.
5. Install pipes where concentrated flows could cause a problem.

Permanent BMPs

Permanent BMPs are measures that are intended for permanent use. They are part of the overall design of the development and become part of the overall site stormwater plan. They address long-term post-construction ESC requirements. Permanent ESC measures may include:

- Infiltration basins and trenches
- Grassed swales
- Vegetation strips
- Sediment basins
- Wet ponds and detention ponds
- Constructed wetlands

The remainder of this chapter provides examples of commonly used ESC measures/BMPs. More detailed descriptions and photographs of typical BMPs are provided in **Chapter 5.0** of the *Erosion and Sedimentation Control Field Manual*.

The BMP examples in this chapter and Chapter 5.0 of the Field Manual are **provided as a guideline only and should NOT be considered an exhaustive list of all possible BMPs.**

7.3 BEST MANAGEMENT PRACTICES

7.3.1 Good Housekeeping Measures

Good housekeeping measures should be employed on site during construction to minimize and/or eliminate concerns such as mud tracking from construction sites onto adjacent properties and streets, and wind blown dust. Particularly for those activities that are not required to submit a formal ESC Plan (e.g., house construction on single lot), good housekeeping measures are essential. The following measures should be considered when preparing the construction schedule¹:

- Place stockpiles away from watercourses, environmentally sensitive areas, drainage courses, ravines and existing adjacent developments. Stabilize stockpiles against erosion immediately following stripping. Stabilization can include, but is not limited to, establishment of a cover crop or a hydroseed matrix consisting of seed, fiber bond, and tackifier.
- Limit access of construction vehicles leaving the site to designated locations. Graveling or paving of access roads may be required to minimize tracking of mud off-site. Internal haul roads and/or track packs can be designated and maintained to help reduce offsite tracking. In

some cases, a washdown facility may be required to wash truck wheels before leaving the site.

- Take measures to minimize sediment and debris from entering sewers. Protect catch basins and manholes from sediment.
- Implement dust control measures such as vegetation, water, windbreaks, screens, and limiting vehicle speeds to prevent wind transport of dust from disturbed soil surfaces.
- Remove accumulated sediment and debris as required. Remove construction related materials and structures upon completion of construction.

7.3.2 Erosion Control BMPs

Erosion Control BMPs minimize soil detachment from taking place. They serve to protect exposed surfaces and control runoff, and may include source controls and some conveyance controls. Typical examples include maintaining existing vegetation, slope treatments, seeding, mulching, sodding, erosion control blankets or mats, and dust control. These tend to be the least expensive and most effective BMPs. Examples include:

- **Preservation of Existing Vegetation** – Prior to construction, vegetation and unique areas that are to be preserved must be assessed, marked



6. Existing vegetation that needs to be protected must be indicated on the design drawings, and fenced off in the field

¹ Source: The City of Calgary, Wastewater and Drainage Urban Development, *Guidelines for Erosion and Sediment Control* (February 2001)

and protected. Federal, provincial and municipal regulatory requirements should be checked to determine what areas must be protected. Construction should be phased to use existing vegetation as an ESC measure as much as possible.

- **Just-In-Time Grading** is the concept of only grading the areas needed for the immediate construction activities. This will leave the existing ground cover in place for as long as possible, minimizing exposed soil and potential erosion. It also includes the prompt restoration of ground cover once the local work is complete.
- **Construction Sequence Scheduling** is an extension of just-in time grading. It involves breaking the project into phases that are executed in sequence. The clearing, grubbing and stripping of the later phases are done just in time while the site restoration is being implemented on the earlier phases. Vegetation is restored on earlier phases of the project as soon as the other construction work there is complete. Work may be scheduled for periods when rainfall is less likely.
- **Slope Treatments** – Surface roughening is a slope treatment in which horizontal depressions or grooves are provided on slopes to help trap seed, reduce runoff velocity and increase infiltration. It can also help trap eroded soil and create “seeding safe sites”. Tracking is used for slopes less than 3H:1V, but stair stepping or grooving is required on steeper slopes. The slopes should be seeded and mulched immediately after the surface roughening is carried out. Slope treatments include surface roughening, stair step grading, furrowing and tracking.

- **Seeding** is carried out to stabilize disturbed areas and to establish a vegetation cover. Seeding may be either a temporary or permanent practice. Depending on the size of area to be seeded, the slope inclination and site conditions, hydroseeding may be carried out.



8. Rills forming along stripped slope; vegetated slope resists erosion. Terracing also breaks up slope and, where properly constructed helps resist erosion.



7. Track Roughening

- **Erosion Control Blankets (ECBs)** are typically used on short, steep slopes where there is a high erosion potential and slow vegetation establishment. Rolled Erosion Control Products (RECPs) are manufactured mulch blankets that protect soil from erosion. Turf Reinforcement Mats (TRMs) are used to help establish

vegetation in channels. Erosion control blankets stabilize and protect the soil from raindrop impact, increase infiltration, decrease soil compaction & crusting, and conserve soil moisture. They typically consist of degradable netting enclosing straw, wood fiber or coconut fiber.



9. Erosion Control Blanket

7.3.3 Transport Control BMPs

Transport Control BMPs deal with the velocity and flow of stormwater at the site to minimize additional erosion and to convey existing sediment to selected locations where they can be deposited on site. Typical examples include grassed waterways, stormwater ditches or channels, and various silt fences, buffer strips, filters and check dams associated with them. They can help to direct stormwater away from exposed soils.

- **Buffer Strips** are used as an ESC measure around construction site perimeters, above steep slopes and around protected areas/critical resources.



10. Vegetated buffer used as a Transport Control BMP

- **Silt Fences** are considered a TRANSPORT and/or SEDIMENTATION CONTROL measure, NOT an erosion control measure. They are suitable for controlling sedimentation from sheet and rill erosion on relatively short slopes and should not be used where the flow exceeds $0.03 \text{ m}^3/\text{s}$. Properly installed, silt fences can be cost-effective for runoff detention and sediment settling. Silt fences should not be installed on a slope, and should be located some distance

from the toe of a slope in order that water can pond and settling of the sediment can occur. It is essential to provide adequate water storage capacity behind the silt fence. The drainage area should be no more than 0.1 ha per 30 m of fence. Posts should be no more than 3 m apart for standard strength fabric and 2 m apart for extra strength fabric. They must be inspected and maintained frequently.



11. Well installed silt fence, but requires maintenance

- **Check Dams/Dikes** are temporary berms used to divert or channel runoff to a desired location. These measures are used to divert runoff around the construction site, divert runoff from stabilized areas and to direct runoff to sediment traps or basins. The drainage areas should be restricted to 4 ha or less and must direct runoff to a stabilized outlet. The berms must not be constructed of highly erodible soils. Rock check dams may be constructed across a swale or ditch to reduced velocities of concentrated flows. They are suitable for small drainage areas of less than 0.8 ha, and are not suitable for active streams. The check dams must extend beyond the tops of the banks and the centre lines must be low enough that flow does not go around the ends. With a series of check dams, the top of a downstream dam must be at the same elevation as the toe of the adjacent upstream dam.
- **Riprap** can protect and stabilize areas prone to erosion, erodible soils and drainage channels. It can be cheaper than other flexible slope liners and less expensive to repair. Riprap can also be used in riprap-lined swales/channels. They are suitable for grades of 5 to 15%, and where the design flow velocity may exceed 60 cm/s. Side slopes must be 3H:1V or less. A non-woven geotextile liner should be used at the top of the channel to avoid migration of fines. Riprap rock must be hard, durable and erosion resistant. Riprap depth should be at least 300 mm and 1.5 times the maximum stone diameter.



12. Synthetic ditch checks on steep offshoot ditch

- **Energy Dissipaters** are used as outlet protection as an erosion/velocity control measure used to prevent scouring at outlets where high concentrated flow velocities occur.



13. Well protected outfall

7.3.4 Sedimentation Control BMPs

Sedimentation Control BMPs capture soil that has eroded, and generally achieve this by filtration and impounding sediment from water flows. Typical examples include silt fences, check dams, sediment traps and sedimentation ponds. The latter tend to be more expensive and often become permanent features.

- **Sediment Traps** are temporary sediment containment devices constructed by excavation and/or embankment construction to detain sediment-laden runoff. Drainage areas should be less than 2 ha, and storage volumes should be at least 25 m³/ha. Berms should not be more than 1.5 m in height, with a minimum top width of 1.5 m, and slopes no steeper than 3H:1V. Outlets must be stabilized, and sediment should be removed when it reaches one third the design depth of the trap.



14. Sediment trap for a small area

7.0 EROSION AND SEDIMENTATION CONTROL MEASURES

- **Inlet Protection Measures** are considered the “last line of defence”. The measure consists of a permeable barrier installed around an inlet to reduce sediment content in the water before it enters the inlet. They must be inspected and maintained regularly and all materials and sediment must be removed when construction is completed and the drainage area stabilized. Inlet protection measures are types of sediment traps used around catch basins, drop inlets and culvert inlets. There are two primary types: Drop inlet sediment barriers and catch basin inlet barriers.



15. Some protection of inlet, but it needs protection along top of curb

- **Stabilized Construction Entrance** – The construction entrance/exit must be stabilized to reduce tracking of mud and dirt from the site onto public roads and streets. Typically a graveled area will be constructed. Additional measures to remove mud and dirt from the vehicles before they leave the site include rumble racks, tire washes, and sediment traps. It can be supplemented by a good street cleaning program and inlet protection. The gravel pad should be constructed using 75 to 150 mm diameter rock on level ground, and a minimum of 15 m long and 9 m wide.



16. Gravel pad reduces off-site mud-tracking

7.4 BMP DRAWINGS/ SPECIFICATIONS

Table 7.1 on the following page provides a partial list of BMPs with references to specifications and drawings from several sources.

Table 7.1: BMP Specifications Sources
ESC Specifications/Drawings

BMP	City of Edmonton Design and Construction Standards	City of Calgary Guidelines for Erosion and Sediment Control (February 2001)	Alberta Transportation Design Guidelines for Erosion and Sediment Control for Highways (March 2003)	Minnesota Department of Transportation	Wisconsin Department of Transportation	National Master Specifications
Erosion Control BMPs						
preserve existing vegetation			BMP 30			01561, 02901
scheduling of the work			BMP 32			
slope treatments					PAL 15-18	
surface roughening			BMP 34	2575, 3884		
tracking			BMP 34	Description		
terracing			BMP 34			
seeding	Section 02920		BMP 22, 24	2575 & 3876		02921
mulching	Section 02913		BMP 23, 24	2573, 2575, 3882		02922
sodding	Section 02920		BMP 26	2575, 3878		02933
erosion control blankets			BMP 13 F 5.1	2575 & 3885	PAL 5-14	
erosion control mats			BMP 13 F 5.1	2575, 3888, 3894	PAL 5-14	
dust control						02362
construction entrance/exit			BMP 33			
Transport Control BMPs						
grass-lined channel			F			02379
stormwater ditches or channels			F			02379
silt fences		SCM 4	BMP 1	3886 & 2573		
buffer strips		SCM 1				02379
filters		SCM 2	BMP 3			
check dams		SCM 3, 5	BMP 3, 7 – 12	3889	PAL 23	
riprap			BMP 14		PAL 25-32	02371
energy dissipation			BMP 17	2511 & 3601		
Sedimentation Control BMPs						
sedimentation ponds		SCM 8	G, BMP 18	BMP dwgs		02661
sediment traps		SCM 7	BMP 18	BMP dwgs	PAL 24	
silt fences		SCM 4	BMP 1	3886 & 2573		
check dams		SCM 3, 5	BMP 3, 7 – 12		PAL 23	
inlet controls		SCM 6	BMP 6		PAL 19-22	
silt bag			BMP 31			

Alberta Transportation, *Design Guidelines For Erosion and Sediment Control for Highways* (March 2003)

Alberta Transportation, *Field Guide for Erosion and Sediment Control for Highways* (March 2003)

City of Portland, Environmental Services, Clean River Works, *Stormwater Management Manual* (September 2002, Revision #2)

City of Denver, Urban Drainage and Flood Control District, *Urban Storm Drainage, Criteria Manual, Volume 3.0 Best Management Practices* (September 1999)

De La Mare, Geri & Tait, Graham, *Practical Approaches for Erosion & Sediment Control* (20 May 2004 Presentation)

Department of Fisheries and Oceans, *Land Development Guidelines for the Protection of Aquatic Habitat* (September 1993)

Minnesota Department of Transportation, *Erosion Control Handbook*

The City of Calgary, Wastewater & Drainage, Urban Development, *Guidelines for Erosion & Sediment Control* (February 2001)

The City of Calgary, Wastewater & Drainage, Urban Development, *Field Manual for Effective Erosion and Sediment Control* (February 2001)

Washington State, Department of Ecology, Water Quality Program, *Stormwater Management Manual for Western Washington – Volumes I, II, III, IV and V* (August 2001)

Best Management

Practices (BMPs) Activities, practices, products or devices, or combinations thereof, designed to prevent or reduce the release of sediment and other pollutants into receiving water bodies or streams. They operate by preventing the detachment of soil particles, controlling the transport, or by facilitating sedimentation at controlled locations on the site.

Compliance Adhering to all provisions, directions and requirements of legislation, permits, bylaws and contract documents, and other regulatory instruments or requirements.

Consultant The Professional Engineer, Professional Landscape Architect, or engineering or architectural consulting firm that has been retained to design the project and perform any other required functions as the owner/developer's delegate.

Contractor The entity contracted to construct the works and implement the ESC Plan.

Convex Pertaining to a silt fence, the curve of the fence should tend slightly toward the origin of flow.

Critical Area. Environmentally sensitive or ecologically important areas on or near the project site.

Disturbed Area. The portion of the site at any given time that has been subject to disturbance of its surface and vegetation and is without protective cover.

Drainage Services The Drainage Services Branch of the City of Edmonton.

Erosion The process or detaching soil particles and their transport by wind or water.

Erosion and Sedimentation

Control (ESC). Practices that protect the soil from erosive and sediment transport forces during and after construction activities.

Erosion and Sedimentation

Control (ESC) Framework The process developed by The City of Edmonton, Drainage Services, whereby erosion and sedimentation issues are addressed beginning at the earliest possible stages of the development/project, from planning/design through to construction and post-construction, and measures are put in place to ensure that land is being developed in an environmentally sound manner. The framework includes the requirement to develop and implement an ESC Plan, or at a minimum, to implement good housekeeping measures to address erosion and sedimentation issues.

Erosion and Sedimentation

Control (ESC) Plan. A document or parts of multiple documents that describes and addresses the methods, practices, devices, and products that are to be used to minimize erosion and the transport of sediment from the site.

GLOSSARY

Erosion and Sedimentation

Control (ESC) Schedule.	A schedule for the application of the ESC plan including installation, inspection, maintenance and removal.
Ground Cover	Vegetation, mulch or some other material that covers and protects the soil.
Implementation	Putting the practices into action, installing devices and products, then carrying out inspections and maintenance to ensure proper function.
Inspection	Review of BMPs in place to check for proper function and maintenance. It should also include review of disturbed areas and watercourses for signs of erosion.
Landscape Architect	A professional concerned with analysis, design, planning, management and rehabilitation of the land. Landscape architects integrate and apply knowledge of ecology, socio-cultural factors, economics and aesthetics to create environments that are functional, innovative, appropriate and attractive.
Maintenance	Any and all efforts to keep BMPs functioning properly.
Off-site Areas.	Areas outside the property boundary or defined work site.
Owner/Developer	The entity (private or public) that owns or is the developer of the project, the site, or the land upon which the construction or project is taking place.
Permanent Measures	Measures that will remain in place after construction is complete.
Project ESC Team.	Representatives from the City, permitting authority, developer, consultant, and contractor that are involved in the design, installation, inspection, maintenance, and/or removal of the materials and methods specified in the ESC Plan.
Rain Event	Events with sufficient rainfall to product runoff that leaves the boundary of the site.
Runoff	The water from precipitation, snow melt, or dewatering that does not soak into the ground and leaves the site boundary in either sheet or concentrated flow.
Runoff Control.	Practices that reduce the erosive and sediment transport capacity of stormwater by reducing velocity, concentration and flow path of the runoff.
Sediments	Soil particles that have been detached and are being transported by wind or water.
Sedimentation	Deposition of soil particles by wind or water. Erosion control practices reduce the amount of sediment.
Sediment Barriers	Transport control measures designed to separate sediment from sheet flow runoff. They tend to reduce the velocity of the runoff, creating small ponds and allow the sediment to settle out. They require regular removal of collected sediment to function properly.

Sediment Basin	A pond designed to detain runoff long enough to allow the sediment to settle out.
Sedimentation Control	Devices or practices used to keep sediment on site.
Sediment Laden Runoff	Runoff containing sediment. The sediment in the water can strike the soil surface and cause additional soil to erode.
Sediments, tracked	Sediments carried off the site on the wheels, tracks or undercarriage of vehicles and equipment.
Servicing Agreement	Contract between the City of Edmonton and the owner/developer that sets out all requirements related to construction and installation of municipal improvements (e.g., storm and sanitary sewers, paved roads, sidewalks, curb and gutter, landscaping), and provisions related to Construction Completion Certificates and Final Acceptance Certificates.
Site Erosion Plan	A plan to deal with unexpected, emergency, or difficult erosion or sedimentation control situations.
Stabilized Soil	Areas of soil that have been temporarily or permanently covered with vegetation, mulch, blankets, etc. to the extent that erosion will be minimized under most conditions.
Temporary Measures	Measures that will be removed or replaced during the course of the project.
Time of Disturbance	The amount of time between stripping or other land disturbing activity and the stabilization of the area.
Turbidity	The measurement of how “cloudy” or “muddy” the water is. Most turbidity is caused by the presence of soil sediments or other organic matter.
Turf Establishment	Seeding, sodding or otherwise establishing vegetative ground cover, typically composed of grasses and grass like plants.

**APPENDIX A
ESC PLAN CHECKLIST**

APPENDIX A: ESC PLAN CHECKLIST

NOTE: The ESC Plan must be developed to apply to the specifics of the site and project, but as a minimum the ESC Plan must address the following information [Note: An **X** appears if the information should appear/be addressed in the report, drawings and/or calculations portion(s) of the ESC Plan].

Application Information

Project Name

Project Address

Owner/Developer

Company Name of Applicant

Contact Name

Contact Telephone Number

Contact Fax Number

Site Location and Characteristics:

Legal land description

Nature of proposed development

Size of proposed development (ha)

Site access

Adjacent properties/landmarks

Existing Land Use:

Element \ Format	Report	Drawings		Calculations
		Site Plan	BMP Details	
Existing use (agricultural/residential, etc.)	X	X		
General topography (slope gradients, lengths, orientation)	X	X		X
Drainage patterns – provide topography map with contour intervals sufficient to show drainage patterns, drainage divides, and flow directions	X	X		X
Vegetation (e.g., locations and types of trees, shrubs, grass, rare vegetation)	X	X		
Soil types (grain size, erodibility)	X			X
Critical areas (protected vegetation, ravines, etc.)	X	X		
Neighbouring areas that may be impacted by development (e.g., streams, lakes, residential and commercial developments, parks, roads)	X	X		

Proposed Development:

Element \ Format	Report	Drawings		Calculations
		Site Plan	BMP Details	
General description of proposed development	X			
Development phasing	X	X		
Locations, amount and timing of clearing and grading for each stage of development	X	X		
Stockpile locations, heights, volumes, and timing	X	X		X
Drainage flow directions and divides for each drainage area after each stage of development, including contour plan of finished grades	X	X		X
Location and description of permanent stormwater management facilities including storm drain inlets, pipes, outlets, waterways, swales, ponds, etc.	X	X	X	X

Erosion and Sedimentation Controls:

Element \ Format	Report	Drawings		Calculations
		Site Plan	BMP Details	
Erosion potential – slope lengths/gradients, soil erodibility, evaluation summary	X		X	X
Erosion control – protection of exposed surfaces, runoff control, wind erosion	X		X	
Sedimentation control – filtering, impoundment, mud control (road tracking), catchbasin protection	X	X	X	
Description, location and timing of all temporary and permanent ESC measures including construction details	X	X	X	
Describe good housekeeping measures	X		X	
Stockpile locations, heights, volumes, and timing	X	X		
Cut/fill slope locations, heights, volumes and timing	X	X		
Exposed soil horizons, soil types (topsoil, fill, bedrock, clay, sand, etc.), locations and timing	X	X		
Temporary diversion of water on site	X	X		
Winter operations/shut-down measures	X			
Post-construction stabilization measures	X		X	
Seeding and mulching descriptions and locations	X	X		

Signage, Inspection and Maintenance:

Element \ Format	Report	Drawings		Calculations
		Site Plan	BMP Details	
Signage (Private property/No trespassing/ No unauthorized personnel beyond this point, etc.)	X			
Schedule and records of regular inspections and expected maintenance of ESC measures	X			
Records of inspections and maintenance after storm events	X			
Update ESC Plan for changing conditions	X			

Appendices

Contractor/builder BMPs

Homebuilder association bulletins/information, etc.

**APPENDIX B
DRAINAGE SERVICES ESC PLAN
REVIEW CHECKLIST**

**APPENDIX B: DRAINAGE SERVICES
ESC PLAN REVIEW CHECKLIST**

Project Name

Subdivision Number

Development Permit Number

Development Agreement Number

ESC File Number

Date Received

Applicant Name

Applicant Company

Contact Telephone Number

Contact Fax Number

☐

Received As Record

☐

Further Information Required

After reviewing this ESC Plan, it was noted that the information in the X marked boxes was missing or incomplete. Upon receipt of the outstanding information, review of your application will be resumed.

Existing Land Use:

Element \ Format	Report	Drawings		Calculations
		Site Plan	BMP Details	
Existing use (agricultural/residential, etc.)				
General topography (slope gradients/lengths/orientation)				
Hydrology – provided topography map with contour intervals sufficient to show drainage patterns, drainage divides, flow directions, peak flow rate, drainage/catchment area				
Vegetation (locations and types of trees, shrubs, grass, rare vegetation)				
Soil types (grain size, erodibility)				
Critical areas (protected vegetation, ravines, etc.)				
Neighbouring areas that may be impacted by development (e.g., streams, lakes, residential and commercial developments, parks, roads)				

Proposed Development:

Element \ Format	Report	Drawings		Calculations
		Site Plan	BMP Details	
General description of proposed development				
Development phasing				
Locations, amount and timing of stripping and grading for each stage of development				
Stockpile locations, heights, volumes, and timing				
Drainage flow directions and divides for each drainage area after each stage of development, including contour plan of finished grades				
Location and description of permanent stormwater management facilities including storm drain inlets, pipes, outlets, waterways, swales, ponds, etc.				

Erosion and Sedimentation Controls:

Element \ Format	Report	Drawings		Calculations
		Site Plan	BMP Details	
Erosion Potential – slope lengths/gradients, soil erodibility, evaluation summary				
Erosion Control (e.g., protection of exposed surfaces, runoff control, wind erosion)				
Sedimentation Control (e.g., filtering, impoundment, mud control (road tracking), catchbasin protection)				
Description, location and timing of all temporary and permanent ESC measures including construction details				
Describes good housekeeping measures				
Stockpile locations, heights, volumes, and timing				
Cut/fill slope locations, heights, volumes and timing				
Exposed soil horizons, soil types (topsoil, fill, bedrock, clay, sand, etc.), locations and timing				
Temporary diversion of water on site				
Winter operations/shut-down measures				
Post-construction stabilization measures				
Seeding and mulching descriptions and locations				

Inspection and Maintenance:

Element \ Format	Report	Drawings		Calculations
		Site Plan	BMP Details	
Schedule and records of regular inspections and expected maintenance of ESC measures				
Records of inspections and maintenance after storm events				
Update ESC Plan for changing conditions				

APPENDIX C
**SAMPLE ESC INSPECTION/
MAINTENANCE REPORT**

APPENDIX C: SAMPLE ESC INSPECTION/MAINTENANCE REPORT

Project Name:		File No./Contract No.:	
Inspection Date/Time:		Date of Last Inspection	
Inspected By:			
Verbal/Written Notification given to:		Date:	
Current Weather		Weather Forecast	
mm of rain in last week			mm of rain in last 24 hours
Stage of Construction			
Contractors on Site			
Construction Activities on Site			
Heavy Equipment on Site			

INSPECTION CHECKLIST	Yes	No	Comments	Action Required
Has stripping and grading been phased where possible?				
Have stripped areas/exposed soils/steep slopes been protected and stabilized?				
Have waterways and drainage ways been protected and stabilized?				
Are perimeter controls in place and functioning adequately?				
Are offsite/downstream properties/ waterways protected?				
Are construction entrances stabilized to minimize tracking of soil and mud offsite?				
Are Sedimentation Control BMP's in place and functioning adequately?				
Are Transport Control BMP's in place and functioning adequately?				
Are Erosion Control BMP's in place and functioning adequately?				

