

8.0 SELECTION OF BMP FOR EROSION AND SEDIMENT CONTROL

8.1 Preliminary Tasks

The following tasks should be completed before erosion and sediment control measures are selected for a given site:

- Conduct the Site Assessment (Section 5.0);
- Conduct the Site Evaluation (Section 6.5);
- Site Hazard Classification (Section 6.5.3); and
- Connectivity to Downstream Resources (Section 6.5.4).

The order in which these tasks should be completed is presented as a flow chart in Figure 8.1.

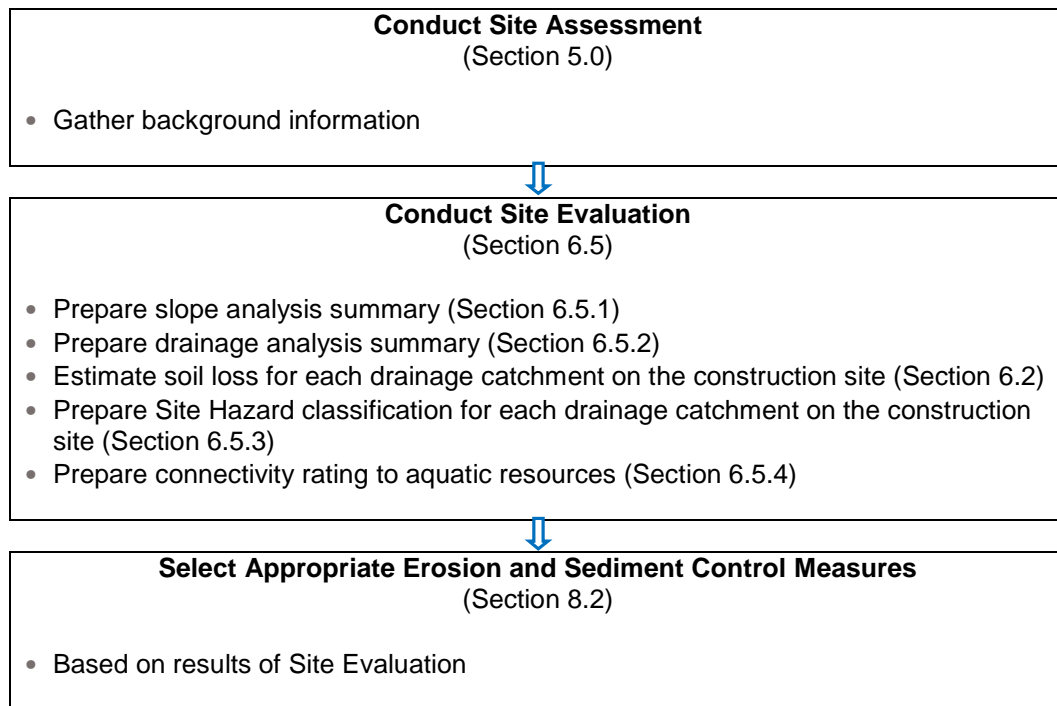


Figure 8.1: Steps in Preparing an Erosion and Sediment Control Plan

8.2 Guidelines for Selecting Appropriate Erosion and Sediment Control Measures

Failure of erosion and sediment control measures can result in three types of potential consequences:

- Ecological consequences, related to the introduction of sediment to the aquatic environment. This is related to the connectivity to aquatic resources (see Table 6.2).

- Project consequences, related to the need to repair erosion damage and the implications for project schedule and cost; and
- Legal consequences, associated with the deposition of sediment in receiving waterbodies.

The aim in selecting, designing, and constructing the appropriate erosion and sediment control measures is to reduce the risk of these negative consequences.

Following the site assessment and evaluation, the information required to adequately select the erosion and sediment control measures for preparing an ESC Plan will be available. Selection of BMPs and other measures can be guided by a combination of the site erosion potential, the consequences of erosion and sediment control, as well as the experience and judgement of the designer.

A summary of the BMPs and other measures required based on site erosion potential and consequences of erosion and sedimentation is presented in Table 8.1.

Table 8.1: Required Levels of Erosion and Sediment Control

Erosion Potential	Consequences of Erosion and Sedimentation	Level of Erosion and Sediment Control (BMPs and Other Measures)					
		Procedural BMPs and Planning Strategy	ESC Plan and Structural BMPs	Water Management BMPs	Staged Construction and Progressive Rehabilitation	More Intensive Sediment Control BMPs	Water Quality Monitoring
Low	Low	Recommended ^b	-	-	-	-	-
	High	Required	Required	-	-	-	-
Moderate	Low ^a	Required	-	-	-	-	-
	High	Required	Required	Recommended ^b	Recommended ^b	Recommended ^b	Recommended ^b
High	Low ^a	Required	Required	Required	Required	Required	Recommended ^b
	High	Required	Required	Required	Required	Required	Required ^c
Reference in Manual Section		7.2	7.3, 7.4, 8.0	7.3	7.2, 7.2.1	7.5	9.9

Source: Transportation Association of Canada, 2005

- Notes:
- If economically justified, it may be acceptable to limit ESC measures for low-consequence projects, including those distant from sensitive areas, to procedural BMPs only.
 - This level of ESC should be implemented where practical. For example, a small, short-duration project may not require staged construction and progressive rehabilitation. Recommended actions may be necessary to demonstrate due diligence in the event of the release of sediment due to an extreme runoff event.
 - Water quality monitoring provides a quantitative measurement of the effectiveness of ESC measures. Monitoring may be required by regulatory agencies.

The information presented in Table 8.1 must be supplemented with the designers experience and judgement during the preparation of the erosion and sediment control strategy. Those responsible for the design and implementation of BMPs and other measures should continue to utilize innovative approaches which best address specific situations. Advances in technology will also continue to improve the methods and materials that are currently employed. Reference should be made to AT's Products List for the most up-to-date approved products (www.transportation.alberta.ca/689.htm).

Specific measures and BMPs are published in many manuals and standards, which describe criteria and specifications in detail. Many of the BMPs most commonly used in Alberta are presented in Appendix C. The BMPs are listed in terms of erosion control and sediment control, and the description, typical applications, advantages and limitations for each are provided. For each BMP, installation information and construction, maintenance and inspection considerations are provided. Where applicable, similar measures are also noted to provide the designer with options and flexibility in choice.

Other factors effecting the selection of erosion and sediment control BMPs include:

- Site Specific Design Requirements;
- Specific Construction Requirements including available space;
- Regulatory laws and guidelines; and
- Cost.

8.3 Construction Phase Activities

Erosion control considerations for various construction phase activities are presented as follows. These construction-related activities must be addressed in the contractor's ECO Plan.

Clearing and Grubbing

Clearing operations include slashing, cutting, stockpiling, and removal (or burning) of trees and brush. Clearing operations leave the stump and root mass intact, as well as the organic mat in the soil. Grubbing operations include the removal of the tree stumps and root masses left behind during clearing operations, however, the topsoil and the majority of the organic mat remains in place. Grubbing operations may cause localized soil exposure in areas where roots and stumps were removed.

Stripping

Stripping is the removal of the organic mat from the construction site to expose the underlying mineral soil. The exposed soil will be disturbed during the stripping operation, thereby increasing the erosion potential.

Borrow Excavations

These are excavations outside of the road right-of-way, made solely for the purpose of removing borrow material for:

- Roadway subgrade construction, or
- The construction of a dam, canal, dike, structure or erosion protection works associated with a provincial water management infrastructure project which may be connected with the borrow excavation.

Borrow excavations can either be landscape borrows or dugout borrows. Landscape borrows can be topographical highs such as hills or ridges, or if utilized on relatively flat terrain a maximum of 1m in depth and must be free draining. Dugout borrows are large excavations utilized for the extraction of construction material with the excavated area

being returned to an “equivalent land capability” as required by Provincial Legislation, which may include holding water.

Development of borrow excavations may include clearing, stripping, grubbing and excavation. The development of borrow excavations and haul roads may cause soil disturbance, create exposed slopes and/or alter the natural drainage courses in the vicinity of the borrow excavation.

Stockpiles

Stockpiles may include material removed from excavations, stripping, clearing, and from borrow pits. The creation of stockpiles may disturb the vegetated soil surface, create exposed slopes, and/or alter the natural drainage courses.

Cut Slope Construction

Cut slopes are slopes created through the excavation and removal of native soil. Cut slopes may increase the slope angle, disturb the soil surface, create exposed slopes, and/or alter the natural drainage courses.

Fill Slope Construction

Fill (embankment) slopes are constructed by placing and compacting fill material. Embankments may create disturbed exposed slopes, create steep slope angles, and/or alter the natural drainage courses.

Ditch Construction

Where channels or ditches are constructed to direct and transport water along or transverse to the highway alignment, the original drainage pattern may be altered and concentration of flows created thereby increasing flow velocity and erosion potential. Ditch construction creates exposed slopes which can be eroded.

Culvert Installation

Culverts are installed to connect drainage courses and surface drainage flow. Installation of culverts may cause flow concentrations, create cut slopes, disturb the soil surface on slope faces, and create scour zones at the culvert inlet or outlet.

Temporary Access Road Construction

Temporary access roads are constructed to accommodate construction equipment on the project site. Construction of temporary haul roads may alter drainage courses and may include the construction of cut slopes, fill slopes, ditches or culvert installation.

8.4 Selection of Best Management Practice (BMP) According to Construction Activity

A large number of erosion and sediment control BMPs are available for use in an erosion and sediment control plan. The BMPs presented in this section have been proven to be effective when properly implemented. Since effective implementation of control measures is a site-specific operation, the BMPs have been grouped by typical construction activities that occur on highway construction sites in Table 8.2. BMPs

typically used for streambank stabilization applications are summarized in Tables 8.3 and 8.4.

Site conditions may be such that the BMPs presented in this guideline are not appropriate. As such, modified methods and techniques may be required to meet the specific requirements of any given construction site. Erosion and sediment controls to be considered should be easy to design, implement, maintain and inspect.

Table 8.2: Application for BMPs Based on Construction Activities

BMP Name	Construction Activity									
	Clearing and Grubbing	Stripping	Borrow Pits	Stockpiles	Cut Slopes	Fill Slopes	Ditches/Channels	Culverts	Temporary Haul Roads	
1. Silt Fence	✓	✓	✓	✓	✓	✓		✓	✓	
2. Gabions							✓	✓		
4. Continuous Perimeter Control Structures	✓	✓	✓	✓	✓	✓			✓	
5. Berm Interceptor	✓	✓	✓	✓	✓	✓			✓	
6. Storm Drain Inlet							✓	✓		
7. Rock Check							✓			
10. Synthetic Permeable Barrier							✓			
12. Straw Bale Barrier			✓	✓	✓	✓			✓	
13. Rolled Erosion Control Products (RECP)				✓	✓	✓	✓			
14. Riprap Armouring							✓	✓		
15. Cellular Confinement System					✓	✓	✓			
17. Energy Dissipators							✓	✓		
18. Sediment Traps and Basins		✓					✓			
19. Slope Drains					✓	✓				
20. Groundwater Control			✓		✓	✓				
21. Offtake Ditches		✓	✓	✓	✓	✓				
22. Seeding			✓	✓	✓	✓	✓			
23. Mulching			✓	✓	✓	✓	✓			
35. Straw Mulching and Crimping (Straw Anchoring)			✓		✓	✓				
24a. Hydroseeding			✓	✓	✓	✓	✓			
24b. Hydromulching			✓	✓	✓	✓	✓			
25. Topsoiling			✓	✓	✓	✓	✓			
26. Sodding			✓	✓	✓	✓	✓			

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BMP Name	Construction Activity								
	Clearing and Grubbing	Stripping	Borrow Pits	Stockpiles	Cut Slopes	Fill Slopes	Ditches/Channels	Culverts	Temporary Haul Roads
27a. Live Staking					✓	✓	✓		
30. Riparian Zone Preservation	✓	✓	✓	✓	✓	✓	✓	✓	✓
31. Pumped Silt Control Systems							✓	✓	
32. Scheduling	✓	✓	✓	✓	✓	✓	✓	✓	✓
33. Stabilized Worksite Entrances	✓	✓	✓	✓	✓	✓	✓	✓	✓
34. Slope Texturing			✓	✓	✓	✓			✓
36. Polyacrylamide (PAM)			✓		✓	✓	✓		
37. Compost Blanket				✓	✓	✓			✓
38. Rolls (Fibre)			✓	✓	✓	✓			

Table 8.3: BMPs for Streambank Applications

BMP #	BMP Name	Category	Also Known As
38.	Rolls (Fibre)	Bank Armour and Protection	Coir Rolls and Coir Mats
27a.	Live Staking	River Training	Live Staking
27b.	Brushlayering	River Training	Live Brushlayering
39.	Brush Mattress	Bank Armour and Protection	Live Brush Mattress, Brush Mat
40.	Live Siltation	River Training	Vertical Brushlayering
41.	Willow Posts & Poles	River Training	Pole Planting, Dormant Live Posts
42.	Rock Vanes	River Training	Rock Vanes, Upstream Angled Spurs
43.	Longitudinal Stone Toe	River Training	Longitudinal Peaked Stone Toe Protection (LPSTP), Stone Toe, Rock Toe, Stone Toe Buttress, Weighted Riprap Toe, Longitudinal Fill Stone Toe Protection (LFSTP)
44.	Vegetated Mechanically Stabilized Earth (VMSE)	River Training	Vegetated Geogrids, Brushlayering with Soil Wraps, Vegetated Geofabric Wrapped Soil
45.	Vegetated Riprap	Bank Armour and Protection	Vegetated Rock Revetment, Vegetated Rock Slope Protection (VRSP), Face Planting, Joint Planting

Note: Adapted from E-SenSS Software, 2005, Salix Applied Earthcare

Table 8.4: BMPs for Streambank Applications Based on Erosion Process

	BMP 38 Roll (Fibre)	BMP 27a Live Staking	BMP 27b Brushlayering	BMP 39 Brush Mattress	BMP 40 Live Siltation	BMP 41 Willow Posts & Poles	BMP 42 Rock Vanes	BMP 43 Longitudinal Stone Toe	BMP 44 VMSE	BMP 45 Vegetated Riprap
Erosion Process										
Toe erosion with upper bank failure	✓				✓		✓	✓		✓
Scour of middle and upper banks by currents		✓	✓	✓	✓	✓	✓		✓	✓
Local scour	✓	✓	✓	✓	✓	✓	✓			✓
Erosion of local lenses or layers of non-cohesive sediment	✓	✓	✓	✓	✓	✓			✓	✓
Erosion by overbank runoff			✓							
General Bed Degradation										
Headcutting										
Piping										
Erosion by navigation waves	✓	✓			✓	✓				✓
Erosion by wind waves	✓	✓			✓	✓				✓
Erosion by ice and debris gouging	✓							✓		✓
General bank instability or susceptibility to mass slope failure		✓	✓					✓	✓	
Spatial Application										
Instream							✓			
Toe	✓			✓	✓		✓	✓		✓
Midbank		✓	✓	✓		✓			✓	✓
Top of bank				✓						✓
Hydrologic / Geomorphic Setting										
Resistive	✓			✓				✓	✓	✓
Redirective							✓			
Continuous				✓	✓			✓	✓	✓
Discontinuous							✓		✓	
Outer Bend	✓			✓	✓		✓	✓	✓	✓
Inner Bend				✓					✓	
Incision								✓		
Lateral Migration	✓						✓			✓
Aggradation					✓		✓			
Complexity										
Low					✓	✓		✓		
Moderate	✓	✓	✓	✓			✓			✓
High									✓	

Note: Adapted from E-SenSS Software, 2005, Salix Applied Earthcare