APPENDIX A

Prospectors and Developers Association of Canada's (PDAC) Environmental Excellence in Exploration (E3) e-manual for drilling (part of)

Environmental Excellence in Exploration

An Initiative of the Prospectors & Developers Association of Canada

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erosion. Trenching is the exploration activity that most disturbs bedrock.

Causes of Erosion

1.2.2 Consequences of Erosion

Erosion can result in

- Degradation of surface waters with eroded sediment.
- Altered patterns of surface water flow and drainage.
- Increased stream flow velocity or channeling flow (channelization).
- Loss of valuable and productive topsoil.
- Generation of non-point source pollution (mainly sediment, but also spilled fuels).
- Destruction of natural habitat (on land and in aquatic ecosystems).
- Compaction of soil, which reduces the capacity of water to infiltrate soil resulting in higher runoff volumes.

Consequences of Erosion

1.2.3 Methods of Erosion Control

Camp construction, road building, trenching, drilling, line cutting and other exploration activities disturb the landscape and can accelerate the erosion of unstable soils. It is essential that you introduce appropriate erosion and sediment control structures and procedures into activities.

Your goal should be to expose the smallest practical area of land for the shortest possible time to eroding forces. The best approach requires that you plan exploration activities in advance, anticipating the needs of the exploration program such as roads, limiting the area of impact, and selecting sites that are unlikely to flood. Careful planning facilitates the eventual reclamation process.

There are many different erosion and sediment control structures available to you which, if properly designed, installed and maintained, will effectively reduce the transport of sediments, minimize the degradation of water resources and reduce negative impacts to natural resources. It is very important that you do not discharge sediment-laden water into streams or lakes.

Control structures protect the watershed and natural resources in a number of ways. For example, they

- Prevent the formation of, or the advancement of, rills and gullies.

- Reduce the flow velocity in watercourses or provide structures capable of withstanding high flow velocity.
- Stabilize the grade and control head cutting in natural or artificial channels.
- Convey water from one elevation to another.
- Divert water away from unstable slopes.
- Filter and retain sediment.

You should use erosion control structures where there is potential for a sediment control or an erosion problem. This could happen when

- Flow velocity of runoff is high enough to cause erosion.
- Excessive grade or overfill conditions occur (where the existing drainage system is at its maximum capacity.)
- Water needs to be moved from higher to lower elevations.
- Critical slopes have sheet erosion problems.
- Vegetative cover is being established.
- Concentrated runoff from unstabilized areas can be diverted onto stabilized areas.

The steps that you can take to reduce and control erosion caused by natural forces and exploration activities include

- Minimizing vegetation, soil and bedrock disturbance and exposure to wind and water,
- Collecting and managing (dispersing) runoff and drainage, and
- Collecting and removing sediment.

Methods of Erosion Control

1.2.4 Minimizing Disturbances

You should make every effort to minimize vegetation removal and soil and bedrock disturbances. You can minimize the disturbance caused by vehicle and mobile equipment use through proper equipment selection. Wherever possible you should use natural clearings and avoid unstable slopes, areas of permafrost and wetlands.

Further discussion on minimizing disturbances is presented in the following sections:

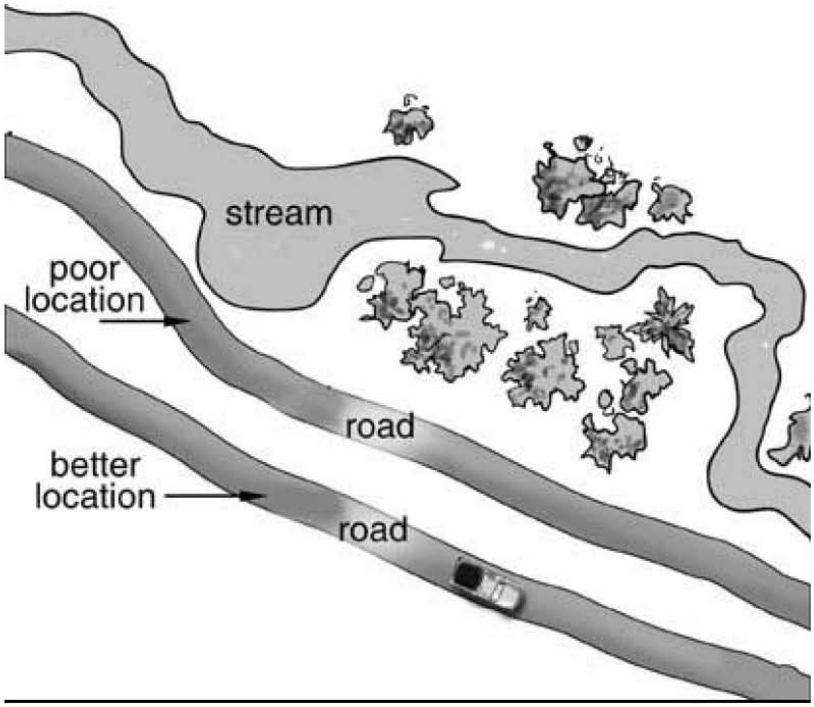
- Clearing of Vegetation.
- Soil Conservation.
- Vehicle and Equipment Use.

Minimizing Disturbances

1.2.4.1 *Clearing of Vegetation*

There are important issues for you to consider when clearing trees or vegetation. You should

- Not clear land of vegetation more than 6 months in advance of when it is required.
- Avoid clear cutting and blading with a bulldozer.
- Where possible, drive over flattened vegetation, to preserve rootstock and prevent soil erosion.
- Limit the amount of clearing with heavy machinery.
- Preserve the organic mat wherever possible.
- Avoid cutting commercial plant species (presume someone is cultivating them).
- Cut and remove unstable or snagged trees where they pose a danger to workers or could fall across the roadway.
- Not leave trees leaning into marginal timber.
- Leave large trees standing, if possible.
- When constructing access roads or other facilities, weave roads around trees or relocate facilities to help reduce the visual impact of vegetation clearance.
- Avoid removing vegetation adjacent to lakes, rivers and streams. Leave a buffer zone of undisturbed vegetation at least 10 metres wide on either side of the stream or waterway.



Leave protection/buffer zones between roads and watercourses.

Cutting Vegetation

You should be aware that each jurisdiction will have local guidelines and permit requirements for cutting and removal of trees. Ensure that you know the regulations and that all authorizations or permits have been granted before commencement of any work.

As a general guideline, you should

- Cut vegetation close to ground level to avoid dangerous 'spikes' of stumps protruding.
- Cut the boles (trunks) of trees from the stump at the root crown.
- Saw felled trees into manageable lengths.
- Trim overhanging vegetation to reduce the hazard of protruding branches.
- Not fell live trees of any species over 150 mm diameter unless absolutely necessary.

- Ensure cutters learn to recognize and avoid cutting any native species that are subject to local regulations.
- Minimize cutting in sensitive areas (see section on Special Terrains)
- Remove all introduced debris (bottles, cans, paper).

When using power equipment, you should

- Collect waste oil when changing oil and take it to an appropriate disposal area. Do not dump used oil in the bush.
- Keep a knapsack filled with not less than 10 litres of water, or a powder-type extinguisher of not less than one kilogram capacity, within reach on all work sites where chainsaws, power augers, and other gasoline-driven machinery are being used.
- Be aware of any fire bans.
- Be sure to keep the exhaust area clear of leaves and twigs when using a portable generator.

Line Cutting and Surveys

When establishing a grid and conducting ground surveys, you should ensure that

- Cut lines or walking tracks do not exceed one metre in width.
- Access to cut lines is discreet in order to reduce the possibility of subsequent misuse by unauthorized users. This is for environmental as well as safety reasons.
- Cut lines are established using only hand tools such as machete, fern hook, axe and chainsaw.
- Biodegradable tape is used in preference to ordinary plastic type. This tape will last at least two years, but will eventually disintegrate.
- Only small lengths of tape are used. "Streamer-type" markers of several metres of tape are not necessary.
- Grids in sensitive areas are only pegged and flagged with tape wherever possible rather than cut.

On completion of the program, you should ensure that

- All equipment, including wires, is removed from the grid.
- Hipchain cotton is removed from grid lines. Birds can, and do, become entangled in this line.

- Conspicuous markers such as pegs and tape are removed wherever possible, especially from the beginning of grid lines (special attention should be given to this in sensitive areas).
- All pickets are removed from ice on water courses prior to breakup.

Managing Removed Vegetation

You can use vegetation cut during the establishment of lines and during construction in a number of ways, including the acceleration of the process of re-vegetating disturbed areas. You may wish to consider the following procedures in this regard:

- Store removed vegetation so that it can be later used as a seed source, moisture retention aid and shade for new growth during reclamation.
- Incorporate some of the cut timber and slash into a road sub grade and dispose of the remainder of the slash by scattering, piling and burning, or burying.
- Use some of the vegetation that was removed as mulch.
- Lop or limb cut bulldozed trees and scatter the branches and limbs.
- Cut slashed vegetation into less than 4-metre lengths, cover with at least 1 metre of soil, and re-seed and fertilize.
- Dispose of slash such that it does not degrade aquatic habitats or pose a fire hazard.
- Check to determine if you can burn slash legally. If slash burning is permitted, do not burn during dry periods or when there is a high fire hazard. Residues from burning should be scattered or buried.

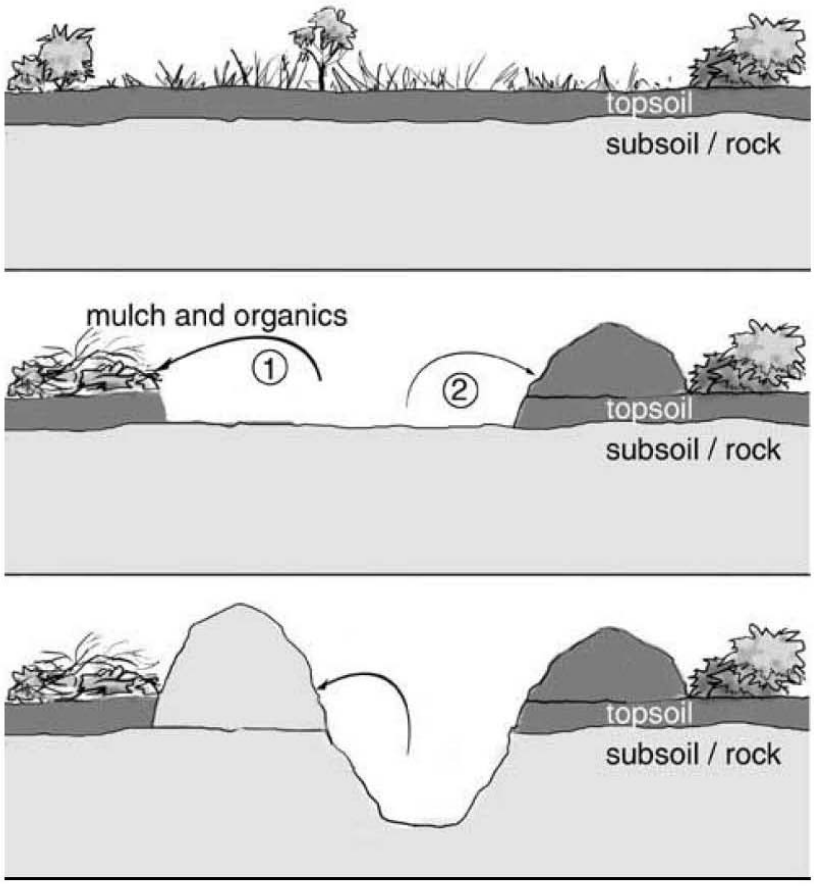
1.2.4.2 Soil Conservation

In order to protect and support vegetation that inhibits surface erosion, it is critical that you conserve topsoil in disturbed areas. Topsoil contains valuable nutrients, microorganisms, minerals, seeds, and root stocks, which are important for reclamation. Of particular importance is the seed resource of native species contained in topsoil. This seed resource is essential to restoring the diversity of plant species within the disturbed area.

You should plan all activities that disturb the ground surface in such a way that you minimize the amount of topsoil that is moved.

Stockpiling Topsoil

You should stockpile topsoil separately from subsoil and protect it for future use in reclamation.



Removal and storage of soil.

You should consider the following factors before disturbing topsoil:

- If there is a heavy mulch of decaying vegetation overlying the soil layer, it should be removed first and stockpiled separately.
- Topsoil usually constitutes the top 10-20 cm of soil, but in some areas may be very shallow.

- Excavated soil should be stockpiled for reapplication to disturbed areas.
- Topsoil and the subsoil should be stored in separate piles no higher than 1-2 metres. This ensures proper aeration for soil fauna. (Best practice for topsoil storage height from various sources ranges between 0.6m and 3m. The 1-2m height has been chosen here as a reasonable mid-point within this range.)
- Soil should be covered with permanent or temporary vegetation to prevent erosion.
- Subsoil needs to be reapplied before the topsoil.

1.2.4.3 Vehicle and Equipment Use

Mobile equipment and vehicles can damage vegetation and disturb topsoil, which accelerates erosion. You should plan your activities to minimize disturbance such as rutting and soil compaction.

You should consider the following:

- Perform work during the season in which the least amount of disturbance is likely to occur (such as winter, or dry season).
- Limit the number of routes and volume of traffic.
- Locate routes to minimize disturbance. Use frozen waterways, natural clearings, and avoid slopes.
- Use the lightest equipment and vehicles possible. For instance, use all-terrain vehicles (ATVs) in place of trucks if possible.
- Transport heavy equipment on multi-axle trailers.
- Use dedicated roads for heavy machinery and dedicated snow paths for snowmobiles where possible.

1.2.5 Managing Drainage and Runoff

Runoff is water that flows over land into natural drainage systems consisting of the streams, rivers and lakes in a region. Runoff contributes to erosion and the transport of soil into waterways.

Your exploration activities can disturb natural runoff and drainage patterns. Altering of drainage patterns through blockage or diversion can result in major changes to affected areas, such as the ponding of water, or the deprivation of water to other areas. Since drainage in arid regions is usually as sheet flow, it is important that you ensure that any land and water disturbances do not result in channelization of surface runoff.

It is important for you to anticipate the consequences of all your exploration activities, to take actions to control flow velocity and water volume and resulting erosional effects. You should bear in mind that it is generally better to spread out water than to concentrate it.