Technical Note

Site Clearing and Soil Handling on Upland Forested Sites

Introduction

This document discusses the process for construction of wellsites with consideration for their final reclamation. Upon abandonment, wellsites must be reclaimed to the standards as described in Alberta's *2010 Reclamation Criteria for Wellsites and Associated Facilities in Forested Lands.* The initial planning and construction of a wellsite have a significant impact on the cost and success of final reclamation.

Preventative Planning

Prior to construction make a detailed assessment of the proposed wellsite location to identify potential reclamation challenges and to plan mitigating strategies. Frequently reclamation problems can be eliminated by careful siting and modified construction methods. Among the challenges to reclamation that can be addresses during well location and construction are impairing natural drainage, surface soil erosion or slumping, soil compaction and extent of disturbance.

Preventative planning and actions will reduce effort and cost of reclamation. In the case of soil-related impediments to reclamation prevention may be the only successful reclamation alternative.

Impaired Surface Drainage

Avoid all natural drainages, as even small draws can have significant runoff following heavy rainfall or snow melt. This runoff can then pool on or adjacent to the site resulting in a semi-permanent or permanent wet area which will require special treatment at reclamation to ensure it will meet the 2010 Criteria. Streamflow in the boreal forest is highly variable as shown by Figure 1[1] thus even very small

[1] J.M. Buttle and R.A. Metcalfe. 2000. Boreal forest disturbance and streamflow response, north-eastern Ontario. Can. J. Fish. Aquat. Sci. 57(Suppl. 2): 5–18

ephemeral stream channels, if blocked, can result in substantial ponding of water. Figures 2 and 3 are examples of ephemeral streams that might be overlooked and thus result in semi-permanent or permanent wet areas.

Cold, wet soils are the most common and difficult manage challenge facing reforestation - thus care in construction to avoid this problem will significantly reduce the risk of failure and the cost of reclamation treatment.

Fig. 5. Daily mean runoffs for M1, L1, and M2 (1986–1993) and type of event (diamonds, snowmelt; squares, rain-on-snow; circles, rainfall) that generated each peak flow in the partial duration series.

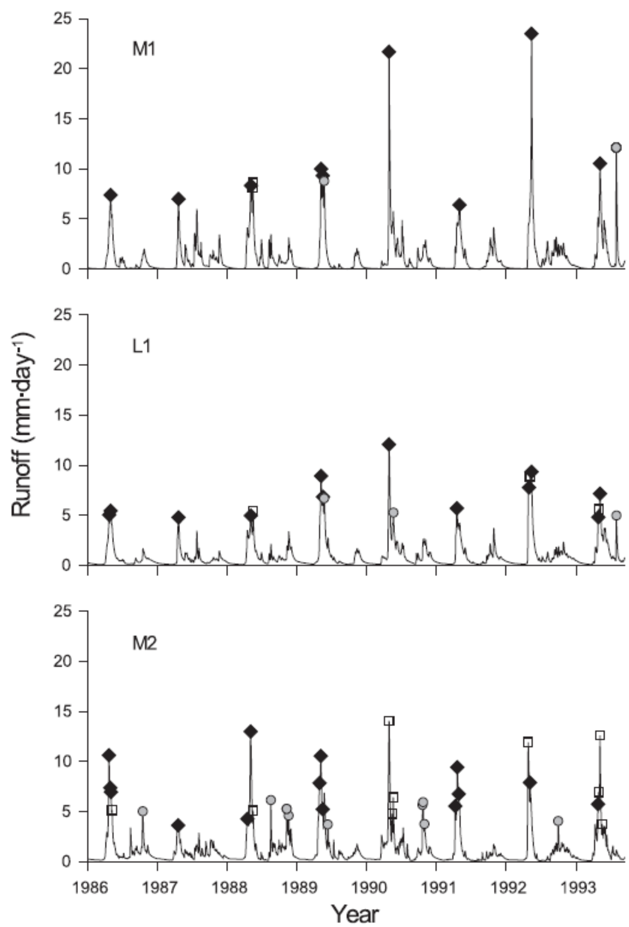

Figure 1. Streamflow events in a boreal setting (Buttle and Metcalfe.)

Figure 3. Boreal ephemeral stream channel.

Figure 2. Easily overlooked ephemeral stream that could result in flooding

Erosion Potential

Boreal forest soils, in Alberta, are generally fine textured (clays and clay loams) making them extremely susceptible to erosion. Erosion generally begins as *sheet erosion* where surface soil particles are moved by water flowing across the soil surface (Figure 4).

Figure 4. Example of sheet erosion.

Figure 5. Rill erosion (USDA-Forest Service image).

Sheet erosion is not even across the site because heavier particles are less susceptible to movement - this results in sheet erosion evolving into *rill erosion* (Figure 5) which if unchecked results in *gully erosion* (Figure 6).

Figure 6. Gully erosion arising from unchecked rill erosion.

Figure 7. Result of using erosion netting on an erodible side slope.

As the pictures clearly show it is easier to prevent erosion than to control it. Likewise it is easier to remedy sheet or rill erosion than gully erosion. The simplest way to avoid erosion is to avoid construction on slopes. Unfortunately, fine textured boreal soils are highly susceptible to erosion even on shallow slopes. Thus erosion mitigation measures such as erosion netting (Figure 7), straw bale flow blocks (Figure 8) or cobble (pit-run) armour (Figure 9) should be put in place at construction to prevent erosion. If erosion of slumping is permitted to start remediation and reclamation can become extremely expensive and are prone to failure.

Figure 8. Straw bale erosion control at install and 6 years later.

Figure 10. Cobble armour used to prevent erosion along a road cut (USDA-Forest Service image)

Figure 9. Massed soil.

Care should be taken when deploying erosion control treatments and during construction to avoid soil compaction (see next section).

Soil Compaction

The fine texture of boreal forest soils makes them extremely susceptible to soil massing (where air space in the soil is lost) or compacted (where soil structure is almost completely eliminated). Figure 10 above shows a compacted soil - note the complete lack of plant roots in this soil despite its being taken within a few centimetres of the soil surface. Clearly, soil massing or compaction poses a challenge to reclaiming the site as plant roots have difficulty penetrating such soils and slow movement of water into and through these soils results in effective drowning of plant roots. Figure 11 illustrates water ponding on the surface of a compacted well site - posing a challenge to operations as well as to reclamation. Research on boreal soils has demonstrated that wet soils are far more susceptible to massing and compaction than dry soils; but that all fine textured (clay loam, clay, silty clay, and silty clay loam) are at extreme risk of compaction. Significant effort and time are required to alleviate compaction or soil massing as the best methods of remediation involve exposing deeper (40-60 cm depth) portions of the soil profile to freeze-thaw activity. Figure 12 shows a common decompaction treatment - ploughing with Rip-plows®. Whenever possible efforts avoid trampling wet sites with heavy equipment - this can be achieved by using "boardwalks" to support equipment or by confining equipment to the keyhole portion of the site when wet.

Figure 11. Water ponding on the surface of a compacted well site.

Figure 12. Using Rip-Plows® to de-compact a road.

Reducing Area

Minimizing the area (or, at least the actively operated area) of the wellsite will reduce the cost and effort of reclamation. Minimal disturbance strategies, such as frozen pads or construction with artificial snow, can also reduce the cost and effort of reclamation(Figure 13). In all cases, where problem areas cannot be avoided, mitigating strategies must be implemented during and immediately after construction.

Figure 14. Snow padding a well site.

Figure 13. Feller-buncher harvesting trees.

Construction Operations

Clearing of the site begins with the harvest and storage (salvage logging) of the forest overstory. Hiring a professional logging contractor is the most efficient way to do this work, as they have specialized equipment and knowledge. Typically the forest products company that holds the Forest Management Agreement for the area will be able to recommend a logging contractor and may purchase the salvage wood to supplement their wood supply.

After the harvest of timber, the worksite needs to cleared of all woody debris, including stumps. Confine this clearing and stumping activity to as small an area as possible to reduce the future reclamation requirements. Spread woody debris on any slopes and exposed soils to prevent soil erosion. Also distribute as much woody debris as possible around the wellsite. During final reclamation this spread material can be recovered and redistributed across the wellsite where it will reduce erosion and help with the establishment of vegetation through shading, soil water retention and nutrient cycling. Any remaining debris must be piled and burned.

Following clearing of woody debris, the surface soil horizons are salvaged (Figure 15). This includes the forest floor litter (LFH) and all the topsoil (Ah, Ahe and Ae horizons). The forest soils in Alberta are quite thin, so only one lift is recommended with a minimum depth of 15 to 20 cm. Soil stripping and salvage should only take place under dry or frozen conditions. Stripping soils when they are wet will compact the wellsite and the salvaged soil.

Salvaged soil should be piled in a location where it will not be eroded by surface water runoff. Contour the soil piles to a stable gradient. If possible, place topsoil stockpiles in a shaded location (e.g. on the north side of standing trees). This keeps the topsoil piles cooler, reducing the rate at which soil organic matter is broken down by soil organisms thus retaining the organic matter for future reclamation. Topsoil piles should be seeded promptly with desirable plant species to reduce erosion and the establishment of weed species

Figure 15. Dozer and industrial backhoe salvaging topsoil (note storage piles).