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Repair of the Kitseguecla* Forest Service Road: A Blend of Conventional and Bioengineering Methods

Editor's Note: Kitseguecla has a number of alternative spellings including Kitsegukla and Gitsegukla. The latter is the current spelling used by the Band Council and the Gitskan First Nation.

Alan Harrison

Introduction

The Kitseguecla Forest Service Road (FSR) is located in the Kispiox Forest District, approximately 107 km west of Smithers (Figure 1). It provides access to the Kitseguecla Valley and the Chart Areas held by Hobenshield Logging and Skeena Cellulose Carnaby Division. Road use for log hauling is high and based on current forecasts, logging access to the area will be required for at least the next 25 years.

In 1995, surficial slides of both cut and fill slopes occurred at km 9.5 on the FSR, an area with a history of stability problems. At this location, the road alignment is on steep terrain with 50 % sideslopes. The soils are glacio-fluvial outwash material composed of layers of coarse gravel and thin layers of silt and clay, underlain by glacial till. The sand and gravel are relatively permeable while the layers of silt, clay and till are not. Water percolates down to the impermeable layers, flows downhill and exits on cut slopes as seepage.

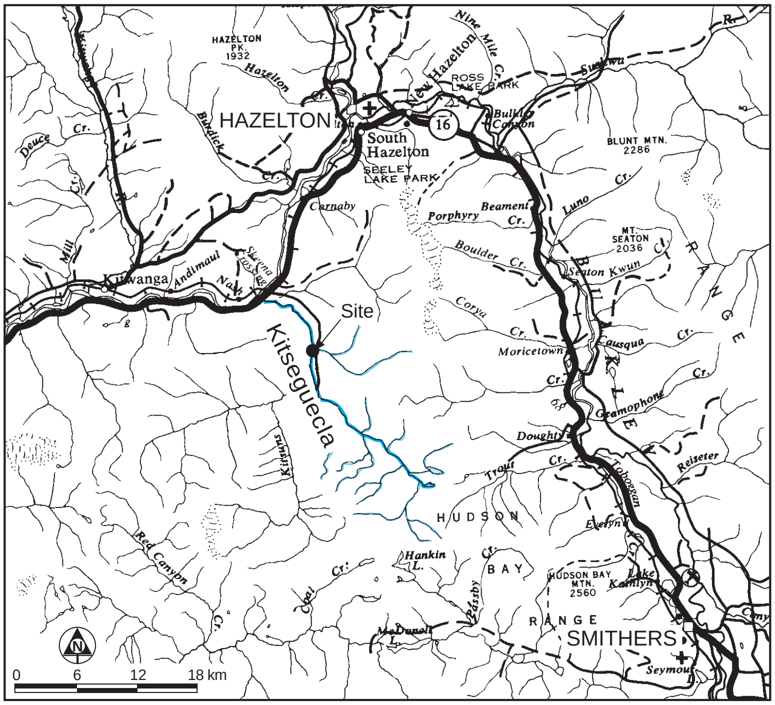


Figure 1. The location of the Kitseguecla River Watershed Restoration Project.

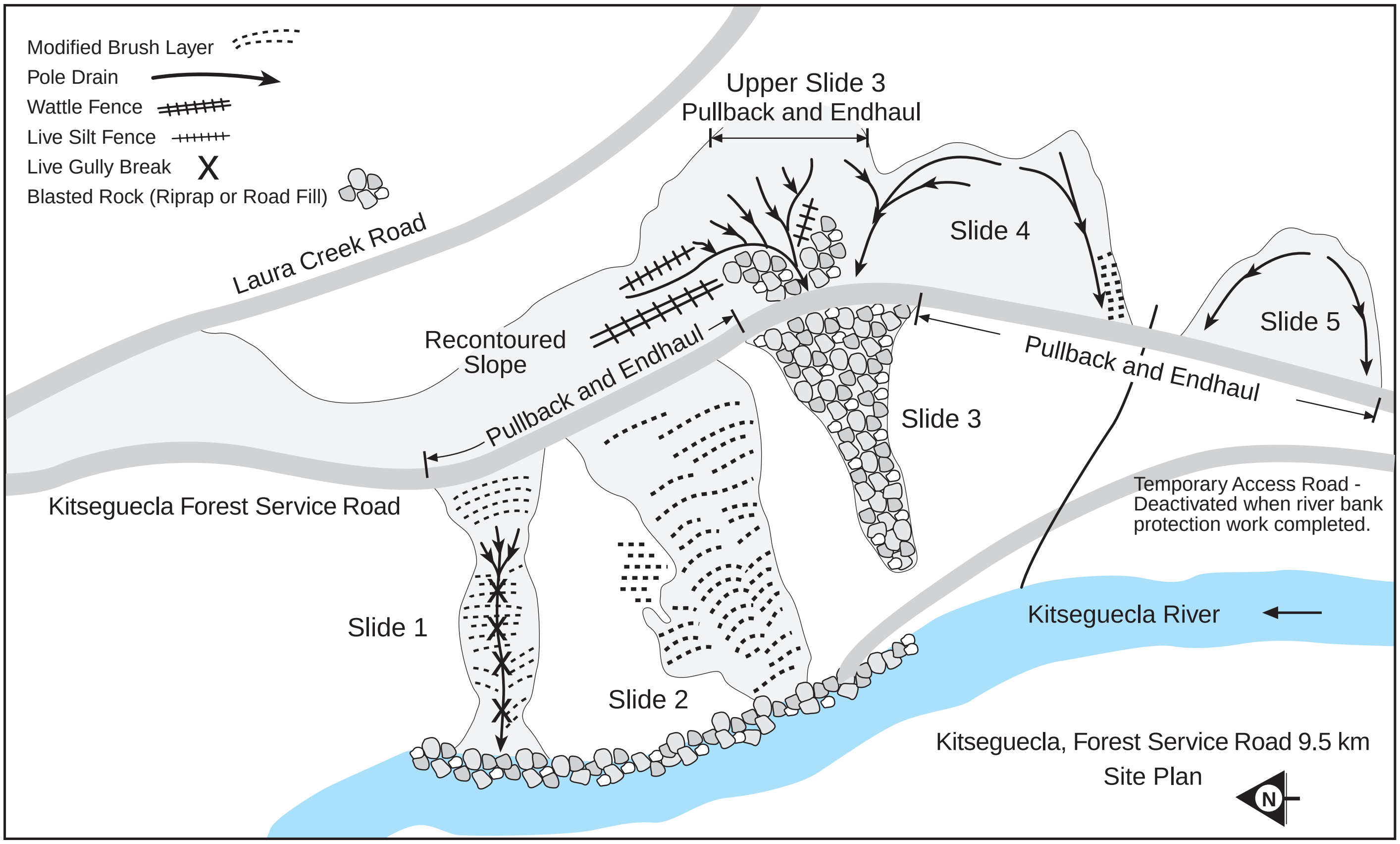


Figure 2. Site plan showing location of various completed conventional and bioengineering work (adapted from Rabnett 1997)

The road failures were caused by a combination of three factors:

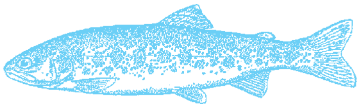
- reduction of the shear strength of the soil caused by moisture from the seepage;
- an increase in the load on the natural slope from fill material spoiled over the edge of the road during construction; and
- continuous undercutting of the toes of two of the slides by river erosion.

In 1996 the Ministry of Forests stabilized the road using the conventional techniques of reducing the load on the slope, protecting the toe from erosion and improving drainage. In 1997 bioengineering techniques of slope stabilization were incorporated to complete the project (Figure 2). The objectives of the project were to stabilize the road for safety and to reduce the delivery of sediment to the Kitseguecla River, a Class A stream.

Site Stabilization by Conventional Methods

In 1995 the Ministry of Forests designed remedial works to stabilize the road to allow continued log hauling. The estimated cost of the work was $233,000. Design features included:

- Improving the road alignment by moving the road into the hillside and away from the unstable slide scarps, removing the excess road sidecast materials from Slides 1, 2, and 3, and cutting back the oversteepened cut slopes at Slides 1 and 2. This is illustrated in Figure 3.
- Replacing the existing unstable road fill at Slide 3 with select fill (filter cloth, blasted rock and granular fill) to stabilize the road prism on the existing alignment.
- Placing a blanket of blasted rock 2 m up the cutslope above the road at Slide 3, to buttress the slope and prevent sloughing.
- Improving drainage by draining runoff away, and constructing a French Drain along the new road alignment to intercept seepage.
- Constructing a rock rip-rap berm (150 m long, 3.5 m wide) along the edge of the river to protect the toe of the slides from erosion. The berm is to provide access for construction and maintenance, and to serve as a runout area to prevent any future slides from flowing directly into the river.
- Revegetating all disturbed soil in the project area.



Forest Renewal BC contributed $75,000 funding for that portion of the project posing an imminent environmental threat. The balance was shared between the Ministry of Forests and the licensee, Skeena Cellulose.

Construction began in July 1996 under the management of the regional office of the Ministry of Forests, with site supervision contracted out to Forlands Management Ltd. of Terrace. Local contractors provided equipment on an hourly basis.

Approximately 18,600 m^3 of material from sidecast and cut slope pullback was removed to the waste area (Figure 4). To construct the river berm and to fill Slide 3 required the quarrying of approximately 4,300 m^3 of rock. Access to construct the river berm was by a temporary tote road, which was deactivated on completion of the berm. Figure 5 illustrates the completed berm. Instream construction was coordinated with, and approved by, the Department of Fisheries and Oceans and the Ministry of Environment. During construction, the latter agency found that the 3.5 m wide berm restricted river flow and required that it be pulled back and blended with the natural slope.

Conventional stabilization work was completed in 1996 except for pullback of Slides 1 and 2. This work was carried forward to 1997. The total cost of this phase of the work was $228,556. Some typical costs were $7.12 /m^3 to excavate and haul to the waste site, $10.16/m^3 to drill, blast, haul and place the rock rip-rap and $33,385 (16%) for engineering and supervision, including construction layout and as-built drawings.

Site Stabilization By Bioengineering Methods

In 1997, stabilization work continued with the major emphasis on the use of bioengineering techniques. Soil bioengineering relies on the tendency of certain plants, such as willows (*Salix spp.*) and cottonwood (*populus balsamifera*), to root and sprout new growth when plant cuttings are embedded in moist soil. The plants develop roots that resist surface

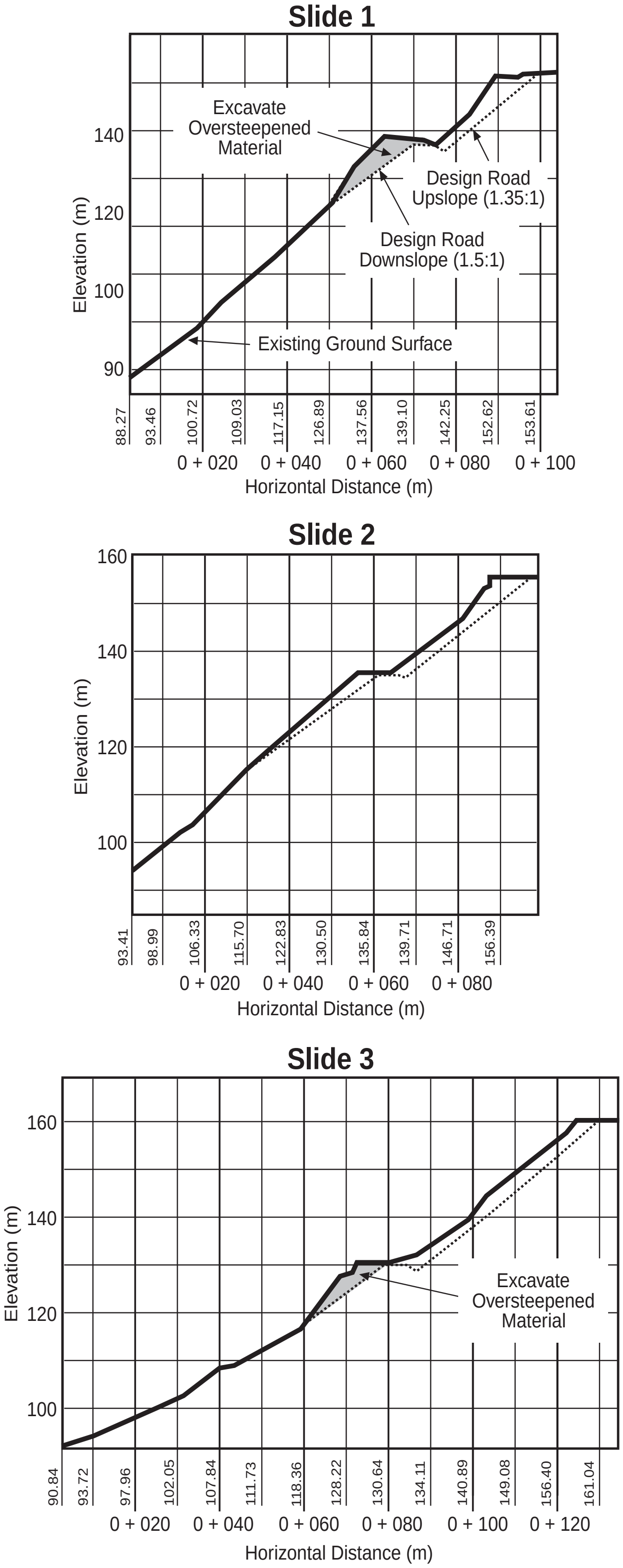


Figure 3. Road construction profiles by Ministry of Forests Regional Office (adapted from Graham 1995)

erosion and shallow mass wasting and assist in removing excess soil moisture through plant transpiration. The plants act as pioneering species allowing time for natural succession to form a more permanent cover.

The Gitsegukla Band Council, as lead proponent, managed the project. Band members carried out the bioengineering work. Workers received three days of on-the-job training under the direction of the site supervisor. The initial bioengineering work done in July 1997 followed a prescription developed by staff of the Ministry of Forests regional office in Smithers. Polster Environmental Services produced a supplemental prescription for additional follow up work that was carried out in October 1997.

A variety of bioengineering techniques were used. Modified brush layers were used on Slides 1, 2, and 4 as well as their offshoot gullies. A typical installation is illustrated in Figure 6. This technique reinforces the slope and the cuttings can provide significant mechanical strength to the soil even before they start to grow, and as the cuttings sprout and take root, this strength increases (Figures 7 and 8). In addition, the brush layers 500 lineal m of live pole drains to capture seepage water and drain it away in a controlled manner. A typical pole drain installation is illustrated in Figure 9. The pole drains consist of bundles of living cuttings, which are placed in shallow trenches to intersect, collect and conduct excess soil moisture away from unstable areas. The live pole drains grow into a dense stand of hydrophilic vegetation, which promotes site de-watering through the process of plant transpiration. The drain locations are shown on Figure 2. Figure 10 shows a worker preparing material for use in the drain.

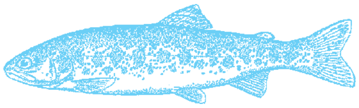


Figure 4. Conventional road stabilization, July 1996.

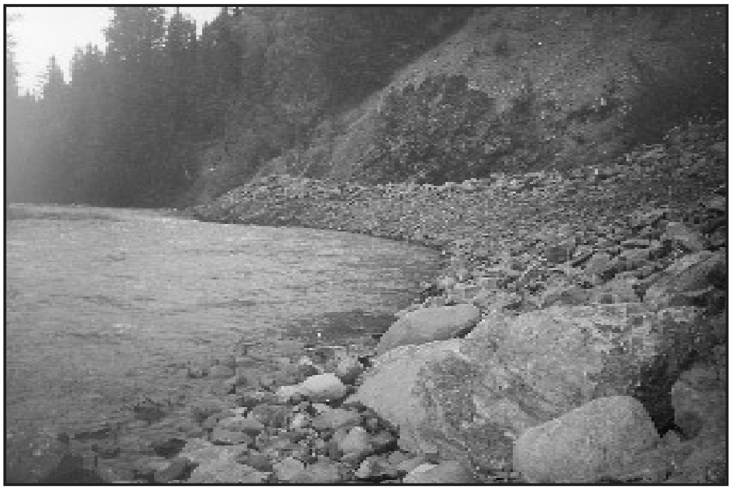


Figure 5. Finished berm constructed instream to prevent undercutting slopes.

Additional planting of alder and cedar plugs, hemlock bare root seedlings, live staking using willow and cottonwood cuttings, and dry seeding and hydroseeding was used to fill in gaps and supplement the brush layers and pole drains. The purpose is to encourage natural succession, as well as to provide complete ground cover to minimize surface erosion following initial construction. The supplementary prescription carried out in October 1997 included other techniques such as live silt fences, wattle fences and live gully breaks.

The total cost of the bioengineering work was $46,250. The bioengineering work generated approximately 225 person-days of employment, or $38,000 in wages, for local Gitksan forest workers. Unit costs were approximately $28/lineal m of modified brush layer and $19/lineal m of pole drain.

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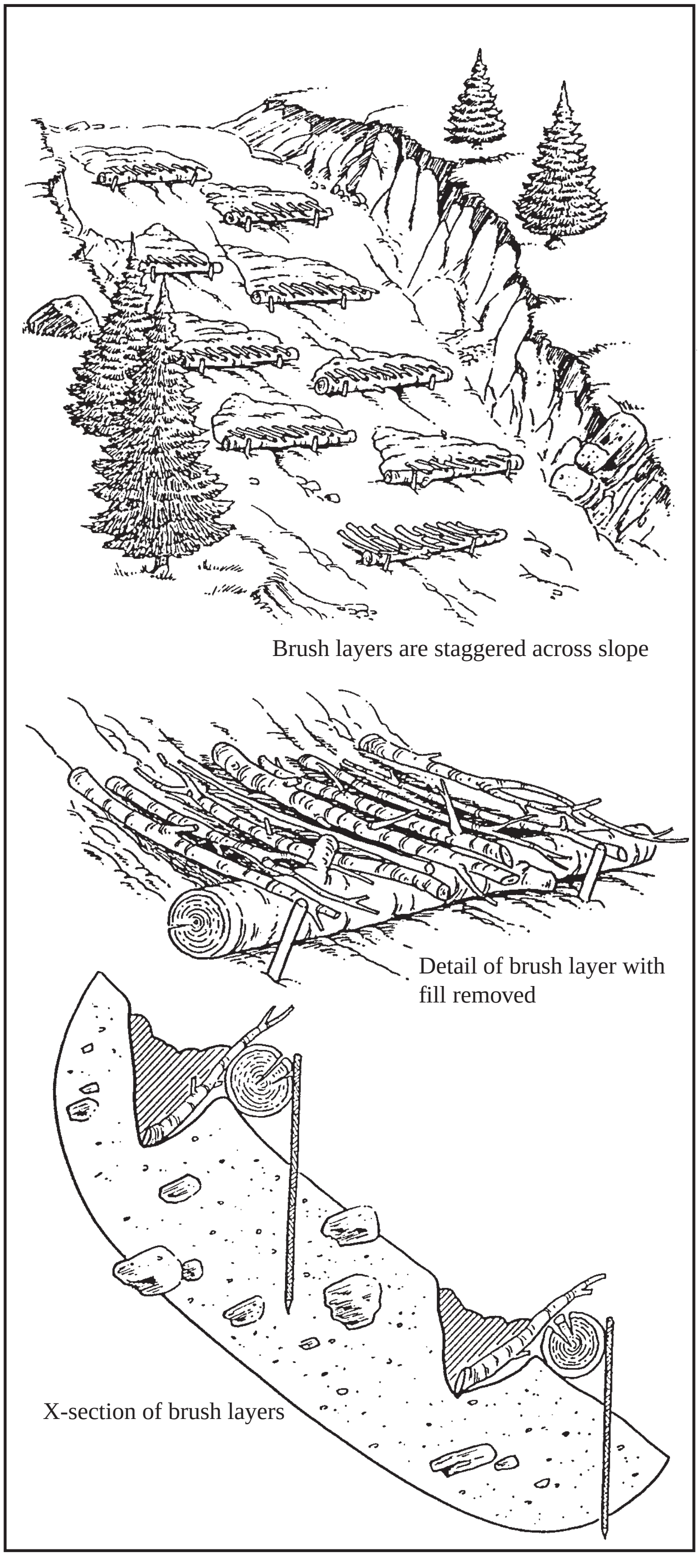

Figure 6. Brush layers provide a small terrace that settles out soil sediments. Stems, sprouted from the rhizome-like rooted cutting, trap rolling rock and soil, arresting surface material migrating down the slope (adapted from Polster 1997).

Figure 7. This forest worker is placing de-leafed, soaked, and sprouted cuttings in a modified brush layer (from Rabnett 1997).

Conclusions

This project is an example of blending the conventional slope stabilization measures and bioengineering techniques. Bioengineering techniques used alone will not stabilize an unstable area, but when used in conjunction with conventional stabilization methods can greatly enhance

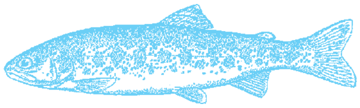

Figure 8. Three days of soaking ensures the success of sprouting. Root development is controlled by the soaking period, and is limited by the installation technique and site conditions (from Rabnett 1997).

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the results. Soil bioengineering, while not new, is becoming popular in watershed restoration projects because it employs natural, indigenous materials and produces a cost-effective solution for soil stabilization. In addition, it employs local workers, thus helping to meet the employment and community stability goals of Forest Renewal BC.

As with all stabilization work, soil bioengineering requires maintenance to ensure continued integrity of the work and periodic monitoring to assess the effectiveness in attaining the goals of the project.

Figure 10. Forest worker preparing cuttings for live pole drain construction (from Rabnett 1997)

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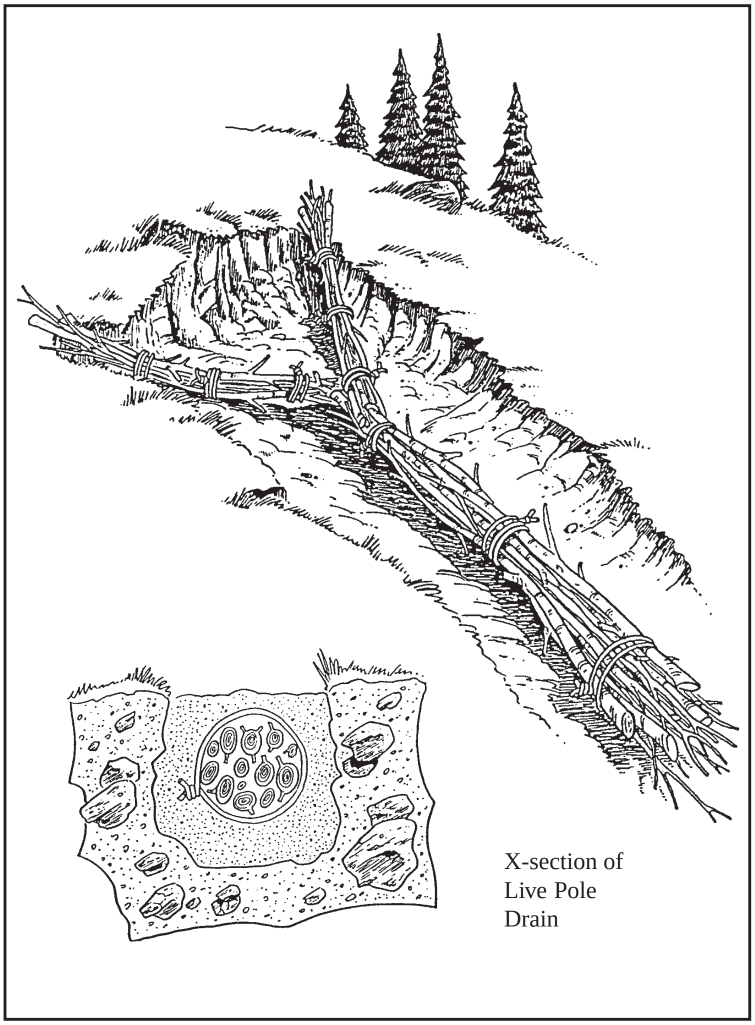

Figure 9. A typical installation of a live pole drain (adapted from Polster 1997)

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