Executive Summary

The University of Washington’s Forest Engineering Class of 2002 presents the Transportation & Road Management Requirements to Facilitate Habitat Restoration in the Tyee South Planning Area. This project is a result of the collaboration between the Washington State Department of Natural Resources (DNR) and the University of Washington’s College of Forest Resources (UW). In completing this project, the FE seniors have provided, for the DNR, verification of US Fish and Wildlife projects as viable by verifying road use conditions for existing roads and analysis for developing viable action plans. For the UW (and themselves) they have gained practical experience in working on a major project as well as skills in forest engineering practices and technology.

This report details a harvest and transportation plan that works towards the goal of habitat restoration in the Tyee South planning area through careful setting and road design over the course of 30 years. It is based on several months of planning, analysis, and design both in the office and in the field.

Project Expectations and Results

The DNR presented the UW with the following desired goals for the project

Goals/Expectations:

• General objective is to prepare harvest plan that optimizes costs
• Expectations/Proposed objectives
• Specific harvest plan
• Economic analysis
• Field locations for road locations & setting boundaries
• Structure design for any fish-bearing stream crossing
• Use lidar data to develop stream restoration plans three fill removals for abandonment
• Update trans layer
Results:

- 6 miles of designed new roads, and 5.6 miles of reconstruction.
- New roads are staked out in the field, although settings are not as they were designed in the office after fieldwork.
- One bridge design with AutoCAD and RoadEng files.
- When we arrived in the field, the abandonment sites that needed fill removal had already been surveyed, so all those notes should be on file for use in volume calculations.
- Setting design with harvest phases over 30 years, including thinnings and final cuts.
- Economic analysis for harvest settings and road designs over three decades.
- Map deliverables both on disk and with the report, including setting design, preliminary design work, working field maps, unstable areas, lidar-based stream locations, and orthophotos.

Road Design

Listed below are some summary statistics for the road design. The majority of roads that we designed were close to $1400 per station.

- Total network road length: 12 miles
- New construction road length: 6 miles
- Reconstruction length: 5.6 miles
- Cost per station: $900-$1800

<table>
<thead>
<tr>
<th>Road</th>
<th>Grade Range %</th>
<th>Stations</th>
<th>Cost ($)</th>
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</thead>
<tbody>
<tr>
<td>South Tyee Loop</td>
<td>0-20</td>
<td>101+56</td>
<td>181501</td>
</tr>
<tr>
<td>Road Off STL</td>
<td>0-15</td>
<td>23+20</td>
<td>57699</td>
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<tr>
<td>GUNCC</td>
<td>0-16</td>
<td>22+00</td>
<td>61648</td>
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Table 1. Designed roads with grade range, stations, and total construction costs.

The roads in Table 1 were designed using RoadEng, and the designs are included on the included data CD. These roads are also staked out in the field, so only restaking for offsets and adding cut/fill information is required to begin construction.

A bridge design is included with the overall road design. The location allows the use of only one bridge at a reasonable span (50-feet) and also keeps the main access route completely on state land.
Environmental Analysis

Environmental analysis for the planning area consisted of slope stability analysis using the Shaw-Johnson model, sediment delivery using a new model developed at the University of Washington by Florentiu Damian, and stream generation using high-quality digital topography.

Slope stability analysis shows a gradation of risks of instability across the planning area. Most of the truly unstable areas are located on the steeper sideslopes with a high curvature value, usually in deep draws. For the most part, the Tyee South is relatively stable and the slopes are generally less than 50%, except for some areas on Gunderson Mountain and the very south end of Tyee Ridge. The areas that have a greater risk of instability on Gunderson Mountain, for example, are located outside the immediate planning area on the east side of the mountain.
Sediment delivery from cross drains, arguably one of the major contributors to overall sediment delivery to aquatic resources, was analyzed for the area using a new GIS model developed at the University of Washington by graduate student Florentiu Damian. Using the model, one can interactively place cross drains in such a way as to minimize sediment delivery impacts. As seen in the examples below, adding a cross drain in the right place can minimize sediment delivery from subsequent cross drains.
One of the aspects of stream generation in GIS was discovering the differences between stream locations in the state HYDRO layer and where GIS predicts where streams should be (see Figure 5 below). The largest effect of these locations is a great increase in the landbase taken out of consideration due to buffer requirements. It should be noted that while the GIS method of “flowaccumulation” puts streams in their expected channels, it can both over- and underestimate the stream lengths. As well, due to the time constraints on the project stream typing could not be done. Because of this, we assumed an average
buffer width of 75-feet just to get an idea of what effects buffer requirements would have on the harvest settings (see Figure 6).

**Figure 5.** This figure shows an enlarged view of Tyee Study Area, showing stream channels and DNR stream layer and LIDAR produced stream layers. State HYDRO is in yellow, while the streams generated in GIS are in blue. The background is a hillshade from the LIDAR-based digital topography.

**Figure 6.** LIDAR generated streams and their buffers. Average buffer width is 75 feet.
**Harvest Phases**

The harvest plan for the Tyee South planning area covers the time from present to about 2034. This period of time is about right for one rotation for all the stands in the area, from the older stands to the younger. This period of time is broken up into three phases for planning purposes. They are as follows:

- Phase I 2005-2014
- Phase II 2015-2024
- Phase III 2025-2034

Each phase comprises a series of expected thinnings and final cuts distributed across the area. Plus, by organizing a series of phases allows decision-makers to have greater flexibility in assigning harvest units over time to allow for green-up periods.

**Executive Conclusions**

The University of Washington Forest Engineering Capstone Project provides a feasible set of harvest and road designs for the Tyee South Planning Area. This project, as with those in the past, represents a successful collaboration between forest engineering students and DNR staff in which students gain valuable hands-on experience.

The following report presents a detailed harvest and transportation plan for the Tyee South Planning Area based upon months of planning and analysis in the office and field. The plans here provide a starting point for management decisions in this area for the years to come.