Appendix C

Implementation and Effectiveness Monitoring of Wetland Best Management Practices on the Tongass National Forest

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Newly Constructed Road through a Wetland on the Skipping Cow Project Area

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Introduction and Background

The Tongass National Forest Monitoring Plan (1997) includes wetland implementation and effectiveness monitoring questions. The wetland questions stated in Chapter six of the Forest plan are:

- Are wetland standards and guidelines being implemented?
- Are wetlands Standards and Guidelines effective in minimizing the impacts to wetlands and their associated functions and values?

Wetlands Standards and guidelines are provided on page 4-111 of the forest plan. The Standards and guidelines incorporate the State Approved BMPs in FSH 2509.22 and the 15 Baseline Provisions from 33 CFR 323.4. The 15 Baseline Provisions are also listed in BMP 12.5 (FSH 2509.22).

Routine BMP implementation monitoring documents whether or not BMP 12.5 was prescribed or implemented, and qualitatively assesses if the amount roads in wetlands are minimized, if vegetative disturbance was minimized in the wetlands, and if borrow sources are located in upland areas. Implementation monitoring has also documented acres of wetland loss at the forest scale. Quality control of routine BMP implementation monitoring is conducted on a random sample of sites. The random site selection may or may not include sites with wetland impacts.

In 1999 a group of watershed specialists met to discuss the wetlands effectiveness monitoring question. The group discussed several ongoing research studies that had the potential to answer part of the effectiveness monitoring question. Of particular interest were McGee's master's thesis (2000) regarding road/soil-water interception. During the 1999 meeting a need for a better wetland classification system was identified. There is a desire to have a wetland classification system that can be used to help identify wetland functions and be crosswalked with the existing USFWS (Cowardin system) and the Common land Unit (wetlands habitat types) derived from interpretation of soil data. The 1999 group also discussed the assessment of wetland functions and values. Wetland values are based on human perceptions and are subject to change with time and may be specific to a project area. The 1999 group stated that an assessment of wetland values would not be addressed in a Tongass-wide protocol. (See the wetlands section of the 1999 Monitoring and Evaluation Report for the Tongass.)

Following the 1999 meeting work began on a Tongass wetland classification system. By 2003 the wetland classification system became part of a larger vegetation classification system to populate the Existing Vegetation module of the National Resource Information System database (2003 M&E Report). At current funding levels, several more years of data collection will be required before a vegetation classification can be developed.

The 2002 and 2003 M&E reports indicate that a wetland functional assessment literature review would be completed by the Forestry Sciences Lab and that the assessment would help determine if the wetland monitoring protocols outlined in "The Impacts of Forestry roads on Peatlands within the Tongass National Forest, Southeast Alaska" (Glaser,1999) or the "Effects of forest roads on surface and subsurface flow in Southeast Alsaka (McGee 2000) are still the direction we wish to go, or if new protocols are needed. The

wetland functional assessment is in draft form and it did not recognize or choose a wetland effectiveness monitoring protocol for the Tongass. M&E reports since 1999 have stated that the wetlands classification system is a necessary precursor to implementing wetlands effectiveness monitoring projects.

As of fiscal year 2005 a direct answer to the wetlands effectiveness monitoring question is still pending. The wetland classification system and existing vegetation classification system is still in progress. A wetland functional assessment literature review was drafted in the form of a problem analysis, but is not finalized. The timber sale program on the forest is greatly reduced in size and the amount of wetlands impacted on an annual basis is also greatly reduced. The strength of the wetlands monitoring question is somewhat less than when the questions were included in the 1997 forest plan.

The Corps of Engineers and US Fish and Wildlife Service have commented on the Forest's approach to displaying wetland avoidance, and wetland loss in annual monitoring and evaluation reports. They are concerned that at the Tongass National Forest scale (16.8 million acres) the acres of wetland lost due to road construction are meaningless and does not provide a context for wetland loss at the watershed or landscape scale.

In the long-term a Tongass specific wetland classification system is a key component for identifying and assessing specific wetland functions. At current funding levels a wetland classification system specific to the Tongass National Forest will take several years to complete. To answer the effectiveness monitoring question in the short-term, a different approach is needed.

For fiscal year 2006 the forest plan wetland monitoring question was reviewed and a method was designed to qualitatively assess the implementation and effectiveness of the standards and guidelines in avoiding and minimizing impacts to wetlands. This question review and protocol development was documented by Landwehr (2006). This report presents the findings of the first year of implementing this approach and makes recommendations for future monitoring.

The intent of this monitoring is not to supplant or replace the long-term approach the forest has taken to develop a Tongass specific wetland classification system and to subsequently document functions for each wetland type. The monitoring design for fiscal year 2006 and the short term (until a Tongass specific classification is completed) is to qualitatively assess the implementation and effectiveness of the 15 federal wetland baseline provisions to determine if they are effective in avoiding and minimizing impacts to wetlands. A second goal is to document the physical and hydrologic impacts to wetlands. The revised wetland monitoring protocol (Landwehr 2006) includes four basic components:

1) Revised wetland avoidance documentation at the project scale,
2) Cross-walking, to the extent possible, existing wetland classification schemes,
3) Qualitative assessment of the implementation and effectiveness of the 15 Baseline Provisions in avoiding wetlands and minimizing impacts to wetlands,

4) A quantitative wetland impact analysis based on physical measures of wetland soil disturbance within the road corridor and a literature review to determine the extent of wetland hydrology impacts beyond the disturbed road corridor.

This report will not include the results for item number 1 because the forest is currently including this recommendation in project-level NEPA documents in progress.

Purpose and Need

There is a need to document wetland avoidance at a scale that meets the intent of the Baseline Provisions and concerns identified by cooperating agencies. There is a need to display how well implementation of standards and guidelines (baseline provisions) minimize impacts to wetlands. There is a need to understand and clearly articulate the impacts of forest roads on wetland hydrology, and specifically the conversion of wetlands to uplands. There is a need for a wetland classification system that provides the appropriate level of detail to estimate hydrologic effects of roads and timber harvest. There is a need for a wetland classification system that defines wetland types in a way that is easily understood between agency representatives, resource specialists, and land managers.

Objectives

- Test a revised wetland monitoring protocol that incorporates stakeholder concerns.
- Discuss existing wetland classification/mapping systems at each site to determine if the existing classification systems adequately describe our wetlands and if the existing classification systems can be cross-walked.
- If no existing classification system fits our wetlands, identify the important wetland characteristics that are missing.
- Determine if wetland avoidance and minimization was achieved for each road segment reviewed.
- Describe the physical impacts to the wetland.
- Review the literature for pertinent information related to the effects of roads on wetland hydrology for the wetland types encountered.
- Once a year bring together wetland scientists and stakeholders to discuss wetland classification and monitoring protocols.
- Implement the wetland monitoring protocol together in the field.

Methods

The methods for the revised wetland implementation and effectiveness monitoring are detailed in the *Proposed Wetland Monitoring Protocol* document (Landwehr 2006). Briefly the Methods for each of the four components of the monitoring are as follows.

1) At each of the 3 to 5 randomly selected wetland/road segments document the wetland habitat type (DeMeo and Loggy 1989), the National Wetlands Inventory System-subsystem-class-subclass, The Wetlands of British Columbia wetland

type, and the Soil Series. Discuss and describe best classification fit for the wetland in question.

2) Using the standard forms developed, qualitatively assess the implementation and effectiveness of each of the 15 Federal Baseline Provisions (Wetland BMPs) described in 33 CFR 323 (4).
3) Assess physical impacts to the wetland soils by measuring the area of disturbed soils. Along each road section take evenly spaced cross section measurements of the road running surface, road fill, disturbed soil width, soil slope and road gradient.
4) For the wetland types encountered, determine if there is literature available to estimate hydrologic effects to the wetland beyond the disturbed soil corridor.

Site Selection

Road Segments across wetlands were identified by asking each of the Tongass Districts to describe project areas and miles of road constructed across wetlands. Three districts responded with projects that constructed roads across wetlands in 2006. To save travel costs one project area with the most new road constructed across wetlands (Skipping Cow Project Area) was chosen. Using soil maps, NWI maps, and the road maps in a GIS individual road segments across wetlands were identified. A random group of these road segments were selected for monitoring.

Results and Discussion

In FY 2006 four road segments constructed through wetlands on the Skipping Cow Project Area (Zarembo Island) were measured. The total length of the four road segments was 6,459 feet (1.97 km). The new roads on the Skipping Cow project accessed the top of Nesbitt Ridge and another ridge to the southeast of Nesbitt Ridge. All wetland road segments were located on these two ridges. Elevation of the wetland road segments ranged from 1400 to 2100 feet (427 to 640 meters). The sites were located on summit and shoulder slope landscape positions on the rounded summits landform. The soils on three road segments were shallow (less than 50 centimeters to bedrock) and consisted of poorly and very poorly drained peat or mineral soil. On one road segment the soil consisted of moderately deep and deep (50 to 150 centimeters) very poorly drained peat.

Wetlands Classification Crosswalk

Existing wetland classification systems were used to identify wetlands along the four road segments constructed across wetlands. None of the existing wetland classification systems perfectly fit the wetlands encountered along the four road segments monitored. Each of the wetland classification systems documents different characteristics of the wetland. The wetland classification system that best fits the forest's purposes depends on the interpretation the forest wishes to derive from the classification system. For purposes of assessing the effectiveness of the 15 Federal Baseline Provisions in preserving wetland functions the classification system should focus on hydrologic characteristics of wetlands and vegetation characteristics of wetlands. Hydrologic characteristics should include precipitation characteristics, runoff characteristics, soil permeability, available water holding capacity, pH, conductivity, and landscape position. Vegetation characteristics

should include enough detail about species composition and abundance to correlate vegetation with hydrologic function. At a minimum the new classification system needs to be a tool that is easily understandable for the public and personnel from cooperating agencies. A brief discussion of each of the classification systems and the functions they quantify follows. Table 1 provides the wetland name by classification system and road segment number for the Skipping Cow wetland sites measured.

Table 1. Wetland classification by road segment number.

Road Segment Number	**NWI classification**	**Wetland habitat type**	**Wetlands of British Columbia**	**Canadian Wetland System**	**Soil Series**
6594	PFO4/EM1B	FW or FEF	Ws55	Treed Sloping Bog	St. Nicholas
52033 #2	PFO4/EM1B	FEF	Ws55	Treed Sloping Bog	Sunnyhae & St. Nicholas
52033 #3	PFO4/EM1B	FES	Wb53 variant?	Treed Sloping Bog	Sunnyhae & St. Nicholas
520332	PEM1B	MS	Wb53	Sloping Fen	Grindall

The National Wetlands Inventory (NWI) Classification (Cowardin 1979) is a nation-wide classification system that provides a very coarse descriptor of wetland vegetation and hydrology. The NWI classification has four components, system, subsystem, class, and subclass. A NWI code of PFO4B equates to a Palustrine Forested Needle-leaved Evergreen wetland on saturated soils. Modifiers can be used to more accurately describe the water regime, water chemistry, soil or other special circumstances. The NWI is a nation-wide system that is easily communicated to other agencies and interested publics. NWI maps are available for most of the Tongass. The drawback to using NWI is that it lacks the detail necessary to differentiate between wetland types at all but a very coarse scale. NWI does not provide good descriptors for estimating wetland hydrologic or habitat functions.

The wet-hab wetland mapping system was derived from a need for a wetland map for the 1997 Tongass Forest Plan revision (DeMeo and Loggy 1989). The wetland habitat-type is an interpretation of soil and vegetation data. The wet-hab types provides more detail on wetland vegetation than the NWI, but still lacks detail regarding landscape position and vegetation community. Like NWI, the wet-hab does not provide the descriptors necessary for estimating hydrologic function or detailed habitat functions.

The Wetlands of British Columbia Classification provided the most detail regarding plant communities and landscape position (Mackenzie and Moran 2004). Unfortunately, Wetlands of BC did not provide a direct fit for any of the plant communities documented along the four road segments monitored. Most of the sites had slope bog characteristics

with poor fen vegetation. The wetland on the 520332 road had more definitive fen vegetation. The St. Nicholas soils identified on the 6594 segment and the 52033 segments did not have the density of skunk cabbage necessary to classify as the swamp forest (Ws55), nor was it acid enough to fall into the treed bog Wb53 site association. Modifications to the Wetlands of British Columbia Classification would be necessary to adequately describe wetland vegetation in Tongass wetlands. Based on experience on the Skipping Cow Sale, the northern part of the Tongass, especially the Yakutat Ranger District, is far enough removed from British Columbia that wetlands encountered will likely be further outside the range of characteristics found in wetlands described in the Wetlands of British Columbia. The level of vegetation detail is the highest of any of the classification systems discussed, but this system does not make a strong linkage between vegetation and hydrologic function.

The Wetlands of Canada Classification System (National Wetlands Working Group 1988) is a hierarchical classification based on surface features, soils, water source, and vegetation type. The vegetation type is based soley on life form class. This system provides the highest level of detail regarding landscape position and topographic form but still lacks enough detail to estimate wetland hydrologic and habitat functions.

Three different soil series were represented on the four sites (Table 1). Wetland habitat types are designated by a correlation with soil map unit, so it should not be a surprise that 4 wetland habitat types were present based on the combinations of the three soils in different soil map unit complexes. Soil mapping and wet-hab mapping directly matched the soil series found on the 52033 #2 and #3 road segments. On the 6594 road Niblack soils were mapped and St. Nicholas soils were typical along the road segment. The 6594 segment is located near the polygon boundary where the soil transitions to a well drained hill-slope soil down slope. On the 520332 road segment the soil mapped was deeper and slightly more ombotrophic than the Kina soil identified by soil mapping at this segment. The soil series provided necessary detail regarding soil permeability, available water holding capacity, and soil depth. These details are important for determining how water resides in the soil and how water moves through the soil. The soil series did not provide adequate information on landscape position to document hydrologic effects of a road crossing on the wetland. The soil series provided only cursory vegetation information. Soil Map units have been mapped over much of the Tongass National Forest.

The non-forest wetlands classification system currently being developed for the Tongass National Forest will eventually provide a wetland classification system specific to Tongass wetlands. The classification system needs to incorporate the criteria needed to make the desired interpretations. Specifically soil information, vegetation information, and landscape position need to be incorporated in the classification of wetlands. Until the Tongass specific classification system is developed, we suggest continuing to refine the crosswalk between the existing classification/mapping systems for the wetlands encountered during annual monitoring trips. This data will continue to provide insight into needed wetland interpretations and the data (wetland characteristics) necessary to support the interpretations.

Assessment of the application of the 15 Federal wetland Baseline provisions
The 15 Federal wetland baseline provisions (Wetland BMPs) are described in 33 CFR 323 (4). Criteria to measure or qualitatively evaluate each of the 15 Baseline Provisions have been developed. See Appendix B, Monitoring Forms, for a list of the criteria by baseline provision.

Note that 33 CFR 323.4 describes application of State approved Best Management Practices (BMPs) *and* the 15 Baseline Provisions (BPs). For the Tongass National Forest the State approved BMPs include the BMPs in Forest Service Handbook (FSH) 2509.22. Implementation of the State approved BMPs is monitored annually through routine BMP implementation monitoring. The 15 Federal Baseline provisions are included in their entirety in FSH 2509.22 BMP 12.5. Effectiveness monitoring of State Approved BMPs also occurs for items like aquatic life passage. The protocol document (Landwehr 2006) describes the existing implementation and effectiveness monitoring that directly and indirectly pertains to several of the 15 Federal Baseline Provisions. Quality control of the routine BMP implementation monitoring relies on a random sample of projects and selected projects may not include wetland areas. The revised wetland monitoring protocol was written to ensure that monitoring of the 15 Baseline Provisions would occur on an annual basis.

The 15 Baseline Provisions can be grouped into three categories; 1) wetlands avoidance provisions, 2) provisions to minimize impacts to wetlands, and 3) provisions to mitigate impacts to wetlands. Eight of the 15 provisions are written to avoid wetlands in general or wetlands with specific characteristics (i.e. waterfowl breeding areas). Six of the provisions are focused on minimizing impacts to wetlands from roads. One of the provisions is written to mitigate impacts from temporary fills. The baseline provisions emphasize avoiding and minimizing impacts to wetlands.

Appendix A provides detailed findings from the monitoring of each baseline provision for the four road segments monitored. The results will further be summarized here by the three categories, 1) avoidance of wetlands or avoidance of effects to wetlands, 2) minimization of impacts to wetlands, and 3) mitigation of impacts to wetlands.

Baseline Provisions to avoid wetlands
All of the road segments through wetlands monitored in FY 2006 were constructed as part of the Skipping Cow Timber Sale Project. All of the wetlands were identified on the road cards for the project. Estimated lengths of roads through wetlands on the road cards were similar to the lengths of road implemented. The road cards in the Skipping Cow FEIS and ROD provide documentation at to why the wetland could not be avoided in road location. The inventory data used provided a reasonable estimate of miles of road through wetlands. In the case of the 6594 road segment, the road was located lower on the hill than anticipated on the road card, thus impacting less wetland area.

Within the context of overall project goals and objectives wetland avoidance was generally good along the road segments monitored. The ratings (on a scale from 1 to 5) were either 4 or 5. Baseline provision number 8 addresses borrow sources in wetlands.

On two road segments monitored rock pits were developed in wetlands because there was no practicable upland alternative. In both cases implementation of BP 8 was rated a 3 because more wetland was impacted than necessary. In both cases over shots occurred during pit development resulting in shot rock burying short sections of intermittent streams (Tongass non-streams) in the wetlands.

Several of the avoidance baseline provisions were not rated because the specific wetland characteristics were not present in the wetland monitored. Examples are: BP 9 which describes avoiding habitat of threatened and endangered species, BP 10 is about avoiding breeding and nesting areas for migratory waterfowl, BP 11 is about avoiding public water supplies, BP 12 is about avoiding areas of concentrated shellfish production, BP 13 speaks to avoiding components of the National Wild and Scenic River System.

Baseline provisions to minimize impacts to wetlands

Baseline provisions to minimize impacts to wetlands were rated between 3 and 5. The installation of culverts for cross drainage was rated a 3 on two segments. The lower ratings were due to the lack of cross drains on intermittent streams that were flowing during the monitoring trip. In six cases the streams appeared to be flowing unimpeded through the shot rock road prism. In four instances the inside ditch was diverting small

Figure 1. Water flowing through shot rock fill on the 520332 road segment.

intermittent streams short distances to culverts. In two cases small muskeg ponds were unnecessarily drained.

Other reasons for lower ratings for baseline provisions that seek to minimize impacts to wetlands included the size of road turnouts. Several turnouts on the 52033 #2 road segment were larger in size than typical turnouts on forest roads. Road turnouts are necessary for safety reasons and for turning around vehicles. The contract specified minimum turnout sizes of 16 by 20 feet (4.9 by 6.1 meters). The contract does not specify a maximum turnout size. Some turnouts measured were nearly double the minimum width and depth measurements. If turnout size in wetlands continues to be a concern identified in the wetland monitoring, maximum turnout size in wetlands could be specified in road contracts.

Operator errors made while pioneering resulted in lower ratings for several baseline provisions. The errors were likely the result of pioneering road construction on the 52033 road when up to two feet of snow was present on the ground. The snow cover resulted in the equipment operator placing fill outside the final road prism in some areas, unnecessarily draining two small muskeg ponds, and equipment operation outside the clearing limits for approximately 150 feet (45.7 meters). If road pioneering when snow is present is causing unnecessary impacts to wetlands, road construction contracts could specify road that pioneering only occur when snow is not present.

Figure 2. Small wetland pond inadvertently drained while pioneering in the snow.

Shallow soils on steep slopes resulted in disturbed soil widths that were wider than those estimated for the roads through wetlands on the Skipping Cow Timber Sale and a lower rating for BP 5. All of the wetland/road segments were located in high elevation areas near the summits of hills and plateaus. The soils in these areas were typically less than 20 inches (50 cm) thick over bedrock and consisted of organic and mineral soils. Slopes were generally 15 to 20 percent but ranged from 1 to 43 percent. Road construction involved grubbing or scraping the thin soil from the bedrock and using it to construct a level road sub-grade to which two feet of cap rock is applied. Due to the thin soils in this area the hoe operator reached as far as possible from the road prism to scrape soil from the bedrock to construct the road prism. This practice resulted in an average disturbed soil width for these four road segments of 45.5 feet (13.85 meters). Contract specifications allow grubbing within the clearing limits which in this road contract were typically 75 feet (22.86 meters). The Skipping Cow FEIS estimated a 24 foot (7.3 meters) wide disturbed soil corridor associated with roads in wetlands.

Grubbing seemed excessive on the 52033 #2 road segment where the average of 10 cross section measurements was 52.7 feet (16.1 meters). The width of grubbing could have been limited to the road prism in most wetland areas if more rock overlay would have been used rather than soil to build a level road base. The road fill widths averaged 25.2 feet on the four road segments monitored. The average road fill width is similar to the 24 foot road width predicted for road impacts to wetlands in the Skipping Cow FEIS. If rock overlay would have been used to construct the road segments we monitored physical impacts to wetlands could have been 45% less than the cut-and-fill road construction method. The four road segments monitored totaled 6459 feet in length. The average disturbed soil width was 45.5 feet for 6.75 acres of wetland impacted. The average road fill width was 25.2 feet and covered about 3.73 acres of wetlands. Less area of wetland would have been impacted if rock overlay was used versus cut and fill. The cost of the additional rock needs to be weighed against the environmental cost of wetland soil disturbed next to the road prism. The additional rock for overlay construction would have resulted in additional size of rock pits, some of which are located in wetlands.

The road running surface width is designed at 14 feet (4.3 meters) plus 2 feet (0.6 meters) for tolerance. All road running surface widths measured were within the contract specifications for forest roads.

The baseline provision requiring stabilization of fill was rated a five on all road segments monitored with one caveat. The engineering representative and the contractor mutually agreed to waive the requirement for an erosion control plan. The engineering representative felt that the contract specifications provided enough detail so that an erosion control plan was not needed. The erosion control plan could have provided the timing for installation of erosion control practices such as grass seeding and timing for pioneer road construction.

Baseline provisions to mitigate impacts to wetlands
Baseline Provision number 15 states that all temporary fills shall be removed in their entirety and the area restored to its original elevation. All fills in wetlands monitored in FY 2006 are permanent fills and thus BP 15 was not rated.

Assessment of Wetland Impacts
Under the revised monitoring protocol physical impacts to wetlands were assessed by collecting physical measurements of impacts on the soil resource. Wetland hydrology impacts were assessed by gathering soils data, road drainage (culvert) data, landform and landscape position data, and through a literature review of the effects of roads and ditches on wetlands with similar soils, slopes, and landscape positions. Vegetation impacts from road construction fall into two categories. 1) direct impacts occurring within the road clearing limits and grubbing limits and 2) indirect impacts that can include changes to vegetation as a result of changes in soil hydrology adjacent to grubbing and fill areas. Indirect impacts to vegetation could extend beyond the road clearing limits.

Physical Impacts to wetlands
Physical impacts to wetland soils from road construction were easily measured with evenly spaced road cross section measurements. On long road segments ten cross section measurements were taken. On short road segments at least five cross section measurements were taken.

Road surface width and slope of the ground traversed dictates the width of the road fill. Road fill widths averaged between 21 and 27 feet (6.4 to 8.2 meters). The average for all 30 cross sections is 25.2 feet (7.7 meters) On the 6459 lineal feet of road measured in the four road segments the road fill covered 3.73 acres (1.51 hectares). Hill slope angles measured at the 30 cross sections ranged from 1 to 43 percent. There was not a strong correlation between hill slope angle and road fill width in this monitoring. The lack of strong correlation could be due to the tendency to locate and construct roads at the base of slopes. The hill slope angle measured across the entire disturbed corridor at our cross sections may not be representative of the hill slope under the road prism.

Disturbed soil widths averaged 45.5 feet (14 meters) at the 30 road cross sections measured. On the 6459 lineal feet (1969 meters) of road measured the disturbed soil width (including the road fills) covered 6.75 acres (2.73 hectares) of wetlands. Ten cross sections of disturbed soil width on the 52033 #2 road segment averaged 52.7 feet (16.1 meters). On three of the four road segments monitored the soils were typically less than 20 inches (50 centimeters) thick over bedrock. On the 520332 road segment soils were deeper and the disturbed soil corridor averaged 41.2 feet (12.6 meters), the narrowest of the four road segments monitored.

Where soils are less than 20 inches (50 cm) to bedrock, the wider disturbed soil width resulted from soils being scraped off the bedrock (as described in the assessment of the baseline provisions). Disturbed soil on the downhill side of the road typically extended just past the toe of the shot rock fill. Within the disturbed soil corridor wetland soils were either scraped off the bedrock substrate or buried under the shot rock road fill. It is

unlikely that wetland vegetation will grow on top of the road fill. On the "cutslope" where wetland soils were scraped off the bedrock, enough organic soil may remain

Figure 3. Cut banks along 6594 road segment. Note depth to bedrock.

so that some wetland species may occupy the site. In other areas rain will wash the remaining organic soil from the rock, and the rock substrate will no longer support wetland vegetation. In either case the "cutslope" vegetation will be changed, often to favor upland species versus wetland species.

The Skipping Cow EIS estimated wetland impacts from a disturbed soil corridor 24 feet (6.4 meters) wide. The actual disturbed soil corridor measured at 30 cross sections averaged 45.5 feet (13.9 meters) wide. The 45.5 foot disturbed corridor width is a 90 percent difference from the predicted disturbed corridor width. If the roads would have been constructed using rock overlay techniques the disturbed soil corridor would have averaged approximately 25.2 feet (7.68 meters) which is close to the 24 foot disturbed soil width predicted in the Skipping Cow FEIS. The higher cost (more rock and larger rock pits some of which would have been in wetland) need to weighed against the additional area of wetland impacted using the cut and fill road construction technique.

Soils that are shallow to bedrock resulted in the contractor reaching further with the excavator to gather soil material to construct a level road sub-grade. Roads on gentler

slopes will likely have a narrower disturbed soil corridor (Glaser, 1999). Other Timber Sale NEPA documents on the forest have used a 40 or 42 foot (12.2 to 12.8 meter) wide disturbed soil corridor and that figure seems more appropriate for future estimates.

Hydrologic Impacts to wetlands

The goal of most of the 15 Federal Baseline Provisions and State approved BMPs is to assure that the flow and circulation of waters within wetlands is not diminished. The implementation of the 15 Federal Baseline Provisions and the potential impacts to hydrology of the wetland was discussed in the Assessment of the 15 Federal Baseline Provisions. This section discusses probable impacts to wetland hydrology.

Hydrologic impacts to wetlands as a result of road construction can occur within the disturbed soil corridor and beyond the disturbed soil corridor. Within the disturbed soil corridor wetland soils are excavated, buried and/or compacted. Water movement over and through soils within the disturbed soil corridor will be altered.

The wetlands monitored in FY 2006 consisted primarily of shallow (less than 20 inches, (50 cm) deep) organic and mineral soils over bedrock at elevations ranging from 1400 to 2100 feet (427 to 640 meters). The inactive horizons in the organic soils (catotelm) stay saturated throughout the year. The active layers of the organic soils (acrotelm) are saturated for part of the year. Overland flow occurs during storm events when the acrotelm is saturated and overland flow was witnessed during our monitoring. The effect of the road prism and exposed bedrock cut slopes on these road segments will be to replace semi permeable organic soil surfaces with shot rock or exposed bedrock. The exposed bedrock cutslope, road surface and fill will be less permeable and less "active" than the active layer of the organic soils. Runoff from the road corridor will be more rapid during times when the surrounding acrotelm is not saturated. These hydrologic impacts extend to the width of the disturbed soil corridor. The road can also concentrate surface runoff down slope. Ditches can collect small streams and sheet flow from the wetland and route the flow through culverts, effectively redistributing the water downslope (McGee 2000).

Hydrologic impacts from roads can also extend beyond the disturbed soil corridor. Studies measuring the effects of roads on groundwater have been very limited in southeast Alaska. Kahklen and Moll (1999) studied the effects or roads on groundwater at 5 sites in southeast Alaska. Four of the sites were located on upland soils. One of the five sites was on a gently sloping (13%) blanket bog with 1 to 2 meter (40 to 80 inches) deep organic soils over dense till. This site had a deep inside ditch that left a vertical cutbank 40 inches (one meter) high in the peat. Wells placed upslope and downslope of the road prism indicated that the effect of the road on groundwater at this site was limited to within a few meters of the ditch cutslope and toe of road fill. Kahklen and Moll (1999) concluded that the effects of the road on groundwater appear to be localized to within a few meters of the road. When summarizing the findings for all five of the sites studied Kahklen and Moll stated that their results showed two effects of roads on groundwater levels on the uphill side of the road prism: either a bulge or a drawdown in groundwater

level near the ditch. These effects appear for distances between 5 and 10 meters (16.4 to 32.8 feet) on each side of the road prism (disturbed soil corridor).

Glaser (1999) studied vegetation both upslope and downslope at the same Wrangell Island wetland site studied by Kahklen and Moll and 13 other wetland sites located on Wrangell, Chichagof, and Kupreanof Islands in southeast Alaska and found that "the impacts of roads are minimal except for a few localized instances where vegetation

Figure 4. Shallow peatland soil over bedrock (Sunnyhae Series). The acrotelm is the two to three inch thick soil layer at the top of the soil profile. The catotelm is the well decomposed (remainder) of the soil profile.

flushes were noted down slope of outlets of culverts". Glaser attributed the localized response to 1) high precipitation rates, 2) the use of porous roadbed material and 3) the road bed construction technique. Glaser noted that preferential flow paths (conduits or pipes) occurred at some of the sites he studied. Glaser did not find ponding of water or other hydrologic effects associated with the forestry roads he studied.

McGee (2000) studied the effects of roads on surface and subsurface flow on two sloping (non-wetland) mineral soils on Prince of Wales Island and found that subsurface flow typically occurred at the organic soil/weathered till interface and because the soils at her study sites were shallow to dense till, the road cutbanks and ditches were capable of intercepting water from the entire soil profile during storm events. At low water levels there was no significant change. Peak water levels decreased significantly post road

construction. The decrease in peak water levels was most pronounced in wells immediately upslope of the cutbank and below the road fill-slope. The change in peak water levels appears to recover rapidly with increasing distance down slope.

The results of studies from southeast Alaska are similar to those found by researchers studying the effects of contour ditching on "sloping moors" (peatlands) in northern England. Coulson et. al. 1990 found that at higher altitude wetlands where rainfall is greater the ditches had little influence on the position of the water table. Coulson et. al measured water table depth, decomposition rates, vegetation composition and nutrient content, and soil invertebrates at four sites in northern England. The Moor House study site in Coulson's et. al. study received about 79 inches (2000 mm) of rain annually (similar precipitation to the city of Wrangell). The ditches were able to intercept surface runoff but due to continuous rewetting of the soil by precipitation and low hydraulic conductivities of the peat, the peat (catotelm) was able to remain saturated year-round. Changes in water table, decomposition rates, and vegetation composition were not significant. At lower elevation sites where precipitation was less, ditches were able to influence soil water tables, decomposition rates, soil macroinvertebrates, and vegetation composition in close proximity to the ditches. In general, the effects identified at Coulson et.al.'s study sites were limited to within 3 meters below the ditch. The effects were attributed to the ditch removing surface water from the soil immediately below the ditch.

Holden et al (2006) studied hydrology at the small catchment scale in peatland catchments with and without disturbance (ditches). Holden et al's study re-gauged ditched and control catchments that were first gauged over 40 years ago. Holden et al found that the drained catchments had a greater sensitivity to rainfall with shorter lag times than control catchments. The ditches improved runoff efficiency. The water table depth is increased in drained peat catchments more by topographic controls than by drawdown around individual ditches. Holden et al also found there was a reduction in overland flow and relative increase in the proportion of matrix through-flow in drained peat catchments. Holden et al used ground penetrating radar to identify an increase in the density of soil pipes in drained peat catchments. Holden et al suggests that the formation of additional soil pipes is a result of wetland drainage and that the formation of additional soil pipes is a long-term effect that would not have been immediately evident after drainage.

Stewart and Lance (1991) studied the effects of half meter deep drainage ditches on the soil hydrology and vegetation of blanket bogs. Stewart and Lance concluded that the ditches did not significantly affect water table depths more than 2 meters from the ditch. Stewart and Lance also concluded that the ditches acted mainly to intercept surface runoff and withdrew water from the peat only alongside the drain edge. On sloping ground the zone of influence of the ditch was greater on the downhill side than the uphill side of the ditch. The results of Stewart and Lance's (1991) study suggest that vegetation was more sensitive and efficient than water-table measurements for indicating the long-term effects of drainage.

Bromley et al (2004) used a variety of methods to assess hydraulic conductivity of peat at different scales. Their conclusion is that equations that assume a homogenous peat material can not be applied over large areas of peatland. Hydraulic conductivity of peat will vary at different scales due to root holes, localized woody material, infilled ditches, and other preferential flow paths. Bromley et al's findings are similar to those of Holden et al (2006) concerning the effects of preferential flow paths (soil pipes) in interpreting hydraulic conductivity of and water balance in peatlands.

Most of the soils described in the wetlands on the Skipping Cow sale were less than 20 inches (50 cm) thick over bedrock. Most soils consisted of moderately well decomposed organic material with a relatively thin acrotelm (less than 2 inches or 5 cm) and a thicker catotelm. Some of the soils described were poorly drained mineral soils less than 20 inches (50 cm) thick over bedrock. The wetlands had a surface slope that ranged from 1 to 43 percent gradient. Slope lengths were estimated at less than 200 feet at most sites, and the landscape position was rounded summits and shoulder slopes. All of the sites have an annual precipitation of more than 80 inches per year. Most of these wetlands can be described as blanket bogs (Wetlands of BC), or sloping poor fens (Wetlands of Canada). The organic soil materials, slope, climate and precipitation are similar to the Moor House site described by Coulson et al (1991) in his studies. The depth of organic material over bedrock at the Skipping Cow road/wetland sites averaged about 50 cm, which is shallower than the studies cited here, but similar in depth to the ditches described by Stewart and Lance (1991).

Based on the literature described above and the similarity to the soils and climate at the Skipping Cow sites, these studies suggest that measurable hydrologic effects beyond the disturbed soil corridor will be minimal (less than 3 meters or 10 feet) in the first 10 years after construction. The results reported by Glaser (1999) suggest that the distance of measurable effects on vegetation will be associated with disturbed soil areas or "soil bulge" areas that form adjacent to road prisms placed on deep peats or in vegetation flushes down slope of culverts.

Based on studies by Coulson et al.(1991) and Holden et al (2006) precipitation at the sites monitored will not allow a noticeable change in water table levels or saturation of the soils. Preferential flow paths were noted in some of the soils we described and these flow paths may enlarge and change over time as described by Holden et al (2006). The hydrologic effects beyond the disturbed soil corridor may increase in later years if soil pipes develop in the soils upslope of the road cut bank.

Stewart and Lance (1991) suggest that vegetation may be a more sensitive indicator of effects of long-term drainage than water table measurements. Glaser (1999) described vegetation at 13 different wetland road crossings on the Tongass National Forest and noted that the effects of the roads on wetland vegetation are minimal except for a few localized instances where vegetation flushes were noted down slope of outlets of culverts. Glaser did not provide a distance measurement for vegetation effects adjacent to the road prism, but suggested that effects beyond the disturbed road corridor (shoulder and berm) were very limited. Glaser also noted that road impacts on gently sloping peatlands will

be less than on more steeply sloping peatlands. Most of Glaser's sites were on roads less than 30 years old and the vegetation changes described by Steward and Lance (1991) and the physical changes described by Holden et al (2006) may not yet be evident. Future monitoring of the effects of roads on wetlands should be conducted on wetlands with road crossings more than 30 years old.

Figure 5. Sunnyhae soil profile. Gray material is weathered bedrock.

None of the authors cited in this report suggest a change from wetland status to non-wetland status due to hydrologic changes outside the disturbed soil corridor. The vegetation may change slightly but the wetland outside the disturbed soil corridor will continue to classify as a wetland. Based on the literature cited here the primary hydrologic effect of forest roads on the organic soil wetlands similar to the ones monitored on the Skipping Cow Sale is the rerouting of surface water across the wetland.

Over the course of 40 years, Holden et al (2006) noted an increase in soil pipes (preferential flow paths in soils) on the ditched catchments he monitored. An increase in soil pipes may be expected on the upslope side of the cut-banks on the Skipping Cow roads. The effect of an increase in soil pipes may be offset by rapid re-growth of vegetation in the disturbed soil areas just down slope of the cut-bank. Even if soil pipes develop on the Skipping Cow road segments monitored, based on the literature cited here it is unlikely that the effect will be evident in the vegetation more than 2 or 3 meters from the road cutbank. Based on the literature it is unlikely that the conditions beyond the disturbed soil corridor would change enough to reclassify the site from wetland to upland.

The hydrologic impacts to wetlands from road construction will vary based on soil type, slope, landscape position, and precipitation or climate. Future monitoring efforts should stratify wetland/road crossings by age of road, wetland landscape position, and wetland type. The effects described in this report are specific to the wetlands monitored on the Skipping Cow Project Area. Although the abundance of precipitation is a common theme for wetlands over most of the Tongass National Forest, lower elevation wetlands, and especially fen wetlands may respond to road construction differently.

Biologic Impacts to Wetlands

Biologic impacts to wetlands are best described at the landscape scale. The Skipping Cow Final Environmental Impact Statement (FEIS) discussed the effects of roads on the wildlife habitat, fish habitat, and sensitive plant habitat on the project area. Due to topographic position of the wetlands impacted by Skipping Cow roads, there were no fish species present in the streams draining the road segments in the wetlands monitored. Wildlife habitat is a concern in the wetlands and surrounding forested areas. The FEIS identified several road management options to address hunter access/wildlife concerns. One sensitive plant, *Platantherea chorisana* was found in muskegs in the vicinity of the wetland sites monitored. The FEIS concluded that the impacts to individuals or small populations would not contribute to the loss of viability for this species.

The wetlands impacted by the road segments were not unique or uncommon on the Skipping Cow Project Area. Due to topographic position the wetlands impacted by the road segments monitored were generally quite large. In general the roads were located near the edges of the wetlands, where timber stands down slope could be accessed. The 6594 road segment monitored was located on the edge of a large (895 acre, 362 hectare) forested wetland/emergent sedge wetland polygon. The 52033 #2 and #3 road segments are located in different lobes of the same large (457 acre, 185 hectare) palustrine forested/emergent sedge wetland polygon. The 520332 road segment is located in a 60 acre (24.3 hectare) palustrine emergent/scrub-shrub wetland polygon. The wetland polygons described here are all adjacent to similar and larger wetland polygons. According the Skipping Cow FEIS the primary biological concern associated with these roads is the increased access for hunters and trappers.

Summary and Conclusions

The wetland classification system that best fits the forest's purposes depends on the interpretation the forest wishes to derive from the classification system. For purposes of assessing the effectiveness of the 15 Federal Baseline Provisions in preserving wetland hydrologic functions the classification system should focus on wetland hydrology and vegetation characteristics. Important hydrology characteristics include: precipitation, runoff, soil texture and permeability, pH, conductivity, available water holding capacity, and landscape position. Vegetation characteristics include species composition and abundance. Ideally the vegetation characteristics should be adequate to correlate with wetland hydrologic function.

This monitoring qualitatively assessed the implementation and effectiveness of the 15 Federal Baseline Provisions. The Baseline Provisions can be separated into three groups

1) Provisions to avoid impacts to wetlands, 2) Provisions to minimize impacts to wetlands, and 3) Provisions to mitigate impacts to wetlands. The qualitative assessment indicates that on the Skipping Cow Timber Sale wetlands were avoided to the extent practicable while meeting project goals and objectives.

The assessment also indicates that impacts to wetlands were minimized to the extent practicable with room for improvement in three areas: 1) providing cross drainage at all preferential flow paths in wetlands, 2) limiting the size of turn-outs in wetlands, and 3) limiting the amount of grubbing adjacent to the road prism. The cost of further minimizing impacts to wetlands needs to be weighed against the economic cost of using more rock rather than native soil material to construct the road sub-grade, and installing more culverts or waterbars when surface runoff often flows unimpeded through coarse textured fill. Limiting the size of turnouts has not been necessary as a contract provision in the past. The turnouts on the 52033 road are the first we have seen this large. If large turn-outs in wetlands becomes a recurrent theme in future monitoring, then a contract specification regarding maximum size of turnouts in wetlands may be appropriate.

Physical impacts to wetland soils were relatively easy to quantify. The disturbed soil corridor associated with the road segments monitored averaged 45.5 feet (13.9 meters) in width. This means that 5.5 acres (2.2 hectares) of wetland were impacted for every mile of road constructed through wetlands. If rock overlay road construction would have been used the impacts to wetlands would have been about 45 percent less than the impacts we measured from the cut-and-fill construction technique used on the Skipping Cow roads. Rock fill widths averaged 25.2 feet (7.68 meters), which is similar to the 24 foot (7.3 meters) width of disturbed soil in wetlands estimated in the Skipping Cow FEIS. The Skipping Cow FEIS underestimated impacts to wetlands by 90 percent.

Other timber sale NEPA documents on the forest have used a 40 or 42 foot (12.2 to 12.8 meters) wide disturbed soil corridor and that figure seems more appropriate for future estimates. The disturbed soil corridor was wider than typical due to several factors: 1) the wetlands monitored had slopes up to 43 percent gradient, 2) the soils were less than 20 inches thick over bedrock and to collect enough soil material to construct a road sub-grade the operator had to reach further, and 3) pioneering of the road sub-grade occurred when up to two feet of snow cover was on the ground and the pioneering resulted in inefficient use of soil material collected for fill, and in one case equipment operation outside the road clearing limits.

The literature review in conjunction with the soil, slope, precipitation, and landscape position data collected at the Skipping Cow sites have allowed us to estimate the hydrologic impacts to wetlands outside the disturbed soil corridor. On similar sites both on the Tongass and in northern England, the literature would indicate that the hydrologic impacts to wetland soils and vegetation will be very limited (typically less than 3 meters) beyond the physically disturbed soil corridor associated with the road. Based on the literature, the hydrologic and vegetation changes that are anticipated beyond the disturbed soil corridor will not result in a change in status from wetland to upland.

Stewart and Lance (1991) suggest that vegetation may be a more a sensitive indicator of changes in hydrologic conditions than measurements of water table or soil hydraulic conductivity. Holden et al (2006) suggests that it may take more than 30 years following draining of peatlands before changes in vegetation are significant enough to detect change. A recommendation from this monitoring is that the Tongass implement a retrospective wetland vegetation study similar to Glaser's (2000) work to determine the extent of wetland vegetation change associated with roads more than 30 years old. Use preconstruction aerial photos to assist in determining the extent of vegetation change associated with road construction.

The literature review and results reported here are somewhat specific to the wetland types encountered during the monitoring of four road segments through wetlands on the Skipping Cow Project Area. Lower elevation wetlands and fen wetlands may have different impacts than those reported here.

Recommendations

Continue to document wetland type based on existing classification systems at road/wetland sites monitored for BMP implementation and effectiveness. For the Tongass vegetation classification project, consider modifying the vegetation plot data collection to include the list of soil, slope and hydrologic characteristics listed in the summary section.

Continue monitoring 3 to 5 wetland sites impacted by new road construction annually to determine if the 15 Federal Baseline Provisions are being implemented and qualitatively assess the effectiveness of the provisions at avoiding and minimizing impacts to wetlands. Use a team of wetland scientists that include the Corps of Engineers and Environmental Protection Agency to the extent practicable.

Continue to measure the physical wetland impacts with the parameters described in this report. Continue to incorporate wetland literature to define hydrologic impacts beyond the disturbed soil corridor.

Conduct a retrospective wetland vegetation study similar to Glaser's (1999) work to determine the extent of wetland vegetation change associated with roads more than 30 years old. Use preconstruction aerial photos to assist in determining the extent of vegetation change associated with road construction.

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Appendix A

Summary of Implementation Monitoring of the 15 Federal Wetland BPs.

This appendix summarizes the results of implementation monitoring of the 15 federal wetland BPs on four road segments constructed through wetlands for the Skipping Cow Timber Sale. The road segments were constructed in the fall of 2005 and spring of 2006. The monitoring was completed the week of September 25th, 2006. The following narratives discuss the application and implementation of each of the 15 federal wetland BPs. The implementation of the BPs were ranked on a scale of 1 to 5 using a process similar to water quality BMP rankings used on the forest. Notes were taken to describe the ranking of each BP on each road segment (See scanned field sheets attached). The BPs are grouped into three categories 1) avoidance, 2) minimization, and 3) mitigation. The original BP numbers from 33 CFR 323 have been maintained.

1) BPs to Avoid Impacts to Wetlands

BP-1- permanent roads (for farming or forestry activities) temporary access roads (for mining, forestry, or farm purposes), and skid trails (for logging) held to minimum feasible number, width, and total length consistent with the purpose of specific farming, silviculture, or mining operations, and local topographic and climatic conditions, project purpose and site conditions.

- Any obvious avoidance opportunities based on local conditions, road card data or project wetland map? (BMP 14.2 & 14.3)
-Does width of road surface match design criteria?
-Measure road surface width, road fill width, and disturbed soil width (top of cut to toe of fill) document on this form.
-Do implemented road miles through wetlands on this project match the planned road miles through wetlands.
-Was this wetland identified on the road card?

Evaluation for BP-1

On three of the four road segments monitored this BP was rated a 5. On one segment it was rated a four. All wetlands were identified on road cards and no obvious wetland avoidance opportunities exist with the road location. On the road segment rated a "four" (52033 #2) the lower rating was given due to turnouts that were larger than typical and areas of grubbing beyond the road prism. The excess grubbing on this road segment was due in part to pioneering while there was still up to two feet of snow on the ground. On one road segment (the 6594) the road was constructed lower on the hill than as planned, impacting less wetland than estimated on the road cards. All wetland road segments monitored were identified on the Road cards for the Skipping Cow project. Based on air photo review the wetland were unavoidable while meeting project objectives.

The road running surface widths for all segments matched the design criteria. For forest roads the design width is a 14 foot wide running surface with a construction tolerance of

up to 2 feet (16 foot width). We measured road running surface widths at 30 cross sections on the four road segments and found the average widths reported in Table 1. All road running surface widths were within the minimum construction tolerances for forest roads on the Tongass.

Table 1. Average road widths, disturbed soil width, and hill slope for four road wetland segments monitored in FY 2006.

Road segment number	Segment length (feet)	Number of cross sections	Road running surface width average (feet)	Disturbed soil corridor width (feet)	Hill Slope average (%)
6594	379	5	14.1	42.2	n/a
52033 #2	3352	10	14.9	52.7	18.9
52033 #3	2125	10	15.1	42.3	14.7
520332	603	5	15.2	41.2	18.6

The disturbed road corridor width or disturbed soil width is often used to estimate impacts to wetlands. In the Skipping Cow Project the disturbed soil width for these roads was estimated at 24 feet through the wetlands. The average disturbed soil widths from measurements at 30 cross sections are reported in Table 1. The results reported in Table 1 indicate the average disturbed soil width was substantially more than estimated in the Skipping Cow FEIS. Other project level Timber Sale NEPA documents on the Tongass have used 40 or 42 feet to estimate disturbed soil widths. Based on the data collected for the four wetland segments monitored in 2006, 42 feet would have been a better estimate of effects than 24 feet.

Grubbing width on the 52033 #2 segment averaged 52.7 feet while the other segments averaged 42 feet. . The soils in this section are often less than 20 inches thick over bedrock and mostly non-forested with small areas of scrub vegetation (this was the case for all segments except the 6594). The operator used the backhoe to reach from the pioneer road location to scrape and pull scrub vegetation and soil to build a level pioneer road on terrain that averaged almost 19% slope. Less clearing could have been accomplished with more rock fill, but construction costs were kept lower by using "native" fill material and capping it with rock. Contract specifications allow grubbing and clearing within the clearing limits of the road corridor. Pioneering this section in the snow lead to the operator occassionally "missing" the flag line and getting off track, and this resulted in wider grubbing widths at some of the cross sections measured.

BP-2 -All roads, temporary and permanent, shall be located a sufficiently far from streams or other waterbodies (except for portions of such roads which must cross water bodies) to minimize discharge of dredged or fill materials into waters of the US.

-Measure or estimate distance to the nearest water body.
-Could the distance have been greater while still meeting project objectives? (BMP 14.2 & 14.3)
-Is 100 feet a sufficient distance for a road from a water body?
-Forest Plan Riparian S&G applied?

Evaluation of BP-2, Overall rating is 5
BP-2 was rated on three of the four road segments monitored. On the segment where the BP was not rated a note indicates that all streams were crossed at right angles and thus the road could not have been further from the water body. On the three segments where the BP was rated it was rated a 5 for fully implemented. The road segments monitored in 2006 were all located on the shoulder slope or hilltop landscape position. Because of the topographic high landscape position all streams crossed were non-fish bearing and typically small in incision, width and flow volume. The road segments typically crossed these streams at right angles thus impacts to water bodies were kept to a minimum.

On the 52033 #2 road segment, two small muskeg ponds about 1/3 acre in size were visible from the road prism. One pond received no fill (the road was located more than 50 feet away from the pond). The road skirted the edge of the second pond resulting in a minor fill of clean shot rock in the pond. Alternate locations to avoid skirting the edge of this pond were sought but not practical without impacting more wetland area. On this same segment a small muskeg pond (approximately 20 feet in diameter) was inadvertently drained by the contractor, probably because pioneering occurred in the snow and the pond was frozen and perhaps not recognizable.

BP-8 -Borrow material shall be taken from upland sources whenever feasible.
-Is borrow source located in wetlands or did the development of the borrow source impact wetlands?
-Was there a practicable option to locating the borrow source in wetlands? (BMP 12.5)

Evaluation of BP-8
BP-8 applied on 2 of the four road segments monitored. On the other two segments the rock pit was located in uplands. On the two road segments where rock pits were located in wetlands the wetlands were unavoidable and the sites selected for rock development had very shallow overburden. The BP was rated a 3 on both road segments. On each road segment the rock pit appeared to be overshot slightly and excess rock was spread across the wetland down slope of the pit. On the 6594 road the pit was overshot and approximately 130 feet of a small intermittent stream was buried. Overburden was ponding some water in the stream on the south side of the same pit. Rehabilitation at this site involved shaping a channel in the shot rock and installing a culvert under the road.

On the 52033 #2 road segment the rock pit appeared to be slightly overshot and a small quantity of rock ended up in an intermittent stream channel down slope of the pit. The rock was not ponding any water.

BP-9 The discharge shall not take, or jeopardize the continued existence of, a threatened or endangered species as defined under the Endangered Species Act, or adversely modify or destroy the critical habitat of such species.
- Are threatened or endangered species individuals or critical habitat present at the site?
-Any T&E habitats identified on the project area? (Review the project NEPA)

Evaluation of BP-9
BP-9 did not apply on any of the road segments monitored in 2006. Marbled Murrelets are a sensitive species that occurs in the area. Effects of the proposed activities on Marbled Murrelets were discussed in the FEIS.

BP-10 - Discharges into breeding and nesting areas for migratory waterfowl, spawning areas, and wetlands shall be avoided if practical alternatives exist.
-Are spawning areas or nesting areas for migratory waterfowl present at the site?
-Were breeding or nesting areas for waterfowl a concern at this site in the NEPA analysis?

Evaluation of BP-10
BP-10 did not apply at any of the road segment monitored in FY 2006. A concern for migratory waterfowl within these wetlands was not identified in the FEIS. There was no evidence of migratory waterfowl use in the wetlands monitored. It is possible ducks or geese may use the wetlands but the concern was not identified in the FEIS.

BP-11 - The discharge shall not be located in the proximity of a public water supply intake.
-Is there a public water supply intake downstream of the wetland? How Far?
-Is there a visible or quantifiable impact to the public water supply from the management activity? Explain.
-Also a forest plan standard.

Evaluation of BP-11
BP-11 was not rated at any of the road segments monitored. There are no public water supplies down slope of the road segments monitored in FY 2006.

BP-12- The discharge shall not occur in areas of concentrated shellfish production.
- Is the wetland in an area of concentrated shellfish production?
-Is there a visible or quantifiable impact to the shellfish production from the management activity?

Evaluation of BP-12
BP-12 was not rated at any of the road segments monitored in FY 2006. The wetlands/road segments monitored are located on the shoulder slope and summits, well away from any areas of concentrated shellfish production.

BP-13-The discharge shall not occur in a component of the National Wild and Scenic River system.
-Is the discharge in a component of the National Wild and Scenic River System?

Evaluation of BP-13
BP-13 did not apply and was not rated at any of the road segments monitored in FY 2006. There are no components of the National Wild and Scenic Rivers located in the vicinity of the Project Area.

2) BPS to Minimize impacts to Wetlands

BP-3 -The road fill shall be bridged, culverted, or otherwise designed to prevent the restriction of expected flood flows.

-Is there evidence of flood flow restriction at the site? (evidence of water moving across the road, eroded ditchlines, erosion of culvert inlets or outlets) (BMPs 14.9, 14.14, &14.17)
-Are culverts adequate and designed for expected flood flows?
-Will fill disrupt the flow of water enough to alter soil drainage at the site? (BMPs 14.3 & 14.9)
- Will the management activity result in headcutting that will eventually change the soil drainage in the wetland? (BMPs 14.3 & 14.9)

Evaluation of BP-3

BP-3 was rated along all four road segments monitored in FY 2006. The ratings and rationale for the rating are provided in Table 2.

Table 2. Ratings for BP-3 and Rationale for the rating.

Road segment number	Rating	Rationale for rating
6594	4	Intermittent stream (non-stream) is ponding in low spot in ditch upslope of road, then seeping through fill and dispersing over wide area down slope. The road needed one more cross drain.
52033 #2	3	There are four sites along this 3300 foot long road segment where intermittent streams (non-streams) are flowing through the road prism. There is one site with a perched culvert inlet that is ponding some water. There are two sites where wetland ponds were unnecessarily drained.
52033 #3	3	There is one site on this 2125 foot road segment where an intermittent stream (non-stream) is flowing through the fill. There are two sites where the inside ditch diverts an intermittent stream (non-stream) to a culvert on another stream.
520332	5	One small intermittent stream (non-stream) is not culverted and the water appears to be flowing unimpeded through the shot rock. Organic soil was excavated around 2 culvert inlets leaving a vertical drop of 2 to 3 feet, some headcutting is anticipated, but given the peat composition and depth to bedrock, headcutting will be minor.

BP-3 ratings varied depending on the number of intermittent stream without culverts and the amount of water diversion down the inside ditch. The team had much discussion about the impacts of small intermittent stream flowing through shot rock fill and visited some heavily used roads where small stream are still flowing through shot rock fills after 20 years of traffic and use. Likewise headcutting in peat soils can be severe in some climates, but in southeast Alaska headcutting at overflow points for peat sag ponds in not common. More work needs to be done to fully understand the impacts of porous road fills on wetland hydrology, and the vertical stability of exposed peat cutbanks. In the wetlands/road segments monitored in FY 2006 the problem of exposed peat cutbanks and

water flowing through porous road fill appeared limited at this point in time. There is concern that as road fills settle and fines fill the interstices, that the road prism will begin to pond water and create sever erosion problems. The road segments monitored on this project will be stormproofed and/or put in storage. Both of these road treatments could result in waterbars or relief ditches dug across the road at the intermittent stream sties that are not culverted.

BP-4 -. The fill shall be properly stabilized and maintained during and following construction to prevent erosion.

- Is there evidence of fill erosion at the site? (BMPs 12.7, 14.5 & 14.8)
-Are ditchlines seeded? (BMPs 12.7, 14.5 & 14.8)
-Are rock walls or ditchblocks or other erosion control structures in place as needed? (BMPs 13.11, 13.14, & 14.5)
-Were suspension requirements met in harvest units? (BMP 13.9)
-Have disturbed areas been revegetated? (BMP 12.17)
-Was an erosion control plan used? (BMPs 12.7, 14,5, & 14.8)

Evaluation of BP-4

BP-4 was rated a 5 for all four road segments monitored with one caveat. The COR and contractor mutually agreed that a written erosion control plan was not necessary. Most erosion control requirements are included in the contract specifications. The timing of erosion control is one item that is generally not in the contract specifications and is usually specified in an erosion control plan. There was also some question as to whether or not exposed organic soils cutbanks need grass seeding. Well decomposed organic material can erode but organic material with high amounts of plant fibers still intact are difficult to erode. Spreading grass seed presents a risk of introducing unwanted plant species. In organic soils seed banks and root tubers may revegetate relatively quickly. At two sites along the 520332 road segment 2 to 3 foot high vertical organic soils banks were left in the ditch cutbank upslope from culvert inlets. These sites may benefit from a few well placed rocks to support the banks, but the general consensus is that the banks will stand without rock support, or the sloughing will be so minor it will not plug the culvert inlet.

BP-5 – Discharges of dredged or fill material into waters of the US to construct a road fill shall be made in a manner that minimizes the encroachment of trucks, tractors, bulldozers, or other heavy equipment within waters of the US that lie outside the lateral boundaries of the fill itself.

-Is there excess fill or excess turnouts in wetlands?
-Measure width of road surface – Does it match the design criteria? (BMPs 14.2, 14.3 & 14.20)
Was end-haul material placed in wetlands? Was there a practicable alternative? (BMP 14.19)

Evaluation of BP-5

BP-5 was rated 5 (fully implemented) on 3 of the four road segments monitored. On the 52033 #2 road segment BP-5 was rated a 3. In most cases turnouts were minimal in size and located every 500 feet or so in the wetland. This spacing is necessary for safety reasons and logistics of backing dump trucks and dumping rock. On the 52033 #2 road

segment the notes indicate that the turnouts were larger than necessary and two "unhardened" turnouts on bedrock were noted. Contract specifications indicate the minimum turnout size is 16 feet wide and 20 feet deep. Two turnouts were measured, one was 19 by 33 feet and the other was 23 by 42 feet. The contract specifications do not include a maximum turnout size.

In other areas trackhoe buckets of organic soil were placed on wetlands well away from the road prism. The team assumed this condition existed not because of blatant disregard for the wetland but because of pioneering when there was snow on the ground. The backhoe operator temporarily lost the flagline and was pioneering road at a different location than the center line. In one area the backhoe operator was clearing outside the clearing limits for about 150 feet, again because snow on the ground and trees made finding the centerline difficult.

The amount of grubbing outside the fill itself was discussed in the evaluation of BP-1. BP-5 speaks more specifically to operating equipment outside the fill itself. Grubbing of soil material in wetlands to create a level road base for cap rock is a common practice and is dictated in part by economics. All of the road segments monitored in FY 2006 could have been built without grubbing outside the road prism, however the cost would have been much higher than using native materials to construct part of the road fill. The physical impacts to the wetland would have been less. Road fill widths were measured as part of the wetland impact monitoring. The average road fill width was 26 feet for three of the four segments and 21 feet for the fourth segment. The cost of reducing the physical impact to the wetland and reducing the economics of the timber sale needs to be weighed against the environmental impact of the additional disturbed soil width.

BP-6 – In designing, constructing, and maintaining roads, vegetative disturbance on waters of the US shall be kept to a minimum.
-Measure vegetative clearing width. Does the clearing width match the design criteria? (BMPs 12.5, 14.2 & 14.3)
-Could the clearing width have been less?
-What about harvest units in forested wetlands?

Evaluation of BP-6

On road construction projects vegetation clearing limits are established in the contract and clearing limits are flagged on either side of the road centerline. On the three of the four road segments monitored BP-6 was rated a 5. On the 52033 #2 road this BP was rated a 4 because there was one area where the equipment disturbed vegetation and soil for about 150 feet outside the clearing limits. The operation of equipment outside the clearing limits was large due to the presence of snow on the ground during road pioneering. The equipment operator missed the centerline of the road. No rehabilitation is needed at this site. Minimization of grubbing beyond the road prism is discussed in the Evaluation of BP-5.

BP-7 –The design, construction, and maintenance of the road crossing shall not disrupt the migration or other movement of those species of aquatic life inhabiting the water body.
-Culverts functional? (BMP 14.9)
-Fish passage? (BMPs 14.14 & 14.17)
-FS and ADF&G concurrence details implemented? (BMPs 14.14 & 14.17)
-Timing guidelines met for fish stream crossings? (BMP 14.6)
-Effectiveness is evaluated forest-wide.

Evaluation of BP-7
None of the streams crossed by the four road segments monitored were designated as anadramous or resident fish streams. No Species of aquatic organism was identified in the planning phase to require design criteria for passage. The culverts were functional and on the 3 road segments where BP-7 was rated, it was rated a 5. It is possible that Rough skinned newts or toads may be present.

BP-14 – The discharge of material shall consist of suitable material free of toxic pollutants in toxic amounts.
-Is the fill clean shot rock? (BMP 12.5)
-Is there evidence of oil or other pollutants in the wetland? (BMPs 12.8 & 12.9)

Evaluation of BP-14
BP-14 was rated a 5 on all four road segments monitored. There was no evidence of oil spills or other pollutants in the shot rock fill. On the 52033 #2 road segment a gallon container of gas was found in the rock pit, probably left there by a hunter.

3) BPs to Mitigate Impacts to Wetlands

BP-15 – All temporary fills shall be removed in their entirety and the area restored to its original elevation.
-Is there a temporary fill placed in the wetland?
-Was the fill completely or partially removed? (BMP 14.24)
- Was there a practicable alternate site for fill disposal? (BMP 14.19)
-Can the fill be practicably removed? (BMP 14.24)

Evaluation of BP-15
BMP WET-15 was not rated on any of the road segments monitored. All road segments were designed and constructed as permanent fills. All road segments monitored will be storm-proofed after timber harvest is complete. Stormproofing will involve removal of high-risk drainage structures and installation of water bars.

Appendix B

Wetland Implementation and Effectiveness Monitoring Forms

And Wetland Impact Monitoring Form.

Road Wetland BMP Implementation Monitoring Form

Date Monitored:	**ER/ COR Name:**	**Road Construction Contract:**	**Date Monitored**
Road #:	**Timber Sale:**	**EIS/EA:**	**District:**
Air photo number and notes:			
Township/Range/1/4 section	Milepost	GPS coordinates	
Wetland Information			
Length of road through wetland:			
Cowardin Classification:			
Soil Series:		Landform or landscape position:	
Wetland Habitat Type:			
Wetlands of Canada Type:			
Wetland Acres in Road Corridor:			
Soil pH surface:	Soil pH @ 50 cm:	Soil pH @ 20cm above impermeable layer: Depth:	
Number of drainage structures of road in wetland:			
Size and channel type of any associated streams:			

Standing water present in wetland?

Wetland Road BP Implementation Monitoring Form

[1] BP rating (rate after road final): F = BP fully implemented; D = Departure from full BP implementation; N = BP not implemented

[2] Departure occurred during Site Evaluation (SE), Environmental Analysis (EA), Contract (CT), Lay Out (LO), Administration (AD)

Item Monitored	Applies	BP Rating [1]	Corrective Action	Corrective Action Implemented	Departure Occurred [2]	Comments (PRINT!)
BP-1- permanent roads (for farming or forestry activities) temporary access roads (for mining, forestry, or farm purposes), and skid trails (for logging) held to minimum feasible number, width, and total length consistent with the purpose of specific farming, silviculture, or mining operations, and local topographic and climatic conditions, project purpose and site conditions. - Any obvious avoidance opportunities based on local conditions, road card data or project wetland map? (BMP 14.2 & 14.3) -Does width of road surface match design criteria? -Measure road surface width, road fill width, and disturbed soil width (top of cut to toe of fill) document on this form. -Do implemented road miles through wetlands on this project match the planned road miles through wetlands. -Was this wetland identified on the road card?	yes/ no		yes/ no no			
BP-2 -All roads, temporary and permanent, shall be located a sufficiently far from streams or other waterbodies (except for portions of such roads which must cross water bodies) to minimize discharge of dredged or fill materials into waters of the US. -Measure or estimate distance to the nearest water body. -Could the distance have been greater while still meeting project objectives? (BMP 14.2 & 14.3) -Is 100 feet a sufficient distance for a road from a water body?	yes/ no		yes/no			

-Forest Plan Riparian S&G applied?						

Wetland Road BP Implementation Monitoring Form

[1] BP rating (rate after road final): F = BP fully implemented; D = Departure from full BP implementation; N = BP not implemented

[2] Departure occurred during Site Evaluation (SE), Environmental Analysis (EA), Contract (CT), Lay Out (LO), Administration (AD)

Item Monitored	Applies	BP Rating [1]	Corrective Action	Corrective Action Implemented	Departure Occurred [2]	Comments (PRINT!)
BP-8 -Borrow material shall be taken from upland sources whenever feasible. -Is borrow source located in wetlands or did the development of the borrow source impact wetlands? -Was there a practicable option to locating the borrow source in wetlands? (BMP 12.5)	yes/ no		yes/no			
BP-9 -The discharge shall not take, or jeopardize the continued existence of, a threatened or endangered species as defined under the Endangered Species Act, or adversely modify or destroy the critical habitat of such species. - Are threatened or endangered species individuals or critical habitat present at the site? -Any T&E habitats identified on the project area? (Review the project NEPA)	yes/ no		yes/ no no			

BP-10 - Discharges into breeding and nesting areas for migratory waterfowl, spawning areas, and wetlands shall be avoided if practical alternatives exist. -Are spawning areas or nesting areas for migratory waterfowl present at the site? -Were breeding or nesting areas for waterfowl a concern at this site in the NEPA analysis?	yes/ no		yes/no			

Wetland Road BP Implementation Monitoring Form

[1] BP rating (rate after road final): F = BP fully implemented; D = Departure from full BP implementation; N = BP not implemented

[2] Departure occurred during Site Evaluation (SE), Environmental Analysis (EA), Contract (CT), Lay Out (LO), Administration (AD)

Item Monitored	Applies	BP Rating [1]	Corrective Action	Corrective Action Implemented	Departure Occurred [2]	Comments (PRINT!)
BP-11 - The discharge shall not be located in the proximity of a public water supply intake. -Is there a public water supply intake downstream of the wetland? How Far? -Is there a visible or quantifiable impact to the public water supply from the management activity? Explain. -Also a forest plan standard.	yes/ no		yes/no			
BP-12- The discharge shall not occur in areas of concentrated shellfish production. - Is the wetland in an area of concentrated shellfish production? -Is there a visible or quantifiable impact to the shellfish production from the management activity?	yes/ no		yes/ no no			
BP-13-The discharge shall not occur in a component of the National Wild and Scenic River system. -Is the discharge in a component of the National Wild and Scenic River System?	yes/ no		yes/no			

Wetland Road BP Implementation Monitoring Form

[1] BP rating (rate after road final): F = BP fully implemented; D = Departure from full BP implementation; N = BP not implemented

[2] Departure occurred during Site Evaluation (SE), Environmental Analysis (EA), Contract (CT), Lay Out (LO), Administration (AD)

Item Monitored	Applies	BMP Rating [1]	Corrective Action	Corrective Action Implemented	Departure Occurred [2]	Comments (PRINT!)
BP-3 -The road fill shall be bridged, culverted, or otherwise designed to prevent the restriction of expected flood flows. -Is there evidence of flood flow restriction at the site? (evidence of water moving across the road, eroded ditchlines, erosion of culvert inlets or outlets) (BMPs 14.9, 14.14, &14.17) -Are culverts adequate and designed for expected flood flows? -Will fill disrupt the flow of water enough to alter soil drainage at the site? (BMPs 14.3 & 14.9) - Will the management activity result in headcutting that will eventually change the soil drainage in the wetland? (BMPs 14.3 & 14.9)	yes/ no		yes/no			
BMP WET-4 -. The fill shall be properly stabilized and maintained during and following construction to prevent erosion. - Is there evidence of fill erosion at the site? (BMPs 12.7, 14.5 & 14.8) -Are ditchlines seeded? (BMPs 12.7, 14.5 & 14.8) -Are rock walls or ditchblocks or other erosion control structures in place as needed? (BMPs 13.11, 13.14, & 14.5) -Were suspension requirements met in harvest units? (BMP 13.9) -Have disturbed areas been revegetated? (BMP 12.17) -Was an erosion control plan used? (BMPs 12.7, 14,5, & 14.8)	yes/ no		yes/ no no			

Wetland Road BP Implementation Monitoring Form

[1] BP rating (rate after road final): F = BP fully implemented; D = Departure from full BP implementation; N = BP not implemented

[2] Departure occurred during Site Evaluation (SE), Environmental Analysis (EA), Contract (CT), Lay Out (LO), Administration (AD)

Item Monitored	Applies	BP Rating [1]	Corrective Action	Corrective Action Implemented	Departure Occurred [2]	Comments (PRINT!)
BP-5 – Discharges of dredged or fill material into waters of the US to construct a road fill shall be made in a manner that minimizes the encroachment of trucks, tractors, bulldozers, or other heavy equipment within waters of the US that lie outside the lateral boundaries of the fill itself. -Is there excess fill or excess turnouts in wetlands? -Measure width of road surface – Does it match the design criteria? (BMPs 14.2, 14.3 & 14.20) Was end-haul material placed in wetlands? Was there a practicable alternative? (BMP 14.19)	yes/ no		yes/no			
BP-6 – In designing, constructing, and maintaining roads, vegetative disturbance on waters of the US shall be kept to a minimum. -Measure vegetative clearing width. Does the clearing width match the design criteria? (BMPs 12.5, 14.2 & 14.3) -Could the clearing width have been less? -What about harvest units in forested wetlands?	yes/ no		yes/no			

BP-7 –The design, construction, and maintenance of the road crossing shall not disrupt the migration or other movement of those species of aquatic life inhabiting the water body. -Culverts functional? (BMP 14.9) -Fish passage? (BMPs 14.14 & 14.17) -FS and ADF&G concurrence details implemented? (BMPs 14.14 & 14.17) -Timing guidelines met for fish stream crossings? (BMP 14.6) -Effectiveness is evaluated forest-wide.	yes/ no		yes/ no no			

Wetland Road BP Implementation Monitoring Form

[1] BP rating (rate after road final): F = BP fully implemented; D = Departure from full BP implementation; N = BP not implemented

[2] Departure occurred during Site Evaluation (SE), Environmental Analysis (EA), Contract (CT), Lay Out (LO), Administration (AD)

Item Monitored	Applies	BP Rating [1]	Corrective Action	Corrective Action Implemented	Departure Occurred [2]	Comments (PRINT!)
BP-14 – The discharge of material shall consist of suitable material free of toxic pollutants in toxic amounts. -Is the fill clean shot rock? (BMP 12.5) -Is there evidence of oil or other pollutants in the wetland? (BMPs 12.8 & 12.9)	yes/ no		yes/no			
BP-15 – All temporary fills shall be removed in their entirety and the area restored to its original elevation. -Is there a temporary fill placed in the wetland? -Was the fill completely or partially removed? (BMP 14.24) - Was there a practicable alternate site for fill disposal? (BMP 14.19) -Can the fill be practicably removed? (BMP 14.24) .	yes/ no		yes/no			

Road/wetland Impact Monitoring Form

Date Monitored:	**ER/ COR Name:**	**Road Construction Contract:**	**District:**
Road #:	**Timber Sale:**	**EIS/EA:**	Road gradient through wetland:

Width of disturbed soil corridor (top of cut to toe of fill):	Road location, edge of wetland, middle of wetland	
Width of road fill every 100 feet:	Length of road through wetland:	Number of turnouts in wetland: Number of turnouts minimized?
Size of wetland (acres):		
Width of hydrologic effects from road (based on Kahklen and Moll 1999): Does this width match the width estimated in the NEPA document?		
Percent of wetland impacted by road and hydrologic effect:		
Cross drainage and culverts at each end of wetland and a preferential flow points?		
Is there evidence of the ditchline carrying water away from the wetland?		
Is road inhibiting water flow? Water ponding on side of road?		
Wetland habitat-type: Is this wetland scare or rare in this project area		
Narrative describing impacts:		
Landform or landscape position:		

Road-Wetland Impact Monitoring data

Constructed October 16, 2006

Road and segment number	Contract Name	Ranger District	Cross section number	Width of road running surface (ft)	Width of road fill (ft)	Width of disturbed soil corridor (ft)	Slope hill at cross section (%)	Estimated Hydrologic Impact (ft)	Length of road segment through wetland (ft)	Number and size of turnouts	Road gradient through wetland	Total impact (Acres)	Size of wetland polygon (Acres)	Percent of wetland polygon impacted.	Number of culverts	Culverts at preferential flow points?	Is ditchline eroding or carrying water away from wetland?	Is road prism causing ponding of water?	Soil Series at Site.	Notes
6594	Skipping Cow	WRD	1	13	25	50	na		379	0	5%				1	Yes	No	Yes	St. Nich	
6594	Skipping Cow	WRD	2	13.5	25	38	na													
6594	Skipping Cow	WRD	3	13.5	33	34	na													One culvert at stream. Minimal amount of water ponding in ditchline. Site has
6594	Skipping Cow	WRD	4	16	25	39	na													about 30% sideslopes and the road is located at the edge of the wetland
6594	Skipping Cow	WRD	5	14.5	22	50	na													polygon. Mostly St. Nicholas-like soils.
			Ave.	**14.1**	**26**	**42.2**														
52033 #2	Skipping Cow	WRD	1	17.5	27	36	32		3352	6	6				12	Not all	No	Yes	Sunnyhae	
52033 #2	Skipping Cow	WRD	2	15.5	29	50	16				4								St. Nich	
52033 #2	Skipping Cow	WRD	3	12	27	43.5	38				19									
52033 #2	Skipping Cow	WRD	4	14.5	23.5	39	6				10									
52033 #2	Skipping Cow	WRD	5	15	24.5	57	2				12									
52033 #2	Skipping Cow	WRD	6	15	26.5	42	9				14									
52033 #2	Skipping Cow	WRD	7	14.5	25.6	73	18				10									Ponding occurs at 2 of the 3 preferential flow points where culverts are absent.
52033 #2	Skipping Cow	WRD	8	15	22	64	12				7									Rainy foggy weather during monitoring trip, more than 1 inch per day. This was
52033 #2	Skipping Cow	WRD	9	15.5	24.5	61.5	18				9									a long segment over 3300 feet with variable slopes and widths. Soils were
52033 #2	Skipping Cow	WRD	10	14.5	33.5	61	38				6									shallow to bedrock
			Ave.	**14.9**	**26.31**	**52.7**	**18.9**				**9.7**									
52033 #3	Skipping Cow	WRD	1	14.5	22	37	4		2125	4	13				5	Not all	Yes	No	Sunnyhae	
52033 #3	Skipping Cow	WRD	2	15	27.5	35	2				21								St.Nich	
52033 #3	Skipping Cow	WRD	3	14.5	22	35	19				13									
52033 #3	Skipping Cow	WRD	4	15.5	27	40	8				2									
52033 #3	Skipping Cow	WRD	5	15.5	37	53.5	43				11									
52033 #3	Skipping Cow	WRD	6	15.5	20.5	40	25				10									
52033 #3	Skipping Cow	WRD	7	13.5	28.5	54	17				8									There are two locations where surface water is being routed along the road
52033 #3	Skipping Cow	WRD	8	15.5	27	46	18				10									prism in the ditch. There is one location where water is seepng through the
52033 #3	Skipping Cow	WRD	9	15.5	27	33	1				5									road fill at a preferential flow point. At least an inch of rain per day during the
52033 #3	Skipping Cow	WRD	10	15.5	22	49	10				3									week of monitoring
			Ave.	**15.05**	**26.05**	**42.25**	**14.7**				**9.6**									
520332	Skipping Cow	WRD	1	15	20	51	23		603	0	6				4	Not all	Yes	Yes	Grindall?	
520332	Skipping Cow	WRD	2	15	22	34	17				8								Kina	Along this road segment there is one site where a small stream from the fen is
520332	Skipping Cow	WRD	3	16	21	42	11				7									diverted 27 feet to a culvert at the ditchline. Hemic material at this site is
520332	Skipping Cow	WRD	4	15	19	48	23				10									expected to erode a little. At another site water was flowing through the road
520332	Skipping Cow	WRD	5	15	22	31	19				7									prism, but flow
			Ave.	**15.2**	**20.8**	**41.2**	**18.6**				**7.6**									