1.0 INTRODUCTION

The Washington Department of Natural Resources initiated a Level 1 watershed analysis of the Hazel Watershed Administrative Unit (WAU) on October 31, 1994. Members of the assessment and prescription teams included personnel from the Department of Natural Resources, Tulalip Tribes, and Grandy Lakes Forest Associates (Table 1). The Hazel WAU was selected in accordance with the priorities established jointly by the Department of Natural Resources-Northwest Region and local tribes, which rated it second on the list of priority list of watersheds to be analyzed in Northwest Region.

2.0 DESCRIPTION OF THE HAZEL WATERSHED ADMINISTRATIVE UNIT

2.1 Location, Land Use, and Ownership

The Hazel WAU is located in the North Fork Stillaguamish River watershed approximately 15 miles northeast of Arlington and 10 miles west of Darrington. The WAU encompasses approximately 24,800 acres of primarily forested land with scattered parcels of agricultural and residential land along the Stillaguamish floodplain. Landownership includes the U.S. Forest Service (39%), the Department of Natural Resources (35%), Grandy Lakes Forest Associates (6%), and small, non-industrial private landowners (20%).

2.2 Topography, Geology, and Soils

Elevations in the Hazel WAU range from 200 feet along the Stillaguamish floodplain to 5,200 feet at the summit of Mt. Higgins with an average elevation of 1,835 feet. The upper elevations are comprised of bedded sandstones with smaller exposures of rocks associated with the Helena-Haystack melange. Glacial deposits, including lacustrine clays, recessional outwash, and till, extend mainly from the Stillaguamish floodplain to 750 feet in elevation, but are also found in the headwaters of the Dicks Creek subwatershed. In general, soils on the steeper slopes are predominantly sandy or sandy loams underlain by sandstone, and are considered well-drained. Floodplain soils and soils formed on glacial terraces vary from poorly drained to moderately well drained silt loams and gravelly loams.

2.3 Climate and Vegetation

The WAU has a predominantly maritime-type climate, with cool, dry summers, and mild, wet winters influenced by air currents from the Pacific Ocean. Annual precipitation varies from 80 inches along the Stillaguamish floodplain to over 110 inches near the summit of Mt. Higgins. Average annual precipitation for the WAU is estimated at 100 inches. Most of the precipitation occurs as rain during the months of October through March. Snow persists throughout the winter months above 3,000 feet in elevation.

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Table 1. Assessment and prescription team members for the Hazel watershed analysis.

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Prescriptions	Jay Guthrie	DNR 919 N. Township St. Sedro-Woolley, WA 98284	(360) 856-3500

The majority of the WAU is located within the western Hemlock zone as defined by Franklin and Dyrness (1988). This zone is dominated by subclimax Douglas-fir (*Pseudotsuga menziesii*) and climax western hemlock (*Tsuga heterophylla*) and western redcedar (*Thuja plicata*). Elevations above 3,000 feet are typically dominated by Pacific silver fir (*Abies amabilis*) and mountain hemlock (*Tsuga mertensiana*).

2.4 Streams and Fish Species

The WAU consists of a number of separate but adjacent subwatersheds emptying directly into the North Fork Stillaguamish, the most significant of which include Brooks, Rollins, Dicks, and Segelsen Creeks. A total of 17 Type 3 (fish-bearing) subwatersheds drain the Hazel WAU, ranging in size from approximately 500 acres up to 5,000 acres. The dominant anadromous fish species include coho salmon (*Oncorhynchus kisutch*) and steelhead trout (*O. mykiss*), which occupy lower elevation tributary reaches of the Stillaguamish River. Chinook (*O. tshawytscha*), pink (*O. gorbuscha*), and chum salmon (*O. keta*) utilize the lower reaches of the tributaries as well as the mainstem of the Stillaguamish. Resident trout species include cutthroat (*O. clarkii*), rainbow (*O. mykiss*), and dolly varden/bull trout *(Salvelinus malma/S. confluentus*) which occupy much of the mainstem and lower elevation tributaries.

2.5 Land Use History

Since European settlement of the North Fork Stillaguamish basin in the late 1800's, the primary land use within the Hazel WAU has been commercial forestry. The majority of low-elevation old-growth forests were logged during the 1920's and 30's by railroad methods. Much of the area along the Stillaguamish floodplain as well as the lower portions of Brooks, Rollins, and Dicks Creeks were in young second growth forest during the early 1940's. Harvest slowed during the wartime decades of the 1940's and 50's, but accelerated again during the 1960's and 70's. During these latter years, forest roads were built into the upper portions of the Brooks, Rollins, and Segelsen drainages to harvest the remaining old growth timber. Scattered harvesting of second growth forest began during the 1970's and continues today.

Hazel
Watershed Administrative Unit
Prescriptions

December 5, 1997

Washington Department of Natural Resources
919 North Township Street
Sedro-Woolley, WA 98284

OVERVIEW
HAZEL WAU PRESCRIPTIONS

The attached prescriptions guide forest practice activities on state and private forest lands within the Hazel watershed administrative unit (WAU). These prescriptions apply to specific areas of resource sensitivity (ARS) identified through the assessment process. Areas of resource sensitivity include portions of the landscape prone to changes in watershed inputs such as coarse and fine sediment, large woody debris, and shade. Watershed processes that influence the routing of these inputs are assessed; public resources such as water quality and fish habitat that are vulnerable to changes in inputs are also assessed. Combining the watershed process hazard with the public resource vulnerability yields a resource management response or "rule call" which determines the appropriate level of management activity for each ARS. In the Hazel WAU, 18 ARS have been identified: 10 mass wasting units, 1 road erosion unit, 1 hillslope erosion unit, 3 large woody debris units, 2 shade units, and 1 fish passage/migration barrier unit.

Map Resolution Issues

The mass wasting assessment is based on the latest scientific information related to the effects of forest practices on landslide initiation. As a result, forestry-related landsliding is expected to be reduced when prescriptions are followed. However, in some cases, areas of potential landslide hazard may not have been identified accurately due to: (1) the dependence on remote-sensed data (i.e., aerial photos); (2) the relatively short (50 years) and unique history of storms that triggered landlslides used in delineating mass wasting units; and (3) the incomplete scientific understanding of all landslide mechanisms. For all these reasons, map units developed during this analysis may not capture all potentially unstable areas. Conversely, there may be inclusions of stable, low hazard areas within mapped units that do not meet the written description of the mass wasting units. As a result, implementation of prescriptions requires the identification of mass wasting unit boundaries in the field. The identification and field verification of map unit boundaries can be accomplished by foresters or other resource managers using the descriptions included in the mass wasting assessment report (Appendix A, Forms A-2).

Signs of Instability

Road construction prescriptions for ARS 4 (mass wasting map unit 4) require the proponent to adhere to more stringent standards when road construction is to proceed in areas exhibiting signs of instability. The following list includes signs of instability commonly found in forest settings:

- convergent or hollow topography
- landslide scar morphology
- emergent groundwater
- hydric vegetation
- perched groundwater conditions
- streambank erosion at the toe of slope
- evidence of accelerated soil creep
- tension cracks in the soil
- jackstrawed or pistol-butted trees

Signs of Instability (cont'd)

The determination of instability for any given location should be made using a "weight-of-the-evidence" approach. That is, a single sign from the above list may not serve as proof of instability, yet the presence of several signs provides a higher level of certainty of instability.

Cable Yarding Corridors

In some instances, the creation of cable yarding corridors through mass wasting units (e.g., inner gorges of mass wasting units 3, 4, or 6) or riparian management zones may be preferred if their use results in a higher level of resource protection compared to other alternatives. For example, if by using corridors, one or more inner gorge road crossings could be eliminated, timber harvest to facilitate yarding in an otherwise "no-harvest" area may be permitted. The decision whether or not to permit corridors will lie with the DNR forest practices forester, who may seek technical inputs from specialists where he/she feels such input is warranted. In cases where corridors are permitted, the width and total area in corridors is to be minimized so as to limit the cutting of live trees. When corridors cross a mass wasting unit, full suspension yarding techniques must be utilized at all times.

AREA OF RESOURCE SENSITIVITY: 1

DESCRIPTOR: Mass Wasting Map Unit #1: large, active, deep-seated landslides along river bends.

PRESCRIPTION:
No forest practice activity.

AREA OF RESOURCE SENSITIVITY: 2

DESCRIPTOR: Mass Wasting Map Unit #2: groundwater recharge areas associated with MWMU #1

RESOURCE PROTECTION OBJECTIVE:
Forest practice activities should produce no decrease in the factor of safety within the potentially active portion of the associated landslide (MWMU #1).

NOTE: ***The baseline or "background" factor of safety should be determined for current topographic, canopy, and river conditions. Identifying the potentially active portion of the landslide will require field reconnaissance/mapping as part of the factor of safety evaluation (described below).***

PRESCRIPTION:
A detailed, site-specific operation plan shall be developed for any proposed forest practice activity within this MWMU. The plan and associated activity shall meet the resource protection objective stated above. The proposed forest practice activity shall be evaluated to determine if and to what extent the operation results in a change in the factor of safety within the associated deep seated landslide (MWMU #1). The evaluation shall follow the methods established by Miller and Sias (1997) or an equivalent or better method. The evaluation shall explicitly define, describe, and map the groundwater recharge area (MWMU #2) and potentially active portion of the landslide (all or part of MWMU #1). The forest practice application package shall include a detailed report describing the results of this evaluation and a statement confirming the operation meets the above stated resource protection objective.

In addition to the factor of safety analysis required above, a monitoring plan shall be developed and implemented in conjunction with any proposed forest practice activity. The plan shall be implemented for a minimum of five years, although a period of 10 years *is recommended.* The plan shall include, at a minimum, the following monitoring parameters:

1) a record of daily precipitation at or in close proximity to the site;
2) a record of monthly groundwater levels at a point within the groundwater recharge area.

Mass Wasting Prescriptions Rescinded
Use as Screening Tool

It is recommended that monitoring of stream discharge on Headache Creek and daily precipitation be carried out in order to better calibrate the hydrologic model that is part of the overall slope stability (factor of safety) evaluation.

CITATION:

Miller, D. and J. Sias. 1997. Environmental factors affecting the Hazel landslide - level 2 watershed analysis, Hazel, Washington. Unpublished report. M2 Environmental Services, Seattle, WA.

Mass Wasting Prescriptions Rescinded
Use as Screening Tool

AREA OF RESOURCE SENSITIVITY: 3

DESCRIPTOR: Mass Wasting Map Unit #3: inner gorges with steep (>50%) uninterrupted sideslopes; vertical distances from the channel bottom to the slope break greater than 25 feet; associated with colluvial soils over bedrock and till.

PRESCRIPTION:

Harvest:

Uninterrupted slopes greater than 50%-

No timber harvest. Where small, sporadic, deep-seated landslides occur, and where the upslope margin (scarp) of the slide is located near the inner gorge slope break, an undisturbed buffer equivalent to the area of the slide from head to toe shall be left above the slide in an effort to maintain the natural hydrologic regime in the groundwater recharge area. If there is evidence that the groundwater recharge area does not originate directly uphill of the failure, then arrangement of the buffer should be adjusted to include the actual groundwater recharge area. NOTE: depending on the location of the feature relative to the inner gorge slope break, this buffer may extend beyond (upslope of) the defined MWMU

Roads:

Decisions regarding proposed new road construction within MWMU #3 shall be made in the following order:

1) select alternative road locations that avoid the MWMU.
2) if access through the MWMU is essential, select locations free of instability.

If roads are constructed or reconstructed within the MWMU:

1) full bench, end haul construction techniques shall be utilized;
2) all roads shall be designed and staked in the field by a qualified engineer (i.e., possesses a forest or civil engineering degree) with referable experience in forest road design and construction;
3) design drawings are required and shall be reviewed for approval by the DNR;
4) debris or soil deposits placed at the upper slope break adjacent to the MWMU shall be pulled back to a stable location(s);
5) permanent stream crossing structures shall be bridges or culverts with solid, keyed rock fills.

Mass Wasting Prescriptions Rescinded
Use as Screening Tool

AREA OF RESOURCE SENSITIVITY: 4

DESCRIPTOR:

Mass Wasting Map Unit #4: inner gorges with steep uninterrupted sideslopes (>50%); vertical distances from the channel bottom to the slope break greater than 25 feet; associated with low-gradient (3-6%) Type 3 or larger streams and glacial lakebed silt.

PRESCRIPTION:

Harvest:

Uninterrupted slopes greater than 50%-

No timber harvest. Where small, sporadic, deep-seated landslides occur, and where the upslope margin (scarp) of the slide is located near the inner gorge slope break, an undisturbed buffer equivalent to the area of the slide from head to toe shall be left above the slide in an effort to maintain the natural hydrologic regime in the groundwater recharge area. If there is evidence that the groundwater recharge area does not originate directly uphill of the failure, then arrangement of the buffer should be adjusted to include the actual groundwater recharge area. NOTE: depending on the location of the feature relative to the inner gorge slope break, this buffer may extend beyond (upslope of) the defined MWMU.

Roads:

Decisions regarding proposed new road construction within MWMU #4 shall be made in the following order:

1) select alternative road locations that avoid the MWMU.
2) if access through the MWMU is essential, select locations free of instability.
3) if access is essential and the only practical route shows signs of instability, the proponent must demonstrate that the road will not increase the likelihood of mass wasting.

If roads are constructed or reconstructed within the MWMU:

1) full bench, end haul construction techniques shall be utilized;
2) all roads shall be designed and staked in the field by a qualified engineer (i.e., possesses a forest or civil engineering degree) with referable experience in forest road design and construction;
3) design drawings are required and shall be reviewed for approval by the DNR;
4) where construction is permitted at locations showing signs of instability, construction shall be supervised in the field by a qualified engineer or designee with equivalent experience;
5) debris or soil deposits placed at the upper slope break adjacent to the MWMU shall be pulled back to a stable location(s);
6) permanent stream crossing structures shall be bridges or culverts with solid, keyed rock fills.

Mass Wasting Prescriptions Rescinded
Use as Screening Tool

AREA OF RESOURCE SENSITIVITY: 5

DESCRIPTOR: Mass Wasting Map Unit #5: slopes (>50%) on terrace flanks of lower elevation gorges and glacial terrace edges that typically have been deeply incised by streams.

PRESCRIPTION:

Harvest-

Uninterrupted slopes greater than 50%-

No timber harvest. Where small, sporadic, deep-seated landslides occur, and where the upslope margin (scarp) of the slide is located near the inner gorge slope break, an undisturbed buffer equivalent to the area of the slide from head to toe shall be left above the slide in an effort to maintain the natural hydrologic regime in the groundwater recharge area. If there is evidence that the groundwater recharge area does not originate directly uphill of the failure, then arrangement of the buffer should be adjusted to include the actual groundwater recharge area.

NOTE: depending on the location of the feature relative to the inner gorge slope break, this buffer may extend beyond (upslope of) the defined MWMU.

NOTE: due to the resolution of mapping, inlcusions of low hazard areas (areas with no deliverability) exist within this unit. In those areas, the harvest prescription noted above will not apply.

Roads-

1) full bench, end haul construction techniques shall be utilized;
2) where roads cross streams, fills shall be dipped;
3) where roads cross stream channels or seeps, water shall be kept in its original channel or location by installing appropriate drainage structures;
4) on slopes less than 65%, cross-drain spacing shall not exceed 450 feet; on slopes greater than 65%, cross-drain spacing shall not exceed 160 feet.

Note: Inclusions of MWMU #3,# 4, and #6 exist within MWMU #5. Refer to prescriptions for those MWMUs for road construction standards.

Mass Wasting Prescriptions Rescinded
Use as Screening Tool

AREA OF RESOURCE SENSITIVITY: 6

DESCRIPTOR: Mass Wasting Map Unit #6: incised steep-gradient (>12%) confined stream channels with uninterrupted sideslopes (>50%), and vertical distances from the channel bottom to the slope break between 10 and 25 feet.

PRESCRIPTION:

Harvest:

Uninterrupted slopes greater than 50%-

No timber harvest.

Roads:

Decisions regarding proposed new road construction shall be made in the following order:

1) select alternative road locations that avoid the MWMU.
2) if access through the MWMU is essential, select locations free of instability.

New Roads

If proposed new road construction or reconstruction of a **permanent road** falls within MWMU #6, the following prescriptions shall apply:

1) full bench, end haul construction techniques shall be utilized;
2) all roads shall be designed and staked in the field by a qualified engineer (i.e., possesses a forest or civil engineering degree) with referable experience in forest road design and construction;
3) stream crossings shall be located in areas free of signs of instability;
4) permanent stream crossing structures shall be bridges or culverts with solid, keyed rock fills.

If proposed new construction or reconstruction of a **temporary road** falls within MWMU #6, the following prescriptions shall apply:

1) full bench, end haul construction techniques shall be utilized;
2) stream crossings should avoid areas that exhibit signs of instability; if access is essential and the only practical route shows signs of instability, the proponent must demonstrate that the road construction will not increase the likelihood of mass wasting;
3) temporary stream crossing structures shall be bridges or culverts with dipped native fills with armoring on both the upstream and downstream sides;
4) temporary stream crossing structures shall be removed by October 30 of the same year; bridges, culverts and fill materials will be removed and the road within the MWMU will be stabilized.

Mass Wasting Prescriptions Rescinded
Use as Screening Tool

Existing Roads

1) existing roads that within the area of the proposed Forest Practice shall be evaluated for culvert sizing and fill materials; all prescriptions for **permanent roads** (above) shall apply;
2) existing roads within the area of the proposed Forest Practice shall be examined and where appropriate, corrective action to decrease the likelihood of mass wasting shall be taken prior to the conclusion of the operation.

Mass Wasting Prescriptions Rescinded
Use as Screening Tool

AREA OF RESOURCE SENSITIVITY: 7

DESCRIPTOR: Mass Wasting Map Unit #7: steep (>50%), high elevation, naturally unstable, predominately concave slopes.

PRESCRIPTION:

Harvest:

Slopes greater than 65% with convergent or hollow topography-
No timber harvest.

Slopes greater than 65% with planar topography-
Timber harvest shall not reduce canopy cover below 70% and the residual stand shall be comprised of dominant and/or co-dominant trees evenly spaced throughout the unit.

Roads:

1) no road construction on convergent or hollow topography;
2) full bench, end haul construction techniques shall be utilized;
3) on slopes less than 65%, cross-drain spacing shall not exceed 450 feet; on slopes greater than 65%, cross-drain spacing shall not exceed 160 feet;
4) where roads cross stream channels or seeps, water shall be kept in its original channel or location by installing appropriate drainage structures;
5) existing roads within the area of the proposed Forest Practice shall be examined and where appropriate, corrective action to decrease the likelihood of mass wasting shall be taken prior to the conclusion of the operation.

Mass Wasting Prescriptions Rescinded
Use as Screening Tool

AREA OF RESOURCE SENSITIVITY: 8

DESCRIPTOR: Mass Wasting Map Unit #8, sub-units a and b: highly variable slopes, channels, and materials of Rollins Creek headwaters.

PRESCRIPTION (MWMU #8a):
No forest practice activity within Unit 8a.

PRESCRIPTION (MWMU #8b):
Harvest:
Slopes greater than 65% with convergent or hollow topography-
No timber harvest.

Slopes greater than 65% with convex or planar topography-
Timber harvest shall not reduce canopy cover below 70% and the residual stand shall be comprised of dominant and/or co-dominant trees evenly spaced throughout the unit.

Roads:
New Roads-
No new road construction; however, existing road grades may be utilized but must meet the following construction standards:
1) full bench, end haul construction techniques shall be utilized;
2) permanent stream crossing structures shall be bridges or culverts with solid, keyed rock fills;
3) where roads cross stream channels or seeps, water shall be kept in its original channel or location by installing appropriate drainage structures;
4) on slopes less than 65%, cross-drain spacing shall not exceed 450 feet; on slopes greater than 65%, cross-drain spacing shall not exceed 160 feet.

Existing Roads
1) existing roads within the area of the proposed Forest Practice shall be evaluated for culvert spacing, sizing, and armoring. All prescriptions for *New Roads* (above) shall apply.
2) existing roads within the area of the proposed Forest Practice shall be examined and where appropriate, corrective action to decrease the likelihood of mass wasting shall be taken prior to the conclusion of the operation.

Note: Inclusions of MWMU #6 exist within MWMU 8b. Refer to prescriptions for MWMU #6 for conditions.

Mass Wasting Prescriptions Rescinded
Use as Screening Tool

AREA OF RESOURCE SENSITIVITY: 9

DESCRIPTOR: Mass Wasting Map Unit #9: very steep (>55%), high-elevation bedrock slopes, including type 5 streams commonly on bedrock floors, and generally planar slopes between.

PRESCRIPTION:

New Roads-

Avoid new road construction within MWMU #9.

If new roads are constructed:

1) no road construction on slopes greater than 65% which exhibit signs of instability (see list of signs of instability in overview);
2) full bench, end haul construction techniques shall be utilized;
3) on slopes less than 65%, cross-drain spacing shall not exceed 450 feet; on slopes greater than 65%, cross-drain spacing shall not exceed 160 feet;
4) where new roads cross stream channels or seeps, water shall be kept in its original channel or location by installing appropriate drainage structures.

Existing Roads-

An inventory of road-related mass wasting hazards shall be conducted within 12 months of DNR approval of this watershed analysis. Where necessary, corrective action to decrease the likelihood of mass wasting shall be taken within 24 months of approval of this watershed analysis.

Note: Inclusions of MWMU #3 and #6 exist within MWMU #9. Refer to the prescriptions for those MWMUs for road construction conditions.

AREA OF RESOURCE SENSITIVITY: 10

DESCRIPTOR: Mass Wasting Map Unit #10: gently-sloping glaciated highlands (less than 40%), headwaters of Rollins and Dicks Creek.

PRESCRIPTION:

An inventory of road fills associated with stream crossings shall be conducted within 12 months of DNR approval of this watershed analysis. Where road fills greater than 6 feet deep exist, and where the channel immediately downstream of the crossing is confined and has a gradient less than 35%, corrective action to decrease the likelihood of mass wasting shall be taken within 24 months of DNR approval of this watershed analysis. Corrective action includes fill reduction (dipping) on active roads or fill removal on non-essential inactive roads.

Mass Wasting Prescriptions Rescinded
Use as Screening Tool

AREA OF RESOURCE SENSITIVITY: 11

DESCRIPTOR: Road Erosion Unit: Brooks and Segelsen sub-basins

PRESCRIPTION:

Future Road Construction-

1) all mineral soils exposed by road construction shall be seeded with appropriate ground cover within 6 months (including cut slopes, fill slopes, and other scarified surfaces within 200 feet of any stream channel);
2) ballast of new roads should closely follow pioneering of the grade; during wet conditions, road ballast shall be no more than 500 feet from the pioneering;
3) whenever new roads intercept stream channels or seeps, the water shall be kept in its original channel or location;
4) on slopes between 40% and 60%, cross drain spacing shall not exceed 450 feet; on slopes greater than 60%, cross drain spacing shall not exceed 160 feet;
5) road construction shall be carried out in a manner that prevents road drainage from entering inner gorge areas.

Existing Roads [active secondary (AS,6S) and inactive (6I) road segments (refer to Map B-5)]-

1) on inactive roads, to the extent necessary to prevent damage to public resources:
   a) culverts and ditches shall be kept functional;
   b) road surface shall be maintained as necessary to minimize erosion of the surface and subgrade by crowning, outlsloping, or waterbarring.
2) existing roads shall be upgraded to meet *Future Road Construction* prescriptions (see above) when they receive use in future forest practice activities;
3) existing roads noted above shall receive road maintenance which achieves the standards specified in (1) above within 12 months of DNR approval of this watershed analysis.

VOLUNTARY PRESCRIPTION:

Orphaned and/or Abandoned Roads-

It is recommended these roads be abandoned in accordance with DNR Northwest Region Road Maintenance Guidelines dated 6/20/94. Refer to A. Zander's orphaned road inventory (on file with DNR-NW Region) for specific road segment recommendations.

AREA OF RESOURCE SENSITIVITY: 12

DESCRIPTOR: Hillslope Erosion Unit: moderate and high hazard hillslope erosion units

PRESCRIPTION:

General Prescription for all Operations:

1) the number of stream crossings shall be minimized;
2) landings shall be located a minimum of 50 feet from any stream channel;
3) all Type 4 and 5 waters and stream crossings shall be identified on the Forest Practice Application;
4) on Type 4 streams, a minimum of 25 trees 6 inches DBH or larger per 1,000 feet stream length within 25 feet of the OHWM shall be retained on each side of stream; it is preferred that these trees be within 10 feet of the OHWM;
5) adjacent to stream channels, harvest techniques should follow standard fall away, yard away practices wherever feasible;
6) stream channel integrity shall be maintained during all harvest operations which may require the use of temporary crossing structures when water is present.

Ground Based Operations:

1) with the exception of stream crossings, no equipment shall be allowed within 25 feet of any stream channel;
2) with the exception of stream crossings, no skid trails shall be allowed within 50 feet of any stream channel;
3) no ground-based yarding on slopes greater than 30%;
4) equipment shall not operate on any wetland soils connected with stream channels;
5) at the conclusion of the operation, skid trail drainage shall be established at intervals not exceeding 200 feet; within 200 feet of any stream channel, skid trail drainage shall be established at intervals not exceeding 75 feet.

Cable Operations:

1) a minimum of front end suspension shall be used on all cable yarding operations;
2) if the use of front end suspension will not ensure the maintenance of stream channel integrity, full suspension yarding shall be utilized;
3) on slopes less than 50% adjacent to streams, a 15 foot buffer measured horizontally from the OHWM shall be maintained where no soil disturbance is allowed;
4) on slopes greater than or equal to 50% adjacent to streams, a 25 foot buffer measured horizontally from the OHWM shall be maintained where no soil disturbance is allowed.

VOLUNTARY PRESCRIPTION:

It is recommended that livestock be excluded from riparian areas in order to limit streambank erosion. Where fencing along streams currently exists, it should be maintained to limit

livestock access. Eliminating this sediment source will require cooperative efforts between state and federal agencies, local governments, tribes, and landowners.

AREA OF RESOURCE SENSITIVITY: 13

DESCRIPTOR: Riparian zones adjacent to Geomorphic Units 1 and 10

Note: channel migration zones are likely to be associated with geomorphic units 1 and 10, in which case, the following prescription should be applied beginning at the outer edge of the channel migration zone as opposed to the ordinary high water mark of the channel.

PRESCRIPTION:

Conifer-Dominated Stands[1]:

A 100-foot riparian management zone, measured from the ordinary high water mark, shall be established adjacent to the stream channel. No timber harvest is allowed within 45 feet of the ordinary high water mark. Timber harvest is permissible in the outer 55 feet of this zone under the following conditions:

1) a maximum of 30% of the trees within this zone greater than 4 inches in diameter at breast height may be harvested in any 50 year period;
2) the 75 largest trees per acre must be retained;
3) residual trees must be evenly distributed.

Hardwood-Dominated Stands[2]:

A 100-foot riparian management zone, measured horizontally from the ordinary high water mark, shall be established adjacent to the stream channel. No timber harvest is allowed within 30 feet of the ordinary high water mark. Timber harvest is only permissible in the outer 70 feet of this zone under the following conditions:

1) no conifer removal;
2) a maximum of 50% of the trees within this zone greater than 4 inches in diameter at breast height may be harvested in any 50 year period;
3) the 50 largest trees per acre must be retained;
4) residual trees must be evenly distributed;
5) the residual stand must be underplanted with shade-tolerant conifer species within one year of the harvest operation;
6) a detailed plan describing brush (competition) control techniques to ensure seedling survival must be submitted with the Forest Practice Application and approved by the DNR prior to commencing the harvest operation.

Mixed Conifer/Hardwood Stands[3]*:*
A 100-foot riparian management zone, measured from the ordinary high water mark, shall be established adjacent to the stream channel. No timber harvest is allowed within 35 feet of the ordinary high water mark. Timber harvest is permissible in the outer 65 feet of this zone under the following conditions:

1) no conifer removal;
2) a maximum of 30% of the trees within this zone greater than 4 inches in diameter at breast height may be harvested in any 50 year period;
3) the 75 largest trees per acre must be retained;
4) residual trees must be evenly distributed.

1 - Conifer-dominated stands include those stands where coniferous tree species comprise at least 70% of the stand based on density (i.e., trees per acre).
2 - Hardwood-dominated stands include those stands where hardwood tree species comprise at least 70% of the stand based on density (i.e., trees per acre).
3 - Mixed stands include all stands not conifer- or hardwood-dominated.

JUSTIFICATION:
The width of the riparian management zone (100 feet) corresponds to the distance from which nearly 100% of the conifer large woody debris will be recruited in the near-term (10-20 years). This is based on data from McDade et al. (1990) and McKinley (1997), where large woody debris source distances were evaluated in western Washington and Oregon. While all stands within the designated Area of Resource Sensitivity are not conifer-dominated, the width of the riparian management zone was based on recruitment under conifer-dominated situations. This was done because it is recognized that conifers within the 100-foot zone are more likely to be recruited to the stream channel than hardwoods due to differences in height. In addition, the 100-foot zone will conserve future conifer recruitment in cases where hardwood-dominated stands are actively converted to conifer.

The width of the no-harvest portion of the riparian management zone varies according to the dominant vegetation type and corresponds to the distance from which 75% of the large woody debris will be recruited in the near-term. These distances were also based on data from McDade et al. (1990) and McKinley (1997) for conifer-dominated and hardwood-dominated stands. Distances for mixed stands were interpolated between conifer- and hardwood-dominated curves in the aforementioned studies.

Under this prescription, the riparian management zone is divided into two sub-zones; the zone closest to the stream serves as a "core" area where timber harvest is restricted and natural processes (i.e., windthrow, bank undercutting, mortality) guide forest stand development. This is also the zone that provides the large majority of woody debris recruitment. The outer zone serves as an area where some timber harvest (i.e., thinning) is permissible to increase the size and/or quality of potentially recruitable trees.

The specific objective of thinning varies depending on the dominant vegetation type. In conifer-dominated stands, the objective is to accelerate the growth of the residual stand to increase the likelihood that a functional debris piece will be recruited to the stream channel. In hardwood-dominated stands, the objective of thinning is to remove enough of the overstory to accommodate the growth of a conifer understory that will eventually replace the hardwood. A secondary objective is to accelerate the growth of the residual hardwoods to increase the likelihood that a functional debris piece will be recruited to the channel.

The primary assumptions used in developing the prescription for this Area of Resource Sensitivity are as follows:

1) Large woody debris is an important component of fish habitat in geomorphic units 1 and 10 and these channels are most sensitive to large woody debris inputs relative to other channels in the WAU.
2) It is necessary to maintain the zone which supplies nearly 100% of the potential near-term conifer recruitment in a condition that supports the continuous recruitment of large woody debris to the stream channel.
3) It is necessary to provide a minimum of 75% of the potential near-term conifer recruitment to create and maintain desired in-stream habitat conditions for anadromous and resident fish populations.
4) That portion of the riparian management zone that supplies between 75% and nearly 100% of the potential near-term large woody debris recruitment is an important source area for woody debris recruitment and is also an area in which thinning will enhance the size and/or quality of potentially recruitable trees.

REFERENCES:

McDade, M.H., F.J. Swanson, W.A. McKee, J.F. Franklin, and J. VanSickle. 1990. Source distances for coarse woody debris entering small streams in western Oregon and Washington. Can. J. For. Res. 20:326-330.

McKinley, M. 1997. Large woody debris source distances for western Washington Cascade streams. Undergraduate senior research project, unpublished report, University of Washington College of Forest Resources. 36 p.

AREA OF RESOURCE SENSITIVITY: 14

DESCRIPTOR: Riparian zones adjacent to Geomorphic Units 2, 3, 4, 7, 8, and 9

Note: channel migration zones may be associated with portions of geomorphic units 2, 3, and 9, in which case, the following prescription should be applied beginning at the outer edge of the channel migration zone as opposed to the ordinary high water mark of the channel.

PRESCRIPTION:

Conifer-Dominated Stands[1]:

An 80-foot riparian management zone, measured from the ordinary high water mark, shall be established adjacent to the stream channel. No timber harvest is allowed within 45 feet of the ordinary high water mark. Timber harvest is permissible in the outer 35 feet of this zone under the following conditions:

1) a maximum of 30% of the trees within this zone greater than 4 inches in diameter at breast height may be harvested in any 50 year period;
2) the 75 largest trees per acre must be retained;
3) residual trees must be evenly distributed.

Hardwood-Dominated Stands[2]:

An 80-foot riparian management zone, measured horizontally from the ordinary high water mark, shall be established adjacent to the stream channel. No timber harvest is allowed within 30 feet of the ordinary high water mark. Timber harvest is only permissible in the outer 50 feet of this zone under the following conditions:

1) no conifer removal;
2) a maximum of 50% of the trees within this zone greater than 4 inches in diameter at breast height may be harvested in any 50 year period;
3) the 50 largest trees per acre must be retained;
4) residual trees must be evenly distributed;
5) the residual stand must be underplanted with shade-tolerant conifer species within one year of the harvest operation;
6) a detailed plan describing brush (competition) control techniques to ensure seedling survival must be submitted with the Forest Practice Application and approved by the DNR prior to commencing the harvest operation.

Mixed Conifer/Hardwood Stands[3]*:*

An 80-foot riparian management zone, measured from the ordinary high water mark, shall be established adjacent to the stream channel. No timber harvest is allowed within 35 feet of the ordinary high water mark. Timber harvest is permissible in the outer 45 feet of this zone under the following conditions:

1) no conifer removal;
2) a maximum of 30% of the trees within this zone greater than 4 inches in diameter at breast height may be harvested in any 50 year period;
3) the 75 largest trees per acre must be retained;
4) residual trees must be evenly distributed.

1 - Conifer-dominated stands include those stands where coniferous tree species comprise at least 70% of the stand based on density (i.e., trees per acre).
2 - Hardwood-dominated stands include those stands where hardwood tree species comprise at least 70% of the stand based on density (i.e., trees per acre).
3 - Mixed stands include all stands not conifer- or hardwood-dominated.

JUSTIFICATION:

The width of the riparian management zone (80 feet) corresponds to the distance from which 95% of the conifer large woody debris will be recruited in the near-term (10-20 years). This is based on data from McDade et al. (1990) and McKinley (1997), where large woody debris source distances were evaluated in western Washington and Oregon. While all stands within the designated Area of Resource Sensitivity are not conifer-dominated, the width of the riparian management zone was based on recruitment under conifer-dominated situations. This was done because it is recognized that conifers within the 80-foot zone are more likely to be recruited to the stream channel than hardwoods due to differences in height. In addition, the 80-foot zone will conserve future conifer recruitment in cases where hardwood-dominated stands are actively converted to conifer.

The width of the no-harvest portion of the riparian management zone varies according to the dominant vegetation type and corresponds to the distance from which 75% of the large woody debris will be recruited in the near-term. These distances were also based on data from McDade et al. (1990) and McKinley (1997) for conifer-dominated and hardwood-dominated stands. Distances for mixed stands were interpolated between conifer- and hardwood-dominated curves in the aforementioned studies.

Under this prescription, the riparian management zone is divided into two sub-zones; the zone closest to the stream serves as a "core" area where timber harvest is restricted and natural processes (i.e., windthrow, bank undercutting, mortality) guide forest stand development. This is also the zone that provides the large majority of woody debris recruitment. The outer zone serves as an area where some timber harvest (i.e., thinning) is permissible to increase the size and/or quality of potentially recruitable trees.

The specific objective of thinning varies depending on the dominant vegetation type. In conifer-dominated stands, the objective is to accelerate the growth of the residual stand to increase the likelihood that a functional debris piece will be recruited to the stream channel. In hardwood-dominated stands, the objective of thinning is to remove enough of the overstory to accommodate the growth of a conifer understory that will eventually replace the hardwood. A secondary objective is to accelerate the growth of the residual hardwoods to increase the likelihood that a functional debris piece will be recruited to the channel.

The primary assumptions used in developing the prescription for this Area of Resource Sensitivity are as follows:

1) Large woody debris is an important component of fish habitat in geomorphic units 2, 3, 4, 7, 8, and 9; however, these channels are less sensitive to large woody debris inputs relative to geomorphic units 1 and 10 (ARS 13).
2) It is necessary to maintain the zone which supplies 95% of the potential near-term conifer recruitment in a condition that supports the continuous recruitment of large woody debris to the stream channel.
3) It is necessary to provide a minimum of 75% of the potential near-term conifer recruitment to create and maintain desired in-stream habitat conditions for anadromous and resident fish populations.
4) That portion of the riparian management zone that supplies between 75% and 95% of the potential near-term large woody debris recruitment is an important source area for woody debris recruitment and is also an area in which thinning will enhance the size and/or quality of potentially recruitable trees.

REFERENCES:

McDade, M.H., F.J. Swanson, W.A. McKee, J.F. Franklin, and J. VanSickle. 1990. Source distances for coarse woody debris entering small streams in western Oregon and Washington. Can. J. For. Res. 20:326-330.

McKinley, M. 1997. Large woody debris source distances for western Washington Cascade streams. Undergraduate senior research project, unpublished report, University of Washington College of Forest Resources. 36 p.

AREA OF RESOURCE SENSITIVITY: 15

DESCRIPTOR: Riparian zones adjacent to Geomorphic Unit 6

PRESCRIPTION:
A 25-foot riparian management zone, measured from the ordinary high water mark, shall be established adjacent to the stream channel. No timber harvest is allowed within 15 feet of the ordinary high water mark. Timber harvest is permissible in the outer 10 feet of this zone under the following conditions:

1) a maximum of 30% of the trees within this zone greater than 4 inches in diameter at breast height may be harvested in any 50 year period;
2) residual trees must be evenly distributed;
3) harvested trees must be felled are yarded away from the stream channel.

JUSTIFICATION:
This Area of Resource Sensitivity influences channels within Geomorphic Unit 6 which includes first order channels with gradients greater than 12%. Based on information contained in the Fish Habitat and Riparian Function assessment reports, this Geomorphic Unit is limited to small, non-fish-bearing streams. In these channels, large woody debris serves as a roughness element, creates sediment storage sites, and helps to stabilize channel beds and banks (see Stream Channels report). The retention of trees adjacent to these channels is necessary to provide a recruitable supply of large woody debris to fulfill these various functions. It is assumed that providing a minimum of 50% of the potential large woody debris recruitment is sufficient to create and/or maintain desired channel characteristics.

The width of the riparian management zone (25 feet) corresponds to the distance from which 50% of the conifer large woody debris will be recruited in the near-term (10-20 years). This is based on data from McDade et al. (1990) and McKinley (1997). Although none of the riparian zones associated with this Geomorphic Unit were evaluated for woody debris recruitment potential in the Riparian Function assessment (none are Type 1-3 waters), it is assumed that most are conifer-dominated. This is based on the physical characteristics of the channels (high gradient, confined), adjacent hillslopes (relatively steep), and soils (shallow, generally well drained) which result in conditions more conducive to conifer growth.

REFERENCES:
McDade, M.H., F.J. Swanson, W.A. McKee, J.F. Franklin, and J. VanSickle. 1990. Source distances for coarse woody debris entering small streams in western Oregon and Washington. Can. J. For. Res. 20:326-330.

McKinley, M. 1997. Large woody debris source distances for western Washington Cascade streams. Undergraduate senior research project, unpublished report, University of Washington College of Forest Resources. 36 p.

AREA OF RESOURCE SENSITIVITY: 16

DESCRIPTOR: Channel Migration Zones associated with Geomorphic Units 1, 2, 3, 9 and 10

Note: only channel migration zones associated with geomorphic unit 10 appear on the Area of Resource Sensitivity map; channel migration zones associated with geomorphic units 1, 2, 3, and 9 will require field identification.

PRESCRIPTION:

No timber harvest is allowed within 45 feet of any active stream channel within the channel migration zone. In the remaining portions of the channel migration zone, timber harvest is permissible under the following conditions:

1) a maximum of 30% of trees within this zone may be harvested in any 50 year period;
2) harvest is limited to hardwood species only (i.e., no conifer removal);
3) the 75 largest trees per acre must be retained;
4) residual trees must be evenly distributed;
5) operations must be conducted during periods of low soil moisture between July 1 and September 30 or during periods of low soil moisture as approved by the Department of Natural Resources;
6) yarding of timber is limited to low impact harvest methods (i.e., shovel, cable or helicopter);
7) no road or skid trail construction is allowed.

JUSTIFICATION:

The channel migration zone is an area that channels have occupied in the recent past or could reasonably be expected to occupy again in the near future. This zone serves as source area for large woody debris in addition to providing critical habitat for salmonid fish species. As a result, timber harvest within this zone is limited. Large trees serve as a potentially recruitable source of woody debris, help stabilize streambanks, and help reduce flow velocities during overbank flood events, thus decreasing erosion. The conditions placed on timber harvest within this zone are intended to maintain the large majority of potential woody debris recruitment while at the same time increasing the growth and vigor of the residual post-harvest stand to provide even greater wood debris recruitment potential in the future.

No-harvest portions of the channel migration zone are intended to protect side-channels, off-channel areas, and overflow channels by providing a minimum of 75 percent of the potential large woody debris recruitment potential based on data from McDade et al. (1990) and McKinley (1997). Since much of the channel migration zone is dominated by hardwood forests, it is likely that the 45-foot no-harvest zone will supply closer to 90 percent of the potentially recruitable wood. In the remainder of the channel migration zone, limiting harvest operations to 30 percent of the stems in any 50 year period ensures the maintenance of a

residual stand that will: (1) decrease water velocities during overbank flows, (2) maintain rooting strength thereby stabilizing floodplain landforms, and (3) provide a recruitable supply of large woody debris if and when the channel migrates laterally.

AREA OF RESOURCE SENSITIVITY: 17

DESCRIPTOR: Riparian zones adjacent to the following channel segments and/or geomorphic units: channel segments 12, 65, 66, 67, and 68 of geomorphic unit 2; channel segments 5, 7, 81, and 152 of geomorphic unit 3; channel segment 57e of geomorphic unit 8; channel segments 6, 57, 65a, and 159 of geomorphic unit 9; all of geomorphic unit 10 (mainstem North Fork Stillaguamish)

PRESCRIPTION:
Stream shade shall be retained at levels equal or exceeding those specified in WAC 222-30-040. Required shade levels shall be achieved irrespective of riparian management zone (RMZ) width or shade levels shall not be reduced below current levels.

VOLUNTARY PRESCRIPTION:
Segments 57 and 65a (non-forested riparian zones):
It is recommended that a conifer dominated riparian zone be actively reestablished adequate to supply 80% shade cover to the channel. Suggested species include western redcedar and/or sitka spruce planted at a spacing of 15 feet between trees. In areas with severe grass competition, cottonwood whips may be a more appropriate species for planting.

AREA OF RESOURCE SENSITIVITY: 18

DESCRIPTOR: Riparian zones adjacent to channel segments 1, 53, and 54 of geomorphic unit 1

VOLUNTARY PRESCRIPTION:
It is recommended that a conifer dominated riparian zone be actively reestablished adequate to supply 83% shade cover to the channel. Suggested species include western redcedar and/or sitka spruce planted at a spacing of 15 feet between trees. In areas with severe grass competition, cottonwood whips may be more appropriate. Channel morphology indicates active channel migration within the area; when planting, one should account for possible channel migration and may consider these areas for planting.

JUSTIFICATION:
These channel segments are within agricultural areas where no commercial timber harvest is expected in the near future. As a result, only voluntary prescriptions were written to address the rule call. Target shade levels noted above were derived from Forest Practices Board Manual (page M-4).

AREA OF RESOURCE SENSITIVITY: 19

DESCRIPTOR: Road stream crossing structures that serve as partial or complete barriers to fish migration/passage

PRESCRIPTION:
Fish blockages associated with existing forest roads shall be corrected when (1) the road receives active log haul, or (2) in accordance with a five-year culvert correction plan mutually agreed upon by all interested TFW participants in the watershed administrative unit (WAU). The correction plan shall be established within six months of approval of this watershed analysis and must include an explicit timeline for remediating fish blockages associated with forest roads in the WAU.

RECOMMENDATION:
It is recommended that fish blockages associated with non-forest roads (i.e., state, county or private) be corrected to provide for fish passage. The responsible parties should work in cooperation with Tribes and WDFW to ensure that WDFW juvenile and adult fish passage standards are met or exceeded. In addition, a plan to identify and prioritize blockages should be established within one year of approval of this watershed analysis.

Hazel Landslide Inventory Map (A1)

Feet
0 3,500 7,000 14,000 21,000 28,000

WASHINGTON STATE DEPARTMENT OF
Natural Resources

N

Legend

Unknown level of Certainty

CERTAINTY

- Definite
- Probable
- Questionable

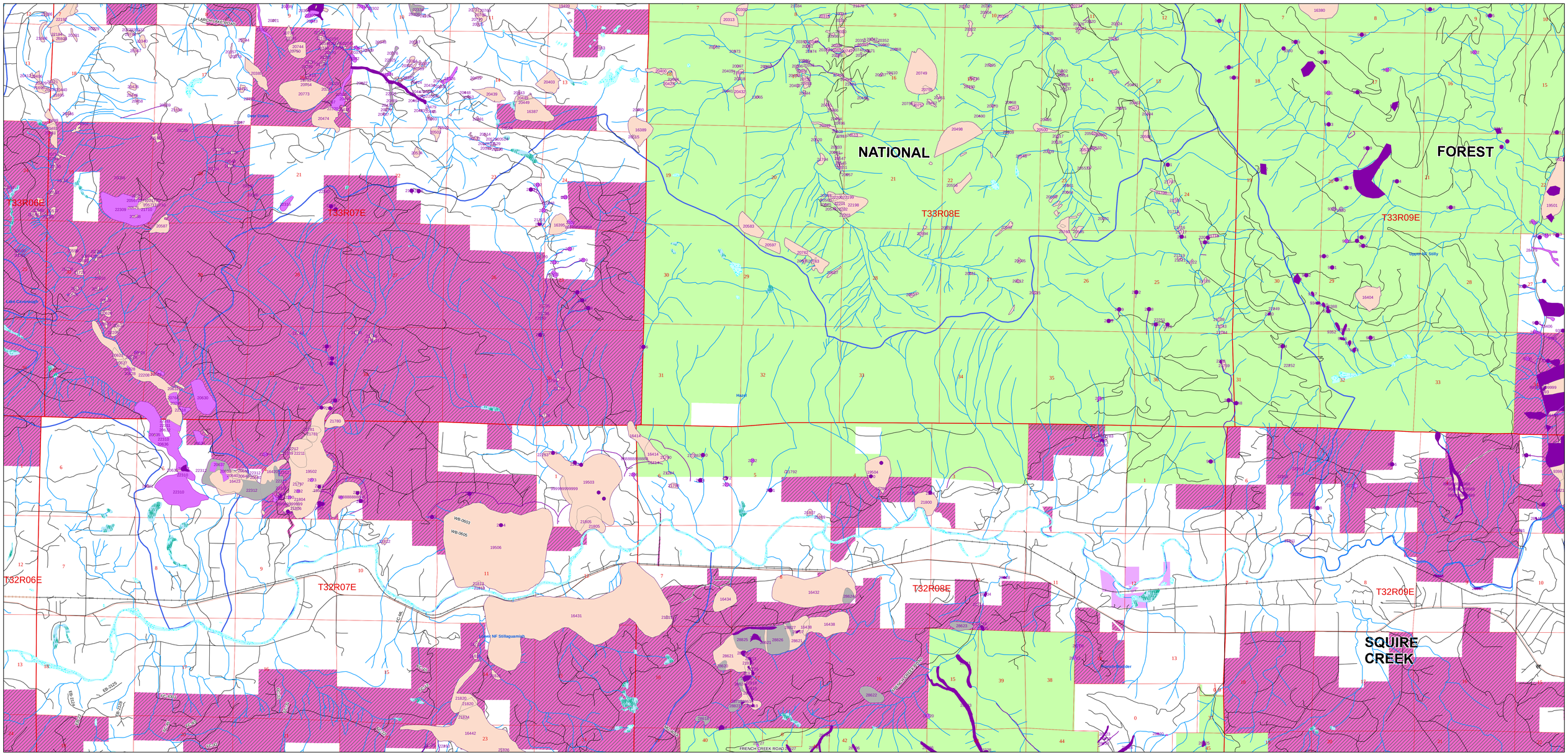
Watercourse
Water Body Interior Line
Other Impoundments
Open Freshwater
Subject to Inundation
Glacier / Snowfield
Wet Area
Open Saltwater
Artificial Feature
Unknown / Unclassified

Roads
Trail
Railroad
Railroad Grade
Ferry Crossing
watershed boundaries
DNR-Managed Lands

Tribal Lands

US Forest Service
National Park Service
US Fish and Wildlife Service
US Bureau of Land Management
Other Federal
Other State
County, Municipal or University

Original Author: Jerry Thorsen, 1994
Map created by L.M. Vaugeois, 2007



Hazel Mass Wasting Map Unit Map (A2)

0 3,500 7,000 14,000 21,000 28,000 Feet

WASHINGTON STATE DEPARTMENT OF
Natural Resources

N

Legend

Landslide Hazard Zones

Interpreted Instability

- Low instability potential
- Moderate instability potential
- High instability potential
- Very high instability potential
- Unknown instability potential
- Variable instability potential
- Indeterminate instability potential

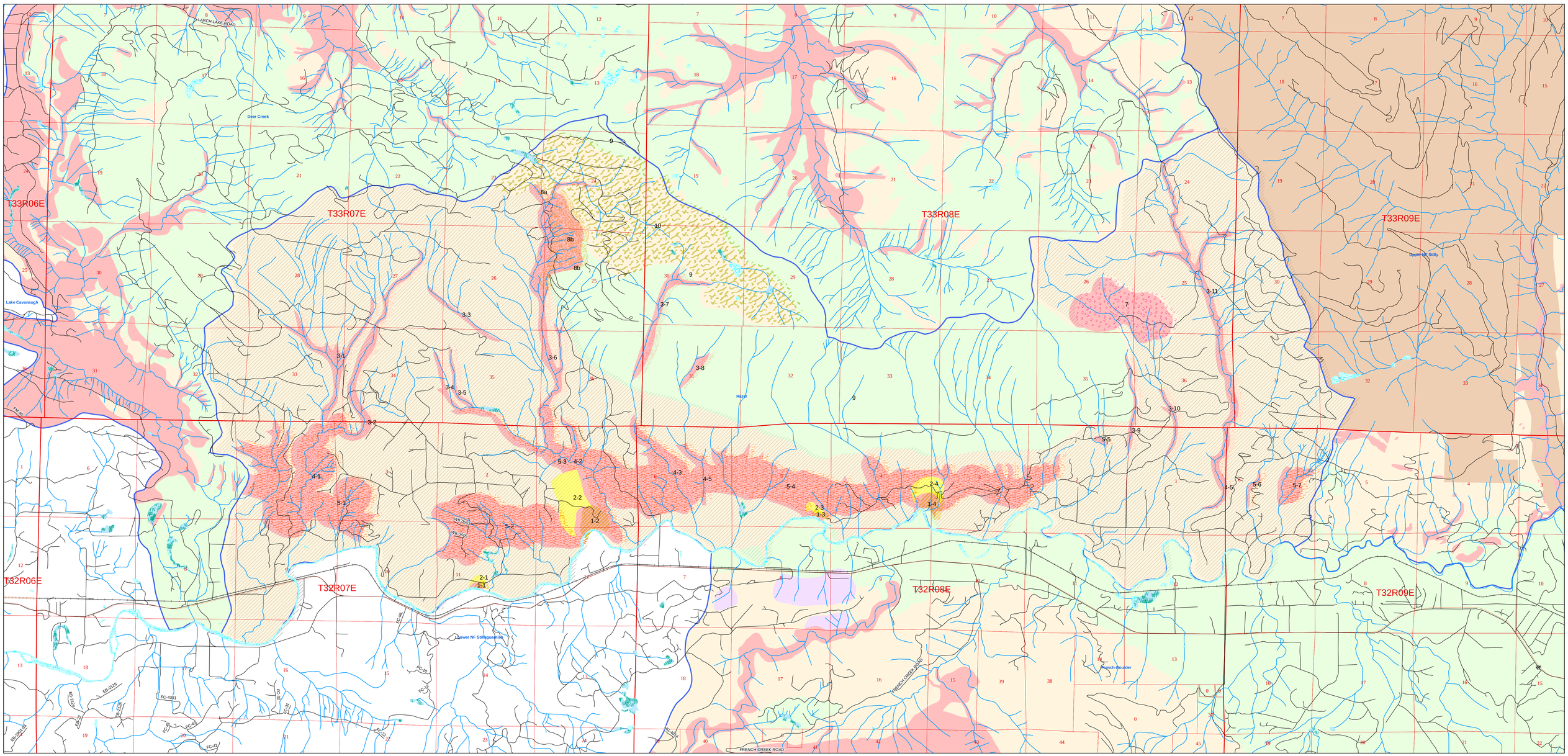
mwmu polygon

MWMU

- 1
- 2
- 3
- 4
- 5
- 6
- 7
- 8
- 9
- 10

- Watercourse
- Water Body Interior Line
- Other Impoundments
- Open Freshwater
- Subject to Inundation
- Glacier / Snowfield
- Wet Area
- Open Saltwater
- Artificial Feature
- Unknown / Unclassified
- Roads
- Trail
- Railroad
- Railroad Grade
- Ferry Crossing
- watershed boundaries

Original Author: Jerry Thorsen, 1994
Map created by L.M. Vaugeois, 2007



A - Mass Wasting Module

A.1. INTRODUCTION-

A.1.1. Geologic Setting- The bedrock framework for the Hazel WAU consists of the tilted sandstone in the Mt. Higgins area bracketed by lower ridges of more highly metamorphosed sedimentary and igneous rocks to the east and west. These latter metamorphic rocks have been compressed, sheared, and faulted, producing a subtle northwest-southeast trending "grain". The sandstones of Mount Higgins are cut by a major fault, which separates a western block of northerly sloping beds from the more spectacular eastern sawtooth peaks.

The ice sheet of the last continental glaciation, advancing down the Puget Lowland, dammed rivers. The "blue clay" exposed in the lower Hazel landslide was deposited on the floor of one such glacial lake. As the ice sheet occupying the Lowland thickened, tongues of ice moved up-valley, smearing glacial till over the earlier sediments and bedrock walls. Eventually, the ice mass moving south became thick enough to overwhelm and smooth bedrock divides of Brooks, Rollins, and Segelsen Creeks, leaving only the crest of Mt. Higgins protruding and uneroded.

As the ice sheet receded, meltwater deposited an extensive blanket of sand throughout the valley of the North Fork, covering the earlier sediments. Both these "outwash" deposits and the underlying glacial-lakebed silt were cut by post-glacial drainage. The early post-glacial drainage included that of the modern Whitechuck, and probably that of the Suiattle, Rivers. Thus, it was able to extensively erode the glacial sediments, leaving remnants such as the Whitman Bench as terraces. The oversteepened edges of such terraces commonly failed as very large deep-seated landslides, possibly encouraged by a climate wetter than today's.

In early post-glacial time a massive eruption of Glacier Peak sent volcanic mudflows downvalley, eventually damming the valley near Darrington and forcing the Whitechuck and Suiattle drainages north into the Skagit. However, the early North Fork of the Stilly and its tributaries continued to downcut, possibly influenced by post-glacial sea level fluctuations or by earlier lowering of the bedrock sill upstream Arlington.

Details of the geology and geologic history of the area are beyond the scope of this overview, however, it is clear that this early history set the stage for the ancient as well as modern patterns of mass wasting we see today.

A.1.2. Ancient Landslides- Large post-glacial landslides are commonly very important to modern mass wasting processes and the Hazel WAU is no exception. They make up substantial portions of MWMU's 3, 5, and 8. Modern mass wasting events, ranging in size from 10 square yards to more than 30 acres have originated from, or been associated with, these ancient slide areas. Bedrock landslides and slides along the edges of glacial terraces produce different materials and delivery problems. Thus, the two contrasting source areas are discussed separately here.

A.1.2.1. Bedrock slide areas- All but the highest peaks forming the north boundary of the Hazel WAU were over-ridden and smoothed by the last continental ice sheet, about 4000 ft thick in the valley of the North Fork. The ice not only eroded and locally steepened these ridges but supported their slopes. When the melting of the ice filling the valley removed that support, landslides commonly occurred near ridge crests.

The best examples of such "relaxation" slides are in the Brooks Creek sub basin, below its divide with Deer Creek. These slides, generally less than 200 yards across and not associated with stream incision, appear to be insensitive to massive reactivation by forest practices. Their oversteepend scarps are, however, sites of small-scale failures probably due to loss of root strength following harvest. Such failures have tended to stop on the more gently-sloping slide mass below the scarp.

In contrast to such isolated bedrock slides in relatively strong rock, are landslide complexes that have developed in rock subjected to intensive fracturing and shearing due to faults. Where such slopes were subject to incision by major streams, such as in upper Swede and Rollins Creeks, major landslide complexes have resulted. They are delineated as MWMUs 7 and 8, respectively. The oversteepened scarps and the shattered debris of lower slopes are naturally unstable and have contributed to modern slope and channel instability (see Sub Basin Overview).

A.2.1.2. Slides in Glacial Sediments- The gently-sloping glacial terrace of Whitman Bench has similar dissected remnants all across the WAU. Edges of these terrace remnants are, in places, delineated by the scarps of at least 17 large, deep-seated, post-glacial landslides. (The scarps of these slides are designated with letters rather than numbers in Map A-1 and Table A-1, to call attention to their apparent dormant state.) Individual slides commonly approach a half-mile across. Most of these slides appear to have failed within the glacial lakebed silt ("blue clay") that underlies western terrace remnants and where modern streams are now cutting at this clay unit. Considerable recent slide activity in MWMU 5 has occurred from the scarp areas or within the slide masses of these post-glacial landslides. Map Unit 4 is largely made up of the toe areas of these slides and probably includes many slides too small to show through the alder canopy.

In general, the large post-glacial, outwash-terrace slides appear to be stable. All appear to have been clearcut at least once, with no apparent response. However, as the Hazel slide (MWMU 1-2) demonstrates, they are potentially susceptible to piecemeal reactivation as a result of stream cutting at bends. Such bank cutting has also destabilized river bank segments with no apparent history of failure - i.e., MWMU 1-1, 1-3, and 1-4. (It is important to note that glacial terrace sediments may be highly variable, and the flanks of Whitman Bench are not necessarily representative of slopes in MWMU 5 to the east.)

A.1.3. Sub Basin Overview- Each major drainage in the Hazel WAU has some unique characteristic(s) which appear to influence not only mass wasting and delivery but the nature of sediment transport. Some of these features were used to help draw MWMU boundaries, and a better understanding of them could also be useful to forest managers. All sub basins except Whitman Bench have headwaters of glaciated bedrock and lower stretches that traverse glacial and/or post-glacial deposits. All sub basins have incised channels, including their uppermost tributaries. In every sub basin mass wasting processes, whether natural or related to forest practices, are almost entirely associated with such stream incision. (The only significant exceptions are in upper Rollins and Swede Creeks, where ancient post-glacial bedrock landslides have set the stage for current modes of mass wasting.)

A better understanding of this strong association between post-glacial events and processes, and mass wasting can be of help to the land manager. First, in most basins the proportion of land currently being affected by channel incision is relatively small. Thus, current forest practice standards are usually adequate to avoid stability problems in such areas. Second, such incision or post-glacial slide scarps are generally recognizable in the field as an abrupt break in slope. Thus, the on-site forest professional can be alerted to areas that might require extra precautions. Possibly, the following overview can give such field personnel a better understanding of the post-glacial events and processes that provide the settings for modern-day mass wasting.

Brooks Creek: This basin has generally moderate slopes of thin soils over bedrock and colluvium in its upper portion. There have been some post-glacial bedrock landslides near the upper divide. Their oversteepened scarps are sites for small-scale slides but they stopped within the slide area. Slopes between incised channels are naturally stable. The channels and their walls, although showing little evidence of instability in the past 20 years, have the potential for MW events.

At about midpoint in the basin (elevation 1400-1600 feet) channels abruptly steepen, and stream incision from here to the lowlands is very pronounced. Inner gorges have developed (MWMU 3), with their steep walls the sites of shallow rapid events and/or channel wall cutting at bends. Either form of failure can trigger destructive debris flows in the narrow, confined channels.

Still lower (900-1000 foot elevation), Brooks Creek and its neighboring stream to the west have deeply incised a terrace of glacial outwash. This incision has triggered large, now apparently dormant, landslides along both sides of the Creek. These steep scarps, and masses of disturbed material with hummocky terrain (MWMU 5) are common sites for small modern landslides, some of which deliver sandy, terrace sediments to the stream. The stream, here flowing at a lower gradient, cuts the blue clay underlying the terraces (MWMU 4).

Whitman Bench: This area is not a basin as such, but essentially a 2-square mile plateau that rises about 600 ft above most of the surrounding terrain. Actually only the southern portion of this geomorphic feature is delineated as a sub basin. Much of the bench is outlined by a series of ancient deep-seated landslides (see Map A-1). There are a few small streams on the bench but most of its drainage is subsurface. Most precipitation appears to infiltrate the sandy glacial outwash of the upper bench surface and emerge as springs in the peripheral

slide scarps. The multiple elevations of the springs reflect apparently discontinuous silty aquicludes within the sands of the mid-to upper Bench.

The steepness of the ancient slide scarps, the perennial wet conditions associated with the springs, and their short steep-gradient streams, account for much of the mass wasting from Whitman Bench flanks (MWMU 5). The rest is essentially as a result of incision and lateral migration of Brooks and Rollins Creeks (MWMU 4). Such erosion is probably enhanced by the disrupted nature of the glacial silts forming much of the toe in the ancient slide sediments.

Rollins Creek: The Rollins Creek drainage includes an extreme range of mass wasting features and terrain, some of which is distinctive enough to warrant consideration as separate map units. The headwaters include a broad, gently-sloping basin above 3000 feet elevation (MWMU 10). This feature, also existing in adjacent Dicks Creek, probably has different snow-accumulation/snow-melt and runoff characteristics from those of other basins in the WAU with more uniform south-facing slopes in their headwaters.

The area below where the Rollins Creek channel abruptly steepens is one with such variety and density of MW conditions as to warrant designation as a separate map unit (MWMU 8). Map unit 8 demonstrated a low tolerance for road building practices such as side casting on steep slopes. The steep upper rim forming the northwest "corner" of this map unit, delineates the scarps of ancient bedrock landslides. It was the source of a debris flow that travelled the entire length of the Creek in 1988. Another ancient slide complex east of the channel is the source of other shallow rapid failures. These ancient slide complexes are the apparent source of a debris apron which extends from about 1200-to-2000 feet in elevation. The creek has deeply incised this material, leaving an inner gorge with steep, unstable banks. (This incision appears to have captured prehistoric parallel channels, leaving "fossil" inner gorges and/or incised channels on both sides of the modern channel.)

As with Brooks Creek, below about 1000 ft elevation Rollins Creek has deeply incised glacial outwash terrace sediments. Similar to neighboring Brooks and Dicks Creeks, post-glacial incision triggered major deep-seated landslides in the terrace sediments. The disturbed sediments, generally "blue clay" along the toes of these ancient failures, are now common sites for small deep-seated slides. These occur at channel bends or where stream flow is along the toe of such slopes.

Contributing to the uniqueness of the Rollins Creek drainage is its history of major floods. As these do not appear to have happened in neighboring basins, in spite of evidence of their channel instability, the Rollins floods are apparently of the dam-break variety rather than being simple hydrologic events. These floods occurred about 1947, 1965, and 1988. Except for the 1988 event mentioned earlier, the points of origin of the events are unknown. The magnitude of the mid forty's event was such that substantial flow left the normal channel and eroded a channel across farmland to the east. It entered the Stilliguamish well upstream of the normal mouth of Rollins Creek. Diverted flow from the 1965 flood event followed much the same path, entering the Stilly more than 200 yards upstream.

Dicks Creek: This relatively small basin has an upper-elevation, rather gently-sloping headwater area similar to that of neighboring Rollins Creek. Also similar to Rollins Creek, even these low-gradient streams are incised, making for substantial storage capacity upstream from any culvert blockages. The Channel Module Team reports, from earlier on-site observation, that small deep-seated slides are common in glacial sediments along the gradient segment draining the upper basin. This may explain the apparent channel instability of upper Dicks Creek, prior to any timber harvest.

Unique to Dicks Creek is the long, straight, steep-gradient (55%) inner gorge down the Mt. Higgins escarpment. The extensive incision here, in contrast to even steeper drainages to the east, may be at least in part because of the extensive upper-elevation catchment basin previously discussed. Despite the steepness of both channel gradient and side slopes, the walls of the inner gorge appear to be rather stable except in the lower segment (elevation 1100 to 1400 ft) where glacial sediments appear to be quite thick.

Dicks Creek has been unable to incise through the glacial outwash terrace to the extent of the larger Brooks or Rollins Creeks. It has, however, deeply incised the flank of that terrace. This incision not only triggered large ancient slides, as with Brooks and Rollins Creeks, but is still causing small-scale deep-seated failures along the channel.

Higgins Sub Basin: The numerous, relatively short and simple systems draining most of this sub basin begin in bedrock, commonly at elevations in excess of 4000 ft. Some appear to also be snow avalanche chutes. Many are probably incised enough (10-25 ft) to warrant the "incised channel" designation use for this WAU. In general, the sensitivity to forest practices of those upper channels is relatively straightforward. Their response to '70s-style road construction is well illustrated by the midslope sections of road west of Dick's Creek, where three stream crossings failed.

Lower in this sub basin channels traverse slopes of till, with aprons and fans of colluvium or talus. In a few cases, ridges of bedrock and/or till (marked by shallow soils and stunted tree growth) occur along the base of the mountain front. Elsewhere, short downslope ridges appear to have greater-than-normal tree growth, probably because the "ridges" are actually fans and trees along their axis receive ample water from streams. Some of the streams in this unit appear to sink into their beds, at least during periods of low flow. Such behavior could complicate the work of the forest engineer charged with sizing culverts.

A terrace of glacial outwash has been mapped (Tabor and others, 1988) along the base of the Mt. Higgins escarpment and its associated fans and colluvial aprons. However, terrace materials near the eastern portion of this sub basin appear, at least locally, to be quite different from those in the western portions of the WAU. For example, the terrace just west of Swede Creek appears to be made up largely of a till-like mixture of non-stratified silt (blue clay) with abundant angular rock chips and isolated subrounded cobbles. This "till" (?) is quite unlike the "normal till" exposed along the Forest Service road above terrace level. In addition, it is overlain by cobbly colluvium rather than thick outwash sand such as exposed along Whitmen Bench. Such substantial differences in mapped outwash terrace materials are a major source of uncertainty.

Swede Creek: Although included in the Higgins sub basin, the Swede Creek basin is quite unlike the other drainages in the sub basin as well as any other in the WAU. Upper Swede Creek is the site of a major bedrock landslide complex totalling almost a mile across. The area probably failed due to weakness brought on by fracturing and faulting. It left an area (MWMU 7) of scarps as steep as 100 %, with an apron of shattered slide debris, some of which moved again as a secondary slide. The area is naturally unstable and showed a low tolerance for road construction in the late sixties.

The rocky slide debris, possible on the order of 50 million cubic yards, appears to have filled the ancestral Swede Creek valley, between about 800 and 200 ft elevation. A distributary point developed just above this deposit, and the modern drainage flows down both sides of the "Swede Creek Bulge". (The east fork channel is itself unstable, and between 1100 and 1600 feet it has taken a short cut from that shown on the USGS map.) The main distributaries continued to diverge downward, and are more than 3000 feet apart on the lowlands near Swede Heaven.

The foregoing reconstruction of Swede Creek's history not only helps explain the marginal stability of much of the upper basin but also of its channels and hydrology. In regard to the latter, last September the "main" channel of Swede Creek was dry and the channel shown as "intermittent" by the USGS was flowing strong. (Both have been mapped as Type 3.) If such erratic flow conditions appear to present a challenge for the forest engineer designing a stream crossing, think about the fish!

Segelsen Creek: In comparison with other major drainages in the WAU, Segelsen's drainage is rather simple and straightforward. Between 1000 and 3000 ft elevation it has the best example of a continuous, classic "inner gorge" of the entire WAU. (Other gorges in the WAU commonly have only one steep wall or may include stretches where walls are less than 25 ft, or sloping less than 50%, thus fail to meet the criteria for an inner gorge.)

Excluding small basins east of Segelsen Creek, stability problems within this WAU are almost entirely confined to inner gorges. Clearcutting of gorge walls in about 1967 triggered a shallow rapid failure that resulted in channel destabilization below 2900 ft elevation. A small deep-seated bank failure in the mid '70s, apparently due to stream cutting, triggered a debris flow that traveled down the main channel for almost a mile. This event occurred along a stretch that was not subject to any forest activities, so may have been a result of the earlier event. Much of the main channel below 2900 ft appeared to be still unstable in 1991.

Despite the common occurrence of glaciated bedrock slopes of 50% or more, there were very few failures that were not related to streams. Despite a rather extensive road network, some built to the early '60s design and construction standards, there were few failures that could be directly attributed to roads. These findings were considered important, because the mid-to-upper Segelsen basin was the only one in the WAU where good photo coverage was available throughout the period of major harvest activity.

Basin Summary: Upper basin stability problems were largely confined to areas of ancient bedrock landslides in Rollins and Swede Creeks. The walls of inner gorges were problem areas at all elevations. Incised channel failures were relatively few, mostly road related, and in areas of greater than 50% slopes. The flanks of the lower (900 ft) glacial terrace had stability problems wherever incised by streams and/or spring complexes.

A.2. MW MAP UNITS

A.2.1. General Discussion- Map unit descriptions are included at the end of the Mass Wasting Assessment. However, some units warrant discussion at a level that is impractical for Form A-2. Those discussions follow.

A.2.2. Discussion of Selected Units

MW Map Units 1 and 2: These units, very large, active, deep-seated slides (MWMU 1) and their individual ground-water recharge areas (MWMU 2), are discussed together here. For further details see appropriate MWMU Description forms (Form A-2). MWMU 2 was essentially "created" by the Synthesis Team, with the outlining of individual recharge polygons on the map assigned to the MW Module Team. Whereas the active slides can, in most cases, be delineated with considerable confidence, the outlining of their recharge areas is fraught with uncertainty. (Obviously, if they could be reliably mapped they wouldn't be "indeterminate".) Resolving, or even significantly reducing, that uncertainty is beyond the scope of this Level 1 analysis. However, the following discussion of each unique slide/recharge unit may provide background useful to any further studies.

It should be emphasized that there is no right or wrong, correct or incorrect, solution to the delineation of the recharge area for a particular landslide short of installing and monitoring an extensive field of test wells. One might, however, get general agreement that a drop of water infiltrating near a slide scarp is more apt to reach that slide than a drop infiltrating further away. Stated another way, the myriad factors that can influence ground-water movement in a real-world setting mean that predicting such movement toward a given slide area becomes less and less likely to be true the further one gets from that slide. The arbitrary recharge area "formula" in the map unit description (Form A-2) was based largely on that assumption as well as upon recognition of the many unknowns involved. Thus, the delineation of recharge areas 2-1, 3, and 4 was meant to emphasize probable rather than possible recharge areas. Recharge area 2-2 was based on an earlier study (Benda, 1988).

The inclusion of a recharge area map unit acknowledges the importance of ground water to active deep-seated landslides. All four such slides in MWMU 1 are influenced by river cutting as well. The question of the relative roles of ground water vs. river cutting in the short term can be addressed by available computer techniques (Miller, in press). The relative roles are, of course, also subject to both natural or man-induced changes, both short and long-term. For example, the ground water supply to a particular landslide can be increased in the short term by clear cutting or wildfire within its recharge area. Alternatively, recharge in the longer term can be reduced by reforestation.

Theoretically, differences in local geology and the resulting ground water patterns can determine how a natural slope fails (e.g., SR or LPD) and the relative mobility of failed sediments. On the other hand, toe erosion by stream cutting can dictate if that particular natural slope will fail. With no toe erosion even an active landslide will eventually reach an angle of equilibrium and stop. On the other hand, a slope of the same cohesive materials but totally devoid of ground water would continue to fail if subjected to oversteepening by cutting at the toe. Such a "dry" slope would merely fail at a steeper angle and a different mode (for example, by collapse or toppling rather than by slump, or lateral-spread flow).

MWMU 1-1 and 2-1: This landslide between Whitman Road and the river (river mile 18.5, see map A-1) was first seen on 1969 photographs. By 1983 the surface of the slide was covered by young (10 year-old?) alder and activity was confined to the slide toe, along the river. Activity in 1991 was also confined to the immediate river bank area. Slide 1-1, like the other three slides in the unit, appears to be related to both river cutting and ground water. Assuming the presence of a water-perching silt here, the top of the silt would be lower than the lowest at the Hazel slide and may be totally unrelated to it. However, available geologic mapping does show localized "advance outwash" along the river in both areas. The upland topography reflects the runout zone of disintegrated outwash deposits that resulted from ancient landslide complex J.

About 15 acres of ponds and bogs exist in the hummocky terrain formed by the runout of ancient landslide complex "J", from southern Whitman Bench. The perennial nature of these wetlands, their common elevations, and their existence on permeable sediments, all indicate that they are part of the local water table. Draining these wetlands, especially the one within 700 feet of Landslide 1, would likely reduce ground water at the slide more than would regulating upslope forest practices. As drainage is probably not an option, the delineated "recharge area" for this slide (MWMU 2-1) is based on the arbitrary formula outlined in the map unit description.

MWMU 1-2 and 2-2: The Hazel landslide at river mile 20 is the only one of the four large active slides in MWMU 1 that has been previously studied (Benda and others, 1988). During the course of that study two recharge areas were identified. I considered it beyond the scope of this Level 1 analysis to attempt to second guess that work. Thus the recharge areas identified in that study are used on Map A-2 herein. However, I feel that there is enough additional information available now (since the 1988 study), and enough unanswered questions, to warrant a new look at this slide and its recharge area.

For example, since 1988 the U.S.G.S. has published 1:24,000 (1"+2000') topo maps for the entire WAU. These base maps would be useful for regional geologic mapping. (Geologic mapping has also been released since the study, but the 1:100,000 scale is too small to be of much help in slope stability analysis.) In addition, DNR has released a map that encompasses an area appropriate for more detailed studies and at a scale (1"=400, 20' contour) suitable for the recording of site-specific data such as spring elevations. Also it should be noted that the more detailed map shows the surface of the Whitman Bench in this area to slope north, away from the slide. Is it safe to assume that ground-water perching silts within the outwash sediments composing the upper several hundred feet of the bench also slope gently north?

In addition, the earliest stereo photography available for the 1988 study was flown in 1955. (A small-scale photomosaic of rather poor resolution was available from 1942 flights, but such prints are a poor substitute for the original stereo contact prints available from National Archives.) Also, in 1988, we did not know of the existence of 1937 photography in the archives of the Snohomish County Public Works Department. (Incidently, the river at that time was making a tight bend at river mile 20 and the Hazel Slide was active.) This early photography could be important in attempts to correlate timber harvest with slide activity, as Whitman Bench may have been largely cut-over as early as 1910.

Information on river bedload and meander patterns that might relate to this area is available now (Pess, 1994). That information was not available in 1988. Harvest patterns (timing, area, elevation) in upstream headwaters that might affect peak river flows were not studied for the 1988 report. Such data could shed light on the continuing "what came first/chicken-or-egg" debate (i.e, does river cutting or ground water cause landslides). Hydrologic data developed during studies for the Hazel WAU might also be helpful in resolving such questions.

Other questions raised in the 1988 and earlier unpublished reports need to be addressed in the light of 1994 data. For example, the Shannon report first raised concern about the possible capture of "Headache Creek" by slide activity and the probability of further resulting destabilization. Shannon reported (p. 15) the slide within 150 feet of the creek. Recent estimates (Todd Thorn, personal communication) indicate that this distance has changed little since 1952. Thus, although important and in need of monitoring, this concern does not appear to be as urgent as it seemed in 1952. Also, in regard to Headache Creek, is it intercepting and draining ground water, or recharging it? A careful on-site hydrologic study might resolve this important question.

Also, there are aspects of the geology of the "recharge area" north of the slide that may be important to any computer modeler contemplating an analysis of that basin (ancient landslide "L"). Dr. Benda refers to a "graben or transverse valley" (1988, p.2) to describe the topography of that basin. This description is clear regarding the surface topography but could be misleading to some future landslide analyst. The term "graben" generally is used to describe a keystone-like block of material that drops near the head of a lateral-spread landslide moving on a near-horizontal failure plane. The symmetrical arcuate scarp of landslide "L" indicates that the north-south ridge creating the "transverse valley" is the result of rotation and uplift from a slump rather than being a residual feature from a lateral-spread failure.

This distinction between lateral-spreading (horizontal movement) and slumping (rotational movement) for this ancient slide is by no means merely academic. It is important to anyone analyzing the slide's potential for reactivation as well as its influence on local ground water flow. (It is probably even more important for anyone concerned with seismic reactivation.) The distinction between lateral and rotational movement could be critical to the potential of recharge of the Hazel slide from this adjacent basin.

For example, any transverse "ridge" left by a lateral-spread landslide is apt to be leaky, whereas such a ridge formed by a slump is apt to reflect a subsurface dam to ground water. (Millennia of erosion might obscure the origin and nature of the ridge, however, the shape of

the scarp is still strong evidence that this is a slump.) Such a dam would restrict flow to the east. If the axis of rotation of the slump is horizontal, ground-water flow would go north as well as south, thus splitting the potential recharge to the Hazel slide. If this is true, the north boundary of the potential recharge area in this basin should be moved south to Headache Spring.

MWMU 1-3 and 2-3: Landslide 3 (at river mile 23.5) was two separate active failures in 1948. By 1969, failures between the two separate deep-seated slides had linked-up, creating a single landslide complex. The river was not impinging on the slide area in 1969 and the slide area appeared to be essentially dormant. In 1983 there was also little river cutting and the slide area was still dormant. In 1991 a river bend was directly impinging on the eastern portion of the slide complex. Most of the complex appeared to be reactivated.

The role of forest practices in the activity of this slide complex is unclear, but study of additional old aerial photography is warranted. The available U.S. Army photomosaic based on 1942 photography has rather poor resolution, but indicates clear cutting all along the base of Mt. Higgins by the late '30s. Slopes within a half-mile above the slide had been cut earlier, possibly in the mid- to late -'20s. A study of stereo contact prints (available from National Archives) could probably determine if the slide was active in 1942 and might help resolve the influence (if any) of harvest on slide activity. (A recent [1991] clearcut 3000 feet upslope seems unlikely to have been a factor in recent activity.)

One of the factors to be considered in any further study of this complex is the possible role of ground water recharge from surface runoff. Surface topography immediately above the slide area has a south-east trending lineal, sloping depression. Why does it not extend directly downslope? Does a stream really exist in this trough or is it a remnant from a period of wetter climate (a fossil topographic feature)? If there is a stream there, is it effluent or influent, seasonal or perennial? These are among the questions that any further studies must consider in order to determine if recharge via indirect surface water might contribute to active slide complex 1-3.

MWMU 1-4 and 2-4: Landslide 4, at river mile 25, is a large earthflow. Local slopes are about 30 percent, but the slope of the slide toe is considerably less, possibly 10 percent. Obviously, ground water must be abundant for activity at such a low angle. However, the '69-'91 photo record suggests that river cutting may also be a critical factor. River current at a tight bend was impinging on the bank in 1969, with little evidence of activity. Some bankside sliding was apparent in 1983. By 1991 sliding along a front more than 300 feet across and as much as 700 feet upslope was apparent, at a point directly above a very sharp river bend. (It should also be pointed out that by '91 a road had been recently built about 400' above the slide.) A dam northeast and upslope of the slide area, built since '91, could also be contributing to recharge.

Probably the first task for anyone attempting to further refine a recharge area for this slide would be to accurately delineate the area of current slide activity. My map outline is based on the area of "jackstrawed" trees evident in 1991 photography, plus including 2 small bare areas (scarps?) in a 1980 clearcut to the east, that were not visible in 1983 photography. Obviously, the area of activity could be greater now than it was in 1991, or in the process of field checking, the two small apparent scarps could be discounted and the slide area

reduced accordingly. I decided not to extend the mapped area of active sliding further to the east, to include areas with possible evidence of slide activity reported by the Channel/Fish Team for the following reasons: 1) I assumed that turbidity they reported in channel segment 175 (during the end of the dry season) was likely to be man-caused; 2) The split old-growth stumps in the area between segments 175 and 180 reported did not appear to be related to slide 1-4; 3) A field check of nearby ancient slide "Q" found no evidence of reactivation, which could impact adjacent areas.

Accurately outlining the "recharge area" for this slide would be a challenge for a Super Fund hazardous-waste-cleanup contractor with unlimited money and lots of time. My preliminary map outline of the head of the potential recharge area along the crest of Mt. Higgins was probably conservative. If one considers the "center-of-mass" and geology of this range, rather than the superficial topography of its south face, it becomes apparent that slopes above slide 4 are probably also receiving recharge from the Deer Creek drainage basin.

Any studies of recharge for this slide should consider such bedrock influences for several reasons. First, the layered rocks above here strike north-south. Thus, there is likely to be better permeability in those directions. This suggests that the extensive low-gradient upper slopes and snow fields north of the ridge are probably leaking considerable ground water to the south. (The local 4000-plus-feet of head in that direction would tend to encourage such flows.) An additional unknown is the permeability along the major northwest-trending fault that separates the eastern from the western portions of the Mr. Higgins escarpment. Depending on factors such as rock mineralogy, depth, and the amount of fault displacement, bedrock faults can either be a barrier or a conduit for ground-water movement.

Should Level 2 workers and/or computer modelers, in order to simplify their analysis, make the assumption that area bedrock is impermeable, they will still need to contend with its topography. There are clear examples of bedrock ridges damming and concentrating ground water along the glacial terrace both east and west of here. Obviously, the buried portions of these ridges are more extensive than their exposed portions, making such barriers to ground water potentially important. Also, it seems reasonable to assume that there are other ridges, completely buried by terrace materials, which would also influence ground-water flows.

In order to develop a manageable model, maybe Level 2 workers could assume that the presence of fractured and faulted bedrock, possibly with buried east-west ridges, is irrelevant because the bedrock under slide 1-4 is smeared and "sealed", and the buried topography smoothed, by glacial till. An on-site examination of the scarp areas nearby ancient landslide "Q" found that the sparsely-exposed aquiclude there was a till-like material of gray non-stratified silt, with abundant pebble-sized rock chips. Whether or not this is a "true" till, some sort of lakebed mudflow deposit, or whatever, it is very hard and impermeable. It appears to be an important water-perching horizon and may have been an important factor for the instability resulting in ancient landslide "Q".

Level 2 workers could, in a further effort to simplify modeling, assume that this "till" seals off any ground-water flow from underlying bedrock and has no relief on its buried surface. (Both assumptions would be a stretch of faith, but maybe worth a try.) Probably an even more important assumption for modeling purposes would be to assume that the till surface is

horizontal. The little available information indicates that it is not horizontal, but slopes west, probably with a southerly component. (One could also need to project these "till-factor" assumptions 2000 ft further west than they were observed, to MWMU 1-4 and 2-4.)

Adding to the interest of any analysis of this slide and its recharge area is the role of streams. Future studies will need to determine if mapped streams upslope, or more important, up-gradient of ground-water flow, are really there and if there are any that are not mapped. Are such streams effluent ("gaining", or draining ground water) or influent (leaking into the ground)? If they exist, are such water "transfers" seasonally consistent, or do some stream segments reverse their transfers from wet to dry seasons? If so, what is the net recharge or discharge of ground water?

An appropriate expert experienced in ground-water flow may think of important factors that I have overlooked, or possibly dismiss some that I have identified. Some of these factors might be evaluated during careful Level 2 field studies. Some, possibly important ones, probably can never be evaluated. With the foregoing uncertainties in mind, it seemed that including all of the possible recharge area for MWMU 1-4 would be overly conservative. Instead, the area now outlined in MWMU 2-4 is based on my best guess as to where recharge is highly probable.

MWMU 3: The "inner" gorges need little explanation beyond that in the unit description (Form A-2). However, some elaboration on the "Confidence/Comments" section might be warranted. Whereas inner gorges might at first appear to be one of the easier units to delineate, the poor visibility through forest canopy and the difficulty of accurately judging slope angles or depths of incision created mapping problems. (For example, are slopes really greater than 50% and incision deeper than 25 ft?) The less obvious problems facing the forest manager or forest practice forester on-site seem to also warrant further discussion.

Some "gorges" (?) in the Rollins Creek Sub Basin illustrate ambiguities in mapping (i.e., streams appearing to ignore topography). Which is "correct", topo maps, stream maps, photos, or "none-of-the-above"? This sub basin may also contain "fossil" gorges on each side of Rollins Creek. I did not map these apparently abandoned channel segments, as their slopes did not appear to be steeper than 50%. Some may actually meet gorge criteria for slope and depth of incision but be dry! A probably more common situation facing the field forester will be "half-gorges", where only one side meets gorge criteria. Such cases emphasize the fact that mapping herein is always subject to on-site verification.

MWMU 5: This unit, the erosion-modified flanks of an extensive 900 feet elevation glacial terrace, warrants discussion beyond form A-2 for several reasons. It is extensive in area, includes numerous slides, has considerable contrast in conditions, and is not readily amenable to subdivision, at east not without extensive field work. Dense alder cover, a legacy of early clearcutting, obscures much of the unit during the time-span of available photos.

The complexity of Unit 5 is largely a reflection of the multiple processes that created it. (Materials are not nearly as simple as available geologic mapping would lead one to believe.) However, even if we grossly oversimplify the origin and geologic materials of this geomorphic unit, it is still possible to get a feel for what is going on here and how those processes can be influenced by forest practices.

River and major-tributary incision set the stage for the post-glacial events that shaped the earlier terrace flanks and gorges. Ancestral Brooks and Rollins Creeks cut completely through the terrace materials, while lesser tributaries primarily incised the terrace edges. These oversteepened slopes, probably also responding to a climate wetter than today's, commonly failed as massive deep-seated landslides. Ground water also appears to have played an important role in shaping the terrace edges, even beyond its contribution to landsliding. Ground water emerging as springs can be important to local erosion modes.

The size of ancient landslide "I" may have been more the result of gradual scarp collapse and sluicing of collapsed materials by spring-fed streams than of a massive landslide. This is suggested not only by its shape (the scarp is wider than the "outlet") but the fact that there are apparently little or no remnants of slide deposits within the slide area. These factors suggest that slide area "I" could have developed as an enlarging "box-canyon" due to spring sapping (such as the modern DeForest Creek slide). Several small dendritic basins along the edges of the eastern remnants of this terrace may be arrested, earlier stages of such erosion.

The potential for the presence of major springs along the terrace edges of Unit 5 is a factor that warrants consideration by the on-site forester. Such spring flows are apt to be rather steady, year-round, and thus not present surprises in regard to runoff rates. However, in low-gradient areas they can present serious foundation and drainage problems for roads. In higher-gradient areas, such as where glacial sediments wrap-around bedrock knobs and ridges, springs may form "headwalls" similar but not as steep as those in bedrock, but of wetter and weaker materials. Thus, spring sources such as may relate to "landslides" (?) 72 and 102 may deserve extra buffers. The heads of spring-fed streams from ancient slide scarps and dendritic basins may also warrant special care, depending on the findings of the on-site forester.

MWMU 6: Forest managers and regulators working within the Hazel WAU should assume that drainages are incised until proven otherwise by on-site inspection. The degree of incision probably ranges from a few feet, for miles of type 5 channels that warrant a small culvert, to the canyon of Segelsen Creek which would require a major bridge to cross. Selecting from that range of incision, channels 10-to-25 feet "deep" with 50 percent sideslopes appeared to be a futile exercise with aerial photos. The problem was compounded by the lack of early photo coverage and the dense forest canopy over most of the WAU. Also, many channels incised enough to warrant care at road crossings, if mapped to scale, would barely be a line on a 1:24,000 map. Thus, it was decided not to attempt to map such channels but to emphasize that they can be found almost anywhere in the WAU, "imbedded" within other MWMUs. As with most other units, the degree of care needed in forest practices involving MWMU 6 will be very site-specific.

MWMU 9: This unit contains numerous steep "rock chutes", some no doubt incised enough to qualify as "incised channels". Excluding these channels (defined, but unmapped MWMU 6), Map Unit 9 appears to be relatively forgiving of forest management activities in spite of its generally steep slopes. However, where such channels exist, midslope roads require extra precautions in design, construction, and maintenance. For example, near the west end of the map unit midslope stream crossings were the source of 3 debris torrents within a thousand feet along one road.

The lower limits of the unit were mapped at the north edge of the 900-foot glacial terrace. Thus, Map Unit 9 locally includes aprons of cobbly colluvium and talus cones interspersed with till-covered bedrock. Such materials will respond differently than the bedrock slopes above to forest practices, especially road building. For example, cut banks in talus can trigger persistent stability problems. Otherwise-stable colluvium, where lying on steep glacially-polished bedrock, may also be sensitive to cuts. This further emphasizes that photo mapping is no substitute for on-site investigation.

Map Unit Zero: The undivided portion of the WAU warrants a brief discussion for several reasons. The numbered map units of the Hazel WAU each have considerable internal consistency, however, the "Low Hazard" area remaining is one of considerable diversity. Here designated "MWMU 0", it ranges in elevation from the flood plains along the Stilliguamish to the glaciated bedrock in upper Segelsen, at more than 4000 feet elevation. Slopes of the latter locally approach 60% whereas those of river and glacial terraces are commonly less than 10%. Materials range from bedrock to alluvial sand and silt. The fundamental distinction between the designated MWMUs and the unclassified MWMU 0 is the almost total lack of delivering slides.

If we neglect the four tiny slides from bedrock scarps in the uppermost Brooks Creek basin (none of which delivered), we are left with a few widely scattered oddities that hardly warrant mention. Probably the largest, and the only significant deliverer is "slide" #103 along the Stilliguamish. I was hesitant to even call this a landslide, because it appears to be essentially a bank of non-cohesive terrace materials undergoing persistent dry ravel as a result of river-bank cutting. (If this is all that ever happens here, it should actually be considered "Surface Erosion" and dropped from the landslide inventory.)

Substantial portions of the area contain, at least in till or bedrock terrain, "hidden" segments of the unmapped MWMU 6. These incised channels, in places possibly large enough to qualify as inner gorges, are potential problem sites. The fact that the identified slope failures associated with MWMU 6 were not identified within MWMU 0 is no cause for complacency. Had quality stereo coverage of '40s and '50s photos been available (for the period closer to the time when much of the area was cut over), I would probably have found incised channel failures there. Such failures tend to be small and, unless they triggered major debris torrents, are apt to have "healed over" in the decades between early logging and the 1969 photos.

Additionally, it should be stressed that any careless activity along streams (forest practices or other) can result in significant sediment delivery. This includes streams that might fall "below" the incised channel category (i.e., stream incised less than 10 ft or with channel walls sloping less than 50%). Thus, it behooves the on-site forester to be alert to potential site-specific problems even within MWMU 0.

A.3. METHODS, CONFIDENCE, RECOMMENDATIONS

An attempt was made to follow, in general, the methods and formats outlined in the manual. Standard scale (1 in ≈ 1000 ft) photos of 1969, 1983, and 1991 vintage were studied in stereo, and partial 1948 coverage was helpful where available. Smaller scale coverage

(NWC-76), available for most of the WAU, provided a useful overview of the geomorphology. Photomosaics of 1942 photography were also examined but their resolution made them of little use beyond a record of earlier patterns of timber harvest.

Supplementary data, such as available soils and geologic maps were consulted but not found to be particularly useful for this module. (The best available geology was at a scale of 1:100,000, too small to be of much help for mass wasting analyses other than to provide an educated guess as to "parent materials".) Discrepancies between USGS and GIS topographic maps, including drainage patterns, were not particularly reassuring. Obviously, slope angles scaled from either must be considered averages, which may vary considerably from the actual sites of slope failures. Again, the analyst is faced with a guess (experience vs. a "scientifically-derived" value which is probably wrong).

Regarding analyst skills vs. basin characteristics, 40 years of experience in air photo interpretation (including 25 intermittently studying slope stability) was of considerable help. However, the basin turned out to be far more geologically complex than available data would indicate. It was well after the ideal 6-week time limit for Level 1 before I began to "understand" some of the eventual MWMUs. Two of the worst units in regard to slope stability (numbers 7 and 8) were not field checked, due largely to poor access and snow problems. Very limited field checking of another problem unit (5) revealed as many new questions as were resolved. Thus, in the skills vs complexity contest, the basin "won".

Nevertheless, I feel that the overall level of confidence is, in general, up to a Level 1 analysis. In regard to depicting recharge areas (MWMU 2) for large active slides however, I have no confidence that the mapped outlines are accurate. Some of the uncertainties involved are reviewed in "Discussion of Selected Map Units" (section A2.02). On-site geologic studies may help resolve some of those uncertainties, but some potentially important ones probably will never be resolved. Still, it is recommended that detailed geologic mapping of at least MWMU 1 polygons and their surrounding areas be done prior to any further studies. (Mapping the glacial geology of the upper Stilliguamish would be an excellent M.S. Thesis project, with modest cost and considerable benefit.)

A.4. FORMS A-2, MASS WASTING MAP UNIT DESCRIPTIONS FORMS A-3, MASS WASTING SUMMARY TABLES

MWMU Number: 1

Description:	Four active landslides along the North Fork of the Stilliguamish at river mile 18.5, r.m. 20, r.m. 23.5, and r.m. 25. The slides range in width from 500-to 1500 ft.
Example:	Hazel slide (river mile 20)
Materials:	Glacial outwash sand and silt overlying lakebed silt ("blue clay")
Landform:	Lower flanks of glacial (and alluvial?) terraces
Slope:	Prefailure est. 25-80%, now 20% - $\propto$
Elevation:	350 ft - 600 ft
MW Processes:	LPD
Forest Practice Sensitivity:	Upstream timber harvest can increase peak river flows and bed load. Harvest on a slide, or in its ground water recharge area, can increase local ground water. Roads can import runoff and increase local recharge.
Delivery:	Yes
Delivery Criteria Used:	Proximity to river, historic delivery
Delivered Hazard Rating:	High
Trigger Mechanisms:	River erosion, especially at outside of bends oversteepens slide-prone sediments contributing to failure and removes slide material, preventing a natural angle of equilibrium to establish. Increases in ground water can also trigger slope failure in such banks and increase the mobility of failed sediments.
Confidence:	Very confident of nature of activity and delivery. Less confident in understanding the reasons for fluctuations in level of activity and dormancy. Studies of full range of photography 1937-91 might help resolve some questions.
Comment:	Each of these slides is unique. Thus, they (along with their "recharge areas", MWMU 2) are discussed individually in the text. (See A2.02)

MWMU Number: 2

Description:	Hypothetical recharge areas for the 4 large active landslides (MWMU 1). Where better information is lacking, the recharge area is defined as an area directly upslope of the slide following the shape of the slide's upslope head and flank scarps. The minimum horizontal length, in the slope direction, is at least as long as the horizontal length of the slide and its width at least equal to the maximum width of the slide. The horizontal area is at least as large as 1 1/3 times that of the slide, to allow some "wrap around" of upslope flanks.
Example:	MWMU 2-1 above the "Whitman Slide".
Materials:	Glacial-lakebed silt and/or till overlain by outwash sand and interbedded silt. Ancient landslide debris in places.
Landforms:	Areas adjacent to and upslope from slides in MWMU 1; portions of a large dormant slide north of MWMU 1-2.
Slope:	0 - 70 %
Elevation:	300 to 800 ft
MW Processes:	Offsite contributor to ground water for LPD
Forest Practice Sensitivity:	Timber harvest contributes to increased ground water. Roads can concentrate runoff and locally increase (or decrease) surface water available for recharge.
Delivery:	None (only as it may influence MWMU 1).
Delivery Criteria:	Destabilizing influences to MWMU 1 can increase delivery.
Delivery Hazard Rating:	Indeterminate
Trigger Mechanism:	Increases in ground water and resulting pore pressure in an active deep-seated landslide decreases its stability, increases mobility of failed sediment, and tends to enlarge the active area.
Confidence:	High, that ground water is (along with factors such as slope angle and height, geologic material, and stream cutting along the toe) a factor in the activity of landslides in MWMU 1 - low, that recharge areas can be accurately mapped (See Discussion of Units, A2.02)

FORM A-3 MASS WASTING SUMMARY TABLE

MWMU 3

ACTIVITY	MASS WASTING FEATURE				
	Shallow Rapid LS	Large Persistent Deep-Seated Failures	Small Sporadic Deep-Seated Failures	Debris Torrents	Totals
Clear Cut 0-20 years	5		5	1	11
Clear Cut 20-50 years	3		9		12
Partial Cut	3				3
Road	1				1
Stream Crossing					
Landing					
Other Forest Practices					
Wildfire					
Mature Forest	1		4		5
Non-Forest Land Use					
Totals	13				32

MWMU Number: 3

Description:	Steep slopes along major tributaries where channel incision exceeds 25 feet vertical.
Example:	Segelsen Creek "Canyon"
Materials:	Bedrock, glacial outwash, till, locally alluvial fan and/or landslide deposits (?).
Landforms:	Inner gorges.
Slope:	Uninterrupted slopes greater than 50%
Elevation:	800 - 3000 ft
MW Processes:	SR, SSD
Forest Practice Sensitivity:	Timber harvest can increase peak flows, rapid recharge of shallow ground water, and loss of root strength.
Delivery:	Yes
Delivery Criteria:	Steep slopes above streams, historic delivery.
Delivered Hazard Rating:	High
Trigger Mechanism:	Increased pore pressure in colluvium and loss of root strength can trigger SR. Toe cutting of stream banks can trigger SSD. Channel blockage can trigger debris flows and dam-break floods.
Confidence:	Confident that such slides have happened within the unit during the photo time-span, and that they can trigger channel events that are devastating in the short-term as well as creating long-term channel destabilization. Not confident that unit 3 has been mapped completely or accurately.
Comment:	Mapping problems and the need for on-site verification are explained in "Discussion of Selected Map Units", A2-02. Unit grades upstream into unmapped incised channels (MWMU 6).

FORM A-3 MASS WASTING SUMMARY TABLE

MWMU 4

ACTIVITY	MASS WASTING FEATURE				
	Shallow Rapid LS	Large Persistent Deep-Seated Failures	Small Sporadic Deep-Seated Failures	Debris Torrents	Totals
Clear Cut 0-20 years					
Clear Cut 20-50 years		1	9		10
Partial Cut					
Road					
Stream Crossing					
Landing					
Other Forest Practices					
Wildfire					
Mature Forest					
Non-Forest Land Use					
Totals		1	9		10

MWMU Number 4

Description:	Channel walls of low-gradient type 3-or-larger streams meandering through glacial lakebed silt.
Examples:	Lower Brooks and Rollins Creeks
Materials:	Silt ("blue clay") with possible contribution from overlying glacial outwash sand and associated colluvium.
Landform:	Floors of lower tributary "valleys" and inner gorges.
Slope:	50 - ∝ % walls along 3 - 6% channels
Elevation:	250 to 700 ft
MW Processes:	SSD and SR
Forest Practice Sensitivity:	Timber harvest increases peak flows. Loss of root strength and road-related failures can trigger debris torrents from upstream, with resulting downstream bank cutting and channel aggradation.
Delivery:	Yes
Delivery Criteria Used:	Steep channel walls of erodible materials (commonly toe areas of ancient slide deposits) adjacent to actively cutting streams.
Delivered Hazard Rating:	High
Trigger Mechanisms:	Bank cutting due to lateral channel migration and fluvial incision trigger SSD. Increases in ground water and loss of root strength can also contribute to instability on local scale. Landsliding occurs when the channel is adjacent to the terrace edge, most commonly at bends.
Confidence:	High, for mode of erosion and certainty of delivery. In regard to distribution and density, channel team reports that this mode of erosion is considerably more common than can be seen by photo inventory through the alder canopy. Transitional upstream to more confined channels of MWMU 3 (Inner Gorge) in some drainages and upslope to MWMU 5 (terrace flanks).
Comment:	It seemed appropriate to differentiate failures due primarily to channel influences and with certain delivery (MWMU 4), from upper slopes subject largely to ground water/root-strength related failures and uncertain delivery (MWMU 5).

FORM A-3 MASS WASTING SUMMARY TABLE

MWMU 5

ACTIVITY	MASS WASTING FEATURE				
	Shallow Rapid LS	Large Persistent Deep-Seated Failures	Small Sporadic Deep-Seated Failures	Debris Torrents	Totals
Clear Cut 0-20 years	5	3	1		9
Clear Cut 20-50 years	5	2	11		18
Partial Cut	2		1		3
Road	2		RR 1 2		5
Stream Crossing					
Landing					
Other Forest Practices					
Wildfire					
Mature Forest	1				1
Non-Forest Land Use					
Totals	14	6	16		36

MWMU Number: 5

Description:	Erosion-modified flanks of the lower glacial outwash terrace remnants that remained after cutting by the ancestral Stilly and its major tributaries. These remnants were further shaped by at least 17 post-incision ancient landslides, some more than 1500 ft across.
Example:	Slopes rimming Whitman Bench.
Materials:	Glacial outwash sand/silt overlying glacial lakebed silt ("blue clay"). Locally, cobbly colluvium on "till" (?).
Landforms:	Ancient landslide scarps (A-Q), slopes flanking streams and small dendritic basins incised in glacial sediments.
Slope/Gradient:	Scarps locally 80%, channels 15-25% with sideslopes generally averaging less than 50%.
Elevation:	250 - 900 ft
MW Processes:	SR, SSD, DT, LPD
Forest Practice Sensitivity:	Timber harvest results in loss of root strength, increases in ground water and increase in peak flows. Roads can concentrate runoff, creating locally increased pore pressure.
Delivery:	Common but not certain
Delivery Criteria Used:	Steep slopes above streams, historic delivery
Delivered Hazard Rating:	High
Trigger Mechanisms:	Increase in pore pressure can result in SR, LPD slides and spring sapping. Increased flows can incise channels resulting in SSD and toe cutting along LPD. Loss of root strength increases susceptibility to SR.
Confidence:	High, regarding larger failures or in areas of recent clearcut. Less for smaller failures in areas of dense alder canopy.
Comment	Deep ground water appears to be a factor in many small slides as well as a few LPD in this unit. Dendritic basins probably include major springs. Unit contains unmapped incised channels (MWMU 6), possibly some inner gorges (MWMU 3). See also Sec. A2.02.

FORM A-3 MASS WASTING SUMMARY TABLE

MWMU 6

ACTIVITY	MASS WASTING FEATURE				
	Shallow Rapid LS	Large Persistent Deep-Seated Failures	Small Sporadic Deep-Seated Failures	Debris Torrents	Totals
Clear Cut 0-20 years	6			1	7
Clear Cut 20-50 years	4				4
Partial Cut					
Road	1			1	2
Stream Crossing				4	4
Landing					
Other Forest Practices					
Wildfire					
Mature Forest				1	1
Non-Forest Land Use					
Totals	11			7	18

MWMU Number: 6

Description:	Unmapped unit consisting largely of type 4/5 streams, which have incised between 10 and 25 feet perpendicular to channel gradient. May include more than half of the plus or minus 75 miles of 4 and 5 streams in the WAU (see "Confidence" below).
Example:	Channel within which landslide #40 originated.
Materials:	Generally colluvium on till, bedrock, or glacial outwash.
Landform:	Incised channels
Slope:	Channel gradient 12 - 70%, sideslopes >50%
Elevation:	Throughout the WAU above about 350 ft
MW Processes:	SR and DT
Forest Practice Sensitivity:	Timber harvest results in a loss of root strength. Harvest and concentration of surface runoff by roads can increase peak flows as well as shallow ground water. Side cast failure or culvert blockage can result in debris torrents or dam break floods.
Delivery:	Yes
Delivery Criteria Used:	Historic delivery, experience elsewhere
Delivered Hazard Rating:	Moderate (based on '70-'91 photos)
Trigger Mechanisms:	Increases in pore pressure within shallow ground water and loss of root strength decreases bank stability. Increases in peak runoff increases channel instability and the mobility of failed sediment, both from channel walls and channel obstructions as well as any "imported" from upstream.
Confidence:	Confidence rather low that earlier slide events in this MWMU could be recognized and that channels within the defined range of incision could be reliably mapped without extensive field work and the availability of '40s and '50s aerial photography. This mass wasting unit grades upstream into "non-incised" (<10') channels and downstream, in places, into "inner gorge (>25' incision). See Discussion of Selected Map Units, A2.02.
Comment:	Due to limitations mentioned, it was felt it would be better to describe this unit generically, for on-site verification during management planning, than to potentially mislead through an inaccurate and incomplete map.

FORM A-3 MASS WASTING SUMMARY TABLE

MWMU 7

ACTIVITY	MASS WASTING FEATURE				
	Shallow Rapid LS	Large Persistent Deep-Seated Failures	Small Sporadic Deep-Seated Failures	Debris Torrents	Totals
Clear Cut 0-20 years					
Clear Cut 20-50 years					
Partial Cut					
Road	3				3
Stream Crossing					
Landing					
Other Forest Practices					
Wildfire					
Mature Forest	2				2
Non-Forest Land Use	1				1
Totals	6				6

MWMU Number: 7

Description:	Steep slopes of an ancient bedrock landslide complex, secondary scarps within old slide.
Example:	Upper Swede Creek
Materials:	Fault-shattered (?) bedrock, landslide debris, talus, and related colluvium.
Landform:	Ancient landslide complex.
Slope:	50 - 200 %
Elevation:	2200 - 4000 ft
MW Processes:	SR, DT
Forest Practice Sensitivity:	Road cutting into slide debris and/or talus, side cast onto steep slopes, possible runoff concentrations.
Delivery:	Yes
Delivery Criteria Used:	Steep unstable slopes above streams, USFS report.
Delivered Hazard Rating:	High
Trigger Mechanisms:	Mechanical destabilization (cutting, and/or loading by sidecast) of naturally unstable slopes. Increased pore pressure from concentrations of shallow ground water.
Confidence:	High, that the area is naturally unstable and sensitive to road construction.
Comment:	Abundance of ancient side debris from this area is probably the reason for the instability of Swede Creek distributory channels below elevation 2100 ft. (See Swede Creek, in Sub Basin Overview, A1.03.)

FORM A-3 MASS WASTING SUMMARY TABLE

MWMU 8a

ACTIVITY	MASS WASTING FEATURE				
	Shallow Rapid LS	Large Persistent Deep-Seated Failures	Small Sporadic Deep-Seated Failures	Debris Torrents	Totals
Clear Cut 0-20 years	2				2
Clear Cut 20-50 years					
Partial Cut					
Road					
Stream Crossing					
Landing					
Other Forest Practices					
Wildfire					
Mature Forest					
Non-Forest Land Use					
Totals	2				2

MWMU Number: 8a

Description:	Complex-shaped ancient bedrock landslide area from which originated two debris avalanches in 1988. (See also 8b)
Example:	SR landslides #56 and 57.
Materials:	Colluvium and fractured bedrock.
Landforms:	Ancient bedrock landslide complex
Slope:	20 - 100%
Elevation:	2600 to 3100 ft
MW Processes:	SR
Forest Practice Sensitivity:	Timber harvest results in a loss of root strength and increases in shallow ground water. Roads can concentrate runoff resulting in further ground-water concentration.
Delivery:	Yes
Delivery Criteria:	Recent history of delivery
Delivered Hazard Rating:	High
Trigger Mechanism:	Increased pore pressure and loss of root strength.
Confidence:	High, that the limits of this unit can be readily identified and of its history of failure.
Comment:	Failures from this ancient slide scarp complex evolved into a debris flow/dam-break flood that travelled the full length of Rollins Creek in 1988. (See Rollins Creek, in Sub Basin Overview, A1.03.)

FORM A-3 MASS WASTING SUMMARY TABLE

MWMU 8b

ACTIVITY	MASS WASTING FEATURE				
	Shallow Rapid LS	Large Persistent Deep-Seated Failures	Small Sporadic Deep-Seated Failures	Debris Torrents	Totals
Clear Cut 0-20 years	1				1
Clear Cut 20-50 years					
Partial Cut					
Road	1				1
Stream Crossing					
Landing					
Other Forest Practices					
Wildfire					
Mature Forest					
Non-Forest Land Use					
Totals	2				2

MWMU Number: 8b

Description:	Highly variable slopes, channels, and materials east of Rollins Creek headwaters. (see also 8a)
Example:	Head of Rollins Creek
Materials:	Include faulted, sheared, and probably hydrothermally-altered bedrock, ancient slide debris, and colluvium.
Landforms:	Incised channels, headwalls, ancient bedrock landslides, steep planar bedrock slopes.
Slope:	0 - ∝ %
Elevation:	1600 - 3000 ft
MW Processes:	SR, DT
Forest Practice Sensitivity:	Timber harvest can increase shallow ground water and reduce root strength. Roads can concentrate runoff and undercut or load steep sensitive slopes.
Delivery:	Yes
Delivery Criteria:	Established history of debris avalanches and debris flows
Delivered Hazard Rating:	High
Trigger Mechanism:	Increases in pore pressure, loss of root strength, mechanical destabilization.
Confidence:	High, that the area is unique in this WAU, has inherent stability problems and will continue to offer surprises for careless road builders. Various small-scale stability factors are difficult to differentiate at map scale, so it seemed appropriate to include them in a separate MWMU.
Comment:	Channel is more susceptible to bank cutting from debris torrent because side bank materials are weak in relation to other material in the sub-basin. Bank materials along the inner gorge separating 8a from 8b are probably more erodible and weaker than elsewhere because they include much slide debris from these units. (See Sub Basin Overview, A1.03.)

FORM A-3 MASS WASTING SUMMARY TABLE

MWMU 9

ACTIVITY	MASS WASTING FEATURE				
	Shallow Rapid LS	Large Persistent Deep-Seated Failures	Small Sporadic Deep-Seated Failures	Debris Torrents	Totals
Clear Cut 0-20 years					
Clear Cut 20-50 years					
Partial Cut					
Road	1			1	2
Stream Crossing					
Landing	1				1
Other Forest Practices					
Wildfire					
Mature Forest					
Non-Forest Land Use					
Totals	2			1	3

MWMU Number: 9

Description:	Very steep, generally planar slopes
Example:	South face of Mt. Higgins
Materials:	Thin colluvium on bedrock
Landforms:	Very steep slopes between channels
Slope:	55-200%
Elevation:	1400 - 5000 ft
MW Processes:	Rolling rock, soil disturbance by snow avalanching.
Forest Practice Sensitivity:	Loss of root strength and increased shallow ground water due to clear cutting on thin soils over steep bedrock increases risk of SR failure. Increased snow avalanche risk from clear cutting, with accompanying root balls and erosion from bared soils.
Delivery:	Yes
Delivery Criteria:	Slopes naturally stable. Small relatively straight, unbranched, streams tend to minimize delivery potential.
Delivered Hazard Rating:	Low (with deletion of "incised channels" from unit)
Trigger Mechanism:	See FP sensitivity
Confidence:	High as to failure potential where clearcut or otherwise disturbed. High, that this unit contains unmapped incised channels (MWMU 6). Low confidence in mapping of the lower unit boundary.
Comment:	Leaving "high stumps" has somewhat decreased snow avalanche potential in similar settings. (See also "Discussion of Selected Units, A2.02.)

MWMU Number: 10

Description:	Streams within gently-sloping glaciated highlands.
Example:	Headwaters of Rollins, Dicks Ck.
Materials:	Till and/or bedrock, related colluvium, on relatively impermeable substrate.
Landforms:	Subalpine headwater basins
Slope:	Channel gradients less than 40%, sideslopes 50 - 70 %
Elevation:	3000 - 4000 ft
MW Processes:	Dam-break floods
Forest Practice Sensitivity:	Potential for higher peak flows due to clear cutting, culvert blockage from slash (or beavers?) and subsequent fill-failure associated with forest roads.
Hazard:	Low probability
Delivery:	Yes
Delivery Criteria:	Experience elsewhere in similar setting, Coho and Burges, 1991.
Delivered Hazard Rating:	Moderate
Trigger Mechanism:	Water impoundment and sudden failure of dams with heights greater than 2 meters on confined channels.
Confidence:	High, that such events can happen. High that probability is low.
Comment:	Although the potential for culvert blockage in such a setting is low, the stakes are high. First, the low channel gradients mean that even a relatively low "fill-dam" can back up a lot of water. Second, because of its location in a headwater area, any sudden failure of such a dam would likely impact the entire downstream channel. (Suggestion: remove any such fills before rainy season.)

B - Surface Erosion Module

B.1. WATERSHED OVERVIEW-

The Hazel Watershed Analysis Unit (WAU) is located on the western side of the Cascade Mountains in northern Snohomish County and southern Skagit County, Washington. The WAU generally is comprised of private and State forest lands in the western half and Federal forest lands in the eastern part. Private and State timberlands are also present along the south part of the eastern half of the WAU. Topography varies greatly in the WAU from a low gradient river valley floor to mountainous sub-alpine peaks. Consequently, surface erosion is an active force which continually shapes the landscape and impacts public resources.

B.1.1. Natural Erosion Processes- References suggest six to twelve feet (or more) of soil typically mantles bedrock in the WAU. These soils are densely forested with conifer and deciduous trees except at high elevations and on the steepest slopes. The dense tree stands generally protect WAU soils against surface erosion, except for soil disturbance caused by animal life. Consequently, most surface erosion processes typically proceed at rates which are not noticeable.

Geology is complex and varied throughout the WAU. Metamorphic, Igneous, and Sedimentary rock types are all present in the WAU. Metamorphics, glacial till and recessional outwash compose the major geologic units in the western part of the WAU. Greenschist and foliated metavolcanic rocks exist in a large fault zone in the eastern part of the WAU. Metamorphic rocks, sandstone, and recessional outwash also exist in the eastern portion of the WAU, but to a lesser extent. Sandstone, glacial till and recessional outwash comprise the major geologic units in the central portion of the WAU. Consequently, rock resistances are suspected to generally be highest in the western part of the WAU, moderate in the central part of the WAU, and lowest in the eastern part of the WAU.

Relief and elevation also greatly affect surface erosion processes in the WAU. Approximate maximum elevations in the Brooks Creek, Whitman Bench, Rollins Creek, Dicks Creek, Mt. Higgins, and Segelsen Creek sub-basins are 3,600, 1,080, 4,100, 4,770, 5,200, and 4,500 feet, respectively. Relief in each sub-basin differs from maximum elevation by about 200 to 250 feet.

Consequently, forces which drive surface erosion rates differ greatly in intensity and spatial extent based on elevation. Examples of surface erosion forces active in the WAU which vary based on elevation includes: frost heaving, snow (normal snowline), rain on snow, rainfall intensity and amount (orographic effect), wind, and mist from cloud/fog cover. Rockfall, rockslides, and avalanches can also affect surface erosion processes (particularly in the central portion of the WAU).

Creep is another important force which promotes surface erosion in the Hazel WAU. Moderately steep to very steep slopes exist in all Hazel WAU sub-basins, except in the North Fork of the Stillaguamish River valley. The influence of gravity on the steeper slopes in the WAU drive the delivery of sediment to the stream channel network. Typical slopes for the sub-basins approximately are: Brooks Creek 20 to 35% (60% maximum); Whitman Bench 10% to 40% (55% maximum); Rollins Creek 15% to 75% (100% maximum); Dicks Creek 10% to 60% (100% maximum); Mt. Higgins 15% to 100% (175% maximum); and Segelsen Creek 20% to 80% (100% maximum).

B.1.2. Human-induced Land-Use Impacts- The most notable land-use activities present in the WAU which can accelerate erosion include agriculture, conversion, forestry, and road construction. Impacts caused by agriculture, conversion, and general-use road construction activities are generally limited to the valley of the North Fork of the Stillaguamish River. Potential cumulative impacts from these activities were not identified during assessment.

Forest practices are the most prevalent land-use activity (by area) that take place in WAU. According to air photos, railroad logging in the WAU had begun by the late 1920's to early 1930's (personal communication, Jerry Thorsen, Hazel Mass Wasting Module leader). Presently, most logging activities are conducted by cable methods, shovel, skidder, and perhaps helicopters. Past surface erosion impacts from older logging methods probably include: large scale soil disturbance by dragging of logs & steam donkeys, soil compaction, damage to Type 1-5 Water channels by hauling of logs up and through these channels, logging on unstable slopes and/or localized areas of mass wasting, and the unchecked concentration of water. Field inspections suggest current cable methods, combined with forest practice regulations, generally do not cause large scale soil disturbance, soil compaction, stream channel disturbance, or concentration of water.

B.2. WATERSHED PARTITIONING

Approximate borders of the Hazel WAU are: Brooks Creek on the West, the North Fork of the Stillaguamish River on the south, Segelsen Creek on the east, and the topographic divide spanning from Brooks Creek to Segelsen Creek on the North (southern topographic boundary of the Deer Creek watershed).

The WAU was partitioned into six sub-basins based on local geographic features (major Type 3 Waters, one county road, and a mountain) to aid analyses. The six sub-basins from west to east are Brooks Creek, Whitman Bench, Rollins Creek, Dicks Creek, Mt. Higgins, and Segelsen Creek. The total area (as measured by a geographic information system) of the Brooks Creek, Whitman Bench, Rollins Creek, Dicks Creek, Mt. Higgins, and Segelsen Creek sub-basins are 4,465, 1,623, 5,095, 2,186, 7,224, and 4,235 acres, respectively (see Map B-1).

B.3. HILLSLOPE SURFACE EROSION RESULTS

Many surface erosion processes alone or combined can be accelerated by forest practices. Soil sensitivities to undue surface erosion caused by forest practices was assessed by: estimating preliminary soil erosion potential ratings for recent forest practices; making field inspections; reviewing 1991 Department of Natural Resources (DNR) aerial photos; researching local soils references; interviewing United States Forest Service (USFS) and DNR personnel; and constructing a final soil erosion potential map.

B.3.1. Preliminary Surface Erosion Potential Ratings- Department of Natural Resources (DNR) 1991 aerial photos were reviewed to assess active surface erosion processes, drainage networks, areas of steep slopes, and forest roads systems and related forest practices. Particular emphasis was given to forest practices which were less than five years old. Log haul-back corridors, location of streams in/next to recent forest practices, and other "interesting features" (mass wasting scars, incised stream channels, etc.) were noted on a draft map for later field inspection.

Standard Surface Erosion Module methodology requires the construction of a "Preliminary Soil Erosion Potential Erosion Map" (See Map B-2) prior to field sampling. The analyst chose to not formally create this map.

The WAU is split by two political boundaries (Snohomish and Skagit Counties) which meant that a Soil Conservation Service manual existed for private and State timberland areas in both Snohomish and Skagit counties. And soils of Federal property were covered by another soil manual and map by the United States Forest Service (USFS). Further, this information was to be combined with preliminary DNR soil erosion potential ratings based on silvicultural soil specifications.

Without field observation, the analyst felt that the creation a useful erosion potential map from the sundry information was a time sink (considering this product is a temporary step in making final soil erosion potential ratings). Consequently, preliminary surface erosion sensitivity ratings were given to individual forest practices (based on reference information) rather than developing an entire map.

B.3.2. Hillslope Sampling- With initial soil erosion potential ratings and aerial photo review completed, work shifted to field sampling of recent forest practices. Field sampling for hillslope erosion caused by forest practices was conducted during mid-November, 1994. Based on aerial photos and age of trees stands acquired from the Hydrology module analyst, at least twenty-seven recent forest practices were documented to have occurred in the WAU in the last five years (See Map B-3 "Past Five Years Activity Map").

Fifteen of the twenty-seven recent forest practices and two "sites of interest" (identified from aerial photos) were inspected for surface erosion. Early snowfall (a snowline of about 1,400' in elevation) precluded observation of six of the twenty-seven recent forest practices. Six additional forest practices could have been sampled, but were not because they had similar ratings/topography of other sampled forest practices and/or the potential for delivery of sediment was judged to remote. Seven of the twelve recent forest practice sites not sampled during assessment were casually observed during road sampling and/or other field visits. No noticeable surface erosion was seen at these sites (see Form B-1.1 "Hillslope Field/Photo Information"). Forest practice sites one and nineteen were observed to have delivered sediment to stream channels as a result of forest practices conducted there.

Based on sampling observations, the following forest practices were noted to have accelerated surface erosion processes: skidder logging, roading, associated soil compaction, and cable yarding of logs over ridgetops from a lower elevation landing. Observations at other forest practice sites revealed that minor water concentration and soil compaction occurs at landings and could potentially cause accelerated surface erosion in the WAU.

B.3.3. Final Soil Erosion Potential Ratings And Hazard Determinations- Field sampling information was used to determine final surface erosion potential ratings at the twenty-one of the twenty seven recent forest practices sites and wherever else the same soils existed. However, six unvisited sites and many WAU soil types still had unknown surface erosion sensitivity(s) to forest practices. To make final erosion potential calls for these soils, Soil Conservation Service (SCS) soil manuals for Snohomish and Skagit counties, the USFS Mt. Baker National Forest service manual and map, and DNR soil erosion hazard ratings were all researched.

Soil types not seen during sampling were evaluated against a constant set of parameters to ensure consistent final erosion potential decisions were made. Parameters evaluated for each soil type during reference research included: soil K factor (SCS rating), % clay, inferred erosion susceptibility(s) (to erosion and forest practices based on soil type descriptions), slope, deliverability potential, etc. Final soil erosion potential ratings were determined from the preponderance of inferred soil erosion sensitivity(s) to forest practices and the likelihood that sediment would be delivered to the stream channel network.

The cumulative information gathered from assessment activities were used to create Map B-4, "Final Soil Erosion Potential Map". Generally, deliverability was assumed to be more likely to occur when a forest practice was located within 200 feet of the channel network, and when slopes exceed 50%. This map was made to be flexible because very little of the WAU was actually visited during assessment. Consequently, the final erosion potential rating for a soil type may be adjusted up or down one rank (low to moderate and high to moderate). Conditions which warrant a localized downgrade of the final soil erosion potential rating include: field evidence shows slopes are less than 50%; no existing channel network occurs on a site; and the proposed forest practice will not use method(s) identified as "triggers" to causing undue surface erosion in the Causal Mechanism Reports HEU-1 and

HEU-2. Conversely, a hazard rating may be upgraded for the opposite reasons when there is site specific evidence.

B.3.4. Agreement/Disagreement with Module Assumptions for the Hillslope Assessment Portion- Hillslope erosion assumptions are shown on pages B-6 and B-7 of the module. No departure from standard module assumptions were made by the analyst during assessment.

B.3.5. Confidence- Additional recent forest practices not shown on Map B-3 were determined to likely exist during field visits. Specifically, these sites include one forest practice in the Brooks Creek sub-basin (just south of road segment #9) and two or three forest practices in the Segelsen Creek sub-basins (just south and north of road segments #254 and #258). Level 1 analysis constraints and the age of the most recent photos did not permit easy identification and/or location of these forest practices. Consequently, a few recent forest practices were, unfortunately, not mapped or observed. Valuable information regarding surface erosion and forest practices may have been missed at these sites.

Final erosion potential ratings for the fifteen forest practices visited during assessment are believed to have a good degree of confidence. Even if field sampling did not detect all soil disturbance(s) caused by a forest practice, field inspections were conducted in a manner to aggressively assess the delivery of sediment to the stream channel network. Consequently, the analyst feels that sites were assessed accurately for the delivery of sediment caused by forest practices.

The six forest practices which the analyst chose not to sample are also believed to have a good confidence in their final erosion potential ratings. Initial soil erosion potential ratings at these sites were low to moderate. Forest practices conducted at these sites involved cable yarding methods generally on gentler slopes. Based on the evidence from visited forest practices, similar forest practices would be expected to affect surface erosion process(es) at similar sites in a like manner.

Unvisited soil types are believed to have fair to good confidence in their final soil erosion potential ratings. The final erosion potential ratings for each soil type was evaluated against a consistent group of parameters and deliverability scenarios. However, these erosion potentials were deciphered from the preponderance of evidence from four different soil references. Consequently, there is inherent doubt that a soil type's inferred susceptibility(s) to surface erosion of is consistently described in each soil reference.

Confidence in final erosion potential for the six sites under snow during hillslope sampling is believed to be fair to good. These forest practices endure relatively intense surface erosion processes due to their higher elevation. Consequently, forest practices are expected to have a relatively higher potential for accelerating surface erosion processes as compared to similar forest practices conducted at lower elevations and gentler slopes. Important information regarding how forest practices affect surface erosion at these sites, however, may have been missed.

B.4. ROAD EROSION RESULTS

B.4.1. Systematic Road Conditions- A majority of existing road networks were built more than five years ago. The number and length of roads less than two years of age is very limited in the WAU. WAU road networks include orphaned railroad grades as well as existing, abandoned, and orphaned vehicular traffic roads (See Map B-7 "WAU Road Network Map"). Construction of USFS roads 18 and 1891 (Segelsen Creek and Mt. Higgins sub-basins, respectively) were completed in the 1960's, for example. Consequently, roads have affected the WAU for several decades.

Roads are typically orientated perpendicular or parallel to Type 1 through 5 waters. Early snowfall prevented access to roads above 1,800 feet of elevation. Field visits conducted below elevation 1,800 feet revealed that road prisms typically were not insloped, outsloped, or crowned. The geometry which best describes the observed road prism in the Hazel WAU is "flatsloped" in the opinion of the analyst.

The analyst defines the "flatsloped" prism as a road which has had no apparent recent grading to define the shape of the prism. Road runoff on the flatslope prism typically flows down the tread, (un)controlled and channelized by tire track imprints left by vehicular traffic. The uncontrolled runoff suggests that road prism maintenance (and likely on cross drains also) has been infrequent, if not inadequate. Further, sub-basin road networks not formally abandoned per current forest practice regulations in November, 1994 consistently lacked (driveable) waterbars.

Road ditchlines were noted to be common for most road prisms. Although not seriously evaluated, fields visits left the analyst with the impression that most ditchlines did not show evidence of abnormal erosion. Consequently, cross drain spacing for roads below 1,800 feet of elevation is generally believed to be adequate. In a few instances, however, abnormal ditchline erosion was seen and/or ditches captured streams at cross drains (redirecting and concentrating flow to adjacent drainages).

B.4.2. Road Network Segmentation- The WAU road network was segmented using standard module methodology. As a result, 330 individual road segments were created (See Map B-5 "Road Segment Map"). Road segments for individual sub-basins were further subdivided based on slope (0% to 7%, 7% to 15%, and > 15%). This assured that the analyst that road segments were grouped based on minimum forest practice cross drain spacing requirements.

Road network lengths were in the Brooks Creek, Rollins Creek, Mt. Higgins, and Segelsen Creek sub-basins were determined to be similar (23.35 30.00, 26.57, 27.39 miles as measured by a geographic information system, respectfully). Whitman Bench and Dicks Creek road networks were determined to be much less in total distance (10.70 and 1.62 miles, respectively).

B.4.3. Defining Road Segment "Types"- Upon the completion of road network segmentation, road segments were sorted for like sub-basin, slope class, geology, surfacing, and traffic. This caused a majority of the road segments to cluster into like groups. Consequently, similar road "types" were created based on the module definition of road "segment" and overall road slope. Roads which grouped in this manner were deemed "typed" by Method #1. The eventual road "type" identifier given to a group of like roads was the number of the road sampled for the group (for example: 9, 32, 247).

A minority of road segments did not conveniently cluster into groups which rendered themselves to easy "typing" by Method #1. Consequently, reasonable assumptions had to be made to make all road segments match a road "type". These assumptions became five additional road "typing" methods described below:

Method #2- If road segments do not group by Method #1, 6I traffic road segments can be grouped to same sub-basin 6A traffic roads with the same geology, surfacing, and slope [6A roads can be matched to 6I roads in the same manner].

Method #3- If road segments did not group by Methods #1 or #2, then match these segments to other roads in the same sub-basin with like geology, surfacing, and traffic by looking up or down at the next slope class.

Method #4- If road segments did not group by Methods #1, #2, or #3, and the road has native (NA/NI) surfacing, the road segment can be typed to other roads in the sub-basin with like geology, slope, but different surfacing/traffic.

Method #5- Match active secondary road segments (6S) and mainline roads (AM) which did not "type" by Methods #1, #2, and #3 to other 6S and AM road segments in different sub-basins with like geology, traffic, surfacing, and slope. If still no "type" match exists, then a "type" match can be made by going up or down one slope class.

Method #6- For those 6I and 6A traffic road segments which did not "type" by Methods #1, #2, #3, "type" the road to a sampled road in a different sub-basin that has the same geology and traffic. The slope class of the untyped road segment may be the same or differ by one slope class (higher or lower).

Methods #2 through #6 grouped all remaining road segments, making it possible to match all remaining road segments to a specific road "type". Final road "type" identifiers follow the rule described for Method #1). However, when two or more road segments were sampled for a defined group of roads, the "type" identifier for that group of roads was determined to be the numbers of each sampled road (for example: 260-263, 254-258).

Fifty-one road "types" were created by using "typing" Methods #1 through #6. As a result, only 7.47% of road network was represented by road "types" that cumulatively were less than one mile in length (See Form B-2.2 "Length of Road Types"). Individual road segments and their corresponding road "type" identifiers are shown in Form B-2.3 "Road Type, Road Segment, and Sub-basin Location".

B.4.4. Road Prism Sampling- Fifty-six individual road segments were sampled during assessment. Individual samples of road segments were generally made because they were: accessible (the snowline hovered around 1,600 to 1,800 feet [and much lower on a couple of days]); located near other road segments to be sampled; and deemed representative for a group of like road "types".

Tread width, cutslope and fillslope percent slope, and length of ditchline/tread delivery were measured for each sampled road segment. Cutslope and fillslope width (map distances) were estimated from the observed width of the measured road tread. Observed cutslope and fillslope widths were then converted to true slope distances (using trigonometry) where slopes existed. Final widths for roads with flat cutslope and fillslope surfaces were determined based on the following assumption: cutslope and fillslope width is 20% (rounded to nearest whole number) of tread width. This acknowledges that these roads had bare and/or partially vegetated soil along the road tread. Road prism geometry was noted, and cutslope and fillslope vegetative cover density were estimated. Additional unique information regarding road segment(s) were also noted (See Form B-3.2 "Road Segment Sampling Notes".

B.4.5. Road "Type" Dimensions, Sampled Road Segments, and the "Reference Road"- Prism dimensions for all road "types" were determined in the following manner: When only one sampled road segment existed for a group "type" of like road segments, those road segments were given the same measured road dimensions as the sampled road segment. When two or more sampled road segments existed for a like group "type" of road segments, those road segments final prism dimensions were determined to be the average of parameters measured for the two or more sampled road segments.

Road prism attributes gathered during field sampling then were analyzed for agreement with the module "Reference Road" (See Form B-3.2 "Road Segment Sampling Notes" and Form B-3.1 "Road Field Form"). Standard assumptions for the "Reference Road" prism geometry were determined to differ greatly from all "type" roads created in the WAU. Differences between the "Reference Road" and the analyst's "type" roads are summarized in Form B-3.3 "Road Type Disagreement with Reference Road".

B.4.6. Sediment Delivery by Roads- At least one measurement for the delivery of sediment from the road tread and/or ditchline was made per sampled road segment. Realizing this measurement gave an initial picture of sediment delivery for the road segment, aerial photos were then analyzed. The rough number of channels crossing a sampled road segment (assumed to be sediment delivery points) were counted. An average distance per delivery point for sampled road segments then was estimated by dividing the road segment

distance by the number of photo identified channel crossings. This allowed a rough percent delivery area for each sampled road segment to be estimated from the ratio of the measured delivery length divided by the average distance per each delivery point. These rough delivery percentages were either used or adjusted slightly based on road prism geometry and/or the "gut feeling" of the analyst.

B.4.7. Roads Delivered Sediment Calculations- Delivered sediment for each individual road segment was calculated in a manner consistent with standard methodology. Results are organized by sub-basin (See Form B-2.1 "Roads Calculation Sheet). These results are summarized in Form B-2.5 "Total Sediment Delivery From Roads." Comparitive sediment delivery rates for road "types" are shown in Map B-6 "Road Segment Sediment Delivery."

B.4.8. Agreement/Disagreement with Module Assumptions for the Roads Erosion Portion- Roads erosion assumptions are shown on page B-7 of the module. No departure from standard module assumptions were made by the analyst during assessment.

B.4.9. Localized Road Problems- The majority of roads open to vehicular traffic below 1,800 feet in elevation were seen during assessment. Localized road problems were seen during field visitations in these parts of the WAU. These problem areas warrant immediate maintenance and/or abandonment work, and are listed below:

Mt Higgins sub-basin: Several cracks were seen in the sidecast fill of road segments #242, #246, and #247 and associated landings while walking the road. The most troubling aspect about these road segments is that this road was built in 1991 and has a low overall gradient.In at least two instances, failure will likely deliver sediment to the stream network and perhaps trigger a debris torrent. Assessing delivery for other crack locations was difficult, and depends on the quantity of water present in Type 5 channels when failure occurs. Further, this road is located upslope of a local water supply reservoir. Consequently, the road may also pose a hazard to the reservoir.

Segelsen Creek sub-basin: Streams flow across the road prism and the road tread delivers significant runoff to the channel network on road segments #259, #262, and #264. Although not intensively inspected during field visits, the same concerns likely exist for nearby road segments #260, #261, #263, #265, and #322.

Rollins Creek sub-basin: Three sidecast failures, ditchline capture, and redirection/concentration of drainages was seen on road segment #146. Ditchline capture and redirection/concentration of drainage was also seen on road segment #148. Road segments #146 and #148 are in need of formal abandonment work which: Pull back sidecast perched on steep/unstable slopes (as great as 110% seen) directly above Rollins Creek; control road runoff with waterbars; and redirect Type 4/5 Waters to their original channels. Although not visited, similar concerns likely exist for nearby road segments #147, #149, and #152.

Rollins Creek sub-basin: Ditchline erosion was seen in vicinity of road segments #140, #143, and #144. The erosion suggests the road needs more cross drains to handle natural drainage and/or road runoff. The use of driveable waterbars to control excess road runoff is also recommended here.

Segelsen Creek sub-basin: Although not seen during field visits, aerial photos did show several mass wasting events occurring in the proximity of the road system including road segments #271, #272, #273, #274, #275, and #317. The mass wasting events may suggest cross drain and/or road runoff problems here. These road segments should be inspected to determine whether road maintenance/abandonment work will reduce hazards to public resources.

Localized public resource concerns also exist below 1,800 feet on 6A traffic roads (not been abandoned per forest practice regulations) and 6I roads which will become orphaned in the next ten years. If problems are seen on these roads, they should receive immediate maintenance or abandonment work. The construction and maintenance of (driveable) waterbars on these roads is recommended.

A low snow level prevented the identification of specific localized road problems above 1,800 feet in elevation. These roads likely lack driveable waterbars as do lower elevation roads. The analyst recommends that landowners be required to assess the condition of all roads (orphaned and driveable) located above 1,800 feet for the concerns listed in items one through six (see above). Accordingly, these roads should be required to install and maintain driveable waterbars. Further, culverts, ditchline piracy, and un-natural concentration of water by drainages should be analyzed.

B.4.10. Confidence- Overall confidence in the results of delivered sediment assumptions and calculations are believed to be good. Standard methodology for estimating the delivery of sediment was generally followed. Field visits suggest only a few existing roads were missed (one 6I segment along/near the south side of road segment #9, and two or three 6I segments along/near the south side of road segments #254 and #258). The omissions of these roads are not expected to significantly affect final results.

The "triggers" which are most believed to be responsible for the delivery of sediment were next evaluated. Traffic, surfacing, cutslope and fillslope densities, road prism geometry, and age of roads were all evaluated "triggers" causing the delivery of sediment to public resources. Further, two different road delivery percentages were used (differing only by 5%) during assessment. Lastly, discrepancies between actual measured road "types" and the "reference road" were documented, and appropriately accounted for.

B.5. ASSESSMENT OF SURFACE EROSION ON PUBLIC RESOURCES

B.5.1. Background Sediment Budget Calculation- The soil creep model was used for estimating background sub-basin sediment production. Stream channel length for the Brooks Creek, Whitman Bench, Rollins Creek, Dicks Creek, Mt. Higgins, and Segelsen Creek sub-basins were measured at 34.75, 14.03, 30.43, 10.91, 57.56, and 30.72 miles, respectively by a geographic information system.

Soil depths of two and three meters were used for background sediment production calculations. And a creep rate of 0.002 meters/year was used for all sub-basins except in Brooks Creek and Whitman Bench. Results are shown in Form B-4.3 "Background Sediment Yield Compared to Delivered Road Sediment".

B.5.2. Hillslope and Road Erosion Impacts and Public Resource Sensitivity- Field sampling showed that little, if any, sediment is delivered from hillslopes when standard rules for harvesting are followed. Consequently, WAU roads were deemed to be the main cause for resource sensitivity to surface erosion. Total sediment delivered from roads was determined to be highest (in percent) in the Brooks Creek and Segelsen Creek sub-basins (52% to 78% and 66% to 99% of background sediment production, respectively). Consequently, the delivery of sediment from roads cause a moderate hazard to public resources in the Brooks Creek and Segelsen Creek sub-basins. The delivery of sediment from roads in all other sub-basins was less than 50% of background sediment. Consequently, roads in Whitman Bench, Rollins Creek, Dicks Creek, and Mt. Higgins sub-basins currently pose a low risk to public resources.

Cutslope/fillslope vegetative density, age of road, and depth of road surfacing were determined to not be major triggers causing the delivery of sediment from roads. These items likely are believed not to be triggers because most all WAU roads are much older than two years of age and likely have not been maintained recently.

Although not entirely clear, overall road segment slope appears not to be a significant sediment delivery trigger. WAU road erosion calculations show that about 77% total delivered sediment comes from roads with overall slopes of 3 percent or greater. This figure suggests lower slope road segments, as well as higher slope road segments, contribute significant amounts of delivered sediment to public resources in the WAU (See Form B-2.4 "Road Segment Slope and Delivered Sediment").

Road segment delivery area was also evaluated as a surface erosion trigger. A five percent change in delivery area per road segment was found to cause significant increases in the total amount of delivered sediment. Consequently, delivery area of a road segment was determined to be a major trigger causing the delivery of sediment. It is also reasonable to assume that traffic and road prism shape are related triggers which cause sediment to be delivered from roads.

Critical review of Brooks Creek and Segelsen Creek sub-basin traffic, delivery, and road prism geometries reveals the following:

Traffic- Collectively, 6I and 6S traffic rates are highest in the Brooks Creek, Segelsen Creek, and Whitman Bench sub-basins (6I/6S road segments comprise slightly greater than 75% of each sub-basin's road network). 6I and 6S road segments comprise about 66% of the total length of road segments in Mt. Higgins. 6I and 6S make up about 35% and 41% of the total length of road segments in the Dicks Creek and Rollins Creek sub-basins, respectively.

The Dicks Creek sub-basin has the largest distance of 6A traffic roads (about 65%) to go along with the least distance of road network in the WAU. Rollins Creek, on the other hand, has the longest distance of roads in the WAU. The length of 6A road segments are correspondingly high in the Rollins Creek sub-basin (about 60%). All other sub-basin 6A road segments comprise less than 30% of the length of each sub-basin's road network

Delivery- A majority all road prisms were determined to deliver sediment. Road prism delivery percentages generally range from 5% to 30%, except when no channels are nearby and/or the ground is very flat.

Road Prism Geometry- Five out of ten and seven out of twelve sampled road segments in the Brooks Creek and Segelsen Creek sub-basins, respectively, were determined to have "Flatsloped" road prisms. This suggests prisms are not maintained on these road networks. Consequently, road runoff is not controlled. The result is that relatively greater quantities of road runoff and sediment are delivered from this type of road prism than other road prism geometries.

Total delivered sediment rankings for total quantity and quantity per unit area are shown in Form B-4.2 "Road Type Sediment Delivery Rankings". These comparisons show sediment delivery for a specific road "type" can vary greatly based on whether delivery is ranked by total delivered quantity per road type or total delivered quantity per unit area of road type.

B.5.3. Confidence- Confidence in background sediment production calculations is fair. Different creep rates and soil depths were used to estimate a range background sediment production. This allowed the analyst to assess how changes in creep rates and soil depth effected final background sediment results.

Type 1 through 5 Waters lengths were estimated by a geographic information system based on existing information, air photo and map interpretation, and some field verified changes. The actual length of Type 1 through 5 Waters likely differs from estimated lengths used for background sediment calculations. However, the estimated length of Type 1 through 5 Waters in each sub-basin certainly is not in error by a magnitude. Type 1 through 5 Waters estimated distances are probably in error by no more that 20 percent. Consequently, a reasonable estimate of each sub-basin's final background sediment production is believed to

have been made. However, an inaccurate length estimates of Type 1 through 5 Waters could cause a final hazard rating to be lower or higher than it should be.

A gate on the 6S road in the Brooks Creek sub-basin casts some doubt on the hazard rating. However, the high proportion of 6I and 6S traffic road segments found in this sub-basins would suggest sediment delivery rates should be relatively high. Further, road prism shapes appear to be maintained on an infrequent basis. Consequently, a fair to good degree of confidence exists for the moderate hazard rating.

The 6S road in Segelsen Creek (USFS Road 18) probably receives more vehicular traffic use than any other WAU road network. Therefore, sediment delivery is anticipated to be relatively high in this sub-basin. Results confirm this hypothesis. Consequently, the hazard rating for Segelsen Creek is believed to have a good degree of confidence.

Confidence in low hazard ratings for all other sub-basins is good for the following reasons:

Whitman Bench: Proportionally speaking, 6I and 6S traffic segment length here is similar to that found in the Brooks Creek and Segelsen Creek sub-basin. This may initially suggest sediment delivery here would be high. However, field sampling suggest sediment delivery rates are very low (typically 0.0% to 0.10%). Consequently, sediment delivery is limited.

Dicks Creek: The total length of roads in this sub-basin is the least in the WAU. Further, 65% of the total length of roads here have 6A traffic. Consequently, it is expected that total delivered sediment would be very low here.

Rollins Creek: Substantial road abandonment work was completed in the sub-basin during 1994. As a result, 6A traffic segments account for almost 60% of the entire sub-basin road network. This undoubtedly has reduced total delivered sediment. Rollins Creek would have likely had a moderate or high surface erosion hazard rating without this work.

Mt. Higgins: The longest total length of stream channel network for all sub-basins exists here. Consequently, background sediment yield is anticipated to be relatively high. This means that delivered sediment from roads would have to be very high to earn a moderate hazard rating. Further, the length of 6S traffic road segments is less than 6S traffic segments in other sub-basins. Consequently, total delivered sediment would be expected to be less here than in other sub-basins.

B.6. REFERENCES

Harcrow, Don, November, 1994, United States Department of Agriculture, United States Forest Service/Mt. Baker National Forest, Washington. Personal communication.

Maier, Ed, November, 1994. Washington State Department of Natural Resources. Personal communication.

Snyder, R.V., and J.M. Wade, September, 1970, Mt. Baker National Forest Soil Resource Inventory. United States Department of Agriculture, United States Forest Service/Mt. Baker National Forest, Washington.

Tabor, R.W., D.B. Booth, J.A. Vance, A.B. Ford, and M.H.Ort, Preliminary Geologic Map of the Sauk River 30 by 60 Minute Quadrangle, Washington. United States Department of the Interior, United States Geological Survey, Open-File Map 88-692.

Thorn, Todd, November, 1994. Washington State Department of Natural Resources. Personal communication.

United States Department of Interior, United States Geological Survey Fortson, Mt. Higgins, and Oso 7.5 Minute Quadrangle Topographic Maps.

United States Department of Agriculture, Soil Conservation Service, Soil Survey of Skagit County Area, Washington, September, 1989.

United States Department of Agriculture, Soil Conservation Service, Soil Survey of Snohomish County Area, Washington, July, 1983.

United States Department of Agriculture, United States Forest Service/Mt. Baker National Forest, Washington. Soil Resource Atlas of Maps and Interpretive Tables.

Washington State Department of Natural Resources, Aerial Photographs, 1991.

Washington State Department of Natural Resources, Orthophoto Maps, 1993.

Washington State Department of Natural Resources, State Soil Survey, Report for the Northwest Area.

Washington State Department of Natural Resources and the Washington Forest Practices Board, Board Manual: Standard Methodology for Conducting Watershed Analysis Under Chapter 222-22 WAC, Version 2.1, November, 1994.

Form B-2.2 "Length of Road Types"

	A	B	C	D	E	F	G	H	I	J
1										
2			ROAD	ROAD						
3		ROAD	LENGTH	LENGTH						
4		"TYPE"	FEET	MILES						
5		1	3676	0.70						
6		8	7235	1.37						
7		9	19223	3.64						
8		13	2199	0.42						
9		14	8844	1.68						
10		22	1112	0.21						
11		28	4157	0.79						
12		29	14677	2.78						
13		32	28574	5.41						
14		36	33616	6.37						
15		60	8826	1.67						
16		61	6196	1.17						
17		63	21287	4.03						
18		71	3639	0.69						
19		83	22858	4.33						
20		124	12611	2.39						
21		125	12364	2.34						
22		126	908	0.17						
23		131	2152	0.41						
24		132	38746	7.34						
25		138	14604	2.77						
26		140	3098	0.59						
27		141	12908	2.44						
28		144	14995	2.84						
29		145	25350	4.80						
30		146	5508	1.04						
31		148	7832	1.48						
32		175	21875	4.14						
33		178	25894	4.90						
34		188	2666	0.50						
35		207	3370	0.64						
36		208	4649	0.88						
37		209	468	0.09						
38		210	2747	0.52						
39		213	5751	1.09						
40		219	5485	1.04						
41		242	23026	4.36						
42		245	12466	2.36						
43		246	1525	0.29						
44		247	23729	4.49						
45		250	16598	3.14						
46		259	3285	0.62						
47		262	21169	4.01						
48		264	16425	3.11						
49		198-203-230-235-	44830	8.49						
50		208-209	757	0.14						
51		224-238	13250	2.51						
52		254-258	12682	2.40						
53		260-263	21090	3.99						
54		29-138	8518	1.61						
55		8-60-125-254-258	3728	0.71						
56										
57										
58										
59										
60										

PART IV: HAZEL WAU
Surface Erosion Module
Form B-2.3 "Road Type, Road Segment, and Subbasin Location"

	A	B	C	D
3				
4		ROAD	ROAD	
5		"TYPE"	SEGMENT	SUBBASIN
64		32	320	SEGELSEN CK
65				
66		36	36	BROOKS CK
67		36	37	BROOKS CK
68		36	39	BROOKS CK
69		36	42	BROOKS CK
70		36	43	BROOKS CK
71		36	44	BROOKS CK
72		36	54	BROOKS CK
73		36	55	BROOKS CK
74		36	57	BROOKS CK
75		36	59	BROOKS CK
76				
77		60	60	WHITMAN BENCH
78		60	62	WHITMAN BENCH
79		60	72	WHITMAN BENCH
80		60	81	WHITMAN BENCH
81				
82		61	61	WHITMAN BENCH
83		61	80	WHITMAN BENCH
84		61	89	WHITMAN BENCH
85		61	110	WHITMAN BENCH
86				
87		63	63	WHITMAN BENCH
88		63	64	WHITMAN BENCH
89		63	65	WHITMAN BENCH
90		63	66	WHITMAN BENCH
91		63	67	WHITMAN BENCH
92		63	68	WHITMAN BENCH
93		63	70	WHITMAN BENCH
94		63	75	WHITMAN BENCH
95		63	76	WHITMAN BENCH
96		63	77	WHITMAN BENCH
97		63	79	WHITMAN BENCH
98		63	87	WHITMAN BENCH
99		63	88	WHITMAN BENCH
100		63	90	WHITMAN BENCH
101		63	91	WHITMAN BENCH
102		63	92	WHITMAN BENCH
103		63	94	WHITMAN BENCH
104		63	95	WHITMAN BENCH
105		63	96	WHITMAN BENCH
106		63	304	WHITMAN BENCH
107		63	325	WHITMAN BENCH
108		63	326	WHITMAN BENCH
109				
110		71	69	WHITMAN BENCH
111		71	71	WHITMAN BENCH
112		71	97	WHITMAN BENCH
113		71	106	BROOKS CK
114		71	107	BROOKS CK
115				
116		83	74	ROLLINS CK
117		83	82	ROLLINS CK
118		83	83	ROLLINS CK
119		83	84	ROLLINS CK
120		83	86	ROLLINS CK
121		83	99	ROLLINS CK
122		83	100	ROLLINS CK
123		83	101	ROLLINS CK

PART IV: HAZEL WAU
Surface Erosion Module
Form B-2.3 "Road Type, Road Segment, and Subbasin Location"

	A	B	C	D
3				
4		ROAD	ROAD	
5		"TYPE"	SEGMENT	SUBBASIN
124		83	102	ROLLINS CK
125		83	109	ROLLINS CK
126		83	112	ROLLINS CK
127		83	116	ROLLINS CK
128		83	128	ROLLINS CK
129		83	130	ROLLINS CK
130		83	328	ROLLINS CK
131				
132		124	105	BROOKS CK
133		124	124	ROLLINS CK
134		124	308	BROOKS CK
135		124	324	MT HIGGINS
136		124	327	BROOKS CK
137				
138		125	73	ROLLINS CK
139		125	103	ROLLINS CK
140		125	113	ROLLINS CK
141		125	125	ROLLINS CK
142		125	127	ROLLINS CK
143				
144		126	126	ROLLINS CK
145				
146		131	129	DICKS CK
147		131	131	DICKS CK
148				
149		132	132	DICKS CK
150		132	137	DICKS CK
151		132	149	ROLLINS CK
152		132	153	ROLLINS CK
153		132	155	ROLLINS CK
154		132	156	ROLLINS CK
155		132	163	ROLLINS CK
156		132	164	ROLLINS CK
157		132	165	ROLLINS CK
158		132	168	ROLLINS CK
159		132	169	ROLLINS CK
160		132	170	ROLLINS CK
161		132	307	ROLLINS CK
162				
163		138	31	ROLLINS CK
164		138	119	ROLLINS CK
165		138	120	ROLLINS CK
166		138	133	ROLLINS CK
167		138	138	ROLLINS CK
168		138	139	ROLLINS CK
169		138	305	ROLLINS CK
170		138	306	ROLLINS CK
171		138	323	ROLLINS CK
172				
173		140	140	ROLLINS CK
174				
175		141	134	ROLLINS CK
176		141	135	DICKS CK
177		141	136	ROLLINS CK
178		141	141	ROLLINS CK
179		141	151	ROLLINS CK
180		141	154	ROLLINS CK
181		141	157	ROLLINS CK
182		141	166	ROLLINS CK
183		141	171	ROLLINS CK

PART IV: HAZEL WAU
Surface Erosion Module
Form B-2.3 "Road Type, Road Segment, and Subbasin Location"

	A	B	C	D
3				
4		ROAD	ROAD	
5		"TYPE"	SEGMENT	SUBBASIN
184				
185		144	143	ROLLINS CK
186		144	144	ROLLINS CK
187		144	267	SEGELSEN CK
188				
189		145	145	ROLLINS CK
190		145	160	ROLLINS CK
191		145	161	ROLLINS CK
192		145	162	ROLLINS CK
193		145	167	ROLLINS CK
194		145	174	ROLLINS CK
195		145	278	SEGELSEN CK
196		145	279	SEGELSEN CK
197		145	317	SEGELSEN CK
198				
199		146	146	ROLLINS CK
200		146	159	ROLLINS CK
201		146	310	ROLLINS CK
202				
203		148	142	ROLLINS CK
204		148	148	ROLLINS CK
205		148	158	ROLLINS CK
206		148	287	SEGELSEN CK
207		148	295	SEGELSEN CK
208				
209		175	2	BROOKS CK
210		175	93	WHITMAN BENCH
211		175	98	WHITMAN BENCH
212		175	175	SEGELSEN CK
213		175	176	MT HIGGINS
214		175	177	MT HIGGINS
215		175	315	SEGELSEN CK
216				
217		178	178	SEGELSEN CK
218		178	179	SEGELSEN CK
219		178	180	SEGELSEN CK
220		178	181	SEGELSEN CK
221		178	182	SEGELSEN CK
222		178	183	SEGELSEN CK
223		178	184	SEGELSEN CK
224		178	185	SEGELSEN CK
225		178	186	SEGELSEN CK
226		178	187	SEGELSEN CK
227		178	189	SEGELSEN CK
228		178	255	SEGELSEN CK
229		178	257	SEGELSEN CK
230		178	316	SEGELSEN CK
231		178	321	SEGELSEN CK
232				
233		188	188	SEGELSEN CK
234				
235		207	207	MT HIGGINS
236		207	217	MT HIGGINS
237				
238		208	208	MT HIGGINS
239		208	212	MT HIGGINS
240				
241		209	209	SEGELSEN CK
242				
243		210	210	SEGELSEN CK

PART IV: HAZEL WAU
Surface Erosion Module
Form B-2.3 "Road Type, Road Segment, and Subbasin Location"

	A	B	C	D
3				
4		ROAD	ROAD	
5		"TYPE"	SEGMENT	SUBBASIN
244		210	214	SEGELSEN CK
245		210	266	SEGELSEN CK
246				
247		213	211	MT HIGGINS
248		213	213	MT HIGGINS
249		213	215	MT HIGGINS
250				
251		219	218	MT HIGGINS
252		219	219	MT HIGGINS
253		219	220	MT HIGGINS
254		219	221	MT HIGGINS
255				
256		242	45	ROLLINS CK
257		242	50	ROLLINS CK
258		242	52	BROOKS CK
259		242	58	ROLLINS CK
260		242	78	ROLLINS CK
261		242	147	ROLLINS CK
262		242	150	ROLLINS CK
263		242	242	MT HIGGINS
264		242	243	MT HIGGINS
265		242	244	MT HIGGINS
266		242	248	MT HIGGINS
267		242	249	MT HIGGINS
268		242	252	MT HIGGINS
269		242	275	MT. HIGGINS
270				
271		245	38	BROOKS CK
272		245	40	BROOKS CK
273		245	41	BROOKS CK
274		245	46	ROLLINS CK
275		245	47	ROLLINS CK
276		245	48	ROLLINS CK
277		245	49	ROLLINS CK
278		245	51	ROLLINS CK
279		245	53	ROLLINS CK
280		245	152	ROLLINS CK
281		245	245	MT HIGGINS
282		245	309	ROLLINS CK
283				
284		246	246	MT HIGGINS
285				
286		247	173	MT HIGGINS
287		247	205	MT HIGGINS
288		247	206	MT HIGGINS
289		247	247	MT HIGGINS
290				
291		250	56	BROOKS CK
292		250	222	MT HIGGINS
293		250	223	MT HIGGINS
294		250	250	MT HIGGINS
295		250	276	SEGELSEN CK
296		250	277	SEGELSEN CK
297		250	286	SEGELSEN CK
298		250	289	SEGELSEN CK
299		250	319	SEGELSEN CK
300				
301		259	256	SEGELSEN CK
302		259	259	SEGELSEN CK
303				

PART IV: HAZEL WAU
Surface Erosion Module
Form B-2.3 "Road Type, Road Segment, and Subbasin Location"

	A	B	C	D
3				
4		ROAD	ROAD	
5		"TYPE"	SEGMENT	SUBBASIN
304		262	253	MT HIGGINS
305		262	261	SEGELSEN CK
306		262	262	SEGELSEN CK
307		262	269	SEGELSEN CK
308		262	270	SEGELSEN CK
309		262	282	SEGELSEN CK
310		262	283	SEGELSEN CK
311		262	288	SEGELSEN CK
312				
313		264	264	SEGELSEN CK
314		264	265	SEGELSEN CK
315		264	280	SEGELSEN CK
316		264	284	SEGELSEN CK
317		264	285	SEGELSEN CK
318		264	296	SEGELSEN CK
319		264	318	SEGELSEN CK
320				
321		198-203-230-235-240	190	MT HIGGINS
322		198-203-230-235-240	191	MT HIGGINS
323		198-203-230-235-240	192	MT HIGGINS
324		198-203-230-235-240	193	MT HIGGINS
325		198-203-230-235-240	194	MT HIGGINS
326		198-203-230-235-240	195	MT HIGGINS
327		198-203-230-235-240	196	MT HIGGINS
328		198-203-230-235-240	197	MT HIGGINS
329		198-203-230-235-240	198	MT HIGGINS
330		198-203-230-235-240	200	MT HIGGINS
331		198-203-230-235-240	201	MT HIGGINS
332		198-203-230-235-240	203	MT HIGGINS
333		198-203-230-235-240	204	MT HIGGINS
334		198-203-230-235-240	226	MT HIGGINS
335		198-203-230-235-240	227	MT HIGGINS
336		198-203-230-235-240	230	MT HIGGINS
337		198-203-230-235-240	231	MT HIGGINS
338		198-203-230-235-240	232	MT HIGGINS
339		198-203-230-235-240	233	MT HIGGINS
340		198-203-230-235-240	234	MT HIGGINS
341		198-203-230-235-240	235	MT HIGGINS
342		198-203-230-235-240	236	MT HIGGINS
343		198-203-230-235-240	239	MT HIGGINS
344		198-203-230-235-240	240	MT HIGGINS
345		198-203-230-235-240	241	MT HIGGINS
346		198-203-230-235-240	311	MT HIGGINS
347				
348		208-209	329	BROOKS CK
349				
350		224-238	199	MT HIGGINS
351		224-238	224	MT HIGGINS
352		224-238	225	MT HIGGINS
353		224-238	228	MT HIGGINS
354		224-238	229	MT HIGGINS
355		224-238	237	MT HIGGINS
356		224-238	238	MT HIGGINS
357		224-238	251	MT HIGGINS
358		224-238	312	MT HIGGINS
359		224-238	313	MT HIGGINS
360		224-238	314	MT HIGGINS
361				
362		254-258	254	SEGELSEN CK
363		254-258	258	SEGELSEN CK

PART IV: HAZEL WAU
Surface Erosion Module
Form B-2.3 "Road Type, Road Segment, and Subbasin Location"

	A	B	C	D
3				
4		ROAD	ROAD	
5		"TYPE"	SEGMENT	SUBBASIN
364				
365		260-263	260	SEGELSEN CK
366		260-263	263	SEGELSEN CK
367		260-263	268	SEGELSEN CK
368		260-263	271	SEGELSEN CK
369		260-263	272	SEGELSEN CK
370		260-263	273	SEGELSEN CK
371		260-263	274	MT. HIGGINS
372		260-263	281	SEGELSEN CK
373		260-263	322	SEGELSEN CK
374				
375		29-138	6	WHITMAN BENCH
376		29-138	7	WHITMAN BENCH
377		29-138	111	WHITMAN BENCH
378		29-138	298	WHITMAN BENCH
379		29-138	301	WHITMAN BENCH
380		29-138	303	WHITMAN BENCH
381				
382		8-60-125-254-258	172	DICKS CK
383		8-60-125-254-258	202	MT HIGGINS
384		8-60-125-254-258	216	MT HIGGINS

PART IV: HAZEL WAU
Surface Erosion Module
Form B-2.4 "Road Segment Slope and Delivered Sediment"

	TOTAL			
	DELIVERED	# OF ROAD		
	SEDIMENT	SEGMENTS/		
	IN WAU	MINIMUM		
	US Tons/Yr	SLOPE		
	181.82	86 RDS/>10%		
	305.98	123 RDS/>7%		
	375.46	172 RDS/>5%		
	649.07	219 RDS/>3%		
	874.35	330 RDS		
				5 PERCENT
			TOTAL	TOTAL
	ROAD	ROAD	DELIVERED	DELIVERED
	SLOPE	SEGMENT	SEDIMENT	SEDIMENT
	%%%		US TONS/YR	US TONS/YR
	26	135	0.09	0.18
	26	302	0.65	0.81
	25	299	0.82	1.02
	24	71	0.00	0.06
	22	69	0.00	0.03
	21.8	141	0.00	0.16
	21	38	0.04	0.06
	20.6	143	3.65	4.56
	20	237	1.27	1.59
	20	287	1.24	1.55
	20	300	0.81	1.02
	19.2	154	0.00	0.09
	18	28	0.94	1.18
	17.8	49	0.12	0.19
	17.7	126	3.25	4.06
	17.5	46	0.04	0.05
	17.5	158	1.22	1.82
	17.1	51	0.02	0.04
	17.1	220	0.02	0.03
	16.8	40	0.02	0.03
	16.7	294	0.95	1.19
	16.7	295	0.93	1.16
	16.5	134	0.00	0.16
	16.4	148	2.52	3.78
	16.2	107	0.00	0.09
	16	106	0.00	0.16
	15.8	97	0.00	0.14
	15.5	142	1.76	2.64
	15.5	256	0.00	0.33
	15.3	26	0.00	0.18
	15.1	245	0.00	0.04
	15	41	0.03	0.04
	14.7	269	12.20	14.23
	14.4	20	0.57	0.86
	14.3	151	0.00	0.15
	14.1	24	0.30	0.46
	14.1	211	3.56	4.45
	13.8	298	0.34	0.68
	13.5	89	0.00	1.14

PART IV: HAZEL WAU
Surface Erosion Module
Form B-2.4 "Road Segment Slope and Delivered Sediment"

				6 PERCENT
			TOTAL	TOTAL
	ROAD	ROAD	DELIVERED	DELIVERED
	SLOPE	SEGMENT	SEDIMENT	SEDIMENT
	%%%		US TONS/YR	US TONS/YR
	13.4	145	10.81	21.62
	13.3	80	0.00	0.13
	13.3	122	0.14	0.21
	13.3	160	0.77	1.55
	13.3	199	1.55	1.93
	13.2	174	2.08	4.16
	12.7	140	7.23	9.04
	12.5	123	0.15	0.23
	12.3	270	1.52	1.78
	12.2	29	0.41	0.62
	12.1	171	0.00	0.09
	12	6	0.42	0.83
	12	214	0.00	0.73
	12	259	0.00	1.16
	11.7	48	0.03	0.05
	11.7	117	0.37	0.55
	11.7	124	16.95	21.19
	11.4	53	0.06	0.09
	11.4	219	0.02	0.04
	11.4	228	1.30	1.63
	11.4	261	3.15	3.68
	11.4	314	3.59	4.49
	11.2	262	22.37	26.10
	11.1	57	1.22	1.52
	11	10	0.17	0.26
	11	144	11.00	13.75
	11	308	7.32	9.15
	10.9	238	9.56	11.95
	10.8	136	0.00	0.21
	10.8	137	0.04	0.08
	10.7	303	0.62	0.93
	10.6	47	0.04	0.06
	10.3	25	1.03	1.55
	10.3	224	13.08	16.35
	10.3	253	8.58	10.01
	10	13	1.66	2.49
	10	15	0.55	0.82
	10	22	0.00	0.05
	10	52	0.06	0.09
	10	110	1.09	1.64
	10	157	0.00	0.64
	10	188	0.00	8.42
	10	282	4.96	5.79
	10	288	9.77	11.39
	10	301	0.47	0.70
	10	305	0.25	0.50
	10	306	0.09	0.18
	9.7	166	0.00	0.30
	9.6	7	0.38	0.76
	9.4	283	20.71	24.16
	9.2	249	0.40	0.60
	9.1	251	1.71	2.13
	9	61	1.74	2.61
	9	324	12.27	14.31

PART IV: HAZEL WAU
Surface Erosion Module
Form B-2.4 "Road Segment Slope and Delivered Sediment"

				5 PERCENT
			TOTAL	TOTAL
	ROAD	ROAD	DELIVERED	DELIVERED
	SLOPE	SEGMENT	SEDIMENT	SEDIMENT
	%%%		US TONS/YR	US TONS/YR
	8.9	229	1.19	1.49
	8.8	208	1.44	2.16
	8.7	279	6.75	8.44
	8.6	162	1.72	3.45
	8.5	5	0.38	0.57
	8.4	62	6.10	12.19
	8.3	152	0.07	0.10
	8.3	317	2.18	2.72
	8.1	210	0.00	2.39
	8.1	278	16.55	20.69
	8	54	1.68	2.10
	8	105	5.66	7.07
	8	120	0.20	0.39
	8	313	1.42	1.77
	7.9	215	13.78	17.23
	7.9	312	1.74	2.18
	7.7	111	0.24	0.49
	7.7	161	2.36	4.71
	7.6	309	0.09	0.13
	7.5	18	0.35	0.52
	7.5	119	0.17	0.33
	7.5	138	0.92	1.85
	7.5	167	2.72	5.44
	7.5	225	0.63	0.79
	7.5	327	13.24	16.55
	7.4	207	2.73	4.10
	7.3	139	0.15	0.30
	7.2	212	0.70	1.05
	7.1	30	1.01	1.52
	7.1	246	0.77	1.15
	6.9	217	1.01	1.52
	6.9	268	0.58	0.86
	6.9	281	2.43	3.65
	6.8	43	0.54	0.67
	6.7	12	0.82	0.96
	6.7	65	0.00	0.15
	6.7	67	0.00	0.08
	6.7	108	1.52	1.90
	6.7	163	0.63	0.94
	6.7	276	2.81	3.52
	6.7	277	0.54	0.67
	6.7	322	0.31	0.47
	6.6	156	1.00	1.49
	6.6	242	0.33	0.50
	6.5	236	0.52	1.05
	6.5	272	3.34	5.01
	6.4	82	0.00	1.02
	6.4	297	0.89	1.04
	6.3	290	3.88	4.85
	6.2	129	0.00	0.50
	6.2	149	1.03	1.55
	6.2	159	0.53	1.06
	6	181	0.10	0.15
	6	239	1.32	2.64

PART IV: HAZEL WAU
Surface Erosion Module
Form B-2.4 "Road Segment Slope and Delivered Sediment"

				5 PERCENT
			TOTAL	TOTAL
	ROAD	ROAD	DELIVERED	DELIVERED
	SLOPE	SEGMENT	SEDIMENT	SEDIMENT
	%%%		US TONS/YR	US TONS/YR
	5.9	216	5.96	7.45
	5.8	4	0.48	0.60
	5.7	234	0.94	1.87
	5.6	32	1.91	2.23
	5.6	44	0.14	0.27
	5.6	146	1.93	3.87
	5.6	168	0.89	1.34
	5.6	233	0.51	1.02
	5.6	248	0.65	0.98
	5.6	275	0.11	0.17
	5.5	8	17.03	21.29
	5.5	45	0.07	0.10
	5.5	50	0.10	0.16
	5.33	173	1.02	1.53
	5.3	42	0.33	0.65
	5.3	320	2.29	2.67
	5.1	17	5.16	6.02
	5	33	0.42	0.50
	5	221	0.04	0.07
	5	223	1.29	1.61
	5	226	0.47	0.94
	5	244	0.03	0.04
	5	285	1.71	2.00
	5	304	0.00	0.35
	5	318	1.86	2.17
	4.9	254	68.18	81.82
	4.8	109	0.00	0.30
	4.8	200	0.15	0.29
	4.8	235	1.35	2.69
	4.8	243	0.07	0.11
	4.7	133	0.20	0.39
	4.6	19	3.22	3.76
	4.5	27	1.05	1.58
	4.5	94	0.00	0.09
	4.4	187	0.79	1.19
	4.3	63	0.00	0.77
	4.3	296	9.28	10.83
	4.2	31	0.76	1.52
	4.2	35	2.25	2.62
	4.2	330	0	1.07
	4.1	36	1.34	1.67
	4.1	264	19.11	22.29
	4.1	274	2.18	3.27
	4	59	1.15	1.44
	4	68	0.00	0.08
	4	79	0.00	0.12
	4	118	0.60	0.70
	4	252	0.04	0.05
	4	257	0.32	0.49
	3.9	150	0.09	0.13
	3.8	289	1.41	1.77
	3.7	180	1.69	2.54
	3.7	206	5.66	8.49
	3.6	213	9.80	12.25

PART IV: HAZEL WAU
Surface Erosion Module
Form B-2.4 "Road Segment Slope and Delivered Sediment"

				5 PERCENT
			TOTAL	TOTAL
	ROAD	ROAD	DELIVERED	DELIVERED
	SLOPE	SEGMENT	SEDIMENT	SEDIMENT
	%%%		US TONS/YR	US TONS/YR
	3.6	280	8.83	10.31
	3.5	222	0.22	0.28
	3.4	37	1.99	2.49
	3.3	55	0.25	0.31
	3.3	125	9.72	12.15
	3.3	170	0.21	0.31
	3.3	183	0.43	0.65
	3.3	186	1.02	1.53
	3.3	255	1.01	1.51
	3.3	265	21.11	24.63
	3.3	271	0.29	0.43
	3.3	284	13.23	15.44
	3.2	39	0.27	0.55
	3.1	267	34.49	43.11
	3	74	0.00	0.15
	3	190	0.16	0.33
	3	197	0.99	1.99
	3	258	48.68	58.42
	2.9	132	0.77	1.16
	2.9	153	0.66	0.99
	2.9	172	4.07	5.08
	2.9	204	1.37	2.75
	2.9	326	0.00	0.28
	2.8	86	0.00	0.15
	2.8	319	2.99	3.73
	2.8	321	1.26	1.88
	2.7	9	14.90	18.63
	2.6	14	3.13	3.91
	2.5	34	0.16	0.33
	2.5	81	1.11	2.22
	2.5	84	0.09	0.17
	2.5	88	0.00	0.05
	2.5	310	1.44	1.80
	2.2	203	0.85	1.71
	2.1	165	0.26	0.38
	2.1	218	0.00	0.28
	2	75	0.00	0.75
	2	91	0.00	0.14
	2	98	0.92	1.83
	2	182	0.14	0.21
	2	323	0.67	1.35
	1.9	1	9.48	18.96
	1.9	2	0.74	1.48
	1.9	16	4.95	6.19
	1.9	128	0.00	0.36
	1.9	130	0.00	0.15
	1.9	202	9.84	12.29
	1.8	175	1.28	2.57
	1.8	184	1.34	2.01
	1.7	104	14.59	18.23
	1.7	185	0.32	0.49
	1.7	196	0.19	0.38
	1.7	232	0.22	0.45
	1.6	286	0.82	1.03

PART IV: HAZEL WAU
Surface Erosion Module
Form B-2.4 "Road Segment Slope and Delivered Sediment"

				5 PERCENT
			TOTAL	TOTAL
	ROAD	ROAD	DELIVERED	DELIVERED
	SLOPE	SEGMENT	SEDIMENT	SEDIMENT
	%%%		US TONS/YR	US TONS/YR
	1.5	11	1.41	1.65
	1.5	76	0.00	0.09
	1.5	205	1.49	2.23
	1.5	250	4.04	5.06
	1.4	96	0.00	0.08
	1.4	178	2.91	4.36
	1.3	3	4.34	5.43
	1.3	66	0.00	0.12
	1.3	77	0.00	0.12
	1.3	78	0.05	0.07
	1.3	87	0.00	0.31
	1.3	209	0.00	0.11
	1.3	266	0.00	1.45
	1.3	329	0.38	0.58
	1.25	95	0.00	0.37
	1.2	114	1.79	2.23
	1.2	121	4.23	4.94
	1.2	155	0.46	0.70
	1.1	101	0.00	0.19
	1.1	103	13.49	16.86
	1.1	112	0.10	0.20
	1	23	0.12	0.25
	1	60	1.46	2.91
	1	64	0.00	0.13
	1	70	0.00	0.08
	1	127	14.83	18.54
	1	192	1.43	2.86
	1	194	0.77	1.54
	1	196	1.60	3.21
	1	325	0.00	0.37
	0.9	85	4.73	5.91
	0.9	116	0.00	0.16
	0.9	147	0.12	0.18
	0.8	201	0.29	0.58
	0.8	247	14.48	21.72
	0.7	58	0.06	0.09
	0.7	92	0.00	0.19
	0.7	169	0.15	0.22
	0.7	177	0.99	1.97
	0.7	230	1.55	3.10
	0.7	231	0.33	0.66
	0.6	131	0.00	0.35
	0.5	56	1.42	1.77
	0.5	72	0.26	0.52
	0.5	73	3.63	4.54
	0.5	191	0.65	1.29
	0.5	195	0.65	1.31
	0.5	291	2.89	3.61
	0.5	292	0.65	0.76
	0.5	293	1.18	1.38
	0.5	307	0.19	0.29
	0.4	99	0.00	0.43
	0.4	100	0.00	0.35
	0.4	113	15.07	18.84

PART IV: HAZEL WAU
Surface Erosion Module
Form B-2.4 "Road Segment Slope and Delivered Sediment"

				5 PERCENT
			TOTAL	TOTAL
	ROAD	ROAD	DELIVERED	DELIVERED
	SLOPE	SEGMENT	SEDIMENT	SEDIMENT
	%%%		US TONS/YR	US TONS/YR
	0.4	240	0.67	1.34
	0.4	241	0.76	1.51
	0.3	102	0.00	0.69
	0.3	164	0.31	0.47
	0.3	193	1.99	3.97
	0.3	227	2.19	4.38
	0.3	315	0.46	0.92
	0.3	328	0.00	0.23
	0.2	83	0.00	1.33
	0.2	90	0.00	0.53
	0.2	176	0.41	0.82
	0.2	179	1.18	1.77
	0.2	189	1.85	2.77
	0.2	260	1.45	2.18
	0.2	263	1.75	2.62
	0.2	273	2.31	3.47
	0.1	21	18.82	23.52
	0.1	93	0.99	1.97
	0.1	115	4.34	5.42
	0.1	311	2.10	4.20
	0.1	316	0.19	0.29

PART IV: HAZEL.WAU
Surface Erosion Module
Form B-2.5 "Total Sediment Delivery From Roads"

	A	B	C	D	E	F
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13		SUBBASIN	ROAD LENGTH FEET	ROAD AREA ACRES	TOTAL DELIVERED SEDIMENT U.S. TONS/YR	5 PERCENT INCREASED TOTAL DELIVERED SEDIMENT U.S. TONS/YR
14						
15		BROOKS CK	128561	96.56	167.33	218.57
16		DICKS CK	8533	5.93	4.97	7.35
17		MT. HIGGINS	142533	110.36	165.74	233.14
18		ROLLINS CK	154406	121.96	139.02	204.05
19		SEGELSEN CK	144645	139.06	378.88	477.52
20		WHITMAN BENCH	56508	31.78	18.40	40.22
21		TOTALS	635186	505.69	874.35	1180.85

PART V: HAZEL WAU FORMB-4.XLS
Surface Erosion Module
Form B-4.1 "Surface Erosion Summary"

	A	B	C	D	E	F	G	H	I
1									
2									
3									
4									
5									
6									
7								SURFACE/	
8								TRAFFIC	ROAD
9						CUTSLOPE	FILLSLOPE	TREAD	PRISM
10		ROAD			ROAD	EROSION	EROSION	EROSION	TOTAL
11		SEGMENT	WAU	SUBBASIN	"TYPE"	RATE	RATE	RATE	EROSION
12									
13		1	Hazel	BROOKS CK	1	1.35	1.35	67.50	70.20
14		2	Hazel	BROOKS CK	175	1.54	1.54	5.14	8.23
15		3	Hazel	BROOKS CK	14	3.16	3.42	4.68	11.27
16		4	Hazel	BROOKS CK	14	3.16	3.42	4.68	11.27
17		5	Hazel	BROOKS CK	13	6.34	2.47	5.83	14.64
18		6	Hazel	WHITMAN BENCH	29-138	1.71	1.71	4.15	7.57
19		7	Hazel	WHITMAN BENCH	29-138	1.71	1.71	4.15	7.57
20		8	Hazel	BROOKS CK	8	3.98	2.27	20.21	26.46
21		9	Hazel	BROOKS CK	9	0.83	0.42	18.46	19.71
22		10	Hazel	BROOKS CK	29	0.94	0.70	4.17	5.82
23		11	Hazel	BROOKS CK	32	1.71	1.45	3.46	6.62
24		12	Hazel	BROOKS CK	32	1.71	1.45	3.46	6.62
25		13	Hazel	BROOKS CK	13	6.34	2.47	5.83	14.64
26		14	Hazel	BROOKS CK	14	3.16	3.42	4.68	11.27
27		15	Hazel	BROOKS CK	13	6.34	2.47	5.83	14.64
28		16	Hazel	BROOKS CK	14	3.16	3.42	4.68	11.27
29		17	Hazel	BROOKS CK	32	1.71	1.45	3.46	6.62
30		18	Hazel	BROOKS CK	29	0.94	0.70	4.17	5.82
31		19	Hazel	BROOKS CK	32	1.71	1.45	3.46	6.62
32		20	Hazel	BROOKS CK	29	0.94	0.70	4.17	5.82
33		21	Hazel	BROOKS CK	9	0.83	0.42	18.46	19.71
34		22	Hazel	BROOKS CK	22	0.74	0.74	0.22	1.69
35		23	Hazel	BROOKS CK	32	1.71	1.45	0.17	3.33
36		24	Hazel	BROOKS CK	29	0.94	0.70	4.17	5.82
37		25	Hazel	BROOKS CK	29	0.94	0.70	4.17	5.82
38		26	Hazel	BROOKS CK	28	3.22	3.22	0.13	6.57
39		27	Hazel	BROOKS CK	32	1.71	1.45	0.87	4.03
40		28	Hazel	BROOKS CK	28	2.78	3.17	2.79	8.73
41		29	Hazel	BROOKS CK	29	0.94	0.70	4.17	5.82
42		30	Hazel	BROOKS CK	29	0.94	0.70	4.17	5.82
43		31	Hazel	ROLLINS CK	138	1.64	1.64	4.22	7.51
44		32	Hazel	BROOKS CK	32	1.71	1.45	3.46	6.62
45		33	Hazel	BROOKS CK	32	1.71	1.45	3.46	6.62
46		34	Hazel	BROOKS CK	32	1.71	1.45	0.17	3.33
47		35	Hazel	BROOKS CK	32	1.71	1.45	3.46	6.62
48		36	Hazel	BROOKS CK	36	0.70	0.49	0.68	1.87
49		37	Hazel	BROOKS CK	36	0.70	0.49	0.68	1.87
50		38	Hazel	BROOKS CK	245	0.32	0.39	0.06	0.77
51		39	Hazel	BROOKS CK	36	0.70	0.49	0.03	1.22
52		40	Hazel	BROOKS CK	245	0.32	0.39	0.06	0.77
53		41	Hazel	BROOKS CK	245	0.32	0.39	0.06	0.77
54		42	Hazel	BROOKS CK	36	0.70	0.49	0.03	1.22
55		43	Hazel	BROOKS CK	36	0.70	0.49	0.68	1.87
56		44	Hazel	BROOKS CK	36	0.70	0.49	0.03	1.22
57		45	Hazel	ROLLINS CK	242	0.52	0.46	0.05	1.03
58		46	Hazel	ROLLINS CK	245	0.32	0.39	0.06	0.77
59		47	Hazel	ROLLINS CK	245	0.32	0.39	0.06	0.77
60		48	Hazel	ROLLINS CK	245	0.32	0.39	0.06	0.77
61		49	Hazel	ROLLINS CK	245	0.32	0.39	0.06	0.77
62		50	Hazel	ROLLINS CK	242	0.52	0.46	0.05	1.03
63		51	Hazel	ROLLINS CK	245	0.32	0.39	0.06	0.77

PART V: HAZEL WAU FORMB-4.XLS
Surface Erosion Module
Form B-4.1 "Surface Erosion Summary"

	A	B	C	D	E	F	G	H	I
6									
7								SURFACE/	
8								TRAFFIC	ROAD
9						CUTSLOPE	FILLSLOPE	TREAD	PRISM
10		ROAD			ROAD	EROSION	EROSION	EROSION	TOTAL
11		SEGMENT	WAU	SUBBASIN	"TYPE"	RATE	RATE	RATE	EROSION
64		52	Hazel	BROOKS CK	242	0.52	0.46	0.05	1.03
65		53	Hazel	ROLLINS CK	245	0.32	0.39	0.06	0.77
66		54	Hazel	BROOKS CK	36	0.70	0.49	0.68	1.87
67		55	Hazel	BROOKS CK	36	0.70	0.49	0.68	1.87
68		56	Hazel	BROOKS CK	250	1.80	1.20	2.67	5.67
69		57	Hazel	BROOKS CK	36	0.70	0.49	0.68	1.87
70		58	Hazel	ROLLINS CK	242	0.52	0.46	0.05	1.03
71		59	Hazel	BROOKS CK	36	0.70	0.49	0.68	1.87
72		60	Hazel	WHITMAN BENCH	60	1.41	1.41	35.48	38.30
73		61	Hazel	WHITMAN BENCH	61	4.15	3.60	3.38	11.14
74		62	Hazel	WHITMAN BENCH	60	1.41	1.41	35.48	38.30
75		63	Hazel	WHITMAN BENCH	63	1.71	1.71	8.21	11.62
76		64	Hazel	WHITMAN BENCH	63	1.71	1.71	8.21	11.62
77		65	Hazel	WHITMAN BENCH	63	1.71	1.71	8.21	11.62
78		66	Hazel	WHITMAN BENCH	63	1.71	1.71	8.21	11.62
79		67	Hazel	WHITMAN BENCH	63	1.71	1.71	8.21	11.62
80		68	Hazel	WHITMAN BENCH	63	1.71	1.71	8.21	11.62
81		69	Hazel	WHITMAN BENCH	71	1.62	1.62	8.40	11.64
82		70	Hazel	WHITMAN BENCH	63	1.71	1.71	8.21	11.62
83		71	Hazel	WHITMAN BENCH	71	1.62	1.62	8.40	11.64
84		72	Hazel	WHITMAN BENCH	60	1.41	1.41	35.48	38.30
85		73	Hazel	ROLLINS CK	125	1.59	3.81	24.00	29.40
86		74	Hazel	ROLLINS CK	83	1.62	1.62	8.40	11.64
87		75	Hazel	WHITMAN BENCH	63	1.71	1.71	8.21	11.62
88		76	Hazel	WHITMAN BENCH	63	1.71	1.71	8.21	11.62
89		77	Hazel	WHITMAN BENCH	63	1.71	1.71	8.21	11.62
90		78	Hazel	ROLLINS CK	242	0.52	0.46	0.05	1.03
91		79	Hazel	WHITMAN BENCH	63	1.71	1.71	8.21	11.62
92		80	Hazel	WHITMAN BENCH	61	4.15	3.60	3.38	11.14
93		81	Hazel	WHITMAN BENCH	60	1.41	1.41	35.48	38.30
94		82	Hazel	ROLLINS CK	83	1.62	1.62	8.40	11.64
95		83	Hazel	ROLLINS CK	83	1.62	1.62	8.40	11.64
96		84	Hazel	ROLLINS CK	83	1.62	1.62	0.42	3.66
97		85	Hazel	BROOKS CK	9	0.83	0.42	18.46	19.71
98		86	Hazel	ROLLINS CK	83	1.62	1.62	8.40	11.64
99		87	Hazel	WHITMAN BENCH	63	1.71	1.71	8.21	11.62
100		88	Hazel	WHITMAN BENCH	63	1.71	1.71	8.21	11.62
101		89	Hazel	WHITMAN BENCH	61	4.32	3.51	0.17	8.00
102		90	Hazel	WHITMAN BENCH	63	1.71	1.71	8.21	11.62
103		91	Hazel	WHITMAN BENCH	63	1.71	1.71	8.21	11.62
104		92	Hazel	WHITMAN BENCH	63	1.71	1.71	8.21	11.62
105		93	Hazel	WHITMAN BENCH	175	1.54	1.54	5.14	8.23
106		94	Hazel	WHITMAN BENCH	63	1.71	1.71	8.21	11.62
107		95	Hazel	WHITMAN BENCH	63	1.71	1.71	8.21	11.62
108		96	Hazel	WHITMAN BENCH	63	1.71	1.71	8.21	11.62
109		97	Hazel	WHITMAN BENCH	71	1.62	1.62	0.42	3.66
110		98	Hazel	WHITMAN BENCH	175	1.54	1.54	5.14	8.23
111		99	Hazel	ROLLINS CK	83	1.62	1.62	8.40	11.64
112		100	Hazel	ROLLINS CK	83	1.62	1.62	8.40	11.64
113		101	Hazel	ROLLINS CK	83	1.62	1.62	8.40	11.64
114		102	Hazel	ROLLINS CK	83	1.62	1.62	8.40	11.64
115		103	Hazel	ROLLINS CK	125	1.59	3.81	24.00	29.40
116		104	Hazel	BROOKS CK	8	3.96	2.27	20.21	26.46
117		105	Hazel	BROOKS CK	124	2.40	2.00	28.44	32.84
118		106	Hazel	BROOKS CK	71	1.62	1.62	8.40	11.64
119		107	Hazel	BROOKS CK	71	1.62	1.62	8.40	11.64

PART V: HAZEL WAU FORMB-4.XLS
Surface Erosion Module
Form B-4.1 "Surface Erosion Summary"

	A	B	C	D	E	F	G	H	I
5									
6									
7								SURFACE/	
8								TRAFFIC	ROAD
9						CUTSLOPE	FILLSLOPE	TREAD	PRISM
10		ROAD			ROAD	EROSION	EROSION	EROSION	TOTAL
11		SEGMENT	WAU	SUBBASIN	"TYPE"	RATE	RATE	RATE	EROSION
120		108	Hazel	BROOKS CK	14	3.16	3.42	4.68	11.27
121		109	Hazel	ROLLINS CK	83	1.62	1.62	8.40	11.64
122		110	Hazel	WHITMAN BENCH	61	4.15	3.60	3.38	11.14
123		111	Hazel	WHITMAN BENCH	29-138	1.71	1.71	4.15	7.57
124		112	Hazel	ROLLINS CK	83	1.62	1.62	0.42	3.66
125		113	Hazel	ROLLINS CK	125	1.59	3.81	24.00	29.40
126		114	Hazel	BROOKS CK	8	3.98	2.27	20.21	26.46
127		115	Hazel	BROOKS CK	14	3.16	3.42	4.68	11.27
128		116	Hazel	ROLLINS CK	83	1.62	1.62	8.40	11.64
129		117	Hazel	BROOKS CK	29	0.94	0.70	4.17	5.82
130		118	Hazel	BROOKS CK	32	1.71	1.45	3.46	6.62
131		119	Hazel	ROLLINS CK	138	1.64	1.64	4.22	7.51
132		120	Hazel	ROLLINS CK	138	1.64	1.64	4.22	7.51
133		121	Hazel	BROOKS CK	32	1.71	1.45	3.46	6.62
134		122	Hazel	BROOKS CK	29	0.94	0.70	4.17	5.82
135		123	Hazel	BROOKS CK	29	0.94	0.70	4.17	5.82
136		124	Hazel	ROLLINS CK	124	2.40	2.00	28.44	32.84
137		125	Hazel	ROLLINS CK	125	1.59	3.81	24.00	29.40
138		126	Hazel	ROLLINS CK	126	2.25	2.25	28.00	32.50
139		127	Hazel	ROLLINS CK	125	1.59	3.81	24.00	29.40
140		128	Hazel	ROLLINS CK	83	1.62	1.62	8.40	11.64
141		129	Hazel	DICKS CK	131	3.60	2.16	5.60	11.36
142		130	Hazel	ROLLINS CK	83	1.62	1.62	8.40	11.64
143		131	Hazel	DICKS CK	131	3.60	2.16	5.60	11.36
144		132	Hazel	DICKS CK	132	1.16	1.35	0.16	2.67
145		133	Hazel	ROLLINS CK	138	1.64	1.64	4.22	7.51
146		134	Hazel	ROLLINS CK	141	1.54	2.01	0.10	3.65
147		135	Hazel	DICKS CK	141	1.54	2.01	0.10	3.65
148		136	Hazel	ROLLINS CK	141	1.54	2.01	0.10	3.65
149		137	Hazel	DICKS CK	132	1.16	1.35	0.16	2.67
150		138	Hazel	ROLLINS CK	138	1.64	1.64	4.22	7.51
151		139	Hazel	ROLLINS CK	138	1.64	1.64	4.22	7.51
152		140	Hazel	ROLLINS CK	140	2.35	0.83	9.85	13.03
153		141	Hazel	ROLLINS CK	141	1.54	2.01	0.10	3.65
154		142	Hazel	ROLLINS CK	148	2.78	3.84	0.12	6.74
155		143	Hazel	ROLLINS CK	144	3.70	2.08	6.74	12.52
156		144	Hazel	ROLLINS CK	144	3.70	2.08	6.74	12.52
157		145	Hazel	ROLLINS CK	145	4.27	12.30	0.07	16.64
158		146	Hazel	ROLLINS CK	146	4.15	5.18	0.12	9.46
159		147	Hazel	ROLLINS CK	242	0.52	0.46	0.05	1.03
160		148	Hazel	ROLLINS CK	148	2.78	3.84	0.12	6.74
161		149	Hazel	ROLLINS CK	132	1.16	1.35	0.16	2.67
162		150	Hazel	ROLLINS CK	242	0.52	0.46	0.05	1.03
163		151	Hazel	ROLLINS CK	141	1.54	2.01	0.10	3.65
164		152	Hazel	ROLLINS CK	245	0.32	0.39	0.06	0.77
165		153	Hazel	ROLLINS CK	132	1.16	1.35	0.16	2.67
166		154	Hazel	ROLLINS CK	141	1.54	2.01	0.10	3.65
167		155	Hazel	ROLLINS CK	132	1.16	1.35	0.16	2.67
168		156	Hazel	ROLLINS CK	132	1.16	1.35	0.16	2.67
169		157	Hazel	ROLLINS CK	141	1.54	2.01	0.10	3.65
170		158	Hazel	ROLLINS CK	148	2.78	3.84	0.12	6.74
171		159	Hazel	ROLLINS CK	146	4.15	5.18	0.12	9.46
172		160	Hazel	ROLLINS CK	145	4.27	12.30	0.07	16.64
173		161	Hazel	ROLLINS CK	145	4.27	12.30	0.07	16.64
174		162	Hazel	ROLLINS CK	145	4.27	12.30	0.07	16.64
175		163	Hazel	ROLLINS CK	132	1.16	1.35	0.16	2.67

PART V: HAZEL WAU

FORMB-4.XLS

Surface Erosion Module

Form B-4.1 "Surface Erosion Summary"

	A	B	C	D	E	F	G	H	I
5									
6									
7								SURFACE/	
8								TRAFFIC	ROAD
9						CUTSLOPE	FILLSLOPE	TREAD	PRISM
10		ROAD			ROAD	EROSION	EROSION	EROSION	TOTAL
11		SEGMENT	WAU	SUBBASIN	"TYPE"	RATE	RATE	RATE	EROSION
176		164	Hazel	ROLLINS CK	132	1.16	1.35	0.16	2.67
177		165	Hazel	ROLLINS CK	132	1.16	1.35	0.16	2.67
178		166	Hazel	ROLLINS CK	141	1.54	2.01	0.10	3.65
179		167	Hazel	ROLLINS CK	145	4.27	12.30	0.07	16.64
180		168	Hazel	ROLLINS CK	132	1.16	1.35	0.16	2.67
181		169	Hazel	ROLLINS CK	132	1.16	1.35	0.16	2.67
182		170	Hazel	ROLLINS CK	132	1.16	1.35	0.16	2.67
183		171	Hazel	ROLLINS CK	141	1.54	2.01	0.10	3.65
184		172	Hazel	DICKS CK	8-60-125-254-258	2.83	3.09	21.71	27.63
185		173	Hazel	MT HIGGINS	247	6.66	3.51	0.23	10.40
186		174	Hazel	ROLLINS CK	145	4.27	12.30	0.07	16.64
187		175	Hazel	SEGELSEN CK	175	1.54	1.54	5.14	8.23
188		176	Hazel	MT HIGGINS	175	1.54	1.54	5.14	8.23
189		177	Hazel	MT HIGGINS	175	1.54	1.54	5.14	8.23
190		178	Hazel	SEGELSEN CK	178	1.54	1.54	8.57	11.66
191		179	Hazel	SEGELSEN CK	178	1.54	1.54	8.57	11.66
192		180	Hazel	SEGELSEN CK	178	1.54	1.54	8.57	11.66
193		181	Hazel	SEGELSEN CK	178	1.54	1.54	8.57	11.66
194		182	Hazel	SEGELSEN CK	178	1.54	1.54	8.57	11.66
195		183	Hazel	SEGELSEN CK	178	1.54	1.54	8.57	11.66
196		184	Hazel	SEGELSEN CK	178	1.54	1.54	8.57	11.66
197		185	Hazel	SEGELSEN CK	178	1.54	1.54	8.57	11.66
198		186	Hazel	SEGELSEN CK	178	1.54	1.54	8.57	11.66
199		187	Hazel	SEGELSEN CK	178	1.54	1.54	8.57	11.66
200		188	Hazel	SEGELSEN CK	188	41.62	23.78	8.92	74.32
201		189	Hazel	SEGELSEN CK	178	1.54	1.54	8.57	11.66
202		190	Hazel	MT HIGGINS	198-203-230-235-240	7.16	2.09	5.81	15.06
203		191	Hazel	MT HIGGINS	198-203-230-235-240	7.16	2.09	5.81	15.06
204		192	Hazel	MT HIGGINS	198-203-230-235-240	7.16	2.09	5.81	15.06
205		193	Hazel	MT HIGGINS	198-203-230-235-240	7.16	2.09	5.81	15.06
206		194	Hazel	MT HIGGINS	198-203-230-235-240	7.16	2.09	5.81	15.06
207		195	Hazel	MT HIGGINS	198-203-230-235-240	7.16	2.09	5.81	15.06
208		196	Hazel	MT HIGGINS	198-203-230-235-240	7.16	2.09	5.81	15.06
209		197	Hazel	MT HIGGINS	198-203-230-235-240	7.16	2.09	5.81	15.06
210		198	Hazel	MT HIGGINS	198-203-230-235-240	7.16	2.09	5.81	15.06
211		199	Hazel	MT HIGGINS	224-238	8.33	2.70	4.50	15.53
212		200	Hazel	MT HIGGINS	198-203-230-235-240	7.16	2.09	5.81	15.06
213		201	Hazel	MT HIGGINS	198-203-230-235-240	7.16	2.09	5.81	15.06
214		202	Hazel	MT HIGGINS	8-60-125-254-258	2.83	3.09	21.71	27.63
215		203	Hazel	MT HIGGINS	198-203-230-235-240	7.16	2.09	5.81	15.06
216		204	Hazel	MT HIGGINS	198-203-230-235-240	7.16	2.09	5.81	15.06
217		205	Hazel	MT HIGGINS	247	6.66	3.51	0.23	10.40
218		206	Hazel	MT HIGGINS	247	6.66	3.51	0.23	10.40
219		207	Hazel	MT HIGGINS	207	1.71	1.56	9.47	12.74
220		208	Hazel	MT HIGGINS	208	1.50	0.24	3.68	5.42
221		209	Hazel	SEGELSEN CK	209	0.48	0.35	4.29	5.13
222		210	Hazel	SEGELSEN CK	210	2.24	3.67	21.74	27.65
223		211	Hazel	MT HIGGINS	213	3.18	0.00	25.41	28.59
224		212	Hazel	MT HIGGINS	208	1.50	0.24	3.68	5.42
225		213	Hazel	MT HIGGINS	213	3.18	1.91	25.41	30.49
226		214	Hazel	SEGELSEN CK	210	2.24	3.67	21.74	27.65
227		215	Hazel	MT HIGGINS	213	3.18	1.91	25.41	30.49
228		216	Hazel	MT HIGGINS	8-60-125-254-258	2.83	3.09	21.71	27.63
229		217	Hazel	MT HIGGINS	207	1.71	1.56	9.47	12.74
230		218	Hazel	MT HIGGINS	219	0.77	0.77	4.29	5.83
231		219	Hazel	MT HIGGINS	219	0.77	0.77	0.21	1.76

	A	B	C	D	E	F	G	H	I
5									
6									
7								SURFACE/	
8								TRAFFIC	ROAD
9						CUTSLOPE	FILLSLOPE	TREAD	PRISM
10		ROAD			ROAD	EROSION	EROSION	EROSION	TOTAL
11		SEGMENT	WAU	SUBBASIN	"TYPE"	RATE	RATE	RATE	EROSION
232		220	Hazel	MT HIGGINS	219	0.77	0.77	0.21	1.76
233		221	Hazel	MT HIGGINS	219	0.77	0.77	0.21	1.76
234		222	Hazel	MT HIGGINS	250	1.80	1.20	2.67	5.67
235		223	Hazel	MT HIGGINS	250	1.80	1.20	2.67	5.67
236		224	Hazel	MT HIGGINS	224-238	8.33	2.70	4.50	15.53
237		225	Hazel	MT HIGGINS	224-238	8.33	2.70	4.50	15.53
238		226	Hazel	MT HIGGINS	198-203-230-235-240	7.16	2.09	5.81	15.06
239		227	Hazel	MT HIGGINS	198-203-230-235-240	7.16	2.09	5.81	15.06
240		228	Hazel	MT HIGGINS	224-238	8.33	2.70	4.50	15.53
241		229	Hazel	MT HIGGINS	224-238	8.33	2.70	4.50	15.53
242		230	Hazel	MT HIGGINS	198-203-230-235-240	7.16	2.09	5.81	15.06
243		231	Hazel	MT HIGGINS	198-203-230-235-240	7.16	2.09	5.81	15.06
244		232	Hazel	MT HIGGINS	198-203-230-235-240	7.16	2.09	5.81	15.06
245		233	Hazel	MT HIGGINS	198-203-230-235-240	7.16	2.09	5.81	15.06
246		234	Hazel	MT HIGGINS	198-203-230-235-240	7.16	2.09	5.81	15.06
247		235	Hazel	MT HIGGINS	198-203-230-235-240	7.16	2.09	5.81	15.06
248		236	Hazel	MT HIGGINS	198-203-230-235-240	7.16	2.09	5.81	15.06
249		237	Hazel	MT HIGGINS	224-238	8.33	2.70	4.50	15.53
250		238	Hazel	MT HIGGINS	224-238	8.33	2.70	4.50	15.53
251		239	Hazel	MT HIGGINS	198-203-230-235-240	7.16	2.09	5.81	15.06
252		240	Hazel	MT HIGGINS	198-203-230-235-240	7.16	2.09	5.81	15.06
253		241	Hazel	MT HIGGINS	198-203-230-235-240	7.16	2.09	5.81	15.06
254		242	Hazel	MT HIGGINS	242	0.52	0.46	0.05	1.03
255		243	Hazel	MT HIGGINS	242	0.52	0.46	0.05	1.03
256		244	Hazel	MT HIGGINS	242	0.52	0.46	0.05	1.03
257		245	Hazel	MT HIGGINS	245	0.66	0.39	0.06	1.11
258		246	Hazel	MT HIGGINS	246	3.52	1.71	0.11	5.34
259		247	Hazel	MT HIGGINS	247	6.66	3.51	0.23	10.40
260		248	Hazel	MT HIGGINS	242	0.52	0.46	0.90	1.89
261		249	Hazel	MT HIGGINS	242	0.52	0.46	0.90	1.89
262		250	Hazel	MT HIGGINS	250	1.80	1.20	2.67	5.67
263		251	Hazel	MT HIGGINS	224-238	8.33	2.70	4.50	15.53
264		252	Hazel	MT HIGGINS	242	0.52	0.46	0.90	1.89
265		253	Hazel	MT HIGGINS	262	3.93	3.53	3.71	11.17
266		254	Hazel	SEGELSEN CK	254-258	6.34	3.47	18.86	28.67
267		255	Hazel	SEGELSEN CK	178	1.54	1.54	8.57	11.66
268		256	Hazel	SEGELSEN CK	259	2.47	3.70	5.14	11.31
269		257	Hazel	SEGELSEN CK	178	1.54	1.54	8.57	11.66
270		258	Hazel	SEGELSEN CK	254-258	6.34	3.47	18.86	28.67
271		259	Hazel	SEGELSEN CK	259	2.47	3.70	5.14	11.31
272		260	Hazel	SEGELSEN CK	260-263	3.12	3.36	0.24	6.72
273		261	Hazel	SEGELSEN CK	262	3.93	3.53	3.71	11.17
274		262	Hazel	SEGELSEN CK	262	3.93	3.53	3.71	11.17
275		263	Hazel	SEGELSEN CK	260-263	3.12	3.36	0.24	6.72
276		264	Hazel	SEGELSEN CK	264	8.99	2.83	4.00	15.81
277		265	Hazel	SEGELSEN CK	264	8.99	2.83	4.00	15.81
278		266	Hazel	SEGELSEN CK	210	2.20	3.31	23.51	29.02
279		267	Hazel	SEGELSEN CK	144	3.70	2.08	6.74	12.52
280		268	Hazel	SEGELSEN CK	260-263	3.12	3.36	0.24	6.72
281		269	Hazel	SEGELSEN CK	262	3.93	3.53	0.19	7.65
282		270	Hazel	SEGELSEN CK	262	3.93	3.53	0.19	7.65
283		271	Hazel	SEGELSEN CK	260-263	3.12	3.36	0.24	6.72
284		272	Hazel	SEGELSEN CK	260-263	3.12	3.36	0.24	6.72
285		273	Hazel	SEGELSEN CK	260-263	3.12	3.36	0.24	6.72
286		274	Hazel	MT. HIGGINS	260-263	3.12	3.36	0.24	6.72
287		275	Hazel	MT. HIGGINS	242	0.52	0.46	0.05	1.03

PART V: HAZEL WAU FORMB-4.XLS
Surface Erosion Module
Form B-4.1 "Surface Erosion Summary"

	A	B	C	D	E	F	G	H	I
6									
6									
7								SURFACE/	
8								TRAFFIC	ROAD
9						CUTSLOPE	FILLSLOPE	TREAD	PRISM
10		ROAD			ROAD	EROSION	EROSION	EROSION	TOTAL
11		SEGMENT	WAU	SUBBASIN	"TYPE"	RATE	RATE	RATE	EROSION
288		276	Hazel	SEGELSEN CK	250	1.80	1.20	2.67	5.67
289		277	Hazel	SEGELSEN CK	250	1.80	1.20	2.67	5.67
290		278	Hazel	SEGELSEN CK	145	4.27	5.91	1.45	11.63
291		279	Hazel	SEGELSEN CK	145	4.27	5.91	0.07	10.25
292		280	Hazel	SEGELSEN CK	264	8.99	2.83	4.00	15.81
293		281	Hazel	SEGELSEN CK	260-263	3.12	3.36	0.24	6.72
294		282	Hazel	SEGELSEN CK	262	3.93	3.53	3.71	11.17
295		283	Hazel	SEGELSEN CK	262	3.93	3.53	3.71	11.17
296		284	Hazel	SEGELSEN CK	264	8.99	2.83	4.00	15.81
297		285	Hazel	SEGELSEN CK	264	8.99	2.83	4.00	15.81
298		286	Hazel	SEGELSEN CK	250	1.80	1.20	2.67	5.67
299		287	Hazel	SEGELSEN CK	148	2.78	3.84	2.42	9.04
300		288	Hazel	SEGELSEN CK	262	3.93	3.53	3.71	11.17
301		289	Hazel	SEGELSEN CK	250	1.80	1.20	2.67	5.67
302		290	Hazel	SEGELSEN CK	9	0.83	0.42	18.46	19.71
303		291	Hazel	SEGELSEN CK	9	0.83	0.42	18.46	19.71
304		292	Hazel	SEGELSEN CK	32	0.00	1.45	3.46	4.92
305		293	Hazel	SEGELSEN CK	32	1.71	1.45	3.46	6.62
306		294	Hazel	SEGELSEN CK	28	3.22	3.22	2.52	8.96
307		295	Hazel	SEGELSEN CK	148	2.78	3.84	2.42	9.04
308		296	Hazel	SEGELSEN CK	264	8.99	2.83	4.00	15.81
309		297	Hazel	SEGELSEN CK	32	1.71	1.45	3.46	6.62
310		298	Hazel	WHITMAN BENCH	29-138	1.71	1.71	4.15	7.57
311		299	Hazel	WHITMAN BENCH	28	3.22	3.22	2.52	8.96
312		300	Hazel	WHITMAN BENCH	28	3.22	3.22	2.52	8.96
313		301	Hazel	WHITMAN BENCH	29-138	1.71	1.71	4.15	7.57
314		302	Hazel	WHITMAN BENCH	28	3.22	3.22	2.52	8.96
315		303	Hazel	WHITMAN BENCH	29-138	1.71	1.71	4.15	7.57
316		304	Hazel	WHITMAN BENCH	63	1.71	1.71	8.21	11.62
317		305	Hazel	ROLLINS CK	138	1.64	1.64	4.22	7.51
318		306	Hazel	ROLLINS CK	138	1.64	1.64	4.22	7.51
319		307	Hazel	ROLLINS CK	132	1.16	1.35	0.16	2.67
320		308	Hazel	BROOKS CK	124	2.40	2.00	28.44	32.84
321		309	Hazel	ROLLINS CK	245	0.32	0.39	0.06	0.77
322		310	Hazel	ROLLINS CK	146	4.15	5.18	2.48	11.81
323		311	Hazel	MT HIGGINS	198-203-230-235-240	7.16	2.09	5.81	15.06
324		312	Hazel	MT HIGGINS	224-238	8.33	2.70	4.50	15.53
325		313	Hazel	MT HIGGINS	224-238	8.33	2.70	4.50	15.53
326		314	Hazel	MT HIGGINS	224-238	8.33	2.70	4.50	15.53
327		315	Hazel	SEGELSEN CK	175	1.54	1.54	5.14	8.23
328		316	Hazel	SEGELSEN CK	178	1.54	1.54	8.57	11.66
329		317	Hazel	SEGELSEN CK	145	4.27	5.91	0.07	10.25
330		318	Hazel	SEGELSEN CK	264	8.99	2.83	4.00	15.81
331		319	Hazel	SEGELSEN CK	250	1.80	1.20	2.67	5.67
332		320	Hazel	SEGELSEN CK	32	1.71	1.45	3.46	6.62
333		321	Hazel	SEGELSEN CK	178	1.54	1.54	8.57	11.66
334		322	Hazel	SEGELSEN CK	260-263	3.12	3.36	0.24	6.72
335		323	Hazel	ROLLINS CK	138	1.64	1.64	4.22	7.51
336		324	Hazel	MT HIGGINS	124	2.40	2.00	28.44	32.84
337		325	Hazel	WHITMAN BENCH	63	1.71	1.71	8.21	11.62
338		326	Hazel	WHITMAN BENCH	63	1.71	1.71	8.21	11.62
339		327	Hazel	BROOKS CK	124	2.40	2.00	28.44	32.84
340		328	Hazel	ROLLINS CK	83	1.62	1.62	8.40	11.64
341		329	Hazel	BROOKS CK	208-209	1.20	0.32	4.00	5.52
342		330	Hazel	ROLLINS CK	83	1.62	1.62	8.40	11.64

PART IV: HAZEL WAU
Surface Erosion Module
Form B-3.3 "Road Segment Types Disagreement with Reference Road"

	A	B	C	D
1				
2				
3			PRONOUNCED	
4			DISAGREEMENT	
5		ROAD	WITH	
6		"TYPE"	REFERENCE ROAD	
7		1	1,2,3,4,5,6,8	
8		8	2,4,6,7,8	
9		9	1,2,4,5,6,7,8	
10		13	2,4,6,7,8	
11		14	2,4,8	
12		22	1,2,4,5,6,7,8	
13		28	2,4,5,6,7,8	
14		29	1,2,4,5,6,7,8	
15		32	1,2,4,5,7,8	
16		36	2,4,7,8	
17		60	1,2,4,6,5,7,8	
18		61	1,2,4,6,7,8	
19		63	1,2,4,5,7,8	
20		71	1,2,4,5,7,8	
21		83	1,2,4,5,6,7,8	
22		124	2,4,5,7,8	
23		125	2,4,5,6,7,8	
24		126	2,4,5,6,7,8	
25		131	2,4,6,7,8	
26		132	2,4,5,8	
27		138	1,2,4,5,6,7,8	
28		140	1,2,4,5,6,7,8	
29		141	1,2,4,7,8	
30		144	1,2,4,5,8	
31		145	2,5,7,8	
32		146	1,2,5,6,7,8	
33		148	2,4,5,7,8	
34		175	1,2,4,5,6,7,8	
35		178	1,2,4,5,7,8	
36		188	1,2,4,5,6,7,8	
37		207	1,2,4,5,7,8	
38		208	1,2,4,5,7,8	
39		209	2,4,5,7,8	
40		210	1,2,4,5,6,7,8	
41		213	2,4,8	
42		219	1,2,4,5,6,7,8	
43		242	2,5,6,8,	
44		245	1,2,4,5,6,7,8	
45		246	2,5,6,7,8	
46		247	2,5,7,8	
47		250	1,2,4,5,7,8	
48		259	1,2,4,5,6,7,8	
49		262	1,2,4,5,6,7,8	
50		264	1,2,4,6,7,8	
51		198-203-230-235-240	1,2,4,5,6,7,8	
52		208-209	2,4,6,7,8	
53		224-236	1,2,4,5,7	
54		254-258	2,4,5,6,7,8	
55		260-263	1,2,4,6,7,8	
56		29-138	1,2,4,5,6,7,8	
57		8-60-125-254-258	2,4,6,7,8	
58				
59		*NOTES:		DISAGREEMENT
60		REFERENCE NUMBER	DISAGREES W/ REF. ROAD	CRITERIA
61		1	Prism not insloped/Ditched	Other Prism
62		2	Not Native Surfaced	Other Surface
63		3	Traffic not pickups/sedans	Other Traffic
64		4	Not 1:1 cutslope	Cutslope Differs >5 deg.
65		5	Not 1:1.5 fillslope	Fillslope Differs >5 deg.
66		6	Road Slope generally not 5-7%	Slopes gen. not 5-7%
67		7	Average X-drain spacing not 500'	Differ by 50'+-
68		8	Road Prism Area(s) Differs from Ref. Road	Differ >5% any component

PART V: HAZEL WAU
Surface Erosion Module
Form B-4.2 "Road Type Sediment Delivery Rankings"

	A	B	C	D	E	F
1						
2						RANK BY
3				AVERAGE	RANK BY	AVERAGE
4			AVERAGE	DELIVERED	AVERAGE	DELIVERED
5			DELIVERED	SEDIMENT	DELIVERED	SEDIMENT
6		ROAD	SEDIMENT	PER ACRE OF	SEDIMENT	PER ACRE OF
7		"TYPE"	US TONS/YR	ROAD PRISM	US TONS/YR	ROAD PRISM
8		1	14.22	5.27	20	8
9		8	37.58	5.95	10	7
10		9	50.87	4.43	8	10
11		13	0.77	0.36	43	38
12		14	21.11	2.54	16	16
13		22	0.02	0.04	51	51
14		28	4.79	1.65	30	19
15		29	5.64	0.73	27	30
16		32	28.89	1.69	13	18
17		36	10.30	0.31	22	41
18		60	13.38	2.87	21	14
19		61	4.17	0.74	33	29
20		63	2.70	0.29	38	42
21		71	0.34	0.20	48	45
22		83	3.04	0.36	36	39
23		124	61.86	7.91	5	1
24		125	63.84	6.62	4	5
25		126	3.66	7.31	34	3
26		131	0.42	0.28	47	43
27		132	8.26	0.33	25	40
28		138	5.10	0.56	29	37
29		140	8.13	2.93	26	13
30		141	1.04	0.10	41	49
31		144	55.28	2.82	7	15
32		145	59.37	1.65	6	20
33		146	5.31	0.91	28	27
34		148	9.30	0.99	23	26
35		175	8.68	0.62	24	36
36		178	18.19	1.46	18	22
37		188	4.21	1.86	32	17
38		207	4.68	1.59	31	21
39		208	2.67	0.68	39	33
40		209	0.06	0.13	50	48
41		210	2.29	0.70	40	31
42		213	30.53	6.80	12	4
43		219	0.25	0.14	49	47
44		242	2.73	0.17	37	46
45		245	0.72	0.09	45	50
46		246	0.96	0.67	42	35
47		247	28.32	1.30	14	23
48		250	17.49	1.28	19	24
49		259	0.75	0.28	44	44
50		262	90.19	3.37	2	12
51		264	81.40	5.14	3	9
52		198-203-230-235-240	36.03	1.13	11	25
53		208-209	0.48	0.69	46	32
54		224-238	42.50	3.49	9	11
55		254-258	128.55	7.88	1	2
56		260-263	18.30	0.84	17	28
57		29-138	3.43	0.67	35	34
58		8-60-125-254-258	22.34	6.22	15	6

PART [redacted]HAZEL WAU
Surface Erosion Module
Form B-4.3 "Background Sediment Yield Compared to Delivered Road Sediment"

WAU	SUBBASIN	STREAM LENGTH (miles)	STREAM LENGTH (feet)	STREAM LENGTH (meters)	STREAM LENGTH x 2 (m)	SOIL DEPTH (m)	SOIL DEPTH (m)	CREEP RATE (m/yr)
Hazel	BROOKS CK	34.75	183480	55922	111844	2	3	1.00E-03
Hazel	DICKS CK	10.91	57605	17557	35114	2	3	2.00E-03
Hazel	MT HIGGINS	57.56	303917	92629	185259	2	3	2.00E-03
Hazel	ROLLINS CK	30.43	160670	48970	97940	2	3	2.00E-03
Hazel	SEGELSEN CK	30.72	162202	49437	98873	2	3	2.00E-03
Hazel	WHITMAN BENCH	14.03	74078	22578	45156	2	3	1.00E-03

PART V: HAZEL WAU
Surface Erosion Module
Form B-4.3 "Background Sediment Yield Compared to Delivered Road Sediment"

				5 PERCENT			5 PERCENT	5 PERCENT
	BACKGRND	BACKGRND		INCREASED	DELIVERED	DELIVERED	INCREASED	INCREASED
	SEDIMENT	SEDIMENT	ROAD	DELIVERY	SEDIMENT	SEDIMENT	DELIVERY	DELIVERY
BACKGRND	(US tons/yr)	(US tons/yr)	SEDIMENT	ROAD	PERCENT	PERCENT	PERCENT	PERCENT
VOLUME	SOIL DEPTH	SOIL DEPTH	DELIVERED	SEDIMENT	OF BKGRND	OF BKGRND	OF BKGRND	OF BKGRND
(m^3/yr)	2 METERS	3 METERS	(tons)	(tons)	(SOIL 2m)	(SOIL 3m)	(SOIL 2m)	(SOIL 3m)
224	246	369	167	219	68	45	89	59
140	155	232	5	7	3	2	5	3
741	815	1223	165	232	20	13	28	19
392	431	646	139	205	32	22	48	32
395	435	653	379	478	87	58	110	73
90	99	149	18	40	18	12	40	27

	Average	Average	
	Roads %	Roads %	
	of Background	of Background	
	Sediment	Sediment	*FINAL*
	Delivery	Delivery	*HAZARD*
SUBBASIN	with soil 2m	with soil 3m	*RATING*
BROOKS CK	78	52	MODERATE
DICKS CK	4	3	LOW
MT HIGGINS	24	16	LOW
ROLLINS CK	40	27	LOW
SEGELSEN CK	99	66	MODERATE
WHITMAN BENCH	29	20	LOW

C - Hydrologic Change Module

C.1. INTRODUCTION-

The purpose of the hydrologic change module is to develop information required in addressing key questions critical to understanding the hydrologic processes at work within the Hazel Watershed Administrative Unit (WAU). Those key questions include:

What are the current watershed conditions influencing hydrologic response?

What is the history of floods and disturbances of hydrologic significance in the watershed?

What is the influence of land use on the water available for runoff?

What is the effect of changes in water available for runoff on flood peaks?

What are the effects of changes in peak flows on public resources?

The module described herein represents a Level 1 assessment of hydrologic change within the Hazel WAU, with Level 2 work performed for two Hydrologic Analysis Units (HAUs) to resolve "Indeterminate" hazard calls. The Level 1 assessment involves modeling snow accumulation and melt under various combinations of storm intensity and land use. In some cases, local data was used in place of regional empirical relationships in an effort to improve the predictive capability of the rain-on-snow model. Estimates of increases in peak flows associated with forest land use are made from calculated values of water available for runoff; the effects of changes in peak flows are then used to identify potential impacts to public resources.

The Level 2 assessment was performed to resolve uncertainties associated with the results of the Level 1 analysis. Two HAUs received "Indeterminate" hazard calls because modeled increases in peak flows approached or exceeded threshold values. The Level 2 work provided further insight into the potential for increased peak flows due to land use by examining factors which influence hydrologic processes within the basin. The work involved (1) improving estimates of hydrologic maturity based on field measurements, and (2) translating estimated peak flow increases into estimates of critical shear stress.

C.2. CURRENT WATERSHED CONDITION-

C.2.4. Hydrologic Analysis Units - The Hazel WAU consists of 24,830 acres of primarily forested land located approximately 15 miles northeast of Arlington and 10 miles west of Darrington. Elevations range from 200 to 5,200 feet with an average elevation of 1,835 feet. The WAU is made up of a number of small, adjacent watersheds emptying directly into the North Fork Stillaguamish River (Map C-2).

The WAU contains a total of 17 separate and distinct Type 3 stream drainages that are tributary to the North Fork Stillaguamish. Eight of the 17 Type 3 drainages were identified as HAUs. Those include (1) Brooks, (2) Whitman, (3) Rollins, (4) Dicks, (5) Skadulgwas, (6) Higgins, (7) Round, and (8) Segelsen (Map C-2). Focusing the assessment on these eight HAUs eliminated the need to analyze all 17 Type 3 basins. In addition, the eight HAUs are representative of the population of Type 3 basins in terms of elevation range and distribution of canopy cover types, which are the two main factors influencing hydrologic response.

Since the WAU is not a "true" watershed in that it is not a single stream network draining to a common outlet, the WAU was not included as a HAU. Also, no gaging stations have been operated within the WAU, which might have led to the designation of additional HAUs. The proportion of each HAU within each precipitation zone-cover type class is provided on Form C-1 in Appendix C-1.

C.2.1. Climate - The Hazel WAU has a predominantly maritime-type climate, with cool, dry summers, and mild, wet winters influenced by air currents from the Pacific Ocean (Figure C-1). Annual precipitation within the WAU increases rapidly with elevation and is estimated to be near 80 inches along the North Fork Stillaguamish and 110 inches near the summit of Mt. Higgins. Average annual precipitation for the WAU is estimated at 100 inches. Three sources of long-term precipitation data exist near the WAU. Average annual precipitation for each of the three stations is as follows: Arlington = 46.9 inches (n=46); Jim Creek Naval Station = 80.1 inches (n=38); Darrington Ranger Station = 79.9 inches (n=63). An additional source of precipitation data exists at the Washington Department of Fish and Wildlife - Arlington Trout Hatchery. Annual precipitation at that location has averaged 79.4 inches over the 10 year period from 1984-93.

Peak streamflows within the Hazel WAU usually result from storms of high-intensity rainfall during October through March; this runoff is sometimes augmented by water from rapid snowmelt during relatively warm winter storms. These storms, commonly referred to as rain-on-snow events, are the focus of the hydrologic change assessment.

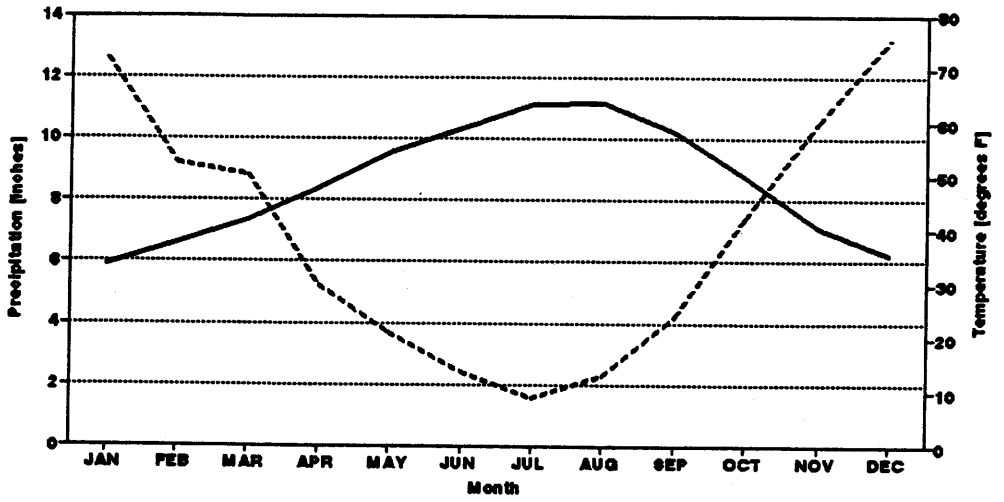


Figure C-1. Average monthly precipitation and temperature for Darrington Ranger Station at Darrington, Washington (1930-91).

C.2.2. Land Use Patterns - Currently, 95% of the WAU is forested (Map C-1). The forests include a variety of conifer and hardwood tree species found in both pure and mixed stands. The remaining 5% of the WAU includes a matrix of agricultural and residential lands along the floodplain of the North Fork Stillaguamish River. Since the early part of the 20th century, forestry has been the dominant land use within the WAU. A chronology of the forest land use was compiled from aerial photos spanning the period 1942-1991. A brief description of that history is provided below.

Brooks Creek- The majority of the area was first logged during the 1920's and 1930's. Second growth timber was harvested at lower and upper elevations during the 1970's. Harvesting of mid-elevation second growth began during the 1980's and continues today.

Whitman Bench- The majority of the area was first logged during the 1920's and 1930's. Logging of the second growth began during the 1980's with only a fraction of mature timber remaining today.

Rollins Creek- The lower and mid-elevations were first logged during the 1920's and 1930's, while harvesting of upper elevation old growth occurred during the 1960's and 1970's. Logging of second growth timber at the lower and mid-elevations began during the 1980's and continues today.

Dicks Creek- The lower and mid-elevations were first logged during the 1920's and 1930's. The upper slopes remain in old growth forest today. No recent harvesting of second growth has occurred at the lower or mid-elevations.

Mt. Higgins- The lower and mid-elevations were first harvested during the 1920's and 1930's. The upper elevations, probably due to extreme steepness, has never been harvested. Lower and mid-elevations have experienced sporadic harvest activity since the 1960's.

Segelsen Creek- The lower elevations were first logged in the 1920's and 1930's. The mid- and upper elevations were logged in the 1960's and 1970's. Scattered small harvests occurred during the 1980's.

C.2.3. Structural Features - The locations of important structural features within the WAU are illustrated on Map C-2. These features include an inactive railroad right-of-way, an inactive railroad bridge, several active county road bridges, and a single active state highway bridge.

C.3. HISTORIC TRENDS IN WATERSHED CONDITION-

C.3.1. Flood History - Annual peak streamflow records from three gaging stations located near the Hazel WAU were obtained from the United States Geological Survey (USGS). The stations include the North Fork Stillaguamish River near Arlington (USGS #12167000), Deer Creek at Oso (USGS #12166500), and Squire Creek near Darrington (USGS #12165000). While the records for both Deer Creek and Squire Creek are relatively short (water years 1918-30 and 1951-69, respectively), the North Fork Stillaguamish gage encompasses a much longer period (water years 1929-93). It was assumed that the peak flow record for these gages is fairly representative of peak flows that have occurred within the Hazel WAU even though the WAU comprises only a small portion ($\sim$15%) of the total drainage area of the North Fork Stillaguamish.

The annual peak flow record for each of the three stations is illustrated in Figure C-2. The results of a Log Pearson Type III flow frequency analysis are superimposed on the annual peak flow record, showing the 2, 5 10, 25, and 50 year flows. The frequency analysis suggests that significant peak flows (>5 year return interval) occurred within the North Fork basin during water years 1918, 1922, 1951, 1956, 1960, 1976, 1980-84, 1986-87, and 1990-91.

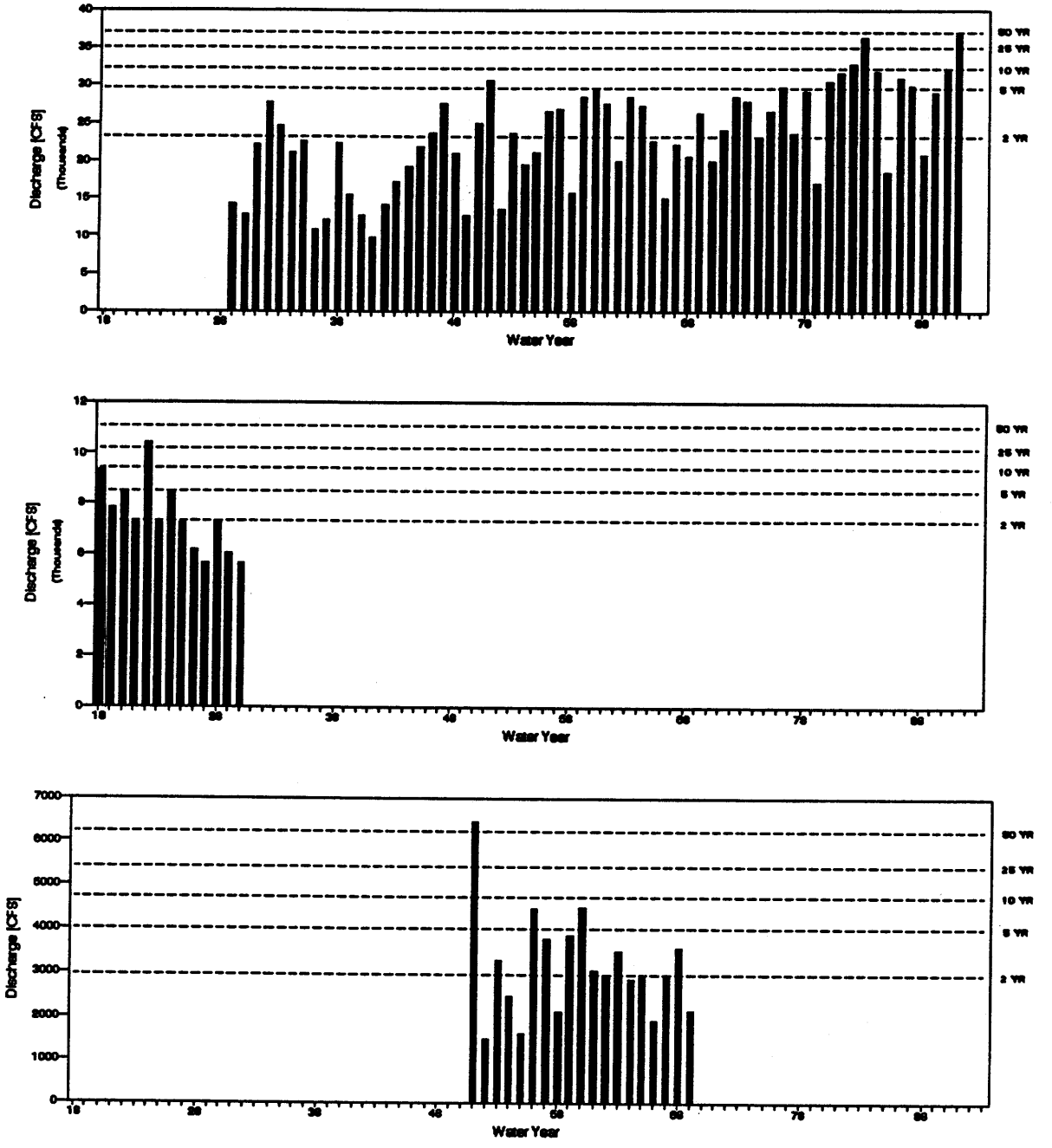


Figure C-2. Instantaneous annual peak flow record for North Fork Stillaguamish River near Arlington (top), Deer Creek at Oso (middle), and Squire Creek near Darrington (bottom). Also shown are the 2, 5, 10, 25, and 50-year flows based on a Log-Pearson Type III flood frequency analysis.

High magnitude annual peak flows within the North Fork basin have occurred more frequently during the last 15 years (Figure C-2), with nine of the 10 largest peak flows on record occurring since water year 1980 (Table C-1). One possible explanation for the recent increase in higher magnitude peaks may be an increased frequency of higher magnitude precipitation events. To test this hypothesis, the rainfall-runoff relationship for the North Fork basin was examined. Precipitation records from the United States Forest Service Ranger Station in Darrington (1931-90) and flow records from the USGS gage on the North Fork Stillaguamish near Arlington (1931-90) were used to construct simple linear regression models of 3-day antecedent precipitation (independent variable) versus annual peak flow (dependent variable). The results suggest the rainfall-peak flow runoff relationship for the North Fork has changed over the 60+ year period of record (Figure C-3). The regression models indicate that for the period 1951-91, a given 3-day antecedent precipitation produced a significantly higher peak flow (30%+) as compared to the same 3-day antecedent precipitation during the period 1929-49. ANOVA results indicate the regression models are statistically significant at the $p = 0.01$ level.

Table C-1. Summary of the ten largest annual peak flows on record for the North Fork Stillaguamish River near Arlington (USGS gage 12167000).

Rank	Water Year	Date	Flow (cfs)
1	1991	24-Nov-90	36,700
2	1983	03-Dec-82	36,300
3	1982	24-Jan-82	32,800
4	1990	05-Dec-89	32,100
5	1984	25-Jan-84	31,800
6	1981	26-Dec-80	31,700
7	1986	19-Jan-86	30,900
8	1951	09-Feb-51	30,600
9	1980	14-Dec-79	30,400
10	1987	23-Nov-86	29,900

Inquires were made to both USGS and Forest Service personnel regarding the quality of data used in the analysis. USGS personnel indicated that the location of the North Fork gaging station had remained unchanged during the period of record and that although several sediment waves had passed the gaging location, the rating curve had been recalibrated on an annual basis. In addition, personnel indicated that the quality of the peak flow records was very good (pers. comm. B. Peck, 1994). USFS personnel indicated that the location of the climate station had remained unchanged, although the adjacent forest vegetation had matured over the years (pers. comm. R. Werthen, 1995).

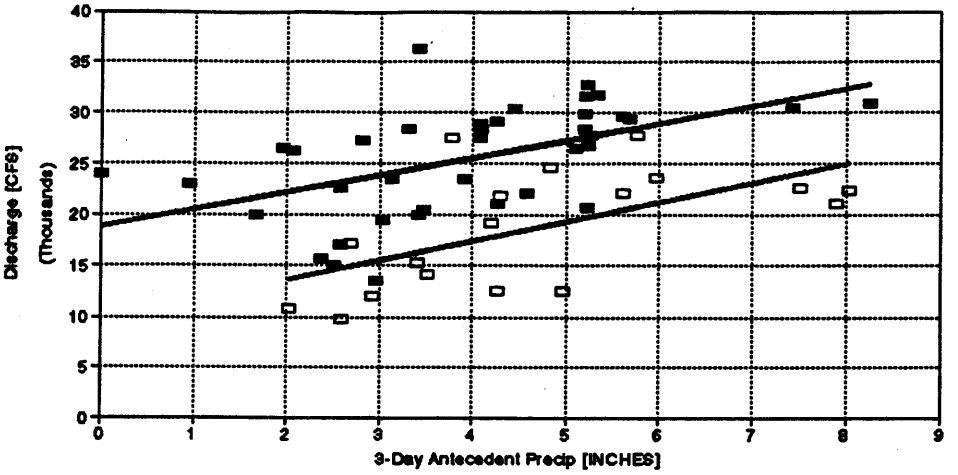


Figure C-3. Linear regression models of 3-day antecedent precipitation (independent variable) and instantaneous peak flow (dependent variable) for the North Fork Stillaguamish watershed for water years 1931-49 (lower line/open squares) and water years 1951-90 (uppper line/closed squares).

In order to more accurately determine if the observed increases in peak flows is attributable to forest land use practices such as timber harvesting and/or road construction, further investigation into the spatial and temporal patterns of forest land use within the North Fork Stillaguamish must be made.

Although not specifically part of the Level 1 hydrologic change assessment of the Hazel WAU, the results of the analysis may have important implications for further investigations into land use-hydrology interactions. Future watershed analysis efforts in the North Fork Stillaguamish should consider the aforementioned information.

C.3.2. Disturbance History - No major disturbances (e.g., fire, insect or disease outbreaks) are known to have occurred within the WAU since the early 1900's.

C.4. WATER AVAILABLE FOR RUNOFF (WAR) AND PEAK FLOWS-

One of the critical questions the hydrologic change module attempts to address involves the effect of land use practices on water available for runoff within the WAU. The approach involves the use of empirical data related to the climate and hydrology of the area to estimate the accumulation and subsequent melt of a "model" snowpack during winter storm conditions. The rate of snow accumulation and melt may be influenced by differences in forest cover; therefore, forest practices such as timber harvesting which alter forest cover may significantly affect the hydrologic regime of the WAU.

A Level 1 hydrologic change assessment was performed as part of the Hazel Watershed Analysis. In some cases, local climate data was used in place of regional empirical equations in an effort to improve the predictive capability of the model. An overview of the model input variables is provided below.

C.4.1. Precipitation - Baseline 24-hour duration precipitation values for the 2-, 5-, 10-, 25-, 50-, and 100-year storm events were obtained from a digital version of the NOAA Precipitation Atlas contained in the Department of Natural Resources' Geographic Information System (GIS). The values represent areally-weighted mean 24-hour precipitation for each precipitation zone (Table C-2).

C.4.2. Snow Accumulation - The Washington Department of Natural Resources Forest Practices Board Manual for conducting Watershed Analysis (hereafter referred to as "Board Manual") proposes the use of a simple linear regression relation to predict average January 1 snow water equivalent (Brunengo, unpublished data). The relation uses mean precipitation zone elevation as the independent predictor variable; regional coefficients are provided which were calculated from a variety of data sources including NOAA climate stations and SCS snow courses throughout the state. Data used to construct the relation for the North Cascades region (Figure C-5 in the Board Manual) was obtained from 42 sites located in Whatcom, Skagit, and Snohomish counties. According to those familiar with local conditions in the area, the Board Manual model probably overpredicts January 1 snow water equivalent at lower elevations. In an effort to improve the model, two linear regression models were constructed; one for elevations below 500 meters and another for elevations between 500 meters and 1,600 meters. Stations above 1,600 meters were not included due to an apparent change in the slope of the regression line above this point. In addition, few, if any WAUs will contain highland precipitation zones with average elevations greater than 1,600 meters.

Table C-2. Baseline information for each HAU used to calcuate water available for runoff.

BASELINE PRECIPITATION (cm) Source: NOAA Atlas

Return Interval	Brooks	Whitman	Rollins	Dicks	Skadulwags	Higgins	Round	Segelsen
2 Year	7.57	6.69	8.68	9.87	8.62	8.47	8.03	8.95
5 Year	8.52	7.72	9.95	11.09	11.23	9.72	9.33	9.92
10 Year	10.00	9.61	11.83	12.48	11.94	9.92	10.13	11.31
25 Year	12.57	12.60	14.07	14.89	14.64	13.79	13.82	14.47
50 Year	13.04	12.78	15.02	16.13	16.50	15.67	15.33	16.16
100 Year	14.53	13.68	16.07	17.84	17.55	16.63	15.98	16.70

MEAN ELEVATION (m) Source: DNR Geographic Information System

Precip Zone	Brooks	Whitman	Rollins	Dicks	Skadulwags	Higgins	Round	Segelsen
Lowland	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Rain-Dom	304	189	305	283	330	261	238	296
R-O-S	678	N/A	696	746	750	682	695	748
Sno-Dom	979	N/A	999	1068	1198	1089	1024	1060
Highland	N/A	N/A	N/A	1250	N/A	1280	1272	1277

The results of constructing a simple linear regression model for each group of data are presented below:

$$SWE_{<500} = -0.2488 + [0.01388 \times ELEV_{<500}];\ R^2 = 0.88,\ SEE = 0.516$$
$$SWE_{>500} = -21.0522 + [0.05567 \times ELEV_{>500}];\ R^2 = 0.48,\ SEE = 17.213$$

where SWE = average January 1 snow water equivalent (cm) and ELEV = elevation (m). Table C-2 provides mean precipitation zone elevations used in the regression models above.

C.4.3. Storm Temperature - The generalized regional lapse rate equation for predicting storm temperature presented in the Board Manual was also modified to more accurately reflect local conditions. Average maximum monthly temperatures for November through February were obtained for six stations in the Skagit River basin. The stations include Sedro-Woolley (record = 63 years), Concrete (record = 63 years), Upper Baker Dam (record = 29 years), Newhalem (record = 34 years), Diablo Dam (record = 63 years), and Ross Dam (record = 33 years). The average monthly maximums for each location were averaged to obtain a winter maximum temperature that reflects the average temperature expected during a rain-on-snow event. The maximum temperatures were regressed against station elevation to obtain a modified lapse rate equation. The results of that regression are as follows:

$$TEMP = 8.14 - (0.0108 \times ELEV);\ R^2 = 0.88,\ SEE = 0.620$$

where TEMP = temperature (degrees Celsius) and ELEV = elevation (meters). Table C-2 provides mean precipitation zone elevations used in the regression model above.

C.4.4. Wind Speed - The Board Manual contains wind speed frequency curves for two locations in western Washington (Olympia Airport and Stampede Pass). However, neither of these stations is in close proximity to the Hazel Watershed Analysis Unit. A more localized source of wind speed data exists approximately 14 miles east of the WAU near the town of Darrington. The Gold Hill Remotely Accessed Weather Station (RAWS) contains approximately five years of winter wind speed data for the period 1985-94. Observations of wind speed during precipitation events (November through March) were extracted from the records. A total of 3699 observations were used to establish a wind speed frequency curve for the Gold Hill RAWS (Figure C-4). Wind speeds measured at.Gold Hill average approximately 1.0 to 2.0 meters/second less than those at Stampede Pass and/or the Olympia Airport.

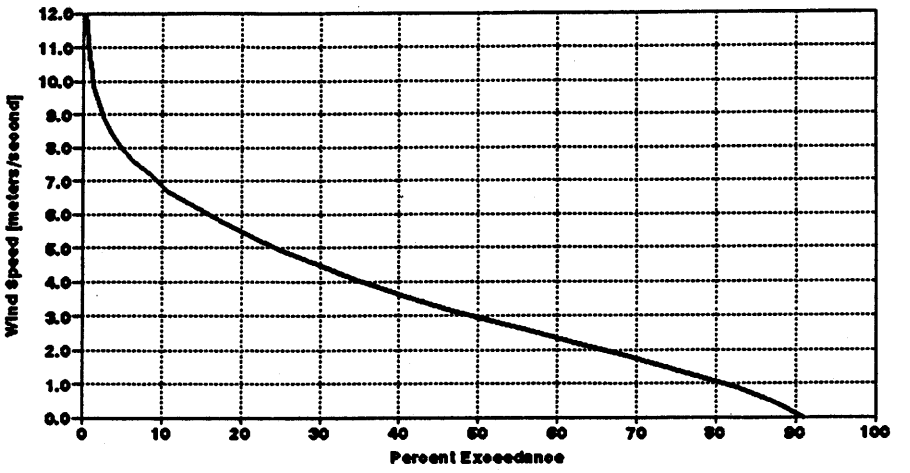


Figure C-4. Wind speed frequency curve for the Gold Hill Remotely Accessed Weather Station (RAWS) near Darrington, Washington. Data represents wind speeds measured during winter precipitation events occuring from 1985-94.

In an effort to validate the wind speed frequency curve, observations of wind speeds during actual storm events were extracted from the Gold Hill RAWS data. Storms were identified through the use of USGS streamflow records for the North Fork Stillaguamish River at Arlington (gage 12167000). The dates of partial duration peak flows were noted; corresponding storm wind speeds from the Gold Hill RAWS were averaged for the 3-day period leading up to and including the day of the peak flow. Wind speeds for 11 storm events averaged 3.5 meters/second and ranged from 1.3 to 6.2 meters/second. The average wind speed of 3.5 meters/second is 0.5 meters/second higher than the average value obtained from the Gold Hill curve (Figure C-4). As a result, the value of 3.5 meters/second was used as the average wind speed in all model runs since it represents actual observations of wind speed during known storm events. The 16% exceedance value of 6.0 meters/second obtained from Figure C-4 was used in the "extreme" storm scenarios.

C.4.5. Results - Values of WAR were calculated for each combination of rainfall recurrence interval (2-, 5-, 10-, 25-, 50- and 100-year), storm type (normal or extreme weather conditions), and vegetative cover scenario (mature forest, current forest cover, or immature forest) for each HAU. Therefore, for each HAU, the model calculates 36 values of WAR (6 recurrence intervals X 2 storm types X 3 vegetative cover scenarios). For each combination of recurrence interval and storm type, the values of WAR under the mature vegetative condition were assumed to represent natural or undisturbed conditions. As a result, relative increases in WAR over mature forest conditions were calculated to determine the effect of forest land use on WAR.

The Board Manual model generates approximately the same amount of additional runoff for all rainfall recurrence intervals. As a result, the 2-year event produces the greatest relative increase in WAR. Percent increases in WAR for the 2-year event provide a baseline for evaluating the hydrologic response to forest land use. Percent increases in WAR for the 2-year recurrence interval are summarized in Table C-3. Results for all recurrence intervals are tabulated on Form C-2, located in Appendix C-2.

Table C-3. Percent increases in WAR for the 2-year precipitation recurrence interval for HAUs within the Hazel Watershed Analysis Unit.

	Storm Type/Vegetative Condition			
HAU	Normal/ Current	Normal/ Immature	Extreme/ Current	Extreme/ Immature
Brooks	6.9	7.8	16.1	18.4
Whitman	12.5	13.0	25.0	26.0
Rollins	3.9	4.7	9.8	11.8
Dicks	2.3	3.6	5.5	9.1
Skadulwags	2.1	4.1	5.8	11.8
Higgins	4.9	6.9	11.0	15.9
Round	3.6	6.2	8.2	14.5
Segelsen	0.6	1.8	2.2	5.5

Under normal storm conditions, increases in WAR ranged from 0.6% to 12.5% for current vegetative conditions and 1.8% to 13.0% for immature vegetative conditions (Table C-3). Extreme storms produced increases in WAR ranging from 2.2% to 25.0% for current vegetative conditions and from 5.5% to 26.0% for immature vegetative conditions (Table C-3). While the average increase in WAR for most of the HAUs was less than 8.0%, values for the Whitman HAU averaged 12.8% under normal storm conditions. The large predicted increases can be attributed to the elevation of the HAU (100% of the HAU is in the rain-dominated precipitation zone) and the high percentage of its area in a hydrologically immature forest condition (68 percent).

The WAR values presented above were subsequently converted into estimates of peak flows. This was done by relating baseline precipitation amounts and baseline peak flows having the same recurrence interval (i.e., the 2-year rainfall yields the 2-year flow). A simple linear regression model was constructed where baseline peak flow estimates (USGS regional equation) were regressed against baseline precipitation estimates (NOAA Atlas). WAR values were substituted into the equation yielding the modified peak flow estimates for each combination of rainfall recurrence interval (2-, 5-, 10-, 25-, 50- and 100-year), storm type

(normal or extreme weather conditions), and vegetative cover scenario (mature forest, current forest cover, or immature forest). The results of the analysis for the 2-year recurrence interval are presented in Table C-4. Results for other return intervals are listed on Form C-3 located in Appendix C-3.

Table C-4. Percent increases in peak flows for the 2-year precipitation recurrence interval for HAUs within the Hazel Watershed Analysis Unit.

	Storm Type/Vegetative Condition			
HAU	Normal/ Current	Normal/ Immature	Extreme/ Current	Extreme/ Immature
Brooks	9.4	10.7	21.2	24.0
Whitman	15.5	16.2	30.3	31.5
Rollins	6.3	7.4	15.1	18.1
Dicks	3.9	6.2	9.0	14.9
Skadulwags	2.6	5.1	6.9	14.2
Higgins	6.6	9.3	14.5	20.9
Round	4.8	8.3	10.7	19.0
Segelsen	0.8	2.3	2.8	7.0

Increases in peak flows for each HAU were similar in magnitude to increases in WAR. Peak flow increases under normal rain-on-snow storm conditions ranged from 0.8% to 15.5% and from 2.3% to 16.2% for current vegetative conditions and fully immature conditions, respectively. Under extreme storm conditions, peak flow increases ranged from 2.8% to 30.3% for current vegetative conditions; fully immature forest cover would be expected to produce increases ranging from 7.0% to 31.5%. Here again, the Whitman HAU showed the largest increases in peak flows (Table C-4).

C.5. POTENTIAL IMPACTS TO PUBLIC RESOURCES-

Increases in peak flows may affect two broad categories of public resources: (1) fish habitat, and (2) public works. Peak flows may affect fish habitat by increasing the frequency and magnitude of bed sediment scour while public works such as roads, bridges, stream channels, and levees may suffer damage from overbank flooding.

C.5.1. Fish Habitat - The Board Manual assumes that the 5-year storm event is sufficient to cause deep bed scour in forest stream channels where fish typically spawn. Fish habitat is considered to be significantly affected when either (1) the shear stress increases substantially,

or (2) the discharge associated with the 5-year event occurs significantly more often. For purposes of this analysis, it is assumed that the latter situation exists when the magnitude of the 2-year event approaches that of the 5-year event. Based on the Log Pearson Type III flood frequency values generated for the various gages located in the North Fork Stillaguamish basin (Figure C-2), the difference between the 2-year and 5-year flows is, on average, approximately 20%. However, results of the USGS flood frequency regression equation indicates that the difference is much larger (47%). Since the Log Pearson estimates of return intervals are based on measured values of local peak flows, 20% was used as the basis for judging changes in the magnitude of the 2-year event.

Table C-4 provides estimates of increases in 2-year peak flows under four combinations of storm intensity and vegetative condition. While none of the HAUs exceed the 20.0% threshold under the normal storm/current vegetation scenario, two HAUs, Brooks and Whitman, show increases of 21.2% and 31.6% respectively, under the extreme storm/current vegetation scenario.

C.5.2. Public Works - While no guidance was provided for determining acceptable levels of change related to peak flows and public works, it was assumed that the percent change between the 50-year and 100-year flows were to be used as the basis for acceptable levels of change. To more accurately determine actual effects on public resources, estimated increases in peak flows must be converted into changes in water level (stage) within the stream channel, which would constitute a Level 2 Analysis. Results of the Log Pearson Type III flood frequency analysis indicates that on average, the difference between the 50-year and 100-year flows is approximately 8.0%. The USGS flood frequency regression equation estimates the difference between the same events to be approximately 13.0%. Since the Log Pearson estimates of return intervals are based on measured values of local peak flows, 8.0% was used as the basis for judging changes in the magnitude of the 50-year event.

Table C-5 provides estimates of increases in 50-year peak flows under four combinations of storm intensity and vegetative condition. Here again, the Brooks and Whitman HAUs show increases in 50-year peak flows which exceed the "threshold" value of 8.0% under extreme storm/current canopy conditions.

Table C-5. Percent increases in peak flows for the 50-year precipitation recurrence interval for HAUs within the Hazel Watershed Analysis Unit.

	Storm Type/Vegetative Condition			
HAU	Normal/ Current	Normal/ Immature	Extreme/ Current	Extreme/ Immature
Brooks	4.9	5.6	12.0	13.5
Whitman	8.1	8.4	16.7	17.4
Rollins	3.0	3.6	7.6	9.1
Dicks	1.9	3.1	4.6	7.7
Skadulwags	1.3	2.5	3.5	7.2
Higgins	3.2	4.6	7.5	10.8
Round	2.3	4.0	5.3	9.5
Segelsen	0.4	1.1	1.4	3.6

C.5.3. Peak Flow Sensitivity Ratings - Each HAU was assigned a peak flow sensitivity rating for both fish habitat and public works based on estimated increases in peak flows. The Board Manual suggests peak flow increases up to 10% have no adverse affects on public resources, and HAUs meeting this criteria are to be assigned a LOW peak flow sensitivity rating. HAUs with peak flow increases which exceed 10% may cause damage to public resources and require a Level 2 analysis if there is an identifiable potential for downstream impacts. HAUs meeting this criteria are assigned an INDETERMINATE peak flow sensitivity rating.

It should be noted that the Board Manual does not identify to which combination of storm intensity/vegetative condition the 10% threshold applies. By using the relative increases in peak flows between the 2- and 5-year events (for fish habitat) and the 50- and 100-year events (for public works) in combination with the 10% Board Manual guideline, a sensitivity rating was established. Throughout the analysis, the Brooks and Whitman HAUs showed the largest increases in peak flows and were therefore assigned **INDETERMINATE** sensitivity ratings. All other HAUs received a **LOW** peak flow sensitivity rating. Level 2 assessment work was performed subsequent to the Level 1 assessment in order to resolve the INDETERMINATE ratings for the Brooks and Whitman HAUs. A description of the methods and results of the Level 2 work follows.

C.6. LEVEL 2 ASSESSMENT-

In order to resolve the Indeterminate sensitivity ratings for the Brooks and Whitman HAUs, a Level 2 Assessment was performed. The Level 2 work consisted of two parts; first, field measurements of canopy density were made to develop a relationship between canopy density and stand age to better estimate hydrologic maturity within each HAU. This resulted from concerns that the LANDSAT imagery underpredicted canopy cover, and thus, hydrologic maturity. Second, channel cross-section data was obtained so that predicted increases in peak flows could be translated into increases in stage. Stage values were then used to estimate shear stress which in turn was used to evaluate bed mobility.

C.6.1. Measurements of Canopy Density-

On February 22, 1995, field measurements of canopy density were made in an effort to more accurately estimate hydrologic maturity in the Brooks and Whitman HAUs. Three stands were visited which ranged from 15 to 60+ years of age. Sample plots were established at two chain (132 feet) intervals along compass transects. Transects were established to minimize any "edge effect" that might exist due to adjacent roads or clearcut harvest units. The results of the sampling are presented below:

Stand Age	Dominant Species	Number of Plots	Average Canopy Density (%)
15	Douglas-fir	12	77
50	Douglas-fir/red alder	10	45
60+	Douglas-fir/hemlock	7	92

Comparison of stand characteristics observable on aerial photographs with LANDSAT classification of maturity suggested that the LANDSAT imagery "underestimated" hydrologic maturity is some cases. The LANDSAT map classified the 15 and 50 year-old stands as hydrologically "immature" and the 60+ year-old stand hydrologically "intermediate". As a result of the field measurements, the 15 and 50 year-old stands were upgraded to hydrologically "intermediate", while the 60+ year-old stand was upgraded to "hydrologically mature". Even though the 15 year-old stand met the 70% canopy density criteria established in the Board Manual, it was not upgraded to "hydrologically mature" because the canopy structure did not exhibit "mature" characteristics (i.e., large branches with deep, well-developed crowns).

Using 1991 aerial photographs, maturity classifications were modified for other stands in the Brooks and Whitman HAUs based on the field information gathered (see Forms C-1a and C-1b). The modifications of hydrologic maturity produced changes in estimates of both water available for runoff (WAR) and peak flows for both the Brooks and Whitman HAUs (see Appendix C-4, Forms C-2a and C-3a). Previously, the 2-year, current canopy condition resulted in estimated peak flow increases of 9.4% and 10.4% for the average storm and extreme storm, respectively in the Brooks HAU. Revisions in hydrologic maturity produced estimated increases of 3.5% and 8.1% for the same storm and canopy conditions. Increases

in peak flows for the Whitman HAU were estimated at 15.5% and 16.2% for the 2-year, current canopy and 2-year, immature canopy conditions. Revised estimates of canopy conditions produced increases of 10.7% and 16.2% for the 2-year, current canopy and 2-year, immature canopy conditions. Assuming the LANDSAT imagery underestimated canopy density for forest stands throughout the WAU, peak flow estimates for other HAUs may also be slightly overestimated.

C.6.2. Estimates of Bed Mobility-

In a separate effort, two sites in Brooks Creek were assessed to estimate how increases in peak flow might affect bed sediment mobility. At each site, channel cross-sectional and longitudinal profiles were inventoried as well as the size distribution of bed sediments. The information gained via the surveys was used to estimate how a 10% increase in streamflow would affect water depth (stage); this information could then be used to estimate the effect on bed sediment mobility via use of a Shield's diagram. The Shield's diagram employs the use of a dimensionless measure of shear stress (τ_*) and the boundary Reynolds number (R_*) to determine the critical particle size (i.e., the particle size that marginally mobile).

C.6.2.1. Methods-

Two survey sites in Brooks Creek were selected for inventory by the channel, fish, and hydrology analysts. The first survey site was located in channel segment 11 (see Map E-1), while the second survey site was located downstream in channel segment 10 (see Map E-1). At each site, the bankfull channel cross-section was surveyed using a Stadia rod and plastic tape. The longitudinal profile upstream and downstream of each cross-section was surveyed using a clinometer and rangefinder. The substrate was inventoried along each channel cross-section; the proportion of cross-section length in each particle size class (e.g., gravel-cobble, cobble-boulder, etc...) was noted. Because this approach to substrate assessment was more qualitative as compared to a pebble count, a measure of the D_{84} for each location was not made. The results of the channel surveys are illustrated in Appendix C-5.

The inventory information was used to estimate the bankfull discharge at each survey location (see calculations in Appendix C-5). The bankfull discharge was then increased by 10% to determine the effect on water depth (stage). In addition, the effect on the dimensionless shear stress (a component of the Shield's equation) was examined. Using this measure, the "critical" particle size (that is, the largest particle size that would be in motion) was back-calculated for a given discharge at each location. This allowed the analyst to determine how variations in discharge affects the "critical" particle size.

C.6.2.2. Results-

The results of the assessment of bed sediment mobility indicate that at the upstream survey location (channel segment 11), the critical particle size increased by 10% when discharge increases by 10%. At the downstream survey location (channel segment 10), the critical particle size increased by 14% with a 10% increase in discharge. These increases are directly proportional to increases in bed shear stress (τ_0). This is because boundary Reynolds

number values above 500 (basically turbulent flow) lead to a constant dimensionless shear stress (0.06) (see Shield's diagram in Appendix C-5).

At the upstream survey site, the critical particle size even under bankfull flow conditions is estimated at 1.14 feet- a particle size well above the "preferred" size for spawning salmon. This means that even under "normal" bankfull flow conditions, significant mobilization of gravel-sized bed sediments is likely to occur at this location. At the downstream site the calculated critical particle size was much smaller (0.37 feet). Here again, under normal bankfull flows, the calculations indicate that smaller sized bed sediments (cobbles and smaller) will be mobilized. While it is important to know what size of sediment is mobilized, the more important question relates to the extent of bed scour. That is "how does bed scour relate to discharge at a given channel location?" Because there is very little research that has been done in this arena, the question is largely unanswerable at this time.

C.7. PEAK FLOW SENSITIVITY RATINGS

Based on the rain-on-snow model results following the incorporation of revised canopy density measurements, the assessment of bed sediment mobility, and field checks of channel condition, the original **INDETERMINATE** peak flow sensitivity ratings for the Brooks and Whitman HAUs were revised to **LOW**. As a result, all HAUs received **LOW** peak flow sensitivity ratings.

C.8. CONFIDENCE IN THE ASSESSMENT

My confidence in the hydrologic change assessment of the Hazel WAU must be separated into distinct groupings. I have fairly HIGH confidence that the values used for the various input parameters (i.e., wind speed, temperature, etc...) reflect those that one might encounter during actual rain-on-snow events in the North Cascades. Similarly, I have HIGH confidence that the calculations of WAR and peak flow were performed correctly. However, due to the many assumptions and generalizations that are part of the module, I have LOW to MODERATE confidence that the numbers generated by the model truly reflect the effects of timber harvesting on rain-on-snow peak flows. In order to more accurately model rain-on-snow effects, a routing component should be incorporated into the model to reflect variations in such things as soils, topography, aspect, and forest roads. With regard to the Level 2 work, I have HIGH confidence that the revised estimates of canopy density reflect actual measures. However, due to the large amount of variability in streamflow and sediment transport estimates, I have only MODERATE confidence in the estimates of bed sediment mobility.

Appendix C-1

FORM C-1 - BASIN ACREAGE BY PRECIPITATION ZONE AND LAND USE/COVER TYPE

Hydrologic Analysis Unit: BROOKS

	Lowland	Rain Dominated	Rain On Snow	Snow Dominated	Highland	Total
Hydrologically Mature	0	12	0	0	0	12
Intermediate Maturity	0	691	733	38	0	1,462
Hydrologically Immature	0	1,948	568	210	0	2,726
Total Forested	0	2,651	1,301	248	0	4,200
Non-Forested Urban	0	0	0	0	0	0
Non-Forested Agriculture	0	264	0	0	0	264
Non-Forested Open Water	0	0	0	0	0	0
Non-Forested Other	0	0	0	0	0	0
Total Non-Forested	0	264	0	0	0	264
Total	0	2,915	1,301	248	0	4,464

FORM C-1 - BASIN ACREAGE BY PRECIPITATION ZONE AND LAND USE/COVER TYPE

Hydrologic Analysis Unit: WHITMAN

	Lowland	Rain Dominated	Rain On Snow	Snow Dominated	Highland	Total
Hydrologically Mature	0	0	0	0	0	0
Intermediate Maturity	0	48	0	0	0	48
Hydrologically Immature	0	359	0	0	0	359
Total Forested	0	407	0	0	0	407
Non-Forested Urban	0	0	0	0	0	0
Non-Forested Agriculture	0	119	0	0	0	119
Non-Forested Open Water	0	0	0	0	0	0
Non-Forested Other	0	0	0	0	0	0
Total Non-Forested	0	119	0	0	0	119
Total	0	526	0	0	0	526

FORM C-1 - BASIN ACREAGE BY PRECIPITATION ZONE AND LAND USE/COVER TYPE

Hydrologic Analysis Unit: ROLLINS

	Lowland	Rain Dominated	Rain On Snow	Snow Dominated	Highland	Total
Hydrologically Mature	0	0	84	323	0	407
Intermediate Maturity	0	849	398	35	0	1,282
Hydrologically Immature	0	773	629	872	0	2,274
Total Forested	0	1,622	1,111	1,230	0	3,963
Non-Forested Urban	0	0	0	0	0	0
Non-Forested Agriculture	0	684	0	0	0	684
Non-Forested Open Water	0	0	0	0	0	0
Non-Forested Other	0	0	110	232	0	342
Total Non-Forested	0	684	110	232	0	1,026
Total	0	2,306	1,221	1,462	0	4,989

FORM C-1 - BASIN ACREAGE BY PRECIPITATION ZONE AND LAND USE/COVER TYPE

Hydrologic Analysis Unit: DICKS

	Lowland	Rain Dominated	Rain On Snow	Snow Dominated	Highland	Total
Hydrologically Mature	0	112	184	567	199	1,062
Intermediate Maturity	0	436	117	70	0	623
Hydrologically Immature	0	217	0	35	3	255
Total Forested	0	765	301	672	202	1,940
Non-Forested Urban	0	0	0	0	0	0
Non-Forested Agriculture	0	58	0	0	0	58
Non-Forested Open Water	0	0	0	0	0	0
Non-Forested Other	0	0	28	11	0	39
Total Non-Forested	0	58	28	11	0	97
Total	0	823	329	683	202	2,037

FORM C-1 - BASIN ACREAGE BY PRECIPITATION ZONE AND LAND USE/COVER TYPE

Hydrologic Analysis Unit: SKADULWAGS

	Lowland	Rain Dominated	Rain On Snow	Snow Dominated	Highland	Total
Hydrologically Mature	0	104	115	3	0	222
Intermediate Maturity	0	61	82	10	0	153
Hydrologically Immature	0	72	41	75	0	188
Total Forested	0	237	238	88	0	563
Non-Forested Urban	0	0	0	0	0	0
Non-Forested Agriculture	0	34	0	0	0	34
Non-Forested Open Water	0	0	0	0	0	0
Non-Forested Other	0	0	0	0	0	0
Total Non-Forested	0	34	0	0	0	34
Total	0	271	238	88	0	597

FORM C-1 - BASIN ACREAGE BY PRECIPITATION ZONE AND LAND USE/COVER TYPE

Hydrologic Analysis Unit: HIGGINS

	Lowland	Rain Dominated	Rain On Snow	Snow Dominated	Highland	Total
Hydrologically Mature	0	130	33	55	15	233
Intermediate Maturity	0	152	161	73	1	387
Hydrologically Immature	0	335	17	0	1	353
Total Forested	0	617	211	128	17	973
Non-Forested Urban	0	0	0	0	0	0
Non-Forested Agriculture	0	59	0	0	0	59
Non-Forested Open Water	0	0	0	0	0	0
Non-Forested Other	0	0	5	0	0	5
Total Non-Forested	0	59	5	0	0	64
Total	0	676	216	128	17	1,037

FORM C-1 - BASIN ACREAGE BY PRECIPITATION ZONE AND LAND USE/COVER TYPE

Hydrologic Analysis Unit: ROUND

	Lowland	Rain Dominated	Rain On Snow	Snow Dominated	Highland	Total
Hydrologically Mature	0	270	156	201	114	741
Intermediate Maturity	0	201	83	8	11	303
Hydrologically Immature	0	135	38	27	0	200
Total Forested	0	606	277	236	125	1,244
Non-Forested Urban	0	0	0	0	0	0
Non-Forested Agriculture	0	238	0	0	0	238
Non-Forested Open Water	0	0	0	0	0	0
Non-Forested Other	0	0	67	2	65	134
Total Non-Forested	0	238	67	2	65	372
Total	0	844	344	238	190	1,616

FORM C-1 - BASIN ACREAGE BY PRECIPITATION ZONE AND LAND USE/COVER TYPE

Hydrologic Analysis Unit: SEGELSEN

	Lowland	Rain Dominated	Rain On Snow	Snow Dominated	Highland	Total
Hydrologically Mature	0	256	197	380	118	951
Intermediate Maturity	0	43	77	23	1	144
Hydrologically Immature	0	22	202	662	129	1,015
Total Forested	0	321	476	1,065	248	2,110
Non-Forested Urban	0	0	0	0	0	0
Non-Forested Agriculture	0	93	0	0	0	93
Non-Forested Open Water	0	0	0	0	0	0
Non-Forested Other	0	0	30	128	0	158
Total Non-Forested	0	93	30	128	0	251
Total	0	414	506	1,193	248	2,361

Appendix C-2

HYDROLOGY MODULE SUMMARY:
FORM C-2 : SUMMARY OF WATER AVAILABLE FOR RUNOFF

Hydrologic Analysis Unit: BROOKS

Return Interval	Storm Type	Water Available for Runoff (inches)		
		Fully Mature	Current Condition	Fully Immature
2 Years	Normal	3.36	3.59	3.62
			6.9%	7.8%
2 Years	Extreme	3.75	4.35	4.43
			16.1%	18.4%
5 Years	Normal	3.79	4.02	4.05
			6.1%	6.9%
5 Years	Extreme	4.18	4.78	4.87
			14.4%	16.5%
10 Years	Normal	4.37	4.60	4.63
			5.3%	6.0%
10 Years	Extreme	4.78	5.38	5.46
			12.6%	14.4%
25 Years	Normal	5.42	5.65	5.68
			4.3%	4.8%
25 Years	Extreme	5.85	6.46	6.54
			10.3%	11.8%
50 Years	Normal	5.59	5.82	5.85
			4.2%	4.7%
50 Years	Extreme	6.02	6.63	6.71
			10.0%	11.4%
100 Years	Normal	6.16	6.40	6.43
			3.8%	4.3%
100 Years	Extreme	6.61	7.22	7.30
			9.1%	10.4%

HYDROLOGY MODULE SUMMARY:
FORM C2 - SUMMARY OF WATER AVAILABLE FOR RUNOFF

Hydrologic Analysis Unit: WHITMAN

Return Interval	Storm Type	Water Available for Runoff (inches)		
		Fully Mature	Current Condition	Fully Immature
2 Years	Normal	3.48	3.91	3.93
			12.5%	13.0%
2 Years	Extreme	3.94	4.93	4.97
			25.0%	26.0%
5 Years	Normal	3.92	4.35	4.37
			11.1%	11.5%
5 Years	Extreme	4.39	5.38	5.42
			22.5%	23.4%
10 Years	Normal	4.71	5.15	5.17
			9.2%	9.6%
10 Years	Extreme	5.21	6.20	6.24
			18.9%	19.7%
25 Years	Normal	5.98	6.42	6.43
			7.2%	7.5%
25 Years	Extreme	6.51	7.49	7.53
			15.2%	15.8%
50 Years	Normal	6.06	6.49	6.51
			7.2%	7.4%
50 Years	Extreme	6.59	7.57	7.61
			15.0%	15.6%
100 Years	Normal	6.44	6.88	6.89
			6.7%	7.0%
100 Years	Extreme	6.98	7.96	8.00
			14.1%	14.7%

HYDROLOGY MODULE SUMMARY:
FORM C-2 : SUMMARY OF WATER AVAILABLE FOR RUNOFF

Hydrologic Analysis Unit: ROLLINS

Return Interval	Storm Type	Water Available for Runoff (inches)		
		Fully Mature	Current Condition	Fully Immature
2 Years	Normal	3.80	3.95	3.98
			3.9%	4.7%
2 Years	Extreme	4.09	4.50	4.58
			9.8%	11.8%
5 Years	Normal	4.31	4.46	4.49
			3.4%	4.1%
5 Years	Extreme	4.61	5.02	5.10
			8.7%	10.5%
10 Years	Normal	5.08	5.23	5.26
			2.9%	3.5%
10 Years	Extreme	5.39	5.80	5.88
			7.5%	8.9%
25 Years	Normal	5.99	6.14	6.16
			2.5%	3.0%
25 Years	Extreme	6.32	6.72	6.80
			6.4%	7.6%
50 Years	Normal	6.37	6.52	6.55
			2.3%	2.8%
50 Years	Extreme	6.71	7.11	7.19
			6.0%	7.2%
100 Years	Normal	6.80	6.95	6.97
			2.2%	2.6%
100 Years	Extreme	7.14	7.54	7.62
			5.6%	6.8%

HYDROLOGY MODULE SUMMARY:
FORM C-2 : SUMMARY OF WATER AVAILABLE FOR RUNOFF

Hydrologic Analysis Unit: DICKS

Return Interval	Storm Type	Water Available for Runoff (inches)		
		Fully Mature	Current Condition	Fully Immature
2 Years	Normal	4.22	4.32	4.38
			2.3%	3.6%
2 Years	Extreme	4.47	4.71	4.87
			5.5%	9.1%
5 Years	Normal	4.72	4.81	4.87
			2.1%	3.2%
5 Years	Extreme	4.97	5.21	5.37
			4.9%	8.2%
10 Years	Normal	5.28	5.37	5.43
			1.8%	2.9%
10 Years	Extreme	5.54	5.78	5.94
			4.4%	7.3%
25 Years	Normal	6.25	6.35	6.40
			1.6%	2.4%
25 Years	Extreme	6.52	6.77	6.93
			3.7%	6.2%
50 Years	Normal	6.75	6.85	6.91
			1.4%	2.3%
50 Years	Extreme	7.03	7.28	7.44
			3.5%	5.8%
100 Years	Normal	7.30	7.40	7.45
			1.3%	2.1%
100 Years	Extreme	7.59	7.83	7.99
			3.2%	5.3%

HYDROLOGY MODULE SUMMARY:
FORM C2 - SUMMARY OF WATER AVAILABLE FOR RUNOFF

Hydrologic Analysis Unit: SKADULWAGS

Return Interval	Storm Type	Water Available for Runoff (inches)		
		Fully Mature	Current Condition	Fully Immature
2 Years	Normal	3.75	3.83	3.90
			2.1%	4.1%
2 Years	Extreme	4.08	4.31	4.56
			5.8%	11.8%
5 Years	Normal	4.81	4.89	4.96
			1.7%	3.2%
5 Years	Extreme	5.16	5.39	5.64
			4.6%	9.3%
10 Years	Normal	5.09	5.17	5.25
			1.6%	3.0%
10 Years	Extreme	5.45	5.69	5.93
			4.3%	8.8%
25 Years	Normal	6.18	6.26	6.34
			1.3%	2.5%
25 Years	Extreme	6.56	6.80	7.04
			3.6%	7.3%
50 Years	Normal	6.93	7.01	7.09
			1.2%	2.2%
50 Years	Extreme	7.33	7.57	7.81
			3.2%	6.6%
100 Years	Normal	7.36	7.44	7.51
			1.1%	2.1%
100 Years	Extreme	7.76	8.00	8.24
			3.0%	6.2%

HYDROLOGY MODULE SUMMARY:
FORM C-2 : SUMMARY OF WATER AVAILABLE FOR RUNOFF

Hydrologic Analysis Unit: MT HIGGINS

Return Interval	Storm Type	Water Available for Runoff (inches)		
		Fully Mature	Current Canopy	Fully Immature
2 Years	Normal	3.89	4.08	4.16
			4.9%	6.9%
2 Years	Extreme	4.26	4.73	4.94
			11.0%	15.9%
5 Years	Normal	4.41	4.60	4.68
			4.3%	6.1%
5 Years	Extreme	4.79	5.26	5.47
			9.8%	14.2%
10 Years	Normal	4.49	4.68	4.76
			4.2%	6.0%
10 Years	Extreme	4.87	5.34	5.55
			9.6%	13.9%
25 Years	Normal	6.09	6.27	6.35
			3.1%	4.4%
25 Years	Extreme	6.50	6.97	7.18
			7.2%	10.4%
50 Years	Normal	6.86	7.05	7.13
			2.8%	3.9%
50 Years	Extreme	7.29	7.76	7.97
			6.4%	9.3%
100 Years	Normal	7.25	7.44	7.52
			2.6%	3.7%
100 Years	Extreme	7.69	8.16	8.37
			6.1%	8.8%

HYDROLOGY MODULE SUMMARY:
FORM C-2 : SUMMARY OF WATER AVAILABLE FOR RUNOFF

Hydrologic Analysis Unit: ROUND

Return Interval	Storm Type	Water Available for Runoff (inches)		
		Fully Mature	Current Condition	Fully Immature
2 Years	Normal	3.63	3.75	3.85
			3.6%	6.2%
2 Years	Extreme	3.94	4.26	4.51
			8.2%	14.5%
5 Years	Normal	4.16	4.29	4.38
			3.1%	5.4%
5 Years	Extreme	4.48	4.80	5.05
			7.2%	12.8%
10 Years	Normal	4.48	4.61	4.71
			2.9%	5.0%
10 Years	Extreme	4.81	5.13	5.38
			6.7%	11.9%
25 Years	Normal	5.99	6.12	6.22
			2.2%	3.8%
25 Years	Extreme	6.35	6.67	6.92
			5.1%	9.0%
50 Years	Normal	6.61	6.74	6.83
			2.0%	3.4%
50 Years	Extreme	6.98	7.30	7.55
			4.6%	8.2%
100 Years	Normal	6.88	7.00	7.10
			1.9%	3.3%
100 Years	Extreme	7.25	7.57	7.82
			4.4%	7.9%

HYDROLOGY MODULE SUMMARY:
FORM C-2 : SUMMARY OF WATER AVAILABLE FOR RUNOFF

Hydrologic Analysis Unit: SEGELSEN

Return Interval	Storm Type	Water Available for Runoff (inches)		
		Fully Mature	Current Condition	Fully Immature
2 Years	Normal	3.68	3.70	3.74
			0.6%	1.8%
2 Years	Extreme	3.83	3.91	4.04
			2.2%	5.5%
5 Years	Normal	4.06	4.09	4.13
			0.5%	1.6%
5 Years	Extreme	4.22	4.30	4.43
			2.0%	5.0%
10 Years	Normal	4.62	4.64	4.68
			0.5%	1.4%
10 Years	Extreme	4.77	4.86	4.99
			1.7%	4.4%
25 Years	Normal	5.87	5.90	5.94
			0.4%	1.1%
25 Years	Extreme	6.05	6.13	6.26
			1.4%	3.5%
50 Years	Normal	6.55	6.57	6.61
			0.3%	1.0%
50 Years	Extreme	6.72	6.81	6.93
			1.2%	3.1%
100 Years	Normal	6.76	6.78	6.83
			0.3%	1.0%
100 Years	Extreme	6.94	7.02	7.15
			1.2%	3.0%

Appendix C-3

HYDROLOGY MODULE SUMMARY:

FORM C-3 : SUMMARY OF PEAK DISCHARGE ESTIMATES

HYDROLOGIC ANALYSIS UNIT: BROOKS

	Discharge and % Increase for Given Recurrence Intervals											
	2-year		5-year		10-year		25-year		50-year		100-year	
	Disch	% Incr	Disch	% Incr	Disch	% Incr	Disch	% Incr	Disch	% Incr	Disch	% Incr
USGS Equation	987		1454		1673		2017		2359		2670	
+ 1 Std Err	1232		1812		2123		2652		3201		3745	
Log Pearson Estimate												
+ 1 Std Err												
Fully Mature												
+ Normal Storm	1389		1633		1963		2560		2657		2981	
+ Extreme Storm	1610		1855		2196		2805		2902		3237	
Current Condition												
+ Normal Storm	1519	9.4	1764	8.0	2094	6.7	2691	5.1	2788	4.9	3118	4.6
+ Extreme Storm	1952	21.2	2196	18.4	2538	15.5	3152	12.4	3249	12.0	3584	10.7
Fully Immature												
+ Normal Storm	1537	10.7	1781	9.1	2111	7.5	2708	5.8	2805	5.6	3135	5.2
+ Extreme Storm	1997	24.0	2248	21.2	2583	17.6	3197	14.0	3294	13.5	3630	12.1

HYDROLOGY MODULE SUMMARY:

FORM C-3 : SUMMARY OF PEAK DISCHARGE ESTIMATES

HYDROLOGIC ANALYSIS UNIT: WHITMAN

	Discharge and % Increase for Given Recurrence Intervals											
	2-year		5-year		10-year		25-year		50-year		100-year	
	Disch	% Incr	Disch	% Incr	Disch	% Incr	Disch	% Incr	Disch	% Incr	Disch	% Incr
USGS Equation	141		207		244		293		335		379	
+ 1 Std Err	176		258		309		386		455		532	
Log Pearson Estimate												
+ 1 Std Err												
Fully Mature												
+ Normal Storm	225		261		325		428		434		465	
+ Extreme Storm	263		299		365		470		476		508	
Current Condition												
+ Normal Storm	260	15.5	296	13.4	360	10.8	463	8.2	469	8.1	500	7.5
+ Extreme Storm	343	30.3	379	26.6	445	21.8	550	17.0	556	16.7	588	15.7
Fully Immature												
+ Normal Storm	262	16.2	297	14.0	362	11.2	464	8.5	470	8.4	501	7.8
+ Extreme Storm	346	31.5	382	27.7	448	22.7	553	17.6	559	17.4	591	16.3

HYDROLOGY MODULE SUMMARY:

FORM C-3 : SUMMARY OF PEAK DISCHARGE ESTIMATES

HYDROLOGIC ANALYSIS UNIT: ROLLINS

	Discharge and % Increase for Given Recurrence Intervals											
	2-year		5-year		10-year		25-year		50-year		100-year	
	Disch	% Incr	Disch	% Incr	Disch	% Incr	Disch	% Incr	Disch	% Incr	Disch	% Incr
USGS Equation	1170		1726		1985		2395		2808		3181	
+ 1 Std Err	1461		2151		2518		3150		3810		4462	
Log Pearson Estimate												
+ 1 Std Err												
Fully Mature												
+ Normal Storm	1486		1806		2285		2853		3093		3360	
+ Extreme Storm	1669		1995		2482		3059		3303		3575	
Current Condition												
+ Normal Storm	1579	6.3	1900	5.2	2379	4.1	2946	3.3	3186	3.0	3453	2.8
+ Extreme Storm	1921	15.1	2247	12.6	2734	10.2	3311	8.2	3556	7.6	3827	7.1
Fully Immature												
+ Normal Storm	1597	7.4	1917	6.1	2396	4.8	2964	3.9	3204	3.6	3471	3.3
+ Extreme Storm	1971	18.1	2296	15.1	2784	12.2	3361	9.9	3605	9.1	3877	8.4

HYDROLOGY MODULE SUMMARY:

FORM C-3 : SUMMARY OF PEAK DISCHARGE ESTIMATES

HYDROLOGIC ANALYSIS UNIT: DICKS

	Discharge and % Increase for Given Recurrence Intervals											
	2-year		5-year		10-year		25-year		50-year		100-year	
	Disch	% Incr	Disch	% Incr	Disch	% Incr	Disch	% Incr	Disch	% Incr	Disch	% Incr
USGS Equation	544		802		931		1123		1305		1478	
+ 1 Std Err	679		1000		1181		1477		1771		2074	
Log Pearson Estimate												
+ 1 Std Err												
Fully Mature												
+ Normal Storm	710		851		1011		1290		1433		1590	
+ Extreme Storm	780		922		1085		1368		1513		1672	
Current Condition												
+ Normal Storm	738	3.9	878	3.3	1039	2.8	1318	2.2	1461	1.9	1617	1.8
+ Extreme Storm	850	9.0	992	7.6	1155	6.4	1438	5.1	1583	4.6	1742	4.2
Fully Immature												
+ Normal Storm	754	6.2	894	5.1	1055	4.3	1333	3.4	1477	3.1	1633	2.8
+ Extreme Storm	896	14.9	1038	12.6	1201	10.7	1484	8.5	1629	7.7	1788	6.9

HYDROLOGY MODULE SUMMARY:

FORM C-3 : SUMMARY OF PEAK DISCHARGE ESTIMATES

HYDROLOGIC ANALYSIS UNIT: SKADULWAGS

	Discharge and % Increase for Given Recurrence Intervals											
	2-year		5-year		10-year		25-year		50-year		100-year	
	Disch	% Incr	Disch	% Incr	Disch	% Incr	Disch	% Incr	Disch	% Incr	Disch	% Incr
USGS Equation	183		270		317		382		438		497	
+ 1 Std Err	228		336		402		502		595		697	
Log Pearson Estimate												
+ 1 Std Err												
Fully Mature												
+ Normal Storm	247		333		356		444		504		539	
+ Extreme Storm	274		361		385		474		537		571	
Current Condition												
+ Normal Storm	254	2.6	339	2.0	362	1.8	450	1.5	511	1.3	545	1.2
+ Extreme Storm	293	6.9	380	5.3	404	4.9	493	4.0	556	3.5	590	3.3
Fully Immature												
+ Normal Storm	260	5.1	345	3.8	368	3.5	456	2.8	517	2.5	551	2.3
+ Extreme Storm	313	14.2	400	10.8	424	10.1	513	8.2	575	7.2	610	6.8

HYDROLOGY MODULE SUMMARY:

FORM C-3 : SUMMARY OF PEAK DISCHARGE ESTIMATES

HYDROLOGIC ANALYSIS UNIT: HIGGINS

	Discharge and % Increase for Given Recurrence Intervals											
	2-year		5-year		10-year		25-year		50-year		100-year	
	Disch	% Incr	Disch	% Incr	Disch	% Incr	Disch	% Incr	Disch	% Incr	Disch	% Incr
USGS Equation	300		442		516		623		719		814	
+ 1 Std Err	374		551		655		819		976		1143	
Log Pearson Estimate												
+ 1 Std Err												
Fully Mature												
+ Normal Storm	408		481		493		719		828		884	
+ Extreme Storm	461		535		547		778		890		946	
Current Condition												
+ Normal Storm	435	6.6	508	5.6	519	5.4	745	3.7	855	3.2	911	3.0
+ Extreme Storm	527	14.5	602	12.5	614	12.2	844	8.6	956	7.5	1013	7.0
Fully Immature												
+ Normal Storm	446	9.3	519	7.9	531	7.7	757	5.3	866	4.6	922	4.3
+ Extreme Storm	557	20.9	631	18.0	643	17.6	874	12.4	986	10.8	1043	10.2

HYDROLOGY MODULE SUMMARY:

FORM C-3 : SUMMARY OF PEAK DISCHARGE ESTIMATES

HYDROLOGIC ANALYSIS UNIT: ROUND

	Discharge and % Increase for Given Recurrence Intervals											
	2-year		5-year		10-year		25-year		50-year		100-year	
	Disch	% Incr	Disch	% Incr	Disch	% Incr	Disch	% Incr	Disch	% Incr	Disch	% Incr
USGS Equation	440		649		754		911		1055		1195	
+ 1 Std Err	549		808		957		1197		1432		1677	
Log Pearson Estimate												
+ 1 Std Err												
Fully Mature												
+ Normal Storm	1186		1419		1562		2224		2496		2613	
+ Extreme Storm	1324		1561		1707		2381		2657		2777	
Current Condition												
+ Normal Storm	1242	4.8	1476	4.0	1619	3.6	2281	2.5	2553	2.3	2670	2.2
+ Extreme Storm	1465	10.7	1703	9.1	1848	8.3	2522	5.9	2799	5.3	2918	5.1
Fully Immature												
+ Normal Storm	1285	8.3	1518	7.0	1661	6.3	2323	4.4	2595	4.0	2712	3.8
+ Extreme Storm	1575	19.0	1813	16.1	1958	14.7	2632	10.6	2909	9.5	3028	9.1

HYDROLOGY MODULE SUMMARY:

FORM C-3 : SUMMARY OF PEAK DISCHARGE ESTIMATES

HYDROLOGIC ANALYSIS UNIT: SEGELSEN

	Discharge and % Increase for Given Recurrence Intervals											
	2-year		5-year		10-year		25-year		50-year		100-year	
	Disch	% Incr	Disch	% Incr	Disch	% Incr	Disch	% Incr	Disch	% Incr	Disch	% Incr
USGS Equation	616		909		1053		1271		1478		1675	
+ 1 Std Err	770		1133		1336		1671		2006		2350	
Log Pearson Estimate												
+ 1 Std Err												
Fully Mature												
+ Normal Storm	848		964		1128		1504		1704		1768	
+ Extreme Storm	893		1010		1176		1555		1757		1822	
Current Condition												
+ Normal Storm	855	0.8	970	0.7	1135	0.6	1510	0.4	1710	0.4	1774	0.4
+ Extreme Storm	918	2.8	1034	2.4	1200	2.1	1579	1.6	1781	1.4	1846	1.4
Fully Immature												
+ Normal Storm	868	2.3	983	2.0	1148	1.7	1523	1.3	1723	1.1	1787	1.1
+ Extreme Storm	956	7.0	1072	6.2	1238	5.3	1617	4.0	1819	3.6	1884	3.4

Appendix C-4

FORM C-1 - BASIN ACREAGE BY PRECIPITATION ZONE AND LAND USE/COVER TYPE

Hydrologic Analysis Unit: BROOKS

	Lowland	Rain Dominated	Rain On Snow	Snow Dominated	Highland	Total
Hydrologically Mature	0	542	823	45	0	1,410
Intermediate Maturity	0	576	337	94	0	1,007
Hydrologically Immature	0	305	108	109	0	522
Total Forested	0	1,423	1,268	248	0	2,939
Non-Forested Urban	0	0	0	0	0	0
Non-Forested Agriculture	0	39	0	0	0	39
Non-Forested Open Water	0	0	0	0	0	0
Non-Forested Other	0	0	0	0	0	0
Total Non-Forested	0	39	0	0	0	39
Total	0	1,462	1,268	248	0	2,978

FORM C-1 - BASIN ACREAGE BY PRECIPITATION ZONE AND LAND USE/COVER TYPE

Hydrologic Analysis Unit: WHITMAN

	Lowland	Rain Dominated	Rain On Snow	Snow Dominated	Highland	Total
Hydrologically Mature	0	80	0	0	0	80
Intermediate Maturity	0	235	0	0	0	235
Hydrologically Immature	0	92	0	0	0	92
Total Forested	0	407	0	0	0	407
Non-Forested Urban	0	0	0	0	0	0
Non-Forested Agriculture	0	119	0	0	0	119
Non-Forested Open Water	0	0	0	0	0	0
Non-Forested Other	0	0	0	0	0	0
Total Non-Forested	0	119	0	0	0	119
Total	0	526	0	0	0	526

HYDROLOGY MODULE SUMMARY:
FORM C-2 : SUMMARY OF WATER AVAILABLE FOR RUNOFF

Hydrologic Analysis Unit: BROOKS

Return Interval	Storm Type	Water Available for Runoff (inches)		
		Fully Mature	Current Condition	Fully Immature
2 Years	Normal	3.41	3.50	3.62
			2.6%	5.9%
2 Years	Extreme	3.77	4.01	4.35
			6.1%	15.3%
5 Years	Normal	3.80	3.89	4.00
			2.3%	5.3%
5 Years	Extreme	4.17	4.40	4.74
			5.6%	13.8%
10 Years	Normal	4.40	4.49	4.60
			2.0%	4.6%
10 Years	Extreme	4.78	5.02	5.36
			4.9%	12.1%
25 Years	Normal	5.45	5.54	5.65
			1.6%	3.7%
25 Years	Extreme	5.85	6.09	6.43
			4.0%	9.9%
50 Years	Normal	5.64	5.73	5.84
			1.6%	3.6%
50 Years	Extreme	6.05	6.28	6.63
			3.9%	9.6%
100 Years	Normal	6.25	6.33	6.45
			1.4%	3.2%
100 Years	Extreme	6.67	6.90	7.25
			3.5%	8.7%

HYDROLOGY MODULE SUMMARY:
FORM C2 - SUMMARY OF WATER AVAILABLE FOR RUNOFF

Hydrologic Analysis Unit: WHITMAN

Return Interval	Storm Type	Water Available for Runoff (inches)		
		Fully Mature	Current Condition	Fully Immature
2 Years	Normal	3.48	3.78	3.93
			8.5%	13.0%
2 Years	Extreme	3.94	4.62	4.97
			17.1%	26.0%
5 Years	Normal	3.92	4.21	4.37
			7.6%	11.5%
5 Years	Extreme	4.39	5.07	5.42
			15.4%	23.4%
10 Years	Normal	4.71	5.01	5.17
			6.3%	9.6%
10 Years	Extreme	5.21	5.89	6.24
			13.0%	19.7%
25 Years	Normal	5.98	6.28	6.43
			5.0%	7.5%
25 Years	Extreme	6.51	7.18	7.53
			10.4%	15.8%
50 Years	Normal	6.06	6.36	6.51
			4.9%	7.4%
50 Years	Extreme	6.59	7.26	7.61
			10.3%	15.6%
100 Years	Normal	6.44	6.74	6.89
			4.6%	7.0%
100 Years	Extreme	6.98	7.65	8.00
			9.7%	14.7%

HYDROLOGY MODULE SUMMARY:

FORM C-3 : SUMMARY OF PEAK DISCHARGE ESTIMATES

HYDROLOGIC ANALYSIS UNIT: BROOKS

	Discharge and % Increase for Given Recurrence Intervals											
	2-year		5-year		10-year		25-year		50-year		100-year	
	Disch	% Incr	Disch	% Incr	Disch	% Incr	Disch	% Incr	Disch	% Incr	Disch	% Incr
USGS Equation	757		1117		1290		1557		1816		2057	
+ 1 Std Err	945		1391		1637		2048		2464		2886	
Log Pearson Estimate												
+ 1 Std Err												
Fully Mature												
+ Normal Storm	1093		1262		1527		1987		2070		2336	
+ Extreme Storm	1251		1423		1694		2165		2250		2522	
Current Condition												
+ Normal Storm	1132	3.5	1300	3.1	1565	2.5	2026	1.9	2109	1.9	2375	1.6
+ Extreme Storm	1353	8.1	1525	7.2	1797	6.0	2267	4.7	2352	4.5	2624	4.1
Fully Immature												
+ Normal Storm	1182	8.1	1350	7.0	1616	5.8	2076	4.5	2159	4.3	2425	3.8
+ Extreme Storm	1505	20.2	1677	17.8	1948	15.0	2419	11.7	2504	11.3	2776	10.1

HYDROLOGY MODULE SUMMARY:

FORM C-3 : SUMMARY OF PEAK DISCHARGE ESTIMATES

HYDROLOGIC ANALYSIS UNIT: WHITMAN

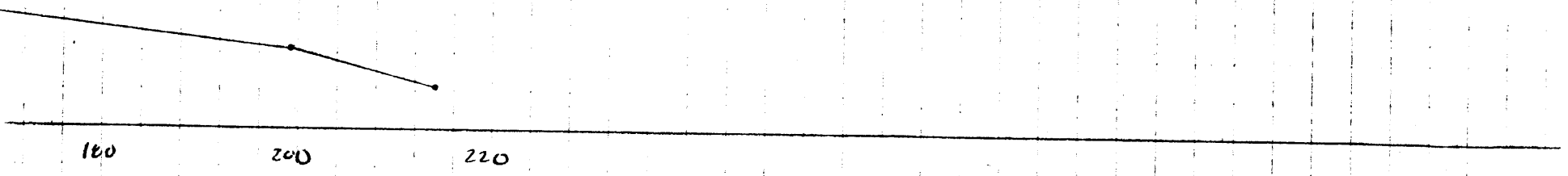
	Discharge and % Increase for Given Recurrence Intervals											
	2-year		5-year		10-year		25-year		50-year		100-year	
	Disch	% Incr	Disch	% Incr	Disch	% Incr	Disch	% Incr	Disch	% Incr	Disch	% Incr
USGS Equation	141		207		244		293		335		379	
+ 1 Std Err	176		258		309		386		455		532	
Log Pearson Estimate												
+ 1 Std Err												
Fully Mature												
+ Normal Storm	225		261		325		428		434		465	
+ Extreme Storm	263		299		365		470		476		508	
Current Condition												
+ Normal Storm	249	10.7	285	9.2	349	7.4	452	5.6	458	5.5	489	5.2
+ Extreme Storm	318	20.8	354	18.3	420	15.0	525	11.6	531	11.5	563	10.8
Fully Immature												
+ Normal Storm	262	16.2	297	14.0	362	11.2	464	8.5	470	8.4	501	7.8
+ Extreme Storm	346	31.5	382	27.7	448	22.7	553	17.6	559	17.4	591	16.3

Appendix C-5

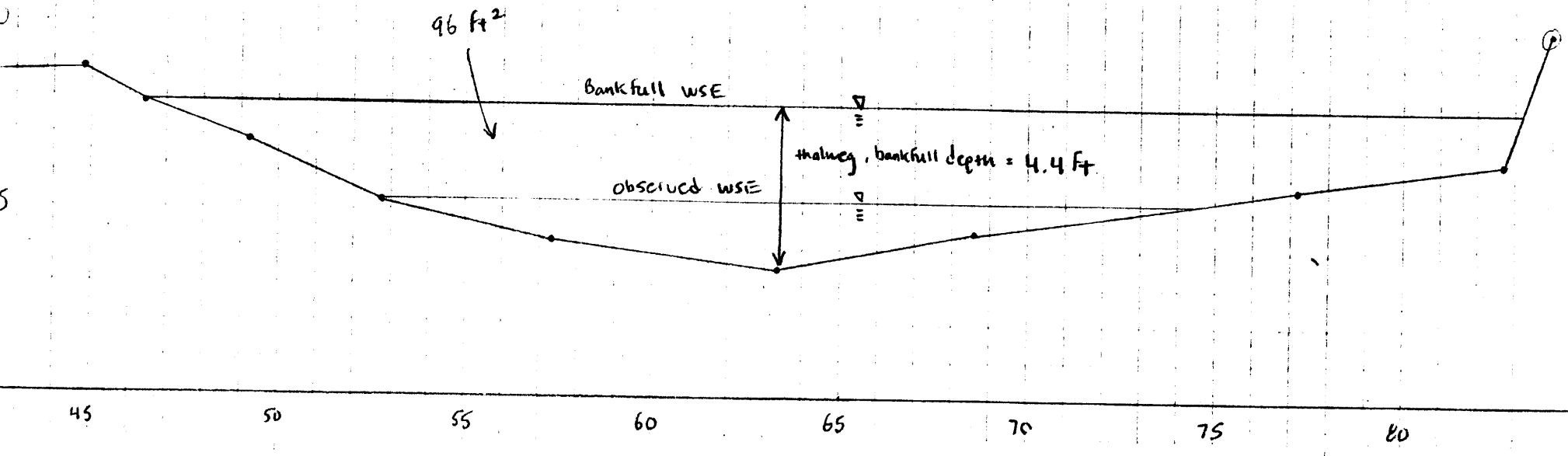
$\frac{\text{rise}}{\text{run}} = \frac{8.9}{214.4} = 0.04$ or 4% slope (entire profile)

Upstream Brooks X-Section

Channel Segment 11



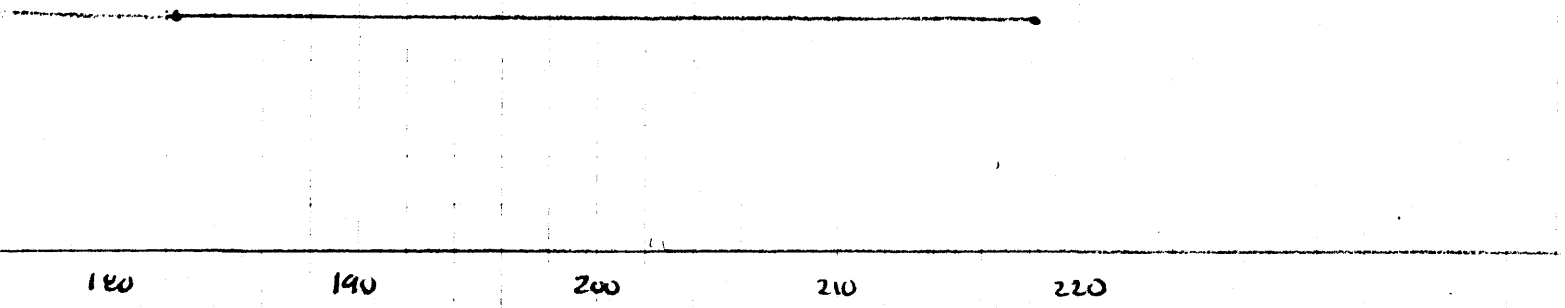
C | B-C | G-C | B-C | C-G | B-C | B | G-C | B-C | C-G | clay |

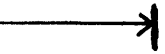


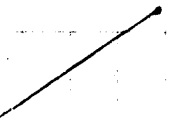
(feet)

Downstream Brooks X-Section

Channel Segment 10

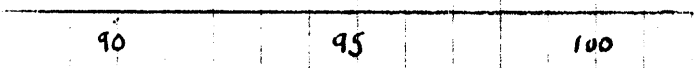






W_B = 84 Ft.

R = 1.3



Upstream Cross Section / Channel Segment 11

Area (A) = 100 ft^2
Slope (S) = 0.06 ft/ft
Mannings n (n) = 0.09
Hydraulic Radius (R) = 2.0 ft

Mannings Eqn:

$$V = \frac{k}{n} R^{2/3} S^{1/2}$$

$$= \frac{1.486}{0.09} (2.0^{2/3})(0.06^{1/2})$$

$$= 6.4 \text{ ft/sec}$$

$$Q \text{ (discharge)} = V \cdot A$$

$$= (6.4 \text{ ft/sec})(100 \text{ ft}^2)$$

$$= \underline{640 \text{ ft}^3/\text{sec}}$$

Objective - Determine how a 10% increase in discharge affects stage.

Q = 640 cfs

(640 cfs)(0.10) = 64 cfs

Assuming V remains constant: $A = \frac{Q}{V} = \frac{704 \text{ cfs}}{6.4 \text{ ft/sec}} = 110 \text{ ft}^2$

Therefore, Area increases by 10 ft^2

Bankfull Width = 50 ft

→ next page

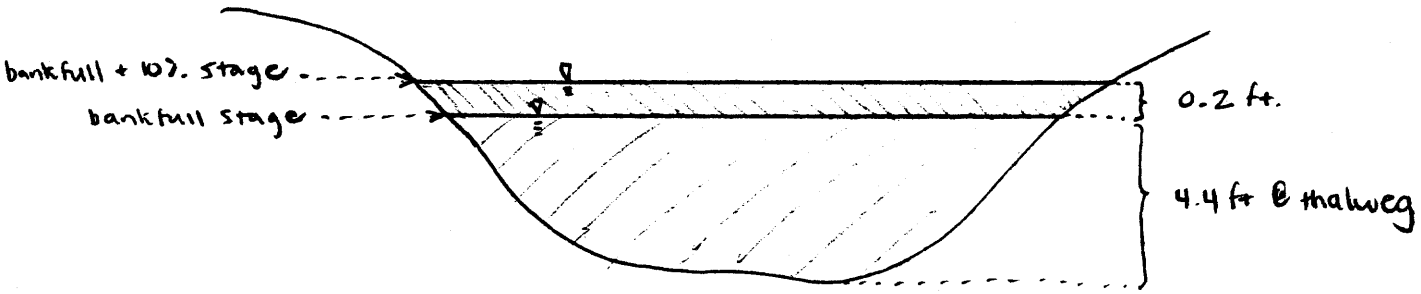
Upstream Cross-Section / Channel Segment 11

A $10\ ft^2$ increase in Area distributed across a wetted channel width of 50 ft:

$$\frac{10\ ft^2}{50\ ft} = 0.2\ ft \text{ (increase in stage)}$$

↓

for example*:



* drawing not to scale!

Define Terms Used In Shield's Diagram :

- $\tilde{\tau}_o$ - bed shear stress (lbs/ft^2)
- $\tilde{\tau}_*$ - dimensionless shear stress
- γ_f - specific weight of fluid (water) (lbs/ft^3)
- R - hydraulic radius (ft)
- S_e - energy slope or gradient (ft/ft)
- γ_s - specific weight of sediment (lbs/ft^3)
- d_s - diameter of sediment particle (ft)
- R_* - boundary Reynolds number (dimensionless)
- U_* - shear velocity
- V = kinematic viscosity of fluid (ft^2/sec)

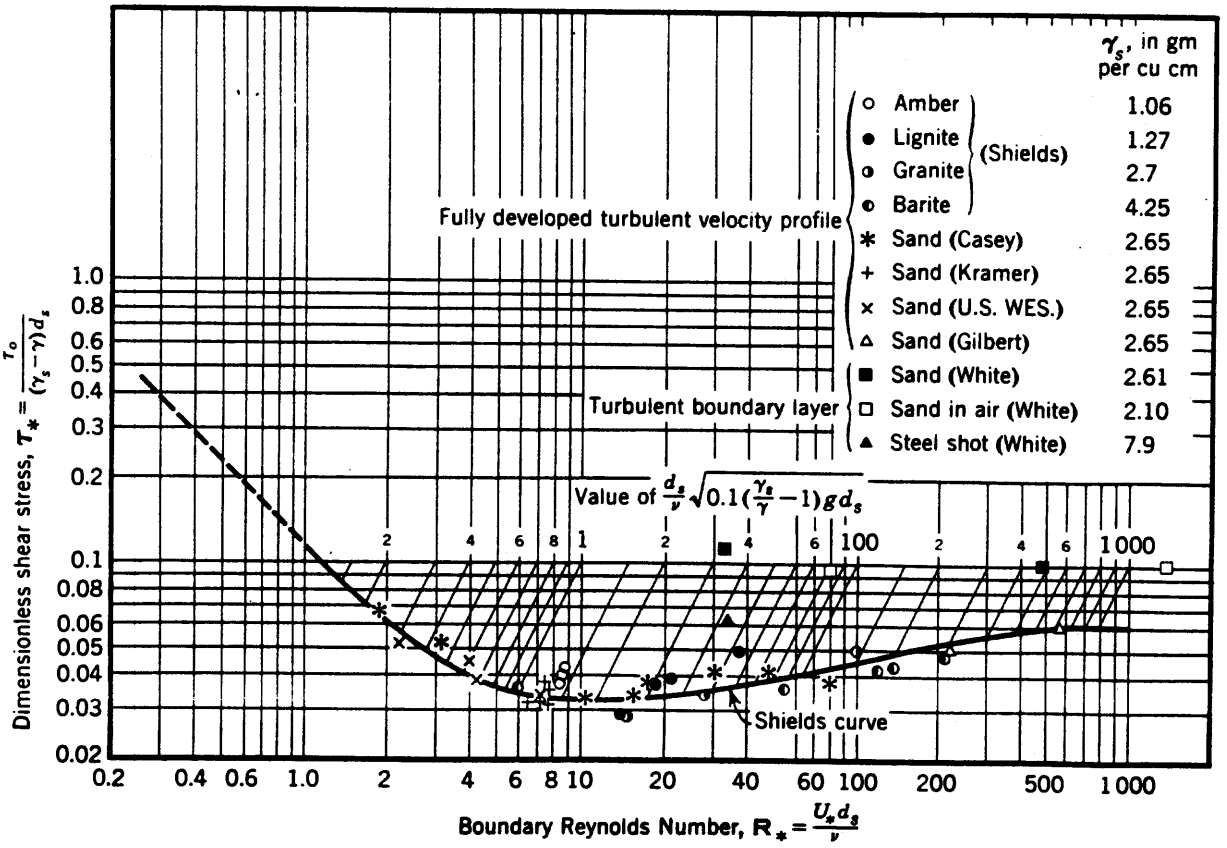


FIG. 2.43.—Shields Diagram with White Data Added

Upstream Cross-Section / Channel Segment 11

Objective - Determine Critical Particle Size for the Bankfull Discharge Using Shields Diagram.

① $\tau_o = \gamma_f R S_e$

$= (62.4 \text{ lbs/ft}^3)(2.0 \text{ ft})(0.06 \text{ ft/ft})$

$= \underline{7.49 \text{ lbs/ft}^2}$

② $\tau_* = \dfrac{\tau_o}{(\gamma_s - \gamma_f) d_s}$

$d_s = \dfrac{\left(\dfrac{\tau_o}{\tau_*}\right)}{(\gamma_s - \gamma_f)}$

$= \dfrac{\left(\dfrac{7.49 \text{ lbs/ft}^2}{0.06}\right) \longrightarrow \text{from Shields Diagram}}{(172.0 \text{ lbs/ft}^3 - 62.4 \text{ lbs/ft}^3)}$

$= 1.14 \text{ ft}$ (critical particle size for bankfull Q)

Objective - Determine Critical Particle Size for the Bankfull Discharge + 10 % using Shields Diagram.

① $\tau_o = \gamma_f R S_e$

$= (62.4 \text{ lbs/ft}^3)(2.2 \text{ ft})(0.06 \text{ ft/ft})$

$= \underline{8.24 \text{ lbs/ft}^2}$

Upstream Cross-Section / Channel Segment 11

② $$\tau^* = \frac{\tau_0}{(\gamma_s - \gamma_f) d_s}$$

$$d_s = \frac{\left(\frac{\tau_0}{\tau^*}\right)}{(\gamma_s - \gamma_f)}$$

$$= \frac{\left(\frac{8.24 \text{ lbs/ft}^2}{0.06}\right)}{(172.0 \text{ lbs/ft}^3 - 62.4 \text{ lbs/ft}^3)} \longrightarrow \text{from Shields Diagram}$$

$$= 1.25 \text{ ft} \quad (\text{critical particle size for bankfull } Q + 10\%)$$

Objective - Determine the Percent Increase In Critical Particle Size Between Bankfull Q and Bankfull Q + 10%.

d_s Bankfull Q = 1.14 ft

d_s Bankfull Q + 10% = 1.25 ft

$$\left(\frac{1.25 \text{ ft} - 1.14 \text{ ft}}{1.14 \text{ ft}}\right) 100 = \boxed{+10\%}$$

Conclusion - In situations when the Boundary Reynolds Number exceeds 500, and the critical dimensionless shear stress becomes a constant 0.06, the change in critical particle size is directly proportional to the change in bed shear stress (τ_0).

Downstream Cross Section / Channel Segment 10

Area (A) = 113 ft^2
Slope (S) = 0.03 ft/ft
Manning's n = 0.09
Hydraulic Radius (R) = 1.3 ft

Manning's Eqn:

$$V = \frac{k}{n} R^{2/3} S^{1/2}$$

$$= \frac{1.486}{0.09} (1.3^{2/3})(0.03^{1/2})$$

$$= 3.4 \text{ ft/sec}$$

$$Q \text{ (discharge)} = V \cdot A$$

$$= (3.4 \text{ ft/sec})(113 \text{ ft}^2)$$

$$= 385 \text{ ft}^3/\text{sec}$$

Objective - Determine how a 10% increase in discharge affects stage.

Q = 385 cfs

(385 cfs)(0.10) = 39 cfs

Assuming V remains constant: $A = \frac{Q}{V} = \frac{424 \text{ cfs}}{3.4 \text{ ft/sec}} = 125 \text{ ft}$

Therefore, Area increases by $(125 \text{ ft}^2 - 113 \text{ ft}^2) = \underline{12 \text{ ft}^2}$

Bankfull width = 82 ft.

next page →

Downstream Cross-Section / Channel Segment 10

- A 12 ft^2 increase in area distributed over a wetted channel width of 82 ft:

$$\frac{12\ ft^2}{82\ ft} = \underline{0.15\ ft} \text{ (increase in stage)}$$

Downstream Cross-Section / channel Segment 10

Objective - Determine critical particle size for the bankfull discharge using Shields diagram..

① $\tilde{\tau}_o = \gamma_f R S_e$

$= (62.4 \text{ lbs/ft}^3)(1.3 \text{ ft})(0.03 \text{ ft/ft})$

$= \underline{2.43 \text{ lbs/ft}^2}$

② $\tilde{\tau}_* = \dfrac{\tilde{\tau}_o}{(\gamma_s - \gamma_f) d_s}$

$d_s = \dfrac{\left(\dfrac{\tilde{\tau}_o}{\tilde{\tau}_*}\right)}{(\gamma_s - \gamma_f)}$

$= \dfrac{\left(\dfrac{2.43 \text{ lbs/ft}^2}{0.06}\right) \rightarrow \text{from Shields diagram}}{(172.0 \text{ lbs/ft}^3 - 62.4 \text{ lbs/ft}^3)}$

$= \boxed{0.37 \text{ ft}}$ (critical particle size for bankfull Q)

Objective - Determine critical particle size for bankfull discharge + 10% using Shields diagram.

① $\tilde{\tau}_o = \gamma_f R S_e$

$= (62.4 \text{ lbs/ft}^3)(1.5 \text{ ft})(0.03 \text{ ft/ft})$

$= \underline{2.81 \text{ lbs/ft}^2}$

Downstream Cross-Section / Channel Segment 10

② $\tau_* = \dfrac{\tau_o}{(\gamma_s - \gamma_f)\, d_s}$

$$d_s = \frac{\left(\dfrac{\tau_o}{\tau_{*c}}\right)}{(\gamma_s - \gamma_f)}$$

$$= \frac{\left(\dfrac{2.81 \text{ lbs/ft}^2}{0.06}\right) \longrightarrow \text{from Shield's diagram}}{(172.0 \text{ lbs/ft}^3 - 62.4 \text{ lbs/ft}^3)}$$

$$= \boxed{0.42 \text{ ft}} \quad \text{(critical particle size for bankfull Q + 10\%)}$$

Objective – Determine % increase between the two scenarios –

d_s bankfull Q = 0.37 ft

d_s bankfull Q + 10% = 0.42 ft

$$\left(\frac{0.42 \text{ ft} - 0.37 \text{ ft}}{0.37 \text{ ft}}\right) 100 = \boxed{+14\%}$$

D - Riparian Function Module

D.1. INTRODUCTION-

A Level 1 assessment was conducted for both sections of the riparian module; large woody debris recruitment and canopy closure/stream temperature. Use of this report as a level II assessment is appropriate as all indeterminate segments were resolved through more intensive evaluation or field investigation. Assessment of riparian function followed standard methodologies as described in Version 2.1 of the Watershed Analysis Manual (implemented November 1, 1994).

Review of large woody debris (LWD) was limited to Type 1-3 waters. Several stretches of Type 4 or 5 waters were upgraded to Type 3 waters by the Fish Habitat Module staff using field verification of physical characteristics. These stretches were treated as Type 3 waters in this module. Assessment of canopy closure/stream temperature was extended to include Type 4 waters that were determined to contribute 20 percent of the flow to a Type 3 water as described in the Manual. The stretch of the North Fork Stillaguamish defining the southern edge of the Watershed Administrative Unit (WAU) was assessed for both LWD and canopy closure.

Products of this investigation include the Riparian Timber Condition and Water Type Map (D-1), Near-term LWD Recruitment Situations (D-2), Target and Estimate Canopy Closure Levels (D-3) and Riparian Shade Situations (D-4). The riparian condition is summarized for the sub-watersheds and major streams in Tables D-1, D-2, and D-3. The shade situation and canopy closure are summarized in Tables D-4 and D-5. Worksheets D-1, D-2, and D-3 are included as supporting data.

D.2. LARGE WOODY DEBRIS RECRUITMENT

D.2.1. Critical Question-

What is the condition of the riparian zone relative to its ability to supply large woody debris to the stream in the near-term?

D.2.2. Methods- Review of aerial photographs (NW 91 1:12,000 black and white, stored at the Stillaguamish Tribal office, 3439 Stoluckquamish Lane, Arlington, WA) was the primary method used to assess riparian vegetative makeup, age and density. Supplemental use of older photos (NW 83 1:12000 color and NW 78 1:12,000 black and white, stored at the Department of Natural Resources, Northwest Region Office, N. Township St, Sedro-Woolley, WA) helped verify the age and boundaries of some stands. Riparian condition was evaluated with emphasis put on significant changes in vegetation. This resulted in some reaches shorter than 2000 feet. The segments established by the Channel Module staff were used for evaluation purposes.

Field review was necessary to verify the age determination of several riparian areas. Due to the inaccessibility of one such stretch the road side vegetation closest to the riparian area was evaluated as a surrogate due to its same aerial photo characteristics. It was found that the aerial photo interpretation of these areas was the same or close to the same as the field verification.

Field data on the function and distribution of LWD was taken on some segments by the Channel and Fish Habitat team members. This data was evaluated using the table for near-term LWD recruitment situations (Figure D-2, Manual p D-15). This information appears in the Riparian Worksheet D-2 (Appendix , Supporting Data).

D.2.3. Results- The near term potential for recruitment of LWD in the Hazel WAU has been impacted along 87% of the assessed streams and river (North Fork Stillaguamish and fish bearing streams). Approximately 23% was rated as high impact, while 64% was rated as medium impact. It should be noted that the near term potential for recruitment for LWD along the entire stretch of the North Fork bordering the Hazel WAU has been impacted (29% high impact and 71% medium impact).

The primary reason for these impacts along the lower elevation, low gradient streams and river is conversion to agriculture and residential development. The primary reason along the higher elevation and higher gradient streams that are Type 3 waters is forest practices prior to the current forest practice rules and regulations. These historical practices allowed the clearing of the riparian zones and did not encourage the regeneration of conifer in those zones.

In the converted, low gradient areas narrow riparian areas (less than 66') are common. These riparian areas often will contain young or sparse deciduous stands which provide poor near term recruitment of LWD. The forested areas often have riparian areas that have been harvested 20 to 40 years ago and have regenerated as mainly deciduous trees (Red Alder). These areas provide some potential for near term recruitment but of an inadequate size and low quality species.

D.2.4. Confidence In Work Products- Confidence in large woody debris work products is very high for species composition, age class and density. Accuracy in these calls was confirmed with field visits to several areas with questionable calls. It must be noted that a number of stands were found to be bordering on 40 years old or 12 inches diameter at breast height (DBH). In these cases calls were made from field verification, comparative photo analysis or historic records.

Most of the streams assessed are Class A streams according to the United States Forest Service classification system. Upper portions of Dicks and Segelsen Creeks that are in the Mt. Baker/Snoqualmie National Forest are Class AA.

Table D-1. Large woody debris recruitment impact calls on significant groupings.

Impact Call	Stream Length (inches)	Percent of Stream Length
All Waters		
High	72.9	23
Med	197.4	64
Low	40.7	13
TOTAL	311.0	100
Mainstem North Fork Stillaguamish River		
High	26.0	29
Med	62.8	71
Low	0.0	0
TOTAL	88.8	100
Tributaries to the North Fork Stillaguamish River		
High	46.9	21
Med	134.6	61
Low	40.7	18
TOTAL	222.2	100

Table D-2. Large woody debris recruitment impact calls on selected streams.

	Impact Call	Stream Length (inches)	Percent of Stream Length
Brooks			
	High	3.3	11
	Med	17.8	61
	Low	8.2	28
	TOTAL	29.3	100
Rollins			
	High	0.0	0
	Med	16.5	70
	Low	7.2	30
	TOTAL	23.7	100
Dicks			
	High	0.0	0
	Med	14.3	69
	Low	6.4	31
	TOTAL	20.7	100
Segelsen			
	High	4.1	23
	Med	8.4	47
	Low	5.3	30
	TOTAL	17.8	100

Table D-3. Riparian large woody debris recruitment impact calls by sub-basin.

Impact Call	Stream Length (inches)	Percent of Stream Length
Brooks		
High	12.8	25
Med	22.3	44
Low	15.5	31
TOTAL	50.6	100
Whitman Bench		
High	10.8	50
Med	4.2	20
Low	6.3	30
TOTAL	21.3	100
Rollins		
High	0.6	2
Med	17.1	69
Low	7.2	29
TOTAL	24.9	100
Dicks		
High	0.0	0
Med	14.3	69
Low	6.4	31
TOTAL	20.7	100
Higgins		
High	18.0	25
Med	55.1	75
Low	0	0
TOTAL	73.1	100
Segelsen		
High	4.65	15
Med	21.65	68
Low	5.3	17
TOTAL	31.6	100

D.3. CANOPY CLOSURE/STREAM TEMPERATURE

D.3.1. Critical Question-

What is the current degree of canopy closure provided by riparian vegetation relative to what is needed to maintain desirable stream temperatures?

D.3.2. Methods- Review of recent aerial photographs (NW 91 1:12,000 black and white) was the primary method for assessment of canopy characteristics. All Type 1-3 waters were assessed in addition to those Type 4 waters that were determined to contribute 20% or more to the flow of a Type 3 stream. The percent shade was determined by estimating the amount of stream surface visible in the aerial photos and ranked according to Table D-9 in the Watershed Analysis Manual (p. D-26).

Field measurements were taken on a number of stream segments where the target shade value was on or very near the border of the estimated shade level groupings (Table D-9). This was done using a densiometer at 50 foot intervals.

The mainstem North Fork Stillaguamish River is quite wide in places but it does not exceed the maximum 100 foot width at normal low flow. Therefore, this stretch of the river was included in the assessment.

D.3.3. Results- Existing shade levels along 41% of the assessed streams and river are below target values. The shade situation along the mainstem of the North Fork Stillaguamish River that defines the southern border of the WAU is quite different from smaller streams within the WAU. The entire mainstem (100%) is below target shade levels while 21% of all other streams do not meet target shade levels. (See Map D-4 and Table 4).

Approximately 3,700 feet or 1% of the assessed streams have naturally low shade levels. These are beaver ponds or ponded stretches of streams in old river channels.

Most of the streams that do not meet the shade requirement are in the low elevation, low gradient areas that have significant conversion to agriculture and residential development. The riparian vegetation in these areas consists mainly of shrubs, grasses and small trees that do not provide adequate shade. Those stretches in the forest land that do not meet the requirements have been harvested prior to the current forest practices rules and regulations. These stretches now have a riparian zone with trees of inadequate size and density to provide the necessary shade.

None of the North Fork Stillaguamish River within the WAU meets the target shade requirements. Due to the wide channel and high target shade level (70%) it is difficult to achieve adequate shading from the riparian zone. Potential shade has been reduced due to harvest practices, agricultural conversion and residential development. Channel movement has also reduced effective riparian shade. Frequent flooding of the riparian zone discourages

conifer regeneration and promotes hardwood dominated stands. These stands are typically shorter than conifer stands when mature which limits potential shade over the long term.

D.3.4. Confidence In Work Products- Confidence in canopy cover/stream temperature work products is high given that the estimated levels of canopy closure determined from aerial photo analysis described in the Riparian module (Table D-9, p. D-26) is accurate and reliable. Field verification of assessed values confirmed that in most cases estimated values were met or exceeded. An influencing factor is that a large percentage of the riparian area consists of deciduous trees and other shrubs and grasses that have a tendency to lean out over the stream as they grow toward light. Due to this it is unlikely that shade levels would be underestimated using the standard methodology.

Table D-4. Shade condition by water type.

Stream	Stream Length (feet x 1000)	Stream Length Below Target Shade Levels (feet x 1000)	(%)
Type 1-3 waters	219.7	45.7	21
Type 4 waters	37.0	7.6	21
North Fork Stillaguamish	88.8	88.8	100
TOTAL	345.5	142.1	41

Table 5. Estimated canopy closure by sub-basin (values are expressed in [feet x 1000]).

Canopy Cover Class	Brooks	Whitman	Rollins	Dicks	Higgins	Segelsen	Main	Total	Percent of Total
>90%	29.4	11.8	5.2	21.3	47.8	15.1	0.0	130.6	38
70-90%	17.4	3.6	5.8	4.3	17.6	8.2	0.0	56.9	16
40-70%	3.2	3.5	5.6	2.4	3.8	7.4	0.6	26.5	8
20-40%	3.8	0.2	6.0	2.6	4.8	0.0	35.4	52.8	15
0-20%	6.5	4.9	5.6	0.0	1.0	7.9	52.8	78.7	23
TOTAL	60.3	24.0	28.2	30.6	75.0	38.6	88.8	345.5	100

Worksheet D-1: Stream Length* by Riparian Type and Channel Segment

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Brooks Sub-Basin	Stream Channel Segment																	
	1	2	3	4	5	6	7		9	10	11	12	13	14	15	16	17	→
Riparian Timber Class									Brooks Cr.									
Deciduous/Young/Sparse	2.6																	
Deciduous/Young/Dense																		
Mixed/Young/Dense					2.3													
Mixed/Young/Sparse						.9	1.0			.25	.8	.9						
Conifer/Young/Sparse						1.3												
Conifer/Young/Dense						.9												
Deciduous/Mature/Sparse																		
Deciduous/Mature/Dense	3.0								2.4				.75	1.15	1.0	1.8		
Mixed/Mature/Sparse																		
Mixed/Mature/Dense	2.8	1.6	.6	.6	.5		1.0			1.15	.8	1.65		.45	2.2			
Conifer/Mature/Sparse																		
Conifer/Mature/Dense													.75	.75	.7	.4	2.8	
Deciduous/Old/Sparse																		
Deciduous/Old/Dense																		
Mixed/Old/Sparse																		
Mixed/Old/Dense																		
Conifer/Old/Sparse																		
Conifer/Old/Dense																		
Segment Total**	8.4	1.6	.6	.6	2.8	3.1	2.0		2.4	1.4	1.6	3.3	1.5	2.3	3.2	2.2	2.8	

* Lengths measured using a map wheel (recorded in cm or in)

** Total length = 2x actual segment length because both sides are measured.

Worksheet D-1: Stream Length* by Riparian Type and Channel Segment

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Brooks Sub-Basin	Stream Channel Segment																			
	20	21	22	50	53	54														
Riparian Timber Class	Brooks Cr →																			
Deciduous/Young/Sparse																				
Deciduous/Young/Dense					1.4	.4														
Mixed/Young/Dense																				
Mixed/Young/Sparse																				
Conifer/Young/Sparse		1.3																		
Conifer/Young/Dense																				
Deciduous/Mature/Sparse																				
Deciduous/Mature/Dense				.7																
Mixed/Mature/Sparse																				
Mixed/Mature/Dense	.7			2.5																
Conifer/Mature/Sparse																				
Conifer/Mature/Dense	2.9	1.8	.75																	
Deciduous/Old/Sparse																				
Deciduous/Old/Dense																				
Mixed/Old/Sparse																				
Mixed/Old/Dense																				
Conifer/Old/Sparse																				
Conifer/Old/Dense		.5	.75																	
Segment Total**	3.6	3.6	1.5	3.2	1.4	.4														

* Lengths measured using a map wheel (recorded in cm or in)

** Total length = 2x actual segment length because both sides are measured.

Worksheet D-1: Stream Length* by Riparian Type and Channel Segment

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Whitman Bench Sub-Basin								Stream Channel Segment												
	55A	56		57	57A	57B		60	60A	61	62	63								
Riparian Timber Class																				
Deciduous/Young/Sparse				4.0	.9	.9														
Deciduous/Young/Dense		1.2			.9	.9														
Mixed/Young/Dense									2.0											
Mixed/Young/Sparse																				
Conifer/Young/Sparse																				
Conifer/Young/Dense																				
Deciduous/Mature/Sparse																				
Deciduous/Mature/Dense	1.4							1.5	1.15											
Mixed/Mature/Sparse																				
Mixed/Mature/Dense								2.9	1.15	.4	1.4	.4								
Conifer/Mature/Sparse																				
Conifer/Mature/Dense																				
Deciduous/Old/Sparse																				
Deciduous/Old/Dense																				
Mixed/Old/Sparse																				
Mixed/Old/Dense																				
Conifer/Old/Sparse																				
Conifer/Old/Dense																				
Segment Total**	1.4	1.2		4.0	1.8	1.8		4.4	4.3	.4	1.4	.4								

* Lengths measured using a map wheel (recorded in cm or in)

** Total length = 2x actual segment length because both sides are measured.

Worksheet D-1: Stream Length* by Riparian Type and Channel Segment

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Rollins Cr. Sub-Basin	Stream Channel Segment																			
	65	66	67	68	69	70		81			659									
Riparian Timber Class	Rollins Cr →																			
Deciduous/Young/Sparse																				
Deciduous/Young/Dense																				
Mixed/Young/Dense																				
Mixed/Young/Sparse																				
Conifer/Young/Sparse																				
Conifer/Young/Dense						.6														
Deciduous/Mature/Sparse											.6									
Deciduous/Mature/Dense	2.5	2.8	2.9	.8	1.7						.6									
Mixed/Mature/Sparse																				
Mixed/Mature/Dense				4.6																
Conifer/Mature/Sparse								2.6												
Conifer/Mature/Dense					3.3			1.8												
Deciduous/Old/Sparse																				
Deciduous/Old/Dense																				
Mixed/Old/Sparse																				
Mixed/Old/Dense																				
Conifer/Old/Sparse																				
Conifer/Old/Dense																				
Segment Total**	2.5	2.8	2.9	5.4	5.0	.6		4.4			1.2									

* Lengths measured using a map wheel (recorded in cm or in)

** Total length = 2x actual segment length because both sides are measured.

Worksheet D-1: Stream Length* by Riparian Type and Channel Segment

Dicks Cr. Sub-Basin								Stream Channel Segment												
	122	123	124	125	126	133	134													
Riparian Timber Class	Dicks		Cr.				→													
Deciduous/Young/Sparse																				
Deciduous/Young/Dense																				
Mixed/Young/Dense																				
Mixed/Young/Sparse																				
Conifer/Young/Sparse																				
Conifer/Young/Dense																				
Deciduous/Mature/Sparse																				
Deciduous/Mature/Dense	2.2	3.5	.9			2.5	1.0													
Mixed/Mature/Sparse																				
Mixed/Mature/Dense		.3	4.3	.4			4.8													
Conifer/Mature/Sparse																				
Conifer/Mature/Dense				2.7																
Deciduous/Old/Sparse																				
Deciduous/Old/Dense																				
Mixed/Old/Sparse																				
Mixed/Old/Dense																				
Conifer/Old/Sparse																				
Conifer/Old/Dense				5.4	1.0															
Segment Total**	2.2	3.8	5.2	8.5	1.0	2.5	5.8													
	* Lengths measured using a map wheel (recorded in cm or in)																			
	** Total length = 2x actual segment length because both sides are measured.																			

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Worksheet D-1: Stream Length* by Riparian Type and Channel Segment

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Higgins Mtn. Sub-Basin

Riparian Timber Class	Stream Channel Segment																					
	138	138A	138B	139	140	147	148	149	150	151	152	155	159	164	165							
Deciduous/Young/Sparse												.5										
Deciduous/Young/Dense	1.6																					
Mixed/Young/Dense																						
Mixed/Young/Sparse																						
Conifer/Young/Sparse													1.2									
Conifer/Young/Dense																						
Deciduous/Mature/Sparse																						
Deciduous/Mature/Dense	.6		2.5	.8	1.5	2.2	1.0			2.8		.5		1.6	1.5							
Mixed/Mature/Sparse																						
Mixed/Mature/Dense	1.8						.6	.7	.4		2.4											
Conifer/Mature/Sparse																						
Conifer/Mature/Dense																						
Deciduous/Old/Sparse																						
Deciduous/Old/Dense																						
Mixed/Old/Sparse																						
Mixed/Old/Dense																						
Conifer/Old/Sparse																						
Conifer/Old/Dense																						
Segment Total**	2.4	1.6	2.5	.8	1.5	2.2	1.6	.7	.4	2.8	2.4	1.0	1.2	1.6	1.5							

* Lengths measured using a map wheel (recorded in cm or in)

** Total length = 2x actual segment length because both sides are measured.

Worksheet D-1: Stream Length* by Riparian Type and Channel Segment

Higgins Mtn. Sub-Basin								Stream Channel Segment												
	175	180	181	182		194	195	198		203	204	205	209	210	218	221	222			
Riparian Timber Class																				
Deciduous/Young/Sparse								1.4			.7	.5	1.0							
Deciduous/Young/Dense	1.5	2.0	.8	1.5											.9					
Mixed/Young/Dense																				
Mixed/Young/Sparse																				
Conifer/Young/Sparse																				
Conifer/Young/Dense												1.0	.3	.8						
Deciduous/Mature/Sparse						.25														
Deciduous/Mature/Dense	.5	.8		.25		.25	1.0	.6		3.8			.3	.8	.9	1.0	1.0			
Mixed/Mature/Sparse																				
Mixed/Mature/Dense				.25			1.4													
Conifer/Mature/Sparse																				
Conifer/Mature/Dense																				
Deciduous/Old/Sparse																				
Deciduous/Old/Dense																				
Mixed/Old/Sparse																				
Mixed/Old/Dense																				
Conifer/Old/Sparse																				
Conifer/Old/Dense																				
Segment Total**	2.0	2.8	.8	2.0		.5	2.4	2.0		3.8	.7	1.5	1.6	1.6	1.8	1.0	1.0			

* Lengths measured using a map wheel (recorded in cm or in)

** Total length = 2x actual segment length because both sides are measured.

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Worksheet D-1: Stream Length* by Riparian Type and Channel Segment

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Higgins Mtn. Sub-Basin

Riparian Timber Class	Stream Channel Segment 224	225	226	227		247
Deciduous/Young/Sparse						
Deciduous/Young/Dense						
Mixed/Young/Dense						
Mixed/Young/Sparse						
Conifer/Young/Sparse						
Conifer/Young/Dense						
Deciduous/Mature/Sparse	4.4	.7				
Deciduous/Mature/Dense	.6	.5	1.6			1.2
Mixed/Mature/Sparse						
Mixed/Mature/Dense				2.6		
Conifer/Mature/Sparse						
Conifer/Mature/Dense						
Deciduous/Old/Sparse						
Deciduous/Old/Dense						
Mixed/Old/Sparse						
Mixed/Old/Dense						
Conifer/Old/Sparse						
Conifer/Old/Dense						
Segment Total**	5.0	1.2	1.6	2.6		1.2

* Lengths measured using a map wheel (recorded in cm or in)

** Total length = 2x actual segment length because both sides are measured.

Worksheet D-1: Stream Length* by Riparian Type and Channel Segment

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Segelsen Cr. Sub-Basin

Riparian Timber Class	250	251	252	253	254	250A	286	287	288	289	290	293	294	295
	Segelsen Cr. →													
Deciduous/Young/Sparse						3.8								
Deciduous/Young/Dense	1.2											.5		
Mixed/Young/Dense														
Mixed/Young/Sparse														
Conifer/Young/Sparse			.4	2.3										
Conifer/Young/Dense												.5		
Deciduous/Mature/Sparse														
Deciduous/Mature/Dense	2.0	1.0					1.8	.4				1.9		
Mixed/Mature/Sparse														
Mixed/Mature/Dense							.2	.8	1.6	2.0		2.0	1.6	
Conifer/Mature/Sparse														
Conifer/Mature/Dense			4.5	.5										
Deciduous/Old/Sparse														
Deciduous/Old/Dense														
Mixed/Old/Sparse														
Mixed/Old/Dense														
Conifer/Old/Sparse														
Conifer/Old/Dense	1.8	1.3	1.1	1.0										
Segment Total**	2.0	4.0	5.8	2.0	3.3	3.8	1.8	.6	.8	1.6	2.0	1.9	3.0	1.6

* Lengths measured using a map wheel (recorded in cm or in)

** Total length = 2x actual segment length because both sides are measured.

Worksheet D-1: Stream Length* by Riparian Type and Channel Segment

Main Stem N. Fk.	Stillaguamish River							Stream Channel Segment
	298	299	300	301	302	303	304	305
Riparian Timber Class								
Deciduous/Young/Sparse		.7	1.3					3.7
Deciduous/Young/Dense		1.9		1.2	2.6	.1	2.2	.7
Mixed/Young/Dense								
Mixed/Young/Sparse								
Conifer/Young/Sparse								
Conifer/Young/Dense								
Deciduous/Mature/Sparse	.8	1.4				.4	4.8	4.2
Deciduous/Mature/Dense	6.2	14.0	5.5	6.8	5.2	7.7	2.6	14.8
Mixed/Mature/Sparse								
Mixed/Mature/Dense								
Conifer/Mature/Sparse								
Conifer/Mature/Dense								
Deciduous/Old/Sparse								
Deciduous/Old/Dense								
Mixed/Old/Sparse								
Mixed/Old/Dense								
Conifer/Old/Sparse								
Conifer/Old/Dense								
Segment Total**	7.0	18.0	6.8	8.0	7.8	8.2	9.6	23.4

* Lengths measured using a map wheel (recorded in cm or in)

** Total length = 2x actual segment length because both sides are measured.

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Riparian Worksheet D-2: Situation Summary by Stream Segment.

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Recruitment	Segment Number** 9		Segment Number 10		Segment Number 11		Segment Number 16		Segment Number 59	
	LWD Target: On ☐ Off ☒		LWD Target: On ☒ Off ☐		LWD Target: On ☐ Off ☒		LWD Target: On ☒ Off ☐		LWD Target: On ☐ Off ☒	
Situation Category*	length***	%	length	%	length	%	length	%	length	%
RF1			1.15	82			1.95	89		
RF2					.8	50				
RF3			.25	18			.25	11		
RF4	2.4	100			.8	50			.4	100
RF5 (moderate haz.)										
RF6 (high hazard)										
RF7 (other)										
RF8 (other)										
RF9 (other)										
RF10 (other)										
Total	2.4		1.4		1.6		2.2		.4	

* See Figure d-2 for descriptions/definitions of RF1-RF4.

** Only list those segments where in-channel LWD counts have been made.

*** Lengths from segment tally on riparian worksheet d-1.

Riparian Worksheet D-2: Situation Summary by Stream Segment.

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Recruitment	Segment Number** 64 On ☐ Off ☒		Segment Number 65 On ☐ Off ☒		Segment Number 66 On ☐ Off ☒		Segment Number 122 On ☐ Off ☒		Segment Number ____ On ☐ Off ☐	
Situation Category*	length***	%	LWD Target length	%	LWD Target length	%	LWD Target length	%	LWD Target length	%
RF1										
RF2	1.15	27								
RF3										
RF4	3.15	73	2.5	100	2.8	100	2.2	100		
RF5 (moderate haz.)										
RF6 (high hazard)										
RF7 (other)										
RF8 (other)										
RF9 (other)										
RF10 (other)										
Total	4.3		2.5		2.8		2.2			

* See Figure d-2 for descriptions/definitions of RF1-RF4.

** Only list those segments where in-channel LWD counts have been made.

*** Lengths from segment tally on riparian worksheet d-1.

Riparian Worksheet D-2: Situation Summary by Stream Segment.

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Recruitment	Segment Number**		124	Segment Number		250	Segment Number		257	Segment Number			Segment Number		
	LWD Target: On ☐	Off ☒		LWD Target: On ☐	Off ☒		LWD Target: On ☒	Off ☐		LWD Target: On ☐	Off ☐		LWD Target: On ☐	Off ☐	
Situation Category*	length***	%		length	%		length	%		length	%		length	%	
RF1							1.8	45							
RF2	4.3	83													
RF3							2.2	55							
RF4	.9	17		2.0	100										
RF5 (moderate haz.)															
RF6 (high hazard)															
RF7 (other)															
RF8 (other)															
RF9 (other)															
RF10 (other)															
Total	5.2			2.0			4.0								

* See Figure d-2 for descriptions/definitions of RF1-RF4.

** Only list those segments where in-channel LWD counts have been made.

*** Lengths from segment tally on riparian worksheet d-1.

Worksheet D-3: Estimated Canopy Closure by Channel Segment

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Brooks Cr. Sub-Basin	Stream Channel Segment																
	1	2	3	4	5	6	7	8	59	9	10	11	12	13	14	15	16	17
Canopy Closure Estimate										Brook Cr.								→
From Photo Interpretation																		
>90%	2.6	.8	.3										.65	.1	.3	1.6	1.1	1.4
70-90				.3	1.1				.5		1.2	.7	.8		.65	.85		
40-70						.9	1.0											
20-40						.3	.65	.5										
0-20	1.6																	
From Field measurements																		
>90%																		
80-90																		
70-80																		
60-70																		
50-60													1.0					
40-50																		
30-40																		
20-30																		
10-20%																		
<10																		
Segment Total	4.2	.8	.3	.3	1.4	1.55	1.0	.5	.5	1.2	.7	.8	1.65	.75	1.15	1.6	1.1	1.4

* Lengths measured using a map wheel (recorded in cm or in)

Worksheet D-3: Estimated Canopy Closure by Channel Segment

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Brooks Cr. Sub-Basin							Stream Channel Segment												
	18		20	21	22	23	32	46	50	51	53	54							
Canopy Closure Estimate	Brooks		Cr. →																
From Photo Interpretation																			
>90%	.5		.1	.9	.75	.5	.5	.5	1.6	.5									
70-90			1.7	.9															
40-70											.7								
20-40																			
0-20												.2							
From Field measurements																			
>90%																			
80-90																			
70-80																			
60-70																			
50-60																			
40-50																			
30-40																			
20-30																			
10-20%																			
<10																			
Segment Total	.5		1.8	1.8	.75	.5	.5	.5	1.6	.5	.7	.2							

• Lengths measured using a map wheel (recorded in cm or in)

Worksheet D-3: Estimated Canopy Closure by Channel Segment

Pg. 3 of

Whitman Bench Sub-Basin

	Stream Channel Segment														
	55A	56		57	57A	57B	58		60A		60	61	62	63	64
Canopy Closure Estimate															
From Photo Interpretation															
>90%						.3			1.0		2.2	.7	.7	.7	.5
70-90				.4			.5		.9						
40-70	.7	.6			.8										
20-40					.1										
0-20				1.6		.6			.25						
From Field measurements															
>90%															
80-90															
70-80															
60-70															
50-60															
40-50															
30-40															
20-30															
10-20%															
<10															
Segment Total	.7	.6		2.0	.9	.9	.5		2.15		2.2	.7	.7	.7	.5

* Lengths measured using a map wheel (recorded in cm or in)

Worksheet D-3: Estimated Canopy Closure by Channel Segment

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Rollins Cr. Sub-Basin	Stream Channel Segment										
	65	66	67	68	69	70	81	82	91	65A	65B
Canopy Closure Estimate	Rollins Cr. →										
From Photo Interpretation											
>90%							1.4	.3	.5		.5
70-90				.2	.7						
40-70					1.4					.6	
20-40		.3	1.45	.5	.4	.35					
0-20	1.25	1.1				.45					
From Field measurements											
>90%											
80-90											
70-80				2.0							
60-70											
50-60											
40-50							1.0				
30-40											
20-30											
10-20%											
<10											
Segment Total	1.25	1.4	1.45	2.7	2.5	.8	2.4	.3	.5	.6	.5

* Lengths measured using a map wheel (recorded in cm or in)

Worksheet D-3: Estimated Canopy Closure by Channel Segment

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Dichs Cr. Sub-Basin	Stream Channel Segment												
	122	123	124	125	126	133	134	135					
Canopy Closure Estimate	Dichs	Cr.											
From Photo Interpretation													
>90%	1.1	1.1	.6	1.2	1.0	1.25	2.9	.5					
70-90			1.6	.55									
40-70				1.2									
20-40				1.3									
0-20													
From Field measurements													
>90%			.8	.4									
80-90													
70-80													
60-70													
50-60													
40-50													
30-40													
20-30													
10-20%													
<10													
Segment Total	1.1	1.1	.9	2.6	4.25	1.0	1.25	2.9	.5				

• Lengths measured using a map wheel (recorded in cm or in)

Worksheet D-3: Estimated Canopy Closure by Channel Segment

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Higgins Mtn. Sub-Basin	Stream Channel Segment																			
	138	138A	138B	139	140	141	143		147	148	149	150		151	152	153		155		
Canopy Closure Estimate																				
From Photo Interpretation																				
>90%	1.2	.8	1.25	.4	.75	.5	.2		1.1	.8	.45	.7		1.4	1.3					
70-90																				
40-70																		.8		
20-40															.2	.2				
0-20																				
From Field measurements																				
>90%																				
80-90																				
70-80																				
60-70																				
50-60																				
40-50																				
30-40																				
20-30																				
10-20%																				
<10																				
Segment Total	1.2	.8	1.25	.4	.75	.5	.2		1.1	.8	.45	.7		1.4	1.5	.2		.8		

* Lengths measured using a map wheel (recorded in cm or in)

Worksheet D-3: Estimated Canopy Closure by Channel Segment

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Higgins Mtn. Sub-Basin	Stream Channel Segment																			
	159	160		164	165	166	169		175	176	180	181	182	183		194	195	196		*
Canopy Closure Estimate																				
From Photo Interpretation																				
>90%				.5	.2	.5	.5		1.0	.5	.3		.8	.5		.25	.9	.5		
70-90				.3	.55						1.1	.4	.2				.3			
40-70	.6																			
20-40																				
0-20		.5																		
From Field measurements																				
>90%																				
80-90																				
70-80																				
60-70																				
50-60																				
40-50																				
30-40																				
20-30																				
10-20%																				
<10																				
Segment Total	.6	.5		.8	.75	.5	.5		1.0	.5	1.4	.4	1.0	.5		.25	1.2	.5		

* Lengths measured using a map wheel (recorded in cm or in)

Worksheet D-3: Estimated Canopy Closure by Channel Segment

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Higgins Mtn. Sub-Basin

Stream Channel Segment	198	199	201	203	204	205	206	207	209	210	218	221	222	223
Canopy Closure Estimate														
From Photo Interpretation														
>90%	.4			1.9	.35	.25			.0	1.3		.5	.5	
70-90							.4	.1			.9			
40-70														.5
20-40	.6	.5	.5											
0-20														
From Field measurements														
>90%														
80-90														
70-80														
60-70														
50-60														
40-50														
30-40														
20-30														
10-20%														
<10														
Segment Total	1.0	.5	.5	1.9	.35	.25	.4	.1	.0	1.3	.9	.5	.5	.5

* Lengths measured using a map wheel (recorded in cm or in)

Worksheet D-3: Estimated Canopy Closure by Channel Segment

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Higgins Mtn. Sub-Basin	Stream Channel Segment				
	224	225	226	227	247
Canopy Closure Estimate					
From Photo Interpretation					
>90%			.5		
70-90		2.5		1.3	.6
40-70			.6	.3	
20-40				.5	
0-20					
From Field measurements					
>90%					
80-90					
70-80					
60-70					
50-60					
40-50					
30-40					
20-30					
10-20%					
<10					
Segment Total	2.5	.6	.8	1.8	.6

• Lengths measured using a map wheel (recorded in cm or in)

Worksheet D-3: Estimated Canopy Closure by Channel Segment

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Segelsen Sub-Basin								Stream Channel Segment												
	250	251	252	253	254	255	273		2508		286	287	288	289	290	291		293	294	295
Canopy Closure Estimate	Segelsen Cr. →																			
From Photo Interpretation																				
>90%	1.0								.4			.3	.4	.8	1.0	.5		.95	1.2	1.3
70-90		1.6					.5				.9								.3	
40-70			1.5	.6																
20-40																				
0-20				.2	1.65	.5			1.5											
From Field measurements																				
>90%																				
80-90																				
70-80		.4	.2																	
60-70			1.2	.2																
50-60																				
40-50																				
30-40																				
20-30																				
10-20%																				
<10																				
Segment Total	1.0	2.0	2.9	1.0	1.65	.5	.5		1.9		.9	.3	.4	.8	1.0	.5		.95	1.5	1.3

• Lengths measured using a map wheel (recorded in cm or in)

Worksheet D-3: Estimated Canopy Closure by Channel Segment

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Main Stem N Fk. Stillaguamish R.	Stream Channel Segment							
	298	299	300	301	302	303	304	305
Canopy Closure Estimate								
From Photo Interpretation								
>90%								
70-90								
40-70								.3
20-40	3.0	3.3						11.4
0-20	.5	5.7	3.4	4.0	3.9	4.1	4.8	
From Field measurements								
>90%								
80-90								
70-80								
60-70								
50-60								
40-50								
30-40								
20-30								
10-20%								
<10								
Segment Total	3.5	9.0	3.4	4.0	3.9	4.1	4.8	11.7

* Lengths measured using a map wheel (recorded in cm or in)

E - Stream Channel Module

E.1. WATERSHED OVERVIEW-

E.1.1. Watershed Description- The Hazel Watershed Administrative Unit (WAU) consists of a group of North Fork Stillaguamish tributaries draining the south side of the Mt. Higgins massif, between the town of Oso and immediately upstream of the Whitehorse store. Included in this analysis is the portion of the mainstem NF Stillaguamish that receives these tributaries between the approximate river miles 15 and 30 1/2. In the 25,000 acre WAU, thirty tributaries are identified and grouped in five sub-watersheds. The drainage areas and stream lengths are in Table E1, the 15 1/2 mile portion of the mainstem analyzed has a drainage area of approximately 150,000 acres upstream of the WAU.

Like other valleys draining the west side of the North Cascade mountains, the NF Stillaguamish bears a striking legacy of continental glaciation, reflected in the present day land forms and sediments. These geologic materials and morphologies strongly control stream channel characteristics, and their relative sensitivities to disturbance. Further information on the geologic setting and geomorphic significance of glaciation is in the mass wasting assessment, and also in Miller (1995). The geology of area was previously mapped by Tabor and others (1988).

In the vicinity of the study area, the N.F. Stillaguamish occupies a broad valley, which is over a mile wide in places. As seen in the generalized surficial geology map (Fig. E1), the tributary headwaters are the steep slopes of the north valley wall, which consists of shallow soils overlaying bedrock, or locally, till. Down slope, the gradients moderate, and the area is till mantled. The locations of the till bedrock contact generally corresponds to the upstream fish migration barriers (see the fish habitat assessment).

Below about 620' elevation, on the steeper terrace risers, glacial lake deposits (clays and silts) are exposed and strongly influence landsliding and stream character. The remainder of the lower valley consists of alluvium and lacustrine deposits in the form of a series of terraces, and the present day flood plain and channel. Locally, Rollins Creek is influenced by a mechanically weak, clay rich bedrock, interpreted to be fault gouge.

The predominant land use in the WAU is industrial forestry. However, there is agricultural and residential development on the lower terraces and along the mainstem river. Several valley bottom tributaries and the mainstem have been subject to manipulation including removal of large pieces of in stream wood, diking, and alteration from road crossings and bridges. Additionally, wetland segments have been subject to water level manipulation and drainage.

Table E1 - Sub-basin drainage areas and stream lengths

Sub-basin	Drainage Area Acres	Stream Length Miles
Brooks Creek	4,465	34.8
Dicks Creek	2,186	10.9
Whitman Bench	1,623	14.0
Rollins Creek	5,095	30.4
Mount Higgins	7,224	57.6
Segelson Creek	4,235	30.7
Total	24,827	178.4

E.1.2. Dominant Processes- Since the 1940's, all the large tributaries have suffered catastrophic disturbances in the forms of debris flows and landslide dam-break floods. These disturbances mechanically alter the channel, promote chronic streamside landsliding, and remove large wood which increase channel sensitivity to flood events. Debris flows have a severe, though relatively localized direct effect, and dam-break floods tend to impact the tributaries from the initiation site to the mainstem.

Dicks Creek had a debris flow and the tributary west of Segelson (Swede Creek) had two debris flows (one of which called the stream to "hop" drainages to an adjacent channel). Segelson had a debris flow and dam-break flood, and Rollins was subject to multiple debris flows and dam- break floods. Brooks Creek probably had a landslide dam-break flood.

Many of the channels in the lower valley are currently aggrading or incising. Several segments have had recent aggradation followed by incision, interpreted to be the response to passage of a coarse sediment wave. In the lower valley, where lake clays are present, local incision is influenced by deep-seated landslide activity. Information on sediment supply trends to the tributaries is in the mass wasting assessment module.

The lower tributaries exhibit sets of terraces. In general, in the moderately and unconfined segments, there is a flood plain, and younger Holocene terraces and older terraces. The younger terraces are typically "flood prone," being susceptible to inundation at flows less than twice bankfull depth (Rosgen, 1994). The likelihood of these intermediate surfaces flooding is strongly influenced by bed aggradation and downcutting. The older terraces, perched above the flood prone area, are considered relict.

The channels are confined by the valley walls or older terraces and their character is strongly influenced by large wood and debris jams. In the moderate and lower gradient channels (<8%), avulsion associated with debris jam collapse is common, and locally controls channel location within the channel migration zone (CMZ), the area of potential channel location.

The unconfined mainstem has not historically been directly affected by catastrophic disturbance, but has exhibited vertical and lateral instability in response to sediment waves (Pess and Benda, 1994). The aggradation and down cutting are attributed to changes in supply of coarse sediment and to peak flow effects, exacerbated by a historic decrease in channel roughness due to a reduction in the number of large, functional pieces of wood. Information on sediment production from the upper North Fork Stiilaguamish is in Pess and Benda (1994). Five of the largest peak flows on record in the mainstem at Arlington have occurred in the last decade (Ketcheson, 1992). More information on flood history is in the hydrology assessment module.

E.2. METHODS-

The methods used in this channel assessment generally follow the standard procedures outlined in version 2.1 of the watershed analysis manual. There are no significant deviations from the manual, and additions are noted below. The analysis is level 1 although the minimum criteria were exceeded in most areas.

The majority of the channel surveys were conducted with the fish module co-analyst, George Pess, and others. Pool frequency, wood, and pool forming factor information were collected by, or under the supervision of, George Pess. Additional tributary survey data were supplied by the Tulalip Tribes, from an on-going study on the physical limiting factors to coho production in the Stillaguamish and Snohomish River Basins. Mainstem channel data were derived from a study done by Pess and Benda (1994). Additional insights were derived from discussion and field assistance of Andy Haas (University of Washington), David Brock (currently with the Tulalip Tribes), and Pat Stevenson, fish module co-analyst (Stillaguamish Tribe).

In addition to partitioning the fish-bearing and response reaches of the stream channel, the entire known drainage network was divided into segments. This provided the assessment team with the flexibility to consider the sensitivity of all portions of the channel system, and facilitated identification of specific parts of the channel in the casual mechanism reports (CMRs).

The principle product of the channel module is to determine the sensitivity of channel segment to changes of a variety of channel inputs. An attempt was made to systemize this process, beyond the guidance supplied in the manual. This method is discussed in the "Channel Sensitivity" portion of this module.

An additional assessment product, not prescribed in the module, is a surficial geology map (Fig. E1), which was generated because of the strong linkage of channel form and sensitivity to geologic materials and land forms. The map, based on limited information, is schematic in nature and no systematic attempt was made to incorporate information from previous maps (e.g., Tabor and others, 1988).

E.3. STREAM CHANNEL PARTITIONING-

Initially, the entire known drainage network was partitioned into channel segments, based on gradient and valley confinement classes. Information on stream channel location was derived from USGS (1:24,0000 scale) topographic maps, the DNR GIS hydrology layer, and, where available, large scale (1":400' scale) topographic maps prepared for the DNR Proprietary Division. Segments were consecutively numbered from mouth to headwater within a tributary, and from east to west by tributary. The main stem segments were numbered last. The numbering system was subsequently modified based on information generated by the analysis team, and a few segments were deleted and numerous segments were added, and labeled alpha-numerically. The segments are mapped in figure E2, and Table E2 lists segment by slope and confinement classes. The segment identification worksheet (substitute form E1) is in E9.0 Summary Data.

E.4. HISTORIC TRENDS-

Time series of aerial photographs were used to determine historic trends in channel conditions. For tributaries surveyed, the channel disturbance worksheets (form E-2) are in E9.0 Summary Data. Information on the mainstem segments is from Pess and Benda (1994).

E.4.1. Mainstem Trends- Channel widths for mainstem segments were measured using photographs from 1970, 1978, 1983, 1987, and 1991. The data are listed in Table E3. The 1942 photographs are of lower quality, and were used for qualitative observation only.

Between 1942 and 1970 the mainstem was transformed from a multichanneled river in to essentially a single channel, due to the loss of large wood jams. From 1970 to the present there has been significant channel widening in all but one of the segments. When the mainstem width data is looked at in its entirety (from RM 20.5 to 34.5), there is evidence of the passage of two distinct coarse sediment waves. The magnitude and timing of the wave is controlled by the coarse sediment production in the NF Stillaguamish and flooding in the NF Stillaguamish (Pess and Benda, 1994).

Sediment production from landslides was calculated form a landslide inventory above RM 34.5 using the 1962, 1978, 1983 and 1987 photographs. Volumetric rates are plotted in Figure E3. All landslides were associated with timber harvest and roads, in approximately equal amounts.

Table E2 - Channel segments by slope and confinement classes

Sub-basin	Segment#	Slope Class	Confinement Class	Sub-basin	Segment#	Slope Class	Confinement Class
Brooks	1	<1	UC		22	>20	C
Creek	2	2-4	UC		23	8-20	C
	3	4-8	C		23a	8-20	C
	3a	>20	C		24	>20	C
	3b	8-20	C		25	>20	C
	4	>20	C		26	>20	C
	4a	8-20	C		27	8-20	C
	4b	8-20	C		28	4-8	C
	5	8-20	C		29	8-20	C
	5a	4-8	MC		29a	8-20	C
	5b	4-8	MC		30	>20	C
	5c	4-8	MC		31	8-20	C
	5d	4-8	MC		32	8-20	C
	5e	4-8	MC		33	>20	C
	5f	4-8	MC		34	8-20	C
	6	1-2	C		35	>20	C
	7	4-8	MC		36	8-20	C
	7a	>20	C		37a	>20	C
	8	>20	C		37	>20	C
	9	<1	UC		38	>20	C
	10	2-4	MC		39	8-20	C
	10a	>20	C		40	>20	C
	10b	>20	C		41	>20	C
	10c	>20	C		42	>20	C
	10d	>20	C		43	8-20	C
	11	8-20	C		44	>20	C
	11a	>20	C		45	8-20	C
	11b	>20	C		46	8-20	C
	11c	>20	C		47	>20	C

Table E2 - Channel segments by slope and confinement classes

Sub basin	Segment#	Slope Class	Confinement Class	Sub-basin	Segment#	Slope Class	Confinement Class
	12	4-8	MC		48	8-20	C
	12a	>20	C		49	>20	C
	13	4-8	C		49a	>20	C
	14	4-8	MC		50	8-20	C
	14a	4-8	C		51	>20	C
	14b	4-8	C		52	4-8	MC
	14c	4-8	C		52a	8-20	C
	15	4-8	C		52b	8-20	C
	16	8-20	C		52c	8-20	C
	17	4-8	C		53	<1	UC
	18	8-20	C		53a	<1	C
	19	>20	C		54	<1	UC
	20	2-4	MC	Whitman	55	1-2	UC
	20a	8-20	C	Bench	55a	1-2	UC
	20b	4-8	MC		56	4-8	MC
	20c	4-8	MC		56a	>20	C
	21	8-20	C		56b	>20	C
	21a	4-8	C		56c	>20	C
	56d	>20	C		78	8-20	MC
	56e	>20	C		79	8-20	C
	56f	>20	C		80	8-20	C
	56g	>20	C		80a	1-2	MC
	57	2-4	C		81	4-8	MC
	57a	>20	C		82	>20	C
	57b	>20	C		83	8-20	C
	57c	>20	C		84	>20	C
	57d	>20	C		85	>20	C
	57e	<1	C		86	8-20	C
	57f	<1	C		87	>20	C
	57g	>20	C		88	8-20	C

Table E2 - Channel segments by slope and confinement classes

Sub basin	Segment#	Slope	Confinement	Sub-basin	Segment#	Slope	Confinement
		Class	Class			Class	Class
	58	8-20	MC		89	>20	C
	59	>20	C		90	8-20	C
	60	1-2	C		91	8-20	C
	60a	2-4	C		92	>20	C
	60b	4-8	MC		93	>20	C
	60c	4-8	MC		94	>20	C
	60d	<1	C		95	>20	C
	60f	2-4	C		96	>20	C
	60g	4-8	C		96a	>20	C
	60h	8-20	C		97	>20	C
	60i	4-8	C		98	>20	C
	60j	8-20	C		99	>20	C
	61	8-20	C		100	>20	C
	62	2-4	C		101	2-4	MC
	62a	8-20	C		102	8-20	C
	63	8-20	C		103	>20	C
	64	>20	C		104	8-20	C
Rollins	65	2-4	UC		105	4-20	MC
Creek	65a	1-2	C		105a	8-20	C
	65b	8-20	UC		106	>20	C
	65c	8-20	UC		107	>20	C
	65d	8-20	C		108	8-20	C
	66	4-8	UC		109	>20	C
	67	4-8	UC		110	>20	C
	67a	8-20	C		111	>20	C
	68	4-8	MC		112	8-20	C
	69	8-20	MC		113	>20	C
	70	>20	C		114	8-20	C
	71	8-20	MC		115	>20	C
	72	2-4	MC		116	>20	C
	73	8-20	C		117	>20	C
	74	4-8	MC		118	>20	C

Table E2 - Channel segments by slope and confinement classes

Sub-basin	Segment#	Slope Class	Confinement Class	Sub-basin	Segment#	Slope Class	Confinement Class
	75	>20	C		119	>20	C
	76	8-20	MC		120	>20	C
	77	>20	C		121	>20	C
Dicks	122	1-2	UC		158	8-20	MC
Creek	123	4-8	MC		159	2-4	C
	124	2-4	MC		160	>20	C
	125	>20	C		161	8-20	C
	125a	>20	C		162	2-4	C
	126	8-20	C		163	>20	C
	128	>20	C		164	2-4	UC
	129	8-20	C		165	8-20	MC
	129a	8-20	C		166	>20	C
	129b	>20	C		167	>20	C
	129c	>20	C		167a	>20	C
	130	<1	C		168	>20	C
	130a	<1	C		169	>20	C
	131	>20	C		170	>20	C
	131a	<1	C		171	2-4	MC
	132	8-20	C		172	4-8	MC
	133	1-2	UC		173	4-8	MC
	134	8-20	MC		173a	8-20	C
	135	>20	C		174	8-20	C
	136	>20	C		175	8-20	C
	136a	>20	C		176	>20	C
	137	>20	C		177	>20	C
Mount	138	<1	UC		178	>20	C
Higgins	138a	<1	C		179	>20	C
	138b	<1	C		180	<1	UC
	138c	<1	C		181	<1	UC
	138d	<1	C		182	8-20	MC

Table E2 - Channel segments by slope and confinement classes

Sub-basin	Segment#	Slope Class	Confinement Class	Sub-basin	Segment#	Slope Class	Confinement Class
	139	8-20	MC		183	8-20	C
	140	8-20	MC		184	>20	C
	141	8-20	MC		184a	>20	C
	142	>20	C		185	8-20	C
	143	>20	C		186	>20	C
	144	>20	C		187	>20	C
	144a	>20	C		188	>20	C
	145	8-20	C		189	>20	C
	146	8-20	MC		190	>20	C
	147	4-8	UC		191	>20	C
	148	8-20	MC		192	>20	C
	149	8-20	MC		192a	>20	C
	150	>20	C		193	>20	C
	151	8-20	MC		194	<1	UC
	152	8-20	C		195	8-20	MC
	153	>20	C		196	>20	C
	154	>20	C		196a	>20	C
	155	4-8	UC		197	>20	C
	156	8-20	MC		198	8-20	MC
	157	>20	C		199	>20	C
	200	>20	C		247	<1	UC
	201	8-20	C		247a	<1	UC
	202	>20	C		248	2-4	UC
	203	2-4	UC		249	<1	UC
	204	4-8	UC	Segelson	250	2-4	UC
	206	>20	C	Creek	250a	2-4	C
	207	4-8	MC		251	2-4	MC
	208	>20	C		252	8-20	MC
	209	2-4	MC		252a	8-20	C
	210	8-20	C		252b	>20	C

Table E2 - Channel segments by slope and confinement classes

Sub-basin	Segment#	Slope Class	Confinement Class	Sub-basin	Segment#	Slope Class	Confinement Class
	211	>20	C		252c	>20	C
	212	>20	C		252d	8-20	C
	213	>20	C		253	>20	C
	214	>20	C		254	8-20	C
	215	>20	C		254a	>20	C
	216	>20	C		255	8-20	C
	217	>20	C		256	8-20	C
	218	8-20	MC		256a	>20	C
	219	>20	C		256b	8-20	C
	220	>20	C		257	8-20	C
	221	4-8	UC		258	>20	C
	223	4-8	MC		261	4-8	MC
	224	1-2	UC		262	>20	C
	225	2-4	UC		263	>20	C
	227	8-20	MC		263a	>20	C
	229	8-20	C		264	>20	C
	230	>20	C		264a	>20	C
	231	>20	C		265	>20	C
	232	>20	C		266	>20	C
	232a	>20	C		266a	>20	C
	233	>20	C		266b	>20	C
	234	>20	C		267	>20	C
	235	>20	C		268	>20	C
	235a	>20	C		269	>20	C
	236	>20	C		270	>20	C
	237	>20	C		271	>20	C
	238	>20	C		272	>20	C
	238a	>20	C		273	>20	C
	240	8-20	C		273a	>20	C
	241	>20	C		273b	>20	C
	242	>20	C		274	>20	C
	243	>20	C		275	>20	C

Table E2 - Channel segments by slope and confinement classes

Sub-basin	Segment#	Slope Class	Confinement Class	Sub-basin	Segment#	Slope Class	Confinement Class
	244	8-20	UC		276	>20	C
	245	8-20	C		277	>20	C
	245a	8-20	C		278	8-20	C
	246	8-20	MC		279	>20	C
	246a	8-20	MC		280	>20	C
	281	8-20	C				
	282	>20	C				
	282a	>20	C				
	283	>20	C				
	284	>20	C				
	285	>20	C				
	285a	>20	C				
	285b	>20	C				
	286	2-4	MC				
	289	4-8	MC				
	290	8-20	C				
	291	>20	C				
	292	>20	C				
	292a	>20	C				
	293	2-4	UC				
	294	8-20	MC				
	295	>20	C				
	296	8-20	MC				
	296a	>20	C				
	297	8-20	C				
	297a	>20	C				
	297b	>20	C				
	297c	8-20	MC				
	298	<1	UC				
	299	<1	UC				

Table E2 - Channel segments by slope and confinement classes

Sub-basin	Segment#	Slope	Confinement				
		Class	Class				
	300	<1	UC				
	301	<1	UC				
	302	<1	UC				
	303	<1	UC				
	304	<1	UC				
	305	<1	UC				

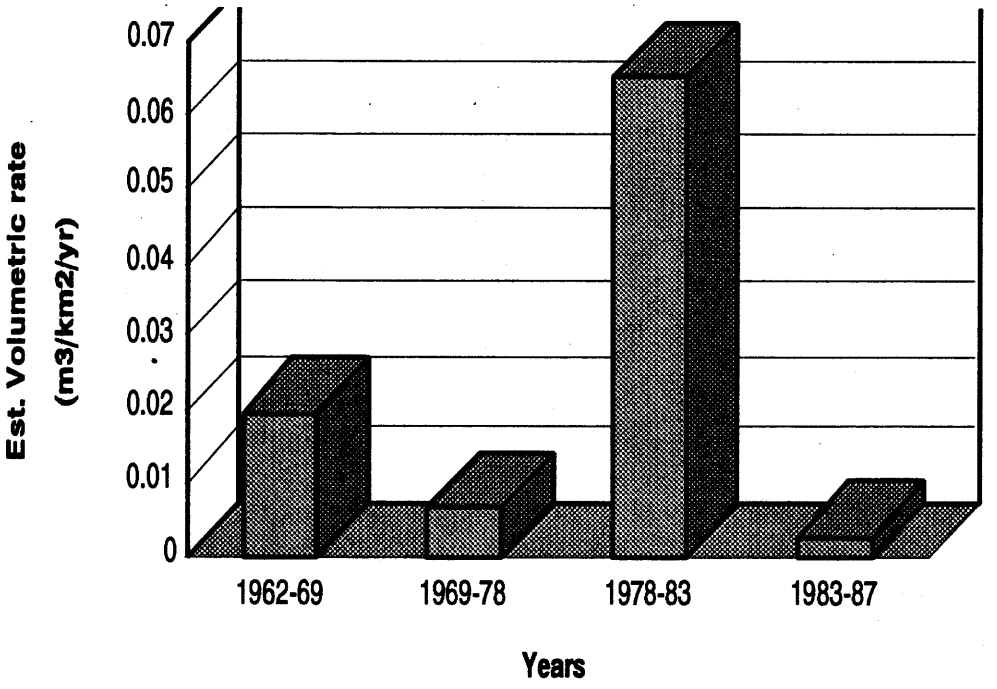
Table E3 - Mainstem channel width (in meters) trends

Mainstem channel segments

Photo Year	Above 305	305	304	303	302	301	300	299	298
1970	26	31	44	55	53	81	50	no data	no data
1978	26 +	37 +	57 +	63 +	75 +	115 +	61 +	no data	no data
1983	33 +	47 +	60 +	45 -	86 +	99 -	80 +	no data	no data
1987	28 -	41 -	63 +	48 +	89 +	90 -	88 +	no data	no data
1991	33 +	43 +	64 +	60 +	85 -	63 -	101 +	no data	no data

+ indicates channel widening from previous photo year.
- indicates channel narrowing from previous photo year.

Figure E3 - Sediment production from landslides - Upper NF Stillaguamish
(from Pess and Benda, 1994)



North Fork Stillaguamish flow data were obtained from a USGS gage near Arlington, with a 63 year period of record from 1929-1991. Of the ten largest flows on record, nine were from 1980 or later. Of the 20 largest flows recorded, 14 were from 1972 or after. When partial peaks are included, 17 of the 19 largest floods have occurred since 1976 (Ketcheson, 1992). The trend of recent large floods does not correlate well with storm magnitudes, and strongly suggests a land use influence. The NF Stillaguamish is one of two river in Western Washington exhibiting the anomalous behavior (Ketcheson, 1992). Refer to the hydrology assessment module for more details.

E.4.2. Tributary Trends- Qualitative changes in channel widths of select tributaries were interpreted using 1942, 1969, 1983, and 1991 aerial photographs, and are listed in Table E4. Portions of all larger, named tributaries were surveyed, in addition to two tributaries (known locally as Swede Creek and Trigger Lady Slough) to ensure uniform east-west coverage. The Brooks Creek analysis was done by the fish module analyst.

Most tributaries had wider riparian canopy openings in 1969 then in 1944 and experienced at least partial closure by 1983, before widening again by 1991. The exceptions are Trigger Lady Slough and Brooks Creek. Todd Thorn, public works module analyst, reported that the former creek is sub-surface year around between segments 183-184a. In Brooks Creek, the 1942 photos were not used for most segments, so channel width changes from 1942 to 1969 were not determined.

The system-wide trend of channel width changes is consistent with the pattern exhibited in Deer Creek, a sub-basin of the NF Stillaguamish adjacent to the Hazel WAU. In Deer Creek, the mainstem and major tributaries widened between the 1940's and 1960's, narrowed in the 1980's (but did not recover to initial widths), and widened again in the 1990's (Collins and others, 1994). Channel widening was interpreted to be the result of floods and riparian harvest.

Unlike Deer Creek, the dominant process influencing channel widths for the Hazel tributaries is catastrophic disturbance, debris flows and landslide dam-break floods, and to a lesser extent, other landslide types. Typically, debris flows ran out one to three segment lengths while dam-break floods ran to or near the mouth of the impacted tributary, from the initiation site. Mass wasting, where observed in the photos, is included in Table E4. This includes information on landslide type, photo year, and the segments directly affected.

All segments, expect for Trigger Lady Slough, has catastrophic disturbance in the period of record, and Rollins, Dicks, Swede, and Segelson Creeks had multiple events. All catastrophic disturbances observed, except for one debris flow, were associated with forest activities. Reactivation of deep-seated landslides is both a cause and effect of riparian canopy opening. Erosion of the toe of the landslide by the stream contributes to failure. Once failing, the features can remain chronic sediment sources for decades. Other causes of riparian opening included removal of riparian vegetation, and the passage of pulses of coarse sediment.

Channel widening associated with the passage of pulses of coarse sediment is influenced by sediment supply. Coarse sediment sources include increased landslide activity, bed and bank erosion, and fluvial mobilization of previously stored sediment, particularly after passage of a dam-break flood. Flooding and loss of large pieces of in-channel wood also contribute stream bed erosion and transport. In short, the recent history of the tributaries is dominated by "exploding hillslopes and streams gone bad."

Table E4 - Tributary channel width and trends

Brooks Creek

Segment-	22	15	14	13	12	11	10	9
1942	DA +	NA	NA	NA	NA	NA	NA	NA
1969	- -	0 0	IG 0	DS 0	0	0	0	0
1983	- -	0 0	0	-	+	0	DF -/+	0
1991	0 0	0 0	0	0	+	DS 0	+/-	(+)

Rollins Creek

Segment-	102	70	69	68	67	66	65
1942	0 0	0 0	0	DF +	0	0	0
1969	0 0	IG +	DF/DB +	DF/DB 0	DF/DB 0	DF/D B 0	DF/D B +
1983	0 0	DF +	(-)	DF (-)	IG (-)	(-)	(-)
1991	0 0	DF/DB +	DF/DB 0	DF/DB 0	DF/DB 0	DF/D B 0	DF/D B 0

Key

Relative change in riparian opening:
0 = no change
+ = significant opening
(+) = smaller opening
- = significant closure
(-) = smaller closure

Landslide type:
DF = debris flow
DB = dam break
IG = numerous inner gorge failures
DS = deep seated
DA = debris avalanche

Table E4 - Tributary channel width and trends (continued)
Dicks Creek

Segment-	129	125b	125	124	123	122
1942	IG +	0	+	DF? +	0	0
1969	-	0	DS (-)	-/+	IG, DS +	IG, DS +
1983	0	0	DF +	(-)	(-)	(-)
1991	0	0	-	0	-	0/-

Mt. Higgins - Trigger Lady Slough (goes subsurface between segments 184a & 183)

Segment-	184	183	182	181	180
1942	0	0	0	0	+
1969	0	0	0	0	-
1983	0	0	+	0	0
1991	0	0	-	0	0

Key

Relative change in riparian opening:
0 = no change
+ = significant opening
(+) = smaller opening
- = significant closure
(-) = smaller closure

Landslide type:
DF = debris flow
DB = dam break
IG = numerous inner gorge failures
DS = deep seated
DA = debris avalanche

Table E4 - Tributary channel width and trends (continued)

Mt. Higgins - Swede Creek

Segment-	231	230	229	228	227	226	225	224
1942	0	0	0	0	+	0	+	0
1969	+	DF +	DF +	DF +	(-)	+	0	+
1983	0	-	-	(-)	-	(-)	0	(-)
1991	DF +	DF +	DF +	DF +	+	0	+	(+)

Segelson Creek

Segment-	256	255	254	253	252	251	250
1942	IG 0	IG 0	0	0	+	0	0
1969	0	DF +	DF +	DF +	+	+	+
1983	0	0	+	0	DF +	(-)	(-)
1991	NA	NA	(-)	0	-	-	0

Key

Relative change in riparian opening:
0 = no change
+ = significant opening
(+) = smaller opening
- = significant closure
(-) = smaller closure

Landslide type:
DF = debris flow
DB = dam break
IG = numerous inner gorge failures
DS = deep seated
DA = debris avalanche

E.5. CURRENT CONDITIONS-

The principle objective of the field survey was to generate information that is used in conjunction with data from the fish habitat assessment module to determine the channel and fish habitat response to changes in hillslope inputs. All mainstem segments were qualitatively surveyed (Pess and Benda, 1994). Tributary segments were chosen to sample all types of response reaches, and a wide variety of channel types, well disturbed spatially across a representative suite of landforms and types of geologic material.

Field work for the mainstem was conducted between August and September of 1994, and for the tributary segment between 11-2-94 and 11-16-94. Conditions in November were generally stormy, and access to the upper basin was limited by snow.

Table E5 lists the tributary segments sampled, the percentage of length surveyed, and the field forms used. Channel information on segment 53 was collected for the fish habitat module and is included in the fish habitat assessment. All field forms (Form E-3, V* and pebble count) are in E9.0 Summary Data. Additional information collected for all segments includes recent trends in changes of stream bed elevation, active wood recruitment processes, evidence of recent avulsion, and presence of beaver sign.

Table E5 - Tributary field segments and field forms used

Field segments surveyed	Percent of segment surveyed	Channel assessment form E-3	Fine sediment form (v*)	Pebble count form
9	10%	yes	yes	yes
10	100%	yes	yes	yes
14	40%	yes	no	no
15	5%	no	no	yes
16	100%	yes	no	no
60a	35%	yes	no	no
65	100%	yes	yes	yes
66	100%	yes	no	yes
67	100%	yes	yes	yes
122	100%	yes	no	no
123	100%	yes	yes	yes
124	60%	yes	yes	yes
175	20%	yes	no	no
180	100%	yes	no	no
181	15%	yes	no	no
250	100%	yes	no	yes
251	100%	yes	no	yes
252	25%	yes	no	no

E.5.1. Tributary Conditions- Select survey data are summarized in Table E6. Qualitative ratings are included where no quantitative information is available, or to group segments by similar characteristics. Data on pool forming factors were collected as part of the fish habitat assessment, and this, and other channel data, are in the fish habitat assessment module.

As seen in Table E6, many low and moderate gradient depositional response reaches show evidence of recent (post 1983) dam-break flood passage or deposition. Dam-break floods typically removed much of the functional wood from the channel, reducing roughness and sinuosity, and increase bank and terrace erosion. Channel reaches that are currently plane-bed (such as segments 10, 66, and 67) bear the strongest dam-break signature, most likely having been forced pool-riffle channel types before the dam-break. All dam-break affected segments most likely have fewer pools and larger substrate, associated with loss of wood (and increasing gradient) resulting from dam-break flooding.

All the named tributaries visited, with alluvial or glacial lake silt and clay substrate, have experienced significant recent changes in stream bed elevations. Two styles of bed changes are recognized: recent aggradation followed by degradation, and incision (without evident prior aggradation).

Reaches with evidence of the aggrade/degrade sequence had, or were directly below, dam-break floods (segments 9 and 10), had upstream debris flows (segments 250 and 251), or were downstream of multiple debris avalanches and deep-seated failures (segments 122 and 123). The aggradation followed by degradation is interpreted to be the passage of a fluvially transported coarse sediment wave.

All of the remaining non-till tributaries of moderate or low gradients, and portions of segments 10 and 123, which had wave passage, were recently incised. All of these incised channel were in glacial lake silt and clays. Additionally, a smaller low-gradient segment (60a) on clay also was incised almost its entire length. Two steeper segments, ($\geq$15%), on clay showed no evidence of significant incision (175 and 252). One of these segments (175) runs down the face of an active deep-seated failure.

Segments with incision had significant bank erosion, ranging from 20% to 99% of the segment length. The average eroded length was 48%. Depending upon the segment, incision is interpreted to be related to recent deep-seated activity (segments 65, 66, 67, 123, and 124) or possible flow changes (segment 60a), or unknown causes (segment 10).

The mechanism for incision associated with deep-seated failure is assumed to be similar to that found in Montague Creek, a nearby sub-basin to the NF Stillaguamish. In Montague, deep-seated failure would locally elevate the stream bed in the more confined reaches (Kennard and Pess, 1994). The bed would armor over time, and at some point the stream side bank (comprised of fine grain materials) would become more erodible, relative to the bed, during high flows. The stream would erode laterally, "falling off" its coarse bed, and incise to 1-2 meters below the old bed, which remained perched above the newer channel. This phenomenon was most evident in segment 67, which had active deep-seated failure along 72% of its length.

A different mechanism is interpreted for segment 60a, a smaller low gradient reach on clay. The incision along 99% of its length was interpreted to be flow related. Possible contributing factors include rain-on-snow events (see hydrology module) or increased flow to the channel due to a forest road diverting drainage from another stream (see the causal mechanism reports). The cause of incision in segment 10, which had evidence of a sediment wave, was less obvious, and a contributing factor probably includes loss of in-stream wood and flow effects. The effect of mainstem vertical bed changes (of approximately 2 meters) on tributary incision is unknown.

All depositional reaches, with potential coarse sediment sources, had high sediment supply relative to transport capacity. This conclusion is supported by the q* calculation which ranged from 0.8 to 0.95. The q* reading in segment 9 (0.63) was in an area the recently degraded following a sediment wave, and the local coarsening causes the q* calculation to be less indicative of channel sediment supply.

V* values are a measure of fine sediment storage in a gravel bedded reach. V* measurements ranged from 0.21 to 0.63, and exceeded 0.2, the value associated with high fine sediment supply. Sub-surface fines percentages, from pebble counts, supported this conclusion. Fine levels are partitioned by geology, with segments on till having low fines, based on qualitative observation.

Confidence in channel conditions interpreted from the field data is high. Confidence in extrapolating the interpretations to the unsurveyed segments is generally high. Confidence is moderate to low in assuming the channel characteristics seen in segment 60a apply to all the smaller streams in the lower valley on clay, and that other stream segments on active deep-seated failures are similar to segment 175.

E.5.2. Mainstem Conditions- Mainsten conditions are described in Pess and Benda (1994). Currently all segments of the mainstem, except for 301, are wider than in 1970, and all have downcut relative to their highest elevation in the same time period. As a result, the mainstem is a broad, shallow, single channel with a reduced amount of wood and pools. Specifics are in the fish habitat module.

Table 6 - Select Channel Survey Data

Sub basin	Segment	Gradient	Res type	Chl type	Landform	Geomat	Confine	Entrench	Side chls	q*	V*	Sub fines	Cat dist	Lslide type	Bed alt	Bk erosion	Avulsion	WRP	Rip cond	% LWD pools	Beaver Sign
Brooks Cr	9	<1%	D	B/PR	LT	Al	UC	E,UE	Y	0.63	0.33	36 %	Below DB	1-DA. Low	A,D	5-10%,L		BC		64 %	Y
Brooks Cr	10	3-4%	T/D	PB,FPR, SP	T	Cl	MC	ME	Y	0.91	0.39	19 %	DB	Many DA. High	A,D,INC.	40%M,H		LJ,BC		44 %	
Brooks Cr	14	5%	T/D	SP,C	T	T	MC	ME	Y		L			Many DA. High		25%,M		LJ			
Brooks Cr	15	4-5%		FPR		T			N	0.95				Many DA. High		32%,M					
Brooks Cr	16	12%	T	SP,C	T	T	C	ME	N		L			Low		5%,L	Y	BC		50 %	
Whitbench	60a	2%	D	PR/FPR	LT	Cl	C	E	N		H	H		2-DA. Moderate	INC.	99%,H		BC		50 %	Y
Rollins Cr	65	3%	D	FPR/PR	T	Cl	UC	UE,ME	Y	0.87	0.49	46 %	DB-2	Major DS. High	INC.	60%,H		LJ,BC	L	59 %	
Rollins Cr	66	5%	D	PB/SP	T	Cl	UC.MC	ME	Y	0.83	H	18 %	DB	MultDS(33 %),DA. High	INC.	25%,M		LJ,BC,MW	L	22 %	
Rollins Cr	67	4%	D	PB/SP	T	Cl	UC,MC	ME	N	0.92	0.63	20 %	DB	DS-72%. High	INC.	50%,H		MW,BC	L		
Dicks Cr	122	2%	D	PR	LT,FP	Al	UC	ME	Y	0.88		10 %		Low	A,D	25%,M		BC, LJ	L	69 %	?
Dicks Cr	123	4-6%	T/D	SP,PB,FPR	T	Cl	MC,UC	ME	Y	0.95	0.33	53 %		Mult.DS/DA. High	A,D,INC.	20%,M	Y	LJ,BC	L,M	42 %	
Dicks Cr	124	3-4%	T/D	FPR,PR, SP	T	C, T, G	MC,C	ME,E	N	0.8	0.21	29 %		Mult. DS. High	INC.	50%,H		MW,LJ	M	34 %	
Mt. Hig	175	15%	T	SP,C	T	Cl, G	C	E	N			H		On DS				BC,	M,L		
Mt. Hig	180	<1%	D	SLOUGH	FP	Al	UC	ME	Y					Low		L		BD	M		Y
Mt. Hig	181	<1%	D	PR	LT	G	UC	UE	Y			H		Low				BC	L		Y
Segel Cr	250	2-3%	D	PB,FPR	LT	Al	UC,MC	UE	Y	0.89	H	21 %	DB,DF up	Low	A,D	5%,L	Y	BC	L	50 %	?
Segel Cr	251	4%	D	PB,FPR	T	Cl	MC,UC	ME,UE	Y					DS. High	A,D	5%,L	Y	BC, LS	M	25 %	
Segel Cr	252	17%	T/D	SP,C		Cl, G,Br	MC	E,ME						1-DA. Moderate		5%,L	Y	BC, LS	H		

KEY TO SELECT CHANNEL SURVEY DATA (TABLE E6)

Response Type D= depositional T = transport	*Landform* LT = low (young) terrace T = terrace FP = flood plain	*Confinement* UC = unconfined MC = moderate confinement C = confined	Sub-surface fines, landslide types, and bank erosion L = low M = moderate H = high	Bed altitude trends A = aggradation D = degradation (following aggradation) INC. = incision (without prior aggradation)	Riparian Condition L = < 12" DBH deciduous M = < 12' DBH confierous & deciduous H = > 12" DBH coniferous
Channel type B = braided PR = pool-riffle FPR= forced pool-riffle PB = plane-bed SP = step-pool C = cascade	*Geologic material* Al = alluvium Cl = silt/clay T = till G = undifferentiated glacial sediments Br = bedrock	*Entrenchment* UE = unentrenched ME = moderate entrenchment E = entrenched	Catastrophic disturbance DA = debris avalanches DS = deep-seated landslides DB = dam-break floods DF = debris flows	Wood recruitment processes (WRP) BC = bank cutting LJ = log jams MW = mass wasting BD = blowdown	

E.6. CHANNEL SENSITIVITY AND GEOMORPHIC MAP UNITS

E.6.1. How Channel Sensitivities And Geomorphic Units Are Determined- All segments are assigned to one of the ten geomorphic units (shown on Figure E4 - Map of Geomorphic Units). The primary criterion defining a specific geomorphic cluster is that all grouped segments have the same sensitivities to changes in inputs of wood, sediment, and water. The secondary driver to geomorphic unit differentiation is to identify specific segment types to facilitate synthesis and prescription writing.

In the analysis, nine of the ten geomorphic clusters have differences in sensitivity to at least one channel input. In the instance where two units have identical sensitivities, the units are differentiated by gradient. The lower gradient segments were found to have a higher potential for fish presence; a useful distinction for the prescription team.

Surveyed channels were analyzed for sensitivity to changes in inputs from hillslopes, specifically: coarse and fine sediments, peak flows, and large woody debris, along with response to catastrophic damage. The sensitivity diagnosis was done with the fish module analyst. As a result, some channel calls, noted later, are different than would result from purely geomorphic considerations. The sensitivity diagnosis is extended to the unsurveyed channel based on physical similarities and differences of the characteristics associated with the sensitivities of the field segments.

Rather than rely solely on the Channel Response Matrix (Table E2), I attempted to systematize my approach to determining channel sensitivities. I relied on physical characteristics currently evinced in the channel, and evidence of past response when available. When explicit fish habitat criteria are used, they are also identified.

To determine a segment's sensitivity to changes in large woody debris loading, I tried to discern how important is the role of wood is in influencing the processes that form all channel surfaces (bed, bars, flood plain, and flood prone areas). The primary consideration is the role of wood as a pool forming factor for low and moderate gradient channels. For steeper channels, the importance of wood in storing sediment is investigated. Plane-bed channel types are noted, as increases in functional wood transform these reaches into forced pool-riffle channel types. The role of log jams and the importance of avulsions are considered along with the potential association of wood with changes in sinuosity and recent incision. In reaches where wood is not geomorphically significant, such as lakes, naturally occurring bedrock chutes, and channel with minimal sidebanks, the role of wood as fish cover is considered.

For sensitivity to peak flows, I determined if the channel is currently sensitive to larger flows and typical bankfull events, as impacted channels may further degrade under even normal flow regimes. Key characteristics include entrenchment and a history of bed elevation changes. For incision, the style is noted, including bed lowering: 1) following an aggradational pulse of sediment , 2) from erosion through accumulated sediment following log jam collapse, and 3) by incision through in place fine sediment, especially if adjacent to deep-seated failure. Other primary factors are the importance of log jams and avulsion processes, side bank vegetation and evidence of recent erosion, and riparian condition (with respect to root contributions to stream bank and channel integrity). The position, or potential position, of a channel relative to a terrace edge or valley wall, particularly if there is landslide potential, is also noted. A fish habitat factor is the presence or absence of spawning gravels.

For coarse sediment sensitivity, I determined past response to changes in coarse sediment production where possible. Evidence of past and recent aggradation (especially if field surveys reveal different levels of advantageous roots on riparian vegetation, indicative of surface level changes) is considered, along with q* values on channels not recently incised. Reach type (particularly depositional), bar types and trends (especially medial bars and deposits on the outside of bends and on terrace and flood prone areas), and substrate (gravel versus cobble) are noted.

For fine sediment sensitivity, primary considerations include field evidence of pool filling (V* calculations), the amount of fines in the sub-surface pebble counts, and the particle size distribution (especially if bi-modal) from the surface and subsurface pebble counts, in addition to the reach type (particularly depositional). The presence of significant local fine sources, particularly deep-seated failures in glacial sediment or fault gouge, and turbidity levels relative to flow amounts,if known, are considered. Factors relating to fish include the potential for fish usage, and if present, the distribution of spawning gravels. If there is no fish potential, and the channel bed is undisturbed and is established on fine grained materials, sensitivity is considered low.

E.6.2. Gemorphic Units, Associated Segments And Their Sensitivities- The sensitivity of the geomorphic units to changes in channel units are listed in Table E7. The basis for the clustering and sensitivity diagnosis for each geomorphic unit follow, in a format similar to form E6. Included are the field surveyed and extrapolated segments.

Table E7 - Geomorphic unit sensitivities

Geomorphic Unit	Indicator Reach	Coarse Sediment	Fine Sediment	Large Wood	Peak Flows	Catastrophic Damage
1)Alluvium	9, 53	high	high	high	med	high
2)Clay, < 12%	65,251	med	high[1]	high	high	high
3)Till, < 12%	16	low	low	high	med	high
4)Steep	-	low	low	high	med[1]	high
5)Bedrock	-	low	low	low	low[1]	med[2]
6)First order	-	low	low	high	high	high
7)Deep-seated	175	low	low	high	high	high
8)Ox-bow	180	med	high[1]	med[1]	low	high
9)Clay, < 3%	60a	low	high[1]	high	high	high
10)Main	301	high	high	high	high	high

1 - includes fish consideration
2 - variable sensitivity, see text.

Geomorphic unit #1: Low gradient (<3%), gravel bedded tributaries on low terraces.

Description: Gradients are less than 3%. These segments are located on the lowest glacial terraces and the flood plain of the mainstem, with generally little interaction with the higher terrace risers. The response type is depositional with some transitional transport/depositonal. Channel types include braided, pool-riffle, plane-bed, and forced pool-riffle, with bankfull widths of approximately 15 meters. They are unconfined and unentrenched, with inclusions of moderately entrenched channel.

Segments:

Field verified: 9, 122, 250
Extrapolated: 1, 2, 53, 54, 55, 55a, 138, 181, 194, 203, 224, 286, 293

Conditions and Response Potential:

Coarse Sediment:
Condition: All surveyed channel are predominantly depositional reaches that have experienced recent aggradation. Braided channels, medial bars, and high q*'s (even though channel has subsequently incised) indicate high coarse sediment loadings. Brooks Creek avulsed to a new channel after receiving a pulse of coarse sediment in 1990.
Response: Increased coarse sediment will cause channel aggradation, widening, and bar growth. Stream segments may go sub-surface at low flows.
Sensitivity: High

Fine Sediment:
Condition: Fines were observed in pools and in sheltered locations. The one V* (0.33) indicates a high amounts of fines which could affect spawning gravels. Moderate turbidity was observed in segment 9 during rain. Fines from the sub-surface pebble count ranged from 10% to 36%.
Response: Increase fines would decrease pool volumes, increase turbidity, and increase sub-surface fines.
Sensitivity: High

Peak Flow:
Condition: All surveyed channel have recently incised 1 to 2 meters. The percentage of eroded banks ranges from 5% (low) to 25% (moderate). The channels are typically unentrenched with moderately entrenched inclusions.
Response: Increased flows will increase incision and bank erosions. Lack of entrenchment moderates impact.
Sensitivity: Moderate

Large Woody Debris:
Condition: Approximately 50% to 70% of pools are from log jams or large pieces of wood (approximately 50-90cm). Wood contributes to bar stability and is a significant component of channel roughness, and root mats are a principle source of bank protection.
Response: Reduced wood loading results in fewer pools, increased bar instability, decreased roughness (and increased source of gravels), and increased bank erosion.
Sensitivity: High

Catastrophic damage:
Condition: Segments are just downstream of debris flow and dam-break flood depositional sites and have received pulses of fine and coarse sediment.
Response: Debris torrents will exacerbate impacts from fine and coarse sediment.
Sensitivity: High

Geomorphic unit #2: Moderately steep (3% - 12%) tributaries on upper terraces with glacial lake clays.

Description: This unit applies to tributaries with gradients 3% to 12% on upper terraces with significant exposures of glacial lake clays, and glacial-fluvial clays, silts, and sands. First order channels fitting this description are included. The segments surveyed have gradients from 3% to 6%, but similar features were seen on the lower portion of segment 252, which had a gradient of 17% on clay, with obstructions reducing the local slope. The segments are moderately to unconfined with some confined areas, and the channel frequently abuts risers from higher terraces. The principle response type is transitional transport/depositional and depositional. Channel types are primarily forced pool-riffle, plane-bed, step-pool, and lesser amounts of pool-riffle. The bed and alluvial banks are boulder/cobble. Bankfull widths range from approximately 12 to 20 m.

Segments:

Field verified: 10, 65, 66, 67, 123, 124, 251

Extrapolated: 3, 11, 12, 20, 56, 58, 60b, 60c, 61, 62a, 63, 64, 68, 74, 80a, 133, 139, 140, 146, 147, 148, 151, 155, 156, 163, 164, 165, 171, 172, 173, 182, 195, 198, 204, 209, 218, 221, 225, 244, 246, 248, 249, 251

Conditions and Response Potential:

Coarse Sediment:

Condition: Three of the segments experienced aggradation prior to incision, though most incision was not preceded by aggradation. The segments are transitional between transport and depositional reaches, and the substrate is generally boulder/cobble.

Response: Increases in coarse sediment may cause local aggradation exacerbating bank erosion and terrace landsliding. Coarse sediment inputs have less of an impact than wood or peak flows.

Sensitivity: Moderate

Fine Sediment:

Condition: In moderate flows, fines were observed in sheltered locations and in downstream strands. More fines were adjacent and downstream of active deep-seated failures. V* values averaged 0.41 and ranged from 0.21 and 0.63. Surface particle size distributions were bi-modal, and sub-surface fines, from pebble counts, ranged from 18% to 53%. Gradients are moderate, and there are minimal spawning gravels. Several segments were turbid during the survey period.

Response: Increased fines will decrease pool volumes, increase turbidity, and increase sub-surface fines.

Sensitivity: High

Peak Flow:
Condition: All surveyed segments have recently incised 1 to 3 meters, and the percentage of eroding banks ranges from 5% to 50%, with most segments experiencing excessive amounts. There is a high percentage of landsliding (debris avalanches and dep-seated failures) where the terrace riser abuts the active channel. Approximately 72% of segment 67 has active deep-seated slides along the channel. Incision and bank erosion are contributing factors to the landslides. The channel is generally moderately entrenched with some unentrenched areas. It is locally entrenched near active clay failures.
Response: Elevated peak flows will contribute to further incision, bank cutting, terrace landsliding, and loss of channel sinuosity.
Sensitivity: High

Large Woody Debris:
Condition: Large wood (60 - 90 cm DBH) and log jams form 22% to 59% of the pools in the surveyed segments. The dominant process controlling channel morphology in most segments is avulsion at log jams. Wood additionally contributes to bar stability, traps sediment, and forms steps. Wood is a significant component of channel roughness, and tree roots contribute to bank (and channel) stability. Channel have recently incised 1 to 3 meters, and sinuosity has been reduced.
Response: Reduced wood loading will result in fewer pools and log jams, reduced roughness and bar stability, and increased bank erosion. Bed incision and channel straightening will be enhanced.
Sensitivity: High

Catastrophic damage:
Condition: All surveyed segments have experienced debris torrent passage and deposition, or had deposition immediately upstream. Rollins had two dam-break floods in the photo record. Segments with dam-break passage have had most of the functional wood removed from the channel and obliteration of the active channel. Increased bank and terrace erosion results, roughness is decreased, and sinuosity is lost.
Response: Catastrophic disturbances decrease wood, pools, roughness, and sinuosity, and increase sediment.
Sensitivity: High

Geomorphic unit #3: Moderately steep tributaries on upper terraces with competent glacial materials.

Description: This unit applies to tributaries with gradients of 4 to 12% on upper terraces with significant exposures of glacial till and other competent materials. The response types were transport and transitional transport/depositional, with step-pool and cascade channel types. The channel bed and alluvial banks were primarily boulder/cobble, and the terraces were comprised of colluvium overlying indurate clays, silts, and sands with clast inclusions of all particle sizes found in the bed, including house size boulders. Measured bankfull widths ranged from 7 to 22m.

Segments:

Field verified: 14, 16

Extrapolated: 5, 5a, 5b, 7, 15, 17, 21, 27, 28, 39, 59, 69, 71, 76, 81, 101,104, 105, 125b, 126, 131,132, 134, 141, 149, 152, 183,185, 207, 227, 246a, 289, 294, 296, 297

Conditions and Response Potential:

Coarse Sediment:

Condition: No observed segments have aggraded recently, and the response type is predominantly transport, with inclusion of depositional. The one measured q* was high (0.95), and there are medial bars.

Response: An increase in coarse sediment would cause local aggradation and increase bank erosion and debris avalanches from the terraces. These are secondary effects relative to the influence of wood and flows.

Sensitivity: Low

Fine Sediment:

Condition: In moderate flows, no fines were observed in pools. Sand was deposited locally behind obstructions and over banks on the flood plain. Sub-surface fines from the pebble count were 32%, and the surface count was unimodal.

Response: Increases in fine sediment inputs would generally have little effect. There would be local increases in deposition behind obstructions and on the flood plain, and an increase in subsurface fines.

Sensitivity: Low

Peak Flow:

Condition: Surveyed segments did not appear to have recently aggraded or incised, are moderately entrenched, and have minimal spawning gravels. Observed bank erosion ranged from 5% to 25% of bank length.

Response: Increased peak flows increase bank erosion, particularly where the active channel is along a terrace riser. Additionally, there is a potential to destabilize bars associated with wood.

Sensitivity: Moderate

Large Woody Debris:
Condition: Wood pieces and log jams are significant pool forming factors, accounting for a measured 50% of the pools in segment 16, and an estimated 30% of the pools in segment 14. Wood function includes promoting bar stability, trapping sediment, and forming steps. Tree roots are the principle component of bank stability (particularly where colluvium overlays till) and contributes to channel roughness.
Response: Loss of wood will result in loss of pools, bar stability, roughness, and an increase in bank erosion.
Sensitivity: High

Catastrophic damage:
Condition: There is no evidence of debris flow or dam-break passage in the field or photo observations. However, channel types could support torrent initiation and transport.
Response: Catastrophic disturbances decrease wood, pools, roughness, and bar stability. Bank and bed erosion and terrace landsliding would increase.
Sensitivity: High

Geomorphic Unit #4: Steep (>12%) channel with obstructions, alluvium, and colluvium.

Description: This unit includes second and higher order streams, and applies to streams with gradients exceeding 12%. The unit is a collection of a variety of stream types with similar responses to changes in inputs of wood, water, and sediment. Response types include both transport and source reaches, and the channel types are cascade and step-pool for the former, and colluvial for the latter. Channels are confined and usually entrenched, and bed material is primarily boulders and cobbles, with gravels behind obstructions. It applies to streams of all sizes. First order streams are in other geomorphic units.

Segments:

Field verified: 252

Extrapolated: 4, 13, 18, 22, 23, 32, 33, 34, 36, 43, 46, 50, 52, 70, 73, 78, 80, 82, 83, 91, 94, 96, 102, 107, 108, 110, 112, 114, 117, 119, 125, 129c, 135, 143, 153, 160, 166, 169, 176, 196, 199, 201, 206, 210, 214, 216, 229, 230, 231, 234, 237, 240, 253, 254, 255, 256, 263, 265, 266, 273, 277, 278, 282, 290, 291.

Conditions and Response Potential:

Coarse Sediment:

Condition: Coarse sediment is mobile, but transport is reduced by obstructions. Transport capacity generally exceeds supply.

Response: When sediment reservoirs are filled, all but largest particles are mobile.

Sensitivity: Low

Fine Sediment:

Condition: Transport capacity greatly exceeds sediment supply. There is local storage in substrate and near obstructions.

Response: An increase in fines will be delivered downstream relatively rapidly.

Sensitivity: Low

Peak Flow:

Condition: Channels have frequent wood jams, which are generally stable. The banks and bed are comprised of boulders, cobbles, roots, wood, and bedrock and are generally resistant to lateral migration and down cutting. There is local bank erosion, often in association with obstructions. Channels are constrained and usually entrenched.

Response: Peak flows can destabilize wood jams, and the channels are typically entrenched. However, with natural wood loadings, the jams, and the bed and banks, are stable. Decreased wood and large inputs of coarse sediment could reduce the quantity of obstructions, or bury them. Dam-break floods can initiate during peak flows in channel with large quantities of small wood (Coho and Burges, 1993).

Sensitivity: High (With large quantities of slash in channels of approximately 40% gradient).
Moderate/High (With reduced amounts of large wood, or large quantities of coarse sediments). Moderate (With natural wood loadings).

Large Woody Debris:
Condition: On average, 15 times as much sediment is stored behind wood in the segments, than is transported through the segment annually (Megahan, 1982). In addition to trapping sediment, wood and jams are an important component of channel roughness (up to 70%), and tree roots are a factor in bed and bank stability.
Response: Reduction in wood will drastically reduce sediment storage, lower hydraulic roughness, and increase bank and bed mobility.
Sensitivity: High

Catastrophic damage:
Condition: Several segments have experienced debris flows and landslide dam-break floods.
Response: Undifferentiated debris torrents will generally travel through these segments, and debris flows will be extremely erosive if the gradient exceeds approximately 20%. Torrents will remove wood, decreasing sediment storage and roughness, and erode stream bed and banks.
Sensitivity: High

Geomorphic unit #5: Bedrock channels

Description: These segments are comprised of competent bedrock channels with little storage of sediment or wood. Applies to all gradients, though most are steep. Includes snow avalanche chutes and first order channels.

Segments:

Field verified: none

Extrapolated: 144, 144a, 167a, 177, 178, 184, 184a, 187, 188, 189, 190, 192, 192a, 193

Conditions and Response Potential:

Coarse Sediment: Transport capacity exceeds sediment supply, which means that increases in coarse sediment will be transported downstream at a relatively rapid rate. Relative sensitivity is low.

Fine Sediment: Relative sensitivity is low for the same reason as with coarse sediment; transport capacity exceeds sediment supply. Fines will be transported downstream.

Peak Flow: There will generally be no response to peak flows because these are bedrock channels. One major exception is if the bedrock is significantly weathered, made of saprolite, or fault gouge clay. Relative sensitivity will be moderate to high in this case.

Large Woody Debris: Wood will typically be transported downstream, resulting in relative low sensitivity call.

Catastrophic damage: Moderate relative sensitivity if bedrock is competent. High sensitivity if bedrock is highly weathered.

Geomorphic unit #6: First Order Channels with Obstructions, Alluvium and Colluvium.

Description: This unit includes only first order streams with gradients exceeding 12%. The unit is a collection of a variety of stream types with similar responses to changes in inputs of wood, water, and sediment. Response types include both transport and source reaches, and the channel types are cascade and step-pool for the former, and colluvial for the latter. Channels are confined and usually entrenched, and bed material is primarily boulders and cobbles, with gravels behind obstructions. It applies to streams of all sizes.

Segments:

Field verified: none

Extrapolated: 3a, 3b, 4a, 4b, 5d, 5e, 5f, 7a, 8, 10a, 10b, 10c, 10d, 11a, 11b, 11c, 12a, 14a, 14b, 14c, 19, 20a, 20b, 20c, 21a, 23a, 24, 25, 26, 29, 29a, 30, 31, 35, 37a, 38, 40, 41, 42, 44, 45, 47, 48, 49, 49a, 51, 52a, 52b, 52c, 56a, 56b, 56c, 56d, 56e, 56f, 56g, 57a, 57b, 57c, 57d, 57g, 65b, 65c, 65d, 67a, 72, 75, 77, 79, 84, 85, 86, 87, 88, 89, 90, 92, 93, 95, 96a, 97, 98, 99, 100, 103, 105a, 106, 109, 111, 113, 115, 116, 118, 120, 121, 125a, 128, 129, 129a, 129b, 136, 136a, 137, 142, 145, 150, 153a, 154, 157, 158, 161, 167, 168, 170, 179, 186, 191, 196a, 197, 200, 202, 208, 211, 212, 213, 215, 217, 219, 220, 223, 232, 232a, 233, 235, 235a, 236, 238, 238a, 241, 242, 243, 245, 245a, 252a, 252b, 252c, 252d, 254a, 256a, 256b, 257, 258, 261, 262, 263a, 264, 264a, 266b, 267, 268, 269, 270, 271, 272, 273a, 273b, 274, 275, 276, 279, 280, 281, 282a, 283, 284, 285, 285a, 285b, 292, 292a, 295, 296a, 297a, 297b, 297c.

Conditions and Response Potential:

The text for geomorphic unit 4 describing channel conditions, responses, and sensitivities to coarse and fine sediment, large woody debris, and catastrophic damage applies to geomorphic unit 6.

Peak Flow:

Condition: Same as geomorphic unit 4.

Response: Same as geomorphic unit 4, with this addition. Increases in water inputs to the drainage area above the channel can cause headward erosion of the first order channel. Sufficient concentrated water, such as from forest road drainage, can erode a surface channel from the source to the channel head (Montgomery, 1993). The initial channel erosion mobilizes coarse and fine sediment. Additonally, it establishes a permanent path for delivery of road generated fines to water courses. The integration of the road drainage network with the stream channel can permanently increase with the drainage efficientcy and run-off magnitudes, potentially contributing to further channel erosion and enhanced downstream flooding (Jones and Grant, 1995).

Sensitivity: High

Geomorphic unit #7: Tributaries on deep-seated landslide features in glacial lake clays on upper terraces.

Description: Applies to tributaries of all gradients and sizes flowing down active (within the last 50 years) deep-seated landslides in glacial-fluvial clays, silts, and sands. The surveyed channel had a gradient of 15% and was a transport reach, and the channel types were step-pool and cascade. Channels are usually confined and entrenched.

Segments:

Field verified: 175
Extrapolated: 60f, 60g, 60h, 60i, 173a, 174, 250a

Conditions and Response Potential:

The text for geomorphic unit 4 describing channel conditions, responses, and sensitivities for coarse and fine sediment, large woody debris, and catastrophic disturbance applies to geomorphic unit 7. For less steep channels, conditions and response potentials similar to geomorphic unit 2 may be more appropriate.

Peak Flow:
Condition: Same as geomorphic unit 4.
Response: The same as geomorphic unit 4, with the following addition. There is a potential for a stream on a deep-seated slide to be influent, losing water to the slide mass. Since changes in pore water pressure influences stability (Sidle and others, 1988), an increase in stream flow could contribute to deep-seated movement.
Sensitivity: High

Geomorphic unit #8: Low gradient oxbows, sloughs, wetlands, beaver dam impoundments, and lake areas.

Description: These segments are low gradient (<1%) depositional reaches of riverine impounded wetlands (e.g., segment 60d), depressional headwater lakes (segment 130), and depressional in-line (segment 131a) lakes.

Segments:

Field verified: 180
Extrapolated: 57e, 57f, 60d, 130, 130a, 131a, 138a, 138b, 138c, 138d

Conditions and Response Potential:

Coarse Sediment:
Condition: Due to low gradients, almost all coarse sediment will deposit in these segments.
Response: Increased deposition will fill these pool-like reaches, reducing residual volumes.
Sensitivity: Moderate

Fine Sediment:
Condition: Due to low gradients, all but the smallest fine particles will deposit in these segments.
Response: An increase in fine sediment will increase deposition rates, reducing the residual pool volumes.
Sensitivity: High, in part for fish considerations. Refer to the fish habitat assessment.

Large Woody Debris:
Condition: Large wood, being submerged, decays slowly, but has no geomorphic function.
Response: None
Sensitivity: Moderate for fish consideration. Refer to the fish habitat assessment module.

Peak Flow:
Condition: Channel types are pool-like, with bed material varying from fines to resistant bedrock and till. Peak flows are not a significant channel forming process, except in segments 138a, 138b, and 180, which occupy abandoned portions of the mainstem channel.
Response: No significant change unless beaver dam failure or avulsion.
Sensitivity: Low

Catastrophic damage:
Condition: Debris torrents entering these reaches will deposits coarse and fine sediment.
Response: Debris torrents will exacerbate impacts from coarse and fine sediment.
Sensitivity: High

Geomorphic unit #9: Low gradient fine bedded tributaries on low terraces

Description: These segments include tributaries with gradients less than 3%, typically located on lower glacial terraces or the flood plain of the mainstem. In areas, the active channel runs along the base of terrace risers of higher terraces. The response type is depositional, and the channel types are pool-riffle, and forced pool-riffle. Bankfull widths are generally 12m or less. The observed segment was entrenched and confined.

Segments:

Field verified: 60a
Extrapolated: 6, 53a, 57, 60, 60e, 62, 65a, 159, 162, 247, 247a

Conditions and Response Potential:

Coarse Sediment:
Condition: The segment is a low gradient depositional reach. The channel is currently incising, with minimal amounts of spawnable gravel.
Response: If a transport reach is upstream, a fan could form with increased coarse sediment at the head of segment, possibly going sub-surface at low flow. In general, little effect is expected.
Sensitivity: Low

Fine Sediment:
Condition: Bed is mostly fines with minor inclusion of pebbles and gravels (also covered with fines), and fines were observed in pools. Approximately 99% of the banks are eroded.
Response: Increases in fines will further fill pools, increase sub-surface fines in gravels, and increase turbidity.
Sensitivity: High

Peak Flow:
Condition: Entire channel was recently incised. Evidence included exposed roots above channel, 99% of the bank was unvegetated and eroding, and terrace landsliding. Channel was entrenched.
Response: Increased flows will favor further incision, bank erosion, and decrease bar stability.
Sensitivity: High

Large Woody Debris:
Condition: Approximately 50% of the pools are associated with jams or wood pieces (60cm DBH). Wood contributes to bar stability, traps sediment, and is a significant component of channel roughness. Tree roots are a source of bank protection. If entrenched, wood from the riparian zone may span above the channel, reducing function.
Response: Reduction of wood will reduce the number of pools, decrease bar stability and channel roughness, and increase bank erosion.
Sensitivity: High

Catastrophic damage:
Condition: There is no evidence of catastrophic disturbance, though two recent debris avalanches entered channel.
Response: Debris flows or dam-break floods would deposit in the segment, leaving a large, persistent lag deposit, and worsen the fines situation. Upstream torrent deposition would contribute fines.
Sensitivity: High

Geomorphic unit #10: Mainstem North Fork Stillaguamish

Description: Low gradient (<1%) valley bottom segments that interact with the flood plain and young terraces. All reach sites are depositional and the segments are generally gravel bedded pool-riffle channel types, with bankfull widths ranging from approximately 25 to 100 meters. The mainstem in the Hazel WAU is unconfined and unentrenched.

Segments:

Field verified: 298, 299, 300, 301, 302, 303, 304, 305
Extrapolated: none

Conditions and Response Potential:

The channel sensitivity diagnosis for the mainstem is based on information in Pess and Benda (1994), and is summarized in the fish habitat assessment module (page F-41). Please see the fish habitat module for details regarding the mainstem.

Coarse Sediment:
Sensitivity: High

Fine Sediment:
Sensitivity: High

Peak Flow:
Sensitivity: High

Large Woody Debris:
Sensitivity: High

Catastrophic damage:
Sensitivity: High

E.7. HABITAT FORMING PROCESSES (SEE FISH HABITAT SECTION 4.0)-

The channel and fish habitat analysts worked together to determine the channel sensitivity and fish habitat vulnerabilities, and in the course of the collaboration identified linkages among hillslope inputs, channel characteristics, and fish habitat conditions. **The results are summarized in F4.0 Channel-Fish Habitat Vulnerability in the fish habitat module.** For detailed information about habitat forming processes please refer each section of the fish habitat module. The fish habitat analyst made a concerted effort to link geomorphic units to fish habitat throughout the report.

E.8. REFERENCES

Coho, C. and S.J. Burges, 1994, "Dam-break floods in low order mountain channels of the Pacific Northwest", Department of Civil Engineering, University of Washington, Seattle, WA, report to Timber/Fish/Wildlife, TFW-SH9-93--001.

Jones, J.A. and G.E. Grant, in press, "Peak flow responses to clearcutting and roads, Western Cascades, Oregon: II) Large Basins", Water Resources Research.

Kennard, P.M. and G.R. Pess, 1994, "Forest management and stream degradation in Montague basin - a watershed assessment", report to the Tulalip Tribes Environmental Department, Marysville, WA.

Ketcheson, G., 1992, "Flooding in West Cascade mountain basins - a perspective on the November 1990 flooding in Western Washington", report to the Mount Baker Snoqualmie National Forest, U.S. Forest Service, Mountlake Terrace, WA.

Miller, D.J., 1995, in press,"Coupling GIS with physical models to assess deep-seated landslide hazards", Bulletin of the Association of Engineering Geology.

Montgomery, D.R., 1993, "Road surface drainage, channel extension, and slope stability", in Geomorphological Watershed Analysis Project, Final Report for the Period from 10/1/91 to 6/30/93, in Montgomery, D.R., Dunne, T., and Dietrich, W.E., report to Timber/Fish/Wildlife, TFW-SHI0-93-001.

Pess, G.R. and L. Benda, 1994, "Spatial and temporal dynamics of spawning chinook salmon in the North Fork Stillaguamish, WA", Geological Society of America (GSA) Abstracts with Programs, Vol. 26, Number 7.

Rosgen, D., 1994, "A Classification of Natural Rivers", Catena, 22, p169-199.

Sidle, R.C., Pierce, A.J., and C.L. O'Loughlin, 1985, "Hillslope Stability and Landuse", Water Resources Monograph 11, American Geophysical Union.

Tabor, R.W., Booth, D.B.,; Vance, J.A.,; Ford, A.B., and M.H. Ort, 1988, "Preliminary geologic map of the Sauk River 30 by 60 minute quadrangle, Washington", U.S. Geological Survey Open File Report 88-692, U.S. Geological Survey.

E.9. DATA SUMMARY

Form E1 - Segment Identification Worksheet
(Channel Segment Slope and Confinement Classes)

Confinement Class	*Slope Class*	*Segments*
Unconfined VW>4CW	<1%	1,9,53,54,138,180,181,194,247,247a249,298,299,300,301,302,303, 304,305
	1-2%	55,55a,122,133,224
	2-4%	2,65,164,203,225,248,250,286,293
	4-8%	3,66,67,147,155,204,221
	8-20%	244
Moderately confined 2CW<VW<4CW	<1%	
	1-2%	80a
	2-4%	10,20,101,124,171,209,251
	4-8%	5a,5b,5c,5d,5e,5f,7,12,14,20b,20c,52,56,60b,60c,68,72,74,81,105
	8-20%	58,69,71,76,78,134,146,148,149,151,156,158,165,182

Form E1 - Segment Identification Worksheet (continued)
(Channel Segment Slope and Confinement Classes)

Confinement Class	*Slope Class*	*Segments*
Confined VW<2CW	<1%	53a,57e,57f,60d,130,130a,131a,138a,138b,138c,133d
	1-2%	6,60,65a
	2-4%	57,60a,60c,62,159,162,250a
	4-8%	13,14a,14b,14c,15,17,21a,28,60f,60h
	8-20%	3b,4a,4b,5,11,16,18,20a,21,23,23a,27,29,29a,31,32,34,36,39, 43,45,46,48,50,52a,52b,52c,60g,60i,61,62a,63,65b,67a,73,79, 80,83,86,88,90,91,102,104,105a,108,112,114,125b,126,129a, 129b,132,145,152,161,166, 173a,174,175,183,185,201,210,229, 240,245,245a,252a,252d,254,255,256,256b,257,278,281,285, 290,297.
	>20%	3a,4,7a,8,10a,10b,10c,10d,11a,11b,11c,12a,19,22,24,25,26,30, 33,35,37,37a,38,40,41,42,44,47,49,49a,51,56a,56b,56c,56d, 56e,56f,56g,57a,57b,57c,57d,57g,59,64,70,75,77,82,84,85,87, 89,92,93,94,95,96,97,98,99,100,103,106,107,109,110,111, 113,115,116,117,118,119,120,121,125,125a,128,129,129c, 131,135,136,136a,137,142,143,144,144a,150,153,153a,154, 157,160,163,167,167a,168,169,170,176,177,178,179,184,184a, 186,187,188,189,190,191,192,192a,193,196a,197,199,200,202, 206,208,211,212,213,214,215,216,217,219,220,230,231,232, 232a,233,234,235,235a,236,237,238,238a,241,242,243,252b, 252c,253,254a,256a,258,262,263,263a,264,264a,265,266,266a, 266b,267,268,269,270,271,272,273,273a,273b,274,275,276, 277,279,282,282a,283,284,285a,285b,291,292,292a,295,296a, 297a,297b.

Form E-2. Channel Disturbance Worksheet

p1 of 2

Brooks

Channel Response Segment Number	Change in Channel Width (+ or -)	Time Interval (years)	Disturbance Indicators: Channel pattern change, alluvial fans, adjacent landsliding, channel widening, narrowing, catastropic damage
Brooks Crk 9		1970	follows old meander belt of NFS. Against valley wall. canopy cover ~100%. Alt takes steep bend + heads west just downstream of bridge.
	same	1983	same as 1970.
	+	1991	Channel now flows through eastern portion of old meander belt. Increase in gravel bar area in upper most portion
Brooks Crk 10	—	1970	Closed canopy in upper portion. Bifurcation occurs where Alt comes out of confined valley and deposits just upstream of bridge. Possible old side RB in middle of segment.
	L — | U +	1983	Riparian harvest ~50%. Channel narrower in bifurcated section and widens upper portion. Increase in gravel bar area.
	L + | U —	1991	Increase in channel width of lower portion decrease in width of upper portion
Brooks Crk 11		1970	Channel confined in upper portion. Canopy closure precludes channel in some spots. ?
	same	1983	Riparian area left after harvest. No change in channel width.
	same	1991	Stable. Slump in upper portion of #11. Deep-seated possibly related to increase in width in lower portion of #10
Brooks Crk 12		1970	Canopy closure high. Lower portion of #12 shows some depositional (e.g. gravel bars), just above tributary junction. Large amphitheatre-like area in lower portion of segment #12 where segment #13 covers it
	+	1983	Riparian harvest ~50% of right bank. Increase in channel width in lower section of segment #12
	+	1991	Increase in channel width below cut in upper portion of
Brooks Crk 13		1970	Upper portion of #13 shows possible deep-seated on right bank. Canopy closure high, even on DSL.
	—	1983	Canopy closure precludes ability to see the channel.
	same	1991	Stable no change
Brooks Crk 14		1970	Canopy closure high. Channel only apparent at tributary junction with segment #32. Possible slumps along left bank in 3 locations
	same	1983	Left riparian zone along right bank. Channel not apparent. Slumps still evident.
	same	1991	Stable no change.
Brook Crk 15		1970	Canopy closure high. Confined channel. Side channels in several location (log jams?).
	some	1983	Riparian zone left during harvest. Side channels less apparent.
	same	1991	Stable

analyst: GP this one only.

Form E-2. Channel Disturbance Worksheet

Brooks p2

Channel Response Segment Number	Change in Channel Width (+ or -)	Time Interval (years)	Disturbance Indicators: Channel pattern change, alluvial fans, adjacent landsliding, channel widening, narrowing, catastropic damage
Beaver Crk 22	Wide channel	1944	Massive inner gorge failure along both sides of #22. Road above it
	—	1970	Inner gorge failure still evident. Some revg. Road not apparent. Decrease in
	—	1983	Only upper portion of inner gorge still eroding. Channel width decrease throughout segment. All width
	none	1991	Inner gorge revegd over.

Form E-2. Channel Disturbance Worksheet

Rollins Creek

Channel Response Segment Number	Change in Channel Width (+ or -)	Time Interval (years)	Disturbance Indicators: Channel pattern change, alluvial fans, adjacent landsliding, channel widening, narrowing, catastropic damage
65		1944-ortho	-Channel not visible. Note mainstem NFStilli.
	+	1970	-Channel widened + visible. Fanwhere NFStilli mainstem was. Islands visible. Newchannel to East - inferred to the dam-break RUNout. Large new deposition zone.
	-	1984	-Channel narrowed slightly. Several stream bank failures - DS inglacials? Gravel bar in NFStilli formed at mouth.
		1991	-No width change. Known Dam-break deposit. Changes on bar in mainstem.
66		1944	-No canopy openings. OG
	+	1970	-Channel openned + widened. Inferred dam-break passage.
	-	1983	- Channel narrowed.
		1991	-No change in openning. Known dam-break passage from field evidence.
67		1944	No canopy openning. OG.
	+	1970	Channel evident + widened. Inferred dam-break passage.
	-	1983	Channel narrowed slightly. Some streamside failures
		1991	-No width change. Dam-break passage?
68	+	1944	-Inferred Debris Flow LB ~920' - Stop at end of seg. Hillslopes harvested, 80% Riparian Removal. — channel widen.
		1970	- Remains open. Stream-side failures. Inferred dam-break passage.
	-	1983	- Most of Channel Narrowed - except where debris flow => 108, 107 + hit 68 and deposited at bend. fm. Road
		1991	-No apparent change in width. Dam-break passage
69 (trenched / filled)		1944	Lower 2/3, 100% Riparian non-st. Channel evident.
	+	1970	Channel evident + widened. Debris flow from seg. 117.- Stopped at tr. b. junction? RB failures. Deep-seated
	-	1983	Channel narrowed throughout. - Inferred dam-break to #68
		1991	No change in width. Possible dam break passage.
70		1944	Channel visible. 80% OG. 20% harvest? - wider here.
	+	1970	Channel widened. RB streamside failures (glac?) - No debris torrent? Upper recent harvest.
	+	1983	Channel continued to widen throughout. Debris flow from - f Road. Deposit at Lower part of segment.
	+	1991	Debris Flow fm RB unit - end at lower part segment or became dam-break
102		1944 -	Channel Not visible. Old growth.
		1970 -	Channel not visible. OG.
		1983 -	Harvested, Channel Marginally visible. No response.
		1991 -	No change

Form E-2. Channel Disturbance Worksheet

Dicks - (OF)

Channel Response Segment Number	Change in Channel Width (+ or -)	Time Interval (years)	Disturbance Indicators: Channel pattern change, alluvial fans, adjacent landsliding, channel widening, narrowing, catastropic damage
122		1942	Closed canopy, area harvested. Bifurcated channel in mid area. At mouth can't tell if 2 channels.
	+	1969	Intermittant openninss (~30%). Split at mouth?
	−	1983	Some openings on Still. floodplain or young terrace. Deposition? (gravels?)
		1991	1983 openninss closed. 2 channels visible (on old mainstem bend).
123		1942	Closed canopy. Area harvested.
	+	1969	Intermittant openninss (~30%). Inferred IG landslides. Possible large Deep-seated RB.
	−	1983	Intermittent openninss ~ 20%. Active toes of multiple DS?
	−	1991	New openning ~ 550' - Deep seated? Otherwise closed.
124 (upper 1/2 entrenched)	+ (upper 1/2)	1942	Canopy opened upper 1/2. Probably debris flow from below segment across from 128. Upper 1/2 mature. Lower 1/2 closed canopy, No rip. veg.
	- upper, + lower	1969	Upper 1/10 mature, rest young veg. Lower 1/2 ~ 20% open - inter inner gorge landslides. Apparent islands.
	−	1983	Closed canopy. By veg contrast, 2 possible deep-seated. Channel [illegible] at ~ 650' - Deep seated?
		1991	New opening LB ~ 1200' and RB - New Road ~ 800. Debris avalanche?
125 (entrenched)	+ (lower 2/3)	1942	Canopy opened lower 2/3. Some adjacent younger veg. but rip. mature. Probably debris flow from mature area. Upper 1/3 - mature. Channel visible
	- (lower 2/3)	1969	Upper 1/3 mature, lower RB harvest. Closed canopy. RB opening - deep-seated
	+	1983	Debris flow from top of segment, deposit in lower. Mature (but hiking trail)
	−	1991	1969 opening is larger + open further downstream. Still open, but Recovering.
125 "b" (entrenched)		1942	Closed canopy w/ intermittent openninss (inner gorge failures)
		1969	Similar to 1942. Mature.
		1983	Similar to 1969. < 5% open.
		1991	Same. Some IG failures.
129 (entrenched)	+ (inferred)	1942	unnamed trib to E of 129 open. - mature.
	−	1969	Canopy closed. Mature.
		1983	Canopy may be slightly more open (or better photo) Mature.
		1991	Same

11-10-94
lcennard

Form E-2. Channel Disturbance Worksheet

"Trigger Lady Slough" - Mt. Higgins 11-22-94

Channel Response Segment Number	Change in Channel Width (+ or -)	Time Interval (years)	Disturbance Indicators: Channel pattern change, alluvial fans, adjacent landsliding, channel widening, narrowing, catastropic damage
180		1942	Segment is one active channel of stillz. Channel wide + visible. Mature rip?
	—	1949	Oxbow - (from split channel). Still open, 1/3 unveg.
	-	1969	Channel not open.
	ø	1983	No change
	ø	1991	no change.
181		1942	Channel not visible. Rip. - age unknown
	ø	1969	No change.
	ø	1983	no change
	ø	1991	no change. (Roads in area - suspect harvested after.)
182		1942	Channel not visible. Rip - probably not OG.
	ø	1969	No change.
	+	1983	CC. Sparse veg. Channel visible.
	—	1991	Channel closed.
183		1942	Channel not visible. Rip age <20 yo?
	ø	1949	CC in upper part? Channel not visible
	ø	1969	Channel not visible.
	ø	1983	- no change
		1991	no change
18.4		1942	Channel mostly not visible. Upper 1/2 Rip = OG. Lower <20 so?
	ø	1949	cc lower part? Channel not visible.
	ø	1969	no change. (Though enlargement near by avalanche chute)
	ø	1983	no change.
		1991	no change.

p1 of 2

Form E-2. Channel Disturbance Worksheet

(16) (2 DF) Swede Creek - Mt. Higgins

Channel Response Segment Number	Change in Channel Width (+ or -)	Time Interval (years)	Disturbance Indicators: Channel pattern change, alluvial fans, adjacent landsliding, channel widening, narrowing, catastropic damage
224		1942	Mostly cleared. 1/3 Rip veg. Channel appears undisturbed.
	+	1969	Rip. veg. increasing. Side bank disturbance or widening from deposition.
	-	1983	Some openning persist.
	∅ +	1991	Slight opening in ~10% of channel w/ Rip. veg.
225	(inferred) +	1942	upper and RB cleared. Upper is wide and disturbed (graded?).
	∅	1969	Upper seg. still appears disturbed.
	∅	1983	1/2 has Rip. 1/4 is mech. disturbed.
	+	1991	1/2 unveg from flow (where no Rip).
226		1942	Area cleared around, though Rip. trees. Canopy closed.
	+	1969	upper 2/3 no Rip. veg, Channel open.
	-	1983	Ripaeian closing. Channel not visible.
	∅	1991	no change.
227	(inferred) +	1942	Rip. young or gone, wide openning at bottom.
	-	1969	Channel visible with openings.
	-	1983	Canopy closed.
	(Lower) +	1991	-Lower, RB harvest, Rip. intact. Openings Lower (fluvial?)
228		1942	young veg (fire). Canopy closed.
	+	1969	All but bottom open (DF deposit?)
	-	1983	Channel open.
	+	1991	Channel openned, except Lowest (DF deposit?)
229		1942	young veg. (fire). Canopy closed.
	+	1969	upper 1/2, LB, cc. Open throughout as if DF passage.
	-	1983	Canopy closing
	+	1991	Channel openned, as if DF passage.
230		1942	Upper 1/4 OK. Lower younger veg (fire?) Segment 211 and 224 splits below and rejoins below. Canopy closed. (connects to saveee, while mainch., 2 visible.)
	+	1969	Upper 1/4 cc, LB. Open throughout. Can't see a DF
	-	1983	Canopy narrowing throughout. 2 ch. visible.
	+	1991	LB harvest, though Rip appears intact and mature. Significant openning, as if DF passage.

p 2

Form E-2. Channel Disturbance Worksheet

(16)-continued Swede Cr.

Channel Response Segment Number	Change in Channel Width (+ or -)	Time Interval (years)	Disturbance Indicators: Channel pattern change, alluvial fans, adjacent landsliding, channel widening, narrowing, catastropic damage
231	+	1942 1969	Upper 2/3 is avalanche chute+channel visible. Lower is upper 2/3 appear wider w/ exposed Bedrock. Openning in below. Lower 1/4 is cc and open. 06, 06
	Ø	1983	No change. Possible slight openning Lower 1/4.
	+	1991	No coverose upper. Lower 1/4 - in unit (LB) and/or Road failure. Two openings in lower segment DF initiate?

11-21-94 PK

Form E-2. Channel Disturbance Worksheet

Segelson Cr. - 2 DT (one DB, DF?)

Channel Response Segment Number	Change in Channel Width (+ or -)	Time Interval (years)	Disturbance Indicators: Channel pattern change, alluvial fans, adjacent landsliding, channel widening, narrowing, catastropic damage
250	+	1942	Harvested, though riparian trees lower. Channel not visible.
		1969	Major bar deposition at upper part.
	−	1983	Bars revegetated. House built by stream below road.
	∅	1991	No apparent change.
			(partially)
251	∅	1942	Harvested. Moderately entrenched. No openings.
		1949	Parts of channel visible.
	upper +	1969	Segment widened, with large widening in middle. Lower less to no widening
	—	1983	Whole segment narrowed, but channel visible.
	−	1991	Narrowing. Openings persist.
252	+	1942	Both sides harvested. Channel visible. Lower may have widened.
	Lower +	1949	Lower segment widened. No coverage on upper stream.
	+	1969	Segment widened. More pronounced upper.
	+	1983	LB - Debris torrent at top (DF?). Whole segment widen. Deposit near bottom of segment.
	−	1991	Narrowing. Significant openings persist.
253	+	1942	RB - old growth, LB cut. Channel visible.
		1969	old growth. Significant widening from debris torrent.
	∅	1983	Slight widening. Essentially no change.
	∅	1991	No change. Still DB.
254	+	1942	Old growth riparian. Entrenched. No openings.
		1969	Old growth. Significant widening from above debris torrent.
	+	1983	2/3 Rip. cc. Widened further where harvested.
	−	1991	Slight narrowing in earlier harvested area.
255	+	1942	- Mature riparian. Entrenched. One possible DA.
		1969	- Rip, LB+RB, is cc + some OG. LB - Debris torrent (DF?) - widen channel below. Road not destroyed. Slight widen in OG.
	∅	1983	- No change
		1991	- No coverage available
256	∅	1942	Lower only on photo. Mature Rip. 3 openings. - DA?
		1969	Lower - RB - old growth, LB - cc / LB debris avalanche. Channel visible.
	∅	1983	No change
		1991	- Not available.

Channel Assessment Field Form E-4

Stream Brooks WAU Hazel Observers PK, GP
Segment No. 9 Response Type depositional Date 11-14-94
ngth Sampled just below Total Segment Length _____ Flow: (high) mod low
bridge. Walked all for fish limit factor

Raining. Turbidity increasing.

Channel Dimensions

Mean bkfl width: 14.5m Wetted width: 33'
Mean bkfl depth: 4.1' Wetted depth: 1.1'
Valley bottom width: Channel slope: <1%

Bed Conditions

Morphology: colluvial bedrock regime (braided upper) (pool-riffle lower) forced pool-riffle plane-bed step-pool cascade

Gravel Bars: (point) (medial) multiple forced
_____ % active area in bars Bars unveg.
riparian opening wider than active channel? yes.

Channel Pattern: meandering sinuous straight (braided) Sinuosity: _____

Pool spacing: POOL TALLY (approx width X length X max depth)

Free	LWD Forced	Bldr Forced	Banks Forced
	See fish module		
Total:			

Pool spacing = (reach length/channel width)/ number of pools =

Primary LOD Function(s): (pool scour) bank stability (bar stability) (sediment trap) step former
describe:
Large percentage of undercut banks assoc with large wood.

LWD Tally (> ")

✓ Fine Sediment Deposits:
In pools: avg V* and range (see V* forms): V* = 0.33. Range = 0 - 2
Repres 7% of pools
In riffles:
(1) locally in sheltered locations 3) over most of bed
2) strands extending downstream 4) thin draping over larger clasts
Flow relatively high, so may lower V*

✓ Stream Bed Material:
Surface Texture: _____
Distribution & patterns: _____
_____
_____
D50 (see pebble count forms): ‡braided

Other Comments: Channel aggraded in 90's here. If its incising now, q* unreliable.

Bank Conditions

Bank Material: Terrace - fines (silts + clays)

Texture: Alluv - fines + some gravels.

Source: Terrace - glacial/fluv. Alluv - still. floodplain

Sources of protection: Wood and tree roots.

5-10%?

Bank erosion: ^ % of reach

location:
(1) locally where forced by obstructions
2) outside of bends
3) intermittent; independent of channel geometry
4) extensively along one side
5) continuously along both banks

Where wetted channel hits terrace

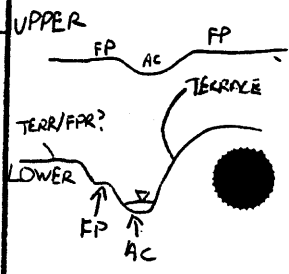
Mass Wasting (record approx length and height; mark on map)

One debris avalanche on terrace. Location not noted.

Floodplain Conditions

upper - Not. Lower - entr.

Entrenchment: Entrenched Cross-Section Sketch



Terrace material, source and size:

See above.

Overbank Deposits:

1) wood berms
2) debris trash lines
3) boulder berms
(4) other, significant amounts of sand

Channel margin vegetation: Blackberry

Riparian condition: Hardwood mostly <12". Some conifers.

Other Comments:

Approximately half water goes to seg. 53 after '90 event. Aggradation in upper portion, just below bridge. Gradient controlled by meander of NE. Still.

Migration: No barriers.

Spawning (gravel presence & stability): see fish module.

Rearing (pool formation): Good, due to wetland in middle portion of segment.

Overwinter (off-channel): Same as above.

Channel Assessment Field Form E-4

Stream Brooks WAU Hazel Observers PK, GP
Segment No. 10 Response Type depositional Date
Length Sampled all - Total Segment Length / Flow: high mod low Raining.
also Limit factor analysis — actually transitional trans/dep.

Channel Dimensions

Mean bkfl width: 20.2 m Wetted width: 10 m
Mean bkfl depth: 3.8' Wetted depth: 1.5'
Valley bottom width: Channel slope: 3-4%

Bed Conditions

Morphology: colluvial bedrock regime braided pool-riffle (forced pool-riffle)
(plane-bed) (step-pool) cascade

Gravel Bars: point (medial) multiple (forced)
% active area in bars ~100% in active channel. 0% Floodplain/prone.
riparian opening wider than active channel? Yes Flood plain is young trees.

Channel Pattern: meandering sinuous (straight) braided Sinuosity:

Pool spacing: POOL TALLY (approx width X length X max depth)

Free	LWD Forced	Bldr Forced	Banks Forced
	See fish module		
Total:			

Pool spacing = (reach length/channel width)/ number of pools =

Primary LOD Function(s): (pool scour) bank stability (bar stability) (sediment trap) step former
describe: Much large wood out of channel and not functional. May be dam-break deposits.
Wood jams control formation of channel surfaces.

LWD Tally (> ")

Fine Sediment Deposits:
✓ In pools: avg V* and range (see V* forms): at ~250', V*=.039, Range=0-3. Repres. % pools

In riffles:
(1) locally in sheltered locations 3) over most of bed
2) strands extending downstream 4) thin draping over larger clasts

✓ Stream Bed Material: (just downstream from 2' thick unconsolidated gravels + sands)
Surface Texture:
Distribution & patterns:

D50 (see pebble count forms):

Other Comments: Channel appears to be incising into sediments deposited behind wood jams (~1-1.5m). Recent aggradation in segment below. Incision is a different style than in Dicks + Rollins.

page 2 of 2

Bank Conditions

Bank Material: Terrace: fines (including clays) and gravels – 5-10m hgt.
Texture: Alluvium: Boulder, cobble
Source: Terrace: glac/fluv. Alluv-fluv.
Sources of protection: Tree Roots + understory veg.

Bank erosion: 30-40 % of reach (60-70% of terrace)
location:
(1) locally where forced by obstructions
(2) outside of bends
3) intermittent; independent of channel geometry
4) extensively along one side
5) continuously along both banks

ON terrace - wherever about wetted channel.

Mass Wasting (record approx length and height; mark on map)

(IN seg 11 - LB - ~400' elev - deep-seated and assoc. debris flow - may have caused dam-break).

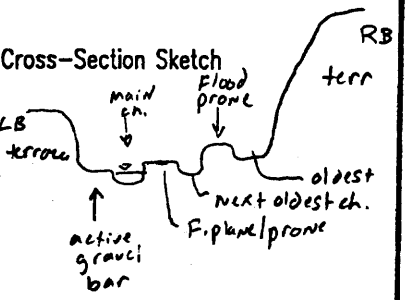
Seg 10 → many S/R where terrace undercut. Possible RB valley deep-seated to older channel.

Floodplain Conditions

Entrenchment: mod. entrenched / mod. confined

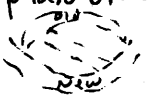
Terrace material, source and size: Lake clay (silt/clay), till, fluvial materials >> fines + gravels.

Cross-Section Sketch



Overbank Deposits:
(1) wood berms
2) debris trash lines
(3) boulder berms
4) other, some sand

plan view



Channel margin vegetation:

Riparian condition: Terrace - mat. conifer, >12" hardwood
Flood prone - < and > 12" hardwood. Some young conifer
Flood plane - < 12" hardwood.

Other Comments:
3 channels have spanned valley at various times.
Newest channel is less sinuous and incising. Wood jams control channel form. Wood jams cause channel avulsions.

Migration: No barriers

Spawning (gravel presence & stability): See fish module.

Rearing (pool formation): See fish module

Overwinter (off-channel): See fish module.

Channel Assessment Field Form E-4

page 1 of 2

Stream Brooks WAU Hazel Observers PK, GP
Segment No. 14 Response Type Response Date 11-14-94
ength Sampled ~880' to 980' elevation Range. Total Segment Length ___ Flow: high mod low - water opaque (tannin?)
→ while steep, it has medial bars. Transitional.

Channel Dimensions

Mean bkfl width: 22m Wetted width: 12m
Mean bkfl depth: 3' Wetted depth: ~1.2 (2 channels - 1.6, 0.8)
Valley bottom width: Channel slope: 5%

Bed Conditions

Morphology: colluvial bedrock regime braided pool-riffle forced pool-riffle plane-bed step-pool cascade

Gravel Bars: point medial multiple forced
70 % active area in bars (30% young veg - 1990?)
riparian opening wider than active channel? No. Many trees in channel.

Channel Pattern: meandering sinuous straight braided Sinuosity: ___

Pool spacing: POOL TALLY (approx width X length X max depth)

Free	LWD Forced	Bldr Forced	Banks Forced
	30%	70%	← Visual est.
Total:			

Pool spacing = (reach length/channel width)/ number of pools =

Primary LOD Function(s): pool scour bank stability bar stability sediment trap step former
describe: ___

LWD Tally (> ")

× Fine Sediment Deposits:
In pools: avg V* and range (see V* forms): No V* - no fines in pools.
In riffles:
1) locally in sheltered locations
2) strands extending downstream
3) over most of bed
4) thin draping over larger clasts

× Stream Bed Material:
Surface Texture: Boulder/cobble
Distribution & patterns: ___
D50 (see pebble count forms): No q* as coarse.

Other Comments: Bed has huge boulder below 900'. Trees in active channel - contribute to stability.

Bank Conditions

Bank Material: Terrace - till with all grain sizes. ~900' => very large Boulders

Texture: Alluv - Boulder, cobble

Source: Terrace - glacial, +colluvium

Sources of protection: Tree roots, Boulders.

Bank erosion: 25 % of reach LB - 10% RB - <10%

location:
1) locally where forced by obstructions
2) outside of bends
3) intermittent; independent of channel geometry
4) extensively along one side
5) continuously along both banks
where channel next to terrace

Mass Wasting (record approx length and height; mark on map)

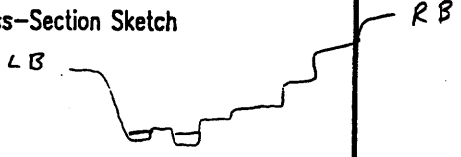
Multiple debris avalanches where channel next to terrace Risers. (Colluvium fail over till). ~ 10m x 10m. Especially where % exceed 30-35%

Floodplain Conditions

Entrenchment: mod confine (locally confined) mod entrench

Terrace material, source and size: See above

Cross-Section Sketch



Overbank Deposits:
1) wood berms
2) debris trash lines
3) boulder berms
4) other, some sand

Channel margin vegetation: Terraces - mature conifer 40-80 yo. Valley bottom - smaller conifer and hardwood ~ 12" dbh.

Riparian condition:

Other Comments:

Migration: Upstream of anadromous barrier.

Spawning (gravel presence & stability): UNKNOWN.

Rearing (pool formation): UNKNOWN

Overwinter (off-channel): UNKNOWN.

Hazel Watershed Analysis

November 4, 1994
Brooks Creek
Snowy, Cloudy, cold
Moderate to high flows
GP, PK, PS, and AH

Segment #15

1.4m

Bankfull depth - 4.6 ft
Bankfull width - 20m
Geoglogy - leftbank composed of till. Dropstones correlate with with channel bed particle size.
Photo #21 - Brooks Creek, looking upstream. Top of segment $15 large log jam, approximately 6ft high with old growth stump on leftbank. Large amount of sediment behind it.

Channel Assessment Field Form E-4

Stream Brooks WAU Hazel Observers PK, GP, PS, AH
Segment No. 16 Response Type transport Date 11-4-94
Length Sampled total Total Segment Length _____ Flow: high (mod) low Snow, Rain,

Channel Dimensions

Mean bkfl width: 7.3m Wetted width: 10'
Mean bkfl depth: 4.1' Wetted depth: 1'
Valley bottom width: CW < 2VW Channel slope: 12%

Bed Conditions

Morphology: colluvial bedrock regime braided pool-riffle forced pool-riffle plane-bed (step-pool) (cascade).

Gravel Bars: point medial multiple forced
100 % active area in bars
riparian opening wider than active channel? NO. Riparian inter-act w/ channel. Roots Reinforce sidebanks.

Channel Pattern: meandering sinuous (straight) braided Sinuosity: _____

Pool spacing: POOL TALLY (approx width X length X max depth)

Free	LWD Forced	Bldr Forced	Banks Forced
See fish module			
Total:			

Pool spacing = (reach length/channel width)/ number of pools =

Primary LOD Function(s): pool scour ____ bank stability
bar stability (sediment trap) (step former)
describe: _____

LWD Tally (> ")

Fine Sediment Deposits:
X In pools: avg V* and range (see V* forms): No V*
Some sands behind log jams
In riffles:
1) locally in sheltered locations
2) strands extending downstream
3) over most of bed
4) thin draping over larger clasts

Stream Bed Material:
Surface Texture: Boulder/cobble + (Peagravel, pebble, gravel, sand)
Distribution & patterns: (Boulders not moved)
X D50 (see pebble count forms): Did at Seg 16 (Below Seg 15)

Other Comments: Jams + Boulders primary roughness.
where jams span channel => storage of sed.

Bank Conditions

Bank Material:

Texture: Boulder/cobble. Valley is glacial till w/colluv.

Source: Alluv.

Sources of protection: Roots + Boulders

Bank erosion: <5 % of reach

location:
1) locally where forced by obstructions
2) outside of bends
3) intermittent; independent of channel geometry
4) extensively along one side
5) continuously along both banks

Mass Wasting (record approx length and height; mark on map)

LS - ~1420 RB. - SR 2.5m x 5m. Del. Stream Below devoid of wood for a while. In area where valley was recently cut.

Floodplain Conditions

Entrenchment: Entrenched Cross-Section Sketch

Terrace material, source and size:

Glacial till, w/ colluv.

Overbank Deposits:
1) wood berms
2) debris trash lines
3) boulder berms - few
4) other, LWD

Channel margin vegetation:

Riparian condition: Generally >40yr conifer + Alder Med 12"

Other Comments:

Many pieces of wood in channel. Much recent windfall. Some large Relict cedars much larger storage Reach.

Migration: No

Spawning (gravel presence & stability): Patchs of gravel avail. for cut-throat behind logjams.

Rearing (pool formation): Predominately fm Boulder + wood. Plunge + pool dominate. See fish map

Overwinter (off-channel): None.

Channel Assessment Field Form E-4

page 1 of 2

Stream Between (4) + (5) Whitman Bench WAU Hazel Observers PK, GP, PS, AH

60a → Segment No. Fau x 60 Response Type Depositional Date 11-4-94

ength Sampled FM Road to NF Stilli Total Segment Length _____ Flow: high (mod) low

Channel Dimensions

(multiple) Mean bkfl width: ~10' Wetted width: ~6'

Mean bkfl depth: ~3' Wetted depth: ~1'

Valley bottom width: = CW Channel slope: ≥ 2% — (5% on terrace riser)

Bed Conditions

Morphology: colluvial bedrock regime braided (pool–riffle) (forced pool–riffle) plane–bed step–pool cascade

Gravel Bars: point medial multiple forced

100 % active area in bars

riparian opening wider than active channel? Areas w/ no riparian due to cut.

Channel Pattern: meandering sinuous (straight) braided Sinuosity: _____

Pool spacing: POOL TALLY (approx width X length X max depth)

Free	LWD Forced	Bldr Forced	Banks Forced
See Fish module			
Total:			

Pool spacing = (reach length/channel width)/ number of pools =

Primary LOD Function(s): pool scour bank stability (bar stability) (sediment trap) step former

describe: _____

LWD Tally (> ")

Fine Sediment Deposits:

X In pools: avg V* and range (see V* forms): Sig. fines pools: No V*

In riffles:

1) locally in sheltered locations
2) strands extending downstream
3) (over most of bed) — as Bed mostly on clay.
4) thin draping over larger clasts

Stream Bed Material:

Surface Texture: silts, clay, sand + some gravel cobble

Distribution & patterns: Most of bed on clay + is fines. Gravel in middle 1/2 of lower portion

X D50 (see pebble count forms): No pebble count

Other Comments:

page 2 of 2

Bank Conditions

Bank Material:

Texture: Mostly clays w/ inclusions of pebbles. In FP ⇒ alluv Still.

Source: Glacial

Sources of protection: Riparian veg - roots.

Bank erosion: 99 % of reach

location:
1) locally where forced by obstructions
2) outside of bends
3) intermittent; independent of channel geometry
4) extensively along one side
(5) continuously along both banks

Associate SR colluv over clay where valley wall abuts channel.

Mass Wasting (record approx length and height; mark on map)

- In area. Below Whitman Rd - DS to MS still.
- RB, below culvert SR colluv over clay. 15m x 10m. - Consistent w/ Recent incision.
- RB - channel on young terrace + against older terrace riser ⇒ 5m x 10m. SR, colluv over clay. Consistent w/ Recent incision.

Floodplain Conditions

Entrenchment: Entrenched

Cross-Section Sketch

Terrace material, source and size: Glacial
Mostly clay (silt) w/ pebbles

Overbank Deposits: - None. In area w/ small FP, fines.
1) wood berms
2) debris trash lines
3) boulder berms
4) other,

Channel margin vegetation: <12" alder, blk berry, Japanese knot plant.

Riparian condition: Near terrace >12" hardwood.
Rest <12" or missing.

Other Comments:
Re: possible Recent incision. Evidence - consistent w/ valley LS.
Exposed roots above channel bed + unvgs. banks. Possible causes:
Lower - pull beaver dam w/ > flow for change of water height in seg (old) 60 cf higher, > water to this channel.
Also concentration by culvert ⇒ local incision + LS.

Migration: Culvert at Whitman Road perched. 4' drop.

Spawning (gravel presence & stability): Minimal quantity, low quality from fines.

Rearing (pool formation): See Fish module.

Overwinter (off-channel): Abundant above perched culvert. None Below.

Channel Assessment Field Form E-4

page 1 of 2

Stream Rollins WAU Hazel Observers PK, GP
Segment No. 65 Response Type Depositional Date 11-7-94
ength Sampled all Total Segment Length _____ Flow: high (mod) low
320'-

Channel Dimensions

Mean bkfl width: 52' (15.8 m) Wetted width: 19'
Mean bkfl depth: 5.6' (1.7 m) Wetted depth: ~1'
Valley bottom width: wide - unconfined Channel slope: 3%

e channel
: accounted for

Bed Conditions

Morphology: colluvial bedrock regime braided pool–riffle (forced pool–riffle) (plane–bed) step–pool cascade

Gravel Bars: (point) (medial) multiple forced
25 % active area in bars
riparian opening wider than active channel? Yes from 1989 Dam-break flood.

Channel Pattern: meandering sinuous (straight) braided Sinuosity: _____

Pool spacing: POOL TALLY (approx width X length X max depth)

Free	LWD Forced	Bldr Forced	Banks Forced
See fish habitat module.			
Total:			

Pool spacing = (reach length/channel width)/ number of pools =

Primary LOD Function(s): (pool scour) bank stability (bar stability) sediment trap step former
describe: Much Large woody debris out of active channel. Most not functional.
Most Rehab potential to add Large wood. Not do near DS.

LWD Tally (> ")

✓ Fine Sediment Deposits:
In pools: avg V* and range (see V* forms): 0.49 = V*. Range = 0-1.66
Repres. 50% pools.

In riffles:
(1) locally in sheltered locations
(2) strands extending downstream
3) over most of bed
4) thin draping over larger clasts

Stream Bed Material:
Surface Texture: _____
Distribution & patterns: _____

D50 (see pebble count forms): _____

✓✓ Other Comments: Did pebble count on inferred 1965-1989 channel. May want to compare to seg 66.

page 2 of 2

Bank Conditions

Bank Material: RB

Texture: Terrace = silt clay. Alluv = Boulder, cobble, gravel.

Source: Terrace – Lacustrine dep., Floodplane + prone => alluvial.

Sources of protection: Roots, but Riparian is <12" hardwood.

Bank erosion: 60 % of reach (30% is active deep seated, 30% eroded banks)

location:
1) locally where forced by obstructions – medial bars
2) outside of bends
3) intermittent; independent of channel geometry
4) extensively along one side – deep-seated RB.
5) continuously along both banks

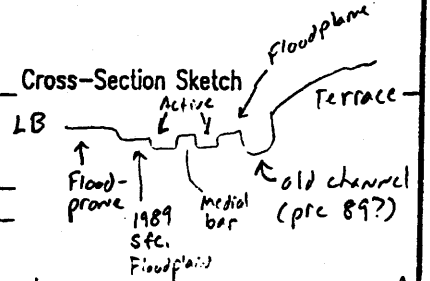
Mass Wasting (record approx length and height; mark on map)

Two major DS. Active but some still vegetated toe. New (I think) since 1989 Dam-break RB ~ 310'. Other RB, below seg 66. 30% of segment length, height >20 m.

Floodplain Conditions

Entrenchment: Low-mod

Cross-Section Sketch



Terrace material, source and size: Mostly silt + Lake clays.

Overbank Deposits:
1) wood berms – deposition of 1965 + 1989 dam-break large wood.
2) debris trash lines
3) boulder berms
4) other, _____

Channel margin vegetation: Blackberry.

Riparian condition: Small hardwood + occaisonal conifer. Probably controlled by ① Dam-breaks and ② Deepseated activity on hillslope.

Other Comments:

Incised since 1965 dam-break (tree ring verified) and 1989 dam-break. 1965 sfc. is 2-3 m above active channel, 1989 is 1-1½ above. 1965 is flood prone, 1989 - Floodplain. Aggrade or just after 1965 event (need data). Also Rollins moderately turbid before relative to NF Stilli. Also Rollins is incised rela to tribs. + NF MS Stilli incised rela to Rollins.

Migration: No barriers.

Spawning (gravel presence & stability): Minimal.

Rearing (pool formation): Limited

Overwinter (off-channel): Several side channels (were old main channels) Majority are high water refuge.

Channel Assessment Field Form E-4

Stream Rollins WAU Hazel Observers PK, GP
Segment No. 66 Response Type Deposition Date 11-7-94
ngth Sampled all Total Segment Length ____ Flow: high (mod) low
elev. 460'-320'

Channel Dimensions

Mean bkfl width: 20m Wetted width: 10.2m
Mean bkfl depth: 5.4' - 1.6m Wetted depth: 1'
Valley bottom width: mostly wide. Channel slope: 5%
low to mod. confine

missed a significant sidechannel (on 1965 sfc)

Bed Conditions

Morphology: colluvial bedrock regime braided pool-riffle forced pool-riffle (plane-bed) (step-pool) cascade

Gravel Bars: (point) (medial) multiple forced
40 % active area in bars
riparian opening wider than active channel? yes. 1965 and 1989 (?) dambreak flood remove Riparian buffer. 1965 → Flood prone area.

Channel Pattern: meandering sinuous (straight) braided Sinuosity: ____

Pool spacing: POOL TALLY (approx width X length X max depth)

Free	LWD Forced	Bldr Forced	Banks Forced
see fish module.			
Total:			

Pool spacing = (reach length/channel width)/ number of pools =

Primary LOD Function(s): (pool scour) bank stability (bar stability) sediment trap step former
describe: Clumps of large wood out of active channel from 1965+1989 dam-breaks.
Most not functional. Rehab potential, especially away from DS.

LWD Tally (> ")

Fine Sediment Deposits:
In pools: avg V* and range (see V* forms): No V* - see seg above, below.
Fines in pools.

In riffles:
(1) locally in sheltered locations 3) over most of bed
(2) strands extending downstream 4) thin draping over larger clasts

Stream Bed Material:
Surface Texture:
Distribution & patterns:

D50 (see pebble count forms): at 450' elev.

Other Comments: Bed fined just downstream of active deep-seated slides, where less gradient and less confined. Compare pebble count sfc with seg 65 on "old" (1965-1989) channel.

page 2 of 2

Bank Conditions

Bank Material:

Texture: Terrace - Lake clays, silts, colluvium. Flood prone - boulder, cobble, gravel.
Source: Glac = terrace. Alluv = Floodprone.
Sources of protection: Some roots of hardwood <12" DBH.

Bank erosion: ~25 % of reach 10% of non-DS sidebanks. 33% is Deepseated eroded toes.
location:
(1) locally where forced by obstructions - sidebank
2) outside of bends
3) intermittent; independent of channel geometry
(4) extensively along ~~one~~ side - where terrace hits channel.
5) continuously along both banks

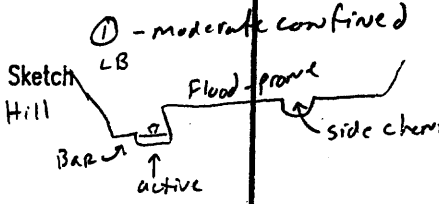
Mass Wasting (record approx length and height; mark on map)

elev = 340' - RB - mod-large
360' - LB - 50m x 20m - mod-large.
33% total length of segment.
Essentially where channel abuts terrace = active deep-seated.

Floodplain Conditions

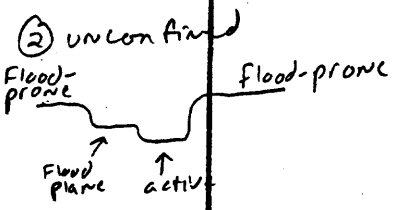
Entrenchment: moderate

Cross-Section Sketch



Terrace material, source and size:
Glac. Lake clays, silt.

Overbank Deposits:
(1) wood berms
2) debris trash lines
(3) boulder berms
4) other, _____



Channel margin vegetation:

Riparian condition: Mostly hardwood <12" DBH. Occasional conifer. Controlled in flood-prone areas by dambreaks, or terrace by landslide activity.

Other Comments:
Incised since 1965 dam-break + 1989 dam-break. See seg 67.
Comments re: incision. Downstream trend in segment is > medial bars, and more 1989 sfc (usually flood-plain).

Migration: No barriers

Spawning (gravel presence & stability): Minimal - patchs behind obstructions.

Rearing (pool formation): see fish module.

Overwinter (off-channel): See fish module.

Channel Assessment Field Form E-4

Stream Rollins WAU Hazel Observers PK, GP
Segment No. 67 Response Type deposition Date 11-7-94
Length Sampled partial Total Segment Length _____ Flow: high (mod) low
elev 560' - 460'

Channel Dimensions

Mean bkfl width: 26.7m Wetted width: 24'
(2 channels) Mean bkfl depth: 7.6', 7.0' Wetted depth: 1'
Valley bottom width: visually wide. Channel slope: 4%
Local confine.

Bed Conditions

Morphology: colluvial bedrock regime braided pool–riffle forced pool–riffle
(plane–bed) (step–pool) cascade
← mostly

Gravel Bars: (point) (medial) multiple forced
50 % active area in bars
riparian opening wider than active channel? yes, from passage of 1965 and 1989 dam-break floods.

Channel Pattern: meandering (sinuous) straight braided Sinuosity: _____

Pool spacing: POOL TALLY (approx width X length X max depth)

Free	LWD Forced	Bldr Forced	Banks Forced
	Visual est: ½ from boulders or channel bed. ½ from Log jam		
Total:			

Pool spacing = (reach length/channel width)/ number of pools =

Primary LOD Function(s): pool scour bank stability LWD Tally (> ")
(bar stability) (sediment trap) step former
describe: Most of wood out of active channel and not functional. Large wood mainly from debris jams.

✓ Fine Sediment Deposits:
✓ In pools: avg V* and range (see V* forms): V* = 0.63, Range = 0 to 1.67
Represents ~40% pools. Down-stream of deep-seated.

In riffles:
(1) locally in sheltered locations 3) over most of bed
(2) strands extending downstream 4) thin draping over larger clasts

More extensive just downstream of deep-seated (scour and less confined).

Stream Bed Material:
Surface Texture:
Distribution & patterns:

✓ sfc ✓ D50 (see pebble count forms):
sub-sfc

Other Comments: Bed relatively finer downstream from deep-seated. Also fines just below trib. (seg 73).

page 2 of 2

Bank Conditions

Bank Material:

Texture: Terrace - lake clays. Floodprone - boulder, cobble, gravel.
Source: Glac - terrace. Alluv. Floodprone area.
Sources of protection: Roots from <12" DBH hardwood.

Bank erosion: 50 % of reach 72% active deepseated. 20% side bank erosion.
location:
(1) locally where forced by obstructions
2) outside of bends
3) intermittent; independent of channel geometry
4) extensively along one side
5) continuously along both banks

Sidebank erosion opposite bank of active DS and where incised the most.

Mass Wasting (record approx length and height; mark on map)

Field notes have location of all deep-seated.
Of total hipchain length, 623m, 72% is active deepseated.

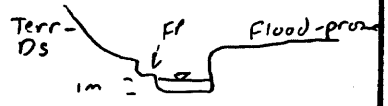
Floodplain Conditions

Entrenchment: Moderate.

Terrace material, source and size:
Glac. Lake clays, silts

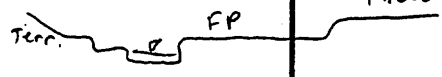
Cross-Section Sketch

(1) Mod. confined - By very active DS



Overbank Deposits:
(1) wood berms
2) debris trash lines
(3) boulder berms
4) other,

(2) Unconfined



Channel margin vegetation:

Riparian condition: Mostly small hardwood <12" DBH.

Other Comments: Floodprone controlled by dam break floods. On terrace, treease controlled by deep-seated activity.

Deepseated on alternating banks, where channel abut terrace. Side banks 2-3 m (flood plain and floodprone) that were channels before. (1965 + 1989 sites from dam breaks). See rel. incision. Greater incision (and gradient) where active deep-seated.

seg #65

Migration: No barriers.

→ Boulders (very large) at ~560' (mean top of clay soon?).

Spawning (gravel presence & stability): Minimal. Pockets of gravel behind obstructions.

Rearing (pool formation): Minimal amount backwater pools.

Overwinter (off-channel): No side channels.

Channel Assessment Field Form E-4

Stream Dicks Creek WAU Hazel Observers GP
Segment No. 122 Response Type deposition Date 1/11/94 (field)
Length Sampled Total Total Segment Length _____ Flow: high (mod) low

Channel Dimensions

Mean bkfl width: 11 M Wetted width: ?
Mean bkfl depth: 1 M Wetted depth: 1'
Valley bottom width: Unconfined Channel slope: 2%

Bed Conditions

Morphology: colluvial bedrock regime braided (pool–riffle) forced pool–riffle plane–bed step–pool cascade

Gravel Bars: point medial (multiple) forced
_____ % active area in bars
riparian opening wider than active channel? No.

Channel Pattern: meandering sinuous (straight) braided Sinuosity: _____

Pool spacing: POOL TALLY (approx width X length X max depth)

Free	LWD Forced	Bldr Forced	Banks Forced
	See fish module		
Total:			

Pool spacing = (reach length/channel width)/ number of pools =

Primary LOD Function(s): (pool scour) bank stability (bar stability) sediment trap step former
describe: See fish module.

LWD Tally (> ")

Fine Sediment Deposits:
In pools: avg V* and range (see V* forms): No V*, Fines not apparent in pools.

In riffles:
(1) locally in sheltered locations 3) over most of bed
2) strands extending downstream 4) thin draping over larger clasts

Stream Bed Material:
Surface Texture:
Distribution & patterns:

D50 (see pebble count forms):

Other Comments: Note that channel is incised.

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Bank Conditions

Bank Material:

Texture: cobbles, gravels

Source: Alluvium.

Sources of protection: Roots, cobbles,

Bank erosion: 25 % of reach

location:
(1) locally where forced by obstructions
(2) outside of bends
3) intermittent; independent of channel geometry
4) extensively along one side
5) continuously along both banks

Mass Wasting (record approx length and height; mark on map)

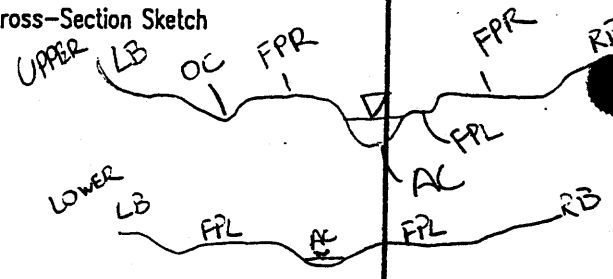
None observed,

Floodplain Conditions

Entrenchment: moderate

Terrace material, source and size: No terraces (flood prone only).

Cross-Section Sketch



Overbank Deposits:

(1) wood berms
2) debris trash lines
3) boulder berms
4) other, fines?

Channel margin vegetation: Blackberry.

Riparian condition: Mostly alder <8", some conifer.

Other Comments:

→ Riparian recruitment - Bank cutting and avulsions. Two factors influence segment. Upper segment, Log jams cause bed aggradation. Lower portion affected by mainstem (causing good spawning gravels) and aggradation from upstream. Result is past braid channel has incised into one (or two) channels.

Migration: no barriers

Spawning (gravel presence & stability): good - 7-8% area

Rearing (pool formation): adequate

Overwinter (off-channel): excellent.

Channel Assessment Field Form E-4

Stream Dicks Creek WAU Hazel Observers PK, GP, AH, RS - cloudy, rain,
Segment No. 123 Response Type depositional Date Field 11-11-94
Length Sampled all Total Segment Length 1 . Flow: high (mod) low
~320' elev - 550' ↳ upper is transport.

Channel Dimensions

Mean bkfl width: 13 m Wetted width: 5m
Mean bkfl depth: 3.2' Wetted depth: 1.2'
Valley bottom width: moderate confine Channel slope: 4-6% upper 6% lower 3-4%
Range - unconfined to mod confine.

Bed Conditions

Morphology: colluvial bedrock regime braided pool-riffle (forced pool-riffle lower) (plane-bed) (step-pool) cascade

Gravel Bars: point (medial) multiple forced
____ % active area in bars 70% of bars active (0-5yr)
riparian opening wider than active channel? No

Channel Pattern: meandering sinuous (straight) braided Sinuosity: ____

Pool spacing: POOL TALLY (approx width X length X max depth)

Free	LWD Forced	Bldr Forced	Banks Forced
	See fish module		
Total:			

Pool spacing = (reach length/channel width)/ number of pools =

Primary LOD Function(s): pool scour bank stability (bar stability) (sediment trap) (step former)
describe: Wood important for pool formation in plane bed

LWD Tally (> ")

Fine Sediment Deposits:
✓ at ~550' In pools: avg V* and range (see V* forms): V* = 0.33; Range = 0.0 to 1.2
note: Dampools Represent = 0% of pools

In riffles:
1) locally in sheltered locations
2) strands extending downstream
3) over most of bed
4) thin draping over larger clasts

More fines adjacent and downstream of active deep-seated fail-ures.

✓ Stream Bed Material:
Surface Texture:
Distribution & patterns:
D50 (see pebble count forms):

Other Comments:

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Bank Conditions

Bank Material: Terrace - fines - (some boulder/cobble)

Texture: Side-bank - boulder, cobble

Source: Terrace - glacial/fluvial. Sidebank - alluvial.

Sources of protection: Tree Roots, boulders.

Bank erosion: 20 % of reach

location:
1) locally where forced by obstructions
2) outside of bends
3) intermittent; independent of channel geometry
4) extensively along one side
5) continuously along both banks

where channel adjacent to terrace and/or recent incision.

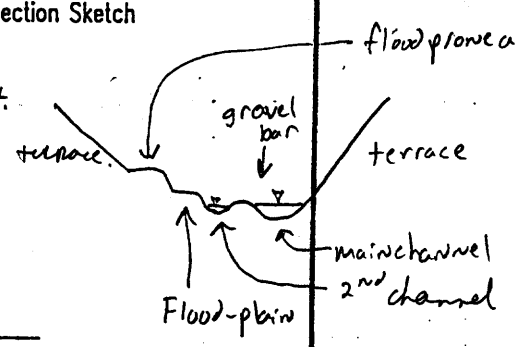
Mass Wasting (record approx length and height; mark on map)

elev:
<400' - LB clay. Debris avalanche 2.5 m x 10 m.
~410' - RB, DS or DA on clay - 2.5 m x 10 m.
~480' - continuous terrace failure (Deep-seat?)
~560' - Large DS, LB - 40 m x 70 m - seeps.

Floodplain Conditions

Entrenchment: Moderate mod. confine

Cross-Section Sketch



Terrace material, source and size:
Terrace mostly glacial lake clay/silt.
Some fluvial boulder, cobbles,

Overbank Deposits:
1) wood berms
2) debris trash lines
3) boulder berms
4) other, fines

Channel margin vegetation:

Riparian condition: Hardwood, conifer mix. Hardwood <12" typically (I think...).

Other Comments:
Channel also incised, though bars have vegetation 0-5 yr. (so less recent than 124 incision).
In lower segment, a tree w/ with advantageous roots indicate an aggradational + erosional sequence in last 30 years (though aggradation not since 1990).

Migration: no barrier

Spawning (gravel presence & stability): minimal

Rearing (pool formation): see fish module

Overwinter (off-channel): see fish.

Channel Assessment Field Form E-4

Stream Picks Creek WAU Hazel Observers PK, AH, GP, PS
Segment No. 124 Response Type Both Date Field = 11-11-94, form 11-15-94
Length Sampled ~560' to 910' elev. Total Segment Length _____ Flow: high (mod) low - Rain.
→ lower transport, upper depositional

Channel Dimensions

Mean bkfl width: 17m Wetted width: 7.3'
Mean bkfl depth: 4.1' Wetted depth: 1.1'
Valley bottom width: variable Channel slope: 3-4%
overall - moderately confined

Bed Conditions

Morphology: colluvial bedrock regime braided pool-riffle (forced pool-riffle) (plane-bed) (step-pool) cascade
↳ lower

Gravel Bars: point (medial) multiple forced
_____ % active area in bars All bars have veg. <1990.
riparian opening wider than active channel? No.

Channel Pattern: meandering sinuous (straight) braided Sinuosity: _____

Pool spacing: POOL TALLY (approx width X length X max depth)

Free	LWD Forced	Bldr Forced	Banks Forced
	See fish module.		
Total:			

Pool spacing = (reach length/channel width)/ number of pools =

Primary LOD Function(s): (pool scour) bank stability (bar stability) (sediment trap) (step former)
describe: Wood important for pools and where mod entrenched for jams that control channel location and surfaces. Especially in new channel (~820'-720' elev)

LWD Tally (> ")

Fine Sediment Deposits:
✓ In pools: avg V* and range (see V* forms): V* = 0.21 (0-0.4)
Represents 33% pools.

In riffles:
1) locally in sheltered locations
2) strands extending downstream
3) over most of bed
4) thin draping over larger clasts

More fines adjacent and immediately downstream of deep-seated failures.

Stream Bed Material:
✓ Surface Texture: _____
Distribution & patterns: _____
_____
_____
D50 (see pebble count forms): _____

Other Comments: Turbid below ~560', where run over clay drop & deep-seated failure.

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Bank Conditions

Alluv - Boulder/cobble.

Terrace: 320'-660' elev. - Lake clay (silt/clay)
660'-740'(?) - till (silt/clay w/ drop stones)
~920 - silt/clay (not till) and sand

Bank Material:
Texture:
Source: Terrace => glacial/fluvial.
Sources of protection: Boulders, tree roots, Till is competent.

Bank erosion: 50 % of reach - variable terrace next to wet => 90%
- alluv. 30-80%

location:
1) locally where forced by obstructions
2) outside of bends
3) intermittent; independent of channel geometry
(4) extensively along ~~one~~ side S
(5) continuously along both banks

Incision causes. Also where wetted channel next to terrace.

Mass Wasting (record approx length and height; mark on map)

elev
560' - LB Deep-seated 40m×20m, seep.
580' - Deep-seated
650' - RB Deep-seated - Large - Appears Rotational.
Others not noted.

elev	confine	entrench
540'	conf	ent
700'	mod	mod
800	UN-mod	mod

Floodplain Conditions

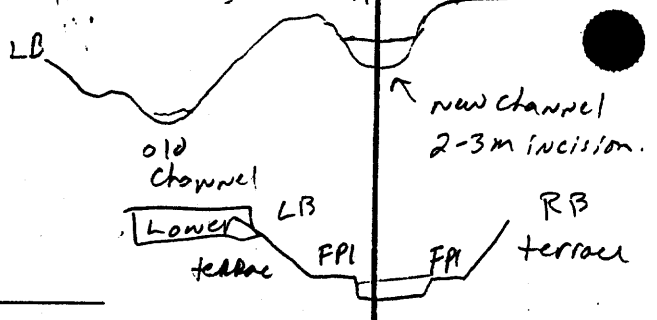
upper segment

Entrenchment: moderate, overall

Terrace material, source and size:
Terrace - glacial/fluvial (see above)

Overbank Deposits:
(1) wood berms
2) debris trash lines
(3) boulder berms
4) other,

Cross-Section Sketch



Channel margin vegetation:

Riparian condition: Conifer, hardwood mix. On untalled terrace mature conifer. Otherwise mostly <12" hardwood in new channel

Other Comments:
Entire channel visited, recently incised ~720'-910'
very recent incised (since 91??). This area has island in 1969 photos. No evidence of aggradation before incise.
Lower evidence of aggradation behind jams (but not a classic wave), and subsequent incision.

Migration: no barriers.

Spawning (gravel presence & stability): minimal

Rearing (pool formation): minimal

Overwinter (off-channel): minimal

Channel Assessment Field Form E-4

Stream Trigger Lady Creek WAU Hazel Observers PK, GP
Segment No. 175 Response Type transport Date 11-16-94
ength Sampled point Total Segment Length _____ Flow: high (mod) low

All visual estimations

Channel Dimensions

Mean bkfl width: unknown Wetted width: 2m
Mean bkfl depth: unknown Wetted depth: 1'
Valley bottom width: confined Channel slope: 15%

Bed Conditions

Morphology: colluvial bedrock regime braided pool–riffle forced pool–riffle plane–bed (step–pool) (cascade)

Gravel Bars: point medial multiple forced None
_____ % active area in bars
riparian opening wider than active channel? No. Tree in channel.

Channel Pattern: meandering sinuous (straight) braided Sinuosity: _____

Pool spacing: POOL TALLY (approx width X length X max depth)

Free	LWD Forced	Bldr Forced	Banks Forced
	unknown		
Total:			

Pool spacing = (reach length/channel width)/ number of pools =

Primary LOD Function(s): pool scour bank stability bar stability (sediment trap) (step former)
describe: _____

LWD Tally (> ")

Fine Sediment Deposits:
In pools: avg V* and range (see V* forms): No V*, but no sig. depth of fines in pools because of flow.
In riffles:
1) locally in sheltered locations
2) strands extending downstream
(3) over most of bed
4) thin draping over larger clasts

Stream Bed Material:
Surface Texture: Boulder, cobble, covered
Distribution & patterns: with clay veneer.

D50 (see pebble count forms):
No pebble count

Other Comments:

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Bank Conditions

Bank Material:

Texture: Boulder cobble (+ fines)
Source: Alluv.
Sources of protection: Trees, tree roots, and boulders.

Bank erosion: % of reach UNKNOWN.
location:
1) locally where forced by obstructions
2) outside of bends
3) intermittent; independent of channel geometry
4) extensively along one side
5) continuously along both banks

Mass Wasting (record approx length and height; mark on map)

Tributary below 520' runs on active deep-seated (described on seg 180 form). Dam at ~550' level (~20-25m high). Water from dam mod. turbid and tributary very turbid. Dam recent, may cause future incision.

Floodplain Conditions

Entrenchment: Entrenched. Cross-Section Sketch

Terrace material, source and size:
Lower - glacial lake clays
Above - assumed recessional outwash, bedrock-colluv.

Overbank Deposits:
(1) wood berms
2) debris trash lines
(3) boulder berms
4) other, _____

Channel margin vegetation: _____

Riparian condition: Lower - mature conifer + alder < 12"
middle - small hardwood (fm DS or harvest)
upper - unk.

Other Comments:
Just visited lower seg.

Migration: Assumed no fish.

Spawning (gravel presence & stability):

Rearing (pool formation):

Overwinter (off-channel):

Channel Assessment Field Form E-4

Stream "Trigger Lady" Creek WAU Hazel Observers PK, GP
Segment No. 180 Response Type depositional Date 11-16-94
Length Sampled whole Total Segment Length _____ Flow: high (mod) low

visual estimation

Channel Dimensions

Mean bkfl width: ~150' Wetted width: ~150'
Mean bkfl depth: deep-unknown Wetted depth: unk.
Valley bottom width: wide- Channel slope: <1%

Bed Conditions

Morphology: colluvial bedrock regime braided ~~pool-riffle~~ ~~forced pool-riffle~~ plane-bed step-pool cascade (a big pool - slough)

Gravel Bars: point medial multiple forced (none)
0 % active area in bars
riparian opening wider than active channel? No.

Channel Pattern: meandering sinuous (straight) braided Sinuosity: _____

Pool spacing: POOL TALLY (approx width X length X max depth)

Free	LWD Forced	Bldr Forced	Banks Forced
	not applicable		
Total:			

Pool spacing = (reach length/channel width)/ number of pools =

Primary LOD Function(s): pool scour bank stability ~~bar stability~~ sediment trap step former
describe: (Cover)

LWD Tally (> ") —

Fine Sediment Deposits:
In pools: avg V* and range (see V* forms): Not measured.

In riffles:
1) locally in sheltered locations (3) over most of bed
2) strands extending downstream 4) thin draping over larger clasts

Stream Bed Material:
Surface Texture: fines as low energy.
Distribution & patterns:

D50 (see pebble count forms): No pebble count.

Other Comments: Occupies ox-bow of N.F. Still.

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Bank Conditions

Bank Material: RB- terrace - mostly silt + clay
Texture: LB - Floodprone (or floodplain) area of Still: - fines.
Source: Terrace - glacial lake deposits. Still: floodplain.
Sources of protection: Roots.

Bank erosion: % of reach unknown.
location:
1) locally where forced by obstructions
2) outside of bends
3) intermittent; independent of channel geometry
4) extensively along one side
5) continuously along both banks

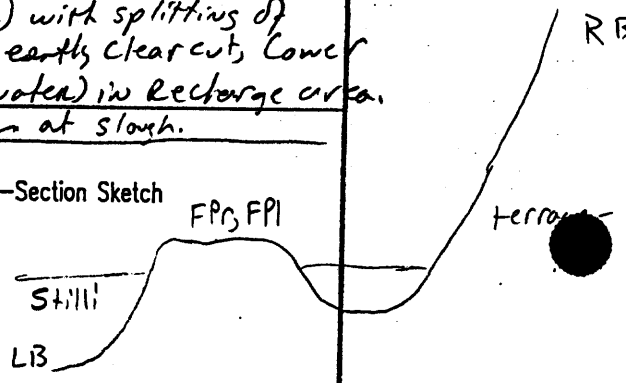
Mass Wasting (record approx length and height; mark on map)
Along almost entire Right bank - deep-seat slump/earthflow complex, going up to old USFS road. Currently active including mature forest (lower segment) with splittings of old growth stumps. Upper seg portion recently clear cut, Lower segment has dam (with impounded water) in recharge area.

Floodplain Conditions: More active upslope than at slough.

Entrenchment: Moderate
unconfined at high flows.

Terrace material, source and size:
Glacial lake silt/clay.

Cross-Section Sketch



Overbank Deposits:
1) wood berms
2) debris trash lines
3) boulder berms
4) other, fines

Channel margin vegetation: Blackberry

Riparian condition: >12" hardwood both sides. Lower RB segment has some mature conifer.

Other Comments:
See notes on dam. Segment 175 delivering very turbid water, and lower segment is turbid on day visited.

Migration: No barrier

Spawning (gravel presence & stability): None

Rearing (pool formation): Excellent - may rival Blue Slough across Still:

Overwinter (off-channel): Excellent.

Channel Assessment Field Form E-4

Stream "Trigger Lady" Creek WAU Hazel Observers PK, GP
Segment No. 181 Response Type Depositional Date 11-17-94
Length Sampled all Total Segment Length _____ Flow: high (mod) low

Rain, snow

Visual estimation

Channel Dimensions

Mean bkfl width: (unconfined) wetland Wetted width: ~4'
Mean bkfl depth: estimated ~1m Wetted depth: ~1/2'
Valley bottom width: unconfined. Channel slope: <1%

Bed Conditions

Morphology: colluvial bedrock regime braided (pool–riffle) forced pool–riffle plane–bed step–pool cascade

Gravel Bars: point medial multiple forced None. Dunes / Ripples
_____ % active area in bars
riparian opening wider than active channel?

Channel Pattern: (meandering) sinuous straight (braided) Sinuosity: _____

Pool spacing: POOL TALLY (approx width X length X max depth)

Free	LWD Forced	Bldr Forced	Banks Forced
	No information		
Total:			

Pool spacing = (reach length/channel width)/ number of pools =

Primary LOD Function(s): (pool scour) bank stability bar stability sediment trap step former
describe: _____

LWD Tally (> ")

X

Fine Sediment Deposits:
In pools: avg V* and range (see V* forms): _____
In riffles:
1) locally in sheltered locations (3) over most of bed
2) strands extending downstream 4) thin draping over larger clasts

Stream Bed Material:
Surface Texture: Silt / clay with inter-
Distribution & patterns: mittent pebbles and gravels.

X

D50 (see pebble count forms): No pebble count.

Other Comments: At elev = 400', beam ~75m to stop water from Lake behind beaver dam.

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Bank Conditions

Bank Material:

Texture: Fines

Source: Young (lowest) glacial terrace

Sources of protection: Wood, roots.

Bank erosion: % of reach No real banks.

location:
1) locally where forced by obstructions
2) outside of bends
3) intermittent; independent of channel geometry
4) extensively along one side
5) continuously along both banks

Mass Wasting (record approx length and height; mark on map)

No mass wasting observed or expected.
Large deepseated landslide to west.

Floodplain Conditions

Unconfined

Entrenchment: None. Cross-Section Sketch FP FP EP

Terrace material, source and size:
Lowest glacial terrace - in borrow pit => fines + gravels

Overbank Deposits:
1) wood berms
2) debris trash lines
3) boulder berms
4) other, fines

Channel margin vegetation: Blackberry, blackberry + more blackberry.

Riparian condition: Mostly young hardwood <12", occasional >12", and small conifer

Other Comments:
Fish habitat could be improved by restoring conifer to the Riparian area.

Migration: No barrier seen.

Spawning (gravel presence & stability): None seen.

Rearing (pool formation): minimal

Overwinter (off-channel): Minimal

Channel Assessment Field Form E-4

Stream Segelson WAU Hazel Observers PK, GP, PS
Segment No. 250 Response Type Dep Date 11-2-94
ngth Sampled all Total Segment Length _____ Flow: high (mod) low

Channel Dimensions

Mean bkfl width: 12.7 m Wetted width: same
Mean bkfl depth: 5' Wetted depth: 1.'
Valley bottom width: Channel slope: 2-3%

Bed Conditions

Morphology: colluvial bedrock regime braided pool–riffle (forced pool–riffle) (plane–bed) step–pool cascade

Gravel Bars: point medial multiple forced
100 % active area in bars
riparian opening wider than active channel? No

Channel Pattern: meandering sinuous (straight) (braided) Sinuosity: _____ → while aggraded.

Pool spacing: POOL TALLY (approx width X length X max depth)

Free	LWD Forced	Bldr Forced	Banks Forced
	See fish mod.		
Total:			

Pool spacing = (reach length/channel width)/ number of pools =

Primary LOD Function(s): (pool scour) bank stability (bar stability) (sediment trap) step former
describe: LWD did not span channel.

LWD Tally (> ")

X Fine Sediment Deposits:
In pools: avg V* and range (see V* forms): Sig. fines in pools in lower segment
No V* (got dark)

In riffles:
(1) locally in sheltered locations 3) over most of bed
2) strands extending downstream 4) thin draping over larger clasts

Stream Bed Material:
Surface Texture: cobble, gravel.
Distribution & patterns:

✓ D50 (see pebble count forms): Have sfc, subsfc pebble count.

Other Comments: Recent channel avulsions. Inferred degradation after passage of aggradational wave. Degradation => avulsion (new channels narrow).

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Bank Conditions

Bank Material:
Texture: cobble, gravel
Source: alluvium
Sources of protection: Roots. Not much wood.

Bank erosion: 5 % of reach
location:
(1) locally where forced by obstructions
(2) outside of bends
3) intermittent; independent of channel geometry
4) extensively along one side
5) continuously along both banks

Mass Wasting (record approx length and height; mark on map)
None.

Floodplain Conditions

Entrenchment: Low Cross-Section Sketch (FP) Low to mod confine

Terrace material, source and size:
Glacial / fluvial

Overbank Deposits:
1) wood berms . LWD,
2) debris trash lines
3) boulder berms
4) other, gravel, cobble wedge (wave)

Channel margin vegetation:

Riparian condition: Deciduous.
Active recruit fm. bank cut.

Other Comments:
Herb Cargill is modifying bank on his property + Removing wood from jams.

Migration: No barriers

Spawning (gravel presence & stability): Higher percentage Relative to Seg. 251.

Rearing (pool formation): Larger pools from wood.

Overwinter (off-channel): one good over-winter

Channel Assessment Field Form E-4

Stream Sagelson WAU Hazel Observers PK, GP, PS 11-2-94
Segment No. 251 Response Type Planebed Date 11-2-94
Length Sampled all Total Segment Length _____ Flow: high (mod) low

Channel Dimensions

Mean bkfl width: 11.6M Wetted width: 25-30'
Mean bkfl depth: 3.7FT Wetted depth: 15-20'
Valley bottom width: — Channel slope:

upper ?
mid UC 2-4%
lower 4-6%

Bed Conditions

Morphology: colluvial bedrock regime braided pool-riffle (forced pool-riffle) (plane-bed) step-pool cascade

Gravel Bars: point medial multiple (forced)
100 % active area in bars
riparian opening wider than active channel? NO

Channel Pattern: meandering sinuous (straight) braided Sinuosity:
w/avulsions at log jam, which create side channel

Pool spacing: POOL TALLY (approx width X length X max depth)

Free	LWD Forced	Bldr Forced	Banks Forced
GP	See fish habitat module		
Total:			

Pool spacing = (reach length/channel width)/ number of pools =

Primary LOD Function(s): (pool scour) bank stability (bar stability) (sediment trap) (step former)
describe: cause, bank erosion, bed part fines
destabilize banks in valley wall

LWD Tally (> ")
GP

Fine Sediment Deposits:
X In pools: avg V* and range (see V* forms): → No V* due to high flows + no fines in pools

In riffles:
1) locally in sheltered locations
2) strands extending downstream
3) over most of bed
4) thin draping over larger clasts

Stream Bed Material:
Surface Texture: Visual estimation
Distribution & patterns:

✓ D50 (see pebble count forms): – Have sfc. count

boulder/cobble except where there is abs. fine to gravel/sand. ~~Gravel~~ Cobble/gravel predom w sands.

Other Comments:

Bank Conditions

Bank Material:

Texture: LB - 15mh - glac - clay/sc — 2 Row 1100' Long. 500 LB

Source:

Sources of protection:

Bank erosion: 5 % of reach

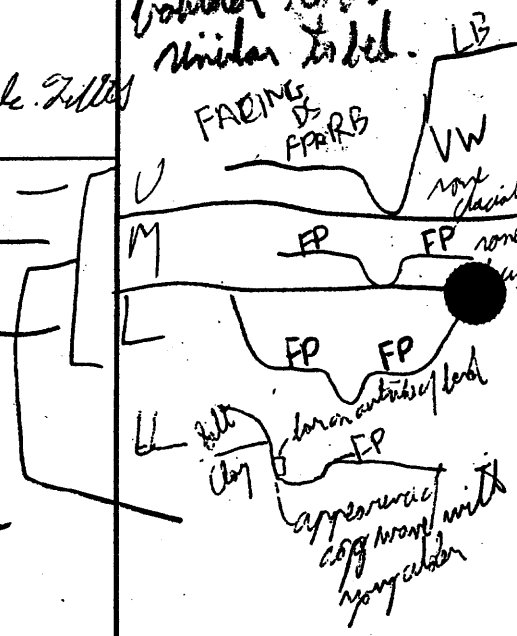
location:
1) locally where forced by obstructions ✓✓
2) outside of bends ✓✓
3) intermittent; independent of channel geometry
4) extensively along one side LB ✓✓
5) continuously along both banks

Texture - Valley wall - glacial 15M, lower part relatively massive clay with silt above. RB - Generally boulder/cobble similar to bed.

Mass Wasting (record approx length and height; mark on map)

U — Valley bank is a bank failure - combo driver + destabilized veg.

LL - 20MH, 80M long failure silt/clay collapse glacial. Tilted trees.



Floodplain Conditions

Entrenchment: Cross-Section Sketch

low to mod — U

low — M

mod — L

Terrace material, source and size: Glacial

Overbank Deposits: — LWD, cobble, gravel, some boulders
1) wood berms
2) debris trash lines
3) boulder berms
4) other,

Channel margin vegetation:

Riparian condition: Varied from mature conifer to a mix of mature conifer/decidous. Active Recruit for Bank cut.

Other Comments:

Middle, unconfined area, may be related to glacials. No log jam in middle area.

Migration:

Spawning (gravel presence & stability): No spawning gravels

Rearing (pool formation): Pools formed log jam ~~[illegible]~~

Overwinter (off-channel): Side chls formed by avulsion due to log jam

☆ See Paul's notes for sens.

Channel Assessment Field Form E-4

Stream Seaelson WAU Hazel Observers PK, GP, PS
Segment No. 252 Response Type transl/cp Date 11-2-94
Length Sampled 740'-680' elev. Total Segment Length _____ Flow: high (mod) low

Channel Dimensions

Mean bkfl width: 14.7m Wetted width: ~10m
Mean bkfl depth: 6' Wetted depth:
Valley bottom width: Channel slope:

at 700' = 4 = 18%

Bed Conditions

Morphology: colluvial bedrock regime braided pool-riffle forced pool-riffle plane-bed (step-pool) (cascade)

Gravel Bars: point medial multiple (forced)
100 % active area in bars
riparian opening wider than active channel? No

Channel Pattern: meandering sinuous (straight) braided Sinuosity: _____

Pool spacing: POOL TALLY (approx width X length X max depth)

	Free	LWD Forced	Bldr Forced	Banks Forced
>700'			most	
<700'		1/4	3/4	
Total:				

Pool spacing = (reach length/channel width)/ number of pools = X

Primary LOD Function(s): (pool scour) bank stability (bar stability) (sediment trap) (step former)
describe:

LWD Tally (> ")

X Fine Sediment Deposits:
In pools: avg V* and range (see V* forms): No fines in pools

In riffles:
1) locally in sheltered locations
2) strands extending downstream
3) over most of bed
4) thin draping over larger clasts

Stream Bed Material:
Surface Texture: Boulder
Distribution & patterns: Heavily armored,

X D50 (see pebble count forms):

Other Comments: No pebble counts

page 2 of 2

Bank Conditions

Bank Material:

Texture: Above 700' elev - Bedrock. Below 700' - cobble/boulde

Source: _____

Sources of protection: _____

Bank erosion: 5 % of reach

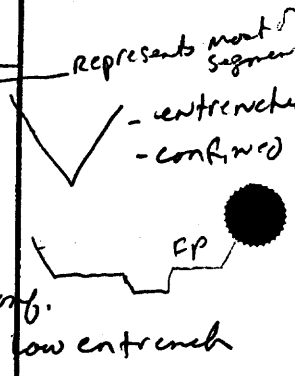
location:
1) locally where forced by obstructions ✓
2) outside of bends ✓
3) intermittent; independent of channel geometry
4) extensively along one side
5) continuously along both banks

Mass Wasting (record approx length and height; mark on map)

Shallow Rapid 10m x 5m, Left Bank ~ 710' elev
(fm. Bankcut?)

Floodplain Conditions

Entrenchment: _____ Cross-Section Sketch



Terrace material, source and size:
Alluvial

Overbank Deposits: Below 700'
1) wood berms
2) debris trash lines
3) boulder berms
4) other, LWD, cobble, boulder

Channel margin vegetation: _____

Riparian condition: >700' - Old growth conifer
<700' - Mature conifer
Active Recruit by Bankcut.

Other Comments:
<700' - log jams spanned channel.

Migration: Falls - several.

Spawning (gravel presence & stability): minimal - due to lack gravels.

Rearing (pool formation): >700' - plunge pools. <700', some plunge + some backwater habitat.

Overwinter (off-channel): <700' elev - 2 sidechannel (150' length) - fm. avulsions due to log jams.

Rainins Brooks Observer: PK, GP

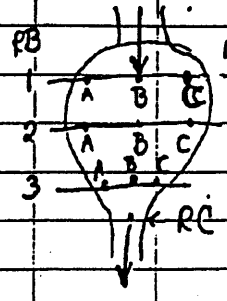
No. 312

V* Data Date: 11-14-94

Segment #: 9

Pool Type: Lateral scour pool

Cover by: Standing snag (some buried)



Width: wetted 9.5' bkfl ____ feet

Length: wetted 24' bkfl ____

Riffle Crest. 0.9'

	Transect #1			Transect #2			Transect #3		
	A	B	C	A	B	C	A	B	C
Depth to fines D_f	0.8	1.6	2.1	0.9	1.9	2.3	1.2	1.2	1.2
Depth to gravel D_g	1.0	1.6	2.1	1.2	1.9	2.3	1.2	1.2	1.2
F = $D_g - D_f$	0.2	0.0	0.0	0.3	0.0	0.0	0.16	0.0	0.0
D: D_g - RC	0.1			0.3					
V* = F/RD	2.0	0.0	0.0	1	0.0	0.0	0.0	0.0	0.0

Avg V* for pool = 0.33

Represents ___ % of pools in the segment see fish mod.

Comments: Fel, high flow. much over-bank (OR out of wetted) sand. Mag → min. V* no fines move.

Rainins Observer: PK, GP

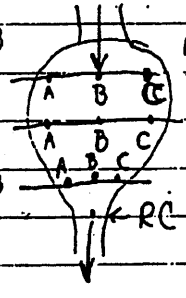
No. 312

V* Data Date: 11-14-94

Segment #: 10

Pool Type: SCOUR

Cover by: Bank + Bed



Width: wetted 22' bkfl ____ feet

Length: wetted 40' bkfl ____

Riffle Crest. 1.6'

	Transect #1			Transect #2			Transect #3		
	A	B	C	A	B	C	A	B	C
Depth to fines D_f	1.8	2.0	1.4	1.8	2.0	0.9	1.5	1.8	0.8
Depth to gravel D_g	2.0	2.0	1.7	1.8	2.0	1.4	1.5	1.8	0.8
F = $D_g - D_f$	0.2	0.0	0.3	0.0	0.0	0.5	0.0	0.0	0.0
D: D_g - RC	0.4		0.1			(-.2)			
V* = F/RD	0.5	0.0	3	0.0	0.0	0	0.0	0.0	0.0

Avg V* for pool = 0.39 see fish mod.

Represents ___ % of pools in the segment See

Comments: Below plane bed reaches. elev ~ 250' (Below 1st dry), Not ~~wetted~~ to dry.

Observer: PK, GP

Date: 11-7-94

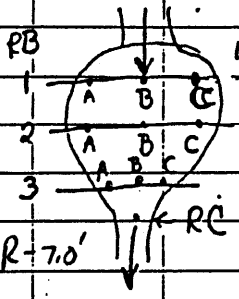
V* Data

Segment #: 67 - Hazel DA

Pool Type: Plunge

Caused by: Boulders

Left = 6.5 (M)



Width: wetted 24' (R) bkfl 26.7 (M)

Length: wetted 18' bkfl L-7.6', R-7.0'

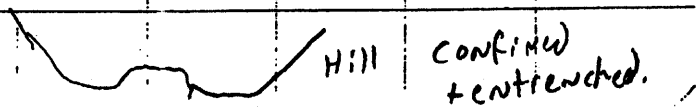
Riffle Crest. 1.4'

In feet	Transect #1			Transect #2			Transect #3		
	A	B	C	A	B	C	A	B	C
Depth to fines (D_f)	1.9	1.9	1.4	1.3	2.0	1.0	1.2	1.3	0.85
Depth to gravel (D_g)	1.9	2.1	2.0	1.6	2.0	2.0	1.2	1.8	1.4
F = $D_g - D_f$	0	0.2	0.6	0.3	0.0	1.0	0	0.5	0.45
RD: D_g - RC	0.5	0.7	0.6	0.2	0.6	0.6	0.2	0.4	0
$V^* = F/RD$	0	0.29	1	1.5	0	1.67	0	1.25	0

Avg V^* for pool = 0.63

Represents ≈40% of pools in the segment

Comments: Just down stream fm deep seated failure. R channel split by medial Bar. Elev = 5610'



Pebble count on medial bar.

Observer: PK, GP

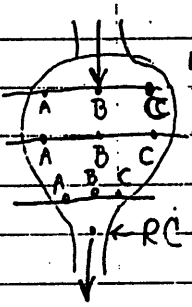
Date: 11-7-94

V* Data

Segment #: 65 - lower pool

Pool Type: Lateral Scour

Caused by: LWD > 50cm Dia.



Width: wetted 19' bkfl 52'

Length: wetted 35' bkfl = 5.6'

Riffle Crest. 1.1'

In feet	Transect #1			Transect #2			Transect #3		
	A	B	C	A	B	C	A	B	C
Depth to fines (D_f)	1.3	3.4	3.7	1.0	2.6	2.0	1.8	2.3	0.9
Depth to gravel (D_g)	1.8	3.4	3.0	2.4	3.0	2.3	1.8	2.6	1.4
F = $D_g - D_f$	0.5	0	0.7	1.4	0.4	0.3	0	0.3	0.5
RD: D_g - RC	0.7	2.3	1.9	1.3	1.9	1.2	0.7	1.5	0.3
$V^* = F/RD$	0.7	0	0.36	1.0	0.2	0.25	0	0.2	1.66

Avg V^* for pool = 0.49

Represents ≈50% of pools in the segment

Comments:

Observer: CP, PB, AH

Date: 11/1/94

V* Data

Segment #: 124

Pool Type: PLUNGE POOL

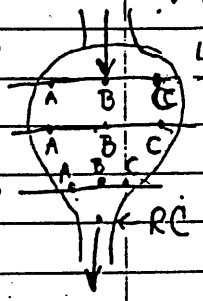
Caused by: BOULDERS

GRADIENT: 3-4%

Width: wetted 73 bkfl 17M

Length: wetted 1.1 bkfl 4.1FT

Riffle Crest . 0.6FT

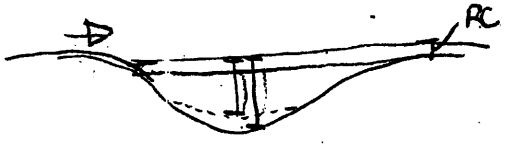


	Transect #1			Transect #2			Transect #3		
	A	B	C	A	B	C	A	B	C
Depth to fines D_f	.2	1.3	.2	1.2	1.7	.9	.6	1.0	.6
Depth to gravel D_g	.3	1.5	.2	1.3	2.2	1.1	.8	1.0	.6
$F = D_g - D_f$	0.1	0	0	0.1	0.5	0.2	0.2	0	0
$RD: D_g - RC$ (-.3)				0.7	1.6	0.5	0.2		
$V^* = F/RD$	0	0	0	0.14	6.31	0.4	NO	0	0

Avg V^* for pool = 0.21

Represents 33 % of pools in the segment

Comments:



Observer: AK, AH

Date: 11/11/94

V* Data

Segment #: 123

Pool Type: dam

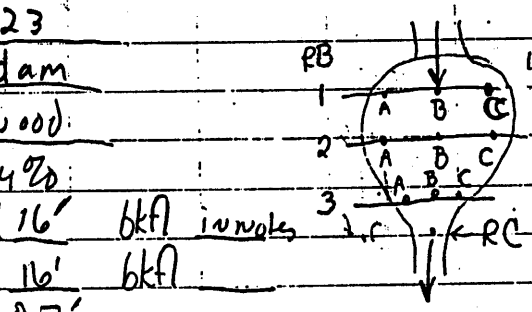
Caused by: wood

% = 3-4%

Width: wetted 16' bkfl in rocks

Length: wetted 16' bkfl

Riffle Crest . 0.7'

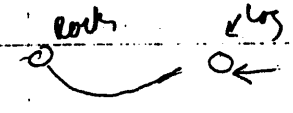


	Transect #1			Transect #2			Transect #3		
feet	A	B	C	A	B	C	A	B	C
Depth to fines D_f	2.2	1.8	1.9	2.3	2.6	1.5	0.6	0.7	1.1
Depth to gravel D_g	2.5	2.0	2.0	2.7	2.6	1.5	1.2	0.9	1.2
$F = D_g - D_f$	0.3	0.2	0.1	0.4	0.0	0.0	0.6	0.2	0.1
$RD: D_g - RC$	1.8	1.3	1.3	2.0	1.9	0.8	0.5	0.2	0.5
$V^* = F/RD$	0.17	0.15	0.08	0.2	0	0	1.2	1	0.2

Avg V^* for pool = 0.33

Represents ___ % of pools in the segment

Comments: Raining.



Pebble Counts

Segment	9	Brooks				
Subbasin	Hazel					
Observer	PK, GP					
Date	11/14/94					
Locale	Just below bridge, medial bar sample across channel, mostly bar					
Surface				Subsurface		
D50	51			D50	11	
D84	90			D84	61	
Size	Count	Cum % <		Size	Count	Cum % <
mm				mm		
2	4	4%		2	36	36%
2.8	0	4%		2.8	0	36%
4	0	4%		4	2	38%
5.6	0	4%		5.6	5	43%
8	0	4%		8	3	46%
11	1	5%		11	10	56%
16	3	8%		16	8	64%
22	7	15%		22	10	74%
32	4	19%		32	5	79%
45	22	41%		45	3	82%
64	21	62%		64	6	88%
90	21	83%		90	10	98%
128	10	93%		128	1	99%
180	5	98%		180	1	100%
256	2	100%		256	0	100%
>256	0			>256	0	
Total	100	2%		Total	100	0%

Segment	10	Brooks				
Subbasin	Hazel					
Observer	GP, PK					
Date	11/14/94					
Locale	Medial GB, Lower seg					
Surface						
				Subsurface		
D50	45			D50	16	
D84	123			D84	45	
Size	Count	Cum % <		Size	Count	Cum % <
mm				mm		
2	12	12%		2	19	19%
2.8	0	12%		2.8	0	19%
4	0	12%		4	4	23%
5.6	0	12%		5.6	2	25%
8	1	13%		8	4	29%
11	2	15%		11	7	36%
16	2	17%		16	13	49%
22	11	28%		22	12	61%
32	4	32%		32	14	75%
45	16	48%		45	9	84%
64	18	66%		64	4	88%
90	14	80%		90	8	96%
128	7	87%		128	4	100%
180	8	95%		180	0	100%
256	4	99%		256	0	100%
>256	1			>256	0	
Total	100	4%		Total	100	0%

Segment	15	Brooks				
Subbasin	Hazel					
Observer	PK, GP, PS, AH					
Date	11/4/94					
Locale	Trib junction					
Surface				Subsurface		
D50	35			D50	8	
D84	92			D84	22	
Size	Count	Cum % <		Size	Count	Cum % <
mm				mm		
2	3	3%		2	32	32%
2.8	0	3%		2.8	0	32%
4	1	4%		4	6	38%
5.6	0	4%		5.6	3	41%
8	3	7%		8	10	51%
11	3	10%		11	3	54%
16	14	24%		16	16	70%
22	10	34%		22	13	83%
32	12	46%		32	9	92%
45	10	56%		45	6	98%
64	14	70%		64	2	100%
90	12	82%		90	0	100%
128	5	87%		128	0	100%
180	7	94%		180	0	100%
256	6	100%		256	0	100%
>256	0			>256	0	
Total	100	6%		Total	100	0%

050

Segment	65	Rollins				
Subbasin	Hazel					
Observer	PK, GP					
Date	11/7/94					
Locale	lower seg mostly on medial bar and some in channel					
Surface				Subsurface		
D50	60			D50	5	
D84	128			D84	44	
Size	Count	Cum % <		Size	Count	Cum % <
mm				mm		
2	10	10%		2	46	46%
2.8	0	10%		2.8	0	46%
4	0	10%		4	1	47%
5.6	0	10%		5.6	4	51%
8	2	12%		8	0	51%
11	3	15%		11	6	57%
16	3	18%		16	5	62%
22	1	19%		22	6	68%
32	7	26%		32	8	76%
45	11	37%		45	10	86%
64	16	53%		64	5	91%
90	12	65%		90	5	96%
128	19	84%		128	4	100%
180	7	91%		180	0	100%
256	6	97%		256	0	100%
>256	3	6%		>256	0	
Total	100			Total	100	0%

65B

Segment	65	Rollins				
Subbasin	hazel					
Observer	PK, GP					
Date	11/7/94					
Locale	Overflow upper part of seg.					
Surface						
				Subsurface		
D50 ~52mm				D50		
D84				D84		
Size	Count	Cum % <		Size	Count	Cum % <
mm				mm		
2	11	11%		2		0
2.8	0	11%		2.8		0
4	0	11%		4		0
5.6	0	11%		5.6		0
8	0	11%		8		0
11	0	11%		11		0
16	3	14%		16		0
22	2	16%		22		0
32	13	29%		32		0
45	12	41%		45		0
64	24	65%		64		0
90	19	84%		90		0
128	6	90%		128		0
180	8	98%		180		0
256	2	100%		256		0
>256	0			>256		
Total	100	2%		Total	0	0

Segment	66	Rollins				
Subbasin	Hazel					
Observer	PK, GP					
Date	11/7/94					
Locale	Elev =450 bar on bend					
Surface						
				Subsurface		
D50	128			D50	11	
D84	244			D84	31	
Size	Count	Cum % <		Size	Count	Cum % <
mm				mm		
2	14	14%		2	18	18%
2.8	0	14%		2.8	0	18%
4	0	14%		4	2	20%
5.6	0	14%		5.6	4	24%
8	1	15%		8	2	26%
11	2	17%		11	22	48%
16	1	18%		16	12	60%
22	5	23%		22	18	78%
32	7	30%		32	9	87%
45	2	32%		45	5	92%
64	5	37%		64	1	93%
90	7	44%		90	4	97%
128	7	51%		128	2	99%
180	20	71%		180	1	100%
256	17	88%		256	0	100%
>256	12	17%		>256	0	
Total	100			Total	100	0%

Segment	67	Rollins				
Subbasin	Hazel					
Observer	PK,GP					
Date	11/7/94					
Locale	Elev= 500'					
Surface				Subsurface		
D50	70			D50	11	
D84	180			D84	22	
Size	Count	Cum % <		Size	Count	Cum % <
mm				mm		
2	7	7%		2	20	20%
2.8	0	7%		2.8	0	20%
4	0	7%		4	4	24%
5.6	1	8%		5.6	2	26%
8	2	10%		8	10	36%
11	3	13%		11	12	48%
16	3	16%		16	21	69%
22	4	20%		22	14	83%
32	3	23%		32	9	92%
45	8	31%		45	4	96%
64	15	46%		64	1	97%
90	18	64%		90	0	97%
128	12	76%		128	3	100%
180	8	84%		180	0	100%
256	8	92%		256	0	100%
>256	8	8%		>256	0	
Total	100			Total	100	0%

Segment	122	Dicks				
Subbasin	Hazel					
Observer	GP, PK					
Date	11/11/94					
Locale	pt. bar lower portion					
Surface						
				Subsurface		
D50	37			D50	13	
D84	84			D84	32	
Size	Count	Cum % <		Size	Count	Cum % <
mm				mm		
2	4	4%		2	10	10%
2.8	0	4%		2.8	0	10%
4	1	5%		4	6	16%
5.6	0	5%		5.6	3	19%
8	1	6%		8	5	24%
11	2	8%		11	11	35%
16	7	15%		16	28	63%
22	9	24%		22	13	76%
32	11	35%		32	10	86%
45	26	61%		45	7	93%
64	18	79%		64	6	99%
90	11	90%		90	1	100%
128	8	98%		128	0	100%
180	2	100%		180	0	100%
256	0	100%		256	0	100%
>256	0			>256	0	
Total	100	0%		Total	100	0%

Segment	123	Dicks				
Subbasin	Hazel					
Observer	PK, AH					
Date	11/11/94					
Locale	elev 510- pt bar- sample along edge behind obstr.					
Surface						
				Subsurface		
D50	22			D50	2	
D84	85			D84	22	
Size	Count	Cum % <		Size	Count	Cum % <
mm				mm		
2	12	12%		2	53	53%
2.8	0	12%		2.8	0	53%
4	2	14%		4	3	56%
5.6	2	16%		5.6	6	62%
8	6	22%		8	3	65%
11	6	28%		11	3	68%
16	10	38%		16	8	76%
22	10	48%		22	8	84%
32	11	59%		32	5	89%
45	14	73%		45	6	95%
64	6	79%		64	1	96%
90	10	89%		90	0	96%
128	8	97%		128	4	100%
180	2	99%		180	0	100%
256	1	100%		256	0	100%
>256	0			>256	0	17%
Total	100			Total	100	

Segment	124	Dicks				
Subbasin	Hazel					
Observer	PK, GP, AH					
Date	11/11/94					
Locale	point bar, vs of deep-seated					
Surface				Subsurface		
D50	79			D50	8	
D84	162			D84	22	
Size	Count	Cum % <		Size	Count	Cum % <
mm				mm		
2	8	8%		2	29	29%
2.8	0	8%		2.8	0	29%
4	1	9%		4	7	36%
5.6	0	9%		5.6	8	44%
8	1	10%		8	8	52%
11	5	15%		11	9	61%
16	4	19%		16	15	76%
22	2	21%		22	9	85%
32	5	26%		32	6	91%
45	5	31%		45	2	93%
64	8	39%		64	6	99%
90	18	57%		90	1	100%
128	18	75%		128	0	100%
180	18	93%		180	0	100%
256	5	98%		256	0	100%
>256	2	8%		>256	0	
Total	100			Total	100	0%

Segment	250	Segelson				
Subbasin	Hazel					
Observer	GP, PK					
Date	11/2/94					
Locale	bottom of seg., last bar before Stilli					
Surface				Subsurface		
D50	48			D50	15	
D84	125			D84	20	
1						
Size	Count	Cum % <		Size	Count	Cum % <
2	4	4%		2	21	21%
2.8	0	4%		2.8	0	21%
4	0	4%		4	2	23%
5.6	1	5%		5.6	4	27%
8	1	6%		8	3	30%
11	1	7%		11	9	39%
16	2	9%		16	14	53%
22	6	15%		22	18	71%
32	13	28%		32	10	81%
45	19	47%		45	9	90%
64	18	65%		64	4	94%
90	14	79%		90	5	99%
128	7	86%		128	1	100%
180	14	100%		180	0	100%
256	0	100%		256	0	100%
>256	0			>256	0	
Total	100	0%		Total	100	0

Segment	251	Segelson				
Subbasin	Hazel					
Observer	PK, GP					
Date	11/2/91					
Locale	~480' elev-lower seg on bar below jam					
Surface				Subsurface		
D50	72			D50		
D84	99			D84		
Size	Count	Cum % <		Size	Count	Cum % <
mm				mm		
2	8	8%		2		0
2.8	0	8%		2.8		0
4	0	8%		4		0
5.6	0	8%		5.6		0
8	1	9%		8		0
11	1	10%		11		0
16	1	11%		16		0
22	4	15%		22		0
32	1	16%		32		0
45	11	27%		45		0
64	15	42%		64		0
90	20	62%		90		0
128	10	72%		128		0
180	19	91%		180		0
256	10	101%		256		0
>256	8			>256		
Total	100	10%		Total	0	0

F - Fish Habitat Module

F.1. DISTRIBUTION AND ABUNDANCE OF SALMONIDS-

F.1.1. Introduction- Methods used in this module were consistent with Version 2.1 of the Watershed Analysis Manual (Forest Practices Board, 1994). Personal interviews were held with professionals familiar with the Stillaguamish river basin. Individuals included Don Hendricks, Pete Castle, Bret Barkdahl and Curt Kraemer with the Washington Department of Fisheries and Wildlife (WDFW), as well as John Drotts and Kip Killebrew with the Stillaguamish Tribe. Fish distribution and usage information was obtained from the WDFW Streams and Salmon Utilization Catalog (Williams and others, 1975), and the Stillaguamish Natural Resources Fish Database (Drotts, 1994). Maps included Washington Department of Natural Resources (DNR) water type maps and proprietary maps (Scale 1:400), and United States Geological Survey (USGS) topographic maps (Scale 1:24,000). Field analysis was performed on 15 channel segments with qualitative observations conducted on all the mainstem segments.

F.1.2. Distribution and life histories- *Oncorhynchus tshawytscha* (chinook), *Oncorhynchus keta* (chum), *Oncorhynchus gorbuscha* (pink), *Oncorhynchus mykiss* (steelhead), and occasionally *Oncorhynchus nerka* (sockeye) use the mainstem N.F. Stillaguamish and lower portions of Brooks, Rollins, Dicks, Segelson and other unnamed tributaries draining Higgins Mountain (Map F-1). *Oncorhynchus kisutch* (coho), *Oncorhynchus clarki* (cutthroat trout), and steelhead use the lower elevation tributaries in the flood plain and those reaches which are on terraces of glacial deposits throughout the WAU. *Salvelinus malma/Salvelinus confluentus* (dolly varden/bull trout complex) are also known to use the mainstem and tributaries throughout their life cycle (personal communication, Kraemer 1994). *Prosopium williamsoni* (mountain whitefish) also range throughout the upper N.F. Stillaguamish and larger tributary systems.

Anadromous species are limited in their upstream migration by natural barriers in all of the major tributaries, as well as, the mainstem just upstream of the WAU boundary near river mile (R.M.) 36 (Map F-2). Natural barriers are normally falls or continuous boulder cascades and generally follow the glacial till/bedrock contact (see Map E-1). This contact is located between the 900 and 1200 ft elevation. Resident trout occupy the reaches above the anadromous barrier. Summer low flow conditions play a significant role in determining the timing and extent of upstream migration for several species entering the river during August through October.

Life histories of salmonids using the Hazel WAU are outlined below. Fisheries management on the Stillaguamish River is wild stock driven. Chum and steelhead are the stocks of primary commercial interest. There has been no commercial river fishery for coho in the past two years or a commercial chinook river fishery for the past 12 years. Occasionally there are pink fisheries in the river when the prices justify the effort.

F.1.2.1. ***Chinook-*** Adult Stillaguamish summer/fall chinook enter the river during the months of May through July. Spawning occurs between late August and early October, with peak spawning occurring between late August through the first two weeks of September. Chinook spawning ranges between R.M. 34.5, just above the bridge-to-nowhere, down to the mouth of the North Fork Stillaguamish. Key spawning areas are located between R.M. 26 (French Creek) to R.M. 17.5 (Whitman Bridge) (Map F-2). Eggs remain in the gravel until February, March or April when the fry emerge and begin the journey downstream. Chinook do not stay in fresh water long after emergence. Studies have shown some fish residualize in estuaries shortly after emergence while other fish begin the migration north. Adults return to their natal stream after two to five years in salt water. The dominant age class in the Stillaguamish River over the past five years has been four year olds.

F.1.2.2. ***Chum-*** Chum enter the river in September and continue through December with the peak around early to mid November. Spawning in the North Fork and its tributaries occurs during November and December with the peak coming in late November or early December. Chum utilize several key spawning locations in the North Fork Stillaguamish, including the areas between R.M. 27 (Forston Ponds) down to R.M. 24.3 (Boulder River), and R.M. 22.3 (Hazel pool) down to R.M. 20.4 (Hazel slide). Emergence from the gravel occurs from March through April. Emergence generally occurs at night with the fry promptly migrating downstream to esturine waters where they linger until they make the transition to high salinity waters. Chum remain in salt water for three to five years before returning to spawn. In the Stillaguamish River the majority of returning adults are four year olds. Escapement levels for chum are separated by even year - odd year because of interactions with the odd year pink runs.

F.1.2.3. ***Coho-*** Coho enter the Stillaguamish River beginning in late August and continue into December with the peak occurring from late September to mid October. Spawning occurs from late October into February with the peak spawning occurring between November and December. The majority of spawning in the Hazel WAU occurs in the tributaries between Brooks and Segelson. Fry emerge from the gravel from March to as late as June depending on water temperature and dissolved oxygen levels. Juvenile fish remain in fresh water for a year or more until they become smolts and migrate to salt water. Coho juveniles occupy pools in tributaries during the summer, and avoid riffles and glides (Beechie, Hansen WAU, 1994). Most coho salmon leave tributary pools during the winter, and seek backwater pools in the mainstem and tributaries, as well as beaver ponds, sloughs and oxbows. Prime winter rearing habitat in the form of beaver ponds, sloughs, and wetlands occurs on the North side of Blue Slough near river mile 26, and between Dicks Creek and an unnamed stream which meets the North Fork Stillaguamish at R.M. 24.5 (stream #05.0227).

Smolt migration generally occurs between April and June depending on factors such as water temperature, flow conditions, dissolved oxygen, day length and availability of food. Once in salt water coho begin a rapid growth phase. After 18 months at sea, coho travel thousands of

miles across oceans, streams and lakes to return to their place of origin. Adults return to the river as 3 year olds to spawn.

F.1.2.4. ***Pinks-*** Pink salmon enter the river from early August to early October. Spawning occurs in early September and continues through October. Stillaguamish pinks spawn in odd-number years only, although pinks are occasionally reported during even-numbered years. Historically, pink salmon spawned from R.M. 34.5 (bridge-to-nowhere) to R.M. 27 (Fortson ponds), however, between 1978 and 1983 discrete pulses of sediment, or "sediment waves" altered channel bed substrate composition and effected salmonid spawning patterns (Pess and Benda, 1994). According to WDFW, fine sediment has encroached the channel bed between the "bridge-to-nowhere" and Fortson ponds, resulting in more diffuse pink salmon spawning patterns throughout the WAU.

Fry emerge from the gravel primarily during March and April depending on temperature and day length. After emergence and after achieving neutral buoyancy, pink salmon fry migrate quickly downstream at the surface. They spend less time in fresh water after leaving the gravel than other salmonids. Adult salmon return to spawn in the river after two years at sea.

F.1.2.5. ***Steelhead (winter-run)-*** Steelhead enter the river from December through January. Spawning occurs from April to early June. Some of the key tributaries in the Hazel WAU for steelhead spawning include Brooks, Rollins, and Segelson Creek. Mainsten spawning also occurs throughout the WAU, with a recent shift in peak spawning density towards the upper portion of the WAU between R.M. 34.5 (bridge-to-nowhere) and 31.2 (Squire Creek) (personal communication with Larry Lowe, WDFW, 1994). Peak fry emergence occurs in mid to late July. Juvenile fish remain in fresh water for two or three years as smolts before heading to sea. Adults remain at sea for two or three years before returning to spawn. Unlike other salmonids, steelhead may return to spawn more than once. Fish returning to salt water after spawning are referred to as "kelts". Scale samples have shown that fish have returned to spawn up to four or five times. The Stillaguamish River also has a native summer run steelhead that uses Deer Creek, as well as a hatchery summer run that originates from the Whitehorse Ponds. The hatchery stock uses the mainstem within the Hazel WAU.

The bulk of steelhead parr production occurs in the mainstem, as well as other main tributaries such as Brooks, Rollins, and Segelson (personal communication with Curt Kraemer, 1994). Over the last several years there has been a shift in peak spawning density towards the upper end of the mainstem North Fork Stillaguamish (personal communication with Curt Kraemer, 1994).

F.1.2.6. ***Coastal cutthroat (sea-run, resident)-*** Cutthroat spawn in small streams during the period from February to May. Fry emerge in the early spring and begin to migrate downstream. Cutthroat migration coincides closely with the heavy exodus of coho fry, on which the cutthroat feed extensively. Cutthroat which migrate to sea seem to remain within

the estuaries, moving in and out with the tide. Adults usually reach sexual maturity at 3 or 4 years of age and spawn for the first time.

All creeks throughout the Hazel WAU have cutthroat, however, the majority of use occurs in the major tributaries such as Brooks, Rollins, and Dicks Creek (personal communication with Curt Kraemer, 1994). Rollins Creek is a particularly good producer of sea-run cutthroat (personal communication with Curt Kraemer, 1994). The population of sea-runs has rebounded dramatically since 1980 due to changes in fish harvest management that encourage more repeat spawners (personal communication with curt Kraemer, 1994).

F.1.2.7. ***Dolly Varden/Bull Trout complex-*** Dolly Varden start to enter rivers and migrate upstream between June through August. Spawning for both Dolly Varden and Bull Trout occurs between October and November, when temperatures can drop below 8 degrees C. In order to spawn, Dolly Varden migrate through the mainstem North Fork Stillaguamish to areas upstream of the Hazel WAU, and other tributaries that come into the mainstem from the south side such as Squire Creek and the Boulder River. Fry emerge in May and juveniles drop downstream of spawning sites and rear throughout the Hazel WAU.

F.1.3. Abundance- Annual escapement and historical trends over time have been calculated for the dominant salmonid species. With the exception of winter run steelhead and even-year chum salmon escapement goals have not been consistently reached in several years.

F.1.3.1. ***Coho Salmon-*** Estimates based on data from fish habitat inventories (Tulalip, 1994) indicate that smolt production capacity for the Hazel WAU varies seasonally and by sub-basin. Summer smolt potential for the Hazel WAU sub-basins is approximately 33,420, while winter smolt potential is 6,273. The winter smolt potential estimate for the Hazel WAU is conservative because it does not account for the movement of smolts during the fall and early winter into the mainstem North Fork Stillaguamish, where low-velocity, off-channel areas (e.g., beaver ponds, sloughs, oxbows, and wall-base channels) are much more prevalent. Overall winter smolt potential estimates would subsequently be larger if off-channel area were quantified for the mainstem that is part of the Hazel WAU. Furthermore, juvenile coho can migrate out of the Hazel WAU to find winter refuge downstream, just as coho can migrate from upstream into off-channel area in the Hazel WAU.

For example, a smolt outmigration study that took place between 1986 and 1990 in the Stillaguamish River Basin estimated between 1,934 and 4,500 smolts produced per year for the Hazel side channel (RM 22.3), which is a 1000m meter stretch of pond area located on the south side of the mainstem North Fork Stillaguamish (Loch, 1994). These and other secondary channel areas where not incorporated into the potential estimates because; 1) no quantitative habitat surveys were done on the mainstem, and 2) movement to and from the Hazel sub-basins into mainstem secondary channels is unknown.

The Rollins sub-basin has the highest production potential because of greater overall

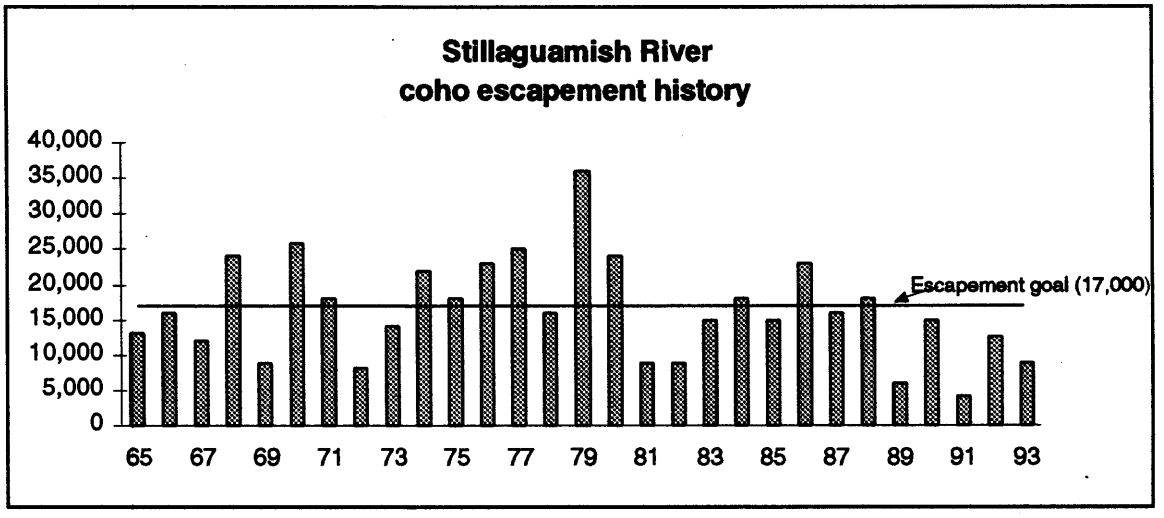
anadramous area, even though overall habitat quality is fair to poor in most segments. Segleson and Brooks Creek sub-basins had a similar smolt potential, even though Brooks Creek has 1.5 miles less of potential coho habitat. This is primarily due to the higher percentage of pool area in Brooks (approximately 33-59%), than in Segelson (approximately 14-33%). Dicks Creek had a higher winter smolt potential than Segelson and Brooks due to the larger percentage of secondary and backwater habitat.

Table F-1. Coho smolt production estimates. Summer and winter smolt potential estimates is calculated from available habitat based on surveys done in the summer and winter of 1994. Number in bold indicate the limiting habitat (summer or winter) for the sub-basin.

Sub Basin	*Summer smolt potential*	*Winter smolt potential*
Brooks	5,170	**289**
Rollins	17,196	**4,960**
Dicks	3,254	**864**
Segelson	7,800	**160**
Total	33,420	**6,273**

To identify trends over time, escapement data was used instead of peak fish per mile (PFPM) data because coho spawner surveys are not done in these sub-basins. Escapement data of Stillaguamish coho, in general, indicates a relative stable population between 1965 and 1988 (Figure F-1) (SASSI, 1993). This trend changed from 1989 through 1991, where we see two of the lowest escapement levels recorded, indicating a short-term severe decline (SASSI, 1993).

Figure F-1

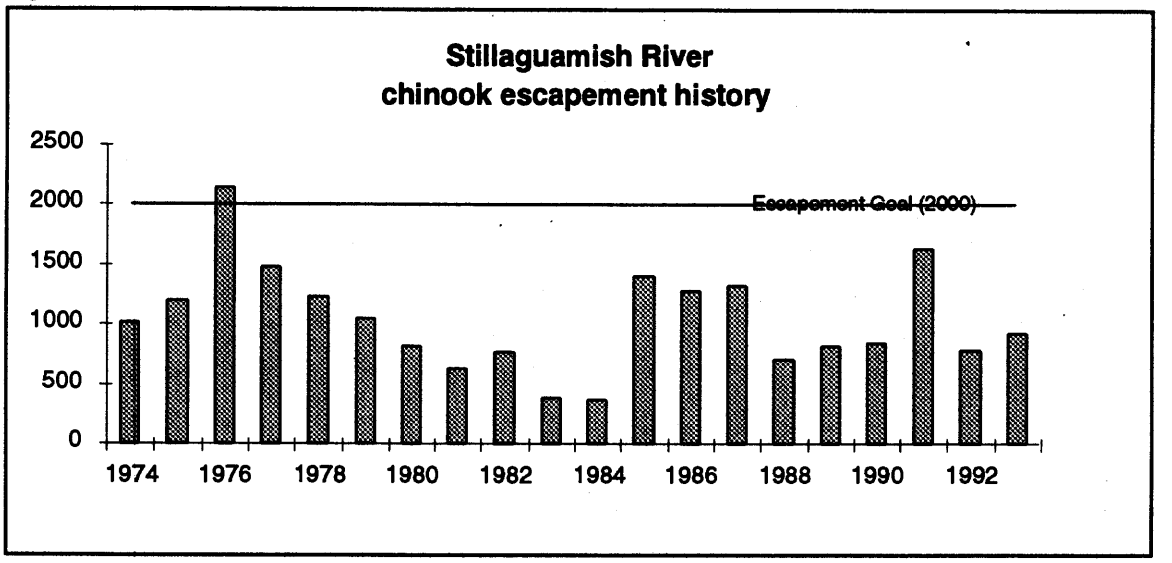


F.1.3.2. ***Chinook Salmon-*** The Stillaguamish has had chronically low chinook escapement levels between 1974 and 1994, with the escapement goal only being met once in the last 20 years. Survival of Stillaguamish chinook has been on the decline since 1983 (SASSI, 1993). Returns since 1991 are in large part due to the Stillaguamish Tribe supplementation program (SASSI, 1993).

Approximately 70 to 80% of all chinook entering the Stillaguamish spawn in the North Fork (SASSI, 1993), meaning that trends in North Fork escapement levels will, more than likely, dictate what is seen in the larger Stillaguamish system. Some of the key freshwater environmental factors to affect survival in the North Fork Stillaguamish include low summer flows, loss of deep pools (greater than 1 meter) with cover, and high water temperature (SASSI, 1993). The loss of deep pools has been hypothesized to be linked to large scale changes in channel morphology and bed particle size due to several discrete pulses of coarse sediment, or sediment waves, that have moved through the mainstem North Fork between 1978 and 1987 (Pess and Benda, 1994).

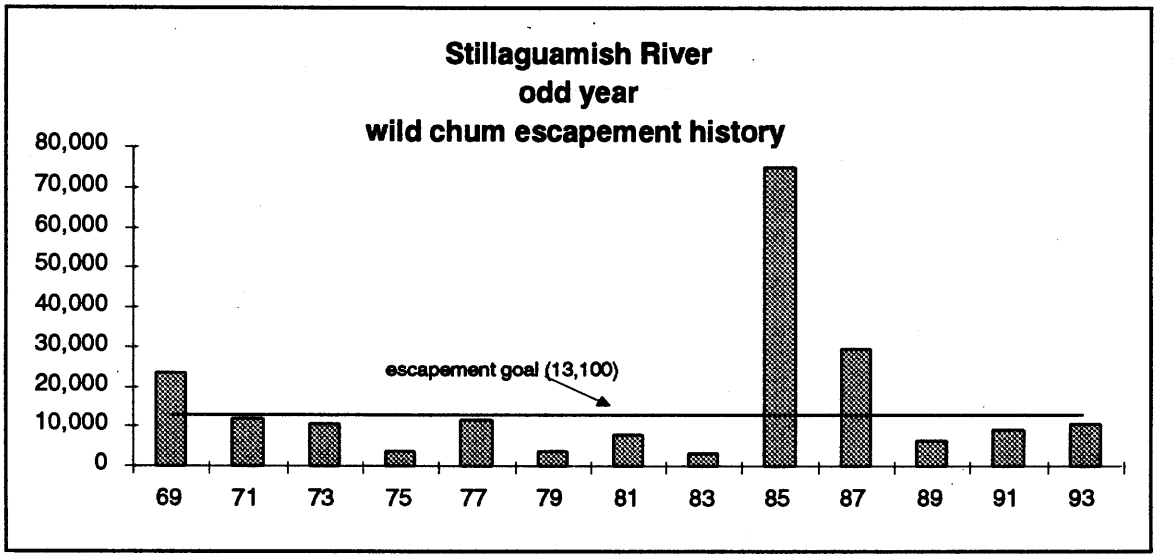
Pess and Benda (1994) hypothesize that this, in combination with low summer flows, have resulted in the downstream migration of where the peak chinook spawning distribution occurs. Between 1976 and 1991, peak chinook per mile has moved from R.M. 27 to R.M. 22 at a rate of 200 to 2300 meters per year (Pess and Benda, 1994). Future research will investigate the effects of this on chinook survival rates over that time period.

Figure F-2



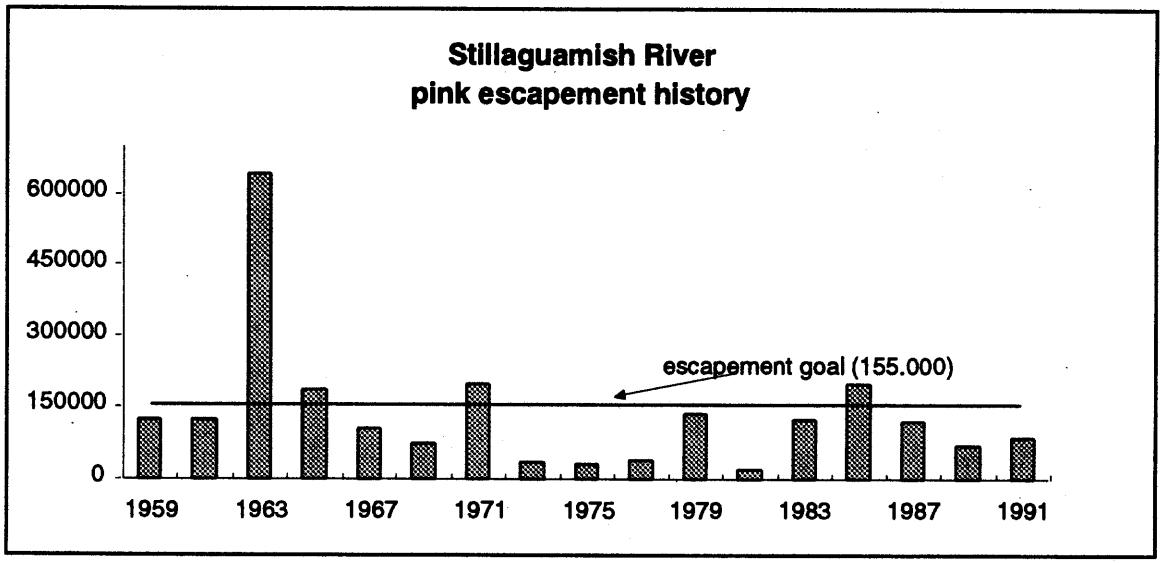
F.1.3.3. ***Chum Salmon-*** Escapement levels for chum salmon (odd and even year) have been met, or close to being met since 1991. Trends in the data for odd-year chum indicate a slight decline from 1969 to 1983, and a slight increase from 1989 to 1993.

Figure F-3



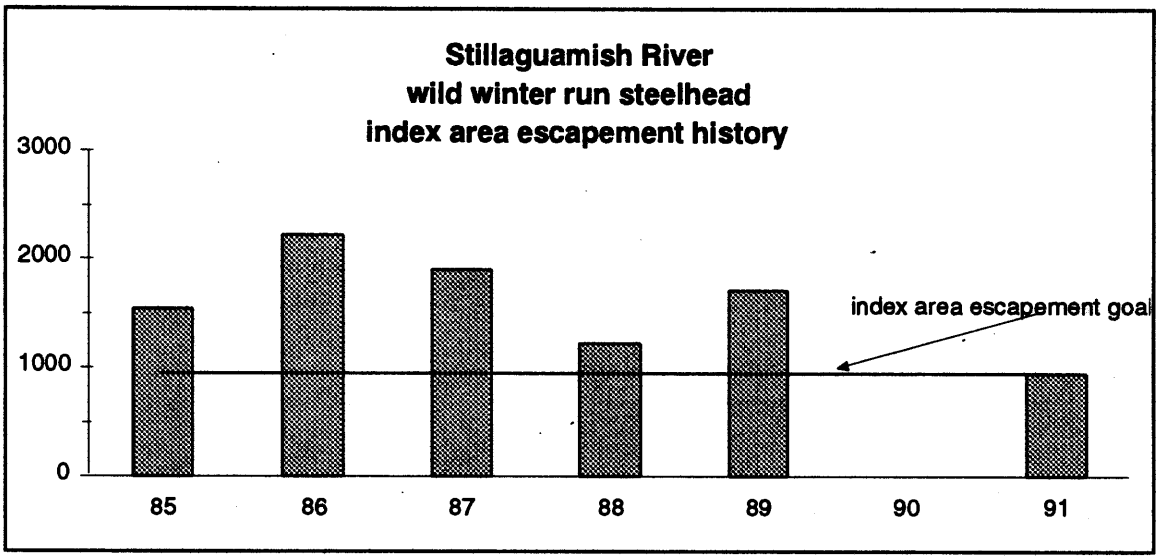
F.1.3.4. ***Pink Salmon-*** Escapement levels for pink salmon show a similar trend to that of chum. Pink escapement levels declined from 1963 to 1981, with an increase seen since 1983. Pink escapement levels range between 7,700 to 147,000 since 1975 (SASSI, 1993).

Figure F-4



F.1.3.5. ***Steelhead trout-*** The index area escapement goal of 950 wild winter steelhead has been met since 1985, however the escapement trend has been downward since 1989.

Figure F-5



F.1.3.6. ***Stock Status-*** Although nine stocks inhabitat portions of the Hazel WAU, (please see section F1.1 of this report), the Washington Department of Fish and Wildlife in conjunction with the tribes have evaluated the status of five (Table F-2). This includes chinook, chum, coho, pink, and winter steelhead. Four of the five are native or wild production only. In 1986, the Stillaguamish Tribe established a broodstock program to supplement the declining number of returning summer chinook that is still ongoing today. The status of chum, pink, and steelhead are healthy. Chinook are depressed which is evidenced by escapement numbers being chronically low, while coho are also depressed (as defined by SASSI), due to a short term severe decline.

Table F-2. Status of stocks in Hazel WAU (SASSI, 1993). North Fork Summer Chinook and Stillaguamish Coho are depressed stocks.

Species/Stock	*Stock Origin*	*Production Type*	*Status*
Summer Chinook	**Native**	**Composite**	**Chronically Low**
Fall Chum	Native	Wild	Healthy
Coho	**Mixed**	**Wild**	**Depressed**
Pink	Native	Wild	Healthy
Winter Steelhead	Native	Wild	Healthy

F.2. SUMMARY OF HABITAT ANALYSES-

F.2.1 Adult upstream migration- Migration barriers identified in this report primarily relate to natural barriers, and not barriers due to roads or low flow. Man-made barriers were identified if they were obvious, however, no systematic attempt was made to document them during the analysis. It is assumed that the natural barriers identified in the Washington Stream Catalog are inclusive for all anadramous species.

F.2.1.1. ***Summary-*** Natural barriers on all major streams are due geologic boundaries at the 500 or 1200ft elevation. These are either due to; 1) a bedrock-recessional outwash boundary near Whitman Bench, or 2) a lacustrine deposit (predominantly silt/clay)-glacial till boundary (see Map E-1), and are bedrock falls or continuous cascades (Map F-2). Individual natural barriers area listed below, and man-made barriers are listed under areas of concern (Section F2.1.4). Resident trout are found above several of the anadramous barriers including Johnson, Brooks, Rollins, Dicks, and Segelson Creek.

Summer/fall low flows in the mainstem North Fork Stillaguamish and large tributaries effect upstream migration and spawning grounds accessibility. Salmonids spawning before September and on the margins of a wetted channel area can have a decrease potential

survival rates of eggs due to the dewatering of redds, which can lead to desiccation or a lethal reduction in dissolved oxygen levels. Since 1987, a portion of segment 304, at RM 27.5, has gone sub-surface for a short period of time, leading the stranding of adult and juvenile salmonids in shallow pools with high temperatures. In addition, low flows can force salmonids to spawn in the channel thalweg, which may increase redd scour potential during peak flow events. During extreme low flow conditions, such as 1987, upstream salmonid migration is impeded by obstructions outside the Hazel WAU, such as the Army Corps of Engineers diversion dam on the mainstem of the Stillaguamish (personal communication with Pat Stevenson, Stillaguamish Tribe, 1994).

F.2.1.2. ***List of natural barriers-***

(05-0212 Johnson Creek). Segment 4. RM 1.7 Cascades.

(05.0215 Brooks Creek). Segment 11. RM 0.8 Small falls in bedrock canyon. resident trout habitat above.

(05.0216 Rollins Creek). Segment 91. RM 3.3. Cascades.

(05.0221 tributary to Rollins Creek). Segment 81. RM 1.0. Cascades.

(05.0223 Dicks Creek). Segment 124. RM 1.6. Cascades

(05.0224 tributary to Dicks Creek). Segment 134. Falls

(05.0226 Unnamed). Segment 166. RM 1.7. Falls

(05.0227 Unnamed). Segment 170. RM 0.9. Falls

(05.0241 Unnamed). Segment 172. RM 0.4. Falls

(05.0242 Unnamed). Segment 175. RM 0.9. Large dam upstream of segment 180, which is a slough.

(05.0243 Unnamed). Segment 182. RM 1.0. Cascades upstream of segment 180.

(05.0250 Unnamed). Segment 203. RM 0.5. Cascades.

(05.0252 Unnamed). Segment 228. RM 2.3. Falls.

(05.0255 Segeslon). Segment 252. RM 2.3. Falls.

(05.0259 Unnamed). Segment 290. RM 1.5. Cascades.

F.2.1.3. ***Holding areas-*** Holding areas (defined in Version 2.1 of the watershed analysis manual as pools > 1m deep with good cover) are concentrated in the mainstem of the North Fork Stillaguamish and side channel sloughs (Map F-2). With the exception of Brooks Creek, none of the tributaries draining the Hazel WAU have key holding pools, because of the lack of pools greater than 1m in depth and adequate cover.

Some of the known key holding pools in the mainstem North Fork Stillaguamish area located in the following locations (Map F-2):

- RM 15.8 - Just downstream of Brooks Creek, underneath highway 530 and train trestle.
- RM 17.0 - Bend where North Fork Stillaguamish abuts Whitman Bench.
- RM 18.0 - Whitman Bridge
- RM 19.5 - Rowan, where North Fork Stillaguamish abuts train tracks, just below Hazel slide.
- RM 21.3 - "C"-post bridge.
- RM 22.3 - "Hazel pool"
- RM 24.3 - "Boulder river pool," just downstream of confluence with the Boulder river.

The potential for these and other holding pools to act as long term holding areas (e.g., those used more than several days prior to spawning) for chinook, and other species, is rated poor in all mainstem segments due the lack of cover throughout the mainstem, and the amount of pool filling observed since 1986 (Personal communication with Pat Stevenson of the Stillaguamish Tribe, 1994). Snorkel survey observations also indicate a decrease in the quantity of holding pools in the mainstem North Fork Stillaguamish since 1986 (Personal communication with Pat Stevenson of the Stillaguamish Tribe, 1994).

These observations are supported by research that has documented recent large scale changes in channel morphology in the mainstem North Fork Stillaguamish (Pess and Benda, 1994). Ten of the fourteen largest peak flow events occurring in the last twenty years, in combination with a four to five fold increase in hillslope sediment input between 1978 and 1983 from the upper portion of the North Fork Stillaguamish basin above RM 35, have resulted in large scale changes in channel morphology. Particular reaches of the mainstem North Fork Stillaguamish have widened over 100%, and aggraded and degraded up to two meters in eleven years (Pess and Benda, 1994).

Pess and Benda (1994) hypothesize that an increase in the magnitude and frequency of flow and sediment supply could alter, and increase, the rate of pool filling, as well as result in a decrease in pool frequency during aggradation periods within a given reach. Channel aggradation and widening can potentially increase spawning area, however, it can also reduce large holding pool quantity due to pool filling, and increase the duration of low summer flows. In addition, holding pool quality has also decreased due to a reduction in LWD and log jams, which are an important source of cover in holding pools for salmonids, as well as a major pool forming factor. A lack of cover in holding pools has altered migration and spawning timing for steelhead (personal communication with Curt Kraemer, WDFW, 1994), and possibly chinook migration and spawning timing.

LWD reduction is due to several reasons including removal by humans, peak flow events, and channel bed aggradation. Aerial photos from 1942 indicate that log jams historically stabilized gravel bars, and allowed vegetation to take hold. The log jams would create in-channel "islands" that had multiple channels around them. On the upstream side of islands would be large pools that are no longer there today due to removal of log jams and the reduction of LWD input. A series of peak flows that followed each other from 1978 to 1991 also mobilized large portions of the LWD loading to the river and made it difficult to establish log jams as seen in the 1942 photos. Channel bed aggradation due to pulses of coarse sediment resulted in a potentially higher rate of LWD burial between 1978 and 1987, as well.

The lack of cover, decrease in pool depths, and pool frequency leads to an increase in temperature and increased poaching. The majority of holding pools identified are accessible by a short hike, leading to increased poaching potential. Increased poaching has been observed over the last several years, as evidenced by an increase in the amount of illegal gear pulled out since 1986 (Personal communication with Pat Stevenson of the Stillaguamish Tribe regarding annual snorkel surveys, 1994).

F.2.1 Spawning and incubation

F.2.2.1. *Spawning gravel area-*

The Hazel WAU sub-basins- Map F-3 gives the distribution of spawning and incubation habitat in the Hazel WAU. Two data sets were used to rate spawning gravel area. The first data set was gathered by WDFW in 1980 as part of their qualitative fish habitat inventory in the Stillaguamish river basin. Of the 15 segments visited during that survey, approximately 47% of the segments were rated as having "good" quantities of spawning gravel for coho and chum. Over 70% (5 out of 7 segments) ran along or were above the North Fork Stillaguamish flood plain and just below the first glacial terrace, and all had gradients less than 4%. The source of the gravels seems to be associated with a younger alluvium holocene deposit that consists of moderately sorted cobbles and gravels. Segments which were rated as having "fair" to "poor" spawning gravel area were steeper segments immediately upstream of the segments rated as "good" spawning area. These segments cut through the Whitman

Bench or the recessional outwash terrace that consists of stratified sand and gravel, as well as portions of silty clay.

Data gathered during the Hazel WAU identified only 20% (3 of 15 segments) of the segments visited as having "good" quantities of spawning gravel area for coho and steelhead. Each segment was less than 2% and either a pool-riffle or forced pool-riffle channel type, with gravel being the dominant substrate. The majority of segments visited were (7 of 15 segment, 50%) cobble/clay dominated plane-bed channels with gradients of 3% to 6%. Table F-3 shows the range of percent spawning gravels for each channel type broken down into geomorphic units. Lack of LWD to store gravel-size sediment in the channel was the main reason why more spawning area was not seen in these segments. Although the current rating indicates that these segments have a "poor" spawning gravel area rating, their potential can be classified as "good" because the main mechanism to retain gravels is LWD, which can alter the channel type and turn plane-bed dominated reaches into forced pool-riffle channel types.

Table F-3. Relationship between percent spawning gravels, channel type and geomorphic units in the Hazel WAU tributaries

Geomorphic Unit	*% Spawning Gravels for Coho and Steelhead in Plane-bed Segments*	*% Spawning Gravels for Coho and Steelhead in Pool-Riffle and Forced Pool-Riffle Segments*
1- Low Gradient (<3%) Gravel-bedded tributaries on low terraces with alluvium	0% to 0.3%	7.6% to 24%
2- Moderately Steep (3% to 12%) tributaries on upper terraces with glacial lake clays	0.1% to 0.4%	No data

Approximately 13% of the segment visited had a "poor" spawning gravel area rating because they are associated with low gradient (less than 1%) sloughs. Segment 60A, was rated as having "poor" spawning gravel area, due to in-channel sediments that are dominated by large portions of sand and silty clay. This segment cut through the Whitman Bench. Cobble/boulder dominated step-pool cascade channel types with gradients between 10 to 15% (2 of 15 segments, 13%) were rated as "poor" for anadramous spawning, however, patches of gravel behind obstructions such as log jams and boulder clusters are considered "good" spawning habitat for resident trout.

The Mainstem North Fork Stillaguamish- The mainstem North Fork Stillaguamish has an abundance of spawning gravel area between RM 14.5 and RM 31. It includes prime holding and spawning habitat for several species including chinook, pink, chum, steelhead, and sea-run cutthroat. Substrate in the mainstem is primarily gravel/cobble with sand and boulders.

Spawning gravel area ratings are identified on a species-specific level using WFDW spawner survey (e.g., fish density estimates) and redd count data. The entire mainstem North Fork Stillaguamish is utilized by summer-run chinook, and makes up approximately 75% of all summer-run chinook spawning (Pess and Benda, 1994). "Good" chinook spawning area is considered to go from the Whitman Bridge at RM 17.5 to Forston Ponds (RM 27.8). This includes segments 299 through 304. Lower densities of spawning chinook area seen below RM 17.5 and above RM 27.8. This includes segments 298 and 305. Highest densities of spawning chinook are seen in braided sections of the North Fork Stillaguamish, which is hypothesized to be due to appropriate gravel size, water depth and velocities in combination with holding areas (Personal communication with Pete Castle, WDFW, 1994).
As map F-3 indicates, the entire North Fork Stillaguamish within the Hazel WAU is considered "good" pink spawning habitat. Higher densities of spawning chum are seen between RM 19.5 and 22.3 (Hazel pool), as well as RM 26 (French creek) to RM29 (Segelson creek). This includes segments 300, 301, 302, 304, and the lower portion of 305. Steelhead data was not evaluated, however, it is know that steelhead spawn in all mainstem segments (298 to 305) are utilized (Personal communication with Curt Kraemer, 1994).

Aerial photo analysis and fieldwork indicate that spawning gravel area in the North Fork Stillaguamish is spatially and temporally dynamic because of large scale changes in channel morphology and bed particle size due to several discrete pulses of coarse sediment, or sediment waves, that have moved through the mainstem between 1978 and 1987 (Pess and Benda, 1994). The result has been aggradation and degradation of up to two meters in eleven years for particular reaches of each segment in the mainstem (Pess and Benda, 1994).

Aggradation resulted in extensive channel widening, up to 100%, in segments 300, 301, 302 and 304, and an overall decrease in bed particle size. Overall bed material fining was identified through aggradational surfaces, which lie between the current floodplain and terraces of the North Fork Stillaguamish (Pess and Benda, 1994). There is also recent evidence of a discrete pulse of small gravel and sand, or "sand wave," in segment 305 Communication with Don Hendricks, WDFW, 1994). This sand wave that goes from the confluence of Segeslon Creek to the Whitehorse bridge is the primary reason for the "poor" spawning and incubation call in segment 305 (see Map F-3). This is based on the observation of spawning gravels being buried under sand.

F.2.2.2. ***Spawning gravel quality (survival to emergence)***- Spawning gravel quality and overall spawning habitat quality includes several variables such as percentage of fine sediment in spawning gravels, potential of depth of scour below redd depths, relationship of spawning area to quality holding pool locations, and cover. This section will concentrate on

the first two variables, fine sediment and depth of scour, since the last two variables, holding pools and cover, have already been discussed in a previous section.

All spawning gravel quality data for the Hazel WAU is qualitative because no McNeil samples (bulk samples of sediment in spawning areas) were collected. Qualitative data is based on what has been seen over time (e.g., the last 15 to 20 years) by professional fish biologists, or what was evaluated as part of an on-going study by the Tulalip Tribes and the University of Washington (Pess and Benda, 1994). Quantitative data collected by the channel module that is used as a potential indicator of a high sediment supply, and potentially high levels of fine sediment, is Q*, V*, and % fines in subsurface. For a description of each parameter please see the channel module.

The Hazel WAU sub-basins- Fish and channel surveys in geomorphic unit (GMU) #1 (low gradient (<3%) gravel-bedded tributaries on the lower terrace with alluvium) indicate that most segments visited are response reaches that have had recent aggradation evident due to braided channels, medial bars, a high q* (range between 0.63 and 0.89, average of 0.80) even though channels have subsequently incised, and a high percentage of fine sediment in sub-surface counts (10%-36%). In general, segments are depositional sites and have received pulses of coarse and fine sediment (e.g., Segment 9 and 53 in Brooks Creek). The channel features, in combination, indicate high sediment loading.

Three of the four segments visited in GMU #1 (segment 9 and 53 in Brooks, and segment 122 in Dicks) have channel beds that favor spawning due to large percentage of spawnable gravels. The data point to a high level of fine sediment, which could entomb salmonids in redds or reduce oxygen levels and increase incubation mortality. In addition, channel aggradation and widening can also result in the burial and dewatering of redds. Channel bed fining can lead to an increase in redd scour frequency and depth due to decreased bed roughness. This can lead to a decrease in egg to fry survival rates for all species.

Fish and channel surveys in GMU #2 (moderately steep (3% to 12%) tributaries on upper terraces with glacial lake clays) identified that segments are predominantly transitional between transport and depositional reaches, and aggradation occurred in three segments prior to incision. Fines were observed in sheltered locations, and more fines were observed adjacent to and downstream of deep-seated failures. High levels of fines in sub-surface counts (18%-53%), as well as a average Q* of 0.87, and V* of 0.41 (range of 0.21 to 0.63) point to a high sediment supply relative to transport capacity. The data in GMU #2, coupled with field observations points to a high fine sediment load that can degrade spawning gravel quality. However, the biggest effect with regard to spawning gravel quality in this GMU is the loss of spawning gravels due to recent incision and a lack of LWD.

Unlike GMU #1 and #2, GMU #3 (Moderately steep (3%-12%) tributaries on upper terraces with competent glacial materials) showed no evidence of recent aggradation. Segments visited were primarily transport reaches with sediment storage behind LWD. No fines

observed in pools, sand was deposited locally behind obstructions and overbank in floodplain. Fines will affect pools and available spawning gravels for steelhead and cutthroat, but stream energy will limit the extent of this effect.

The Mainstem North Fork Stillaguamish- As mentioned in the spawning gravel area section, sediment waves, in conjunction with large consecutive peak flow events have moved through the mainstem North Fork Stillaguamish have resulted in channel widening, aggradation and degradation, and bed particle size changes. Fine sediment can entomb salmonids in redds or reduce oxygen levels and increase incubation mortality. Channel bed fining can result in an increase in redd scour frequency and depth due to a decrease bed roughness. This can lead to a decrease in egg to fry survival rates. An increase in peak flows result in an increase in redd scour frequency and depth due to an increase in shear stress. This can also lead to a decrease in egg to fry survival rates.

F.2.3. Summer rearing habitat

F.2.3.1. ***Subsurface flows***- Subsurface flow conditions occur in small and large tributaries throughout the Hazel WAU. In each case subsurface flow condition can occur near tributary junction with the mainstem North Fork Stillaguamish where alluvial fans begin. Based on WDFW data from 1980 some of the segments that have been observed to go subsurface include 122 (portions of Dicks creek), 133 (tributary to Dicks Creek), 147 (near Dicks Creek slough complex at RM 22.5), 203 (RM 26.6), and 250 (Segelson Creek).

Segments 122, 133, and 147 are low gradient segments running along the North Fork Stillaguamish flood plain, and are affected by mainstem lateral migration and sediment deposition. In addition, beaver activity within and immediately upstream of these segments can also effect summer flow levels, by damming or redirecting flow into one of the many channels that are found there.

Segments 203 runs through residential and pasture lands, and the creek may be used as a watersource for nearby houses or cattle (WDFW, 1980). Segment 250 (lowest portion of Segelson) is a larger tributary that occasionally goes subsurface. It is hypothesized that subsurface flows in Segelson are a result of aggradation in segment immediately upstream that occurred in the late 70's through early 80's (Pess and Benda, 1994).

Summer/fall low flows in the mainstem North Fork Stillaguamish can also result in portions of the mainstem running subsurface. Since 1987, a portion of segment 304, at RM 27.5, has gone sub-surface for a short period of time, leading to the stranding of adult and juvenile salmonids in shallow pools with high temperatures (Personal communication with Pat Stevenson, Stillaguamish Tribe, 1994).

F.2.3.2. ***Rearing pools***- Two main indicators were used to identify the amount of rearing pool area in the Hazel WAU - percent pool area and pool spacing (channel widths per pool).

Each indicator identified that the majority of the tributaries entering the Hazel WAU have a low percentage of summer rearing area.

GMU #1 varied in percent pool area (PPA) based on channel type. In pool-riffle and forced pool-riffle reaches, PPA was on average almost one-half of total surface area, while in plane-bed reaches the PPA was only 14% (Table F-4). Pool spacing was rated fair to poor in GMU #1 due to pool-riffle and forced pool-riffle segments having approximately 4 channel widths per pool (CW/pool), and plane-bed segments averaging approximately 7 CW/pool. Even though all LWD indicators (LWD/100m, LWD/CW, and key LWD/CW) identified wood counts as fair to poor (Table F-7), approximately one-half (range between 12% to 69%) of all pools formed in segments visited that are part of GMU #1 were still created by LWD (Table F-6). This shows the importance of LWD in forming pools in GMU #1. Approximately one-third of the pools measured were created by root-protected banks in conjunction with the channel bed.

The future loss or lack of LWD recruitment can result in a decrease in pool spacing and quantity of rearing area. Loss of LWD can also reduce rearing area quality by reducing instream LWD cover. Cover was low in three of the four segments visited in GMU #1. The segments that make up the mouth of Brooks Creek (segments 9 and 53) have shown evidence of avulsions into an old meander bend of the North Fork Stillaguamish. Segment 53 currently flows though pasture land, which means future recruitment potential is low due to the removal of LWD and riparian vegetation.

GMU #2 did not have the range of PPA as did GMU #1. Plane-bed, forced pool-riffle, and step-pool channel types had an average PPA of approximately 30% (Table F-4). The range of PPA seen in plane-bed channel types was greater, but this may be due to sample size. Pool spacing varied between channel types in GMU#2, with plane-bed segments having an average of 4 CW/pool (range of 1 to 7 CW/pool), and step-pool segments having an average of approximately 1 CW/pool.

As documented in recent literature (Montgomery and others, in press) pool spacing in the plane-bed and forced pool-riffle segments had a close association with functioning LWD. For example, the largest functioning LWD was seen in segment 251 (Segelson Creek), which had a pool spacing of approximately 4 CW/pool, while segment 66 (Rollins Creek) had the least amount of functioning LWD (more than 75% of the LWD was non-functioning) and a pool spacing of 7.7 CW/pool. Functioning sizes of LWD in segment 66 were above the current floodplain due to dam-break floods which haver periodically occurred since the 1960s. Almost 40% of all pools measured in GMU #2 were formed by the channel bank and bed, while 37% (range between 22% to 59%) of all pools formed in segments visited were created by LWD. LWD loadings in GMU #2 were only adequate for one segment visited (#251, Segelson Creek), which means pool area and spacing can increase with an increase in LWD, and increase the amount of rearing area. As is the case with GMU #1, loss of LWD in GMU #2 can reduce rearing area quality by reducing instream LWD cover. Cover was

low in 71% of all segments visited.

In both GMU #1 and #2 pool spacing and cover in low to moderate gradient segments were low as a result of the lack of LWD in channels. As suggested in previous watershed analyses (see Beechie, Hansen WAU, 1994), this can be an indicator of low habitat complexity due to the lack of boundaries between low and high velocity flow areas, which are considered preferred feeding stations. This reduces summer rearing habitat suitability for coho and steelhead trout (Beechie, Hansen WAU, 1994). In addition, the lack of large pools and good cover may indicate a reduced potential rearing capacity for age 1+ steelhead and age 1+ and older resident trout (Beechie, Hansen WAU, 1994).

The majority of segments visited in GMU #3 were step-pool/cascade segments that had a different rearing pool makeup than GMUs #1 and #2. PPA was approximately 40%, while pool spacing was less than 1 CW/pool. The majority of pools formed in GMU #3 were due to boulders (62%), while LWD accounted for 30%-50% of pool forming factors in segment visited.

Table F-4. Relationship between percent pool area (PPA), channel type, geomorphic unit in the Hazel WAU tributaries.

Geomorphic unit	*Either Pool-Riffle or Forced Pool-Riffle Channel Types*	*Plane-Bed Channel Types*	*Step-Pool Channel Types*
1- Low Gradient (<3%) Gravel-bedded tributaries on low terraces with alluvium	Average-48% Range-26% to 59%	Average-15% Range-10% to 30%	No data
2- Moderately Steep (3% to 12%) tributaries on upper terraces with glacial lake clays	No data	Average-30% Range-17% to 38%	Average-33% Range-33%
3- Moderately Steep (3% to 12%) tributaries on upper terraces with competent glacial till	No data	No data	Average-42% Range-42%

Table F-5. Relationship between pool spacing (CW/pool), channel type, geomorphic unit in the Hazel WAU tributaries.

Geomorphic unit	*Either Pool-Riffle or Forced Pool-Riffle Channel Types*	*Plane-Bed Channel Types*	*Step-Pool Channel Types*
1- Low Gradient (<3%) Gravel-bedded tributaries on low terraces with alluvium	Average-4.2 Range-3.8 to 4.5	Average-5.3 Range-4.0 to 6.5	No data
2- Moderately Steep (3% to 12%) tributaries on upper terraces with glacial lake clays	No data	Average-3.73 Range-1.3 to 7.7	Average-1.2 Range-1.2
3- Moderately Steep (3% to 12%) tributaries on upper terraces with competent glacial till	No data	No data	Average-0.6 Range-0.6

Table F-6. Relationship between pool forming factors (PFF) and geomorphic unit in the Hazel WAU tributaries

Geomorphic unit	*LWD*	*Bank/Chl Bed*	*Boulder*	*Bedrock*	*Beaver Dam*
1- Low Gradient (<3%) Gravel-bedded tributaries on low terraces with alluvium	50%	33%	13%	1%	3%
2- Moderately Steep (3% to 12%) tributaries on upper terraces with glacial lake clays	37%	14%	38%	11%	0%
3- Moderately Steep (3% to 12%) tributaries on upper terraces with competent glacial till	38%	0%	62%	0%	0%

LWD and residual pool depth (RPD)- Obstruction size and residual pool depth data indicate that large obstructions create deeper pools (Figure F-1). Residual pool depth had a good correlation to LWD size (r2=.67), as evidenced by Figure F-1, which shows the relationship in Segment 251 of Segelson Creek, where LWD loading is considered adequate. Residual pool depth also seemed to be influenced by substrate size in GMUs #1 and #2, with deeper pools in finer substrate. Average RPD in GMU #1 and #2 was approximately 0.23 to 0.26 meters (Table F-7), and was dominated by either gravel or cobble, while GMU #3 had a RPD of 0.19 meter and was dominated by cobble and boulder. There were several exceptions to this relationship, especially if obstruction size was large enough in any GMU.

Figure F-6. Relationship between obstruction size and residual pool depth in forced pool-riffle reaches of Segelson Creek.

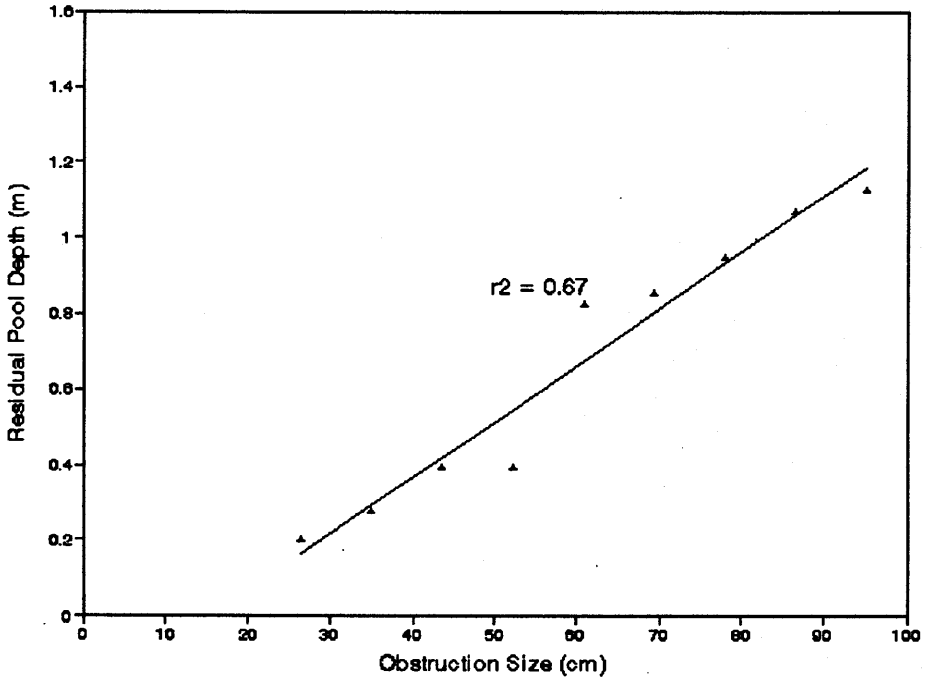


Table F-7. Relationship between residual pool depth (PFF) (meters), channel type, and geomorphic unit in the Hazel WAU tributaries.

Geomorphic Unit	*Either Pool-Riffle or Forced Pool-Riffle Channel Types*	*Plane-Bed Channel Types*	*Step-Pool Channel Types*
1- Low Gradient (<3%) Gravel-bedded tributaries on low terraces with alluvium	Average-0.26 Range-0.22 to 0.30	Average-0.23 Range-0.17 to 0.30	No data
2- Moderately Steep (3% to 12%) tributaries on upper terraces with glacial lake clays	No data	Average-0.27 Range-0.17 to 0.50	Average-0.28 Range-0.28
3- Moderately Steep (3% to 12%) tributaries on upper terraces with competent glacial till	No data	No data	Average-0.19 Range-0.19

F.2.3.3 ***Stream temperature-*** Stream temperature data was not collected during the analysis, and no previous assessments were found. Please refer to the riparian shade assessment for areas of potential problems. Areas of high hazard are those that are likely to have elevated stream temperatures in the summer.

F.2.4. Winter rearing habitat

F.2.4.1. ***Winter rearing conditions-*** Winter rearing conditions are most important for three species in the Hazel watershed - coho, steelhead, and resident trout. Habitat types of primary use for coho during the winter include off-channel habitat such as sloughs, oxbows, and beaver ponds. Secondary habitat such as backwater pools become key areas for coho as well (Reeves and others, 1989). Backwater pool habitat in the sub-basins of the Hazel watershed is not extensive (see Table F-8), which increases the importance of mainstem off-channel habitat.

Table F-8. Percentage of total pool area that is backwater pool habitat in the Hazel sub-basins

Hazel WAU sub-basins	Backwater pool habitat
Brooks	16%
Rollins	38%
Dicks	11%
Segelson	<1%

In places where backwater habitat exists, such as Rollins creek, quality is an issue because of lack of cover, or stream gradient can, on average, be greater than 3% and limit the coho habitat potential for a given reach. The importance of backwater pools for steelhead and resident trout is assumed to be same as for coho due to their low velocities (Beechie, Hansen WA, 1994).

Coho, steelhead, and resident trout may also use other pools, as well as the interstices of cobble-boulder riffles. Segments sensitive to burial or abrasion of juveniles hiding the streambed interstices during higher flow events correlates to segments sensitive to areas where coarse sediment inputs can aggrade and subsequently degrade a given reach.

Segments (e.g., 300, 301, 303, and 304) with large areas of off-channel habitat such as sloughs, oxbows, and beaver ponds were rated high for coho salmon overwintering (Map F-5). These fall into primarily three GMUs: (8) low gradient (<1%) oxbows, sloughs, wetlands, beaver dam and lake areas, and (9) low gradient (<3%) small tributaries on lower terrace and glacial lake clays, and (10) the mainstem North Fork Stillaguamish. Segments 9 and 53 of GMU #1 was also considered good winter rearing habitat because the segments run through an old meander bend of the mainstem North Fork Stillaguamish and have accompanying beaver ponds and wetlands.

F.3. SUMMARY OF AREAS OF CONCERN FOR SALMONID HABITAT

Areas of salmonid habitat concern are summarized in Map F-6. The information is presented in the following order:
(1) upstream migration and holding;
(2) spawning and incubation; and
(3) summer and winter rearing.

Roads and water impoundments are migration barriers to resident trout and anadramous salmonids.

Map reference numbers: Map F-2, and Map F-6.

Segments: 60a and 175.

Segments Visited: 60a and 175.

1. (05-0??? unnamed tributary to North Fork Stillaguamish). Segment 60a. Perched culvert with a two foot drop along the Whitman Road. Channel has incised through lacustrine deposits and resulted in a perched culvert that does not allow anadramous passage to large wetland/beaver pond area upstream. Incision through clays has resulted in high turbidity levels due to increased bank erosion, and, more importantly, a fragmentation of critical winter rearing habitat upstream of road.

2. (05-0242 unnamed tributary to North Fork Stillaguamish). Segment 175. Concrete dam barrier approximately 20 to 25 meters in height. Will not allow passage of anadramous or resident species.

Data sources: Field surveys (see Form F-2 in Appendix F1).

Chinook and steelhead have a lack of short and long-term holding during their spawning periods due to low flows, pool filling, and lack of cover.

Map Reference Numbers: Map F-2, and Map F-6

Segments: 298 - 305

Segments visited: 299-305

The ability of holding pools on the mainstem North Fork Stillaguamish to act as short and long term holding areas (e.g., those used than more than several days prior to spawning) for chinook, and other species, is rated poor in all mainstem segments due low flows, the lack of cover throughout the mainstem, and the amount of pool filling observed since 1986 (Personal communication with Stillaguamish tribe, 1994).

Summer/fall low flows in the mainstem North Fork Stillaguamish and large tributaries can effect upstream migration and spawning grounds accessibility. Salmonids spawning early (e.g. before September) and on the margins of a wetted channel area can have a decrease potential survival rates of eggs due to the dewatering of redds, which can lead to desiccation or a lethal reduction in dissolved oxygen levels. Since 1987, a portion of segment 304, at RM 27.5, has gone sub-surface for a short period of time, leading the stranding of adult and juvenile salmonids of shallow pools with high temperatures. In addition, low flows can force salmonids to spawn in the channel thalweg, which may increase redd scour potential during peak flow events.

Snorkel survey observations indicate a decrease in the quantity of holding pools in the mainstem North Fork Stillaguamish since 1986 (Personal communication with Stillaguamish tribe, 1994). These observations are supported by research that has documented recent large scale changes in channel morphology in the mainstem North Fork Stillaguamish (Pess and Benda, 1994). Ten of the fourteen largest peak flow events occurring in the last twenty years, in combination with a four to five fold increase in hillslope sediment input between 1978 and 1983 from the upper portion of the North Fork Stillaguamish basin above RM 35, has resulted in large scale changes in channel morphology. Particular reaches the mainstem North Fork Stillaguamish have widened over 100%, and aggraded and degraded up to two meters in eleven years (Pess and Benda, 1994).

Pess and Benda (1994) hypothesize that an increase in the magnitude and frequency of flow and sediment supply could alter, and increase, the rate of pool filling, as well as result in a decrease in pool frequency during aggradation periods within a given reach. Channel aggradation and widening can potentially increase spawning area, however, it can also reduce large holding pool quantity due to pool filling, and increase the duration of low summer flows. In addition, holding pool quality has also decreased due a reduction in LWD and log jams, which are an important source of cover in holding pools for salmonids, as well as a

major pool forming factor. A lack of cover in holding pools has altered migration and spawning timing for steelhead (personal communication with Curt Kraemer, WDFW, 1994), and possibly chinook migration and spawning timing.

The lack of cover, decrease in pool depth, and pool frequency can also lead to an increase in temperature. Prolonged increased temperatures in holding pools can lead to alterations in chinook egg viability and reduced survival (Berman and Quinn, 1989).

Confidence in these calls is high due to field observation and research.

Data sources: Field surveys (see form F-2 in Appendix F1); Pess and Benda, 1994.

High levels of fine sediment can reduce survival to emergence for chinook, steelhead, and chum.

Map reference numbers: Map F-3 and Map F-6

Segments: 298-305. Chinook - 299, 300, 301, 302, 303, and upper portion of 305. Steelhead - 298-301, and upper portion of 305. Chum - 300, 301, upper portion of 303, 304, and 305.

Segments visited: 299-305

High levels of fine sediment are hypothesized for the Mainstem North Fork Stillaguamish segments 298 through 305. This is based upon; 1) qualitative data from by professional fish biologists that has been gathered over the last 15 to 20 years in association with spawner surveys, and 2) what was evaluated as part of an on-going study by the Tulalip Tribes and the University of Washington (Pess and Benda, 1994).

Aerial photo analysis and fieldwork indicate that spawning gravel area in the North Fork Stillaguamish is spatially and temporally dynamic because of large scale changes in channel morphology and bed particle size due to several discrete pulses of coarse sediment, or sediment waves, that have moved through the mainstem between 1978 and 1987 (Pess and Benda, 1994). The result has been aggradation and degradation of up to two meters in eleven years for particular reaches of each segment in the mainstem (Pess and Benda, 1994). Aggradation resulted in extensive channel widening, up to 100%, in segments 300, 301, 302 and 304, and an overall decrease in bed particle size. Overall bed material fining was identified through aggradational surfaces, which lie between the current floodplain and terraces of the North Fork Stillaguamish (Pess and Benda, 1994).

There is also recent evidence of a discrete pulse of small gravel and sand, or "sand wave," in segment 305 (personal communication with Don Hendricks, WDFW, 1994). This sand wave

the goes from the confluence of Segeslon Creek to the Whitehorse bridge, and is the primary reason for the "poor" spawning and incubation call in segment 305 (see Map F-3). This is based on observation of spawning gravels being buried under sand. Fine sediment can entomb salmonids in redds or reduce oxygen levels and increase incubation mortality. Channel bed fining can result in an increase in redd scour frequency and depth due to a decrease bed roughness. Each effect can lead to a decrease in egg to fry survival rates.

Confidence in these calls is high due to field observation and research.

Data sources: Field surveys (see form F-2 in Appendix F1); Pess and Benda, 1994.

Recent bed aggradation and degradation has led to a lack spawning gravels for coho and steelhead in plane-bed channels.

Map reference numbers: Map F-3 and Map F-6

Segments: Extrapolated to all segments within GMU #1 and #2.

Segments visited: 9, 53, 65, 66, 67, 122, 123, 124, 250, and 251

Fish and channel surveys in geomorphic unit (GMU) #1 (low gradient (<3%) gravel-bedded tributaries on the lower terrace with alluvium) indicate that most segments visited are response reaches that have had recent aggradation evident due to braided channels, medial bars, high q* (range between 0.63 and 0.89, average of 0.80), even though channels have subsequently incised, and a high percentage of fine sediment in sub-surface counts (10%-36%). The channel features, in combination, indicate high sediment loading.

Fish and channel surveys in GMU #2 (Moderately steep (3% to 12%) tributaries on upper terraces with glacial lake clays) identified that segments are predominantly transitional between transport and depositional reaches, and aggradation occurred in three segments prior to incision. Fines were observed in sheltered locations, and more fines were observed adjacent to and downstream of deep-seated failures. High levels of fines in sub-surface counts (18%-53%), as well as a average Q* of 0.87, and V* of 0.41 (range of 0.21 to 0.63) point to a high sediment supply relative to transport capacity.

The biggest effect with regard to spawning gravel quality in GMUs #1 and #2 is the loss of spawning gravels due to recent incision and a lack of LWD. Data gathered during the Hazel WAU identified only 20% (3 of 15 segments) of the segments visited as having "good" quantities of spawning gravel area for coho and steelhead. Each segment was less than 2% and either a pool-riffle or forced pool-riffle channel type, with gravel being the dominant substrate. The majority of segments visited were (7 of 15 segment, 50%) cobble/clay dominated plane-bed channels with gradients of 3% to 6%. Table F-3 shows the range of %

spawning gravels for each channel type broken down into geomorphic units. Lack of LWD to store gravel-size sediment in the channel was the main reason why more spawning area was not seen in these segments. Although there current rating indicates that these segments have a "poor" spawning gravel area rating, there potential can be classified as "good" because the main mechanism to retain gravels is LWD, which can alter the channel type and turn plane-bed dominated reaches into forced pool-riffle channel types.

Confidence in these calls is high due to field observation.

Data sources: Field surveys (see form F-2 in Appendix F1)

Lack of secondary habitat (e.g., backwater pools) in the Hazel sub-basins has contributed to the reduction of winter rearing habitat for coho salmon.

Map reference numbers: Map F-3, Map F-4, and Map F-6

Segments: Extrapolated to all segments within GMU #1 and #2.

Segments visited: 9, 53, 65, 66, 67, 122, 123, 124, 250, and 251

Backwater pool habitat in the sub-basins of the Hazel watershed is not extensive (see Table F-8), which increases the importance of mainstem off-channel habitat.

Table F-8. Percentage of total pool area that is backwater pool habitat in the Hazel sub-basins

Hazel WAU sub-basins	**Backwater pool habitat**
Brooks	16%
Rollins	38%
Dicks	11%
Segelson	<1%

In places where backwater habitat exists, such as Rollins creek, quality is an issue because of lack of cover or stream gradient can, on average, be greater than 3% and limit the coho habitat potential for a given reach. The importance of backwater pools for steelhead and resident trout is assumed to be same as for coho due to their low velocities (Beechie, Hansen WAU, 1994). Coho, steelhead, and resident trout may also use other pools, as well as the interstices of cobble-boulder riffles. Segments sensitive to burial or abrasion of juveniles hiding the streambed interstices during higher flow events correlates to segments sensitive to areas where coarse sediment inputs can aggrade and subsequently degrade a given reach.

Confidence in these calls is high due to field observation.

Data sources: Field surveys (see form F-2 in Appendix F1).

Maintenance of mainstem off-channel habitat (e.g., sloughs, oxbows, beaver ponds, and adjacent wetlands) provides winter rearing refugia for juvenile coho salmon that migrate downstream from the upper and middle NFS tributaries.

Map reference numbers: Map F-3, Map F-4, and Map F-6

Segments: Includes segments 9, 53, 180, 300, 301, 303, and 304, and is extrapolated to all segments within GMU #8 and #9.

Segments visited: 9, 53, 180, 300, 301, 303, and 304.

Habitat types of primary use for coho during the winter include off-channel habitat such as sloughs, oxbows, and beaver ponds. Segments (e.g., 300, 301, 303, and 304) with large areas of off-channel habitat were rated high for coho salmon overwintering (Map F-5). These fall into primarily three GMUs: (8) low gradient (<1%) oxbows, sloughs, wetlands, beaver dam and lake areas, and (9) low gradient (<3%) small tributaries on lower terrace and glacial lake clays, and (10) the mainstem North Fork Stillaguamish. Segments 9 and 53 of GMU #1 was also considered good winter rearing habitat because the segments run through an old meander bend of the mainstem North Fork Stillaguamish and have accompanying beaver ponds and wetlands. These areas are presently in fair to good condition for winter rearing and should receive consideration as limiting habitats. The primary concerns are filling with coarse and fine sediments, LWD recruitment and adequate cover.

Confidence in these calls is high due to field observation.

Data sources: Field surveys (see form F-2 in Appendix F1).

F.4. CHANNEL-FISH HABITAT VULNERABILITY

Geomorphic Unit: **(1) Low Gradient (less than <3%) Gravel Bedded Tributaries on Low Terraces with Alluvium.**

Segment to use for example: 9 and 53

Input Factors	Channel Sensitivity & Fish Habitat Description	Vulnerability
Coarse Sediment	Channel: Channel survey indicates that most segments visited are response reaches that have had recent aggradation evident due to braided channels, medial bars and high q* (0.63), even though channels have subsequently incised. Channel features indicate high sediment loading. Substrate is gravel/cobble. Fish: Provides spawning and summer and winter rearing for coho and steelhead. High percentage of spawnable gravels (7.6%-23%) with several exceptions (e.g., segment 250). Channel shifting due to avulsions result in the burial or dewatering of redds.	High
Fine Sediment	Channel: High percentage of fine sediment in sub-surface counts (10%-36%). Segments are depositional sites and have received pulses of coarse and fine sediment. High levels of fines in pools (V*=0.33). Fish: Beds are favorable to spawning, due to large percentage of spawnable gravels. Fine sediment can entomb salmonids in redds or reduce oxygen levels and increase incubation mortality.	High
Large Woody Debris	Channel: Between 50% to 70% (average of 58%)of all pools formed in segments visited were created by LWD. Residual pool depth correlated to LWD size (r2=.67). Channel type which dominates segments visited is pool-riffle, forced pool-riffle, and plane-bed. Fish: Summer and winter rearing habitat in pools. Loss of LWD can decrease pool depth and frequency, and decrease the quantity of rearing area. Loss of LWD can also reduce rearing area quality by reducing instream LWD cover. Cover was low in three of the four segments visited.	High
Peak Flows	Channel: All channels visited have recently incised 1 to 2 meters. Bank erosion ranges from 5% to 25%. Fish: Because the channels are typically unentrenched, thus redd scour is a moderate concern. However, if LWD is lost and channel roughness decreases, redd scour will become more prevalent and become more vulnerable to peak flows.	Moderate

Geomorphic Unit: **(2) Moderately Steep (3%-12%) Tributaries on Upper Terraces with Glacial Lake Clays.**

Segment to use for example: 65 and 251

Input Factors	Channel Sensitivity and Fish Habitat Description	Vulnerability
Coarse Sediment	Channel: Segments are transitional between transport and depositional reaches, and substrate is predominantly cobble/boulder. Aggradation occurred in three segments prior to incision. Fish: Lack of spawning gravels (0-.3%) due to recent incision and lack of LWD. Spawning gravels minimal in areas where local slope exceeds 5%. Aggradation prior to incision, which result in the reduction of the size and number of pools for summer and winter rearing, as well as the burial and dewatering of coho and steelhead redds. Incision, however, is still the dominant factor that effects spawning and rearing habitat for salmonids.	Moderate
Fine Sediment	Channel: Fines observed in sheltered locations; more fines were observed adjacent to and downstream of deep-seated failures. High levels of fines in sub-surface counts (18%-53%) and V* averaged 0.41 (range of .21 to .63), which is considered high. Several segments were also turbid when visited. Fish: Fines can result in loss of summer and, in particular, winter rearing habitat for coho and steelhead due to fines in backwater pools and secondary channel pools. Fines can also reduce amount of interstitial space in cobble/boulder substrate in higher gradient areas (greater than 5%) and result in a loss of fall and winter refuge area.	High
Large Woody Debris	Channel: Between 22% to 59% (average of 32%) of all pools formed in segments visited were created by LWD, which are critical for rearing habitat. Residual pool depth correlated to LWD size. Dominant channel type is forced pool-riffle, plane-bed and step-pool. Fish: LWD loadings were only adequate for one segment visited, which means pool area and frequency can increase with an increase in LWD, and increase the amount of rearing area. Loss of LWD can also reduce rearing area quality by reducing instream LWD cover. Cover was low in 71% of all segments visited. In plane-bed reaches, log jams can trap sediment and increase spawning gravel area, which is minimal in all segments visited.	High
Peak Flows	Channel: Recent incision of 1 to three meters. Bank erosion range from 5% to 60%. Incision and bank erosion are contributing factors to landsliding (debris avalanche and deep-seated failures) where terrace risers abut active channels. Fish: Peak flows can scour redd and effect limited spawning habitat by destabilizing bars and sediment associated with log jams. This can also flush out juveniles during the winter.	High

Geomorphic Unit: **(3) Moderately Steep (3%-12%) Tributaries on Upper Terraces with Competent Glacial Materials**

Segment to use for example: 16

Input Factors	Channel Sensitivity and Fish Habitat Description	Vulnerability
Coarse Sediment	Channel: No observed segments have recently aggraded. Response is primarily transport with sediment storage behind LWD (e.g., jams and root wads). Substrate is cobble/boulder, with gravel behind obstructions. Fish: Summer and winter rearing for steelhead and resident cutthroat, spawning for resident cutthroat in step-pools and in cobble/boulder substrate.	Low
Fine Sediment	Channel: No fines observed in pools, sand was deposited locally behind obstructions and overbank in floodplain. Fish: Fines will effect pools and available spawning gravels for steelhead and cutthroat, but stream energy will limit extent of effect.	Low
Large Woody Debris	Channel: LWD accounted for 30%-50% of pool forming factors in segment visited. LWD traps sediment and forms steps and pools. LWD dissipates energy by increasing roughness and reducing local gradient. Dominant channel type is step-pool and cascade. Fish: LWD increases the number of steps, and increases the number of summer rearing pools and the amount of spawning gravels available by trapping sediment. Critical to habitat that is there.	High
Peak Flows	Channel: Channels are moderately entrenched, and observed bank erosion 5% to 25% of bank length, and composed of colluvium and glacial till. Although till is competent, banks can erode with higher flows due to entrenchment and terrace riser that abuts active channel in certain areas. Fish: Minimal spawning habitat can be effected by destabilizing bars and sediment associated with log jams. This can result in redd scour and the flushing out of juveniles from interstitial spaces during the winter.	Moderate

Geomorphic Unit: **(8) Low gradient (<1%) Oxbows, Sloughs, Wetlands, Beaver dam and Lake areas.**

Segment to use for example: 181

Input Factors	Channel Sensitivity and Fish Habitat Description	Vulnerability
Coarse Sediment	Channel: GMU #8 is sensitive to deposition and loss of water retention over time. Fish: A reduction in water retention can lead to a reduction in the amount of available coho winter rearing habitat.	Moderate
Fine Sediment	Channel: GMU #8 is sensitive to deposition and loss of water retention over time. Fish: A reduction in water retention can lead to a reduction in the amount of available coho winter rearing habitat.	High
Large Woody Debris	Channel: There is no change in morphology. Fish: LWD provides cover for overwintering coho juveniles.	Moderate
Peak Flows	Channel: There is no change in morphology unless beaver dam failures occur. Fish: Winter rearing habitat for coho salmon would not change.	Low

Geomorphic Unit: **(10) Mainstem North Fork Stillaguamish**
Segment to use for example: 301

Input Factors	Channel Sensitivity and Fish Habitat Description	Vulnerability
Coarse Sediment	Channel: Channel type is pool-riffle in each segment. Aggradation and degradation of up to two meters in eleven years for particular reaches of each segment in mainstem. Substrate is primarily gravel/cobble with some sand and boulders. Extensive channel widening in segments 300, 301, 302 and 304. Fining of bed material throughout all segments, and currently occurring in segment 305 due to "sand wave." Discrete pulses of coarse sediment, or sediment waves, evident. Fish: Prime holding and spawning habitat for several species including chinook, pink, chums, steelhead, and sea-run cutthroat. The mainstem is important summer rearing habitat for coho and sea-run cutthroat. Channel aggradation and widening can reduce large holding pool quantity due to pool filling, and increase the duration of low summer flows. This can also reduce holding pool and summer rearing quality by increasing temperatures. Channel aggradation and widening can also result in the burial and dewatering of redds. Channel bed fining can result in an increase in redd scour frequency and depth due to a decrease bed roughness. This can lead to a decrease in egg to fry survival rates for all species. An increase in the rate of channel degradation can result in loss of spawning gravels and resultant loss of habitat.	High

Fine Sediment	Channel: Aggradation and degradation of up to two meters in eleven years for particular reaches of each segment in mainstem. Extensive channel widening in segments 300, 301, 302 and 304. Fining of bed material throughout all segments, and currently occurring in segment 305 due to "sand wave." Discrete pulses of coarse sediment, or sediment waves, evident. Fish: Prime holding and spawning habitat for several species including chinook, pink, chums, steelhead, and sea-run cutthroat. The mainstem is important summer rearing habitat for coho and sea-run cutthroat. Channel aggradation and widening can result in the loss of large holding pool area due to pool filling from fine sediment, especially in the summer. This can also reduce holding pool quality by increasing summer temperatures. Fine sediment can entomb salmonids in redds or reduce oxygen levels and increase incubation mortality. Channel bed fining can result in an increase in redd scour frequency and depth due to a decrease bed roughness. This can lead to a decrease in egg to fry survival rates for all species. Fines in the channel can also reduce summer rearing habitat by pool filling in secondary channel and backwater areas.	High
Large Woody Debris	Channel: Large woody debris in the form of log jams historically stabilized gravel bars, and allowed vegetation to take hold. This would result in-channel "islands" that created multiple channels around islands. On the upstream side of islands would be large pools that are no longer there today due to removal of log jams and the reduction of LWD. Fish: LWD can create holding and backwater pools and is important for cover for holding pools and summer rearing areas (e.g., backwater pools and secondary channel areas). A lack of cover in holding pools has altered migration and spawning timing for steelhead (personal communication with Curt Kraemer, WDFW, 1994), and possibly chinook migration and spawning timing. Loss of cover in summer rearing area also reduces rearing habitat quality for coho.	High
Peak Flows	Channel: Peak flows, in combination with a four to five fold increase in sediment input over the last fifteen years has resulted in large scale changes in channel morphology. A decrease in channel sinuosity and an increase in channel width has resulted from; 1)ten of the fourteen largest flow events occurring in the last twenty years, and 2) channel aggradation and degradation of up to two meters in eleven years. Fish: Prime holding and spawning habitat for several species including chinook, pink, chums, steelhead, and sea-run cutthroat. The mainstem is important summer rearing habitat for coho and sea-run cutthroat. An increase in peak flows result in an increase in redd scour frequency and depth due to an increase in shear stress. This can lead to a decrease in egg to fry survival rates for all species.	High

Geomorphic Unit: **(9) Low gradient (<3%) Small Tributaries on Lower Terrace and Glacial Lake Clays.**

Segment to use for example: 60a

Input Factors	Channel Sensitivity and Fish Habitat Description	Vulnerability
Coarse Sediment	Channel: Low gradient depositional reach that is currently incising. Channel type is pool-riffle and forced pool-riffle. Fish: Minimal amount of spawning gravels. Could use more.	Low
Fine Sediment	Channel: Channel bed is mostly fines with minor inclusions of pebbles and smaller gravels. Fines were also evident in pools. An increase in fines will further increase subsurface fines in gravels and increase turbidity. Fish: Fine sediment will reduce already limited rearing habitat for coho.	High
Large Woody Debris	Channel: Of the segments visited, 50% of pools are associated with log jams or LWD. LWD contributes to bar stability, traps sediment and is a significant component of channel roughness. Fish: LWD associated with pools and is an important source of cover to summer and winter rearing.	High
Peak Flows	Channel: Entire segment visited has recently incised. Evidence included roots above channel and 99% of bank length is eroding. An increase in flows will increase incisions, bank erosion and decrease bank stability. Fish: Peak flows can flush juveniles.	High

F.5. SUMMARIES OF FIELD DATA AND DIAGNOSITC CALLS

GENERAL HABITAT INFORMATION

Habitat Parameters	Brooks					Segelson	
Segment #	9	10	11	16	53	250	251
% Segment Surveyed for data	100%	100%	25%	10%	100%	10%	10%
Gradient	<1%	3-4%	10-15%	12%	<1%	2%	4%
Confinement	UC	UC	C	MC	UC	UC	M/UC
Channel Type	Braid-PR	PB-FPR	SP-CA	SP-CA	Braid-PR	PB-FPR	PB-FPR
Bankfull Width	14.5	20.2	*	7.3	15	12.7	11.6
Bankfull Depth	1.3	1.2	*	1.2	1.3	1.5	1.1
% Pool Area	59%	36%	33%	42%	58%	14%	33%
Channel Widths/Pool	3.8	1.3	1.2	.6	4.2	6.5	3.7
Residual Pool Depth	.22	.24	.28	.19	.3	.3	.5
% Wood cover in pools	6-20%	<5%	<5%	6-20%	<5%	<5%	6-20%
% Riffle-Glide Area	41%	64%	67%	58%	42%	86%	67%
% Spawning Gravels	23%	.3%	0%	0%	19%	.3%	.3%
LWD/100m	24	20.2	1.25	48	5	2	38
LWD per channel width	.89	1	.13	2.8	.3	.16	6
Key LWD per channel width	.4	.04	.13	.52	0	.034	.75

GENERAL HABITAT INFORMATION

Habitat Parameters	Rollins		Dicks		
Segment #	65	66	122	123	124
% Segment Surveyed for data	100%	50%	100%	63%	10%
Gradient	3%	5%	2%	4-6%	3-4%
Confinement	UC	MC	UC	MC	MC
Channel Type	FPR-PB	PB-SP	PR-FPR	PB-FPR	FPR-PB
Bankfull Width	15.8	20	17	13	17
Bankfull Depth	1.7	1.6	1.2	1	1.2
% Pool Area	38%	31%	26%	19%	17%
Channel Widths/Pool	3.7	7.7	4.5	2	4
Residual Pool Depth	.2	.2	.2	.3	.17
% Wood cover in pools	6-20%	<5%	<5%	<5%	<5%
% Riffle-Glide Area	62%	69%	74%	81%	83%
% Spawning Gravels	.4%	.1%	7.6%	.1%	0%
LWD/100m	15	4	19	9.1	3
LWD per channel width	1.25	.55	1.1	4	.23
Key LWD per channel width	.42	.15	.18	.23	.17

GENERAL HABITAT INFORMATION

Habitat Parameters	Whitman Bench
Segment #	60A
% Segment Surveyed for data	80%
Gradient	2-5%
Confinement	C
Channel Type	PR-FPR
Bankfull Width	3
Bankfull Depth	.9
% Pool Area	23%
Channel Widths/Pool	4.5
Residual Pool Depth	.16
% Wood cover in pools	<5%
% Riffle-Glide Area	77%
% Spawning Gravels	0%
LWD/100m	11.4
LWD per channel width	6
Key LWD per channel width	0

POOL-FORMING FACTORS

	Brks	Brks	Brks	Brks	Brks	WB	Roll	Roll	Dcks	Dcks	Dcks	Seg	Seg	Seg
Seg#	**9**	**10**	**11**	**16**	**53**	**60A**	**65**	**66**	**122**	**123**	**124**	**250**	**251**	**252**
Log Jam	38%	27%	0%	0%	12%	0%	35%	11%	38%	11%	17%	0%	42%	25%
LWD	25%	15%	0%	50%	0%	55%	24%	11%	31%	31%	17%	50%	33%	0%
B-B	28%	22%	22%	0%	42%	33%	13%	11%	31%	17%	0%	0%	8%	0%
Bold	0%	19%	23%	50%	0%	12%	13%	67%	0%	33%	67%	50%	8%	75%
Chl	3%	12%	0%	0%	39%	0%	15%	0%	0%	11%	0%	0%	8%	0%
Bed	3%	0%	55%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
MM	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Bev	3%	0%	0%	0%	7%	0%	0%	0%	0%	0%	0%	0%	0%	0%

F.6. REFERENCES CITED

Beechie, T. 1994. Fish habitat module for Hansen Creek Watershed Analysis (WAU). DNR-NW. Unpublished report.

Berman, C. and T. Quinn. 1989. The effect of elevated holding temperatures on adult spring chinook salmon reproductive success. Final Report, TFW-009-89-005. 34pp.

Loch. A. 1993. Wild coho salmon indicator stock study for the Stillaguamish River system, from 1986 to 1991, Final Report. Tulalip Tribes Fisheries Department.

Montgomery, D.R., J.M. Buffington, R.D. Smith, K.M. Schmidt, and G.R. Pess, (accepted in 1994), Pool spacing in forest channels. Water Resources Research.

Pess. G. and L. Benda. 1994. Spatial and temporal dynamics of spawning chinook salmon in the North Fork Stillaguamish river, WA. Geological Society of America (GSA) Abstracts with Programs, Vol 26, Number 7, p440.

Reeves, G.H., F.H. Everest, and T.E. Nickelson. 1989. Identification of physical habitats limiting the production of coho salmon in western Oregon and Washington. PNW-GTR-245. U.S. Department of Agriculture, Forest Service, Portland, Oregon.

SASSI. 1993. 1992 Washington State Salmon and Steelhead Stock Inventory. Washington Department of Fisheries and Wildlife and Western Washington Treaty Indian Tribes.

Tulalip Tribes Environment Department. 1994. Fish habitat and stream channel inventories. Unpublished data.

Williams, R.W., R.M. Laramie, and J.J. Ames. 1975. A Catalogue of Washington Streams and Salmon Utilization, Volume 1, Puget Sound Region. Washington Department of Fisheries, Olympia, Washington.

HABITAT PREFERENCE AND LIFE HISTORY STAGES OF COHO, STEELHEAD, AND RESIDENT TROUT

(Source: Beechie, 1994;USGS, 1983)

Species	Life history stage	Habitat preference	Timing
Coho salmon	Spawning	13mm to 76mm; minimum patch approx 1.5m2	Nov-Jan
	Incubation	Best survival when percent fines (<0.85mm) is <11%	Nov-May
	Summer rearing (Coho spend 1 year in freshwater, 2 years in saltwater)	Pools with good instream cover, temperatures <14oC (lethal at 26oC)	April-Oct
	Winter rearing	Move tens of miles to off-channel refuge (e.g., slough, beaver pond)	Oct-June
Steelhead Trout	Spawning	13mm to 76mm	Jan-May
	Incubation (Steelhead do not always die after spawning)	Assumed similar to coho, best survival when percent fines is (0.85mm) <11%.	Jan-June
	Summer rearing (Steelhead can spend 2 years in freshwater and 1 to 2 years in saltwater)	Age 0+ in pools, glides, and step-pools; age 1+ tend more towards pools, but use other habitats as well; temperature <13oC (lethal at 23.9oC)	April-Oct
	Winter rearing	Move from large mainstems to smaller tributaries; probably seek larger pools with cover or cobble and boulder substrate	Oct-April
Resident Trout	Spawning	Less than 25mm gravels, small patches	Spring
	Summer rearing	Age 0+ prefer backwater pools; older age classes move to larger pools	April-Oct
	Winter rearing	Move to smaller tributaries; move back to larger streams in summer	Oct-April

Form 3: Summary of Field Data Results and Habitat Diagnostic Calls

	Segment No.	Pool (%)		Pool Freq. *		LWD No Pieces/CW		Key Piece* No Pieces/CW		Wood Cover (%)		Dom. Substrate		Off-Channel		Holding Pools		Gravel Quantity	
		Value	Rating	Value	Rating	Value	Rating	Value	Rating	Value	Rating	Value	Rating	Value	Rating	Value	Rating	Value	Rating
BROOKS	9	59	G	38	F	.89	P	.4	F	6-20	F	SAND	F		G	0	P	23%	G
	10	36	F	1.3	G	1	F	.04	P	<5	P	COB/G	F		F	0	P	.3%	P
	11	33	G	1.2	G	.13	P	.13	P	<5	P	BLDR/COB	F		P	0	P	0%	P
	16	42	G	.6	G	2.8	G	.52	G	6-20	F	BLDR/SAND	F		P	0	P	0%	P
	53	58	G	4.2	P	.3	P	0	P	<5	P	SAND/G	F		G	0	P	19%	G
WHITMAN BRANCH	60A	23	P	4.5	P	6	G	0	P	<5	P	CLAY/G	P		P	0	P	0%	P
ROLLINS	65	38	F	3.7	F	1.25	F	.42	F	6-20	F	COB/G	F		P	0	P	.4%	P
	66	31	F	7.7	P	.55	P	.15	P	<5	P	COB/G	F		P	0	P	.1%	P
F-40	122	26	P	4.5	P	1.1	F	.18	P	<5	P	G/COB	G/F		F	1	P	7.6%	G
DICKS	123	19	P	2	F	4	G	.23	F	<5	P	COB/G	F		P	1	P	.1%	P
	124	17	P	4	P	.23	P	.17	P	<5	P	COB/G	F		P	1	P	0%	P
	180	75%	G	—	G	—		—		6-20%	F	SAND	F	—	G	—	G	—	P
	181	~50%	G	—	F	—		—		>20%	G	SAND	F	—	F	—	P	—	P
SEGELSON	250	14%	P	6.5	G	.16	P	.04	P	<5%	P	G/COB	F/G		P	0	P	.3%	P
	251	33%	F	3.7	F	6	G	.75	G	6-20%	F	G/COB	F		P	0	P	.3%	P

(SOURCE: HAZEL WAV, 1994)

* Western Washington Only.

Form 3: Summary of Field Data Results and Habitat Diagnostic Calls

	Segment No.	Pool (%)		Pool Freq.		LWD No Pieces/CW		Key Piece* No Pieces/CW		Wood Cover (%)		Dom. Substrate		Off-Channel		Holding Pools		Gravel Quantity	
		Value	Rating	Value	Rating	Value	Rating	Value	Rating	Value	Rating	Value	Rating	Value	Rating	Value	Rating	Value	Rating
ROLLINS	65	10%	P	—	—	—	—	—	—	—	—	COB		—	—	—	—	—	P/F
	66	10%	P	—	—	—	—	—	—	—	—	COB		—	—	—	—	—	P/F
	67	10%	P	—	—	—	—	—	—	—	—	COB		—	—	—	—	—	P
DICKS	125	5%	P	—	—	—	—	—	—	10%	F	BED		—	—	—	—	—	P/F
	124	10%	P	—	—	—	—	—	—	—	—	COB		—	—	—	—	—	~~P/F~~ G
TRIB TO DICKS	134	10%	P	—	—	—	—	—	—	—	—	COB		—	—	—	—	—	F/P
	133	40%	G	—	—	—	—	—	—	—	—	GRL		—	—	—	—	—	G/F
	138	70%	G	—	—	—	—	—	—	—	—	SAND		—	G	—	—	—	P
	147,148	35%	G/F	—	—	—	—	—	—	—	—	COB		—	—	—	—	—	G
	[illegible]	[illegible]																	
	164	90%	G	—	—	—	—	—	—	—	—	SAND		—	G	—	—	—	F/P
	165	10%	P	—	—	—	—	—	—	—	—	COB		—	P	—	—	—	G
	180	75%	G	—	—	—	—	—	—	—	—	SAND		—	F/G	—	—	—	P
	194	45%	F	—	—	—	—	—	—	—	—	GVL		—	G	—	—	—	F/G
	203	20%	P	—	—	—	—	—	—	—	—	GVL		—	F	—	—	—	G
	209/210	5%	P	—	—	—	—	—	—	—	—	COB		—	P	—	—	—	P
	224	40%	P	—	—	—	—	—	—	—	—	COB		—	—	—	—	—	G
BLACK	286	40%	F	—	—	—	—	—	—	—	—	GVL		—	G	—	—	—	G

SOURCE OF DATA: WDFW, 1980

* Western Washington Only.

Annual

Form 3: Summary of Field Data Results and Habitat Diagnostic Calls

Segment No.	Pool (%)		Pool Freq.		LWD No Pieces/CW		Key Piece* No Pieces/CW		Wood Cover (%)		Dom. Substrate		Off-Channel		Holding Pools		Gravel Quantity	
	Value	Rating	Value	Rating	Value	Rating	Value	Rating	Value	Rating	Value	Rating	Value	Rating	Value	Rating	Value	Rating
67	10%	P									COB							P
125	5%	P							10%	F	B&D							P/F
133	40%	G									GRL							G/F
134	10%	P									COB							F/P
138	70%	G									SAND			G				P
147	35%	G/F									COB							G
148	35%	G/F									COB							G
164	90%	G									SAND			G				F/P
165	10%	P									COB			P				G
194	45%	F									GVL			G				F/G
203	20%	P									GVL			F				G
209	5%	P									COB			P				P
210	5%	P									COB			P				P
224	40%	P									COB			I				G
286	40%	F									GVL			G				G

(SOURCE: WDFW, 1980)

* Western Washington Only.

Brooks

LIMTING FACTORS ANALYSIS FIELD FORM Date: 9/1/94 Stream: Brooks Observers: C.P., A.H., D.M., P.K Weather: Cloudy, 60's

	Dist (ft)	Unit #	Type	Lgth (ft)	Debris	Wdth (ft)	Max D (ft)	Tail D (ft)	Wcov	Pool Hab Form	Sub Dom	Sub SDom	SpGrvl (ft2)	LWD >20 (cm)	LWD >50 (cm)
1	18	1	11	18	1	5.5	—	—	—	—	4	3	—	10	1
1	27	2	6	—	1	7	1.4	0.3	1	3a	4	2	—	1	1
2	27	3	6	—	3	3.3	0.4	0.1	1	3a	4	2	—	1	—
	42	4	6	—	1	7.5	0.8	0.6	1	2	3	2	—	1	—
	55	5	7	—	2	5.3	0.7	0.5	1	2	4	3	—	1	—
	85	6	11	—	4	6.0	—	—	—	—	4	3	—	1	—
(2)	85	7	6	—		3.0	0.6	—	1	2,3a	4	2	—	1	—
(2)	85	8	1	—	2	3.0	0.4	—	1	2,3a	4	2	—	1	—
	115	9	12	—	—	5.3	0.8	—	—	—	4	3	—	—	—
	122	10	6			6.0	0.9	0.7	2	3a,2	4	3	—	—	—
	133	11	11			6.0	—	—	—	—	4	3	—	—	—
	165	12	12			9.0	0.4	—	—	—	4	3	—	—	—
	180	13	11			10.0					6	5			

Type = 1=backwater pool, 2=sidechannel pool, 3=beaver pond <500m2, 4=beaver pond >500m2, 5=straight pool, 6=lateral scour pool, 7=trench pool, 8=plunge pool, 9=dam pool, 10=rapids, 11=riffle, 12=glide.

% wood cover = 1=low (<5%), 2=medium (6-20%), 3=high (>20%)

Pool Habit Forming Factors (PHFF)= 1=channel meander, 2= bank or bend, 3= LWD (a=log, b=tree, c=root, d=jam), 4=gravel, 5=boulder, 6=bedrock, 7=beaver dam, 8=mandmade

Substrate = 1=organics, 2=mud, 3=silt, 4=sand, 5=gravel, 6=cobble, 7=boulder

LIMTING FACTORS ANALYSIS FIELD FORM Date: Stream: Observers: Weather:

	Dist (ft)	Unit #	Type	Lgth (ft)	Debris	Wdth (ft)	Max D (ft)	Tail D (ft)	Wcov	Pool Hab Form	Sub Dom	Sub SDom	SpGrvl (ft2)	LWD >20 (cm)	LWD >50 (cm)
	190	14	12	—	—	5.5	0.5	—	—	—	5	4	—	—	—
②	190	15	1	—	—	5.5	0.5	—	1	2	6	5	—	—	—
	221	16	11	—	—	10	—	—	—	—	5	4	SG	—	—
	255	17	6	—	1	9.0	1.0	0.4	2	2	5	3	—	1	—
	277	18	12	—	—	11.0	0.3	—	—	—	5	3	—	—	—
	306	19	11	—	—	4.0	—	—	—	—	5	4	—	—	—
②	306	20	11	—	1	3.0	—	—	—	—	5	4	—	—	—
②	306	21	1	—	—	5.0	0.3	—	2	2	3	2	—	—	—
	341	22	9	—	4	11	1.1	0.7	3	3d	4	1	—	3	4
②	341	23	1	—	6	9.0	1.0	—	3	3d	4	1	—	—	—
	348	24	11	—	—	5	—	—	—	—	5	4	—	—	—
	1	25	6	—	—	6.5	0.8	0.3	1	3d	4	1	—	—	—
	1	26	1	6	4	5	0.9	—	3	3d	4	1	—	4	—

Type = 1=backwater pool, 2=sidechannel pool, 3=beaver pond <500m2, 4=beaver pond >500m2, 5=straight pool, 6=lateral scour pool, 7=trench pool, 8=plunge pool, 9=dam pool, 10=rapids, 11=riffle, 12=glide.

% wood cover = 1=low (<5%), 2=medium (6-20%), 3=high (>20%)

Pool Habit Forming Factors (PHFF)= 1= channel meander, 2= bank or bend, 3=LWD (a=log, b=tree, c=root, d=jam), 4= gravel, 5=boulder, 6=bedrock, 7=beaver dam, 8=mandmade

Substrate = 1=organics, 2=mud, 3=silt, 4=sand, 5=gravel, 6=cobble, 7=boulder

LIMTING FACTORS ANALYSIS FIELD FORM Date: Stream: Observers: Weather:

Dist (ft)	Unit #	Type	Lgth (ft)	Debris	Wdth (ft)	Max D (ft)	Tail D (ft)	Wcov	Pool Hab Form	Sub Dom	Sub SDom	SpGrvl (ft2)	LWD >20 (cm)	LWD >50 (cm)
361	27	1	—	5	14	0.7	—	3	3d	4	4	—	4	—
371	28	6	—	4	20	0.8	0.4	3	3d	4	4	—	—	—
385	29	12	—	—	7.5	0.5	—	+	—	4	3	—	—	—
~~415~~	30	7	—	—	10.0	1.6	0.3	1	2	4	5	—	—	—
~~458~~	31	11		1	6.5	—	—	—	—	5	4	25%	1	—
526	32	12		2	11.5	—	—	—	—	4	1	—	—	—
542	33	11		—	11	—	—	—	—	5	4	—	—	—
585	34	7	17		~~12~~	0.8	0.3	1	2,3b	4	1	—	—	—
② 542	35	11	17		6.4	—	—	—	—	4	1	—	—	—
② 585	36	1			10	0.4	—	1	2	4	1	—	—	—
① ~~630~~	37	12			~~16~~	0.6	—	—	—	4	1	—	—	—
639	38	6		1	11	1.9	0.4	1	2	4	1	—	—	—
② 619	39	1		1	9	1.4	—	2	3d	4	1	—	—	—

Type = 1=backwater pool, 2=sidechannel pool, 3=beaver pond <500m2, 4=beaver pond >500m2, 5=straight pool, 6=lateral scour pool, 7=trench pool, 8=plunge pool, 9=dam pool, 10=rapids, 11=riffle, 12=glide.

% wood cover = 1=low (<5%), 2=medium (6-20%), 3=high (>20%)

Pool Habit Forming Factors (PHFF)= 1= channel meander,2= bank or bend, 3= LWD (a=log, b=tree, c=root, d=jam), 4= gravel, 5=boulder, 6=bedrock, 7=beaver dam, 8=mandmade

Substrate = 1=organics, 2=mud, 3=silt, 4=sand, 5=gravel, 6=cobble, 7=boulder

52 pebble

(4)

LIMTING FACTORS ANALYSIS FIELD FORM Date: Stream: Observers: Weather:

Dist (ft)	Unit #	Type	Lgth (ft)	Debris	Wdth (ft)	Max D (ft)	Tail D (ft)	Wcov	Pool Hab Form	Sub Dom	Sub SDom	SpGrvl (ft2)	LWD >20 (cm)	LWD >50 (cm)
676	40	11	—	—	9.0	—	—	—	—	5	4	—	—	—
(2) 676	41	1	16.6		6.7	0.6		1	2	4	2 clay	—	—	—
718	42	12	—	1	13	0.5	—	—	—	3	5	—	—	—
755	43	6		4	8.0	2.4	0.4	2	2,1	4	5	—	—	—
762	44	11		6	6.0	—	—	—	—	5	4	100%	—	—
840	45	5		—	10	1.1	0.2	1	2	4	5	—	—	—
860	46	12		—	7	0.5	—	—	—	5	4	—	—	—
874	47	11		1	5.3	—	—	—	—	5	4	50%	—	—
922	48	6		4	11	1.6	0.2	2	2	4	5	—	—	—
(2) 874	49	1		—	10	0.7	—	3	—	5	4	—	—	—
956	50	11		3	7	—	—	—	—	5	4	50%	—	—
978	51	6					0.5	2		4	5			
(2) 978	52	2			6.0	0.5	—	3	1,2	3	3	—	—	—

cutbank approx

Type = 1=backwater pool, 2=sidechannel pool, 3=beaver pond <500m2, 4=beaver pond >500m2, 5=straight pool, 6=lateral scour pool, 7=trench pool, 8=plunge pool, 9=dam pool, 10=rapids, 11=riffle, 12=glide.

~500'

% wood cover = 1=low (<5%), 2=medium (6-20%), 3=high (>20%)

Pool Habit Forming Factors (PHFF)= 1= channel meander,2= bank or bend, 3= LWD (a=log, b=tree, c=root, d=jam), 4= gravel, 5=boulder, 6=bedrock, 7=beaver dam, 8=mandmade

Substrate = 1=organics, 2=mud, 3=silt, 4=sand, 5=gravel, 6=cobble, 7=boulder

65
43.2
219.5

(5)

LIMTING FACTORS ANALYSIS FIELD FORM Date: Stream: Observers: Weather:

Dist (ft)	Unit #	Type	Lgth (ft)	Debris	Wdth (ft)	Max D (ft)	Tail D (ft)	Wcov	Pool Hab Form	Sub Dom	Sub SDom	SpGrvl (ft2)	LWD >20 (cm)	LWD >50 (cm)
1022	53	11	—	1		—	—	—	—	5	4	80%	—	—
(2) 1000	54	1	17		4.25	0.4	—	3	2,3a	5	4	—	1	—
(2) 1010	55	1			8	0.2	—	1	ded	5	4	—	—	—
1050	56	6			7	1.1	0.2	1	2	3	1	—	—	—
(2) 1050	57	6		6	11	1.1	0.2	1	2	3	1	—	3	—
1097	58	6		7	10	1.4	0.3	1	3a,2	4	5	—	3	+
(2) 1067	59	1		2	8	1.0	0.3	1	3a,2	3	1	—	3	+
1123	60	6		7	10	1.7	0.7	3	3a,2	3	1	—	4	—
(2) ~1123	61	1		5	3	0.7	—	1	3d	3	1	—	+	—
1139	62	12			10	0.6	—	—	—	3	—		—	—
1159	63	6		1	12	1.6	0.6	1	3a	3	—		1	—
1168	64	11			5	—	—	—	—	5	4	100%		
1179	65	6		2	4	0.7	0.3	1	3a	5	4		2	—

- dunes
- cutbank 1.2

Type = 1=backwater pool, 2=sidechannel pool, 3=beaver pond <500m2, 4=beaver pond >500m2, 5=straight pool, 6=lateral scour pool, 7=trench pool, 8=plunge pool, 9=dam pool, 10=rapids, 11=riffle, 12=glide.

% wood cover = 1=low (<5%), 2=medium (6-20%), 3=high (>20%)

Pool Habit Forming Factors (PHFF)= 1= channel meander,2= bank or bend, 3= LWD (a=log, b=tree, c=root, d=jam), 4= gravel, 5=boulder, 6=bedrock, 7=beaver dam, 8=mandmade

Substrate = 1=organics, 2=mud, 3=silt, 4=sand, 5=gravel, 6=cobble, 7=boulder

~1104' - chl conjg in. 4' wide; 7' length

LIMTING FACTORS ANALYSIS FIELD FORM Date: Stream: Observers: Weather:

Dist (ft)	Unit #	Type	Lgth (ft)	Debris	Wdth (ft)	Max D (ft)	Tail D (ft)	Wcov	Pool Hab Form	Sub Dom	Sub SDom	SpGrvl (ft2)	LWD >20 (cm)	LWD >50 (cm)	
1142	66	11	—	1	8.0	—	—	—	—	5	4	50%	—	—	
1199	67	12	—		6.0	0.5	—	3	2a	4	5	—	—	—	
1226	68	11			8.0	1.2	0.5	1	2	4	3	—	—	—	
1226	69	1		MINI JAM	7.0	1.0	—	2	3d	5	2	—	—	—	1' cut bank
1284	70	11			8	—	—	—	—	5	4	—	—	—	
1	71	9		5 sm	10.5	0.7	0.2	—	3d	4	5	—	—	—	
1234	72	1		3 sm	6	0.5	—	3	3d			—	—	—	1.5' cut bank
1321	73	12			9.5	0.3	—	—		5	4	50%	—	—	
1234	74	6	8		11	0.0	0.2	3	3c	5	4	—	—	—	
1321	75	6		3	10.5	1.4	0.4	3	2,	4	5	—	—	—	2' cut bank
1335	76	6			8	1.6	0.7	2	3c root	4	5	—	—	—	
1339	77	11			6	—	—	—	—	5	4	—	—	—	
1363	78	6		3	7.5	0.7	0.2	1	3a	4	5	—	2	1	

Type = 1=backwater pool, 2=sidechannel pool, 3=beaver pond <500m2, 4=beaver pond >500m2, 5=straight pool, 6=lateral scour pool, 7=trench pool, 8=plunge pool, 9=dam pool, 10=rapids, 11=riffle, 12=glide.

% wood cover = 1=low (<5%), 2=medium (6-20%), 3=high (>20%)

Pool Habit Forming Factors (PHFF)= 1= channel meander,2= bank or bend, 3= LWD (a=log, b=tree, c=root, d=jam), 4= gravel, 5=boulder, 6=bedrock, 7=beaver dam, 8=mandmade

Substrate = 1=organics, 2=mud, 3=silt, 4=sand, 5=gravel, 6=cobble, 7=boulder

(7)

LIMTING FACTORS ANALYSIS FIELD FORM Date: Stream: Observers: Weather:

Dist (ft)	Unit #	Type	Lgth (ft)	Debris	Wdth (ft)	Max D (ft)	Tail D (ft)	Wcov	Pool Hab Form	Sub Dom	Sub SDom	SpGrvl (ft2)	LWD >20 (cm)	LWD >50 (cm)
1378	79	9		8	9.0	1.1	02	1	3d	3	5	—	3	—
1383	80	1		8	5.7	1.1	—	3	3d	3	5	—	—	—
1393	81	6		1	5.0	0.6	03	1	3a	5	4	—	1	—
1403	82	11		2	4	—	—	—	—	5	4	—	1	—
1412	83	12		1	3.9	0.4	—	—	—	5	4	—	1	—
1431	84	6		4	7.3	2.1	0.4	3	3c dam	4	5	—	2	—
1437	85	12			7.8	0.4	—	+	—	4	—	—	—	—
—	86	6	2		2.5	1.0	0.4		3c dam	4	—	—	1	—
1450	87	11			7	—	—	—	—	5	4	—	—	—
1462	88	12			6.2	—	—	—		5	4	—	—	—
1469	89	6			6.0	0.7	0.4	1	8	4	5	—	—	—
1471	90	11			6.8	—	—	—	—	5	4	—	—	—
1494	91	6			9.5	1.8	0.2	1	8	5	4		—	—

pebble

1'-cut bank

pebble, 1 log, 0 deep

Type = 1=backwater pool, 2=sidechannel pool, 3=beaver pond <500m2, 4=beaver pond >500m2, 5=straight pool, 6=lateral scour pool, 7=trench pool, 8=plunge pool, 9=dam pool, 10=rapids, 11=riffle, 12=glide.

% wood cover = 1=low (<5%), 2=medium (6-20%), 3=high (>20%)

Pool Habit Forming Factors (PHFF)= 1= channel meander,2= bank or bend, 3= LWD (a=log, b=tree, c=root, d=jam), 4= gravel, 5=boulder, 6=bedrock, 7=beaver dam, 8=mandmade

Substrate = 1=organics, 2=mud, 3=silt, 4=sand, 5=gravel, 6=cobble, 7=boulder

(8)

LIMTING FACTORS ANALYSIS FIELD FORM Date: Stream: Observers: Weather:

Dist (ft)	Unit #	Type	Lgth (ft)	Debris	Wdth (ft)	Max D (ft)	Tail D (ft)	Wcov	Pool Hab Form	Sub Dom	Sub SDom	SpGrvl (ft2)	LWD >20 (cm)	LWD >50 (cm)	
1500	92	12			7.5	0.4	—	—	—	4	5	—	—	—	
1514	93	11			8.0	—	—	—	—	5	4	30b	—	—	1.5' cut bank
(2) 1517	94	1	8		3.5	0.4	—	3	—	4	5	—	—	—	
1528	95	6			5.5	0.5	0.2	3	3c live	5	4	—			½ cut
1551	96	11			14.0	—	—	—	—	5	4	59	—	—	
1562	97	12			8.0	0.25	—	—	—	5	4	—	—	—	
(2) 1581	98	1	10		5.2	0.7	0.2	1	2,1	5	4	—	—	—	
1571	99	6			7.5	1.0	0.2	2	3c	5	5	—	—	—	1' cut bank
1594	100	6		1	8.0	1.3	0.2	2	2	4	1	—	—	—	
(2) 1612	101	1			6.0	1.3	—	1	3a	4	1	—	—	—	
1612	102	6		12	8.0	1.5	0.6	3	3d	4	1	—	6	—	
1625	103	6		12	11	1.1	0.7		3d	4	5		—	—	3' cut
1648	104	9		4	19.1	1.1	0.0	3	3d	4	1		—	—	

Type = 1=backwater pool, 2=sidechannel pool, 3=beaver pond <500m2, 4=beaver pond >500m2, 5=straight pool, 6=lateral scour pool, 7=trench pool, 8=plunge pool, 9=dam pool, 10=rapids, 11=riffle, 12=glide.

% wood cover = 1=low (<5%), 2=medium (6-20%), 3=high (>20%)

Pool Habit Forming Factors (PHFF)= 1= channel meander,2= bank or bend, 3= LWD (a=log, b=tree, c=root, d=jam), 4= gravel, 5=boulder, 6=bedrock, 7=beaver dam, 8=mandmade

Substrate = 1=organics, 2=mud, 3=silt, 4=sand, 5=gravel, 6=cobble, 7=boulder

1635 - tributaries in LB in wetland

(9)

LIMTING FACTORS ANALYSIS FIELD FORM Date: Stream: Observers: Weather:

Dist (ft)	Unit #	Type	Lgth (ft)	Debris	Wdth (ft)	Max D (ft)	Tail D (ft)	Wcov	Pool Hab Form	Sub Dom	Sub SDom	SpGrvl (ft2)	LWD >20 (cm)	LWD >50 (cm)	
1658	105	11			6	—	—	—	—	5	4	—	—	—	
1670	106	6			11	0.9	0.1	3	2	4	5	—	—	—	
(2) 1670	107	1		1	6	0.7	—	3	3dc	4	5	—	1	—	0.8
1677	108	6		5x	4.5	0.9	0.3	3	2,3d	4	1	—	—	—	
1677	109	1		cut bank	6	0.7	—	3	3d	4	1	—	—	—	
1690	110	11		5	5.5	—	—	1	—	5	4	30g	—	—	
1709	111	3/4			8	1.9	—	3	7	3	1	—	—	—	1.9
(2) 1709	112	3/4			4	1.9	—	3	7	3	1	—	—	—	
1791	113	11			4	—	—	—	—	5	4	100g	—	—	
	114	6			6	1.5	0.25	2	2	5	4	—	—	—	
(2) 1791	115	2	18		5	0.3	0						—	—	1 cut
(2) 1791	116	11	36		4	—	—	—	—	5	4	—	—	—	
1858	117	11			7	—	—	—	—			100g	—	—	

real gravels

Type = 1=backwater pool, 2=sidechannel pool, 3=beaver pond <500m2, 4=beaver pond >500m2, 5=straight pool, 6=lateral scour pool, 7=trench pool, 8=plunge pool, 9=dam pool, 10=rapids, 11=riffle, 12=glide.

% wood cover = 1=low (<5%), 2=medium (6-20%), 3=high (>20%)

Pool Habit Forming Factors (PHFF)= 1= channel meander, 2= bank or bend, 3= LWD (a=log, b=tree, c=root, d=jam), 4= gravel, 5=boulder, 6=bedrock, 7=beaver dam, 8=mandmade

Substrate = 1=organics, 2=mud, 3=silt, 4=sand, 5=gravel, 6=cobble, 7=boulder

LIMTING FACTORS ANALYSIS FIELD FORM Date: Stream: Observers: Weather:

Dist (ft)	Unit #	Type	Lgth (ft)	Debris	Wdth (ft)	Max D (ft)	Tail D (ft)	Wcov	Pool Hab Form	Sub Dom	Sub SDom	SpGrvl (ft2)	LWD >20 (cm)	LWD >50 (cm)
7865	118	12		2	5	0.3	—	—	—	5	4	50	—	—
1933	119	3		2	11	2.2	—	3	7	3	1	—	2	—
1966	120	11			8	—	—	—	—	5	4	30	—	—
1988	121	7		1	11	1.4	0.2	3	3a line	5	4	—	1	—
2017	122	11			8	—	—	—	—	5	4	20	—	—
2037	123	6		4	7.5	1.3	0.2	3	3c	4	5	—	3	1
2053	124	11			6	—	—	—	—	5	4	—	—	—
2079	125	12			4	—	—	—	—	5	4	—	—	—
2089	126	11												
	127													
	128													
	129													
	130													

Type = 1=backwater pool, 2=sidechannel pool, 3=beaver pond <500m2, 4=beaver pond >500m2, 5=straight pool, 6=lateral scour pool, 7=trench pool, 8=plunge pool, 9=dam pool, 10=rapids, 11=riffle, 12=glide

% wood cover = 1=low (<5%), 2=medium (6-20%), 3=high (>20%)

Pool Habit Forming Factors (PHFF)= 1= channel meander,2= bank or bend, 3= LWD (a=log, b=tree, c=root, d=jam), 4= gravel, 5=boulder, 6=bedrock, 7=beaver dam, 8=mandmade

Substrate = 1=organics, 2=mud, 3=silt, 4=sand, 5=gravel, 6=cobble, 7=boulder

35 2 centers

1 center pool

2017 2037 1988 / 5

29 / 8 / 232

1200
254
36

Gradient ≈ 0.6% Seq #53 ✓ (1)

LIMTING FACTORS ANALYSIS FIELD FORM Date: 8/10 Stream: Brook Observers: C.P.P.K. (D.B.A.H.) Weather: Clear, sunny

Dist (ft)	Unit #	Type	Lgth (ft)	Debris	Wdth (ft)	Max D (ft)	Tail D (ft)	Wcov	Pool Hab Form	Sub Dom	Sub SDom	SpGrvl (ft2)	LWD >20 (cm)	LWD (>50 (cm)
7	1	12	7	1	8	05	—	—	—	4	5	—	—	—
24	2	6		3	8	1.3	0.5	3	3d	3	1	—	—	—
(2) 24	3	1	11		5	05	—	1	3d	5	4	—	—	—
60	4	12		2	5	05	—			5	4	—	—	—
80	5	6		5	11	0.8	0.5		23c	4	5	—	2	—
90	6	12		4	6	05	—	—	—	5	4	—	2	—
124	7	11		1	6	—	—	—	—	5	4	20%	—	—
160	8	6		—	17	1.2	0.2	1	2	5	4	—	—	—
180	9	11		—	7	—	—	—	—	5	4	20%	—	—
219	10	12			12	0.5	—	—	—	5	4	10%	—	—
232	11	11		—	15	~~0.4~~ →	~~0.4~~	—	—	5	6	5%	—	—
PIJ 272	12	5		1	9.5	1.1	0.4	1	1	4	5	5%	—	—
316	13	6		—	16	2.1	1.1	1	1	4	5	—	—	—

Type = 1=backwater pool, 2=sidechannel pool, 3=beaver pond <500m2, 4=beaver pond >500m2, 5=straight pool, 6=lateral scour pool, 7=trench pool, 8=plunge pool, 9=dam pool, 10=rapids, 11=riffle, 12=glide.

% wood cover = 1=low (<5%), 2=medium (6-20%), 3=high (>20%)

Pool Habit Forming Factors (PHFF)= 1= channel meander, 2= bank or bend, 3= LWD (a=log, b=tree, c=root, d=jam), 4= gravel, 5=boulder, 6=bedrock, 7=beaver dam, 8=mandmade

Substrate = 1=organics, 2=mud, 3=silt, 4=sand, 5=gravel, 6=cobble, 7=boulder

filled/flowing in middle of pool.

316
232
84

LIMTING FACTORS ANALYSIS FIELD FORM Date: Stream: Brook Observers: Weather:

Dist (ft)	Unit #	Type	Lgth (ft)	Debris	Wdth (ft)	Max D (ft)	Tail D (ft)	Wcov	Pool Hab Form	Sub Dom	Sub SDom	SpGrvl (ft2)	LWD >20 (cm)	LWD >50 (cm)
326	14	11	—	—	20	—	—	—	—	6	5	22	—	—
343	15	6		—	12	1.2	0.4	1	2,3d	4	5	—	—	—
387	16	5		—	13.5	1.7	1.0	1	2	4	5	—	—	—
406	17	11		—	7.5	—	—			5	4	—	—	—
406	18	1	14	—	7	1.3	—	1	4	4	4	—	—	—
472	19	6		—	12	2.4	0.6	+	7d	3	4	—	—	—
500	20	12		—	10.5	0.4	—	—	—	4	5	—	—	—
510	21	6		—	11.5	1.4	0.4	1	1	4	5	—	—	—
523	22	11		—	10	—	—	—	—	5	4	+03	—	—
550	23	6		—	14.5	2.0	06		1	4	3	—	—	—
550	24	1	20	—	10	1.4	—	1	7,1	2	1	—	—	—
562	25	6		—	4	1.4	0.7	1	2	4	5	—	—	—
577	26	12			4	0.7	—	—	—	5	4	—	—	—

Type = 1=backwater pool, 2=sidechannel pool, 3=beaver pond <500m2, 4=beaver pond >500m2, 5=straight pool, 6=lateral scour pool, 7=trench pool, 8=plunge pool, 9=dam pool, 10=rapids, 11=riffle, 12=glide.

% wood cover = 1=low (<5%), 2=medium (6-20%), 3=high (>20%)

Pool Habit Forming Factors (PHFF)= 1= channel meander,2= bank or bend, 3= LWD (a=log, b=tree, c=root, d=jam), 4= gravel, 5=boulder, 6=bedrock, 7=beaver dam, 8=mandmade

Substrate = 1=organics, 2=mud, 3=silt, 4=sand, 5=gravel, 6=cobble, 7=boulder

S=pebble in the core

(3)

LIMTING FACTORS ANALYSIS FIELD FORM Date: Stream: Brook Observers: Weather: rain

Dist (ft)	Unit #	Type	Lgth (ft)	Debris	Wdth (ft)	Max D (ft)	Tail D (ft)	Wcov	Pool Hab Form	Sub Dom	Sub SDom	SpGrvl (ft2)	LWD >20 (cm)	LWD >50 (cm)
577	27	1	10	—	3.5	0.8	—	1	2	5	4	—	—	—
594	28	11	—	—	11	—	—	—	—	5	4	—	—	—
621	29	6			11	0.4	0.5	1	4	4	5	—	—	—
594	30	1	23		4	0.6	—	1		4	5	—	—	—
639	31	6			6	1.2	0.6	1	2,4	5	4	—	—	—
651	32	11	—	—	15.5	—	—	—	—	5	4	20	—	—
699	33	11			7	0.3	—	—	—	4	5	—	—	—
699	34	6		—	5	1.3	0.3	2 last	2	4	5	—	—	—
733	35	6			8	1.7		2 then	2	5	4	—	—	—
737	36	11			5	—	—	—	—	5	4	—	—	—
~~762~~	37	6			4.5	1.2	0.4	1	2	5	4	—	—	—
776	38				25	—	—	—	—	5	4		—	—
772	39	1	14		7	1.5	—	—	2	5	5	—	—	—

Type = 1=backwater pool, 2=sidechannel pool, 3=beaver pond <500m2, 4=beaver pond >500m2, 5=straight pool, 6=lateral scour pool, 7=trench pool, 8=plunge pool, 9=dam pool, 10=rapids, 11=riffle, 12=glide.

% wood cover = 1=low (<5%), 2=medium (6-20%), 3=high (>20%)

Pool Habit Forming Factors (PHFF)= 1= channel meander, 2= bank or bend, 3= LWD (a=log, b=tree, c=root, d=jam), 4= gravel, 5=boulder, 6=bedrock, 7=beaver dam, 8=mandmade

Substrate = 1=organics, 2=mud, 3=silt, 4=sand, 5=gravel, 6=cobble, 7=boulder

637
16
21

LIMTING FACTORS ANALYSIS FIELD FORM Date: Stream: Observers: Weather:

Dist (ft)	Unit #	Type	Lgth (ft)	Debris	Wdth (ft)	Max D (ft)	Tail D (ft)	Wcov	Pool Hab Form	Sub Dom	Sub SDom	SpGrvl (ft2)	LWD >20 (cm)	LWD >50 (cm)
793	40	12			9	0.5				4	5			
812	41	7		2	5	1.0	0.5	1	4 low	5	4			
824	42	11			6					5	4	25ft		
852	43	6			13	1.0	0.3	1	4,2	5	4			
867	44	12			10	0.5				5	4			
885	45	6			12	2.7	0.4	1/2	4,2	5	4			
896	46	1	18		6	1.5		3	2	5	4			
993	47	11			8.5					5	4	50ft		
1038	48	6			12	1.8	0.3	1	confluence	5	4			
1080	49	1	14		7	0.3		1	1	5	4			
1044	50	11			16					5	4	50ft		
1052	51	6			6	1.1	0.3	2	2,1	5	4			
1093	52	11			6					5	6	40ft		

Type = 1=backwater pool, 2=sidechannel pool, 3=beaver pond <500m2, 4=beaver pond >500m2, 5=straight pool, 6=lateral scour pool, 7=trench pool, 8=plunge pool, 9=dam pool, 10=rapids, 11=riffle, 12=glide.

% wood cover = 1=low (<5%), 2=medium (6-20%), 3=high (>20%)

Pool Habit Forming Factors (PHFF)= 1=channel meander,2= bank or bend, 3= LWD (a=log, b=tree, c=root, d=jam), 4= gravel, 5=boulder, 6=bedrock, 7=beaver dam, 8=mandmade

Substrate = 1=organics, 2=mud, 3=silt, 4=sand, 5=gravel, 6=cobble, 7=boulder

pebble

backwater wetland

(2)

(2)

(4)

Lower connects

Upstream - new ch. 16" deep, 12" wide. H2O is gray. More water than it is usetd.

Downstream - carrying less H2O than ↑ larger ch. Abt of fish, rearable + LWD

↳ entrenched ch, cutting thru riverbank

1256 - feeds into chl we were walking

1109' - noticeably larger substrate not pebble but 30-40MM (5)

LIMTING FACTORS ANALYSIS FIELD FORM Date: Stream: Brooks Observers: Weather:

Dist (ft)	Unit #	Type	Lgth (ft)	Debris	Wdth (ft)	Max D (ft)	Tail D (ft)	Wcov	Pool Hab Form	Sub Dom	Sub SDom	SpGrvl (ft2)	LWD >20 (cm)	LWD >50 (cm)
1109	53	12			5.5	0.3	—	—	—	5	4	—	—	—
1127	54	6			4	0.6	0.3	3	2	5	4	—	—	—
1188	55	11			5	—	—	—	—	5	4	25%	—	—
1271	56	H_2O flows thru canary grass + log jam												
starts at 1256	57	6	1274	2	8	1.8	0.5	1	3b	5	4	10%	—	—
1275	58	12			6.5	0.8	—	—	—	5	4	—	—	—
1285	59	11			7.5	—	—	—	—	5	4	—	—	—
1344	60	12	—	—	15	0.7	—	—	—	5	4	10%	—	—
1382	61	11			26	—	—	—	—	5/6	4	5%	—	—
1418	62	12			21	0.6	—	—	—	5	4	5%	—	—
1440	63	6		4	8.5	1.6	0.5	3	2,3c	5	4	5%	2	—
1453	64	11		1	8	—	—	—	—	5	4	10%	1	—
1463	65	5			8.5	1.0	0.5	1	3c live	5	4	1	—	—

53

1271 LB

RB 1271

Type = 1=backwater pool, 2=sidechannel pool, 3=beaver pond <500m2, 4=beaver pond >500m2, 5=straight pool, 6=lateral scour pool, 7=trench pool, 8=plunge pool, 9=dam pool, 10=rapids, 11=riffle, 12=glide.

% wood cover = 1=low (<5%), 2=medium (6-20%), 3=high (>20%)

Pool Habit Forming Factors (PHFF)= 1= channel meander, 2= bank or bend, 3= LWD (a=log, b=tree, c=root, d=jam), 4= gravel, 5=boulder, 6=bedrock, 7=beaver dam, 8=mandmade

Substrate = 1=organics, 2=mud, 3=silt, 4=sand, 5=gravel, 6=cobble, 7=boulder

Large alluvial fan - combo of old stilly + brooks. Where multiple - chl occurs at that contact

LIMTING FACTORS ANALYSIS FIELD FORM Date: Stream: Observers: Weather:

Dist (ft)	Unit #	Type	Lgth (ft)	Debris	Wdth (ft)	Max D (ft)	Tail D (ft)	Wcov	Pool Hab Form	Sub Dom	Sub SDom	SpGrvl (ft2)	LWD >20 (cm)	LWD >50 (cm)
1506	66	10		2	10	—	—	—	—	5	4	—	—	—
1560	67	12		3	10	1.3	—	—	—	5	4	5%	1	1
1610	68	6		2	10	1.0	0.5	1	2,4,3a	5	4	10%	—	—
1560	69	1	37	2	6	0.6	—	2	2,3d	4	5	—	—	—
1673	70	12	—	—	18	1.0	—	—	—	5	4	—	—	—
1673	71	6		1	8	1.9	0.7	1	8,3a	6	5	—	—	1
1673	72	6	31	—	12	1.5	0.8	1	8	5	4	—	—	—
1733	73	6		1	13	2.0	1.0	1	2,8	5	4	—	—	1
1852	74	11			15	—	—	—	—	6	5	—	—	—
1758	75	6	16	1	6.5	1.7	1.0	2	2,8,3a	5	4	—	1	—
1780	76	6			13	1.0	0.5	1	8,3c	5	4		—	—
	~~77~~													
	~~78~~													

under bridge

Type = 1=backwater pool, 2=sidechannel pool, 3=beaver pond <500m2, 4=beaver pond >500m2, 5=straight pool, 6=lateral scour pool, 7=trench pool, 8=plunge pool, 9=dam pool, 10=rapids, 11=riffle, 12=glide.

% wood cover = 1=low (<5%), 2=medium (6-20%), 3=high (>20%)

Pool Habit Forming Factors (PHFF)= 1= channel meander,2= bank or bend, 3= LWD (a=log, b=tree, c=root, d=jam), 4= gravel, 5=boulder, 6=bedrock, 7=beaver dam, 8=mandmade

Substrate = 1=organics, 2=mud, 3=silt, 4=sand, 5=gravel, 6=cobble, 7=boulder

1642 - brush in ch, H_2O flow over gravel bar (LB) into field, approx

PK

side channel block

(P1)

LIMTING FACTORS ANALYSIS FIELD FORM Date: Stream: Observers: Weather:

Dist (ft)	Unit #	Type	Lgth (ft)	Debris Σ	Wdth (ft)	Max D (ft)	Tail D (ft)	Wcov pool	Pool Hab Form	Sub Dom	Sub SDom	SpGrvl (ft2)	LWD >20 (cm)	LWD >50 (cm)
23	1	6	—	—	12	2.4	0.25	+	3b	5	4	—	—	—
41	2	12	—	—	5	0.5	—	—	+	5	4	—	—	—
46	3	11	—	—	2.5	—	—	—	—	5		25	—	—
70	4	6	—	—	12	1.9	0.2	—	4	6	5	—	—	—
98	5	6	—	—	16	1.5	0.3	—	2	5	4	—	—	—
111	6	6	—	—	4	1.9	0.8	1	2	4	3	—	—	—
161	7	6	—	—	10	2.2	0.6	1	2	3	2	—	—	—
181	8	6	—	2	7.5	1.9	1.0	1	2	3	2	—	2	—
209	9	12	—	—	6.6	0.7	—	—	—	4	3	—	—	—
230	10	12	—	1	6.0	0.6	—	—	—	4	3	—	1	—
235	11	11	—	—	4.6	—	—	—	—	5	4	—	—	—
250	12	6	—	—	4.6	0.9	0.25	1	2	4	3	—	—	—
266	13	11	—	—	3.6	—	—	—	—	5	4	—	—	—

54

Risk

Type = 1=backwater pool, 2=sidechannel pool, 3=beaver pond <500m2, 4=beaver pond >500m2, 5=straight pool, 6=lateral scour pool, 7=trench pool, 8=plunge pool, 9=dam pool, 10=rapids, 11=riffle, 12=glide.

% wood cover = 1=low (<5%), 2=medium (5-20%), 3=high (>20%)

Pool Habit Forming Factors (PHFF)= 1= channel meander, 2= bank or bend, 3= LWD (a=log, b=tree, c=root, d=jam), 4= gravel, bar 5=boulder, 6=bedrock, 7=beaver dam, 8=mandmade

Substrate = 1=organics, 2=mud, 3=silt, 4=sand, 5=gravel, 6=cobble, 7=boulder

LIMTING FACTORS ANALYSIS FIELD FORM Date: Stream: Observers: Weather:

Dist (ft)	Unit #	Type	Lgth (ft)	Debris	Wdth (ft)	Max D (ft)	Tail D (ft)	Wcov	Pool Hab Form	Sub Dom	Sub SDom	SpGrvl (ft2)	LWD >20 (cm)	LWD >50 (cm)
285	14	8	4	2	6	0.8	0.2	2	3C	3	4	1	1	1

Type = 1=backwater pool, 2=sidechannel pool, 3=beaver pond <500m2, 4=beaver pond >500m2, 5=straight pool, 6=lateral scour pool, 7=trench pool, 8=plunge pool, 9=dam pool, 10=rapids, 11=riffle, 12=glide.

% wood cover = 1=low (<5%), 2=medium (6-20%), 3=high (>20%)

Pool Habit Forming Factors (PHFF)= 1= channel meander,2= bank or bend, 3= LWD (a=log, b=tree, c=root, d=jam), 4= gravel, 5=boulder, 6=bedrock, 7=beaver dam, 8=mandmade

Substrate = 1=organics, 2=mud, 3=silt, 4=sand, 5=gravel, 6=cobble, 7=boulder

LIMTING FACTORS ANALYSIS FIELD FORM Date: 8/10 Stream: Brooks Segment #20 Observers: Weather:

Dist (ft)	Unit #	Type	Lgth (ft)	Debris	Wdth (ft)	Max D (ft)	Tail D (ft)	Wcov	Pool Hab Form	Sub Dom	Sub SDom	SpGrvl (ft2)	LWD >20 (cm)	LWD >50 (cm)
79	1	12		—	16	1.2	—	—	—	5	5	—	—	—
79	2	1	76	1	8	0.8	—	3	3a	4	5	—	—	—
119	3	10			11	—	—	—	—	5	6	—	—	—
156	4	12			11.5	1.3	—	—	—	5	4	—	—	—
183	5	11			15	—	—	—	—	6	5	—	—	—
183	6	1	8	2	3	0.8	—	1	5	6	5	—	—	—
214	7	6		2	12	1.7	0.5	2	3ac	6	5	—	2	—
247	8	11			9.5	—	—	—	—	5	4	—	—	—
247	9	11			14.5	—	—	—	—	5	4	—	—	—
259	10	6		2	16	2.7	0.5	1	3,5			—	2	—
259	11	11		11	11	—	—	—	—	5	4	—	—	—
259	12	1	14		7	1.2	—	1	5	4	6	—	—	—
	13													

Type = 1=backwater pool, 2=sidechannel pool, 3=beaver pond <500m2, 4=beaver pond >500m2, 5=straight pool, 6=lateral scour pool, 7=trench pool, 8=plunge pool, 9=dam pool, 10=rapids, 11=riffle, 12=glide.

% wood cover = 1=low (<5%), 2=medium (6-20%), 3=high (>20%)

Pool Habit Forming Factors (PHFF)= 1=channel meander,2= bank or bend, 3= LWD (a=log, b=tree, c=root, d=jam), 4=gravel, 5=boulder, 6=bedrock, 7=beaver dam, 8=mandmade

Substrate = 1=organics, 2=mud, 3=silt, 4=sand, 5=gravel, 6=cobble, 7=boulder

(1) (2)

LIMTING FACTORS ANALYSIS FIELD FORM Date: Stream: Observers: Weather:

Dist (ft)	Unit #	Type	Lgth (ft)	Debris	Wdth (ft)	Max D (ft)	Tail D (ft)	Wcov	Pool Hab Form	Sub Dom	Sub SDom	SpGrvl (ft2)	LWD >20 (cm)	LWD >50 (cm)
284	14	9	9	10	15	2.6	0.5	2	3d2	4	6	—	4	—
268	15	6	8	10	12	2.6	0.3	3	3d	5	4	—	4	—
288	16	11	0	3	5	—	—	—	—	5	4	—	—	—
325	17	11		—	10	—	—	—	—	6	5	—	—	—
303	18	6		—	6	1.1	0.3		2,4	5	4	—	—	—
325	19	11		—	4.5	—	—	—	—	5	4	—	—	—
359	20	6		—	7	1.2	0.3	1	2,4	5	4	—	—	—
380	21	6		7	15	2.9	0.4	3	2,3d	5	4	2%	4	—
~380	22	11	29		[illegible]	—	—	—	—	5	4	50%	—	—
400	23	11			14	—	—	—	—	6	5	—	—	—
430	24	6		5	11	1.3	0.4		3d,8	5	4	—	1	—
400	25	1	7.5		12	1.0	—	2	3d,8	4	5	—	—	—
443	26	8		2	9	1.5	0.6	1	3a	6	5	—	—	—

2-3% below

Type = 1=backwater pool, 2=sidechannel pool, 3=beaver pond <500m2, 4=beaver pond >500m2, 5=straight pool, 6=lateral scour pool, 7=trench pool, 8=plunge pool, 9=dam pool, 10=rapids, 11=riffle, 12=glide.

% wood cover = 1=low (<5%), 2=medium (6-20%), 3=high (>20%)

Pool Habit Forming Factors (PHFF)= 1= channel meander,2= bank or bend, 3= LWD (a=log, b=tree, c=root, d=jam), 4= gravel, 5=boulder, 6=bedrock, 7=beaver dam, 8=mandmade

Substrate = 1=organics, 2=mud, 3=silt, 4=sand, 5=gravel, 6=cobble, 7=boulder

Grad ~5%

Step-pool config

LIMTING FACTORS ANALYSIS FIELD FORM Date: Stream: Observers: Weather:

Dist (ft)	Unit #	Type	Lgth (ft)	Debris	Wdth (ft)	Max D (ft)	Tail D (ft)	Wcov	Pool Hab Form	Sub Dom	Sub SDom	SpGrvl (ft2)	LWD >20 (cm)	LWD >50 (cm)
453	27	12		1	10	0.8	0.8	—	3c	6	5	—	1	—
464	28	8		4	13	1.6	0.8	1	2,3d	6	5	—	1	—
~464	29	11	40	—	6	—	—	—	—	6	5	—	—	—
488	30	8		5	11	1.7	0.4	1	3a	6	5	—	2	—
500	31	9		8	7	2.4	1.0	3	3d	6	5	—	2	—
505	32	11			14	—	—	—	—	7	6	—	—	—
569	33	6		7	22	2.7	0.4	3	3d	4	6	—	2	1
598	34	11		1	19	—	—	—	—	6	5	—	1	—
645	35	6		2	14	1.7	0.6	1	3d	6	5	—	1	—
725	36	10			12	—	—	—	—	7	6	—	—	—
755	37	8		3	15	2.4	0.6	1		6	5		3	—
758	38	11			24	—	—	—	—	7	6	—	—	—
765	39	1	7		5	0.8	—							

Type = 1=backwater pool, 2=sidechannel pool, 3=beaver pond <500m2, 4=beaver pond >500m2, 5=straight pool, 6=lateral scour pool, 7=trench pool, 8=plunge pool, 9=dam pool, 10=rapids, 11=riffle, 12=glide.

% wood cover = 1=low (<5%), 2=medium (6-20%), 3=high (>20%)

Pool Habit Forming Factors (PHFF)= 1= channel meander,2= bank or bend, 3= LWD (a=log, b=tree, c=root, d=jam), 4= gravel, 5=boulder, 6=bedrock, 7=beaver dam, 8=mandmade

Substrate = 1=organics, 2=mud, 3=silt, 4=sand, 5=gravel, 6=cobble, 7=boulder

598 - Berm, RB approx 8' high - fills ch

612 - log jam, large accumulation of LWD. Pk + DB say end of dam break

(4)

LIMTING FACTORS ANALYSIS FIELD FORM Date: Stream: Observers: Weather:

Dist (ft)	Unit #	Type	Lgth (ft)	Debris	Wdth (ft)	Max D (ft)	Tail D (ft)	Wcov	Pool Hab Form	Sub Dom	Sub SDom	SpGrvl (ft2)	LWD >20 (cm)	LWD >50 (cm)
813	40	12	2	—	15	0.5	—	—	—	6	5	—	—	—
880	41	1	16	2	7	0.8	—	1	4,2	4	5	—	—	—
830	42	10	2	2	8	—	—	—	—	6	5	—	—	—
870	43	12	2	2	16.5	1.3	—	—	—	6	5	—	—	—
888	44	8	2	1	18	2.2	—	1	2,3c	7	6	—	1	—
964	45	10	2	2	22	—	—	—	—	7	6	—	—	—
980	46	8	2		15	2.1	0.7	1	5	7	6	—	—	—
1051	47	~~12~~ 5	2	2	11	1.6	0.6	1	1	6	clay bed	—	—	—
1051	48	1	14		4	0.7	—	1	4 bar	6	5	—	—	—
1148	49	10		2	22	—	—	—	—	6	5	—	—	—
1192	50	11	2	1	13.5	—	—	—	—	6	5	—	1	—
1264	51	10		2	16	—	—	—	—	6	5	—	—	—
1297	52	8		5	15	2.6	0.7	1	2,4 bar	bed clay	7	—	2	3

Type = 1=backwater pool, 2=sidechannel pool, 3=beaver pond <500m2, 4=beaver pond >500m2, 5=straight pool, 6=lateral scour pool, 7=trench pool, 8=plunge pool, 9=dam pool, 10=rapids, 11=riffle, 12=glide.

% wood cover = 1=low (<5%), 2=medium (6-20%), 3=high (>20%)

Pool Habit Forming Factors (PHFF)= 1= channel meander,2= bank or bend, 3= LWD (a=log, b=tree, c=root, d=jam), 4= gravel, 5=boulder, 6=bedrock, 7=beaver dam, 8=mandmade

Substrate = 1=organics, 2=mud, 3=silt, 4=sand, 5=gravel, 6=cobble, 7=boulder

964 - LB terrace edge, lacustrine deposit

1192 - bend in river, RB terrace large cobbles + boulders RB - dog hair std 6-8 yrs

1264 - Barn RB, log jam?, terrace cobble/boulder approx 7' height at bed

(5)

LIMTING FACTORS ANALYSIS FIELD FORM Date: Stream: Brooks Seg #31 Observers: Weather:

	Dist (ft)	Unit #	Type	Lgth (ft)	Debris	Wdth (ft)	Max D (ft)	Tail D (ft)	Wcov	Pool Hab Form	Sub Dom	Sub SDom	SpGrvl (ft2)	LWD >20 (cm)	LWD >50 (cm)
Trad x 9%	1354	53	10		—	29	—	—	—	—	7	6	—	—	—
	1370	54	6			11	2.7	0.5	1	2	clay	7	—	—	—
	1375	55	10			13.5	—	—	—	—	7	6	—	—	—
	1389	56	6			7	2.2	0.5	1	2	clay	7	—	—	—
	1423	57	10			19	—	—	—	—	7	6	—	—	—
	1438	58	8			8	1.1	0.5	1	5	7	6	—	—	—
	1446	59	8			8.5	1.3	0.7	1	5	7	6	—	—	—
Trad 9-10%	1580	60	10			20	—	—	—	—	7	6	—	—	—
Seg #31	1598	61	8		1	12	2	0.9	1	6	7	6	—	—	—
TC	1653	62	8			17.5	1.7	0.7	1	6	7	6	—	—	—
	1733	63	10			18	—	—	—	—	7	6	—	—	—
	1737	64	8	11		9	2.9	0.7	1	6	7	6	—	—	—
	1768	65	8			16	2.8	0.8	1	6	7	6	—	—	—

Type = 1=backwater pool, 2=sidechannel pool, 3=beaver pond <500m2, 4=beaver pond >500m2, 5=straight pool, 6=lateral scour pool, 7=trench pool, 8=plunge pool, 9=dam pool, 10=rapids, 11=riffle, 12=glide.

% wood cover = 1=low (<5%), 2=medium (6-20%), 3=high (>20%)

Pool Habit Forming Factors (PHFF)= 1= channel meander, 2= bank or bend, 3= LWD (a=log, b=tree, c=root, d=jam), 4=gravel, 5=boulder, 6=bedrock, 7=beaver dam, 8=mandmade

Substrate = 1=organics, 2=mud, 3=silt, 4=sand, 5=gravel, 6=cobble, 7=boulder

1354 – Large boulders 1½ meter just US of chl bend

1580 – Bedrock canyon

1653 – Start of step pool/cascade

LIMTING FACTORS ANALYSIS FIELD FORM Date: Stream: Observers: Weather:

Dist (ft)	Unit #	Type	Lgth (ft)	Debris	Wdth (ft)	Max D (ft)	Tail D (ft)	Wcov	Pool Hab Form	Sub Dom	Sub SDom	SpGrvl (ft2)	LWD >20 (cm)	LWD >50 (cm)
1814	66	8	+	1	15	3.1	0.6		6,3a	7	6	–	+	+

Type = 1=backwater pool, 2=sidechannel pool, 3=beaver pond <500m2, 4=beaver pond >500m2, 5=straight pool, 6=lateral scour pool, 7=trench pool, 8=plunge pool, 9=dam pool, 10=rapids, 11=riffle, 12=glide.

% wood cover = 1=low (<5%), 2=medium (6-20%), 3=high (>20%)

Pool Habit Forming Factors (PHFF)= 1= channel meander,2= bank or bend, 3= LWD (a=log, b=tree, c=root, d=jam), 4= gravel, 5=boulder, 6=bedrock, 7=beaver dam, 8=mandmade

Substrate = 1=organics, 2=mud, 3=silt, 4=sand, 5=gravel, 6=cobble, 7=boulder

1814 – Falls, bedrock, largest boulders yet

Seg #2 SC ≈488

LIMTING FACTORS ANALYSIS FIELD FORM Date: Stream: Brooks Observers: Weather:

Dist (ft)	Unit #	Type	Lgth (ft)	Debris	Wdth (ft)	Max D (ft)	Tail D (ft)	Wcov	Pool Hab Form	Sub Dom	Sub SDom	SpGrvl (ft2)	LWD >20 (cm)	LWD >50 (cm)
	-1	11	38	6	3	.4		3	6	6	5		B	3
	-2	6	8	-	3	.6	.1	3	8	6	5			1 E
	-3	11	20	-	2.5	.1		3						
	4	6	35	-	6.5	.6	.1	1	1	4	3			

Type = 1=backwater pool, 2=sidechannel pool, 3=beaver pond <500m2, 4=beaver pond >500m2, 5=straight pool, 6=lateral scour pool, 7=trench pool, 8=plunge pool, 9=dam pool, 10=rapids, 11=riffle, 12=glide.

% wood cover = 1=low (<5%), 2=medium (6-20%), 3=high (>20%)

Pool Habit Forming Factors (PHFF)= 1=channel meander,2= bank or bend, 3= LWD (a=log, b=tree, c=root, d=jam), 4= gravel, 5=boulder, 6=bedrock, 7=beaver dam, 8=mandmade

Substrate = 1=organics, 2=mud, 3=silt, 4=sand, 5=gravel, 6=cobble, 7=boulder

LIMTING FACTORS ANALYSIS FIELD FORM Date: Stream: Observers: Weather:

Dist (ft)	Unit #	Type	Lgth (ft)	Debris	Wdth (ft)	Max D (ft)	Tail D (ft)	Wcov	Pool Hab Form	Sub Dom	Sub SDom	SpGrvl (ft2)	LWD >20 (cm)	LWD >50 (cm)

Type = 1=backwater pool, 2=sidechannel pool, 3=beaver pond <500m2, 4=beaver pond >500m2, 5=straight pool, 6=lateral scour pool, 7=trench pool, 8=plunge pool, 9=dam pool, 10=rapids, 11=riffle, 12=glide.

% wood cover = 1=low (<5%), 2=medium (6-20%), 3=high (>20%)

Pool Habit Forming Factors (PHFF)= 1= channel meander,2= bank or bend, 3= LWD (a=log, b=tree, c=root, d=jam), 4= gravel, 5=boulder, 6=bedrock, 7=beaver dam, 8=mandmade

Substrate = 1=organics, 2=mud, 3=silt, 4=sand, 5=gravel, 6=cobble, 7=boulder

Form F-2: Fish Habitat Conditions Field Inventory Data

WAU	STREAM NAME	SURVEY UNIT #	CREW	DATE	PAGE
Hazel	Brooks	#16	GP, PK, AH, PS	11/4/94	1/1

DISTANCE	HAB TYPE	POOLS ONLY MAXDP	RFCDP	RESDP	FORM	%WCVR	SUBSTRATE DOM	SBDOM	SPGRV	LWD TALLY 10-20CM	20-50CM	>50CM	NOTES
			See LRA field form										

SUMMARY:

WATER TEMPERATURE	
STREAM FLOW	M/A
AVERAGE PERCENT SHADE	60%
AVERAGE CHANNEL WIDTH	[illegible]
AVERAGE BED SLOPE	0/10-12%

SUMMARY TOPICS[1]	
OFF-CHANNEL REARING	NONE
HOLDING POOLS	NONE
REDD SCOUR POTENTIAL	Possibly if log jam fail.

[1]Provide summary paragraph describing survey reach characteristics and check box when done.

LWD:

FUNCTIONAL LWD	
10-20 CM	
20-50 CM	
>50 CM	
TOTAL	

DISTANCE SURVEYED	
NON-FUNCTIONAL LWD	

Form F-2: Fish Habitat Conditions Field Inventory Data

WAU STREAM NAME SURVEY UNIT # CREW DATE PAGE

DISTANCE	HAB TYPE	POOLS ONLY					SUBSTRATE			LWD TALLY			NOTES
		MAXDP	RFCDP	RESDP	FORM	%WCVR	DOM	SBDOM	SPGRV	10-20CM	20-50CM	>50CM	

SUMMARY:

WATER TEMPERATURE	
STREAM FLOW	
AVERAGE PERCENT SHADE	
AVERAGE CHANNEL WIDTH	
AVERAGE BED SLOPE	

SUMMARY TOPICS[1]	
OFF-CHANNEL REARING	
HOLDING POOLS	
REDD SCOUR POTENTIAL	

[1]Provide summary paragraph describing survey reach characteristics and check box when done.

LWD:

FUNCTIONAL LWD	
10-20 CM	
20-50 CM	
>50 CM	
TOTAL	

DISTANCE SURVEYED	
NON-FUNCTIONAL LWD	

LIMTING FACTORS ANALYSIS FIELD FORM Date: 11/4 Stream: Beaver Creek 6 Observers: GP, PK, JH PS Weather: Cool Rain

Dist (FQ M)	Unit #	Type	Lgth (FQ M)	Debris	Wdth (ft)	Max D (ft)	Tail D (ft)	Wcov	Pool Hab Form	Sub Dom	Sub SDom	SpGrvl (ft2)	LWD >20 (cm)	LWD >50 (cm)	
3.0	1	10		1	10	—	—	—	—	7	6	—	1	—	
5.8	2	8		1	4	1.4	1.0	1	3a	7	6	—	—	1	3.3'
8.2	3	9		9	10	2.0	1.2	3	3a	5	4	—	1	—	
(2) 8.2	4	1	3		13	2.4	—	3	3a,3d	4	5	—	—	—	
12	5	11		15	11	—	0.6	—	—	5	6	—	2	—	
16	6	6		3	8	1.2	0.6	3	3a	5	4	—	—	—	
20.7	7	8		3	8	2.3	0.7	3	3a	5	4,7	—	—	1	3'
29	8	12			11	0.8	—	—	—	5	4	5b	—	—	
33.1	9	8		3	5	1.0	0.3	—	5	5	4	5b	—	—	
42.5	10	10		10	5	1.5	—	—	—	7	6	—	2	—	
49.5	11	8		2	9	1.8	0.7	—	5	6	5	—	+	—	1.8
59.3	12	10		1	8	—	—	—	—	7	6	—	—	—	
60.3	13	8		—	8	1.5	1.2	+	5	7	6	—	—	—	

Type = 1=backwater pool, 2=sidechannel pool, 3=beaver pond <500m2, 4=beaver pond >500m2, 5=straight pool, 6=lateral scour pool, 7=trench pool, 8=plunge pool, 9=dam pool, 10=rapids, 11=riffle, 12=glide.

% wood cover = 1=low (<5%), 2=medium (6-20%), 3=high (>20%)

Pool Habit Forming Factors (PHFF)= 1= channel meander,2= bank or bend, 3= LWD (a=log, b=tree, c=root, d=jam), 4= gravel, 5=boulder, 6=bedrock, 7=beaver dam, 8=mandmade

Substrate = 1=organics, 2=mud, 3=silt, 4=sand, 5=gravel, 6=cobble, 7=boulder

BFW - 4.1'
BFD - 1.7 m
Flow - 1460 l

ARRP

LIMTING FACTORS ANALYSIS FIELD FORM Date: 11/4 Stream: Brook S 6 Observers: Weather: evident parted segment

Dist (ft)	Unit #	Type	Lgth (ft)	Debris	Wdth (ft)	Max D (ft)	Tail D (ft)	Wcov	Pool Hab Form	Sub Dom	Sub SDom	SpGrvl (ft2)	LWD >20 (cm)	LWD >50 (cm)
64	14	8	—	—	8	1.0	0.7	1	5	7	5	—	—	—
70	15	10	—	—	8	1.4	—	—	—	7	6	—	—	—
79	16	8	—	—	8	1.4	1.4	1	5	7	6	—	—	—
89.5	17	10	—	5	8	—	—	—	—	7	6	—	—	—
95	18	8		4	8	0.5	0.6		3de	7	6	—	—	—
	19													
	20													
	21													
	22													
	23													
	24													
	25													
	25													

Type = 1=backwater pool, 2=sidechannel pool, 3=beaver pond <500m2, 4=beaver pond >500m2, 5=straight pool, 6=lateral scour pool, 7=trench pool, 8=plunge pool, 9=dam pool, 10=rapids, 11=riffle, 12=glide.

% wood cover = 1=low (<5%), 2=medium (6-20%), 3=high (>20%)

Pool Habit Forming Factors (PHFF)= 1= channel meander,2= bank or bend, 3= LWD (a=log, b=tree, c=root, d=jam), 4= gravel, 5=boulder, 6=bedrock, 7=beaver dam, 8=mandmade

Substrate = 1=organics, 2=mud, 3=silt, 4=sand, 5=gravel, 6=cobble, 7=boulder

Rollins

①

LIMTING FACTORS ANALYSIS FIELD FORM Date: 8/16 Stream: Rollins Observers: R.P. AH, R.Y. Weather: Sunny 70's

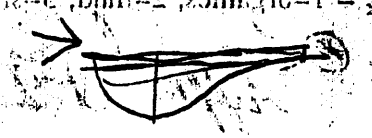
Dist (ft)	Unit #	Type	Lgth (ft)	Debris	Wdth (ft)	Max D (ft)	Tail D (ft)	Wcov	Pool Hab Form	Sub Dom	Sub SDom	SpGrvl (ft2)	LWD >20 (cm)	LWD >50 (cm)
25	1	11	—	2	18	—	—	—	—	5	5	—	—	—
35	2	5		—	15	1.1	0.5	1	cobble bed 2	6	5	—	—	—
80	3	6	—	4	15	1.6	0.6	1	2	6	4	—	—	—
102	4	11	—	—	10.5	—	—	—	—	6	5	—	—	—
120	5	6			13.5	1.7	0.7	1	1,3c	6	5/4	—	—	—
166	6	11	—	—	14	—	—	—	—	6	5	—	—	—
① 178	7	1	—	2	11	1.3	0		3a	5	4	—	—	—
265	8	11	—	—	13.5	—	—	—	—	6	5	5g	—	—
274	9	12	—	—	11.5	0.8	—	—	—	6	5	—	—	—
283	10	6	—	5	10	1.3	0.3	3	3d	5	4	—	—	—
327	11	12	—	6	17.5	1.2	—	—	—	5	4	5g	—	3
349	12	11	—	—	12.5	—	—	—	—	6	5	—	—	—
① 349	13	1	8	—	3.6	0.6	—	1	3c	4	5	—	—	—

Type = 1=backwater pool, 2=sidechannel pool, 3=beaver pond <500m2, 4=beaver pond >500m2, 5=straight pool, 6=lateral scour pool, 7=trench pool, 8=plunge pool, 9=dam pool, 10=rapids, 11=riffle, 12=glide.

% wood cover = 1=low (<5%), 2=medium (6-20%), 3=high (>20%)

Pool Habit Forming Factors (PHFF)= 1= channel meander, 2= bank or bend, 3= LWD (a=log, b=tree, c=root, d=jam), 4= gravel, 5=boulder, 6=bedrock, 7=beaver dam, 8=mandmade

Substrate = 1=organics, 2=mud, 3=silt, 4=sand, 5=gravel, 6=cobble, 7=boulder



LIMTING FACTORS ANALYSIS FIELD FORM Date: Stream: Observers: Weather:

Dist (ft)	Unit #	Type	Lgth (ft)	Debris	Wdth (ft)	Max D (ft)	Tail D (ft)	Wcov	Pool Hab Form	Sub Dom	Sub SDom	SpGrvl (ft2)	LWD >20 (cm)	LWD >50 (cm)
381	14	6	—	—	9	1.1	0.4		4,3d	5	4	—	—	—
381	15	1	9.5	8	5.5	1.1	—	3	3d	4	5	—	2	—
506	16	11	—	—	18.5	—	—	—	—	6	5	—	—	—
507	17	1	24	4	7	1.0	~~0.1~~	1	3d,3c	4	5	—	—	3
507	18	1	19		6	0.5	—	1	1	6	7	—	—	—
545	19	6	—	3 LI	16.5	2.7	0.4	1	3d,2	5	4	—	—	1
556	20	1	20	LI 7	6	2.3	—	3	3d,2	5	4	—	2	—
556	21	9		LI 5	7.5	1.8	—	2	3d,2	7	5	—	—	—
572	22	11	—	—	8.4	—	—	—	—	7	6	—	—	—
572	23	1	12	5	6	0.8	—	3	3d	5	4	—	1	—
580	24	8	—	2	6	0.9	0.5	1	3a,1	6	5	—	—	—
650	25	11	—	—	20	—	—	—	—	c	5	—	—	—
815	26	6	—	1	20	3.1	0.3	1	3a,2	6	5	5 3	1	—

Type = 1=backwater pool, 2=sidechannel pool, 3=beaver pond <500m2, 4=beaver pond >500m2, 5=straight pool, 6=lateral scour pool, 7=trench pool, 8=plunge pool, 9=dam pool, 10=rapids, 11=riffle, 12=glide.

% wood cover = 1=low (<5%), 2=medium (6-20%), 3=high (>20%)

Pool Habit Forming Factors (PHFF)= 1= channel meander, 2= bank or bend, 3= LWD (a=log, b=tree, c=root, d=jam), 4= gravel, 5=boulder, 6=bedrock, 7=beaver dam, 8=mandmade

Substrate = 1=organics, 2=mud, 3=silt, 4=sand, 5=gravel, 6=cobble, 7=boulder

(*) Large gravel bars (composite in cobble, primarily) — push creek into bend + create log jam. Steep grad riffles cut thru bar.

(3)

LIMTING FACTORS ANALYSIS FIELD FORM Date: Stream: Observers: Weather: TMI

Dist (ft)	Unit #	Type	Lgth (ft)	Debris	Wdth (ft)	Max D (ft)	Tail D (ft)	Wcov	Pool Hab Form	SubI Dom	SubI SDom	SpGrvl (ft2)	nLWD >20 (cm)	LWD >50 (cm)
(2) 700	27	1	15	1	7	2.0	—	2	3c	3	4	0	4	1
(2) 715	28	1	175	3	11	3.4	—	2	3c, 3d	6	3	1	4	2
927	29	11	—	—	13	—	—	—	—	6	5	—	0	0
742	30	8	—	4	12	1.4	OS	1	3d, 5	6	4	1	30	4
772	31	11	—	—	13.5	—	—	—	—	6	5	—	2	1
842	32	12	—	3	14	0.4	—	2	—	6	5	0	4	1
867	33	6		2	16	2.9	0.7	3	3c, 3d	6	5	2	2	2
890	34	6		5	14	1.3	0.4		3	6	4	SOFT 2	2	3
877	35	8		2	11.5	2.6	—	2	3a	7	6	2	2	2
(2) 890	36	1		2	14.5	2.0	—	1	3a	7	6	2	1	2
1010	37	11	—	—	17.0	—	—	—	—	6	5	0	0	0
1052	38	6		1	13.4	1.6	0.6	1	3a	6	5	1	1	1
1101	39	12			10.0	0.9	—	—	—	6	5	1	0	1

heavy two rock wedge cut RB, fine bank, provided shelter for large log jam

Type = 1=backwater pool, 2=sidechannel pool, 3=beaver pond <500m2, 4=beaver pond >500m2, 5=straight pool, 6=lateral-scour pool, 7=trench pool, 8=plunge pool, 9=dam pool, 10=rapids, 11=riffle, 12=glide.

% wood cover = 1=low (<5%), 2=medium (6-20%), 3=high (>20%)

Pool Habit Forming Factors (PHFF)= 1= channel meander, 2= bank or bend, 3= LWD (a=log, b=tree, c=root, d=jam), 4=gravel, 5=boulder, 6=bedrock, 7=beaver dam, 8=mandmade

Substrate = 1=organics, 2=mud, 3=silt, 4=sand, 5=gravel, 6=cobble, 7=boulder

1010 - US side of LDT bed in river. Large gravel bars cut in approx 1.5-2m

LIMTING FACTORS ANALYSIS FIELD FORM Date: Stream: Observers: Weather:

Dist (ft)	Unit #	Type	Lgth (ft)	Debris	Wdth (ft)	Max D (ft)	Tail D (ft)	Wcov	Pool Hab Form	Sub Dom	Sub SDom	SpGrvl (ft2)	LWD >20 (cm)	LWD >50 (cm)
1150	40	10	4	5	9.5					6	5	1		
1191	41	11	5	1	13.6					6	5		1	
1160	42	1	15		10	1.5		1	2,4	6	4			
1190	43	6			13	1.7	0.5	3	2,3c	6	5			
1179	44	11			14.5					6	5			
1237	45	12			13	0.8				6	5			
1257	46	6			13	2.1	0.8	2	3c,4	6	5			
1288	47	11		2	13					6	5		3	
1288	48	6		4	7	1.1	0.6	1	1,3d	6	5		2	
1341	49	12			17	0.9				6	5			
1341	50	1	10	1	4	0.8		+	3a	4	1			1
1350	51	1	5		5	0.6		+	5	6	4			
1400	52	11			21					6	4			

Type = 1=backwater pool, 2=sidechannel pool, 3=beaver pond <500m2, 4=beaver pond >500m2, 5=straight pool, 6=lateral scour pool, 7=trench pool, 8=plunge pool, 9=dam pool, 10=rapids, 11=riffle, 12=glide.

% wood cover = 1=low (<5%), 2=medium (6-20%), 3=high (>20%)

Pool Habit Forming Factors (PHFF)= 1= channel meander, 2= bank or bend, 3= LWD (a=log, b=tree, c=root, d=jam), 4= gravel, 5=boulder, 6=bedrock, 7=beaver dam, 8=mandmade

Substrate = 1=organics, 2=mud, 3=silt, 4=sand, 5=gravel, 6=cobble, 7=boulder

1386 - largest fine sediment in backwaters + in channel

LIMTING FACTORS ANALYSIS FIELD FORM Date: Stream: Observers: Weather:

Dist (ft)	Unit #	Type	Lgth (ft)	Debris	Wdth (ft)	Max D (ft)	Tail D (ft)	Wcov	Pool Hab Form	Sub Dom	Sub SDom	SpGrvl (ft2)	LWD >20 (cm)	LWD >50 (cm)
1470	53	6	—	4	11.5	1.2	0.4	1	2,3d	4	5 pebble	—	1	—
1476	54	11	—	—	20	—	—	—	—	5	4	50%	—	—
1529	55	6	—	—	18.5	2.5	0.5	2	2,3c	6	5	—	—	—
1578	56	10			25	—	—	—	—	6	5	—	—	—
1624	57	6	—	[illegible]	10.5	1.2	0.7	1	2,3d	6	5	—	1	—
2 1624	58	2	—	2	10	1.6	0.7	1	4,2	4	[illegible]	25 FT	—	—
1665	59	11	—	4	15	—	—	—	—	6	5	—	2	—
2 1665	60	11	—	—	5	—	—	—	—	5	4	—	—	—
1685	61	6	—	1	11	1.9	0.4	2	3,2	6	5	10 FT	1	—
1697	62	10	—	—	18	—	—	—	—	6	5	—	—	—
1735	63	12	—	—	12.6	1.2	—	—	—	6	5	—	—	—
1751	64	6	—	—	10	1.5	0.6	1	2,5	5	4	—	—	—
1771	65	10	—	—	25	—	—	—	—	6	5	—	—	—

Type = 1=backwater pool, 2=sidechannel pool, 3=beaver pond <500m2, 4=beaver pond >500m2, 5=straight pool, 6=lateral scour pool, 7=trench pool, 8=plunge pool, 9=dam pool, 10=rapids, 11=riffle, 12=glide.

% wood cover = 1=low (<5%), 2=medium (6-20%), 3=high (>20%)

Pool Habit Forming Factors (PHFF)= 1= channel meander,2= bank or bend, 3= LWD (a=log, b=tree, c=root, d=jam), 4= gravel, 5=boulder, 6=bedrock, 7=beaver dam, 8=mandmade

Substrate = 1=organics, 2=mud, 3=silt, 4=sand, 5=gravel, 6=cobble, 7=boulder

1446 - Sidchl, measure on way back

1446 - Δ substrate fine sed (sand) riffle [illegible]

Plane-bed / setup - pool segment
bare forced P/R

[illegible] Date [illegible] Observers: Weather

Dist (ft)	Unit	Type	Lgth (ft)	[illegible]	[illegible]	Wdth (ft)	Max D (ft)	Tail D (ft)	Wcov	[illegible]	Sub Dom	Sub SDom	SpGrvl (ft2)	LWD >20 (cm)	LWD >50 (cm)
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

[illegible] 2=straight pool, 0=lateral scour pool,
[illegible] Height
[illegible] (log, bf, [illegible], c=root, d=jam), 4= gravel,
Substrate = [illegible] sand, [illegible] gravel [illegible]

(6)

LIMTING FACTORS ANALYSIS FIELD FORM Date: Stream: Observers: Weather:

Dist (ft)	Unit #	Type	Lgth (ft)	Debris	Wdth (ft)	Max D (ft)	Tail D (ft)	Wcov	Pool Hab Form	Sub Dom	Sub SDom	SpGrvl (ft2)	LWD >20 (cm)	LWD >50 (cm)
1806	66	11	—	—	25	—	—	—	—	6	5	—	—	—
1859	67	6	—	30 LCH	11.5	3.0	0.6	3	3d	5	4	—	—	—
1873	68	11	—	3 lw 6 H	26	—	—	—	—	6	5	—	—	—
1880	69	12	—	—	9.5	0.8	—	—	—	6	5	—	—	—
2 1890	70	12	—	1	11	0.8	—	—	—	6	5	—	—	—
1918	71	8	—	—	8	—	—	—	—	6	5	—	—	—
(2) 1935	72	11	—	—	8.5	—	—	—	—	5	4	—	—	—
1955	73	8	—	—	10	1.5	0.5	1	5	6	5	—	—	—
1975	74	8	—	—	10	1.1	0.5	1	5	6	5	—	—	—
(2) 1935	75	1	10	—	6	0.9	—	1	5	6	5	—	—	—
(3) 1935	76	1	4		18	0.9	—	1	5	6	5	—	—	—
1966	77	6	—	—	22	2.4	0.7	3	2,3c	6	5	—	—	—
1973	78	12	—	—	18	0.8	—	—	—	6	5	—	—	—

Type = 1=backwater pool, 2=sidechannel pool, 3=beaver pond <500m2, 4=beaver pond >500m2, 5=straight pool, 6=lateral scour pool, 7=trench pool, 8=plunge pool, 9=dam pool, 10=rapids, 11=riffle, 12=glide.

% wood cover = 1=low (<5%), 2=medium (6-20%), 3=high (>20%)

Pool Habit Forming Factors (PHFF)= 1= channel meander,2= bank or bend, 3= LWD (a=log, b=tree, c=root, d=jam), 4= gravel, 5=boulder, 6=bedrock, 7=beaver dam, 8=mandmade

Substrate = 1=organics, 2=mud, 3=silt, 4=sand, 5=gravel, 6=cobble, 7=boulder

+TYPE2 #AND#TYPE=9

1286

LIMTING FACTORS ANALYSIS FIELD FORM Date: Stream: Observers: Weather:

(Dist (ft) (m))	Unit # (m)	Type	Lgth (ft)	Debris	Wdth (ft)	Max D (ft)	Tail D (ft)	Wcov	Pool Hab Form	Sub Dom	Sub SDom	SpGrvl (ft2)	LWD >20 (cm)	LWD >50 (cm)
2011	79	6	—	4	17	2.0	25	2	3d	4	6	—	—	—
2053	80	11	—	—	15	—	—	—	—	6	5	—	—	—
2073	81	8	—	—	13	1.3	0.7	1	5,1	6	5	—	—	—
2180	82	9	—	5	11.8	1.6	—	3	2,3d	6	5	—	2	—
2115	83	11	—	—	13.5	—	—	—	—	6	5	—	—	—
2152	84	8	—	3	13.5	1.1	0.6	1	5	6	5	—	—	1
2226	85	11	—	—	13.5	—	—	—	—	6	5	—	—	—
2174	86	8	11	—	8	1.3	0.8	1	5	6	4	—	—	—
2150	87	1	6	—	7	0.7	0	1	5	4	6	—	—	—
2311	88	12	—	—	11.1	1.0	—	—	—	6	5	—	—	—
2311	89	1	11	—	17	1.2	—	1	5	6	6	—	—	—
2334	90	12	—	—	21	1.3	—	—	—	6	6	—	—	—
2420	91	10	—	—	34.5	—	—	—	—	6	5	—	—	—

Type = 1=backwater pool, 2=sidechannel pool, 3=beaver pond <500m2, 4=beaver pond >500m2, 5=straight pool, 6=lateral scour pool, 7=trench pool, 8=plunge pool, 9=dam pool, 10=rapids, 11=riffle, 12=glide.

% wood cover = 1=low (<5%), 2=medium (6-20%), 3=high (>20%)

Pool Habit Forming Factors (PHFF)= 1= channel meander, 2= bank or bend, 3= LWD (a=log, b=tree, c=root, d=jam), 4= gravel, 5=boulder, 6=bedrock, 7=beaver dam, 8=mandmade

Substrate = 1=organics, 2=mud, 3=silt, 4=sand, 5=gravel, 6=cobble, 7=boulder

~2335' log jam, large wood >50cm DBH start of terrace on right bank, Tree Creek

boulders

400 grad of 2 <8

LIMTING FACTORS ANALYSIS FIELD FORM Date: Stream: Observers: Weather:

Dist (ft)	Unit #	Type	Lgth (ft)	Debris	Wdth (ft)	Max D (ft)	Tail D (ft)	Wcov	Pool Hab Form	Sub Dom	Sub SDom	SpGrvl (ft2)	LWD >20 (cm)	LWD >50 (cm)
2455	92	8	—	—	22	2.4	0.9	1	5	4	6	5	—	—
2486	93	9	—	3	15	1.8	0.6	1	5,2	7	6	—	—	—
2509	94	12	—	5	15	0.9	—	—	—	7	6	—	—	—
2538	95	11	—	—	12.5	—	—	—	—	6	5	—	—	—
2563	96	9	—	—	16	1.2	—	1	5	6	5	—	—	—
2703	97	11	—	—	13	—	—	1	—	7	6	—	—	—
(2) 2600	98	1	9	1	14	0.7	0.6	1	3a	6	4	—	—	1
2740	99	12	—	—	20	1.4	—	—	—	6	5	—	—	—
2771	100	6	—	2	14.5	2.2	1.1	3	3a,2	6	5	—	—	2
2809	101	10	—	—	15	—	—	—	—	7	6	—	—	—
2710	102	5	—	—	10.6	1.4	0.6	1	5	7	6	—	—	—
2883	103	10	—	—	17	—	—	—	—	7	6	—	—	—
(2) 2950	104	1	9	1	10	0.9	—			4			4	—

Type = 1=backwater pool, 2=sidechannel pool, 3=beaver pond <500m2, 4=beaver pond >500m2, 5=straight pool, 6=lateral scour pool, 7=trench pool, 8=plunge pool, 9=dam pool, 10=rapids, 11=riffle, 12=glide.

% wood cover = 1=low (<5%), 2=medium (6-20%), 3=high (>20%)

Pool Habit Forming Factors (PHFF)= 1=channel meander, 2= bank or bend, 3= LWD (a=log, b=tree, c=root, d=jam), 4= gravel, 5=boulder, 6=bedrock, 7=beaver dam, 8=mandmade

Substrate = 1=organics, 2=mud, 3=silt, 4=sand, 5=gravel, 6=cobble, 7=boulder

2703 RB slump or failure. Trees (alder) tipped towards creek. Silty/red bank

LIMTING FACTORS ANALYSIS FIELD FORM Date: Stream: Observers: Weather:

Dist (ft)	Unit #	Type	Lgth (ft)	Debris	Wdth (ft)	Max D (ft)	Tail D (ft)	Wcov	Pool Hab Form	Sub Dom	Sub SDom	SpGrvl (ft2)	LWD >20 (cm)	LWD >50 (cm)
2985	105	8	13		12	1.3	0.5	1	5	7	6	—	—	—
2988	106	8	10		13	1.7	0.6	1	5	7	6	—	—	—
3002	107	8	11		9	1.4	0.5	1	5	7	4	—	—	—
3004	108	8	13		13.5	1.1	0.6	1	5	7	5	5%	—	—
3064	109	8			11	2.5	0.4	1	52	7	6	—	—	—
3085	110	12			11	1.2	—	—	—	4	6	—	—	—
3108	111	8			12	1.3	0.5	1	5	7	6	—	—	—
3204	112	10			13	—	—	—	—	7	6	—	—	—
3220	113	1	65		7	1.0	—	1	5	7	6	—	—	—
3230	114	1	5		5	0.7	—	1	5	6	4	—	—	—
3249	115	6		5	14.5	2.4	0.6	1	232	6	5	—	—	—
3284	116	12		5	11.6	0.9	—	—	—	6	5	—	4	4
3321	117	9		5	13.9	1.7	—	3	32	6	4	—	5	5

Type = 1=backwater pool, 2=sidechannel pool, 3=beaver pond <500m2, 4=beaver pond >500m2, 5=straight pool, 6=lateral scour pool, 7=trench pool, 8=plunge pool, 9=dam pool, 10=rapids, 11=riffle, 12=glide.

% wood cover = 1=low (<5%), 2=medium (6-20%), 3=high (>20%)

Pool Habit Forming Factors (PHFF)= 1= channel meander,2= bank or bend, 3= LWD (a=log, b=tree, c=root, d=jam), 4= gravel, 5=boulder, 6=bedrock, 7=beaver dam, 8=mandmade

Substrate = 1=organics, 2=mud, 3=silt, 4=sand, 5=gravel, 6=cobble, 7=boulder

3324	118	11	100	—	11	—	—	—	—	6	5	—	—	—
3353	119	11	—	5	15	—	—	—	—	6	5	—	4	—

LIMTING FACTORS ANALYSIS FIELD FORM Date: Stream: Rollins Observers: Weather:

Dist (ft)	Unit #	Type	Lgth (ft)	Debris	Wdth (ft)	Max D (ft)	Tail D (ft)	Wcov	Pool Hab Form	Sub Dom	Sub SDom	SpGrvl (ft2)	LWD >20 (cm)	LWD >50 (cm)
2 —	11	11	36	3	15	—	—	—	—	6	5	—	2	—
2 —	12	6	36	3	10	1.8	0.6	3	2,3a	6	4	—	—	1
2 —	13	10	60	—	7.4	—	—	—	—	6	5	—	—	—
2 —	14	11	120	—	9.4	—	—	—	—	6	5	—	—	—
2 —	15	1	30	LT (log jam)	8	2.3	—	3	3d	4	6	—	2	1
2	16	11	9		8	—	—	—	—	6	5	—	—	—
2	7	8	15		5.5	1.0	—	2	5	6	5	—	—	—
2	8	11	108	root 5	4.4	—	—	—	—	6	5	—	—	—
2	9	8	30		8.7	1.6	0.2	1	2,4	6	5	—	—	—
2	10	11	55		4.5	—	—	—	—	5	6	—	—	—
2	11	1	10	5	5	1.0	—		3d	4	5	—	—	5
2	12	1	15		6	0.7	—	3	3c	3	4	—	—	—
	13		75											

Type = 1=backwater pool, 2=sidechannel pool, 3=beaver pond <500m2, 4=beaver pond >500m2, 5=straight pool, 6=lateral scour pool, 7=trench pool, 8=plunge pool, 9=dam pool, 10=rapids, 11=riffle, 12=glide.

% wood cover = 1=low (<5%), 2=medium (6-20%), 3=high (>20%)

Pool Habit Forming Factors (PHFF)= 1= channel meander,2= bank or bend, 3= LWD (a=log, b=tree, c=root, d=jam), 4= gravel, 5=boulder, 6=bedrock, 7=beaver dam, 8=mandmade

Substrate = 1=organics, 2=mud, 3=silt, 4=sand, 5=gravel, 6=cobble, 7=boulder

LIMTING FACTORS ANALYSIS FIELD FORM Date: Stream: Pollution SC Habitat Observers: Weather:

Dist (ft)	Unit #	Type	Lgth (ft)	Debris	Wdth (ft)	Max D (ft)	Tail D (ft)	Wcov	Pool Hab Form	Sub Dom	Sub SDom	SpGrvl (ft2)	LWD >20 (cm)	LWD >50 (cm)
	14													
	15													
	16													
	17													
	18													
	19													
	20													
	21													
	22													
	23													
	24													
	25													
	26													

Type =1=backwater pool, 2=sidechannel pool, 3=beaver pond <500m2, 4=beaver pond >500m2, 5=straight pool, 6=lateral scour pool, 7=trench pool, 8=plunge pool, 9=dam pool, 10=rapids, 11=riffle, 12=glide.

% wood cover = 1=low (<5%), 2=medium (6-20%), 3=high (>20%)

Pool Habit Forming Factors (PHFF)= 1= channel meander,2= bank or bend, 3= LWD (a=log, b=tree, c=root, d=jam), 4= gravel, 5=boulder, 6=bedrock, 7=beaver dam, 8=mandmade

Substrate = 1=organics, 2=mud, 3=silt, 4=sand, 5=gravel, 6=cobble, 7=boulder

1 Dicks

(122)

LIMTING FACTORS ANALYSIS FIELD FORM Date: 9/1/94 Stream: Dicks Observers: C.P., D.B., P.K Weather: Sunny 70s

Dist (ft)	Unit #	Type	Lgth (ft)	Debris	Wdth (ft)	Max D (ft)	Tail D (ft)	Wcov	Pool Hab Form	Sub Dom	Sub SDom	SpGrvl (ft2)	LWD >20 (cm)	LWD >50 (cm)
82	1	11	—	—	11.5	—	—	—	—	5	4	65%	—	—
127	2	6	—	1	10	2.0	0.35	2	2,4	5	4	5%	1	1
138	3	11	—	—	11	—	—	—	—	5	4	75%	—	—
151	4	6	—		7	1.3	0.5	1	2	5	4	5%	—	—
182	5	12	—	1	6.5	0.7	—	—	—	5	4	85%	—	—
284	6	11	—		9	—	—	—	—	5	4	90%	1	—
284	7	1	7	1	3	0.8	—	1	2,3c live	4	3	—	—	—
299	8	6	—	2	7	1.7	0.4	2	3d,3c	5	4	50%	2	—
328	9	12	—	—	9	0.8	—	—	—	5	4	80%	—	—
322	10	6	—	4	7	1.1	0.4	3	2,3d	5	4	80%	2	—
362	11	11	—	—	6	—	—	—	—	5	4	75%	—	—
376	12	12	—	+	9	0.46	—	—	—	5	4	100%	+	—
376	13	6	—	—	6	1.4	0.2	1	3c live, 2	5	4	5%	—	—

Type = 1=backwater pool, 2=sidechannel pool, 3=beaver pond <500m2, 4=beaver pond >500m2, 5=straight pool, 6=lateral scour pool, 7=trench pool, 8=plunge pool, 9=dam pool, 10=rapids, 11=riffle, 12=glide.

% wood cover = 1=low (<5%), 2=medium (6-20%), 3=high (>20%)

Pool Habit Forming Factors (PHFF)= 1= channel meander,2= bank or bend, 3= LWD (a=log, b=tree, c=root, d=jam), 4= gravel, 5=boulder, 6=bedrock, 7=beaver dam, 8=mandmade

Substrate = 1=organics, 2=mud, 3=silt, 4=sand, 5=gravel, 6=cobble, 7=boulder

LIMTING FACTORS ANALYSIS FIELD FORM Date: Stream: Observers: Weather:

Dist (ft)	Unit # (<)	Type	Lgth (ft)	Debris	Wdth (ft)	Max D (ft)	Tail D (ft)	Wcov	Pool Hab Form	Sub Dom	Sub SDom	SpGrvl (ft2)	LWD >20 (cm)	LWD >50 (cm)
400	14	11	—	—	6	—	—	—	—	5	4	30g	—	—
400	15	11	—	—	6	—	—	—	—	5	4	5g	—	—
415	16	6	—	2	7	0.9	0.4	1	3d	5	4	5g	2	—
415	17	6	—	—	6	0.7	0.3	1	3a	5	4	30g	—	—
415	18	12	—	—	9	0.6	—	—	—	6	5	5g	—	—
422	19	12			8.5	0.9	—	—	—	5	4	50g	—	—
431	20	11			10	—	—	—	—	6	5	10g	—	—
448	21	5	—	4	8.5	1.1	0.4	1	3d	6	5	10g	—	—
488	22	10		8	5.5	—	—	—	—	5	6	—	3	—
488	23	1	4	~20	8	0.9	—	3	3d	6	4	—	—	—
488	24	1	4	~20	4	1.1	—	3	3d	4	4	—	—	—
508	25	8	—	~10	10	1.1	0.4	1	3d3a	6	5	3g	—	—
523	26	11	—	—	12	—	—	—	—	6	5	—	—	—

<28 Δgradient >28

Type = 1=backwater pool, 2=sidechannel pool, 3=beaver pond <500m2, 4=beaver pond >500m2, 5=straight pool, 6=lateral scour pool, 7=trench pool, 8=plunge pool, 9=dam pool, 10=rapids, 11=riffle, 12=glide.

% wood cover = 1=low (<5%), 2=medium (6-20%), 3=high (>20%)

Pool Habit Forming Factors (PHFF)= 1= channel meander, 2= bank or bend, 3= LWD (a=log, b=tree, c=root, d=jam), 4= gravel, 5=boulder, 6=bedrock, 7=beaver dam, 8=mandmade

Substrate = 1=organics, 2=mud, 3=silt, 4=sand, 5=gravel, 6=cobble, 7=boulder

Several old channels at this point, approx 1.5 meters above current bed

③

LIMTING FACTORS ANALYSIS FIELD FORM Date: Stream: Observers: Weather:

Dist (ft)	Unit #	Type	Lgth (ft)	Debris	Wdth (ft)	Max D (ft)	Tail D (ft)	Wcov	Pool Hab Form	Sub Dom	Sub SDom	SpGrvl (ft2)	LWD >20 (cm)	LWD >50 (cm)
547	27	12	—	—	12	0.7	—	—	—	5	6	10%	—	—
562	28	12	—	—	12	0.8	—	—	—	6	5	5%	—	—
570	29	6	—	—	8	1.1	0.6	1	2	6	5	[illegible]	—	—
591	30	12	—	—	8.5	0.9	—	—	—	6	5	—	—	—
Δgrad 6% 689	31	10	—	—	9.5	—	—	—	—	6	5	3%	—	—
702	32	6	—	≈20	6.5	1.2	0.3	3	2,3c	5	6	20%	5	—
737	33	10	—	≈5	11.5	—	—	—	—	6	5	—	1	—
747	34	6	✓	2	5	1.5	0.35	3	3c live 3c	6	5	—	1	1
② 737	35	1	5	2	6	0.5	—	3	3c	4	3	3	2	—
804	36	10	—	—	13	—	—	—	—	6	5	5%	—	—
846	37	8	—	1	11	1.4	0.4	1	3c,2	6	5	10%	—	1
885	38	10			11.5	—	—	—	—	6	5	—	—	—
997	39	10			12	—	—	—	—	6	5	5%	—	—

add SC enters from LB

Type = 1=backwater pool, 2=sidechannel pool, 3=beaver pond <500m2, 4=beaver pond >500m2, 5=straight pool, 6=lateral scour pool, 7=trench pool, 8=plunge pool, 9=dam pool, 10=rapids, 11=riffle, 12=glide.

% wood cover = 1=low (<5%), 2=medium (6-20%), 3=high (>20%)

Pool Habit Forming Factors (PHFF)= 1= channel meander,2= bank or bend, 3= LWD (a=log, b=tree, c=root, d=jam), 4= gravel, 5=boulder, 6=bedrock, 7=beaver dam, 8=mandmade

Substrate = 1=organics, 2=mud, 3=silt, 4=sand, 5=gravel, 6=cob, 7=boulder

(4)

LIMTING FACTORS ANALYSIS FIELD FORM Date: Stream: Observers: Weather:

between 807-997

Dist (ft)	Unit #	Type	Lgth (ft)	Debris	Wdth (ft)	Max D (ft)	Tail D (ft)	Wcov	Pool Hab Form	Sub Dom	Sub SDom	SpGrvl (ft2)	LWD >20 (cm)	LWD >50 (cm)
	40	8	30	—	8	1.2	0.2	1	3d	5	4	—	—	—
	41	9	10	~15	7	0.7	0.1	1	3d	5	4	—	—	—
	42	11	23	—	3	—	—	—	—	5	4	—	—	—
	43	11	23	—	5	—	—	—	—	6	5	—	—	—
	44	1	12	—	9	1.0	0.1	1	3a	5	4	—	1	—
1007	45	11	—	—	26	—	—	—	—	6	5	—	—	—
1039	46	6	—	2	14	2.4	0.5	3	3c,3a	6	5	5%	2	—
1151	47	10	—	3	12.5	—	—	—	—	6	5	5%	1	—
1169	48	6	—	3	11.5	2.0	0.9	1	3a,3d	5	6	5%	3	—
1191	49	10	—	1	18	—	—	—	—	6	5	—	1	—
1218	50	6	—	~10	13	2.0	0.6	3	3c,3d,3a	6	5	—	1	2
1267	51	10	—	—	13	—	—	—	—	6	5	—	—	—
1289	52	8	—	2	15	2.0	0.5	2	3a,3c	6	5	—	2	—

Type = 1=backwater pool, 2=sidechannel pool, 3=beaver pond <500m2, 4=beaver pond >500m2, 5=straight pool, 6=lateral scour pool, 7=trench pool, 8=plunge pool, 9=dam pool, 10=rapids, 11=riffle, 12=glide.

% wood cover = 1=low (<5%), 2=medium (6-20%), 3=high (>20%)

Pool Habit Forming Factors (PHFF)= 1= channel meander,2= bank or bend, 3= LWD (a=log, b=tree, c=root, d=jam), 4= gravel, 5=boulder, 6=bedrock, 7=beaver dam, 8=mandmade

Substrate = 1=organics, 2=mud, 3=silt, 4=sand, 5=gravel, 6=cobble, 7=boulder

— Height of fan v. height of levee? Stability (Fred DS).

Reg #1

Reg #2 higher % of boulders in US direction

3400' 123

6.5 ft overhang

LB bar approx 2m high on US log jam

photo #4

LIMTING FACTORS ANALYSIS FIELD FORM Date: Stream: Observers: Weather:

Dist (ft)	Unit #	Type	Lgth (ft)	Debris	Wdth (ft)	Max D (ft)	Tail D (ft)	Wcov	Pool Hab Form	Sub Dom	Sub SDom	SpGrvl (ft2)	LWD >20 (cm)	LWD >50 (cm)
1303	53	10	—	—	13	—	—	—	—	7	6/5	—	—	—
1328	54	6	—	—	8.5	1.9	0.6	1	3c live	6	5	—	—	—
1332	55	11	—	—	7	—	—	—	—	6	5	—	—	—
1342	56	6	—	—	9	1.3	0.4	1	2,1	6	5	—	—	—
1368	57	11	—	—	18	—	—	—	—	6	5	—	—	—
1389	58	12	—	—	12	0.8	—	—	—	6	5	10%	—	—
1409	59	6	—	1	7	1.6	0.6	2	3c,2	6	5	10%	1	—
1419	60	10	—	—	7.5	—	—	—	—	6	5	—	—	—
1432	61	6	—	1	5.5	1.9	0.6	3	2,3d	5	6	—	1	—
1449	62	10	—	—	6	—	—	—	—	6	5	—	—	—
1468	63	12	—	2	11	0.9	—	—	—	6	5	—	—	2
1479	64	10	—		10	—	—	—	—	6	5	—	—	—
1489	65	6		2	10	1.6	0.8	2	5,3d	6	5		2	—

B-overbank clay, silt band, mottled

1.5 ft overhang

Type = 1=backwater pool, 2=sidechannel pool, 3=beaver pond <500m2, 4=beaver pond >500m2, 5=straight pool, 6=lateral scour pool, 7=trench pool, 8=plunge pool, 9=dam pool, 10=rapids, 11=riffle, 12=glide.

% wood cover = 1=low (<5%), 2=medium (6-20%), 3=high (>20%)

Pool Habit Forming Factors (PHFF)= 1= channel meander,2= bank or bend, 3= LWD (a=log, b=tree, c=root, d=jam), 4= gravel, 5=boulder, 6=bedrock, 7=beaver dam, 8=mandmade

Substrate = 1=organics, 2=mud, 3=silt, 4=sand, 5=gravel, 6=cobble, 7=boulder

large amt of incision ≈ 1.5m

(2)

(6)

LIMTING FACTORS ANALYSIS FIELD FORM Date: Stream: Observers: Weather:

Dist (ft)	Unit #	Type	Lgth (ft)	Debris	Wdth (ft)	Max D (ft)	Tail D (ft)	Wcov	Pool Hab Form	Sub Dom	Sub SDom	SpGrvl (ft2)	LWD >20 (cm)	LWD >50 (cm)
1539	66	10	—	—	14	—	—	—	—	7	6	—	—	—
1554	67	6	—	3	10	1.6	0.6	3	2,3c	6	5	—	3	—
1608	68	10	—	+	9.5	—	—	—	—	6	5	—	+	—
1627	69	12	—	—	13	1.3	—	—	—	6	5	—	—	—
1681	70	10	—	1	20	—	—	—	—	6	5/7	—	—	1
1694	71	8	—	8	12	1.7	0.7		3d,3c,2	6	5	—	6	—
1699	72	9	—	—	8.5	1.9	0.6	1	3d	6	5	—	—	—
1726	73	10	—	—	13	—	—	—	—	6	5	—	—	—
1736	74	6	—	—	10	1.3	0.9	1	4,3c,2	6	5	—	—	—
1754	75	11	—	—	13	—	—	—	—	6	5	—	—	—
1774	76	12	—	1	14	0.8	—	—	—	6	5	—	1	—
1828	77	10	—	1	17	—	—	—	—	6	5	—	2	—
1851	78	12			16	1.0	—	—	—	6	5	—	—	—

6 ft overhang

LB-true terrace 3/4 m high

apparent terrace

abl chl 5'8" high

Type = 1=backwater pool, 2=sidechannel pool, 3=beaver pond <500m2, 4=beaver pond >500m2, 5=straight pool, 6=lateral scour pool, 7=trench pool, 8=plunge pool, 9=dam pool, 10=rapids, 11=riffle, 12=glide.

% wood cover = 1=low (<5%), 2=medium (6-20%), 3=high (>20%)

Pool Habit Forming Factors (PHFF)= 1= channel meander,2= bank or bend, 3= LWD (a=log, b=tree, c=root, d=jam), 4= gravel, 5=boulder, 6=bedrock, 7=beaver dam, 8=mandmade

Substrate = 1=organics, 2=mud, 3=silt, 4=sand, 5=gravel, 6=cobble, 7=boulder

LIMTING FACTORS ANALYSIS FIELD FORM Date: Stream: Observers: Weather:

Dist (ft)	Unit #	Type	Lgth (ft)	Debris	Wdth (ft)	Max D (ft)	Tail D (ft)	Wcov	Pool Hab Form	Sub Dom	Sub SDom	SpGrvl (ft2)	LWD >20 (cm)	LWD >50 (cm)
1878	79	10	—	—	14	—	—	—	—	6	5	—	—	—
1893	80	8	—	—	13	1.8	0.6	1	5	6	5	—	—	—
1906	81	6	—	3	8	1.2	0.4	1	3d,2	6	5	—	2	1
1928	82	11	—	—	13.5 20	—	—	—	—	6	5	—	—	—
1941	83	6	—	2	18	20	0.5	1	3c,3a	7	6	5%	2	—
1982	84	10	—	—	13	—	—	—	—	6	5	5%	—	—
1996	85	8	—	—	11	1.4	0.7	1	5	7	6	—	—	—
2056	86	11	—	—	13	—	—	—	—	7	6	5%	—	—
2109	87	11	—	5	5	—	—	—	—	5	4/6	—	3	—
2067	88	5	—	—	9	1.4	0.8	1	5	7	6	—	—	—
2106	89	10	—	—	10	—	—	—	—	7	6	—	—	—
2137	90	8	—	—	9	1.4	0.7	1	5,2	6	5	—	—	—
2400 2457	91	10	—	1	12	—	—	—	—	6	5	—	1	—

Type = 1=backwater pool, 2=sidechannel pool, 3=beaver pond <500m2, 4=beaver pond >500m2, 5=straight pool, 6=lateral scour pool, 7=trench pool, 8=plunge pool, 9=dam pool, 10=rapids, 11=riffle, 12=glide.

% wood cover = 1=low (<5%), 2=medium (6-20%), 3=high (>20%)

Pool Habit Forming Factors (PHFF)= 1= channel meander,2= bank or bend, 3= LWD (a=log, b=tree, c=root, d=jam), 4= gravel, 5=boulder, 6=bedrock, 7=beaver dam, 8=mandmade

Substrate = 1=organics, 2=mud, 3=silt, 4=sand, 5=gravel, 6=cobble, 7=boulder

LIMTING FACTORS ANALYSIS FIELD FORM Date: Stream: Observers: Weather:

Dist (ft)< (m)	Unit # (ft)< (m)	Type	Lgth (ft)	Debris	Wdth (ft)	Max D (ft)	Tail D (ft)	Wcov	Pool Hab Form	Sub Dom	Sub SDom	SpGrvl (ft2)	LWD >20 (cm)	LWD >50 (cm)
2425	92	6	—	—	13	1.3	0.5	1	2,3c	6	5	—	—	—
2484	93	10	—	2	21	—	—	—	—	6	5	—	2	—
2524	94	10	—	—	5	—	—	—	—	7	6	—	—	—
2524	95	10	—	—	14	—	—	—	—	6	5	—	—	—
2540	96	6	14	—	4	1	0.4		2,3c	6	5	—	—	—
2524	97	1	6	2	8	1.2	—	1	3b	6	5	—	2	—
2568	98	10	—	—	10	—	—	—	—	6	5	—	—	—
2568	99	8	—	f	13	1.2	0.4	1	3a,5	6	5	—	1	—
2580	100	6	—	5	11	2.0	0.7	1	3b,2	6	5	—	2	2
2611	101	6	—	1	9	2.4	0.9	1	3b,2	6	5	—	—	—
2673	102	10	—	—	14	—	—	—	—	6	5	—	—	—
2684	103	6	—	—	8	1.4	0.6	1	3b,3c	6	5	—	—	—
2726	104	1	5		6	0.9	—	1	5	6	5	—	—	—

Type = 1=backwater pool, 2=sidechannel pool, 3=beaver pond <500m2, 4=beaver pond >500m2, 5=straight pool, 6=lateral scour pool, 7=trench pool, 8=plunge pool, 9=dam pool, 10=rapids, 11=riffle, 12=glide.

% wood cover = 1=low (<5%), 2=medium (6-20%), 3=high (>20%)

Pool Habit Forming Factors (PHFF)= 1= channel meander,2= bank or bend, 3= LWD (a=log, b=tree, c=root, d=jam), 4= gravel, 5=boulder, 6=bedrock, 7=beaver dam, 8=mandmade

Substrate = 1=organics, 2=mud, 3=silt, 4=sand, 5=gravel, 6=cobble, 7=boulder

LIMTING FACTORS ANALYSIS FIELD FORM Date: Stream: Observers: Weather:

Dist (ft)	Unit #	Type	Lgth (ft)	Debris	Wdth (ft)	Max D (ft)	Tail D (ft)	Wcov	Pool Hab Form	Sub Dom	Sub SDom	SpGrvl (ft2)	LWD >20 (cm)	LWD >50 (cm)
2741	105	10	—	—	12	—	—	—	—	6	5	—	—	—
2754	106	8	—	3	10	1.1	0.6	1	5,3c	6	5	—	3	—
2771	107	10	—	—	11	—	—	—	—	6	5	—	—	—
2791	108	8	—	—	11	1.9	0.8	1	4,5	6	5	—	—	—
2811	109	6	—	2	12	1.5	0.8	1	2,5	6	5	—	2	—
2871	110	10	—	—	11	—	—	—	—	6	5	—	—	—
2882	111	1	—	—	14	1.6	—	1	5.	6	5	—	—	—
2911	112	10			7.5	—	—	—	—	6	5	—	—	—
2941	113	10			6.5	—	—	—	—	6	5	—	—	—
2990	114	8	9	—	5.5	1.1	0.5	1	—	6	5	—	—	—
2990	115	10	—	—	14	—	—	—	—	7	6	—	—	—
2991	116	8	—	—	14	1.9	0.6	1	5	6	4	—	—	—
3041	117	10			14	1.4	0.5	—	—	7	6	—	—	—

Type= 1=backwater pool, 2=sidechannel pool, 3=beaver pond <500m2, 4=beaver pond >500m2, 5=straight pool, 6=lateral scour pool, 7=trench pool, 8=plunge pool, 9=dam pool, 10=rapids, 11=riffle, 12=glide.

% wood cover = 1=low (<5%), 2=medium (6-20%), 3=high (>20%)

Pool Habit Forming Factors (PHFF)= 1= channel meander,2= bank or bend, 3= LWD (a=log, b=tree, c=root, d=jam), 4= gravel, 5=boulder, 6=bedrock, 7=beaver dam, 8=mandmade

Substrate = 1=organics, 2=mud, 3=silt, 4=sand, 5=gravel, 6=cobble, 7=boulder

11 1.4 0.5

| | | |

LIMTING FACTORS ANALYSIS FIELD FORM Date: Stream: Observers: Weather:

Dist (ft)	Unit #	Type	Lgth (ft)	Debris	Wdth (ft)	Max D (ft)	Tail D (ft)	Wcov	Pool Hab Form	Sub Dom	Sub SDom	SpGrvl (ft2)	LWD >20 (cm)	LWD >50 (cm)
3065	118	8	—	—	11	1.4	0.5	1	5	7	6	—	—	—
3097	119	10	—	—	15	—	—	—	—	7	6	—	—	—
3097	120	1	4	2	85	1.2	—	2	5,3a	6	5	—	—	1
3178	121	10	—	4	16	—	—	—	—	7	6	—	4	—
3198	122	12	—	—	17	1.1	—	—	—	6	5	—	—	—
3198	123	11	25	—	65	—	—	—	—	6	5	—	—	—
3246	124	10	—	5	13	—	—	—	—	6	5	—	5	—
3361	125	5	—	1	12	1.3	0.6	1	2,3b	6	5	—	1	—
3375	126	1	16	—	10	0.8	—	1	5,4	6	5	—	—	—
3395	127	10	—	—	10	—	—	—	—	6	5	—	—	—
	128	approx ½ of segment #2 - extrapolate to alter. half. Use upper.												
	129	portion of lower half.												
	130													

Type = 1=backwater pool, 2=sidechannel pool, 3=beaver pond <500m2, 4=beaver pond >500m2, 5=straight pool, 6=lateral scour pool, 7=trench pool, 8=plunge pool, 9=dam pool, 10=rapids, 11=riffle, 12=glide.

% wood cover = 1=low (<5%), 2=medium (6-20%), 3=high (>20%)

Pool Habit Forming Factors (PHFF)= 1= channel meander, 2= bank or bend, 3= LWD (a=log, b=tree, c=root, d=jam), 4= gravel, 5=boulder, 6=bedrock, 7=beaver dam, 8=mandmade

Substrate = 1=organics, 2=mud, 3=silt, 4=sand, 5=gravel, 6=cobble, 7=boulder

LWD >20 (cm)	LWD >50 (cm)
[illegible]	[illegible]

scour pool

gravel

Form F-2: Fish Habitat Conditions Field Inventory Data

WAU STREAM NAME SURVEY UNIT # CREW DATE PAGE

DISTANCE	HAB TYPE	POOLS ONLY MAXDP	RFCDP	RESDP	FORM	%WCVR	SUBSTRATE DOM	SBDOM	SPGRV	LWD TALLY 10-20CM	20-50CM	>50CM	NOTES

SUMMARY:

WATER TEMPERATURE	
STREAM FLOW	
AVERAGE PERCENT SHADE	
AVERAGE CHANNEL WIDTH	
AVERAGE BED SLOPE	

SUMMARY TOPICS[1]	
OFF-CHANNEL REARING	
HOLDING POOLS	
REDD SCOUR POTENTIAL	

[1]Provide summary paragraph describing survey reach characteristics and check box when done.

LWD:

FUNCTIONAL LWD	
10-20 CM	
20-50 CM	
>50 CM	
TOTAL	

DISTANCE SURVEYED	
NON-FUNCTIONAL LWD	

Form F-2: Fish Habitat Conditions Field Inventory Data

WAU	STREAM NAME	~~SURVEY UNITS~~	CREW	DATE	PAGE
[illegible]	[illegible]	5 #124	GP, PS	11/11	1/1

DISTANCE	HAB TYPE	MAXDP	RFCDP	RESDP	FORM	%WCVR	DOM	SBDOM	SPGRV	10-20CM	20-50CM	>50CM	NOTES
		POOLS ONLY					SUBSTRATE			LWD TALLY			

✱ See LFA field notes ✱

SUMMARY:

WATER TEMPERATURE	
STREAM FLOW	4M
AVERAGE PERCENT SHADE	≥30% <50%
AVERAGE CHANNEL WIDTH	7.3 BFW 17m
AVERAGE BED SLOPE	3-4%

SUMMARY TOPICS[1]	
OFF-CHANNEL REARING	
HOLDING POOLS	None
REDD SCOUR POTENTIAL	Minimal

[1]Provide summary paragraph describing survey reach characteristics and check box when done.

LWD:

FUNCTIONAL LWD	
10-20 CM	
20-50 CM	
>50 CM	
TOTAL	

DISTANCE SURVEYED	
NON-FUNCTIONAL LWD	

LIMTING FACTORS ANALYSIS FIELD FORM Date: 11/11 Stream: Dick, Seg #124 Observers: PS, BP ✓ Weather: Cold, Cloudy (1)

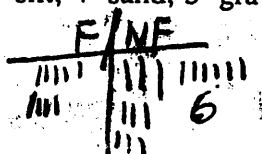
Dist ~~(ft)~~ m	Unit #	Type	Lgth (ft)	Debris	Wdth (ft)	Max D (ft)	Tail D (ft)	Wcov	Pool Hab Form	Sub Dom	Sub SDom	SpGrvl (ft2)	LWD >20 (cm)	LWD >50 (cm)
7.9	1	10		1	22	—	—	—	—	7	6	—	—	—
10.1	2	8		—	22	1.2	1.0	1	5	7	6	—	—	—
44.4	3	10			18	1.1	—	—	—	7	6	—	—	—
2 21.5	4	1	5	2	6	1.3		2	5	7	6	—	—	—
54.2	5	~~8~~ 12		2	22	1.2	~~4~~	—	—	6	5	—	—	2
58.8	6	6			12	1.8	1.0	1	5	6	5	—	—	~~1~~
(2) 67.0	7	1		1	10	1.3		1	5, 3a	6	5	—	—	1
71.5	8	10			10	—	—	—	—	7	6	—	—	—
76.1	9	9		LJ	15	2.9	0.9	1	3d	6	5	—	5	—
83.5	10	10			12	—	—	—	—	7	6	—	—	—
90.2	11	10			12	—	—	—	—	7	6	—	—	—
90.2	12	6		3	12	1.9	1.0	2	3a, 2	6	5	—	—	1
104.6	13	10			12	—	—	—	—	7	6	—	—	—

Type = 1=backwater pool, 2=sidechannel pool, 3=beaver pond <500m2, 4=beaver pond >500m2, 5=straight pool, 6=lateral scour pool, 7=trench pool, 8=plunge pool, 9=dam pool, 10=rapids, 11=riffle, 12=glide.

% wood cover = 1=low (<5%), 2=medium (6-20%), 3=high (>20%)

Pool Habit Forming Factors (PHFF)= 1= channel meander,2= bank or bend, 3= LWD (a=log, b=tree, c=root, d=jam), 4= gravel, 5=boulder, 6=bedrock, 7=beaver dam, 8=mandmade

Substrate = 1=organics, 2=mud, 3=silt, 4=sand, 5=gravel, 6=cobble, 7=boulder



F/NF

6

LIMTING FACTORS ANALYSIS FIELD FORM Date: Stream: Observers: Weather: (2)

Dist ~~(ft)~~ (M)	Unit #	Type	Lgth (ft)	Debris	Wdth (ft)	Max D (ft)	Tail D (ft)	Wçov	Pool Hab Form	Sub Dom	Sub SDom	SpGrvl (ft2)	LWD >20 (cm)	LWD >50 (cm)
110.7	14	8			4	2.4	0.8	1	5,2	7	6	—	—	—
117.4	15	11			18	—	—	—	—	7	6	—	—	—
131.4 ~~124~~	16	10			18	—	—	—		—	—	—	—	—
135	17	8			9	1.4	0.8	1	5	7	6	—	—	—
144.2	18	11	—	—	15	—	—	—	—	7	6	—	—	—
157	19	10	—	—	15	—	—	—	—	7	6	—	—	—
	20	* end of survey *												
	21													
	22													
	23													
	24													
	25													
	26													

Type = 1=backwater pool, 2=sidechannel pool, 3=beaver pond <500m2, 4=beaver pond >500m2, 5=straight pool, 6=lateral scour pool, 7=trench pool, 8=plunge pool, 9=dam pool, 10=rapids, 11=riffle, 12=glide.

% wood cover = 1=low (<5%), 2=medium (6-20%), 3=high (>20%)

Pool Habit Forming Factors (PHFF)= 1= channel meander,2= bank or bend, 3= LWD (a=log, b=tree, c=root, d=jam), 4= gravel, 5=boulder, 6=bedrock, 7=beaver dam, 8=mandmade

Substrate = 1=organics, 2=mud, 3=silt, 4=sand, 5=gravel, 6=cobble, 7=boulder

780' - till layer, valley becomes more confined, DS?

NF/F
4

<1%

RM23
21.3

LIMTING FACTORS ANALYSIS FIELD FORM Date: 11/11 Stream: HWC RM22 Observers: PS, OP Weather: Rainy/Cloudy

Dist ~~(ft)~~ M	Unit #	Type	Lgth ~~(ft)~~ M	Debris	Wdth (ft)	Max D (ft)	Tail D (ft)	Wcov	Pool Hab Form	Sub Dom	Sub SDom	SpGrvl (ft2)	LWD >20 (cm)	LWD >50 (cm)
11.3	1	6		1	10	2.8	0.5	1	3d	5	4	—	+	—
19.8	2	6		—	12	2.0	0.5	1	2	5	4	—	—	—
[illegible]	3	6	17		8	1.8	0.3	1	2	4	5	—	—	—
	4	6	15	1	~~10~~ 6	1.3	0.4	1	2	4	5	—	—	—
200 → smaller slough enters large HWC														
	large amt of fine sediment in pools													
	5	6	20		7	1.6	0.7	2	2	4	3			
	6	6	35		8	2.4	0.4	1	2	4	5			
	7	6	30		15	3.0	0.4	1	2	4	3			

Type = 1=backwater pool, 2=sidechannel pool, 3=beaver pond <500m2, 4=beaver pond >500m2, 5=straight pool, 6=lateral scour pool, 7=trench pool, 8=plunge pool, 9=dam pool, 10=rapids, 11=riffle, 12=glide.

% wood cover = 1=low (<5%), 2=medium (6-20%), 3=high (>20%)

Pool Habit Forming Factors (PHFF)= 1= channel meander,2= bank or bend, 3= LWD (a=log, b=tree, c=root, d=jam), 4= gravel, 5=boulder, 6=bedrock, 7=beaver dam, 8=mandmade

Substrate = 1=organics, 2=mud, 3=silt, 4=sand, 5=gravel, 6=cobble, 7=boulder

LIMTING FACTORS ANALYSIS FIELD FORM Date: Stream: Observers: Weather:

Dist (ft)	Unit #	Type	Lgth (ft)	Debris	Wdth (ft)	Max D (ft)	Tail D (ft)	Wcov	Pool Hab Form	Sub Dom	Sub SDom	SpGrvl (ft2)	LWD >20 (cm)	LWD >50 (cm)

Type = 1=backwater pool, 2=sidechannel pool, 3=beaver pond <500m2, 4=beaver pond >500m2, 5=straight pool, 6=lateral scour pool, 7=trench pool, 8=plunge pool, 9=dam pool, 10=rapids, 11=riffle, 12=glide.

% wood cover = 1=low (<5%), 2=medium (6-20%), 3=high (>20%)

Pool Habit Forming Factors (PHFF)= 1= channel meander,2= bank or bend, 3= LWD (a=log, b=tree, c=root, d=jam), 4= gravel, 5=boulder, 6=bedrock, 7=beaver dam, 8=mandmade

Substrate = 1=organics, 2=mud, 3=silt, 4=sand, 5=gravel, 6=cobble, 7=boulder

Form F-2: Fish Habitat Conditions Field Inventory Data

WAU: Hazel | STREAM NAME: Segelsen | SURVEY UNIT #: SBC-R250 | CREW: GP, PS, PK | DATE: 11/2 | PAGE: 1/1

DISTANCE	HAB TYPE	POOLS ONLY MAXDP	POOLS ONLY RFCDP	POOLS ONLY RESDP	POOLS ONLY FORM	POOLS ONLY %WCVR	SUBSTRATE DOM	SUBSTRATE SBDOM	SUBSTRATE SPGRV	LWD TALLY 10-20CM	LWD TALLY 20-50CM	LWD TALLY >50CM	NOTES
			See LPA form for data										

Segelsen

SUMMARY:

WATER TEMPERATURE	
STREAM FLOW	N/M
AVERAGE PERCENT SHADE	<50%
AVERAGE CHANNEL WIDTH	
AVERAGE BED SLOPE	2-3%

SUMMARY TOPICS[1]	
OFF-CHANNEL REARING	1
HOLDING POOLS	3
REDD SCOUR POTENTIAL	Higher

[1]Provide summary paragraph describing survey reach characteristics and check box when done.

* relative to segment immediately upstream due to higher bed + ban roughness

LWD:

FUNCTIONAL LWD	
10-20 CM	
20-50 CM	
>50 CM	
TOTAL	

DISTANCE SURVEYED	
NON-FUNCTIONAL LWD	

Form F-2: Fish Habitat Conditions Field Inventory Data

WAU STREAM NAME SURVEY UNIT # CREW DATE PAGE

DISTANCE	HAB TYPE	POOLS ONLY					SUBSTRATE			LWD TALLY			NOTES
		MAXDP	RFCDP	RESDP	FORM	%WCVR	DOM	SBDOM	SPGRV	10-20CM	20-50CM	>50CM	

SUMMARY:

WATER TEMPERATURE	
STREAM FLOW	
AVERAGE PERCENT SHADE	
AVERAGE CHANNEL WIDTH	
AVERAGE BED SLOPE	

SUMMARY TOPICS[1]	
OFF-CHANNEL REARING	
HOLDING POOLS	
REDD SCOUR POTENTIAL	

[1]Provide summary paragraph describing survey reach characteristics and check box when done.

LWD:

FUNCTIONAL LWD	
10-20 CM	
20-50 CM	
>50 CM	
TOTAL	

DISTANCE SURVEYED	
NON-FUNCTIONAL LWD	

LIMTING FACTORS ANALYSIS FIELD FORM Date: 11/2 Stream: [illegible] Observers: [illegible] Weather: [illegible]

Dist (ft)	Unit #	Type	Lgth (ft)	Debris	Wdth (ft)	Max D (ft)	Tail D (ft)	Wcov	Pool Hab Form	Sub Dom	Sub SDom	SpGrvl (ft2)	LWD >20 (cm)	LWD >50 (cm)
186	1	11	—	—	32	—	—	—	—	5	6	19	—	—
30	2	10	—	—	32	—	—	—	—	5	6	—	—	—
383	3	7	—	—	32	1.3	0.6	1	5	5	6	—	—	—
107	4	12	—	—	32	1.4	—	—	—	5	6	—	—	—
117	5	10	—	—	32	—	—	—	—	5	6	—	—	0
127	6	9	—	2	32	2.5	1.2	1	3a	5	6	—	2	—

Type = 1=backwater pool, 2=sidechannel pool, 3=beaver pond <500m2, 4=beaver pond >500m2, 5=straight pool, 6=lateral scour pool, 7=trench pool, 8=plunge pool, 9=dam pool, 10=rapids, 11=riffle, 12=glide.

% wood cover = 1=low (<5%), 2=medium (6-20%), 3=high (>20%)

Pool Habit Forming Factors (PHFF)= 1= channel meander,2= bank or bend, 3= LWD (a=log, b=tree, c=root, d=jam), 4= gravel, 5=boulder, 6=bedrock, 7=beaver dam, 8=mandmade

Substrate = 1=organics, 2=mud, 3=silt, 4=sand, 5=gravel, 6=cobble, 7=boulder

BFD Sdep
BFW 12.7m

Plane Sheet 2138

Wdepth Form 11

20"

-Intflow Lentic

-164 Intergravel
-R, 3/4 Eight
-Mill Creek B
-Lentic MCB

LIMTING FACTORS ANALYSIS FIELD FORM Date: Stream: Observers: Weather:

Dist (ft)	Unit #	Type	Lgth (ft)	Debris	Wdth (ft)	Max D (ft)	Tail D (ft)	Wcov	Pool Hab Form	Sub Dom	Sub SDom	SpGrvl (ft2)	LWD >20 (cm)	LWD >50 (cm)

Type = 1=backwater pool, 2=sidechannel pool, 3=beaver pond <500m2, 4=beaver pond >500m2, 5=straight pool, 6=lateral scour pool, 7=trench pool, 8=plunge pool, 9=dam pool, 10=rapids, 11=riffle, 12=glide.

% wood cover = 1=low (<5%), 2=medium (6-20%), 3=high (>20%)

Pool Habit Forming Factors (PHFF)= 1= channel meander,2= bank or bend, 3= LWD (a=log, b=tree, c=root, d=jam), 4= gravel, 5=boulder, 6=bedrock, 7=beaver dam, 8=mandmade

Substrate = 1=organics, 2=mud, 3=silt, 4=sand, 5=gravel, 6=cobble, 7=boulder

Form F-2: Fish Habitat Conditions Field Inventory Data

WAU	STREAM NAME	SURVEY UNIT #	CREW	DATE	PAGE
Nagel	Segelson	Seg #251	GP, PR, PS	11/2	1/1

DISTANCE	HAB TYPE	POOLS ONLY MAXDP	RFCDP	RESDP	FORM	%WCVR	SUBSTRATE DOM	SBDOM	SPGRV	LWD TALLY 10-20CM	20-50CM	>50CM	NOTES

(*) See limiting factors analysis form for details *

~~ISP 22-13~~

SUMMARY:

WATER TEMPERATURE	—
STREAM FLOW	M/H
AVERAGE PERCENT SHADE	≈50%
AVERAGE CHANNEL WIDTH	7.6-9.1M
AVERAGE BED SLOPE	≈4% (2-6%)

SUMMARY TOPICS[1]

OFF-CHANNEL REARING	3 side chls approx 46m long each
HOLDING POOLS	None
REDD SCOUR POTENTIAL	Minimal

[1]Provide summary paragraph describing survey reach characteristics and check box when done.

LWD:

FUNCTIONAL LWD

10-20 CM	58
20-50 CM	18
>50 CM	17
TOTAL	93

DISTANCE SURVEYED	223M
NON-FUNCTIONAL LWD	58

Form F-2: Fish Habitat Conditions Field Inventory Data

WAU	STREAM NAME	SURVEY UNIT #	CREW	DATE	PAGE
Yazel	Sagelson	Seg # 252	GP, PK, PS	11/20	1/1

DISTANCE	HAB TYPE	POOLS ONLY MAXDP	RFCDP	RESDP	FORM	%WGVR	SUBSTRATE DOM	SBDOM	SPGRV	LWD TALLY 10-20CM	20-50CM	>50CM	NOTES
		(*) See notes in field book (*)											

SUMMARY:

WATER TEMPERATURE	—
STREAM FLOW	Mod/High
AVERAGE PERCENT SHADE	<50%
AVERAGE CHANNEL WIDTH	14
AVERAGE BED SLOPE	6%-18%

SUMMARY TOPICS[1]	
OFF-CHANNEL REARING	3-approx 150' long
HOLDING POOLS	<5
REDD SCOUR POTENTIAL	Low

[1]Provide summary paragraph describing survey reach characteristics and check box when done.

LWD:

FUNCTIONAL LWD See chl info

10-20 CM		15%
20-50 CM		30%
>50 CM		55%
TOTAL		

DISTANCE SURVEYED	
NON-FUNCTIONAL LWD	

Lt - Mod to high

LIMTING FACTORS ANALYSIS FIELD FORM Date: 11/2 Stream: [illegible] Observers: [illegible] Weather: [illegible]

Dist (ft)	Unit #	Type	Lgth (ft)	Debris	Wdth (ft)	Max D (ft)	Tail D (ft)	Wcov	Pool Hab Form	Sub Dom	Sub SDom	SpGrvl (ft2)	LWD >20 (cm)	LWD >50 (cm)	
7	1	6	7	1	17	2.2	1.3	1	3a	5	4	—	—	—	
29 ~~[illegible]~~	2	11	—	~~[illegible]~~	22	—	—	—	—	5	4	10%	—	—	20"
29	3	11	—	—	10	—	—	—	—	5	4	5%	—	—	51cm
33 ~~[illegible]~~	4	6	—	LJ 10-20	9	1.4	9	3	3d	5	4	—	5	—	
39	5	9	—	LJ 10-20	30	5	1.3	3	3d	5	4	5%	5	5	36"
50	6	8	20	1	—	4.4	1.3	1	3a	5	4	—	—	1	91
	7														
1.9	1	5	—	1	25	2.4	1.6	—	1	7	8	—	1	—	
6.2	2	12	—	—	25	1.2	—	—	—	7.5	46	—	—	—	
16.4	3	10	—	—	—	1.8	—	—	—	7.5	46	—	—	—	
19.9	4	8	—	—	12	1.8	1.2	—	—	7.5	46	—	—	—	
29.9	5	10	—	1	—	—	—	—	—	7.5	46	—	1	—	
33.4	6	8	—	1	22	1.9	0.6	1	3a	7.5	46	—	—	1	

Type = 1=backwater pool, 2=sidechannel pool, 3=beaver pond <500m2, 4=beaver pond >500m2, 5=straight pool, 6=lateral scour pool, 7=trench pool, 8=plunge pool, 9=dam pool, 10=rapids, 11=riffle, 12=glide.

% wood cover = 1=low (<5%), 2=medium (6-20%), 3=high (>20%)

Pool Habit Forming Factors (PHFF)= 1= channel meander,2= bank or bend, 3= LWD (a=log, b=tree, c=root, d=jam), 4= gravel, 5=boulder, 6=bedrock, 7=beaver dam, 8=mandmade

Substrate = 1=organics, 2=mud, 3=silt, 4=sand, 5=gravel, 6=cobble, 7=boulder

3.4 | 7.63 | 2.3
3 | 2 | 2

LIMTING FACTORS ANALYSIS FIELD FORM Date: Stream: Observers: Weather:

Dist (ft)	Unit #	Type	Lgth (ft)	Debris	Wdth (ft)	Max D (ft)	Tail D (ft)	Wcov	Pool Hab Form	Sub Dom	Sub SDom	SpGrvl (ft2)	LWD >20 (cm)	LWD >50 (cm)	OBS
59.6	7	10	—	—	25	—	—	1	—	7	6	—	—	—	
75.5	8	12	—	—	25	1.4	—	—	—	7	6	—	—	—	
87.2	9	10			25	1.6		B		7	6	—	—	—	91
92	10	9	—	LJ ~15	~~25~~ 14	3.5	—	3	3d	6	5	—	4	5	36"
97.6	11	6	—	LJ ~15	20	4.0	1.3	3	3d,c	6	5	—	~~4~~	~~5~~	24" 61
103.5	12	10	—	—	15	—	—	—	—	7	6	—	—	—	
110.5	13	9/6	—	LJ ~5	12	2.6	1.3	3	3a,d	6	5	58	—	2	24" 61
141.5	14	10	—	—	—	—	—	—	—	7	6	—	—	—	
147.7	15	6	—	2	10	1.6	0.9	2	2,3a	6	5		2	—	51 20r
156	16	9	—		30	3.3	0.5	3	3d	6	5	18	—	3	36" 61
172.5	17	10	—	—	30	—	—	—	—	7	6	—	—	—	

Type = 1=backwater pool, 2=sidechannel pool, 3=beaver pond <500m2, 4=beaver pond >500m2, 5=straight pool, 6=lateral scour pool, 7=trench pool, 8=plunge pool, 9=dam pool, 10=rapids, 11=riffle, 12=glide.

% wood cover = 1=low (<5%), 2=medium (6-20%), 3=high (>20%)

Pool Habit Forming Factors (PHFF)= 1= channel meander,2= bank or bend, 3= LWD (a=log, b=tree, c=root, d=jam), 4= gravel, 5=boulder, 6=bedrock, 7=beaver dam, 8=mandmade

Substrate = 1=organics, 2=mud, 3=silt, 4=sand, 5=gravel, 6=cobble, 7=boulder

Plane bed - 2-48
lower 2 [illegible] - 5-68

Form F-2: Fish Habitat Conditions Field Inventory Data

WAU STREAM NAME SURVEY UNIT # CREW DATE PAGE

DISTANCE	HAB TYPE	POOLS ONLY					SUBSTRATE			LWD TALLY			NOTES
		MAXDP	RFCDP	RESDP	FORM	%WCVR	DOM	SBDOM	SPGRV	10-20CM	20-50CM	>50CM	

SUMMARY:

WATER TEMPERATURE	
STREAM FLOW	
AVERAGE PERCENT SHADE	
AVERAGE CHANNEL WIDTH	
AVERAGE BED SLOPE	

SUMMARY TOPICS[1]	
OFF-CHANNEL REARING	
HOLDING POOLS	
REDD SCOUR POTENTIAL	

[1]Provide summary paragraph describing survey reach characteristics and check box when done.

LWD:

FUNCTIONAL LWD	
10-20 CM	
20-50 CM	
>50 CM	
TOTAL	

DISTANCE SURVEYED	
NON-FUNCTIONAL LWD	

Form F-2: Fish Habitat Conditions Field Inventory Data

WAU | STREAM NAME | SURVEY UNIT # | CREW | DATE | PAGE

DISTANCE	HAB TYPE	POOLS ONLY: MAXDP	RFCDP	RESDP	FORM	%WCVR	SUBSTRATE: DOM	SBDOM	SPGRV	LWD TALLY: 10-20CM	20-50CM	>50CM	NOTES

SUMMARY:

WATER TEMPERATURE	
STREAM FLOW	
AVERAGE PERCENT SHADE	
AVERAGE CHANNEL WIDTH	
AVERAGE BED SLOPE	

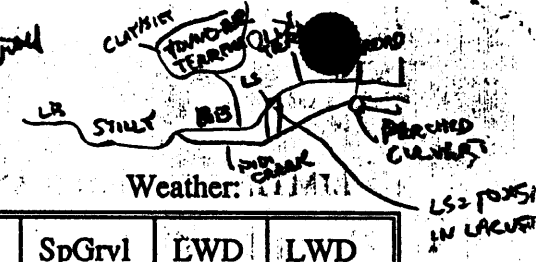
SUMMARY TOPICS[1]	
OFF-CHANNEL REARING	
HOLDING POOLS	
REDD SCOUR POTENTIAL	

[1]Provide summary paragraph describing survey reach characteristics and check box when done.

LWD:

FUNCTIONAL LWD	
10-20 CM	
20-50 CM	
>50 CM	
TOTAL	

DISTANCE SURVEYED	
NON-FUNCTIONAL LWD	



LIMTING FACTORS ANALYSIS FIELD FORM Date: 11/4 Stream: Didi Creek to Mood Observers: Weather:

Dist ~~(ft)~~ M	Unit #	Type	Lgth (ft)	Debris	Wdth (ft)	Max D (ft)	Tail D (ft)	Wcov	Pool Hab Form	Sub Dom	Sub SDom	SpGrvl (ft2)	LWD >20 (cm)	LWD >50 (cm)	
8.3	11	11		—	8	—	—	—		6	5	—	—	—	
11.1	12	6		1	8	1.0	0.4	1	5	6	5	—	—	—	
13.5	[illegible]	10	—	—	8	—	—	—	—	6	5	—	—	—	
15.6	14	9	—	1	8	0.5	—	1	3a	5	4/3	—	—	—	
20.5	[illegible]	8	—	4	8	1.0	0.5	1	3a	5	4	—	—	—	0.7
19.1	[illegible]	10	—	—	8	—	—	—	—	6	5	—	—	—	
32.9	20	10	—	3	8	—	—	—	—	6	5	—	—	—	
34.8	21	8	—	—	4	1.2	0.5	1	3a(2)	5	4	—	—	—	0.4
40.3	22	11	—	—	4.5	—	—	—	—	6	5	—	—	—	
45.9	23	10	—	—	4.5	—	—	—	—	6	5	—	—	—	
48.4	24	6	—	—	5	1.1	0.7	1	2	6	5	—	—	—	
51.1	25	6	—	—	5	1.5	0.5	1	2	6	5	—	—	—	
52.8	26	10	—	—	5	—	—	—	—	6	5	—	—	—	

Type = 1=backwater pool, 2=sidechannel pool, 3=beaver pond <500m2, 4=beaver pond >500m2, 5=straight pool, 6=lateral scour pool, 7=trench pool, 8=plunge pool, 9=dam pool, 10=rapids, 11=riffle, 12=glide.

% wood cover = 1=low (<5%), 2=medium (6-20%), 3=high (>20%)

Pool Habit Forming Factors (PHFF)= 1= channel meander,2= bank or bend, 3= LWD (a=log, b=tree, c=root, d=jam), 4= gravel, 5=boulder, 6=bedrock, 7=beaver dam, 8=mandmade

Substrate = 1=organics, 2=mud, 3=silt, 4=sand, 5=gravel, 6=cobble, 7=boulder

55.2 | 18 | 8   6 | 24 | 12 | 1 | 8 | 6 | 5 | — — — —

Grad - 28 lower

LIMTING FACTORS ANALYSIS FIELD FORM Date: 11/4 Stream: Rich Gulch (Whitney Branch) – lower portion between confluence + bladderwort Observers: CP, PK, AH PS Weather: sunny

Dist (ft) (M)	Unit #	Type	Lgth (ft) m	Debris	Wdth (ft)	Max D (ft)	Tail D (ft)	Wcov	Pool Hab Form	Sub Dom	Sub SDom	SpGrvl (ft2)	LWD >20 (cm)	LWD >50 (cm)
8.1	1	11			5.5	—	—	—	—	4	5	—	—	—
12.3	2	6			5.5	0.8	0.4	1	2	4	5	—	—	—
19.5	3	12			6	0.6		—	—	4	5	—	—	—
19.2	4	8		1	6	0.6	0.3	1	3a	4	5	—	—	—
28.1	5	11	—	—	8	—	—	—	—	5	4	—	—	—
32.7	6	12			8	0.6	—	—	—	4	5	—	—	—
35.7	7	8		2	7	1.3	0.7	+	3a	4	5	—	—	—
45.9	8	12			5	0.7	—	—	—	4	5	—	—	—
52.3	9	11	—	—	6	—	—	—	—	4	5	—	—	—
—	10	—	—	—	—	To bladderwort	—	—	—	—	—	—	—	—
—	[redacted]													
—	[redacted]													
—	[redacted]													

0.5'

Type = 1=backwater pool, 2=sidechannel pool, 3=beaver pond <500m2, 4=beaver pond >500m2, 5=straight pool, 6=lateral scour pool, 7=trench pool, 8=plunge pool, 9=dam pool, 10=rapids, 11=riffle, 12=glide.

% wood cover = 1=low (<5%), 2=medium (6-20%), 3=high (>20%)

Pool Habit Forming Factors (PHFF)= 1= channel meander, 2= bank or bend, 3= LWD (a=log, b=tree, c=root, d=jam), 4= gravel, 5=boulder, 6=bedrock, 7=beaver dam, 8=mandmade

Substrate = 1=organics, 2=mud, 3=silt, 4=sand, 5=gravel, 6=cobble, 7=boulder

H - Water Supply/Public Works Module

H.1. PURPOSE, METHOD AND DEFINITIONS

The purpose of this module is to identify water supply sources and public works existing within the WAU. Vulnerability of these facilities to changes in geomorphic inputs is then assessed. Methods used in the module follow Version 2.1 of the Watershed Analysis Manual. Information was obtained from:

1. Personal interviews (see Forms H-1, H-3);
2. Identifying recorded water rights holders through Department of Ecology;
3. Checks with the PUD (No. 1 of Snohomish County) and Department of Health to verify presence of water systems;
4. Snohomish County Department of Planning and Development Services 100 year flood hazard maps;
5. 1991 black and white aerial photos (1:12000), USGS Quadrangle maps (1:24000);
6. Field inspection;
7. Discussion with other module leaders to assess delivery of hazards.

H.2. WATER SUPPLY

Contacts with personnel representing PUD No.1 of Snohomish County (a water purveyor), Washington Departments of Health, Fish and Wildlife, the Tulalip Tribes of Washington, and Stillaguamish Tribe of Indians provided a list of potential water diversion facilities. Aerial photos and USGS Quadrangle maps were examined for the presence of those or other facilities. Roadside and walk-in examinations were then conducted to verify the existence of facilities.

No public-owned diversion facilities exist in the WAU. Two private domestic diversion facilities were verified. The Watershed Analysis Board Manual Version 2.1 is silent on whether to consider these, but current training specifies that they are not to be considered. Nonetheless, locations of these facilities were noted on Map H-1.

Confidence is high that no public diversion facilities exist in the WAU, based on personal knowledge and information provided by the agencies contacted.

H.3. PUBLIC WORKS

Aerial photos, field examination, and phone interviews were used to collect information on public works in the WAU. Personnel representing Washington Department of Transportation, and Natural Resources, Snohomish County Public Works, and Parks and Recreation, and Burlington Northern Railroad were interviewed.

Public works in the WAU consist of road and a rail bridge (the railroad grade has become a county parkway). Bridge approaches constructed of fill in the 100 year flood plain were considered to be part of the facilities. Also included were segments of a state highway (SR 530), the park rail grade, and their bridges lying immediately adjacent the river's south edge or in its 100 year flood plain.

Bridges are the primary type of public work present in the WAU. Six county road bridges, one state highway bridge, and two railroad grade bridges cross the North Fork and several of its tributaries (see Map H-2). Also, Natural Resources has a bridge crossing of the North Fork which is noted on the map although it may not meet the strict definition of public work.

All the bridges are expected to survive 100 year floods. The county crossings of Segelson and Swede Creeks need regular maintenance in the form of bailing gravel out of the channel. A culvert on the county Whitman Road is also noted on Map H-2. Stream down-cutting associated with this crossing has created a blockage to upstream coho, steelhead, and sea-run cutthroat passage.

Information from Burlington Northern, past owner of the rail grade, indicated that the grade fills are susceptible to peak flow damage. Most of the segments of rail grade (parkway) and SR 530 identified as vulnerable by this analysis actually lie outside the WAU, but adjacent the North Fork channel or within its flood plain. Since the analysis included consideration of the North Fork along the south boundary of the WAU, it was appropriate to include public works on both sides of the river and within its entire flood plain.

Confidence is high that all public works were identified and that their vulnerabilities were correctly assessed.

H.4. FORMS

Following pages include Form H-1, Water Supply Assessment Interview, and Form H-3, Public Works Assessment Interview, used to document the information gained by interviews.

H.5. APPENDICES

Appendix 1 includes DOE recorded water right information obtained from files at their office in Bellevue, and my field notes from checking for the facilities. Appendix 2 includes DOH records of surface water sources in the Northwest Region.

Form H-1: Water supply assessment Interview

Person Interviewed Barbara Smith Representing Snohomish Co. Public Utility Dist No 1

Address 2320 California Date Interviewed 11/8

Phone # 1-800-562-9142

Specific experience in watershed being analyzed? (Y/N) No

If yes, detail.

Are water supply diversions present? No

Where are the diversions located?

What is diverted water used for?

Is diversion sensitive to fine sediment inputs?

Is diversion sensitive to coarse sediment inputs?

Is diversion sensitive to temperature increases?

Is diversion sensitive to changes in flow?

Is diversion sensitive to nutrient inputs?

Are any fish hatcheries located in the watershed?

Are there any diversions of water from this watershed in areas downstream of the WAU?

Form H-1: Water supply assessment interview

Person Interviewed Mike Chamblin Representing WA Dept of Fish & Wildlife

Address _____ Date Interviewed 11/8/94

Phone # (206) 339-1718

Specific experience in watershed being analyzed? (Y/N) Yes

If yes, detail. Habitat biologist

Are water supply diversions present? No

Where are the diversions located?

What is diverted water used for?

Is diversion sensitive to fine sediment inputs?

Is diversion sensitive to coarse sediment inputs?

Is diversion sensitive to temperature increases?

Is diversion sensitive to changes in flow?

Is diversion sensitive to nutrient inputs?

Are any fish hatcheries located in the watershed?

Are there any diversions of water from this watershed in areas downstream of the WAU?

Form H-1: Water supply assessment interview

Person Interviewed David Brock Representing The Stillaguamish Tribe of Indians

Address 3439 Stoluckquamish Lane Arlington WA 98223 Date Interviewed 10/31/94

Phone # (206) 435-2755

Specific experience in watershed being analyzed? (Y/N) Yes

If yes, detail. Tribal biologist working with Forest Practices analysis.

Are water supply diversions present? No

Where are the diversions located?

What is diverted water used for?

Is diversion sensitive to fine sediment inputs?

Is diversion sensitive to coarse sediment inputs?

Is diversion sensitive to temperature increases?

Is diversion sensitive to changes in flow?

Is diversion sensitive to nutrient inputs?

Are any fish hatcheries located in the watershed?

Are there any diversions of water from this watershed in areas downstream of the WAU?

Form H-1: Water supply assessment interview

Person Interviewed Jennifer Prodzinski Representing WA Dept of Health

Address _____ Date Interviewed 11/4/94

Phone #(206) 464-7670

Specific experience in watershed being analyzed? (Y/N) No

If yes, detail.

Are water supply diversions present? No, sent listing of surface sources.

Where are the diversions located?

What is diverted water used for?

Is diversion sensitive to fine sediment inputs?

Is diversion sensitive to coarse sediment inputs?

Is diversion sensitive to temperature increases?

Is diversion sensitive to changes in flow?

Is diversion sensitive to nutrient inputs?

Are any fish hatcheries located in the watershed?

Are there any diversions of water from this watershed in areas downstream of the WAU?

Form H-3: Public works assessment interview

Person Interviewed Mike Parman Representing Snohomish County Parks & Recreation

Address 2828 Rockefeller, Everett Date Interviewed Nov 3, 1994

All interviews conducted between Nov 2 & Nov 11.

Phone # 339-1208

Specific experience in watershed being analyzed? (Y/N)

If yes, detail Parks planner

What public works is interviewee familiar with? Railroad grade and bridges which Parks & Recreation has recently acquired.

Where are the public works located? Crossing North Fork near Brooks Creek and elsewhere adjacent river's south shore or within its 100 year flood plain.

Are the public works being used/maintained?

Are they sensitive to changes in peak flows?

Are they sensitive to mass wasting?

Are they sensitive to coarse sediment inputs?

Are unstable soils or hazard trees located along power lines or structures?

Form H-3: Public works assessment interview

Person Interviewed Tom Rowley Representing Burlington Northern

Address _____ Date Interviewed between Nov 3, 1994 & Nov 11

Phone # 259-9646

Specific experience in watershed being analyzed? (Y/N)

If yes, detail Roadmaster for rail line when Burlington Northern owned it.

What public works is interviewee familiar with? Rail grade & bridges now owned by County Parks and Recreation.

Where are the public works located?

Are the public works being used/maintained?

Are they sensitive to changes in peak flows? Yes, the grade fills are susceptible to peak flows.

Are they sensitive to mass wasting? Possibly, immediately downstream of the Hazel slide, should there be a major slide movement that blocks the river or provides sudden massive sediment input.

Are they sensitive to coarse sediment inputs?

Note: This was discussed during team synthesis, not part of Rowley interview 2/2/95 TT

Are unstable soils or hazard trees located along power lines or structures?

Form H-3: Public works assessment interview

Person Interviewed Brian Davis Representing Dept of Natural Resources

Address 919 N Township, Sedro Woolley Date Interviewed between Nov 3rd, 1994

Phone # (360) 856-3500

Specific experience in watershed being analyzed? (Y/N)

If yes, detail Forest road design, construction, maintenance.

What public works is interviewee familiar with? Seapost bridge.

Where are the public works located?

Are the public works being used/maintained? Yes

Are they sensitive to changes in peak flows? Yes, but designed to withstand 100 year flood.

Are they sensitive to mass wasting?

Are they sensitive to coarse sediment inputs?

Are unstable soils or hazard trees located along power lines or structures?

Form H-3: Public works assessment interview

Person Interviewed Darrell Ash Representing Snohomish Co. Public Works

Address 2930 Wetmore, Everett Date Interviewed 11/4/94

Phone # 206 388-6200

Specific experience in watershed being analyzed? (Y/N) Yes

If yes, detail County bridge engineer

What public works is interviewee familiar with? Road bridges

Where are the public works located? Brooks, Whitman & Swede Haven roads
See map H-2.

Are the public works being used/maintained? Yes

Are they sensitive to changes in peak flows? Yes

Are they sensitive to mass wasting? Yes

Are they sensitive to coarse sediment inputs? Yes, in particular, the crossings of Swede & Segelson Creeks.

Are unstable soils or hazard trees located along power lines or structures?

Appendix L - Water Right Info from DOE.

CONTROL # / #OF PTS	SEC # / P	OLD APPL / LOC. OF POD/POW	OLD PERM / (CHG C#)	OLD CERT / PURPOSE OF USE	DATE OF PRIORITY / USE TYPE	S C A T C M / INST QI	CNTY / M	PERMIT DATE / C R S M U U	NAME / ANNUAL QA	C R S M U U	SOURCE OF APPROPRIATION / IRR AC	C S M U	TRIBUTARY OF / PRO-VISOS	TIME OF USE	R R R I A C
WATER RESOURCE INVENTORY AREA- 05															
TOWNSHIP - 32 RANGE - 06 E															
1	NW4NW4SW4			DOMESTIC MULTIPLE		C	75.0 G		30.6				THNR		
G1*03320A	33	03320			08/03/953	R	SNOH	/ /	THORSEN JACK A		WELL				
1	SW4NW4			IRRIGATION		C	450.0 G				80.0			IS	
G1*05343C	33	05343	05026	03766	07/23/959		SNOH	11/13/959	DARST L C		WELL				
1	SW4NW4			IRRIGATION		C	400.0 G		80.0		40.0		A	IS	
G1*06778P	33	06778	06363		06/26/963	C	SNOH	10/11/963	WALLITNER LOUISE		WELL				
1	NW4SE4			DOMESTIC SINGLE		C	90.0 G 2		45.6 2						
				IRRIGATION		C	90.0 G 2		45.6 2		20.0			IS	
G1*11096C	33	11096	10270	07292	07/27/970		SNOH	04/19/971	ROWEN D C		WELL				
1	SW4 NW4 SE4			DOMESTIC SINGLE		C	30.0 G 2		1.0				NR		
				STOCK WATERING		C	30.0 G 2		2.0				NR		
G1-24350A	33				07/11/983	R	SNOH	/ /	HENDRICKSON GRACE		WELL				
1	EBBY MTN ESTATES			DOMESTIC SINGLE		C	5.0 G 2								
				IRRIGATION		C	5.0 G 2				1.0			IS	
G1-23887G	34				07/20/981		SNOH	05/14/982	NOLTE JOHN E		WELL				
1	S2SW4			DOMESTIC SINGLE		C	50.0 G 2		1.0						
				IRRIGATION		C	50.0 G 2		5.0		5.0			IS	
S1*12305PABB	34	12305A	09294A		04/28/953	C	SNOH	12/01/953	WALLITNER LOUISE		JIM CR			STILLAGUAM S FK	
1	W2SW4SW4			IRRIGATION		C	.55 C				55.0		MSD	04151001 2 0 2	
S1*16366C	34	16366	12146	08568	10/03/969		SNOH	12/22/969	COOPER W L		UNN STR			JIM CR	
1	NE4 NE4 SE4			DOMESTIC GENERAL		C	.01 C 2						SD		
				STOCK WATERING		C	.01 C 2						SD		
				IRRIGATION		C	.06 C		12.0		6.0		SD	IS	
S1*22841CAW	34	22841A	16655A	11770A	01/29/971		SNOH	09/28/971	NELSON JAMES C		UNN SPR			JIM CR	
1	SW4NE4			DOMESTIC SINGLE		C	.01 C		1.0				M		2 2 0
S1*22841CBW	34	22841B	16655B	11770B	01/29/971		SNOH	09/28/971	NELSON JAMES C		UNN STR			JIM CR	
1	SW4NE4			DOMESTIC SINGLE		C	.01 C		1.0				M		2 2 0
S1-22031C	36				08/02/974		SNOH	01/30/976	YOUNG WILMA R		JIM CR			STILLAGU R S FK	
1	NW4SW4			DOMESTIC SINGLE		C	.02 C		1.0				SD		
TOWNSHIP - 32 RANGE - 07 E															
S1*13015P	07	13015	09759		07/12/954	C	SNOH	12/10/954	SMITH LYLE		UNN SL			STILLAGUAM N FK	
1	GL-5 (SE4SE4)			IRRIGATION		C	.45 C				45.0			04151001	
S1*14199C	07	14199	10613	07803	01/18/957		SNOH	05/09/957	LEDBETTER S V		UNN SPR			STILLAGU R S FK	
1	SE4 NE4			DOMESTIC SINGLE		C	.01 C								
				FISH PROPAGATION		N	.49 C								
S1*18014P	07	18014	13272		07/02/963	C	SNOH	12/10/963	JOHNSON D H		UNN STR			STILLAGUAM N FK	
1	E2 SE4 NWE			FISH PROPAGATION		N	1.0 C						S		
S1-00381C	08	23129	16825		06/02/971		SNOH	01/25/972	ARLINGTON SCH DIS		DEER CR			STILLAGU R S FK	
1	SW4SE4			FIRE PROTECTION		C	.17 C						SM		
S1-20673C	08				05/31/973		SNOH	05/15/974	PEDERSON J M & L M		DEER CR			STILLAGU R S FK	
1	SW4SE4			IRRIGATION		C	.01 C		.3		.14			IS	
S1-21998C	08				07/03/974		SNOH	01/15/976	PEDERSON G LESTER		DEER CR			STILLAGU R S FK	
1	SW4SE4			IRRIGATION		C	.02 C		.5		.5		SD	IS	
G1-26277A	09				08/01/991		SNOH	/ /	MYTY SCENIC TOO		WELL				
1	SW4			DOMESTIC MULTIPLE		C	100.0 G								
S1*10980C	09	10980	08061	06190	01/15/952		SNOH	05/26/952	GEORGE D C		STILLAGUAMISH R N FK			STILLAGUAMISH R	
99	GL7 / 11			IRRIGATION		C	.45 C				45.0		S	IS	
S1*14825CAW	09	14825A	12024A	07684A	05/26/958		SNOH	10/17/958	SUNDBERG H		STILLAGUAMISH R N FK			STILLAGUAMISH R	
1	GL-10			IRRIGATION		C	.56 C		120.0		60.0		SMD	04151001 3 3 3	
S1*14825CBW	09	14825B	12024B	07684B	05/26/958		SNOH	10/17/958	SUNDBERG H		JOHNSON CR *			STILLAGU R N FK	
1	GL-9			IRRIGATION		C	.56 C		120.0		60.0		SMD	04151001 3 3 3	
S1*14825CCW	09	14825C	12024C	07684C	05/26/958		SNOH	10/17/958	SUNDBERG H		JOHNSON CR *			STILLAGU R N FK	
1	GL-9			IRRIGATION		C	.56 C		120.0		60.0		SMD	04151001 3 3 3	
S1*15639C	10	15639	11566	08655	08/21/959		SNOH	11/03/959	JENNER L C		STILLAGUAMISH R N FK			STILLAGUAMISH R	
1	GL8			IRRIGATION		C	.19 C		40.0		20.0		SD	IS	

CONTROL # / #OF PTS	SEC / P	OLD APPL / LOC. OF POD/POW	OLD PERM / (CHG C#)	OLD CERT / PURPOSE OF USE	DATE OF PRIORITY	S T	C M	A	CNTY / USE TYPE	PERMIT DATE / INST QI	NAME	C M	R U	S U	ANNUAL QA	C M	R U	S U	SOURCE OF APPROPRIATION / IRR AC	C M	S U	PRO-VISOS	TRIBUTARY OF / TIME OF USE	R I	R A	R C
WATER RESOURCE INVENTORY AREA- 05																										
TOWNSHIP - 32 RANGE - 07 E																										
S1*19451C 3 GL5 / 6	10	19451	14473	10048 IRRIGATION	02/09/966				SNOH C	10/31/966 .95 C	LOVEJOY R L				190.0				STILLAGUAMISH R 95.0	N	FK SD	STILLAGUAMISH R IS			
G1-20850P 1 L 14 PL STILL M REC IN G L 2	11				08/21/973	C			SNOH C	03/15/976 39.0 G	HINES HENRY W				9.9				WELL			R				
S1-22294P 1 GL-14	12			06/30/974 DOMESTIC SINGLE		C			SNOH C	04/30/976 .02 C	GULLIKSON LARRY J				1.0				UNN STR			S	STILLAGUAMISH R			
S1-22805P 1 NW4SW4	12			02/24/977 DOMESTIC SINGLE		C			SNOH C	07/31/981 .02 C	MCPHERSON GARY				1.0				UNN STR			S	STILLAGUAM N FK			
G1*05042C 1 W2 SW4 NE4	17	05042	04687	03475 IRRIGATION	10/20/958				SNOH C	01/05/959 60.0 G	WIKSTROM C B				48.0				WELL 30.0			AE	IS			
S1*13554C 1 NW4 SW4	17	13554	10179	06620 DOMESTIC SINGLE IRRIGATION	08/12/955				SNOH C C	02/24/956 .01 C .02 C	LOTHIAN L E				4.0				UNN STR 2.0			SLD SLD	STILLAGU R N FK IS			
S1-00459C 1 NE4 SE4	17	17225	12767	04/09/962 DOMESTIC SINGLE IRRIGATION					SNOH C C	08/22/962 .01 C .12 C	OLSEN ROLF G				1.0 24.0				UNN STR 25.0			SFM SFM	STILLAGU R N FK 04151001			
S1*13377C 1 NW4NE4	18	13377	10014	07248 IRRIGATION	04/08/955				SNOH C	08/03/955 .4 C	CHRISTENSEN W H				80.0				UNN STR 40.0			SD	STILLAGU R N FK IS			
G1-24057C 2 NE4SE4NE4	19			03/30/982 DOMESTIC MULTIPLE					SNOH C	01/14/983 58.0 G 2	NORMANNA PK INC				12.9				WELLS							
G1-23294C 1 NE4SE4	30			01/18/979 DOMESTIC SINGLE					SNOH C	01/15/982 7.0 G	PARTICK DAVID M				.5				WELL							
G1-26519A 1 E4SW4	30			04/06/992 DOMESTIC MULTIPLE					SNOH C	/ / 80.0 G	SK ENTERPRISES								WELL							
S1-22199A 1 NE4SE4	30			06/28/974 FISH PROPAGATION		R			SNOH N	/ / 5.0 C	REED CH & LILLY								UNN STR				JIM CR			
S1-22499C 1 NE4SE4	30			05/15/975 IRRIGATION					SNOH C	12/15/976 .04 C	CHELLIS ALLEN G				2.5				LAKE RILEY CR M 2.0			SD	JIM CR IS			
S1-22898C 1 NE4SE4	30			06/17/977 IRRIGATION					SNOH C	07/14/978 .04 C	PATRICK DAVID M				4.0				LAKE RILEY CR M 2.0			SD	JIM CR IS			
TOWNSHIP - 32 RANGE - 08 E																										
S1*06642AAL 1 SW4SE4	01	06642A		09/01/945 IRRIGATION		R			SNOH C	/ / .2 C	SKAGLUND DANIEL								SIEGELSON CR M 20.0				STILLAGUAM N FK IS	2	0	2
S1*07755C 1 SW4 SE4	01	07755	05124	03640 DOMESTIC SINGLE IRRIGATION	04/14/947				SNOH C C	07/02/947 .02 C 2 .02 C 2	CLOER JOHN W								SEGELSEN CR 1.0		S S		STILLAGU R N FK IS			
S1*18456C 2 SW4NW4, NW4SW4	01	18456	13471	09790 DOMESTIC SINGLE	04/21/964				SNOH C	07/17/964 .01 C	ROBINSON W / D C								UNN STR			SDU	STILLAGU R N FK			
S1-22801G 1 SE4NW4	01			02/28/977 STOCK WATERING IRRIGATION					SNOH C C	06/30/978 .056 C 2 .056 C 2	TUCKER DAVID L				1.0 8.0				UNN SPR 8.0		SU SU		STILLAGU R N FK IS			
S1-25393A 1 NE4SW4	02			01/05/989 DOMESTIC SINGLE		R			SNOH C	/ / .02 C	ROBERT A RISVOLD								UNN STREAM				STILLAGUAMISH R			
S1*05295C 1 GL4	07	05295	03659	02558 DOMESTIC SINGLE	10/30/940				SNOH C	04/26/943 .02 C	WARE M H								UNN STR				STILLAGU R N FK			
S1*05296P 1 L-3	07	05296	03660	10/30/940 IRRIGATION		C			SNOH C	04/26/943 .67 C	WARE MELVIN H								UNN STR 40.0			M	STILLAGUAM N FK 04151001			
S1*12161C 1 GL9	07	12161	09038	05335 DOMESTIC SINGLE REC & BEAUTIFICATION FIRE PROTECTION POWER	03/16/953				SNOH C N C N	07/10/953 .3 C .3 C .3 C .3 C	SEATTLE DEPT LIGHT								UNN SPRS				STILLAGU R N FK			

CONTROL # / SEC / OLD APPL / OLD PERM / OLD CERT / DATE OF PRIORITY / S T C A M / CNTY / PERMIT DATE / NAME / SOURCE OF APPROPRIATION / TRIBUTARY OF	# OF PTS	R P	LOC. OF POD/POW	(CHG C#)	PURPOSE OF USE	USE TYPE	INST QI	C M	R U	S U	ANNUAL QA	C M	R U	S U	IRR AC	C M	S U	PRO-VISOS	TIME OF USE	R I	R A	R C
WATER RESOURCE INVENTORY AREA- 05																						
TOWNSHIP - 32 RANGE - 08 E																						
					IRRIGATION	C	.3	C							5.0				IS			
S1*12818A 07 12818					03/18/954 R	SNOH	/ /		SPARKS H A		UNN SPR											
1 NE4SE4					DOMESTIC SINGLE	C	.02	C														
S1-22531P 07					06/20/975 C	SNOH	04/30/976		CHARLEY CLAUDE C		UNN STR								STILLAGU R N FK			
1 GL 3					FISH PROPAGATION	N	.1	C 2										SD				
					REC & BEAUTIFICATION	N	.1	C 2										SD				
S1-22961C 07					09/15/977	SNOH	07/14/978		CAESAR DANNY L		UNN STR								STILLAGU R N FK			
1 SE4NW4					DOMESTIC SINGLE	C	.02	C		1.0								S				
G1-22991C 10					10/26/977	SNOH	07/14/978		STILLAGU COUNTRY C		WELL											
1 E2 NE4					DOMESTIC MULTIPLE	C	75.0	G		17.0								E				
S1*14338C 10 14338			10731	07124	05/24/957	SNOH	08/16/957		KRAUSE/BAHR		UNN SPR								FRENCH CR			
1 NW4SE4					DOMESTIC MULTIPLE	C	.02	C														
S1*14327C 11 14327			10723	06923	05/13/957	SNOH	08/08/957		SMITH A		UNN SPR								STILLAGU R N FK			
1 GL1					DOMESTIC MULTIPLE	C	.02	C														
G1-21684A 12					05/21/974 R	SNOH	/ /		PENSEL WOLFGANG K		WELL											
1 GL-7					DOMESTIC SINGLE	C	10.0	G														
G1-24458C 12					03/01/984	SNOH	03/15/985		BOUND MARY JEAN		WELL											
1 SE4SE4					DOMESTIC SINGLE	C	40.0	G		1.0												
G1-24469G 12					03/13/984	SNOH	02/15/985		JONES SAMMIE B		WELL											
1 NE4SW4					DOMESTIC SINGLE	C	17.0	G 2		1.0												
					IRRIGATION	C	17.0	G 2		10.0					5.0				IS			
S1*06642ABL 12 06642B					09/01/945 R	SNOH	/ /		SKAGLUND DANIEL		SIEGELSON CR *								STILLAGUAM N FK			
1 SW4SE4					IRRIGATION	C	.2	C							20.0				IS	2	0	2
S1*08825C 12 08825			06227	04216	06/06/949 E T	SNOH	02/17/950		WA ST DEPT OF GAME		WHITE HORSE MTN SPR *								STILLAGU R N FK			
1 NE4SW4					DOMESTIC MULTIPLE	C	5.0	C 2														
					FISH PROPAGATION	N	5.0	C 2														
S1*12102CAW 12 12102A			09090A	06606A	02/26/953	SNOH	08/07/953		MARTY A SR		SEGELSEN CR								STILLAGU R N FK			
1 NE4					IRRIGATION	C	1.0	C		200.0					100.0		SMD		04151001	2	2	2
S1*12102CBW 12 12102B			09090B	06606B	02/26/953	SNOH	08/07/953		MARTY A SR		STILLAGUAMISH R N FK								STILLAGUAMISH R			
1 NE4					IRRIGATION	C	1.0	C		200.0					100.0		SMD		04151001	2	2	2
S1*17399A 12 17399					07/19/962 R	SNOH	/ /		CAMPBELL LOUISE A		WHITEHORSE SPR								N FK STILL			
1 NW4SE4					IRRIGATION	C	.75	C							80.0				IS			
S1*20549P 12 20549			15069		09/21/967 C	SNOH	02/02/968		CREASAP W W		UNN SPR								STILLAGUAM N FK			
1 L11 WHITE HORSE MAPLE TRS					DOMESTIC SINGLE	C	.01	C		.5								S				
G1-21542B 13					04/25/974	SNOH	07/31/981		PITTSON CHARLES A		INFILTRATION POND											
1 W2NE4					STOCK WATERING	C	203.0	G 2		1.0		S										
					IRRIGATION	C	203.0	G 2		66.7		S			60.0				IS			
S1*07075C 13 07075			04692	02649	04/26/946	SNOH	10/29/946		SHARPLESS I A		UNN STR											
1 S2 NW4					DOMESTIC SINGLE	C	.05	C 2														
					IRRIGATION	C	.05	C 2							25.0				IS			
S1*07668P 13 07668			05046		03/07/947 C	SNOH	05/28/947		SHATTUCK BESS P		UNN STR								STILLAGUAM N FK			
1 SW4NW4					DOMESTIC SINGLE	C	.01	C										M				
					IRRIGATION	C	.16	C							17.0			M	04151001			
S1*10063C 13 10063			07183	04056	01/12/951	SNOH	04/17/951		WHITE HORSE WTR US		MOOSE CR								STILLAGU R N FK			
1 NE4SE4					DOMESTIC MULTIPLE	C	.1	C														
S1*15142C 13 15142			11200	07928	10/17/958	SNOH	01/30/959		DENMAN C J		UNN SPR											
1 W2 SE4 NE4					DOMESTIC SINGLE	C	.01	C U														
S1-00699B 13 23394					09/17/971	SNOH	07/31/981		PITTSON CHARLES A		UNN STR								STILLAGUAMISH R			
1 W2NE4					STOCK WATERING	C	.1	C 2		1.0		S						S				
					IRRIGATION	C	.1	C 2		66.7		S			50.0			S	IS			
S1-21464C 13					04/10/974	SNOH	06/30/975		TUCKER HARRY V ET		UNN SPR											
1 N2NE4SE4					DOMESTIC MULTIPLE	C	.02	C		2.0								S				
S1*04089C 04089			02265	00934	03/20/935	SNOH	05/09/936		SCALZIO A		SCALZIO CR *								STILLAGU R N FK			

CONTROL #	SEC	OLD APPL	OLD PERM	OLD CERT	DATE OF PRIORITY	S T	C M	A	CNTY	PERMIT DATE	NAME	SOURCE OF APPROPRIATION	TRIBUTARY OF
#OF PTS P	LOC. OF POD/POW	(CHG C#)	PURPOSE OF USE						USE TYPE	INST QI	C M R U S U	ANNUAL QA	C M R U S U	IRR AC	C M R U S PROVISOS	TIME OF USE	R I R A R C
WATER RESOURCE INVENTORY AREA- 05																	
TOWNSHIP - 32 RANGE - 08 E																	
1	NE4NE4			DOMESTIC SINGLE					C	.01 C							
S1*05468C	14	05468	03363	01718	05/21/941				SNOH	08/16/941	SCALZIO A	SCALZIO CR *				STILLAGU R N FK	
1	NE4 NE4			DOMESTIC SINGLE					C	.01 C							
S1*03076A	17	03076			08/08/930	R			SNOH	/ /	MATSON O S ET AL	BOULDER R				STILLAGUAM N FK	
1	SE4NE4			DOMESTIC SINGLE					C	125.0 C 3							
				COMMERCIAL/INDUSTRIAL					C	125.0 C 3							
				IRRIGATION					C	125.0 C 3		25000.0				IS	
S1*13152A	19	13152			10/06/954	R			SNOH	/ /	SNOHOMISH CO PUD #	BOULDER R				STILLAGUAM N FK	
1	NW4SE4NE4SW4			DOMESTIC MULTIPLE					C	80.0 C							
S1-24587A	19				12/24/984	R			SNOH	/ /	BOULDER R POWER CO	BOULDER R				STILLIGU R N FK	
1	NE4SW4			POWER					N	155.0 C							
G1-24538C	20				08/15/984				SNOH	05/15/985	CASCADE CAMP CHER	WELL					
1	NW4NE4			DOMESTIC MULTIPLE					C	35.0 G	5.6						
TOWNSHIP - 32 RANGE - 09 E																	
S1*04523P	05	04523	02588		04/28/938	C			SNOH	09/27/938	FULLER ROMIG C	UNN STR				STILLAGUAMISH R	
1	GL-1			DOMESTIC SINGLE					C	.05 C 2							
				IRRIGATION					C	.05 C 2				20.0		04011101	
S1-26651A	05				05/29/992				SNOH	/ /	LOVE TERRANCE G	UNN STR					
1	SE4			DOMESTIC SINGLE					C	.02 C							
G1-00575C	09	11741	10723		03/31/971				SNOH	03/24/972	DARRINGTON HORSEOW	WELL					
1	E2NW4SW4			DOMESTIC MULTIPLE					C	10.0 G	3.0						
S1-21604C	09				05/07/974				SNOH	08/29/975	REED WALDO M	STILLAGUAMISH R N FK				STILLAGUAMISH R	
2	N4 SE4			DOMESTIC SINGLE					C	.01 C 2	1.0				S		
				FIRE PROTECTION					C	.01 C 2					S		
				IRRIGATION					C	.12 C	16.0			8.0	S	04151001	
S1*06313P	17	06313	04082		02/13/945	C			SNOH	05/14/945	ASHE GERALD	ASHTON CR				SQUIRE CR	
1	SW4SW4			DOMESTIC SINGLE					C	.01 C 2					MS		
				IRRIGATION					C	.01 C 2				1.0	MS	04151001	
S1*19755C	17	19755	14465	11317	07/05/966				SNOH	10/28/966	WEST L E	ASHTON CR				SQUIRE CR	
1	NW4 NE4			FISH PROPAGATION					N	.05 C					SD		
				IRRIGATION					C	.2 C	40.0			20.0	SD	07010930	
S1*19933C	17	19933	14726	09991	10/13/966				SNOH	05/26/967	WEST W E	ASHTON CR				SQUIRE CR	
1	NW4NW4NE4			DOMESTIC SINGLE					C	.01 C	1.0				S		
				REC & BEAUTIFICATION					N	.08 C					S		
S1*17894P	21	17894	13202		05/06/963	C			SNOH	10/15/963	CLABOE H M	ASHTON CR				SQUIRE CR	
1	NW4SE4			DOMESTIC SINGLE					C	.01 C					SD		
S1*06670P	27	06670	04436		09/15/945	C			SNOH	04/15/946	PETERSON JOHN W	BROWN CR				SQUIRE CR	
1	NW4NE4			DOMESTIC SINGLE					C	.01 C 2					MS		
				POWER					N	.01 C 2					MS		
				POWER					N	.19 C 2					MS		
				IRRIGATION					C	.19 C 2				20.0	MS	04151001	
S1-22948P	27				08/26/977	C			SNOH	01/31/979	DARRINGTON TOWN OF	SQUIRE CR				STILLAGU R N FK	
1	SW4NW4			DOMESTIC MUNICIPAL					C	.23 C	132.0				SEUM		
S1*04572A	30	04572			07/26/938	R			SNOH	/ /	HOWE E GEORGE	SNOW GULCH CR				STILAGUAMISH R	
1	NE4NE4NE4			DOMESTIC MULTIPLE					C	5.0 C 4							
				MINING					C	5.0 C 4							
				COMMERCIAL/INDUSTRIAL					C	5.0 C 4							
				COMMERCIAL/INDUSTRIAL					C	5.0 C 4							
TOWNSHIP - 33 RANGE - 05 E																	
S1*19431A	27	19431			01/27/966	R			SKAG	/ /	WA ST DEPT FISHERI	PILCHUCK CR				STILLAGUAMISH R	
1	NE4SW4			FISH PROPAGATION					C	5.0 C							
G1-00112P	31	11903			05/20/971	C			SKAG	08/04/972	TATOOSH CO	WELL					
1	SW4NE4			DOMESTIC MUNICIPAL					C	1000.0 G 2	784.0				RM		
				IRRIGATION					C	1000.0 G 2	500.0	S	300.0		RM	05150915	

form_a1……mass wasting inventory
form_a1_2nd……..2nd mass wasting inventory
form_a1_3rd……..3rd mass wasting inventory
form_a1_4th……..4th mass wasting inventory
form_b1……hillslope field/photo information
form_b1_2nd…….2nd hillslope field/photo information
form_b1_3rd…….3rd hillslope field/photo information
form_b1_4th……4th hillslope field/photo information
form_b1_5th……5th hillslope field/photo information
form_b1_6th……6th hillslope field/photo information
form_b2……..roads calculation sheet
form_b2_10th……..10th roads calcultation sheet
form_b2_11th……..11th roads calculation sheet
form_b2_12th……..12th roads calculation sheet
form_b2_13th……..13th roads calculation sheet
form_b2_14th……..14th roads calculation sheet
form_b2_2nd……2nd roads calculation sheet
form_b2_3rd……3rd roads calculation sheet
form_b2_4th……4th roads calculation sheet
form_b2_5th……5th roads calculation sheet
form_b2_6th……6th roads calculation sheet
form_b2_7th……7th roads calculation sheet
form_b2_8th……8th roads calculation sheet
form_b2_9th……9th roads calculation sheet
form_b3_1……..road field form
form_b3_1_10th…….10th road field form
form_b3_1_11th…….11th road field form
form_b3_1_12th…….12th road field form
form_b3_1_13th……..13th road field form
form_b3_1_2nd……2nd road field form
form_b3_1_3rd……3rd road field form
form_b3_1_4th……4th road field form
form_b3_1_5th……5th road field form
form_b3_1_6th……6th road field form
form_b3_1_7th……7th road field form
form_b3_1_8th……8th road field form
form_b3_1_9th……9th road field form
form_b3_2……..road segment sampling notes
form_b3_2_2nd……2nd road segment sampling notes

HAZEL WATERSHED ADMINISTRATIVE UNIT - MASS WASTING INVENTORY (FORM A-1)

SLIDE	SUB-WAU	ID NUMBER	MW MU	PROC/ CERT	SIZE	BARE 1991	DELIV	WTR TYP	PARENT MAT	TEXTURE	GEOMORPHOLOGY	TOPOG	SLOPE (PCT)	ELEV (FT)	LAND USE	COMMENTS
A	BROOKS	3307E-33 R04	5	D/P	VRY LRG	0	I	?	GLAC OUTWASH	FINE	TERRACE FLANK	CONCAVE	30	950	N/A	DORMANT LANDSLIDE, POST GLACIAL, STREAM INCISION
B	BROOKS	3207E-04 A01	5	D/D	VRY LRG	0	I	?	GLAC OUTWASH	FINE	TERRACE FLANK	CONCAVE	40	880	N/A	DORMANT LANDSLIDE, POST GLACIAL, STREAM INCISION
C	BROOKS	3207E-04 G02	5	D/D	VRY LRG	0	I	?	GLAC OUTWASH	FINE	TERRACE FLANK	CONCAVE	20-50	800	N/A	DORMANT LANDSLIDE, POST GLACIAL, STREAM INCISION
D	BROOKS	3207E-04 H01	5	D/D	VRY LRG	0	I	?	GLAC OUTWASH	FINE	TERRACE FLANK	CONCAVE	10-40	880	N/A	DORMANT LANDSLIDE, POST GLACIAL, STREAM INCISION
E	BROOKS	3207E-04 L01	5	D/D	VRY LRG	0	I	?	GLAC OUTWASH	FINE	TERRACE FLANK	CONCAVE	80	600	N/A	DORMANT LANDSLIDE, POST GLACIAL, STREAM INCISION
F	BROOKS	3207E-04 Q05	5	D/D	VRY LRG	0	I	?	GLAC OUTWASH	FINE	TERRACE FLANK	CONCAVE	70	600	N/A	DORMANT LANDSLIDE, POST GLACIAL, STREAM INCISION
G	BROOKS	3207E-04 Q06	5	D/D	VRY LRG	0	I	?	GLAC OUTWASH	FINE	TERRACE FLANK	CONCAVE	70	560	N/A	DORMANT LANDSLIDE, POST GLACIAL, STREAM INCISION
H	BROOKS	3207E-04 R03	5	D/D	VRY LRG	0	I	?	GLACIAL	FINE	TERRACE FLANK	CONCAVE	20-70	840	N/A	DORMANT LANDSLIDE, POST GLACIAL, STREAM INCISION
1	BROOKS	3307E-34 C01(42)	3	SR/D	SMALL	5	Y	3	GLACIAL	FINE & CRS	INNER GORGE	PLANAR	80	1600	CC(0-20)	MULTIPLE, TOP OF ABRUPT CHANNEL STEEPENING, CHNL DESTAB +0.5 MI
2	BROOKS	3307E-33 H01(42)	3	SSD/P	SMALL	0	Y	3	GLACIAL	FINE & CRS	INNER GORGE	CONCAVE	80	1160	CC(0-20)	LOCALIZED CUTTING OF BANK ALONG INCISED CHNL
3	BROOKS	3307E-33 R01(48)	3	SSD/D	MEDIUM	0	Y	3	GLAC OUTWASH	FINE & CRS	INNER GORGE	CONCAVE	100+	840	CC(0-20)	ORIGIN MIDBANK? SPRING? WATERFALL? CHNL CUTTING AT OUTSIDE CURVE?
4	BROOKS	3407E-34 D01(70)	3	SR/D	MEDIUM	0	Y	4	GLACIAL	FINE & CRS	INNER GORGE	CONCAVE	80	1600	CC(0-20)	CHANNEL STEEPENS ABRUPTLY D/S, PERSISTENTLY ERODING HEADWALL
5	BROOKS	3307E-34 C02(83)	3	SR/D	SMALL	0	Y	3	GLACIAL	FINE & CRS	INNER GORGE	PLANAR	80	1600	CC(20-50)	SAME INCISED FLANKS OF GORGE AS LANDSLIDES 1 AND 18
6	BROOKS	3207E-04 J01(70)	4	SSD/D	SMALL	0	Y	3	GLAC OUTWASH	FINE	ANCIENT LANDSLIDE	CONCAVE	50	600	CC(20-50)	AT OUTSIDE CHANNEL BEND, STREAM CUTTING
7	BROOKS	3207E-04 J02(70)	6	SR/P	SMALL	0	Y	3	GLAC OUTWASH	FINE	ANCIENT LANDSLIDE	CONCAVE	60	700	CC(20-50)	LINEAR GAP IN ALDER CANOPY, SHORT STEEP CHANNEL (FROM SPRING?)
8	BROOKS	3207E-04 Q03(70)	6	SR/D	SMALL	0	Y	3	GLAC OUTWASH	FINE	ANCIENT LANDSLIDE	CONCAVE	60	500	CC(0-20)	2 SR MERGE AND TRAVEL 600' AS DT?
9	BROOKS	3207E-04 Q01(76)	5	LPD/D	MEDIUM	0	Y	3	GLAC OUTWASH	FINE	ANCIENT LANDSLIDE	CONVEX?	60	400	CC(20-50)	STRIPE, YOUNG ALDER, CHANNEL CUTTING OR GROUNDWATER?
10	BROOKS	3207E-04 Q04(70)	6	SR/D	SMALL	0	Y	3	GLAC OUTWASH	FINE	ANCIENT LANDSLIDE	CONCAVE	60	450	CC(O-20)	DEBRIS TORRENT?
11	BROOKS	3207E-04 R01(70)	5	SR/P	SMALL	0	Y	4	GLAC OUTWASH	FINE	ANCIENT LANDSLIDE	CONCAVE	60	600	CC(0-20)	GAP IN ALDER CANOPY
12	BROOKS	3207E-04 R02(70)	6	SR/P	SMALL	0	Y	4	GLAC OUTWASH	FINE	ANCIENT LANDSLIDE	CONCAVE	60	600	CC(0-20)	POSSIBLE DEBRIS TORRENT?
13	BROOKS	3307E-21 R01(83)	N/A	SR/D	SMALL	0	N	N/A	BEDROCK	FINE & CRS	ANCIENT LANDSLIDE	CONCAVE	65	3400	CC(0-20)	ACTUALLY TWO TINY SLIDES, ANCIENT BDRK SCARP
14	BROOKS	3307E-22 K02(83)	N/A	SR/D	SMALL	0	N	N/A	BEDROCK	FINE & CRS	GLACIATED BEDROC	CONCAVE	75	3350	CC(0-20)	POSSIBLE GROUNDWATER INCREASE VIA QUARRY PIT?
15	BROOKS	3307E-22 K01(83)	N/A	SR/D	SMALL	0	N	N/A	BEDROCK	FINE & CRS	GLACIATED BEDROC	CONCAVE	75	3350	ROAD OR QUARRY	SPOILS FROM QUARRY AT RIDGE CREST
16	BROOKS	3307E-33 B01(83)	3	SR/D	SMALL	0	Y	4	GLACIAL	FINE & CRS	INNER GORGE	PLANAR	70	1420	PC(20-50)	ENTRENCHED CHANNEL (PAUL), SIMILAR GAPS IN CANOPY D/S TO WATER
17	BROOKS	3307E-33 A01(83)	3	SR/P	SMALL	0	Y	3	GLACIAL	FINE & CRS	INNER GORGE	CONCAVE	40	1300	PC(20-50)	FROM STEEP SIDE CHANNEL
18	BROOKS	3307E-34 C03(83)	3	SR/D	SMALL	10	Y	3	GLACIAL	FINE & CRS	INNER GORGE	PLANAR	80	1600	MATURE FOREST	SEE LANDSLIDES 1 AND 5
19	BROOKS	3307E-33 H02(83)	3	SSD/P	SMALL	0	Y	3	GLACIAL	FINE & CRS	INNER GORGE	CONCAVE	60	1160	CC(20-50)	BANK OPPOSITE LANDSLIDE 2, CUTTING AT BEND?
20	BROOKS	3307E-33 R02(83)	3	SSD/P	SMALL	0	Y	3	GLACIAL	FINE & CRS	INNER GORGE	CONCAVE	70	950	CC(20-50)	STREAM CUTTING TOE AT OUTSIDE BEND
21	BROOKS	3307E-33 R03(83)	3	SSD/P	SMALL	0	Y	3	GLACIAL	FINE & CRS	INNER GORGE	CONCAVE	70	880	CC(20-50)	STREAM CUTTING TOE AT OUTSIDE BEND
22	BROOKS	3207E-04 F01(83)	5	SR/D	SMALL	0	Y	4	GLAC OUTWASH	FINE	TERRACE FLANK	CONCAVE	60	800	CC(0-20)	FROM MID BANK
23	BROOKS	3207E-04 F02(83)	5	SR/D	SMALL	0	Y	4	GLAC OUTWASH	FINE	TERRACE FLANK	PLANAR	60	760	ROAD	PROBABLE SIDECAST FAILURE
24	BROOKS	3207E-04 G01(83)	5	SSD/D	LARGE	0	N	N/A	GLAC OUTWASH	FINE	ANCIENT LANDSLIDE	CONCAVE	50	800	ROAD	OLD CUT AT TOE, MIDSLOPE (CC 0-20)
25	BROOKS	3207E-04 P02(83)	5	SR/D	MEDIUM	0	Y	3	GLACIAL	FINE	ANCIENT LANDSLIDE	CONCAVE	60+	550	PC(0-20)	ANCIENT SLIDE, SCARP PROBABLE ROAD DRAINAGE CONTRIBUTION
26	BROOKS	3207E-04 P01(83)	5	SR/D	SMALL	10	Y	3	GLACIAL	FINE	ANCIENT LANDSLIDE	CONCAVE	60	600	PC(0-20)	ANCIENT SLIDE SCARP AREA
27	BROOKS	3207E-04 K01(83)	5	LPD/D	VRY LRG	0	Y	3	GLAC OUTWASH	FINE	TERRACE FLANK	CONCAVE	60	600	CC(0-20)	OUTSIDE BEND IN CHANNEL, OLD RR GRADE MIDLSOPE
28	BROOKS	3207E-04 K02(83)	5	SSD/D	MEDIUM	0	N	N/A	GLAC OUTWASH	FINE	TERRACE FLANK	PLANAR	70	520	RR GRADE	CUTSLOPE FAILURE, STOPPED ON RR GRADE?
29	BROOKS	3207E-04 Q02(83)	5	SR/D	SMALL	0	Y	3	GLACIAL	FINE	ANCIENT LANDSLIDE	PLANAR	50	400	CC(0-20)	BENCH, DARK SOIL COLOR, GROUNDWATER?
30	BROOKS	3207E-04 P03(83)	5	SR/D	LARGE	0	N	N/A	GLACIAL	FINE	TERRACE FLANK	PLANAR	50	350	CC(0-20)	STARTS LOW, VERY WIDE, GROUNDWATER? POSSIBLE RR GRADE?

HAZEL WATERSHED ADMINISTRATIVE UNIT - MASS WASTING INVENTORY (FORM A-1)

SLIDE	SUB-WAU	ID NUMBER	MW MU	PROC/ CERT	SIZE	BARE 1991	DELIV	WTR TYP	PARENT MAT	TEXTURE	GEOMORPHOLOGY	TOPOG	SLOPE (PCT)	ELEV (FT)	LAND USE	COMMENTS
31	BROOKS	3307E-21 J01(91)	N/A	SR/D	SMALL	100	N	N/A	BEDROCK	FINE & CRS	ANCIENT LANDSLIDE	CONCAVE	50	3500	CC(0-20)	MINOR SLIDE OF MATERIAL IN ANCIENT LANDSLIDE OF BEDROCK
32	BROOKS	3307E-33 K01(91)	N/A	SR/D	LARGE	0	N	N/A	GLACIAL	FINE & CRS	GLACIATED SLOPE	PLANAR	30	1150	ROAD	UNUSUALLY LOW SLOPE ANGLE, DRAINAGE DOWN ROAD?
L	ROLLINS	3207E-01 L01	5	D/D	VRY LRG	0	I	?	GLAC OUTWASH	FINE	TERRACE FLANK	CONCAVE	0-60	880	N/A	DORMANT LANDSLIDE, POST GLACIAL, STREAM INCISION
M	ROLLINS	3207E-01 G01	5	D/P	VRY LRG	0	I	?	GLACIAL	FINE	TERRACE FLANK	CONCAVE	25-50	880	N/A	DORMANT LANDSLIDE, POST GLACIAL, STREAM INCISION
33	ROLLINS	3307E-26 H01(42)	3	SSD/D	MEDIUM	0	Y	4	SLIDE DEBRIS	FINE & CRS	INNER GORGE	CONCAVE	60	2150	MATURE FOREST	STREAM CUTTING AT BEND
34	ROLLINS	3307E-24 M01(76)	8b	SR/D	SMALL	20	N	N/A	BEDROCK	FINE & CRS	ANCIENT LANDSLIDE	CONCAVE	80	3050	CC(0-20)	FROM SCARP, STOPPED ON OLD SLIDE MASS
35	ROLLINS	3307E-23 R01(70)	3	SSD/D	SMALL	0	Y	4	SLIDE DEBRIS?	FINE & CRS	INNER GORGE	CONCAVE	70	2450	MATURE FOREST	STREAM CUTTING AT BEND
36	ROLLINS	3307E-25 D01(70)	6	DT/D	SMALL	0	Y	5	BEDROCK	FINE & CRS	INCISED CHANNEL	CONCAVE	80	2900	STREAM XING	SIDECAST FROM CONSTRUCTION INTO INCISED CHANNEL, 900'
37	ROLLINS	3307E-25 E02(70)	8b	SR/D	SMALL	0	N	N/A	BEDROCK	FINE & CRS	ANCIENT LANDSLIDE	PLANAR	70	2220	ROAD	ROAD HALF CUT; RUNOFF FROM CONVERGING SPUR?, FILL FAILURE?
38	ROLLINS	3307E-25 E01(70)	9	DT/D	SMALL	0	Y	5	BEDROCK	FINE & CRS	GLACIATED SLOPE	CONCAVE	70	2150	ROAD	SIDECAST FAILURE INTO CHANNEL, 1500' TRAVEL , STOPPED IN ROLLINS
39	ROLLINS	3307E-25 E03(70)	9	SR/D	SMALL	0	N	N/A	BEDROCK	FINE & CRS	GLACIATED SLOPE	CONCAVE	70	2100	ROAD	A PAIR OF NEAR IDENTICAL CUT BANK SLIDES, STOPPED BY ROAD
40	ROLLINS	3307E-25 L02(76)	6	DT/D	SMALL	0	Y	5	BEDROCK	FINE & CRS	INCISED CHANNEL	CONCAVE	85	1990	STREAM XING	DEBRIS AVALANCHE FROM ROAD, STOPPED ON BENCH, TRAVELED 800'
41	ROLLINS	3307E-25 P01(76)	6	DT/D	SMALL	10	Y	3	BEDROCK	FINE & CRS	INCISED CHANNEL	CONCAVE	90	2100	STREAM XING	REACHED ROLLINS AFTER 4000' TRAVEL, CONTINUED DOWN
42	ROLLINS	3307E-36 D01(70)	3	SSD/D	MEDIUM	50	Y	3	GLACIAL	FINE & CRS	INNER GORGE	CONCAVE	60	1350	CC(20-50)	STREAM CUTTING OUTSIDE BEND
43	ROLLINS	3307E-36 M01(70)	3	SSD/D	MEDIUM	100	Y	3	GLACIAL	FINE & CRS	INNER GORGE	CONCAVE	70	960	CC(20-50)	STREAM CUTTING OUTSIDE BEND, PERSISTENT GROUNDWATER HORIZON
44	ROLLINS	3207E-01 J01(70)	5	SR/D	SMALL	0	N	N/A	GLAC OUTWASH	FINE	ANCIENT LANDSLIDE	CONCAVE	50	680	CC(20-50)	STOPPED BENCH OF OLD SLIDE MASS, TRACK VIS.
45	ROLLINS	3307E-24 M02(83)	3	SSD/D	SMALL	100	Y	4	SLIDE DEBRIS?	FINE & CRS	INNER GORGE	CONCAVE	60	2660	CC(0-20)	STREAM CUTTING
46	ROLLINS	3307E-24 P01(83)	6	DT/D	SMALL	30	Y	5	BEDROCK	FINE & CRS	INCISED CHANNEL	CONCAVE	70	3040	CC(0-20)	2 ADJACENT HEADWALLS, SAME ELEV, SAME CONDITIONS
47	ROLLINS	3307E-25 F01(83)	3	DT/D	SMALL	0	Y	5	BEDROCK	FINE & CRS	INNER GORGE	CONCAVE	85	3160	CC(0-20)	TRAVELED 1700' AND STOPPED IN CHANNEL
48	ROLLINS	3307E-25 L01(83)	6	DT/D	SMALL	0	Y	5	BEDROCK	FINE & CRS	INCISED CHANNEL	CONCAVE	80	2180	STREAM XING	SIDECAST? POSSIBLE RUNOFF TRANSFER
49	ROLLINS	3307E-36 N01(83)	5	SSD/D	MEDIUM	20	Y	3	GLAC OUTWASH	FINE	TERRACE FLANK	CONCAVE	35	720	CC(20-50)	GAP IN ALDER CANOPY, TOE CUTTING?
50	ROLLINS	3207E-01 E01(83)	5	SSD/D	MEDIUM	20	N	N/A	GLAC OUTWASH	FINE	TERRACE FLANK	PLANAR	50	700	CC(20-50)	GAP IN ALDER CANOPY, GROUNDWATER?, MERGED W/LANDSLIDE 51 IN 1991
51	ROLLINS	3207E-01 E02(83)	4	SSD/D	MEDIUM	50	Y	1	GLAC OUTWASH	FINE	WALL, INCISED CHNL	CONCAVE	45	600	CC(20-50)	GAP IN ALDER CANOPY, TOE CUTTING?, MERGED W/LANDSLIDE 50 IN 1991
52	ROLLINS	3207E-01 F01(83)	4	SSD/P	MEDIUM	0	Y	1	GLAC OUTWASH	FINE	WALL, INCISED CHNL	CONCAVE	45	480	CC(20-50)	STREAM CUTTING OUTSIDE BEND
53	ROLLINS	3207E-01 F02(83)	4	SSD/P	LARGE	0	Y	1	GLAC OUTWASH	FINE	WALL, INCISED CHNL	CONCAVE	45	480	CC(20-50)	STREAM CUTTING OUTSIDE BEND
54	ROLLINS	3207E-01 K01(83)	4	SSD/P	MEDIUM	0	Y	1	GLAC OUTWASH	FINE	WALL, INCISED CHNL	CONCAVE	35	400	CC(20-50)	STREAM CUTTING OUTSIDE BEND
55	ROLLINS	3207E-01 K02(83)	4	SSD/P	MEDIUM	0	Y	1	GLAC OUTWASH	FINE	WALL, INCISED CHNL	CONCAVE	35	400	CC(20-50)	STREAM CUTTING OUTSIDE BEND
56	ROLLINS	3307E-23 J01(91)	8a	SR/D	MEDIUM	100	Y	4	BEDROCK	FINE & CRS	ANCIENT LANDSLIDE	CONCAVE	60	3050	CC(0-20)	MERGED W/J02 FORMING DT, TRAVELED LENGTH OF ROLLINS
57	ROLLINS	3307E-23 J02(91)	8a	SR/D	LARGE	90	Y	4	BEDROCK	FINE & CRS	ANCIENT LANDSLIDE	CONCAVE	60	3040	CC(0-20)	SLUMP/EARTHFLOW, MUCH REMAINS, FUTURE PROBLEMS?
58	ROLLINS	3307E-24 N01(91)	3	SSD/D	SMALL	100	Y	4	SLIDE DEBRIS?	FINE & CRS	INNER GORGE	PLANAR	70	2600	PC(0-20)	PROB RESULT OF IMPACT AND CHANNEL DIVERSION FROM LANDSLIDE 56 AND 57
59	ROLLINS	3307E-25 N01(91)	3	SSD/D	SMALL	80	Y	3	GLACIAL	FINE & CRS	INNER GORGE	CONCAVE	50	1520	CC(20-50)	STREAM CUTTING OUTSIDE BEND
60	ROLLINS	3307E-25 N02(91)	3	SSD/D	MEDIUM	30	Y	3	GLACIAL	FINE & CRS	INNER GORGE	CONCAVE	50	1480	CC(20-50)	STREAM CUTTING OUTSIDE BEND
61	ROLLINS	3307E-26 R01(91)	3	SSD/D	SMALL	50	Y	3	GLACIAL	FINE & CRS	INNER GORGE	CONCAVE	70	1480	CC(20-50)	STREAM CUTTING OUTSIDE BEND
62	ROLLINS	3307E-36 D02(91)	3	SSD/D	SMALL	30	Y	3	GLACIAL	FINE & CRS	INNER GORGE	CONCAVE	70	1320	CC(20-50)	STREAM CUTTING OUTSIDE BEND
63	ROLLINS	3307E-36 E01(91)	3	SR/D	SMALL	50	Y	4	GLACIAL	FINE & CRS	INNER GORGE	PLANAR	70	1100	CC(20-50)	DOWN CUTTING, PIRATED STREAM?
64	ROLLINS	3307E-36 M02(91)	3	SR/D	SMALL	80	Y	3	GLACIAL	FINE & CRS	INNER GORGE	CONCAVE	70	1000	CC(20-50)	STREAM CUTTING OUTSIDE BEND
I	WHITMAN	3207E-03 M02	5	D/D	VRY LRG	0	I	?	GLAC OUTWASH	FINE	TERRACE FLANK	CONCAVE	40-65	950	N/A	DORMANT "LANDSLIDE", POST GLACIAL, STREAM INCISION, SPRINGS?
J	WHITMAN	3207E-02 P01	5	D/D	VRY LRG	0	I	?	GLAC OUTWASH	FINE	TERRACE FLANK	CONCAVE	10-70	900	N/A	ANCIENT LANDSLIDE COMPLEX, POST GLACIAL, STREAM INCISION

HAZEL WATERSHED ADMINISTRATIVE UNIT - MASS WASTING INVENTORY (FORM A-1)

SLIDE	SUB-WAU	ID NUMBER	MW MU	PROC/ CERT	SI E	BARE 1991	DELIV	WTR TYP	PARENT MAT	TE TURE	GEOMORPHOLOGY	TOPOG	SLOPE (PCT)	ELEV (FT)	LAND USE	COMMENTS
K	WHITMAN	3207E-01 P02	5	D/D	VRY LRG	0	I	?	GLAC OUTWASH	FINE	TERRACE FLANK	CONCAVE	25-80	900	N/A	DORMANT LANDSLIDE, POST GLACIAL, STREAM INCISION
65	WHITMAN	3207E-01 P01(42)	1	LPD/D	VRY LRG	30	Y	1	GLAC OUTWASH	FINE	ANCIENT LANDSLIDE	CONCAVE	15+	600	UNKNOWN	RIVER CUTTING, OUTSIDE BEND, GROUNDWATER?, PRE-1937 REACTIVATION
66	WHITMAN	3207E-03 N01(69)	6	SR/P	SMALL	0	Y	5	GLAC OUTWASH	FINE	ANCIENT LANDSLIDE	CONCAVE	30	550	CC(20-50)	DEFOREST CREEK-TYPE BASIN (NECKED, NO MASS REMAINING), SPRINGS?
67	WHITMAN	3207E-03 N02(69)	6	SR/P	SMALL	0	I	5	GLAC OUTWASH	FINE	ANCIENT LANDSLIDE	CONCAVE	40	750	CC(20-50)	DEFOREST CREEK-TYPE BASIN (NECKED, NO MASS REMAINING), SPRINGS?
68	WHITMAN	3207E-03 M01(69)	6	SR/P	SMALL	0	Y	5	GLAC OUTWASH	FINE	ANCIENT LANDSLIDE	CONCAVE	50	750	CC(20-50)	DEFOREST CREEK-TYPE BASIN (NECKED, NO MASS REMAINING), SPRINGS?
69	WHITMAN	3207E-10 B01(70)	N/A	SR/P	LARGE	0	N	N/A	BEDROCK?	FINE	GLACIATED BEDROC	PLANAR	50	400	CC(0-20)	POSSIBLY STRANGE CC INSTEAD?, SLOUGH BELOW, LITTLE DEBRIS?
70	WHITMAN	3207E-11 B01(69)	5	SR/D	SMALL	0	N	N/A	SLIDE DEBRIS	FINE	ANCIENT LANDSLIDE	PLANAR	60	530	CC(0-20)	30 FEET BELOW SWITCHBACK BUT NO EVID. ROAD INFLUENCE
71	WHITMAN	3207E-11 L01(69)	1	LPD/D	LARGE	0	Y	1	ALLUVIUM?	FINE	RIVER TERRACE/SLID	PLANAR	100	350	CC(20-50)	PROB TRIGGERED BY RIVER CUTTING, RUNOUT TOE ANCIENT SLIDE?
72	WHITMAN	3207E-03 R01(91)	5	SPD/P	SMALL	100	Y	5	GLAC OUTWASH	FINE	HEADWALL	CONCAVE	60	800	CC(20-50)	NEAR HEAD OF DRAINAGE, GROUNDWATER?, BEDROCK DAM?
73	WHITMAN	3207E-02 L01(91)	5	SR/D	SMALL	100	N	N/A	GLAC OUTWASH	FINE	TERRACE FLANK	PLANAR	70	840	ROAD	FAILURE OF SIDECAST ON ANGLE-OF-REPOSE SLOPE (ANCIENT SLIDE SCARP)
N	DICKS	3208E-06 E01	5	D/D	VRY LRG	0	I	?	GLAC OUTWASH	FINE	TERRACE FLANK	CONCAVE	20-50	880	N/A	DORMANT LANDSLIDE, POST GLACIAL, STREAM INCISION
O	DICKS	3208E-06 E02	5	D/D	VRY LRG	0	I	?	GLAC OUTWASH	FINE	TERRACE FLANK	CONCAVE	40	880	N/A	DORMANT LANDSLIDE, POST GLACIAL, STREAM INCISION
P	DICKS	3208E-06 F03	5	D/D	VRY LRG	0	I	?	GLAC OUTWASH	FINE	TERRACE FLANK	CONCAVE	50	850	N/A	DORMANT LANDSLIDE, POST GLACIAL, STREAM INCISION (2 SLIDES?)
74	DICKS	3307E-36 A01(48)	3	SSD/D	MEDIUM	50	Y	3	GLACIAL	FINE & CRS	INNER GORGE	PLANAR	85	1750	CC(0-20)	CC < 5 YEARS, LOOKS LIKE MID BROOKS (1, 5, 18)
75	DICKS	3208E-06 F01(69)	4	LPD/D	LARGE	10	Y	3	GLAC OUTWASH	FINE	ANCIENT LANDSLIDE	CONCAVE	40	600	CC(20-50)	STREAM CUTTING OUTSIDE OF BEND
76	DICKS	3208E-06 L01(69)	5	LPD/D	LARGE	5	Y	3	GLAC OUTWASH	FINE	ANCIENT LANDSLIDE	CONCAVE	35	560	CC(20-50)	TOE OF ANCIENT LANDSLIDE "N", CUTTING AND GROUNDWATER
77	DICKS	3208E-06 F02(83)	4	SSD/D	MEDIUM	10	Y	3	GLAC OUTWASH	FINE	ANCIENT LANDSLIDE	CONCAVE	40		CC(20-50)	STREAM CUTTING OUTSIDE OF BEND, TERRACE FLANK
78	DICKS	3308E-06 G01(83)	4	SSD/D	MEDIUM	10	Y	3	GLAC OUTWASH	FINE	TERRACE FLANK	CONCAVE	40	700	CC(20-50)	TOE CUTTING AT STREAM BEND (COULD BE MU 5?)
79	DICKS	3308E-06 G02(83)	5	SR/P	SMALL	10	I	3	GLAC OUTWASH	FINE	TERRACE FLANK	CONCAVE	40	700	CC(20-50)	SPRING? OR TYPE 5 TRIB?
80	DICKS	3308E-06 K01(83)	4	SSD/D	LARGE	10	Y	3	GLAC OUTWASH	FINE	TERRACE FLANK	CONCAVE	30	450	CC(20-50)	TOE CUTTING? (COULD BE MWMU 5 IF "BLUE CLAY" NOT PRESENT)
Q	HIGGINS	3208E-03 F01	5	D/D	VRY LRG	0	I	?	GLACIAL	FINE?	TERRACE FLANK	CONCAVE	25-80	700	N/A	ANCIENT LANDSLIDE, POST GLACIAL, STREAM INCISION
81	HIGGINS	3208E-05 R02(48)	5	LPD/D	VRY LRG	10	Y	1	GLACIAL	FINE?	TERRACE FLANK	PLANAR	85	440	CC(0-20)	BANK CUTTING MAINSTEM N.FK., OLDER THAN 82, LINKED IN 91
82	HIGGINS	3208E-05 R01(48)	5	LPD/D	VRY LRG	10	Y	1	GLACIAL	FINE?	TERRACE FLANK	PLANAR	85	440	CC(0-20)	BANK CUTTING, OUTER BEND; RECENT 1948, STABLE 1970, TOE ACTIVE 1991
83	HIGGINS	3208E-04 G01(48)	6	SR/P	SMALL	5	Y	4	GLACIAL	FINE?	TERRACE FLANK	CONCAVE	<70	840	CC(0-20)	OPEN TRACK ALDER CANOPY, STOPPED AT CONFLUENCE?, SPRINGS?
84	HIGGINS	3208E-04 F01(69)	5	SSD/D	MEDIUM	10	Y	3	GLACIAL	FINE?	TERRACE FLANK	CONCAVE	30	720	CC(20-50)	DENDRITIC BASIN, SPRINGS?
85	HIGGINS	3208E-04 K01(69)	5	SSD/P	SMALL	10	Y	3	GLACIAL	FINE?	TERRACE FLANK	CONCAVE	40	600	CC(20-50)	STREAM CUTTING TOE?, OUTLET, DENDRITIC BASIN
86	HIGGINS	3208E-04 J01(69)	5	SSD/P	SMALL	0	Y	5	GLACIAL	FINE?	TERRACE FLANK	CONCAVE	40	500	CC(20-50)	"HOLE" IN ALDER STILL THERE IN 1983, STREAM & GROUNDWATER?
87	HIGGINS	3308E-26 Q01(69)	7	SR/P	SMALL	0	I	4	BEDROCK	FINE & CRS	ANCIENT LANDSLIDE	CONCAVE	80	2750	MATURE FOREST	CUT TOE OF TALUS/COLLUVIUM? MINE?
88	HIGGINS	3308E-26 J01(69)	7	SR/P	SMALL	0	Y	4	BEDROCK	FINE & CRS	ANCIENT LANDSLIDE	CONCAVE	80	2800	MATURE FOREST	TALUS CHUTE? MINE OR ROAD ACTIVITY?
89	HIGGINS	3308E-25 N01(69)	6	DT/D	SMALL	0	Y	5	BEDROCK	FINE & CRS	ANCIENT LANDSLIDE	CONCAVE	60	3000	MATURE FOREST	START WELL ABOVE CC AND ROAD, DT TRAVELED 1200'
90	HIGGINS	3308E-25 P01(69)	7	SR/D	MEDIUM	10	N	N/A	BEDROCK	FINE & CRS	ANCIENT LANDSLIDE	CONCAVE	80	2750	ROAD CUT	CUTBANK FAILURE, STOPPED ON ROAD
91	HIGGINS	3208E-06 J01(83)	5	SSD/D	MEDIUM	20	Y	3	GLACIAL	FINE	TERRACE FLANK	CONCAVE	40	500	CC(20-50)	BOTH SIDES OF CREEK? AT BEND
92	HIGGINS	3208E-05 E01(83)	5	SR/P	SMALL	10	I	N/A	GLACIAL	FINE	TERRACE FLANK	CONCAVE	30	800	CC(20-50)	SHORT DRAW AT BASE OF STEEPER SLOPE, SPRING?
93	HIGGINS	3208E-05 L01(83)	5	SSD/D	LARGE	20	Y	3	GLACIAL	FINE	TERRACE FLANK	CONCAVE	45	500	CC(20-50)	STREAM BEND? CONFLUENCE?
94	HIGGINS	3308E-25 M01(83)	7	SR/D	SMALL	90	N	N/A	BEDROCK	FINE & CRS	ANCIENT LANDSLIDE	PLANAR	100	3480	NONE	BARE ROCK CLIFF, LANDSLIDE SCARP
95	HIGGINS	3308E-25 N03(83)	7	SR/D	SMALL	0	N	N/A	BEDROCK	FINE & CRS	ANCIENT LANDSLIDE	PLANAR	60	2650	ROAD	SIDECAST FAILURE, ORPHAN? ROAD
96	HIGGINS	3308E-25 P02(83)	7	SR/D	SMALL	20	I	5	BEDROCK	FINE & CRS	ANCIENT BDRK SLID	CONCAVE	60	2660	ROAD	SIDECAST FAILURE, ORPHAN? ROAD
97	HIGGINS	3208E-06 J02(91)	5	SSD/D	MEDIUM	20	Y	3	GLACIAL	FINE	TERRACE FLANK	CONCAVE	40	440	CC(20-50)	STREAM CUTTING?

HAZEL WATERSHED ADMINISTRATIVE UNIT - MASS WASTING INVENTORY (FORM A-1)

SLIDE	SUB-WAU	ID NUMBER	MW MU	PROC/ CERT	SIZE	% BARE 1991	DELIV	WTR TYP	PARENT MAT	TEXTURE	GEOMORPHOLOGY	TOPOG	SLOPE (PCT)	ELEV (FT)	LAND USE	COMMENTS
98	HIGGINS	3208E-05 G01(91)	5	SR/P	SMALL	20	Y	5	GLACIAL	FINE	TERRACE FLANK	CONCAVE	30	760	CC(20-50)	FROM EDGE OF TERRACE, SPRING?
99	HIGGINS	3308E-04 J02(91)	5	LPD/D	VRY LRG	5	Y	1	GLACIAL	FINE	RIVER BEND	CONCAVE	30	550	MATURE FOREST	VERY LARGE EARTHFLOW, LOW SLOPES, ABUND. GROUNDWATER?
100	HIGGINS	3308E-35 K01(91)	9	SR/P	SMALL	90	Y	5	BEDROCK	FINE & CRS	GLACIATED SLOPE	PLANAR	45	1550	LANDING	STOPPED AT CHANNEL, TYPE 5
101	HIGGINS	3208E-02 B02(91)	5	SSD/P	MEDIUM	10	I	4	GLACIAL	FINE	TERRACE	PLANAR	70	850	ROAD CUT	COULD INVOLVE ROAD? (LPD) FIELD CHECK?
102	HIGGINS	3208E-02 B01(91)	5	SSD/P	MEDIUM	10	Y	3	GLACIAL	FINE	TERRACE FLANK	CONCAVE	50	800	CC(0-20)	STREAM INTERSECTION, E. END, BDRK "GROUNDWATER DAM"?
103	SEGELSEN	3209E-07 B01(42)	N/A	SR/D	LARGE	40	Y	1	GLACIAL	FINE & CRS	RIVER BEND	CONCAVE	70	520	RIVER BANK	MAINSTEM STILLY - OUTSIDE OF BEND - DRY RAVEL?
104	SEGELSEN	3308E-25 C01(69)	3	SR/D	SMALL	0	Y	4	GLACIAL	FINE & CRS	INNER GORGE	PLANAR	85	3000	CC(0-20)	CHANNEL UNSTABLE FROM HERE DOWN (STILL UNSTABLE 1991)
105	SEGELSEN	3308E-25 B01(69)	3	SR/D	SMALL	20	Y	4	GLACIAL	FINE & CRS	INNER GORGE	CONCAVE	60	3050	CC(0-20)	CHANNEL DESTAB. 1969, RECOVERED 1991
106	SEGELSEN	3308E-25 B02(69)	3	SR/D	SMALL	20	Y	4	GLACIAL	FINE & CRS	INNER GORGE	CONCAVE	60	3000	CC(0-20)	CHANNEL DESTAB. 1969, RECOVERED 1991
107	SEGELSEN	3308E-36 H01(76)	3	SSD/D	MEDIUM	60	Y	3	BEDROCK	FINE & CRS	INNER GORGE	PLANAR	75	1680	MATURE FOREST	START 30% CHANNEL, 2-3 YEAR ALDER ON DEPOSIT, RAN 4500', STOPPED 20%
108	SEGELSEN	3308E-24 E01(83)	3	SR/D	SMALL	10	Y	4	GLACIAL	FINE & CRS	INNER GORGE	CONCAVE	70	3450	CC(0-20)	DEBRIS AVALANCHE FROM HEALED SLIDE SCAR
109	SEGELSEN	3309E-30 P01(83)	6	SR/D	SMALL	0	Y	5	BEDROCK	FINE & CRS	INCISED CHANNEL	CONCAVE	70	3250	CC(0-20)	TINY, OF INTEREST AS ILLUSTRATION
110	SEGELSEN	3309E-31 B01(83)	6	DT/D	SMALL	10	Y	5	BEDROCK	FINE & CRS	INCISED CHANNEL	CONCAVE	70	2920	ROAD	FROM ROAD, RAN 900' DOWN 35% CHANNEL
111	SEGELSEN	3309E-31 G01(83)	N/A	SR/D	SMALL	0	N	N/A	BEDROCK	FINE & CRS	GLACIATED SLOPE	PLANAR	70	2600	CC(0-20)	NO CHANNEL, STOPPED ON BENCH
112	SEGELSEN	3309E-31 M01(83)	3	SR/D	SMALL	100	Y	3	FAN DEPOSITS	FINE & CRS	INNER GORGE	CONCAVE	85	1280	ROAD?	OUTSIDE BEND OF STREAM, SIDECAST?
113	SEGELSEN	3309E-31 M02(83)	3	SSD/D	MEDIUM	20	Y	3	FAN DEPOSITS	FINE & CRS	INNER GORGE	CONCAVE	70	1280	MATURE FOREST	OUTSIDE BEND
114	SEGELSEN	3207E-06 G01(83)	5	SSD/D	MEDIUM	0	Y	4	GLACIAL	FINE	TERRACE FLANK	CONCAVE	70	800	CC(20-50)	DENDRITIC BASIN, NO CHNL MOBILIZATION?
115	SEGELSEN	3207E-06 H01(83)	5	SSD/D	MEDIUM	0	Y	5	GLACIAL	FINE	TERRACE FLANK	CONCAVE	70	860	CC(20-50)	DENDRITIC BASIN, MINOR CHANNEL DESTAB
116	SEGELSEN	3207E-06 J01(83)	5	SSD/D	MEDIUM	0	N	N/A	GLACIAL	FINE	TERRACE FLANK	CONCAVE	70	760	CC(20-50)	DENDRITIC BASIN, SPRING?
117	SEGELSEN	3309E-30 P02(91)	6	SR/D	SMALL	0	Y	4	BEDROCK	FINE & CRS	INCISED CHANNEL	CONCAVE	70	3150	ROAD	100' DOWN ROAD FROM CHNL XING, PROBABLY PLUGGED CULVERT?
118	SEGELSEN	3309E-05 L01(91)	5	SR/D	SMALL	50	I	4	GLACIAL	FINE	TERRACE FLANK	CONCAVE	35	920	CC(20-50)	SMALL DENDRITIC BASIN, SPRING?

PART III: HAZEL WAU
Surface Erosion Module
Form B-1.1 "Hillslope Field/Photo Information"

SITE	SUBBASIN	PRELIMINARY SOIL EROSION POTENT-IAL (L/M/H)	ACTIVITY/ YEAR	ACTIVITY RATING TABLE B-2 (L/M/H)	FIELD/ PHOTO OBSERVED (F/P)	FIELD VERI FIED (Y/N)	EROSION ACTIVE (Y/N)	SIZE OF SEDIMENT ERODED	EROSION TYPE/ DEGREE	OVERLAND FLOW PRESENT	APPARENT CAUSE OF EROSION	COMPACTION OF SOIL (Y/N)	STANDARD PRACTICE (Y/N)	SEDIMENT DELIVERED	COMMENTS
1	BC	H	Clearcut, cable yarded downhill/over ridgetop/ > = 1991	L/M	F	Y	Y	Silt, Sand	Dry ravel; limited rilling/gullying; rainsplash/Moder ate Degree	Perhaps during high intensity rain storms	Soil disturbance by pulling/staging logs over a ridgetop; minor disturbance by tree felling possible	N	Y	Yes, to Type 5	
2	BC	L/M	93 Acre Clearcut, hi(?)-lead cable yard uphill/1989-1991	L	P	N	Photo shows log haul back corridors;Field visit shows no active erosion	N/A	N/A	Much flowing water present; Type 4 Waters in clearcut	N/A	N/A	Likely	Unknown	Under snow during sampling;***
3	RC	L/H	96 Acre Clearcut,hi(?)-lead cable yard uphill;6 Acre Partial Cut, hi(?)-lead Cable logged/1989-1991	L	P	N	Not apparent by photo	N/A	N/A	Type 4 Waters present in clearcut	N/A	N/A	Likely	Unknown	Under snow during sampling
4	BC	H	Clearcut hi(?)-lead cable logged/ > = 1991	L	Neither; Photo < = 1991	N	Unknown	N/A	N/A	Type 5 Water in clearcut, Type 3 parallels clearcut	N/A	N/A	Likely	Unknown	***
5	BC/RC	H	Clearcut hi(?)-lead cable logged/ > = 1991	L	Neither; Photo < = 1991	N	Unknown	N/A	N/A	Type 5 Water in Clearcut	N/A	N/A	Likely	Unknown	***
6	BC	L	52 Acre Hi(?)-lead/Skyline cable logged/1989-1991	L	F/P	Y	Photo shows log haul back corridors; Field visit shows no active erosion	N/A	N/A	Type 3/4/5 Waters in/bordering clearcut	N/A	N	Y/N	No	For a few hundred feet along the Type 3 No RLA left.
7	BC/RC	L/M	81 Acre Clearcut hi(?)-lead cable logged/1989-1991	L	F/P	Y	Photo shows log haul back corridors; Field visit shows no active erosion	N/A	N/A	Type 4/5 Waters bordering clearcut	N/A	N	Y	No	

NOTES:

1. Subbasin codes: BC=Brooks Creek, DC=Dicks Creek, MH= Mt. Higgins, RC=Rollins Creek, SC=Segelsen Creek, and WB=Whitman Bench.
2. *** Means site viewed casually during road sampling, but not specifically for criteria shown in this form.
3. N/A Means question is not applicable.

PART III: HAZEL WAU
Surface Erosion Module
Form B-1.1 "Hillslope Field/Photo Information"

SITE	SUBBASIN	PRELIMINARY SOIL EROSION POTENT-IAL (L/M/H)	ACTIVITY/ YEAR	ACTIVITY RATING TABLE B-2 (L/M/H)	FIELD/ PHOTO OBSERVED (F/P)	FIELD VERI FIED (Y/N)	EROSION ACTIVE (Y/N)	SIZE OF SEDIMENT ERODED	EROSION TYPE/ DEGREE	OVERLAND FLOW PRESENT	APPARENT CAUSE OF EROSION	COMPACTION OF SOIL (Y/N)	STANDARD PRACTICE (Y/N)	SEDIMENT DELIVERED	COMMENTS
8	WB	L/M	Clearcut cable logged (?)/ > = 1991	L	Neither; Photo < = 1991	N	Unknown	N/A	N/A	Not likely	N/A	N/A	Unknown	Unknown	
9	WB	L/M	23 Acre Clear-cut hi(?)-lead cable logged/1989-1991	L	Neither	N	Unknown	N/A	N/A	Not likely	N/A	N/A	Likely	Unkn own	
10	WB	L/M/H	46 Acre Clearcut hi(?)-lead cable logged/ 1989-1991	L	Viewed from distance	Y	N	Fines, if any	Very minor, if any/Low degree	Bordered by untyped/and/or Type 4 Water	Minor disturbance by dragged logs, if any	N	Y	Not Likely	Viewed from neighboring clearcut (Site #11)
11	RC/WB	M	45 Acre Clearcut, shovel logged/1989-1991	L	F/P	Y	Many shovel trails seen on photos;field visit shows no active erosion	Fines, if any	None seen	Probably little to none	Site scarification by shovel, if any small scale erosion present	Y	Y	Not Seen	Unit is very flat, dry ground
12	RC/WB	M	4 Acre clearcut, shovel logged/1989-1991	L	P	N	Many shovel trails seen on photos; field visit shows no active erosion	fines, if any	N/A	Probably little to none	Site scarification by shovel, if any small scale erosion present	Y	Y	Not likely	Unit is very flat, dry ground
13	DC/RC	L/M/H	Clearcut by hi-lead cable logging/ > = 1991	L	Neither; Photo < = 1991	N	Unknown	N/A	N/A	Probably little to none	N/A	N/A	Likely	Unkn own	Ridgetop unit;***
14	RC	L/M/H	64 Acre clearcut by hi-lead cable logging/1989-1991	L	F/P	Y	N	None	None	Type 4/5(?) Waters present in clearcut	N/A	N	Y	Probably Not	Unit is relatively flat except at inner draw of Type 4/5(?). Unit probably logged 5 years ago, well revegetated, hard n to discern if erosion was ever a problem.

NOTES:

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2. *** Means site viewed casually during road sampling, but not specifically for criteria shown in this form.
3. N/A Means question is not applicable.

PART III: HAZEL WAU
Surface Erosion Module
Form B-1.1 "Hillslope Field/Photo Information"

SITE	SUBBASIN	PRELIMINARY SOIL EROSION POTENT-IAL (L/M/H)	ACTIVITY/ YEAR	ACTIVITY RATING TABLE B-2 (L/M/H)	FIELD/ PHOTO OBSERVED (F/P)	FIELD VERI FIED (Y/N)	EROSION ACTIVE (Y/N)	SIZE OF SEDIMENT ERODED	EROSION TYPE/ DEGREE	OVERLAND FLOW PRESENT	APPARENT CAUSE OF EROSION	COMPACTION OF SOIL (Y/N)	STANDARD PRACTICE (Y/N)	SEDIMENT DELIVERED	COMMENTS
15	RC	M	5 Acre Clearcut, likely logged by loader from road/1989-1991	L/M	P	N	Not apparent by photo	N/A	Likely limited, if any	Type 5 Waters present	Soil disturbance on steep slopes, if any	Unknown	Likely	Unknown	Under snow during sampling;***
16	RC	M	18 Acre Clearcut by hi-lead cable yarding/1989-1991	L/M	P	N	Not apparent by photo	Likely limited, if any	N/A	Type 5 Waters present	Appears sensitive to water concentration, see "comments"	Unknown	Likely	Unknown	Under snow during sampling. Gullying of soil seen in where a culvert "shotgunned" water on bare slopes below road;***
17	DC/RC	L/M	14 Acre Clearcut by Hi-lead cable/1989-1991	M/H	P	N	Log haul back corridors seen on photos, appears to be active gullying on photo	Likely fines	Likely Gullying, rilling, dry ravel, and rainsplash.	Likely;Type 3 and 5 water nearby unit	Guessed to be log haul back corridors created by dragging logs on steep slopes (>40%).	Likely	Unknown	Likely	Under snow during sampling
18/US FS	MH	M/H	50 Acre Clearcut by hi-lead/skyline cable yarding/1991	L	F/P	Y	Log haul back corridors seen on photo; field visit shows no active erosion	None	None	Type 4 Waters inside unit	None	N	Harvest, Yes/ Road perhaps No	No	Cracks seen in harvest road; Large fill landing present.

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3. N/A Means question is not applicable.

PART III: HAZEL WAU
Surface Erosion Module
Form B-1.1 "Hillslope Field/Photo Information"

SITE	SUBBASIN	PRELIMINARY SOIL EROSION POTENT-IAL (L/M/H)	ACTIVITY/ YEAR	ACTIVITY RATING TABLE B-2 (L/M/H)	FIELD/ PHOTO OBSERVED (F/P)	FIELD VERI FIED (Y/N)	EROSION ACTIVE (Y/N)	SIZE OF SEDIMENT ERODED	EROSION TYPE/ DEGREE	OVERLAND FLOW PRESENT	APPARENT CAUSE OF EROSION	COMPACTION OF SOIL (Y/N)	STANDARD PRACTICE (Y/N)	SEDIMENT DELIVERED	COMMENTS
19	MH	L/H	Skidder logged clearcut via dragging logs on skid road/ > = 1991	H	F	Y	Y	Clay, Silt, Sand	Rilling/Gullying, limited dry ravel, rainsplash/Moder ate degree	Type 3/4 Water and small wetland inside unit, Type 1 Water nearby unit.	Sidecast skid road without waterbars on 25% slope directed toward Type 1 Water;Skid trail following slope towards Type 3/4; Minor soil disturbance on draws adjacent to Type 3/4; Need for more waterbars.	Y	Yes/No	Yes	Another cause of erosion was staging/loading of logs directly next to Type 3 Water;
20/US FS	MH	H	33 Acre Clearcut by hi-lead/skyline cable yarding/1991	L	F/P	Y	N	N/A	None	Yes, Type 4 Water borders unit, many smaller channels inside unit.	N/A	N	Y	No	
21/US FS	MH	H	13 Acre Clearcut by hi-lead/skyline cable yarding/1991	L	F/P	Y	N	N/A	None	Small Type 5 Waters present	N/A	N	Y/???	No	Large landing has cracks in it, possibly deliverable when failure occurs (I believe there is a dam downstream on Type 4 Water).
22/US FS	MH	M	49 Acre clearcut by hi-lead cable yarding & minor skidder logging/1989-1991	L/M	F/P	Y	N	N/A	None	Type 3/4 Water borders unit	N/A	Y	Y	No	Most of unit relatively flat
23/US FS	MH	M	26 Acre clearcut by Hi-lead (?) cable yarding/1989-1991	L	P	N	Not apparent by photo	N/A	N/A	Unknown Type Water borders unit	N/A	Unknown	Likely	Unknown	

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3. N/A Means question is not applicable.

PART III: HAZEL WAU
Surface Erosion Module
Form B-1.1 "Hillslope Field/Photo Information"

SITE	SUBBASIN	PRELIMINARY SOIL EROSION POTENT-IAL (L/M/H)	ACTIVITY/ YEAR	ACTIVITY RATING TABLE B-2 (L/M/H)	FIELD/ PHOTO OBSERVED (F/P)	FIELD VERI FIED (Y/N)	EROSION ACTIVE (Y/N)	SIZE OF SEDIMENT ERODED	EROSION TYPE/ DEGREE	OVERLAND FLOW PRESENT	APPARENT CAUSE OF EROSION	COMPACTION OF SOIL (Y/N)	STANDARD PRACTICE (Y/N)	SEDIMENT DELIVERED	COMMENTS
24	SC	L/M/H	Skidder(?)/Clearcut by Hi-lead(?) yarding/ > = 1991	L	F	Y	N	Silt, Sand	Rainsplash, very minor rilling/low degree	Yes, Type 3/4 Waters inside unit	Bare soil from skid trail on Type 4 crossing	Y	Y	Minor amount	Unit is flat except on innerdraw of Type 3 Water
25	SC	M/H	Clearcut by Hi-lead(?) cable yarding/ > = 1991	L	Neither; Photo < = 1991	N	Unknown	N/A	N/A	Type 4 Water inside unit	N/A	Unknown	Unknown	Unknown	Access through private club with "No Trespass" signs
26	DC/RC	M/H	Clearcut by Hi-lead cable yarding;accidental fire during logging operations/ > = 1991	L/M	Neither; Photo < = 1991	N	Unknown	N/A	N/A	Type 5 Waters inside unit, (if any); Type 3 directly downslope of unit	N/A	Unknown	Likely	Unknown	Under snow during sampling;***
27	RC	L/M	No-cut (?) Riparian Leave on Rollins Creek (Type)/ < 1991	N/A	F/P	Y	Y	Glacial sediments (mostly silt, sand, small pebbles and some minor cobble	Calving/slumping by mass failure, rainsplash, dry ravel/High degree	This site is a 100' vertical cliff directly above Rollins Creek	Unknown if natural process or caused by cumulative effects	N/A	Unknown	Y	This is a site of interest identified from photos. If visited, approach site with much caution. Identified as mass wasting process.
28	MH	H	Deeply eroded Type 4 Water along no cut riparian leave area/ < = 1991	N/A	F/P	Y	Y	Mostly silt, sand, and minor gravel/cobble.	Rilling, gullying, rainsplash, slumping, melting snow, frost heaving,/high degree.	Quasioverland flow when melting ice/snow or intense rainfall present.	Based on mass wasting module information, the Type 4 likely experienced debris torrents in 1960's/1970's from upstream road/slope failures; perhaps also caused/aggravated by fault zone.	N/A	Unknown	Y	Much delivery from bare stream banks. West bank of Type 4 Water exposed soil as much as 50-60' high, east bank high. 30' 20-here.

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2. *** Means site viewed casually during road sampling, but not specifically for criteria shown in this form.
3. N/A Means question is not applicable.

PART III: HAZEL WAU
Surface Erosion Module
Form B-1.1 "Hillslope Field/Photo Information"

SITE	SUBBASIN	PRELIMINARY SOIL EROSION POTENT-IAL (L/M/H)	ACTIVITY/ YEAR	ACTIVITY RATING TABLE B-2 (L/M/H)	FIELD/ PHOTO OBSERVED (F/P)	FIELD VERI FIED (Y/N)	EROSION ACTIVE (Y/N)	SIZE OF SEDIMENT ERODED	EROSION TYPE/ DEGREE	OVERLAND FLOW PRESENT	APPARENT CAUSE OF EROSION	COMPACTION OF SOIL (Y/N)	STANDARD PRACTICE (Y/N)	SEDIMENT DELIVERED	COMMENTS
29	BC/WB	H	83 Acre clearcut by hi-lead cable yarding/1989-1991	L	F/P	Y	Y	Sand, silt	Calving/Slumpin g of cutbanks (90% slope measured), inner-gorge failure observed at headwall of Type 4/5 water (slope probably > 75%)/ Moderate degree	Type 3/4/5 Waters inside/bordering unit	Mechanical disturbance of soils on steep slopes, possible loss of root strength (mass wasting issue)	N	Y	Yes	Road from hobby farm (miniature ponies) has had waterbars excavated.

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3. N/A Means question is not applicable.

PART IV: HAZEL WAU
Surface Erosion Module
Form B-2.1 "Roads Calculation Sheet"

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y
1																									
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12																									
13																									
14				T/A RP/YR*	**																				
15				is tons/acre of	means																				
16				road prism/year	generally																				
17										"TYPE"	"TYPE"	"TYPE"				TOTAL						TableB-5			
18										CUTSLOPE	FILLSLOPE	TREAD				ROAD						BASIC			TableB-5
19					ROAD	ROAD	ROAD	ROAD	"TYPE"	MAP	MAP	MAP	CUTSLOPE	FILLSLOPE	TREAD	PRISM	AREA	AREA	AREA	ROAD		EROSION	CUTSLOPE	CUTSLOPE	CUTSLOPE
20			WAU	SUBBASIN	SEGMENT	SLOPE	LENGTH	"TYPE"	METHOD	DISTANCE	DISTANCE	DISTANCE	AREA	AREA	AREA	AREA	CUTSLOPE	FILLSLOPE	TREAD	AGE	GEOLOGY	RATE	PORTION	VEG	VEG FACTOR
21		EQUATION											G*J	G*K	G*L	M+N+O	(M/P)*100	(N/P)*100	(O/P)*100				(Q/100)*U		
22		UNITS				%%%	feet			feet	feet	feet	feet^2	feet^2	feet^2	feet^2	%%%	%%%	%%%			T/A RP/YR*	T/A RP/YR*	%%%	
23			Hazel	BROOKS CK	1	1.9	3676	1	5	4	4	24	14704	14704	88224	117632	12.50	12.50	75.00	>2 YRS	HIWTHRDSED	60	7.50	>80	0.18
24			Hazel	BROOKS CK	2	1.9	2798	175	5	4	4	20	11192	11192	55960	78344	14.29	14.29	71.43	>2 YRS	HIWTHRDSED	60	8.57	>80	0.18
25			Hazel	BROOKS CK	3	1.3	2046	14	1	12	13	16	24552	26598	32736	83886	29.27	31.71	39.02	>2 YRS	HIWTHRDSED	60	17.56	>80	0.18
26			Hazel	BROOKS CK	4	5.8	228	14	1	12	13	16	2736	2964	3648	9348	29.27	31.71	39.02	>2 YRS	HIWTHRDSED	60	17.56	>80	0.18
27			Hazel	BROOKS CK	5	8.5	323	13	1	10	8	17	3230	2584	5491	11305	28.57	22.86	48.57	>2 YRS	HIWTHRDSED	60	17.14	70	0.37
28			Hazel	BROOKS CK	8	5.5	3689	8	1	14	8	16	51646	29512	59024	140182	36.84	21.05	42.11	>2 YRS	HIWTHRDSED	60	22.11	>80	0.18
29			Hazel	BROOKS CK	9	2.7	6335	9	1	4	2	20	25340	12670	126700	164710	15.38	7.69	76.92	>2 YRS	MODWTHRDRK	30	4.62	>80	0.18
30			Hazel	BROOKS CK	10	11	564	29	1	4	3	16	2256	1692	9024	12972	17.39	13.04	69.57	>2 YRS	MODWTHRDRK	30	5.22	>80	0.18
31			Hazel	BROOKS CK	11	1.5	1192	32	1	4	7	15	4768	8344	17880	30992	15.38	26.92	57.69	>2 YRS	MODWTHRDRK	30	4.62	75	0.37
32			Hazel	BROOKS CK	12	6.7	693	32	1	4	7	15	2772	4851	10395	18018	15.38	26.92	57.69	>2 YRS	MODWTHRDRK	30	4.62	75	0.37
33			Hazel	BROOKS CK	13	10	1410	13	1	10	8	17	14100	11280	23970	49350	28.57	22.86	48.57	>2 YRS	HIWTHRDSED	60	17.14	70	0.37
34			Hazel	BROOKS CK	14	2.6	1474	14	1	12	13	16	17688	19162	23584	60434	29.27	31.71	39.02	>2 YRS	HIWTHRDSED	60	17.56	>80	0.18
35			Hazel	BROOKS CK	15	10	466	13	1	10	8	17	4660	3728	7922	16310	28.57	22.86	48.57	>2 YRS	HIWTHRDSED	60	17.14	70	0.37
36			Hazel	BROOKS CK	16	1.9	2335	14	1	12	13	16	28020	30355	37360	95735	29.27	31.71	39.02	>2 YRS	HIWTHRDSED	60	17.56	>80	0.18
37			Hazel	BROOKS CK	17	5.1	4352	32	1	4	7	15	17408	30464	65280	113152	15.38	26.92	57.69	>2 YRS	MODWTHRDRK	30	4.62	75	0.37
38			Hazel	BROOKS CK	18	7.5	1125	29	1	4	3	16	4500	3375	18000	25875	17.39	13.04	69.57	>2 YRS	MODWTHRDRK	30	5.22	>80	0.18
39			Hazel	BROOKS CK	19	4.6	2717	32	1	4	7	15	10868	19019	40755	70642	15.38	26.92	57.69	>2 YRS	MODWTHRDRK	30	4.62	75	0.37
40			Hazel	BROOKS CK	20	14.4	1862	29	1	4	3	16	7448	5586	29792	42826	17.39	13.04	69.57	>2 YRS	MODWTHRDRK	30	5.22	>80	0.18
41			Hazel	BROOKS CK	21	0.1	7999	9	1	4	2	20	31996	15998	159980	207974	15.38	7.69	76.92	>2 YRS	MODWTHRDRK	30	4.62	>80	0.18
42			Hazel	BROOKS CK	22	10	1112	22	1	3	3	16	3336	3336	17792	24464	13.64	13.64	72.73	>2 YRS	MODWTHRDRK	30	4.09	>80	0.18
43			Hazel	BROOKS CK	23	1	1232	32	2	4	7	15	4928	8624	18480	32032	15.38	26.92	57.69	>2 YRS	MODWTHRDRK	30	4.62	75	0.37
44			Hazel	BROOKS CK	24	14.1	989	29	1	4	3	16	3956	2967	15824	22747	17.39	13.04	69.57	>2 YRS	MODWTHRDRK	30	5.22	>80	0.18
45			Hazel	BROOKS CK	25	10.3	3366	29	1	4	3	16	13464	10098	53856	77418	17.39	13.04	69.57	>2 YRS	MODWTHRDRK	30	5.22	>80	0.18
46			Hazel	BROOKS CK	26	15.3	783	28	2	9	9	13	7047	7047	10179	24273	29.03	29.03	41.94	>2 YRS	MODWTHRDRK	30	8.71	75	0.37
47			Hazel	BROOKS CK	27	4.5	4372	32	4	4	7	15	17488	30604	65580	113672	15.38	26.92	57.69	>2 YRS	MODWTHRDRK	30	4.62	75	0.37
48			Hazel	BROOKS CK	28	18	841	28	1	7	8	13	5887	6728	10933	23548	25.00	28.57	46.43	>2 YRS	MODWTHRDRK	30	7.50	75	0.37
49			Hazel	BROOKS CK	29	12.2	1342	29	1	4	3	16	5368	4026	21472	30866	17.39	13.04	69.57	>2 YRS	MODWTHRDRK	30	5.22	>80	0.18
50			Hazel	BROOKS CK	30	7.1	3289	29	1	4	3	16	13156	9867	52624	75647	17.39	13.04	69.57	>2 YRS	MODWTHRDRK	30	5.22	>80	0.18
51			Hazel	BROOKS CK	32	5.6	1611	32	1	4	7	15	6444	11277	24165	41886	15.38	26.92	57.69	>2 YRS	MODWTHRDRK	30	4.62	75	0.37
52			Hazel	BROOKS CK	33	5	358	32	1	4	7	15	1432	2506	5370	9308	15.38	26.92	57.69	>2 YRS	MODWTHRDRK	30	4.62	75	0.37
53			Hazel	BROOKS CK	34	2.5	1652	32	2	4	7	15	6608	11564	24780	42952	15.38	26.92	57.69	>2 YRS	MODWTHRDRK	30	4.62	75	0.37
54			Hazel	BROOKS CK	35	4.2	1897	32	1	4	7	15	7588	13279	28455	49322	15.38	26.92	57.69	>2 YRS	MODWTHRDRK	30	4.62	75	0.37
55			Hazel	BROOKS CK	36	4.1	3543	36	1	17	12	15	60231	42516	53145	155892	38.64	27.27	34.09	>2 YRS	METAMORPH	10	3.86	>80	0.18
56			Hazel	BROOKS CK	37	3.4	5283	36	1	17	12	15	89811	63396	79245	232452	38.64	27.27	34.09	>2 YRS	METAMORPH	10	3.86	>80	0.18
57			Hazel	BROOKS CK	38	21	828	245	6	5	6	17	4140	4968	14076	23184	17.86	21.43	60.71	>2 YRS	METAMORPH	10	1.79	>80	0.18

Form B-2.1 "Roads Calculation Sheet"

	Z	AA	AB	AC	AD	AE	AF	AG	AH	AI	AJ	AK	AL	AM	AN	AO	AP	AQ	AR	AS	AT	AU
14																	ROAD					
15																	PRISM				5 PERCENT	5 PERCENT
16													TableB-8	SURFACE/	ROAD		DELIVERY				INCREASED	INCREASED
17	CUTSLOPE				FILLSLOPE				TREAD	TABLE B-9			TRAFFIC/	TRAFFIC	PRISM	ROAD	AREA		ROAD	TOTAL	DELIVERY	TOTAL
18	EROSION	FILLSLOPE	FILLSLOPE	FILLSLOPE	EROSION	TREAD	SURFACING	SURFACE	EROSION	TRAFFIC		PRECIP	PRECIP	TREAD	EROSION	DELIVERY	INCREASED	EROSION	AREA	DELIVERED	EROSION	DELIVERED
19	RATE	PORTION	VEG %	VEG FACTOR	RATE	PORTION	TYPE	FACTOR	RATE	TYPE	TRAFFIC	ZONE	FACTOR	RATE	RATE	AREA	5 PERCENT	RATE	ACRES	SEDIMENT	RATE	SEDIMENT
20	W*Y	(R/100)*V			AA*AC	(S/100)*V			AE*AG					AH*AL	Z+AD+AM		(AO+.05)**	AN*AO	P/43560	AQ*AR	AN*AP	AT*AR
21	T/A RP/YR*	T/A RP/YR*	%%%		T/A RP/YR*	T/A RP/YR*			T/A RP/YR*			millimeters		T/A RP/YR*	T/A RP/YR*	%%%	%%%	T/A RP/YR*	AC	US TONS/YR	T/A RP/YR*	US TONS/YR
202	2.25	12.50	>80	0.18	2.25	35.00	>6" GRAVEL	0.2	7.00	MOD	6S	1200-3000	4	28.00	32.50	0.2	0.25	6.50	0.50	3.25	8.13	4.06
203	1.59	21.18	>80	0.18	3.81	30.00	>6" GRAVEL	0.2	6.00	MOD	6S	1200-3000	4	24.00	29.40	0.2	0.25	5.88	2.52	14.83	7.35	18.54
204	1.62	9.00	>80	0.18	1.62	42.00	>6" GRAVEL	0.2	8.40	LIGHT	6I	1200-3000	1	8.40	11.64	0	0.05	0.00	0.62	0.00	0.58	0.36
205	1.62	9.00	>80	0.18	1.62	42.00	>6" GRAVEL	0.2	8.40	LIGHT	6I	1200-3000	1	8.40	11.64	0	0.05	0.00	0.26	0.00	0.58	0.15
206	1.64	4.44	70	0.37	1.64	21.11	>6" GRAVEL	0.2	4.22	LIGHT	6I	1200-3000	1	4.22	7.51	0.05	0.1	0.38	0.52	0.20	0.75	0.39
207	1.54	11.14	>80	0.18	2.01	10.29	>6" GRAVEL	0.2	2.06	NONE	6A	1200-3000	0.05	0.10	3.65	0	0.05	0.00	0.88	0.00	0.18	0.18
208	1.54	11.14	>80	0.18	2.01	10.29	>6" GRAVEL	0.2	2.06	NONE	6A	1200-3000	0.05	0.10	3.65	0	0.05	0.00	1.14	0.00	0.18	0.21
209	1.64	4.44	70	0.37	1.64	21.11	>6" GRAVEL	0.2	4.22	LIGHT	6I	1200-3000	1	4.22	7.51	0.05	0.1	0.38	2.46	0.92	0.75	1.65
210	1.64	4.44	70	0.37	1.64	21.11	>6" GRAVEL	0.2	4.22	LIGHT	6I	1200-3000	1	4.22	7.51	0.05	0.1	0.38	0.40	0.15	0.75	0.30
211	2.35	4.62	>80	0.18	0.83	12.31	>6" GRAVEL	0.2	2.46	MOD	6S	1200-3000	4	9.85	13.03	0.2	0.25	2.61	2.77	7.23	3.26	9.04
212	1.54	11.14	>80	0.18	2.01	10.29	>6" GRAVEL	0.2	2.06	NONE	6A	1200-3000	0.05	0.10	3.65	0	0.05	0.00	0.87	0.00	0.18	0.18
213	2.78	10.38	75	0.37	3.84	12.12	>6" GRAVEL	0.2	2.42	NONE	6A	1200-3000	0.05	0.12	6.74	0.1	0.15	0.67	2.61	1.76	1.01	2.64
214	3.70	11.58	>80	0.18	2.08	8.42	>6" GRAVEL	0.2	1.68	MOD	6S	1200-3000	4	6.74	12.52	0.2	0.25	2.50	1.46	3.65	3.13	4.56
215	3.70	11.58	>80	0.18	2.08	8.42	>6" GRAVEL	0.2	1.68	MOD	6S	1200-3000	4	6.74	12.52	0.2	0.25	2.50	4.39	11.00	3.13	13.75
216	4.27	15.97	15	0.77	12.30	7.26	>6" GRAVEL	0.2	1.45	NONE	6A	1200-3000	0.05	0.07	16.64	0.05	0.1	0.83	13.00	10.81	1.66	21.62
217	4.15	9.78	40	0.53	5.18	12.39	>6" GRAVEL	0.2	2.48	NONE	6A	1200-3000	0.05	0.12	9.46	0.05	0.1	0.47	4.09	1.93	0.95	3.87
218	0.52	2.58	>80	0.18	0.46	4.52	>6" GRAVEL	0.2	0.90	NONE	6A	1200-3000	0.05	0.05	1.03	0.1	0.15	0.10	1.15	0.12	0.15	0.18
219	2.78	10.38	75	0.37	3.84	12.12	>6" GRAVEL	0.2	2.42	NONE	6A	1200-3000	0.05	0.12	6.74	0.1	0.15	0.67	3.74	2.52	1.01	3.78
220	1.16	7.50	>80	0.18	1.35	16.07	>6" GRAVEL	0.2	3.21	NONE	6A	1200-3000	0.05	0.16	2.67	0.1	0.15	0.27	3.87	1.03	0.40	1.55
221	0.52	2.58	>80	0.18	0.46	4.52	>6" GRAVEL	0.2	0.90	NONE	6A	1200-3000	0.05	0.05	1.03	0.1	0.15	0.10	0.86	0.09	0.15	0.13
222	1.54	11.14	>80	0.18	2.01	10.29	>6" GRAVEL	0.2	2.06	NONE	6A	1200-3000	0.05	0.10	3.65	0	0.05	0.00	0.83	0.00	0.18	0.15
223	0.32	2.14	>80	0.18	0.39	6.07	>6" GRAVEL	0.2	1.21	NONE	6A	1200-3000	0.05	0.06	0.77	0.1	0.15	0.08	0.90	0.07	0.12	0.10
224	1.16	7.50	>80	0.18	1.35	16.07	>6" GRAVEL	0.2	3.21	NONE	6A	1200-3000	0.05	0.16	2.67	0.1	0.15	0.27	2.48	0.66	0.40	0.99
225	1.54	11.14	>80	0.18	2.01	10.29	>6" GRAVEL	0.2	2.06	NONE	6A	1200-3000	0.05	0.10	3.65	0	0.05	0.00	0.48	0.00	0.18	0.09
226	1.16	7.50	>80	0.18	1.35	16.07	>6" GRAVEL	0.2	3.21	NONE	6A	1200-3000	0.05	0.16	2.67	0.1	0.15	0.27	1.74	0.46	0.40	0.70
227	1.16	7.50	>80	0.18	1.35	16.07	>6" GRAVEL	0.2	3.21	NONE	6A	1200-3000	0.05	0.16	2.67	0.1	0.15	0.27	3.74	1.00	0.40	1.49
228	1.54	11.14	>80	0.18	2.01	10.29	>6" GRAVEL	0.2	2.06	NONE	6A	1200-3000	0.05	0.10	3.65	0	0.05	0.00	3.51	0.00	0.18	0.64
229	2.78	10.38	75	0.37	3.84	12.12	>6" GRAVEL	0.2	2.42	NONE	6A	1200-3000	0.05	0.12	6.74	0.1	0.15	0.67	1.80	1.22	1.01	1.82
230	4.15	9.78	40	0.53	5.18	12.39	>6" GRAVEL	0.2	2.48	NONE	6A	1200-3000	0.05	0.12	9.46	0.05	0.1	0.47	1.12	0.53	0.95	1.06
231	4.27	15.97	15	0.77	12.30	7.26	>6" GRAVEL	0.2	1.45	NONE	6A	1200-3000	0.05	0.07	16.64	0.05	0.1	0.83	0.93	0.77	1.66	1.55
232	4.27	15.97	15	0.77	12.30	7.26	>6" GRAVEL	0.2	1.45	NONE	6A	1200-3000	0.05	0.07	16.64	0.05	0.1	0.83	2.83	2.36	1.66	4.71
233	4.27	15.97	15	0.77	12.30	7.26	>6" GRAVEL	0.2	1.45	NONE	6A	1200-3000	0.05	0.07	16.64	0.05	0.1	0.83	2.07	1.72	1.66	3.45
234	1.16	7.50	>80	0.18	1.35	16.07	>6" GRAVEL	0.2	3.21	NONE	6A	1200-3000	0.05	0.16	2.67	0.1	0.15	0.27	2.35	0.63	0.40	0.94
235	1.16	7.50	>80	0.18	1.35	16.07	>6" GRAVEL	0.2	3.21	NONE	6A	1200-3000	0.05	0.16	2.67	0.1	0.15	0.27	1.17	0.31	0.40	0.47
236	1.16	7.50	>80	0.18	1.35	16.07	>6" GRAVEL	0.2	3.21	NONE	6A	1200-3000	0.05	0.16	2.67	0.1	0.15	0.27	0.96	0.26	0.40	0.38
237	1.54	11.14	>80	0.18	2.01	10.29	>6" GRAVEL	0.2	2.06	NONE	6A	1200-3000	0.05	0.10	3.65	0	0.05	0.00	1.67	0.00	0.18	0.30
238	4.27	15.97	15	0.77	12.30	7.26	>6" GRAVEL	0.2	1.45	NONE	6A	1200-3000	0.05	0.07	16.64	0.05	0.1	0.83	3.27	2.72	1.66	5.44
239	1.16	7.50	>80	0.18	1.35	16.07	>6" GRAVEL	0.2	3.21	NONE	6A	1200-3000	0.05	0.16	2.67	0.1	0.15	0.27	3.35	0.89	0.40	1.34
240	1.16	7.50	>80	0.18	1.35	16.07	>6" GRAVEL	0.2	3.21	NONE	6A	1200-3000	0.05	0.16	2.67	0.1	0.15	0.27	0.55	0.15	0.40	0.22
241	1.16	7.50	>80	0.18	1.35	16.07	>6" GRAVEL	0.2	3.21	NONE	6A	1200-3000	0.05	0.16	2.67	0.1	0.15	0.27	0.78	0.21	0.40	0.31
242	1.54	11.14	>80	0.18	2.01	10.29	>6" GRAVEL	0.2	2.06	NONE	6A	1200-3000	0.05	0.10	3.65	0	0.05	0.00	0.50	0.00	0.18	0.09
243	4.27	15.97	15	0.77	12.30	7.26	>6" GRAVEL	0.2	1.45	NONE	6A	1200-3000	0.05	0.07	16.64	0.05	0.1	0.83	2.50	2.08	1.66	4.16
244	1.64	4.44	70	0.37	1.64	21.11	>6" GRAVEL	0.2	4.22	LIGHT	6I	1200-3000	1	4.22	7.51	0.05	0.1	0.38	0.67	0.25	0.75	0.50
245	1.64	4.44	70	0.37	1.64	21.11	>6" GRAVEL	0.2	4.22	LIGHT	6I	1200-3000	1	4.22	7.51	0.05	0.1	0.38	0.23	0.09	0.75	0.18
246	1.16	7.50	>80	0.18	1.35	16.07	>6" GRAVEL	0.2	3.21	NONE	6A	1200-3000	0.05	0.16	2.67	0.1	0.15	0.27	0.71	0.19	0.40	0.29
247	0.32	2.14	>80	0.18	0.39	6.07	>6" GRAVEL	0.2	1.21	NONE	6A	1200-3000	0.05	0.06	0.77	0.1	0.15	0.08	1.17	0.09	0.12	0.13
248	4.15	9.78	40	0.53	5.18	12.39	>6" GRAVEL	0.2	2.48	LIGHT	6I	1200-3000	1	2.48	11.81	0.2	0.25	2.36	0.61	1.44	2.95	1.80
249	1.64	4.44	70	0.37	1.64	21.11	>6" GRAVEL	0.2	4.22	LIGHT	6I	1200-3000	1	4.22	7.51	0.05	0.1	0.38	1.79	0.67	0.75	1.35

PART IV: HAZEL WAU
Surface Erosion Module
Form B-2.1 "Roads Calculation Sheet"

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y
14				T/A RP/YR*	""																				
15				is tons/acre of	means																				
16				road prism/year	generally																				
17										"TYPE"	"TYPE"	"TYPE"				TOTAL						TableB-5			
18										CUTSLOPE	FILLSLOPE	TREAD				ROAD						BASIC			TableB-6
19					ROAD	ROAD	ROAD	ROAD	"TYPE"	MAP	MAP	MAP	CUTSLOPE	FILLSLOPE	TREAD	PRISM	AREA	AREA	AREA	ROAD		EROSION	CUTSLOPE	CUTSLOPE	CUTSLOPE
20			WAU	SUBBASIN	SEGMENT	SLOPE	LENGTH	"TYPE"	METHOD	DISTANCE	DISTANCE	DISTANCE	AREA	AREA	AREA	AREA	CUTSLOPE	FILLSLOPE	TREAD	AGE	GEOLOGY	RATE	PORTION	VEG	VEG FACTOR
21		EQUATION											G*J	G*K	G*L	M+N+O	(M/P)*100	(N/P)*100	(O/P)*100				(Q/100)*U		
22		UNITS				%%%	feet			feet	feet	feet	feet^2	feet^2	feet^2	feet^2	%%%	%%%	%%%			T/A RP/YR*	T/A RP/YR*	%%%	
250			Hazel	ROLLINS CK	328	0.3	862	83	1	3	3	14	2586	2586	12068	17240	15.00	15.00	70.00	>2 YRS	HIWTHRDSED	60	9.00		0.18
251			Hazel	ROLLINS CK	330	4.2	4009	83	1	3	3	14	12027	12027	56126	80180	15.00	15.00	70.00	>2 YRS	HIWTHRDSED	60	9.00	>80	0.18
252		TOTALS					158415																		
253																									
254																									
255			Hazel	SEGELSEN CK	175	1.8	4853	175	1	4	4	20	19412	19412	97060	135884	14.29	14.29	71.43	>2 YRS	HIWTHRDSED	60	8.57	>80	0.18
256			Hazel	SEGELSEN CK	178	1.4	5178	178	1	3	3	15	15534	15534	77670	108738	14.29	14.29	71.43	>2 YRS	HIWTHRDSED	60	8.57	>80	0.18
257			Hazel	SEGELSEN CK	179	0.2	2094	178	1	3	3	15	6282	6282	31410	43974	14.29	14.29	71.43	>2 YRS	HIWTHRDSED	60	8.57	>80	0.18
258			Hazel	SEGELSEN CK	180	3.7	3010	178	1	3	3	15	9030	9030	45150	63210	14.29	14.29	71.43	>2 YRS	HIWTHRDSED	60	8.57	>80	0.18
259			Hazel	SEGELSEN CK	181	6	176	178	1	3	3	15	528	528	2640	3696	14.29	14.29	71.43	>2 YRS	HIWTHRDSED	60	8.57	>80	0.18
260			Hazel	SEGELSEN CK	182	2	250	178	1	3	3	15	750	750	3750	5250	14.29	14.29	71.43	>2 YRS	HIWTHRDSED	60	8.57	>80	0.18
261			Hazel	SEGELSEN CK	183	3.3	767	178	1	3	3	15	2301	2301	11505	16107	14.29	14.29	71.43	>2 YRS	HIWTHRDSED	60	8.57	>80	0.18
262			Hazel	SEGELSEN CK	184	1.8	2386	178	1	3	3	15	7158	7158	35790	50106	14.29	14.29	71.43	>2 YRS	HIWTHRDSED	60	8.57	>80	0.18
263			Hazel	SEGELSEN CK	185	1.7	576	178	1	3	3	15	1728	1728	8640	12096	14.29	14.29	71.43	>2 YRS	HIWTHRDSED	60	8.57	>80	0.18
264			Hazel	SEGELSEN CK	186	3.3	1818	178	1	3	3	15	5454	5454	27270	38178	14.29	14.29	71.43	>2 YRS	HIWTHRDSED	60	8.57	>80	0.18
265			Hazel	SEGELSEN CK	187	4.4	1406	178	1	3	3	15	4218	4218	21090	29526	14.29	14.29	71.43	>2 YRS	HIWTHRDSED	60	8.57	>80	0.18
266			Hazel	SEGELSEN CK	188	10	2666	188	1	14	8	15	37324	21328	39990	98642	37.84	21.62	40.54	0-2 YRS	HIWTHRDSED	110	41.62	5	1
267			Hazel	SEGELSEN CK	189	0.2	3290	178	1	3	3	15	9870	9870	49350	69090	14.29	14.29	71.43	>2 YRS	HIWTHRDSED	60	8.57	>80	0.18
268			Hazel	SEGELSEN CK	209	1.3	468	209	1	11	8	22	5148	3744	10296	19188	26.83	19.51	53.66	>2 YRS	METAMORPH	10	2.68	>80	0.18
269			Hazel	SEGELSEN CK	210	8.1	1420	210	1	11	18	24	15620	25560	34080	75260	20.75	33.96	45.28	>2 YRS	SCHIST	60	12.45	>80	0.18
270			Hazel	SEGELSEN CK	214	12	436	210	3	11	18	24	4796	7848	10464	23108	20.75	33.96	45.28	>2 YRS	SCHIST	60	12.45	>80	0.18
271			Hazel	SEGELSEN CK	254	4.9	7399	254-258	1	16	18	22	118384	133182	162778	414344	28.57	32.14	39.29	>2 YRS	HIWTHRDSED	60	17.14	75	0.37
272			Hazel	SEGELSEN CK	255	3.3	1789	178	1	3	3	15	5367	5367	26835	37569	14.29	14.29	71.43	>2 YRS	HIWTHRDSED	60	8.57	>80	0.18
273			Hazel	SEGELSEN CK	256	15.5	734	259	3	8	12	15	5872	8808	11010	25690	22.86	34.29	42.86	>2 YRS	HIWTHRDSED	60	13.71	>80	0.18
274			Hazel	SEGELSEN CK	257	4	578	178	1	3	3	15	1734	1734	8670	12138	14.29	14.29	71.43	>2 YRS	HIWTHRDSED	60	8.57	>80	0.18
275			Hazel	SEGELSEN CK	258	3	5283	254-258	1	16	18	22	84528	95094	116226	295848	28.57	32.14	39.29	>2 YRS	HIWTHRDSED	60	17.14	75	0.37
276			Hazel	SEGELSEN CK	259	12	2551	259	1	8	12	15	20408	30612	38265	89285	22.86	34.29	42.86	>2 YRS	HIWTHRDSED	60	13.71	>80	0.18
277			Hazel	SEGELSEN CK	260	0.2	2093	260-263	1	13	14	18	27209	29302	37674	94185	28.89	31.11	40.00	>2 YRS	SCHIST	60	17.33	>80	0.18
278			Hazel	SEGELSEN CK	261	11.4	745	262	1	20	18	17	14900	13410	12665	40975	36.36	32.73	30.91	>2 YRS	SCHIST	60	21.82	>80	0.18
279			Hazel	SEGELSEN CK	262	11.2	5286	262	1	20	18	17	105720	95148	89862	290730	36.36	32.73	30.91	>2 YRS	SCHIST	60	21.82	>80	0.18
280			Hazel	SEGELSEN CK	263	0.2	2515	260-263	1	13	14	18	32895	35210	45270	113175	28.89	31.11	40.00	>2 YRS	SCHIST	60	17.33	>80	0.18
281			Hazel	SEGELSEN CK	264	4.1	4177	264	1	17	11	14	71009	45947	58478	175434	40.48	26.19	33.33	>2 YRS	SCHIST	60	24.29	75	0.37
282			Hazel	SEGELSEN CK	265	3.3	4615	264	1	17	11	14	78455	50765	64610	193830	40.48	26.19	33.33	>2 YRS	SCHIST	60	24.29	75	0.37
283			Hazel	SEGELSEN CK	266	1.3	891	210	3	10	15	24	8910	13365	21384	43659	20.41	30.61	48.98	>2 YRS	SCHIST	60	12.24	>80	0.18
284			Hazel	SEGELSEN CK	267	3.1	10525	144	5	19	22	16	199975	231550	168400	599925	33.33	38.60	28.07	>2 YRS	SEDROCK	30	10.00	75	0.37
285			Hazel	SEGELSEN CK	268	6.9	830	260-263	1	13	14	18	10790	11620	14940	37350	28.89	31.11	40.00	>2 YRS	SCHIST	60	17.33	>80	0.18
286			Hazel	SEGELSEN CK	269	14.7	4211	262	2	20	18	17	84220	75798	71587	231605	36.36	32.73	30.91	>2 YRS	SCHIST	60	21.82	>80	0.18
287			Hazel	SEGELSEN CK	270	12.3	526	262	2	20	18	17	10520	9468	8942	28930	36.36	32.73	30.91	>2 YRS	SCHIST	60	21.82	>80	0.18
288			Hazel	SEGELSEN CK	271	3.3	416	260-263	1	13	14	18	5408	5824	7488	18720	28.89	31.11	40.00	>2 YRS	SCHIST	60	17.33	>80	0.18
289			Hazel	SEGELSEN CK	272	6.5	4807	260-263	1	13	14	18	62491	67298	86526	216315	28.89	31.11	40.00	>2 YRS	SCHIST	60	17.33	>80	0.18
290			Hazel	SEGELSEN CK	273	0.2	3333	260-263	1	13	14	18	43329	46662	59994	149985	28.89	31.11	40.00	>2 YRS	SCHIST	60	17.33	>80	0.18
291			Hazel	SEGELSEN CK	276	6.7	3003	250	6	12	8	16	36036	24024	48048	108108	33.33	22.22	44.44	>2 YRS	SEDROCK	30	10.00	>80	0.18
292			Hazel	SEGELSEN CK	277	6.7	575	250	6	12	8	16	6900	4600	9200	20700	33.33	22.22	44.44	>2 YRS	SEDROCK	30	10.00	>80	0.18
293			Hazel	SEGELSEN CK	278	8.1	5001	145	6	14	33	15	70014	165033	75015	310062	22.58	53.23	24.19	>2 YRS	SEDROCK	30	6.77	15	0.63
294			Hazel	SEGELSEN CK	279	8.7	2315	145	6	14	33	15	32410	76395	34725	143530	22.58	53.23	24.19	>2 YRS	SEDROCK	30	6.77	15	0.63
295			Hazel	SEGELSEN CK	280	3.6	1931	264	1	17	11	14	32827	21241	27034	81102	40.48	26.19	33.33	>2 YRS	SCHIST	60	24.29	75	0.37
296			Hazel	SEGELSEN CK	281	6.9	3503	260-263	1	13	14	18	45539	49042	63054	157635	28.89	31.11	40.00	>2 YRS	SCHIST	60	17.33	>80	0.18
297			Hazel	SEGELSEN CK	282	10	1172	262	1	20	18	17	23440	21096	19924	64460	36.36	32.73	30.91	>2 YRS	SCHIST	60	21.82	>80	0.18

PART IV: HAZEL WAU
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Form B-2.1 "Roads Calculation Sheet"

	Z	AA	AB	AC	AD	AE	AF	AG	AH	AI	AJ	AK	AL	AM	AN	AO	AP	AQ	AR	AS	AT	AU
14																	ROAD					
15															ROAD		PRISM				5 PERCENT	5 PERCENT
16													TableB-8	SURFACE/	PRISM	ROAD	DELIVERY				INCREASED	INCREASED
17									TREAD	TABLE B-9			TRAFFIC/	TRAFFIC	TOTAL	PRISM	AREA		ROAD	TOTAL	DELIVERY	TOTAL
18	CUTSLOPE				FILLSLOPE				EROSION	TRAFFIC		PRECIP	PRECIP	TREAD	EROSION	DELIVERY	INCREASED	EROSION	AREA	DELIVERED	EROSION	DELIVERED
19	EROSION	FILLSLOPE	FILLSLOPE	FILLSLOPE	EROSION	TREAD	SURFACING	SURFACE	RATE	TYPE	TRAFFIC	ZONE	FACTOR	RATE	RATE	AREA	5 PERCENT	RATE	ACRES	SEDIMENT	RATE	SEDIMENT
20	RATE	PORTION	VEG %	VEG FACTOR	RATE	PORTION	TYPE	FACTOR	AE*AG					AH*AL	Z+AD+AM		(AO+.05)**	AN*AO	P/43560	AQ*AR	AN*AP	AT*AR
21	W*Y	(R/100)*V			AA*AC	(S/100)*V			T/A RP/YR*			millimeters		T/A RP/YR*	T/A RP/YR*	%%%	%%%	T/A RP/YR*	AC	US TONS/YR	T/A RP/YR*	US TONS/YR
22	T/A RP/YR*	T/A RP/YR*	%%%		T/A RP/YR*	T/A RP/YR*																
250	1.62	9.00	>80	0.18	1.62	42.00	>6" GRAVEL	0.2	8.40	LIGHT	6I	1200-3000	1	8.40	11.64	0	0.05	0.00	0.40	0.00	0.58	0.23
251	1.62	9.00	>80	0.18	1.62	42.00	>6" GRAVEL	0.2	8.40	LIGHT	6I	1200-3000	1	8.40	11.64	0	0.05	0.00	1.84	0.00	0.58	1.07
252																			123.80	139.02		205.12
253						–																
254																						
255	1.54	8.57	>80	0.18	1.54	42.86	ASPHALT	0.03	1.29	MOD	AS	1200-3000	4	5.14	8.23	0.05	0.1	0.41	3.12	1.28	0.82	2.57
256	1.54	8.57	>80	0.18	1.54	42.86	>6" GRAVEL	0.2	8.57	LIGHT	6I	1200-3000	1	8.57	11.66	0.1	0.15	1.17	2.50	2.91	1.75	4.36
257	1.54	8.57	>80	0.18	1.54	42.86	>6" GRAVEL	0.2	8.57	LIGHT	6I	1200-3000	1	8.57	11.66	0.1	0.15	1.17	1.01	1.18	1.75	1.77
258	1.54	8.57	>80	0.18	1.54	42.86	>6" GRAVEL	0.2	8.57	LIGHT	6I	1200-3000	1	8.57	11.66	0.1	0.15	1.17	1.45	1.69	1.75	2.54
259	1.54	8.57	>80	0.18	1.54	42.86	>6" GRAVEL	0.2	8.57	LIGHT	6I	1200-3000	1	8.57	11.66	0.1	0.15	1.17	0.08	0.10	1.75	0.15
260	1.54	8.57	>80	0.18	1.54	42.86	>6" GRAVEL	0.2	8.57	LIGHT	6I	1200-3000	1	8.57	11.66	0.1	0.15	1.17	0.12	0.14	1.75	0.21
261	1.54	8.57	>80	0.18	1.54	42.86	>6" GRAVEL	0.2	8.57	LIGHT	6I	1200-3000	1	8.57	11.66	0.1	0.15	1.17	0.37	0.43	1.75	0.65
262	1.54	8.57	>80	0.18	1.54	42.86	>6" GRAVEL	0.2	8.57	LIGHT	6I	1200-3000	1	8.57	11.66	0.1	0.15	1.17	1.15	1.34	1.75	2.01
263	1.54	8.57	>80	0.18	1.54	42.86	>6" GRAVEL	0.2	8.57	LIGHT	6I	1200-3000	1	8.57	11.66	0.1	0.15	1.17	0.28	0.32	1.75	0.49
264	1.54	8.57	>80	0.18	1.54	42.86	>6" GRAVEL	0.2	8.57	LIGHT	6I	1200-3000	1	8.57	11.66	0.1	0.15	1.17	0.88	1.02	1.75	1.53
265	1.54	8.57	>80	0.18	1.54	42.86	>6" GRAVEL	0.2	8.57	LIGHT	6I	1200-3000	1	8.57	11.66	0.1	0.15	1.17	0.68	0.79	1.75	1.19
266	41.62	23.78	5	1	23.78	44.59	>6" GRAVEL	0.2	8.92	LIGHT	6I	1200-3000	1	8.92	74.32	0	0.05	0.00	2.26	0.00	3.72	8.42
267	1.54	8.57	>80	0.18	1.54	42.86	>6" GRAVEL	0.2	8.57	LIGHT	6I	1200-3000	1	8.57	11.66	0.1	0.15	1.17	1.59	1.85	1.75	2.77
268	0.48	1.95	>80	0.18	0.35	5.37	>6" GRAVEL	0.2	1.07	MOD	6S	1200-3000	4	4.29	5.13	0	0.05	0.00	0.44	0.00	0.26	0.11
269	2.24	20.38	>80	0.18	3.67	27.17	>6" GRAVEL	0.2	5.43	MOD	6S	1200-3000	4	21.74	27.65	0	0.05	0.00	1.73	0.00	1.38	2.39
270	2.24	20.38	>80	0.18	3.67	27.17	>6" GRAVEL	0.2	5.43	MOD	6S	1200-3000	4	21.74	27.65	0	0.05	0.00	0.53	0.00	1.38	0.73
271	6.34	19.29	>80	0.18	3.47	23.57	>6" GRAVEL	0.2	4.71	MOD	6S	1200-3000	4	18.86	28.67	0.25	0.3	7.17	9.51	68.18	8.60	81.82
272	1.54	8.57	>80	0.18	1.54	42.86	>6" GRAVEL	0.2	8.57	LIGHT	6I	1200-3000	1	8.57	11.66	0.1	0.15	1.17	0.86	1.01	1.75	1.51
273	2.47	20.57	>80	0.18	3.70	25.71	>6" GRAVEL	0.2	5.14	LIGHT	6I	1200-3000	1	5.14	11.31	0	0.05	0.00	0.59	0.00	0.57	0.33
274	1.54	8.57	>80	0.18	1.54	42.86	>6" GRAVEL	0.2	8.57	LIGHT	6I	1200-3000	1	8.57	11.66	0.1	0.15	1.17	0.28	0.32	1.75	0.49
275	6.34	19.29	>80	0.18	3.47	23.57	>6" GRAVEL	0.2	4.71	MOD	6S	1200-3000	4	18.86	28.67	0.25	0.3	7.17	6.79	48.68	8.60	58.42
276	2.47	20.57	>80	0.18	3.70	25.71	>6" GRAVEL	0.2	5.14	LIGHT	6I	1200-3000	1	5.14	11.31	0	0.05	0.00	2.05	0.00	0.57	1.16
277	3.12	18.67	>80	0.18	3.36	24.00	>6" GRAVEL	0.2	4.80	NONE	6A	1200-3000	0.05	0.24	6.72	0.1	0.15	0.67	2.16	1.45	1.01	2.18
278	3.93	19.64	>80	0.18	3.53	18.55	>6" GRAVEL	0.2	3.71	LIGHT	6I	1200-3000	1	3.71	11.17	0.3	0.35	3.35	0.94	3.15	3.91	3.68
279	3.93	19.64	>80	0.18	3.53	18.55	>6" GRAVEL	0.2	3.71	LIGHT	6I	1200-3000	1	3.71	11.17	0.3	0.35	3.35	6.67	22.37	3.91	26.10
280	3.12	18.67	>80	0.18	3.36	24.00	>6" GRAVEL	0.2	4.80	NONE	6A	1200-3000	0.05	0.24	6.72	0.1	0.15	0.67	2.60	1.75	1.01	2.62
281	8.99	15.71	>80	0.18	2.83	20.00	>6" GRAVEL	0.2	4.00	LIGHT	6I	1200-3000	1	4.00	15.81	0.3	0.35	4.74	4.03	19.11	5.54	22.29
282	8.99	15.71	>80	0.18	2.83	20.00	>6" GRAVEL	0.2	4.00	LIGHT	6I	1200-3000	1	4.00	15.81	0.3	0.35	4.74	4.45	21.11	5.54	24.63
283	2.20	18.37	>80	0.18	3.31	29.39	>6" GRAVEL	0.2	5.88	MOD	6S	1200-3000	4	23.51	29.02	0	0.05	0.00	1.00	0.00	1.45	1.45
284	3.70	11.58	>80	0.18	2.08	8.42	>6" GRAVEL	0.2	1.68	MOD	6S	1200-3000	4	6.74	12.52	0.2	0.25	2.50	13.77	34.49	3.13	43.11
285	3.12	18.67	>80	0.18	3.36	24.00	>6" GRAVEL	0.2	4.80	NONE	6A	1200-3000	0.05	0.24	6.72	0.1	0.15	0.67	0.86	0.58	1.01	0.86
286	3.93	19.64	>80	0.18	3.53	18.55	>6" GRAVEL	0.2	3.71	NONE	6A	1200-3000	0.05	0.19	7.65	0.3	0.35	2.29	5.32	12.20	2.68	14.23
287	3.93	19.64	>80	0.18	3.53	18.55	>6" GRAVEL	0.2	3.71	NONE	6A	1200-3000	0.05	0.19	7.65	0.3	0.35	2.29	0.66	1.52	2.68	1.78
288	3.12	18.67	>80	0.18	3.36	24.00	>6" GRAVEL	0.2	4.80	NONE	6A	1200-3000	0.05	0.24	6.72	0.1	0.15	0.67	0.43	0.29	1.01	0.43
289	3.12	18.67	>80	0.18	3.36	24.00	>6" GRAVEL	0.2	4.80	NONE	6A	1200-3000	0.05	0.24	6.72	0.1	0.15	0.67	4.97	3.34	1.01	5.01
290	3.12	18.67	>80	0.18	3.36	24.00	>6" GRAVEL	0.2	4.80	NONE	6A	1200-3000	0.05	0.24	6.72	0.1	0.15	0.67	3.44	2.31	1.01	3.47
291	1.80	6.67	>80	0.18	1.20	13.33	>6" GRAVEL	0.2	2.67	LIGHT	6I	1200-3000	1	2.67	5.67	0.2	0.25	1.13	2.48	2.81	1.42	3.52
292	1.80	6.67	>80	0.18	1.20	13.33	>6" GRAVEL	0.2	2.67	LIGHT	6I	1200-3000	1	2.67	5.67	0.2	0.25	1.13	0.48	0.54	1.42	0.67
293	4.27	15.97	55	0.37	5.91	7.26	>6" GRAVEL	0.2	1.45	LIGHT	6I	1200-3000	1	1.45	11.63	0.2	0.25	2.33	7.12	16.55	2.91	20.69
294	4.27	15.97	55	0.37	5.91	7.26	>6" GRAVEL	0.2	1.45	NONE	6A	1200-3000	0.05	0.07	10.25	0.2	0.25	2.05	3.29	6.75	2.56	8.44
295	8.99	15.71	>80	0.18	2.83	20.00	>6" GRAVEL	0.2	4.00	LIGHT	6I	1200-3000	1	4.00	15.81	0.3	0.35	4.74	1.86	8.83	5.54	10.31
296	3.12	18.67	>80	0.18	3.36	24.00	>6" GRAVEL	0.2	4.80	NONE	6A	1200-3000	0.05	0.24	6.72	0.1	0.15	0.67	3.62	2.43	1.01	3.65
297	3.93	19.64	>80	0.18	3.53	18.55	>6" GRAVEL	0.2	3.71	LIGHT	6I	1200-3000	1	3.71	11.17	0.3	0.35	3.35	1.48	4.96	3.91	5.79

PART IV: HAZEL WAU
Surface Erosion Module
Form B-2.1 "Roads Calculation Sheet"

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y
14				T/A RP/YR*	**																				
15				is tons/acre of	means																				
16				road prism/year	generally																				
17										"TYPE"	"TYPE"	"TYPE"				TOTAL						TableB-5			
18										CUTSLOPE	FILLSLOPE	TREAD				ROAD						BASIC			TableB-6
19					ROAD	ROAD	ROAD	ROAD	"TYPE"	MAP	MAP	MAP	CUTSLOPE	FILLSLOPE	TREAD	PRISM	AREA	AREA	AREA	ROAD		EROSION	CUTSLOPE	CUTSLOPE	CUTSLOPE
20			WAU	SUBBASIN	SEGMENT	SLOPE	LENGTH	"TYPE"	METHOD	DISTANCE	DISTANCE	DISTANCE	AREA	AREA	AREA	AREA	CUTSLOPE	FILLSLOPE	TREAD	AGE	GEOLOGY	RATE	PORTION	VEG	VEG FACTOR
21		EQUATION											G*J	G*K	G*L	M+N+O	(M/P)*100	(N/P)*100	(O/P)*100				(Q/100)*U		
22		UNITS				%%%	feet			feet	feet	feet	feet^2	feet^2	feet^2	feet^2	%%%	%%%	%%%			T/A RP/YR*	T/A RP/YR*	%%%	
298			Hazel	SEGELSEN CK	283	9.4	4894	262	1	20	18	17	97880	88092	83198	269170	36.36	32.73	30.91	>2 YRS	SCHIST	60	21.82	>80	0.18
299			Hazel	SEGELSEN CK	284	3.3	2893	264	1	17	11	14	49181	31823	40502	121506	40.48	26.19	33.33	>2 YRS	SCHIST	60	24.29	75	0.37
300			Hazel	SEGELSEN CK	285	5	374	264	1	17	11	14	6358	4114	5236	15708	40.48	26.19	33.33	>2 YRS	SCHIST	60	24.29	75	0.37
301			Hazel	SEGELSEN CK	286	1.6	880	250	6	12	8	16	10560	7040	14080	31680	33.33	22.22	44.44	>2 YRS	SEDROCK	30	10.00	>80	0.18
302			Hazel	SEGELSEN CK	287	20	574	148	6	13	18	21	7462	10332	12054	29848	25.00	34.62	40.38	>2 YRS	SEDROCK	30	7.50	75	0.37
303			Hazel	SEGELSEN CK	288	10	2308	262	1	20	18	17	46160	41544	39236	126940	36.36	32.73	30.91	>2 YRS	SCHIST	60	21.82	>80	0.18
304			Hazel	SEGELSEN CK	289	3.8	1510	250	6	12	8	16	18120	12080	24160	54360	33.33	22.22	44.44	>2 YRS	SEDROCK	30	10.00	>80	0.18
305			Hazel	SEGELSEN CK	290	6.3	1650	9	5	4	2	20	6600	3300	33000	42900	15.38	7.69	76.92	>2 YRS	MODWTHRDRK	30	4.62	>80	0.18
306			Hazel	SEGELSEN CK	291	0.5	1228	9	5	4	2	20	4912	2456	24560	31928	15.38	7.69	76.92	>2 YRS	MODWTHRDRK	30	4.62	>80	0.18
307			Hazel	SEGELSEN CK	292	0.5	740	32	6	4	7	15	2960	5180	11100	19240	15.38	26.92	57.69	>2 YRS	MODWTHRDRK	30	4.62		
308			Hazel	SEGELSEN CK	293	0.5	997	32	6	4	7	15	3988	6979	14955	25922	15.38	26.92	57.69	>2 YRS	MODWTHRDRK	30	4.62	75	0.37
309			Hazel	SEGELSEN CK	294	16.7	747	28	6	9	9	13	6723	6723	9711	23157	29.03	29.03	41.94	>2 YRS	MODWTHRDRK	30	8.71	75	0.37
310			Hazel	SEGELSEN CK	295	16.7	429	148	6	13	18	21	5577	7722	9009	22308	25.00	34.62	40.38	>2 YRS	SEDROCK	30	7.50	75	0.37
311			Hazel	SEGELSEN CK	296	4.3	2029	264	1	17	11	14	34493	22319	28406	85218	40.48	26.19	33.33	>2 YRS	SCHIST	60	24.29	75	0.37
312			Hazel	SEGELSEN CK	297	6.4	753	32	6	4	7	15	3012	5271	11295	19578	15.38	26.92	57.69	>2 YRS	MODWTHRDRK	30	4.62	75	0.37
313			Hazel	SEGELSEN CK	315	0.3	1745	175	1	4	4	20	6980	6980	34900	48860	14.29	14.29	71.43	>2 YRS	HIWTHRDSED	60	8.57	>80	0.18
314			Hazel	SEGELSEN CK	316	0.1	341	178	1	3	3	15	1023	1023	5115	7161	14.29	14.29	71.43	>2 YRS	HIWTHRDSED	60	8.57	>80	0.18
315			Hazel	SEGELSEN CK	317	8.3	747	145	6	14	33	15	10458	24651	11205	46314	22.58	53.23	24.19	>2 YRS	SEDROCK	30	6.77	15	0.63
316			Hazel	SEGELSEN CK	318	5	406	264	1	17	11	14	6902	4466	5684	17052	40.48	26.19	33.33	>2 YRS	SCHIST	60	24.29	75	0.37
317			Hazel	SEGELSEN CK	319	2.8	3187	250	6	12	8	16	38244	25496	50992	114732	33.33	22.22	44.44	>2 YRS	SEDROCK	30	10.00	>80	0.18
318			Hazel	SEGELSEN CK	320	5.3	1930	32	6	4	7	15	7720	13510	28950	50180	15.38	26.92	57.69	>2 YRS	MODWTHRDRK	30	4.62	75	0.37
319			Hazel	SEGELSEN CK	321	2.8	2235	178	1	3	3	15	6705	6705	33525	46935	14.29	14.29	71.43	>2 YRS	HIWTHRDSED	60	8.57	>80	0.18
320			Hazel	SEGELSEN CK	322	6.7	450	260-263	1	13	14	18	5850	6300	8100	20250	28.89	31.11	40.00	>2 YRS	SCHIST	60	17.33	>80	0.18
321		TOTALS					144645																		
322																									
323																									
324			Hazel	WHITMAN BENCH	6	12	1847	29-138	6	4	4	18	7388	7388	33246	48022	15.38	15.38	69.23	>2 YRS	MODWTHRDRK	30	4.62	75	0.37
325			Hazel	WHITMAN BENCH	7	9.6	1679	29-138	6	4	4	18	6716	6716	30222	43654	15.38	15.38	69.23	>2 YRS	MODWTHRDRK	30	4.62	75	0.37
326			Hazel	WHITMAN BENCH	60	1	1441	60	1	3	3	17	4323	4323	24497	33143	13.04	13.04	73.91	>2 YRS	HIWTHRDSED	60	7.83	>80	0.18
327			Hazel	WHITMAN BENCH	61	9	1745	61	1	15	13	11	26175	22685	19195	68055	38.46	33.33	28.21	>2 YRS	HIWTHRDSED	60	23.08	>80	0.18
328			Hazel	WHITMAN BENCH	62	8.4	6030	60	3	3	3	17	18090	18090	102510	138690	13.04	13.04	73.91	>2 YRS	HIWTHRDSED	60	7.83	>80	0.18
329			Hazel	WHITMAN BENCH	63	4.3	3053	63	1	3	3	13	9159	9159	39689	58007	15.79	15.79	68.42	>2 YRS	HIWTHRDSED	60	9.47	>80	0.18
330			Hazel	WHITMAN BENCH	64	1	515	63	1	3	3	13	1545	1545	6695	9785	15.79	15.79	68.42	>2 YRS	HIWTHRDSED	60	9.47	>80	0.18
331			Hazel	WHITMAN BENCH	65	6.7	611	63	1	3	3	13	1833	1833	7943	11609	15.79	15.79	68.42	>2 YRS	HIWTHRDSED	60	9.47	>80	0.18
332			Hazel	WHITMAN BENCH	66	1.3	487	63	1	3	3	13	1461	1461	6331	9253	15.79	15.79	68.42	>2 YRS	HIWTHRDSED	60	9.47	>80	0.18
333			Hazel	WHITMAN BENCH	67	6.7	316	63	1	3	3	13	948	948	4108	6004	15.79	15.79	68.42	>2 YRS	HIWTHRDSED	60	9.47	>80	0.18
334			Hazel	WHITMAN BENCH	68	4	321	63	1	3	3	13	963	963	4173	6099	15.79	15.79	68.42	>2 YRS	HIWTHRDSED	60	9.47	>80	0.18
335			Hazel	WHITMAN BENCH	69	22	389	71	1	3	3	14	1167	1167	5446	7780	15.00	15.00	70.00	>2 YRS	HIWTHRDSED	60	9.00	>80	0.18
336			Hazel	WHITMAN BENCH	70	1	947	63	1	3	3	13	2841	2841	12311	17993	15.79	15.79	68.42	>2 YRS	HIWTHRDSED	60	9.47	>80	0.18
337			Hazel	WHITMAN BENCH	71	24	686	71	1	3	3	14	2058	2058	9604	13720	15.00	15.00	70.00	>2 YRS	HIWTHRDSED	60	9.00	>80	0.18
338			Hazel	WHITMAN BENCH	72	0.5	257	60	1	3	3	17	771	771	4369	5911	13.04	13.04	73.91	>2 YRS	HIWTHRDSED	60	7.83	>80	0.18
339			Hazel	WHITMAN BENCH	75	2	2950	63	1	3	3	13	8850	8850	38350	56050	15.79	15.79	68.42	>2 YRS	HIWTHRDSED	60	9.47	>80	0.18
340			Hazel	WHITMAN BENCH	76	1.5	346	63	1	3	3	13	1038	1038	4498	6574	15.79	15.79	68.42	>2 YRS	HIWTHRDSED	60	9.47	>80	0.18
341			Hazel	WHITMAN BENCH	77	1.3	467	63	1	3	3	13	1401	1401	6071	8873	15.79	15.79	68.42	>2 YRS	HIWTHRDSED	60	9.47	>80	0.18
342			Hazel	WHITMAN BENCH	79	4	471	63	1	3	3	13	1413	1413	6123	8949	15.79	15.79	68.42	>2 YRS	HIWTHRDSED	60	9.47	>80	0.18
343			Hazel	WHITMAN BENCH	80	13.3	253	61	1	15	13	11	3795	3289	2783	9867	38.46	33.33	28.21	>2 YRS	HIWTHRDSED	60	23.08	>80	0.18
344			Hazel	WHITMAN BENCH	81	2.5	1098	60	1	3	3	17	3294	3294	18666	25254	13.04	13.04	73.91	>2 YRS	HIWTHRDSED	60	7.83	>80	0.18
345			Hazel	WHITMAN BENCH	87	1.3	1233	63	1	3	3	13	3699	3699	16029	23427	15.79	15.79	68.42	>2 YRS	HIWTHRDSED	60	9.47	>80	0.18

PART IV: HAZEL WAU
Surface Erosion Module
Form B-2.1 "Roads Calculation Sheet"

	Z	AA	AB	AC	AD	AE	AF	AG	AH	AI	AJ	AK	AL	AM	AN	AO	AP	AQ	AR	AS	AT	AU
14																						
15																	ROAD					
16															ROAD		PRISM				5 PERCENT	5 PERCENT
17													TableB-8	SURFACE/	PRISM	ROAD	DELIVERY				INCREASED	INCREASED
18	CUTSLOPE				FILLSLOPE				TREAD	TABLE B-9			TRAFFIC/	TRAFFIC	TOTAL	PRISM	AREA			ROAD	TOTAL	DELIVERY
19	EROSION	FILLSLOPE	FILLSLOPE	FILLSLOPE	EROSION	TREAD	SURFACING	SURFACE	EROSION	TRAFFIC		PRECIP	PRECIP	TREAD	EROSION	DELIVERY	INCREASED	EROSION		AREA	DELIVERED	EROSION
20	RATE	PORTION	VEG %	VEG FACTOR	RATE	PORTION	TYPE	FACTOR	RATE	TYPE	TRAFFIC	ZONE	FACTOR	RATE	RATE	AREA	5 PERCENT	RATE		ACRES	SEDIMENT	RATE
21	W*Y	(R/100)*V			AA*AC	(S/100)*V			AE*AG					AH*AL	Z+AD+AM		(AO+.05)**	AN*AO	AQ*AR	P/43560	AQ*AR	AN*AP
22	T/A RP/YR*	T/A RP/YR*	%%%		T/A RP/YR*	T/A RP/YR*			T/A RP/YR*			millimeters		T/A RP/YR*	T/A RP/YR*	%%%	%%%	T/A RP/YR*	AT*AR	AC	US TONS/YR	T/A RP/YR*
298	3.93	19.64	>80	0.18	3.53	18.55	>6" GRAVEL	0.2	3.71	LIGHT	6I	1200-3000	1	3.71	11.17	0.3	0.35	3.35	6.18	20.71	3.91	24.18
299	8.99	15.71	>80	0.18	2.83	20.00	>6" GRAVEL	0.2	4.00	LIGHT	6I	1200-3000	1	4.00	15.81	0.3	0.35	4.74	2.79	13.23	5.54	15.44
300	8.99	15.71	>80	0.18	2.83	20.00	>6" GRAVEL	0.2	4.00	LIGHT	6I	1200-3000	1	4.00	15.81	0.3	0.35	4.74	0.36	1.71	5.54	2.00
301	1.80	6.67	>80	0.18	1.20	13.33	>6" GRAVEL	0.2	2.67	LIGHT	6I	1200-3000	1	2.67	5.67	0.2	0.25	1.13	0.73	0.82	1.42	1.03
302	2.78	10.38	75	0.37	3.84	12.12	>6" GRAVEL	0.2	2.42	LIGHT	6I	1200-3000	1	2.42	9.04	0.2	0.25	1.81	0.69	1.24	2.26	1.55
303	3.93	19.64	>80	0.18	3.53	18.55	>6" GRAVEL	0.2	3.71	LIGHT	6I	1200-3000	1	3.71	11.17	0.3	0.35	3.35	2.91	9.77	3.91	11.39
304	1.80	6.67	>80	0.18	1.20	13.33	>6" GRAVEL	0.2	2.67	LIGHT	6I	1200-3000	1	2.67	5.67	0.2	0.25	1.13	1.25	1.41	1.42	1.77
305	0.83	2.31	>80	0.18	0.42	23.08	>6" GRAVEL	0.2	4.62	MOD	6S	1200-3000	4	18.46	19.71	0.2	0.25	3.94	0.98	3.88	4.93	4.85
306	0.83	2.31	>80	0.18	0.42	23.08	>6" GRAVEL	0.2	4.62	MOD	6S	1200-3000	4	18.46	19.71	0.2	0.25	3.94	0.73	2.89	4.93	3.61
307	0.00	8.08	>80	0.18	1.45	17.31	>6" GRAVEL	0.2	3.46	LIGHT	6I	1200-3000	1	3.46	4.92	0.3	0.35	1.47	0.44	0.65	1.72	0.78
308	1.71	8.08	>80	0.18	1.45	17.31	>6" GRAVEL	0.2	3.46	LIGHT	6I	1200-3000	1	3.46	6.62	0.3	0.35	1.99	0.60	1.18	2.32	1.38
309	3.22	8.71	75	0.37	3.22	12.58	>6" GRAVEL	0.2	2.52	LIGHT	6I	1200-3000	1	2.52	8.96	0.2	0.25	1.79	0.53	0.95	2.24	1.19
310	2.78	10.38	75	0.37	3.84	12.12	>6" GRAVEL	0.2	2.42	LIGHT	6I	1200-3000	1	2.42	9.04	0.2	0.25	1.81	0.51	0.93	2.26	1.16
311	8.99	15.71	>80	0.18	2.83	20.00	>6" GRAVEL	0.2	4.00	LIGHT	6I	1200-3000	1	4.00	15.81	0.3	0.35	4.74	1.96	9.28	5.54	10.83
312	1.71	8.08	>80	0.18	1.45	17.31	>6" GRAVEL	0.2	3.46	LIGHT	6I	1200-3000	1	3.46	6.62	0.3	0.35	1.99	0.45	0.89	2.32	1.04
313	1.54	8.57	>80	0.18	1.54	42.86	ASPHALT	0.03	1.29	MOD	AS	1200-3000	4	5.14	8.23	0.05	0.1	0.41	1.12	0.46	0.82	0.92
314	1.54	8.57	>80	0.18	1.54	42.86	>6" GRAVEL	0.2	8.57	LIGHT	6I	1200-3000	1	8.57	11.66	0.1	0.15	1.17	0.16	0.19	1.75	0.29
315	4.27	15.97	55	0.37	5.91	7.26	>6" GRAVEL	0.2	1.45	NONE	6A	1200-3000	0.05	0.07	10.25	0.2	0.25	2.05	1.06	2.18	2.56	2.72
316	8.99	15.71	>80	0.18	2.83	20.00	>6" GRAVEL	0.2	4.00	LIGHT	6I	1200-3000	1	4.00	15.81	0.3	0.35	4.74	0.39	1.86	5.54	2.17
317	1.80	6.67	>80	0.18	1.20	13.33	>6" GRAVEL	0.2	2.67	LIGHT	6I	1200-3000	1	2.67	5.67	0.2	0.25	1.13	2.63	2.99	1.42	3.73
318	1.71	8.08	>80	0.18	1.45	17.31	>6" GRAVEL	0.2	3.46	LIGHT	6I	1200-3000	1	3.46	6.62	0.3	0.35	1.99	1.15	2.29	2.32	2.67
319	1.54	8.57	>80	0.18	1.54	42.86	>6" GRAVEL	0.2	8.57	LIGHT	6I	1200-3000	1	8.57	11.66	0.1	0.15	1.17	1.08	1.26	1.75	1.88
320	3.12	18.67	>80	0.18	3.36	24.00	>6" GRAVEL	0.2	4.80	NONE	6A	1200-3000	0.05	0.24	6.72	0.1	0.15	0.67	0.46	0.31	1.01	0.47
321																			139.08	378.88		477.52
322																						
323																						
324	1.71	4.62	75	0.37	1.71	20.77	>6" GRAVEL	0.2	4.15	LIGHT	6I	1200-3000	1	4.15	7.57	0.05	0.1	0.38	1.10	0.42	0.76	0.83
325	1.71	4.62	75	0.37	1.71	20.77	>6" GRAVEL	0.2	4.15	LIGHT	6I	1200-3000	1	4.15	7.57	0.05	0.1	0.38	1.00	0.38	0.76	0.76
326	1.41	7.83	>80	0.18	1.41	44.35	>6" GRAVEL	0.2	8.87	MOD	6S	1200-3000	4	35.48	38.30	0.05	0.1	1.91	0.76	1.46	3.83	2.91
327	4.15	20.00	>80	0.18	3.60	16.92	>6" GRAVEL	0.2	3.38	LIGHT	6I	1200-3000	1	3.38	11.14	0.1	0.15	1.11	1.56	1.74	1.67	2.61
328	1.41	7.83	>80	0.18	1.41	44.35	>6" GRAVEL	0.2	8.87	MOD	6S	1200-3000	4	35.48	38.30	0.05	0.1	1.91	3.18	6.10	3.83	12.19
329	1.71	9.47	>80	0.18	1.71	41.05	>6" GRAVEL	0.2	8.21	LIGHT	6I	1200-3000	1	8.21	11.62	0	0.05	0.00	1.33	0.00	0.58	0.77
330	1.71	9.47	>80	0.18	1.71	41.05	>6" GRAVEL	0.2	8.21	LIGHT	6I	1200-3000	1	8.21	11.62	0	0.05	0.00	0.22	0.00	0.58	0.13
331	1.71	9.47	>80	0.18	1.71	41.05	>6" GRAVEL	0.2	8.21	LIGHT	6I	1200-3000	1	8.21	11.62	0	0.05	0.00	0.27	0.00	0.58	0.15
332	1.71	9.47	>80	0.18	1.71	41.05	>6" GRAVEL	0.2	8.21	LIGHT	6I	1200-3000	1	8.21	11.62	0	0.05	0.00	0.21	0.00	0.58	0.12
333	1.71	9.47	>80	0.18	1.71	41.05	>6" GRAVEL	0.2	8.21	LIGHT	6I	1200-3000	1	8.21	11.62	0	0.05	0.00	0.14	0.00	0.58	0.08
334	1.71	9.47	>80	0.18	1.71	41.05	>6" GRAVEL	0.2	8.21	LIGHT	6I	1200-3000	1	8.21	11.62	0	0.05	0.00	0.14	0.00	0.58	0.08
335	1.62	9.00	>80	0.18	1.62	42.00	>6" GRAVEL	0.2	8.40	LIGHT	6A	1200-3000	0.05	0.42	3.66	0	0.05	0.00	0.18	0.00	0.18	0.03
336	1.71	9.47	>80	0.18	1.71	41.05	>6" GRAVEL	0.2	8.21	LIGHT	6A	1200-3000	0.05	0.41	3.82	0	0.05	0.00	0.41	0.00	0.19	0.08
337	1.62	9.00	>80	0.18	1.62	42.00	>6" GRAVEL	0.2	8.40	LIGHT	6A	1200-3000	0.05	0.42	3.66	0	0.05	0.00	0.31	0.00	0.18	0.06
338	1.41	7.83	>80	0.18	1.41	44.35	>6" GRAVEL	0.2	8.87	MOD	6S	1200-3000	4	35.48	38.30	0.05	0.1	1.91	0.14	0.26	3.83	0.52
339	1.71	9.47	>80	0.18	1.71	41.05	>6" GRAVEL	0.2	8.21	LIGHT	6I	1200-3000	1	8.21	11.62	0	0.05	0.00	1.29	0.00	0.58	0.75
340	1.71	9.47	>80	0.18	1.71	41.05	>6" GRAVEL	0.2	8.21	LIGHT	6I	1200-3000	1	8.21	11.62	0	0.05	0.00	0.15	0.00	0.58	0.09
341	1.71	9.47	>80	0.18	1.71	41.05	>6" GRAVEL	0.2	8.21	LIGHT	6I	1200-3000	1	8.21	11.62	0	0.05	0.00	0.20	0.00	0.58	0.12
342	1.71	9.47	>80	0.18	1.71	41.05	>6" GRAVEL	0.2	8.21	LIGHT	6I	1200-3000	1	8.21	11.62	0	0.05	0.00	0.21	0.00	0.58	0.12
343	4.15	20.00	>80	0.18	3.60	16.92	>6" GRAVEL	0.2	3.38	LIGHT	6I	1200-3000	1	3.38	11.14	0	0.05	0.00	0.23	0.00	0.56	0.13
344	1.41	7.83	>80	0.18	1.41	44.35	>6" GRAVEL	0.2	8.87	MOD	6S	1200-3000	4	35.48	38.30	0.05	0.1	1.91	0.58	1.11	3.83	2.22
345	1.71	9.47	>80	0.18	1.71	41.05	>6" GRAVEL	0.2	8.21	LIGHT	6I	1200-3000	1	8.21	11.62	0	0.05	0.00	0.54	0.00	0.58	0.31

PART IV: HAZEL WAU
Surface Erosion Module
Form B-2.1 "Roads Calculation Sheet"

	Z	AA	AB	AC	AD	AE	AF	AG	AH	AI	AJ	AK	AL	AM	AN	AO	AP	AQ	AR	AS	AT	AU
1																						
2																						
3																						
4																						
5																						
6																						
7																						
8																						
9																						
10																						
11																						
12																						
13																						
14																						
15																						
16																	ROAD					
17															ROAD		PRISM				5 PERCENT	5 PERCENT
18	CUTSLOPE				FILLSLOPE								TableB-8	SURFACE/	PRISM	ROAD	DELIVERY				INCREASED	INCREASED
19	EROSION	FILLSLOPE	FILLSLOPE	FILLSLOPE	EROSION	TREAD	SURFACING	SURFACE	TREAD	TABLE B-9			TRAFFIC/	TRAFFIC	TOTAL	PRISM	AREA			ROAD	TOTAL	DELIVERY
20	RATE	PORTION	VEG %	VEG FACTOR	RATE	PORTION	TYPE	FACTOR	EROSION	TRAFFIC		PRECIP	PRECIP	TREAD	EROSION	DELIVERY	INCREASED	EROSION		AREA	DELIVERED	EROSION
21	W*Y	(R/100)*V			AA*AC	(S/100)*V			AE*AG				FACTOR	RATE	RATE	AREA	5 PERCENT	RATE		ACRES	SEDIMENT	RATE
22	T/A RP/YR*	T/A RP/YR*	%%%		T/A RP/YR*	T/A RP/YR*			T/A RP/YR*			millimeters		AH*AL	Z+AD+AM		{AO+.05}**	AN*AO		P/43560	AQ*AR	AN*AP
23	1.35	7.50	>80	0.18	1.35	45.00	ASPHALT	0.03	1.35	HEAVY	AM	1200-3000	50	67.50	70.20	0.05	0.1	3.51	2.70	9.48	7.02	18.96
24	1.54	8.57	>80	0.18	1.54	42.86	ASPHALT	0.03	1.29	MOD	AS	1200-3000	4	5.14	8.23	0.05	0.1	0.41	1.80	0.74	0.82	1.48
25	3.16	19.02	>80	0.18	3.42	23.41	>6" GRAVEL	0.2	4.68	LIGHT	6I	1200-3000	1	4.68	11.27	0.2	0.25	2.25	1.93	4.34	2.82	5.43
26	3.16	19.02	>80	0.18	3.42	23.41	>6" GRAVEL	0.2	4.68	LIGHT	6I	1200-3000	1	4.68	11.27	0.2	0.25	2.25	0.21	0.48	2.82	0.60
27	6.34	13.71	>80	0.18	2.47	29.14	>6" GRAVEL	0.2	5.83	LIGHT	6I	1200-3000	1	5.83	14.64	0.1	0.15	1.46	0.26	0.38	2.20	0.57
28	3.98	12.63	>80	0.18	2.27	25.26	>6" GRAVEL	0.2	5.05	MOD	6S	1200-3000	4	20.21	26.46	0.2	0.25	5.29	3.22	17.03	6.62	21.29
29	0.83	2.31	>80	0.18	0.42	23.08	>6" GRAVEL	0.2	4.62	MOD	6S	1200-3000	4	18.46	19.71	0.2	0.25	3.94	3.78	14.90	4.93	18.33
30	0.94	3.91	>80	0.18	0.70	20.87	>6" GRAVEL	0.2	4.17	LIGHT	6I	1200-3000	1	4.17	5.82	0.1	0.15	0.58	0.30	0.17	0.87	0.26
31	1.71	8.08	>80	0.18	1.45	17.31	>6" GRAVEL	0.2	3.46	LIGHT	6I	1200-3000	1	3.46	6.62	0.3	0.35	1.99	0.71	1.41	2.32	1.65
32	1.71	8.08	>80	0.18	1.45	17.31	>6" GRAVEL	0.2	3.46	LIGHT	6I	1200-3000	1	3.46	6.62	0.3	0.35	1.99	0.41	0.82	2.32	0.96
33	6.34	13.71	>80	0.18	2.47	29.14	>6" GRAVEL	0.2	5.83	LIGHT	6I	1200-3000	1	5.83	14.64	0.1	0.15	1.46	1.13	1.66	2.20	2.49
34	3.16	19.02	>80	0.18	3.42	23.41	>6" GRAVEL	0.2	4.68	LIGHT	6I	1200-3000	1	4.68	11.27	0.2	0.25	2.25	1.39	3.13	2.82	3.91
35	6.34	13.71	>80	0.18	2.47	29.14	>6" GRAVEL	0.2	5.83	LIGHT	6I	1200-3000	1	5.83	14.64	0.1	0.15	1.46	0.37	0.55	2.20	0.82
36	3.16	19.02	>80	0.18	3.42	23.41	>6" GRAVEL	0.2	4.68	LIGHT	6I	1200-3000	1	4.68	11.27	0.2	0.25	2.25	2.20	4.95	2.82	6.19
37	1.71	8.08	>80	0.18	1.45	17.31	>6" GRAVEL	0.2	3.46	LIGHT	6I	1200-3000	1	3.46	6.62	0.3	0.35	1.99	2.60	5.16	2.32	6.02
38	0.94	3.91	>80	0.18	0.70	20.87	>6" GRAVEL	0.2	4.17	LIGHT	6I	1200-3000	1	4.17	5.82	0.1	0.15	0.58	0.59	0.35	0.87	0.52
39	1.71	8.08	>80	0.18	1.45	17.31	>6" GRAVEL	0.2	3.46	LIGHT	6I	1200-3000	1	3.46	6.62	0.3	0.35	1.99	1.62	3.22	2.32	3.76
40	0.94	3.91	>80	0.18	0.70	20.87	>6" GRAVEL	0.2	4.17	LIGHT	6I	1200-3000	1	4.17	5.82	0.1	0.15	0.58	0.98	0.57	0.87	0.86
41	0.83	2.31	>80	0.18	0.42	23.08	>6" GRAVEL	0.2	4.62	MOD	6S	1200-3000	4	18.46	19.71	0.2	0.25	3.94	4.77	18.82	4.93	23.52
42	0.74	4.09	>80	0.18	0.74	21.82	>6" GRAVEL	0.2	4.36	NONE	6A	1200-3000	0.05	0.22	1.69	0	0.05	0.00	0.56	0.00	0.08	0.05
43	1.71	8.08	>80	0.18	1.45	17.31	>6" GRAVEL	0.2	3.46	NONE	6A	1200-3000	0.05	0.17	3.33	0.05	0.1	0.17	0.74	0.12	0.33	0.25
44	0.94	3.91	>80	0.18	0.70	20.87	>6" GRAVEL	0.2	4.17	LIGHT	6I	1200-3000	1	4.17	5.82	0.1	0.15	0.58	0.52	0.30	0.87	0.46
45	0.94	3.91	>80	0.18	0.70	20.87	>6" GRAVEL	0.2	4.17	LIGHT	6I	1200-3000	1	4.17	5.82	0.1	0.15	0.58	1.78	1.03	0.87	1.55
46	3.22	8.71	75	0.37	3.22	12.58	>6" GRAVEL	0.2	2.52	NONE	6A	1200-3000	0.05	0.13	6.57	0	0.05	0.00	0.56	0.00	0.33	0.18
47	1.71	8.08	>80	0.18	1.45	17.31	NATIVE	1	17.31	NONE	NA	1200-3000	0.05	0.87	4.03	0.1	0.15	0.40	2.61	1.05	0.60	1.58
48	2.78	8.57	75	0.37	3.17	13.93	>6" GRAVEL	0.2	2.79	LIGHT	6I	1200-3000	1	2.79	8.73	0.2	0.25	1.75	0.54	0.94	2.18	1.18
49	0.94	3.91	>80	0.18	0.70	20.87	>6" GRAVEL	0.2	4.17	LIGHT	6I	1200-3000	1	4.17	5.82	0.1	0.15	0.58	0.71	0.41	0.87	0.62
50	0.94	3.91	>80	0.18	0.70	20.87	>6" GRAVEL	0.2	4.17	LIGHT	6I	1200-3000	1	4.17	5.82	0.1	0.15	0.58	1.74	1.01	0.87	1.52
51	1.71	8.08	>80	0.18	1.45	17.31	>6" GRAVEL	0.2	3.46	LIGHT	6I	1200-3000	1	3.46	6.62	0.3	0.35	1.99	0.96	1.91	2.32	2.23
52	1.71	8.08	>80	0.18	1.45	17.31	>6" GRAVEL	0.2	3.46	LIGHT	6I	1200-3000	1	3.46	6.62	0.3	0.35	1.99	0.21	0.42	2.32	0.50
53	1.71	8.08	>80	0.18	1.45	17.31	>6" GRAVEL	0.2	3.46	NONE	6A	1200-3000	0.05	0.17	3.33	0.05	0.1	0.17	0.99	0.16	0.33	0.33
54	1.71	8.08	>80	0.18	1.45	17.31	>6" GRAVEL	0.2	3.46	LIGHT	6I	1200-3000	1	3.46	6.62	0.3	0.35	1.99	1.13	2.25	2.32	2.62
55	0.70	2.73	>80	0.18	0.49	3.41	>6" GRAVEL	0.2	0.68	LIGHT	6I	1200-3000	1	0.68	1.87	0.2	0.25	0.37	3.58	1.34	0.47	1.67
56	0.70	2.73	>80	0.18	0.49	3.41	>6" GRAVEL	0.2	0.68	LIGHT	6I	1200-3000	1	0.68	1.87	0.2	0.25	0.37	5.34	1.99	0.47	2.49
57	0.32	2.14	>80	0.18	0.39	6.07	>6" GRAVEL	0.2	1.21	NONE	6A	1200-3000	0.05	0.06	0.77	0.1	0.15	0.08	0.53	0.04	0.12	0.06

PART IV: HAZEL WAU
Surface Erosion Module
Form B-2.1 "Roads Calculation Sheet"

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y
14				T/A RP/YR*	**																				
15				is tons/acre of	means																				
16				road prism/year	generally																				
17										"TYPE"	"TYPE"	"TYPE"				TOTAL						TableB-5			
18										CUTSLOPE	FILLSLOPE	TREAD				ROAD						BASIC			TableB-6
19					ROAD	ROAD	ROAD	ROAD	"TYPE"	MAP	MAP	MAP	CUTSLOPE	FILLSLOPE	TREAD	PRISM	AREA	AREA	AREA	ROAD		EROSION	CUTSLOPE	CUTSLOPE	CUTSLOPE
20			WAU	SUBBASIN	SEGMENT	SLOPE	LENGTH	"TYPE"	METHOD	DISTANCE	DISTANCE	DISTANCE	AREA	AREA	AREA	AREA	CUTSLOPE	FILLSLOPE	TREAD	AGE	GEOLOGY	RATE	PORTION	VEG	VEG FACTOR
21		EQUATION											G*J	G*K	G*L	M+N+O	(M/P)*100	(N/P)*100	(O/P)*100				(Q/100)*U		
22		UNITS				%%%	feet			feet	feet	feet	feet^2	feet^2	feet^2	feet^2	%%%	%%%	%%%			T/A RP/YR*	T/A RP/YR*	%%%	
58			Hazel	BROOKS CK	39	3.2	4429	36	2	17	12	15	75293	53148	66435	194876	38.64	27.27	34.09	>2 YRS	METAMORPH	10	3.86	>80	0.18
59			Hazel	BROOKS CK	40	16.8	411	245	6	5	6	17	2055	2466	6987	11508	17.86	21.43	60.71	>2 YRS	METAMORPH	10	1.79	>80	0.18
60			Hazel	BROOKS CK	41	15	573	245	6	5	6	17	2865	3438	9741	16044	17.86	21.43	60.71	>2 YRS	METAMORPH	10	1.79	>80	0.18
61			Hazel	BROOKS CK	42	5.3	5312	36	2	17	12	15	90304	63744	79680	233728	38.64	27.27	34.09	>2 YRS	METAMORPH	10	3.86	>80	0.18
62			Hazel	BROOKS CK	43	6.8	1429	36	1	17	12	15	24293	17148	21435	62876	38.64	27.27	34.09	>2 YRS	METAMORPH	10	3.86	>80	0.18
63			Hazel	BROOKS CK	44	5.6	2230	36	2	17	12	15	37910	26760	33450	98120	38.64	27.27	34.09	>2 YRS	METAMORPH	10	3.86	>80	0.18
64			Hazel	BROOKS CK	52	10	824	242	6	9	8	14	7416	6592	11536	25544	29.03	25.81	45.16	>2 YRS	METAMORPH	10	2.90	>80	0.18
65			Hazel	BROOKS CK	54	8	4458	36	3	17	12	15	75786	53496	66870	196152	38.64	27.27	34.09	>2 YRS	METAMORPH	10	3.86	>80	0.18
66			Hazel	BROOKS CK	55	3.3	657	36	1	17	12	15	11169	7884	9855	28908	38.64	27.27	34.09	>2 YRS	METAMORPH	10	3.86	>80	0.18
67			Hazel	BROOKS CK	56	0.5	1511	250	6	12	8	16	18132	12088	24176	54396	33.33	22.22	44.44	>2 YRS	SEDROCK	30	10.00	>80	0.18
68			Hazel	BROOKS CK	57	11.1	3224	36	3	17	12	15	54808	38688	48360	141856	38.64	27.27	34.09	>2 YRS	METAMORPH	10	3.86	>80	0.18
69			Hazel	BROOKS CK	59	4	3051	36	1	17	12	15	51867	36612	45765	134244	38.64	27.27	34.09	>2 YRS	METAMORPH	10	3.86	>80	0.18
70			Hazel	BROOKS CK	85	0.9	2011	9	1	4	2	20	8044	4022	40220	52286	15.38	7.69	76.92	>2 YRS	MODWTHRDRK	30	4.62		0.18
71			Hazel	BROOKS CK	104	1.7	3159	8	1	14	8	16	44226	25272	50544	120042	36.84	21.05	42.11	>2 YRS	HIWTHRDSED	60	22.11	>80	0.18
72			Hazel	BROOKS CK	105	8	1390	124	5	6	5	16	8340	6950	22240	37530	22.22	18.52	59.26	>2 YRS	HIWTHRDSED	60	13.33	>80	0.18
73			Hazel	BROOKS CK	106	16	602	71	6	3	3	14	1806	1806	8428	12040	15.00	15.00	70.00	>2 YRS	HIWTHRDSED	60	9.00	>80	0.18
74			Hazel	BROOKS CK	107	16.2	336	71	6	3	3	14	1008	1008	4704	6720	15.00	15.00	70.00	>2 YRS	HIWTHRDSED	60	9.00	>80	0.18
75			Hazel	BROOKS CK	108	6.7	716	14	1	12	13	16	8592	9308	11456	29356	29.27	31.71	39.02	>2 YRS	HIWTHRDSED	60	17.56	>80	0.18
76			Hazel	BROOKS CK	114	1.2	387	8	1	14	8	16	5418	3096	6192	14706	36.84	21.05	42.11	>2 YRS	HIWTHRDSED	60	22.11	>80	0.18
77			Hazel	BROOKS CK	115	0.1	2045	14	1	12	13	16	24540	26585	32720	83845	29.27	31.71	39.02	>2 YRS	HIWTHRDSED	60	17.56	>80	0.18
78			Hazel	BROOKS CK	117	11.7	1189	29	1	4	3	16	4756	3567	19024	27347	17.39	13.04	69.57	>2 YRS	MODWTHRDRK	30	5.22	>80	0.18
79			Hazel	BROOKS CK	118	4	509	32	1	4	7	15	2036	3563	7635	13234	15.38	26.92	57.69	>2 YRS	MODWTHRDRK	30	4.62	75	0.37
80			Hazel	BROOKS CK	121	1.2	3569	32	1	4	7	15	14276	24983	53535	92794	15.38	26.92	57.69	>2 YRS	MODWTHRDRK	30	4.62	75	0.37
81			Hazel	BROOKS CK	122	13.3	453	29	1	4	3	16	1812	1359	7248	10419	17.39	13.04	69.57	>2 YRS	MODWTHRDRK	30	5.22	>80	0.18
82			Hazel	BROOKS CK	123	12.5	498	29	1	4	3	16	1992	1494	7968	11454	17.39	13.04	69.57	>2 YRS	MODWTHRDRK	30	5.22	>80	0.18
83			Hazel	BROOKS CK	308	11	1797	124	5	6	5	16	10782	8985	28752	48519	22.22	18.52	59.26	>2 YRS	HIWTHRDSED	60	13.33	>80	0.18
84			Hazel	BROOKS CK	327	7.5	3252	124	5	6	5	16	19512	16260	52032	87804	22.22	18.52	59.26	>2 YRS	HIWTHRDSED	60	13.33	>80	0.18
85			Hazel	BROOKS CK	329	1.3	757	208-209	5	13	7	20	9841	5299	15140	30280	32.50	17.50	50.00	>2 YRS	METAMORPH	10	3.25	75	0.37
86		TOTALS					128561																		
87																									
88																									
89			Hazel	DICKS CK	129	6.2	1266	131	1	10	6	14	12660	7596	17724	37980	33.33	20.00	46.67	>2 YRS	HIWTHRDSED	60	20.00	>80	0.18
90			Hazel	DICKS CK	131	0.6	886	131	1	10	6	14	8860	5316	12404	26580	33.33	20.00	46.67	>2 YRS	HIWTHRDSED	60	20.00	>80	0.18
91			Hazel	DICKS CK	132	2.9	4511	132	1	6	7	15	27066	31577	67665	126308	21.43	25.00	53.57	>2 YRS	MODWTHRDRK	30	6.43	>80	0.18
92			Hazel	DICKS CK	135	26	617	141	6	10	13	12	6170	8021	7404	21595	28.57	37.14	34.29	>2 YRS	MODWTHRDRK	30	8.57	>80	0.18
93			Hazel	DICKS CK	137	10.8	490	132	3	6	7	15	2940	3430	7350	13720	21.43	25.00	53.57	>2 YRS	MODWTHRDRK	30	6.43	>80	0.18
94			Hazel	DICKS CK	172	2.9	763	8-60-125-254-258	5	11	12	19	8393	9156	14497	32046	26.19	28.57	45.24	>2 YRS	HI WTHRDSED	60	15.71	>80	0.18
95		TOTALS					8533																		
96																									
97																									
98			Hazel	MT HIGGINS	173	5.33	1072	247	1	12	13	15	12864	13936	16080	42880	30.00	32.50	37.50	>2 YRS	HI WTHRDSED	60	18.00	50	0.37
99			Hazel	MT HIGGINS	176	0.2	1556	175	5	4	4	20	6224	6224	31120	43568	14.29	14.29	71.43	>2 YRS	HIWTHRDSED	60	8.57	>80	0.18
100			Hazel	MT HIGGINS	177	0.7	3729	175	5	4	4	20	14916	14916	74580	104412	14.29	14.29	71.43	>2 YRS	HIWTHRDSED	60	8.57	>80	0.18
101			Hazel	MT HIGGINS	190	3	304	198-203-230-235-240	1	10	6	15	3040	1824	4560	9424	32.26	19.35	48.39	>2 YRS	HIWTHRDSED	60	19.35	70	0.37
102			Hazel	MT HIGGINS	191	0.5	1207	198-203-230-235-240	1	10	6	15	12070	7242	18105	37417	32.26	19.35	48.39	>2 YRS	HIWTHRDSED	60	19.35	70	0.37
103			Hazel	MT HIGGINS	192	1	2666	198-203-230-235-240	1	10	6	15	26660	15996	39990	82646	32.26	19.35	48.39	>2 YRS	HIWTHRDSED	60	19.35	70	0.37
104			Hazel	MT HIGGINS	193	0.3	3706	198-203-230-235-240	1	10	6	15	37060	22236	55590	114886	32.26	19.35	48.39	>2 YRS	HIWTHRDSED	60	19.35	70	0.37
105			Hazel	MT HIGGINS	194	1	1439	198-203-230-235-240	1	10	6	15	14390	8634	21585	44609	32.26	19.35	48.39	>2 YRS	HIWTHRDSED	60	19.35	70	0.37

PART IV: HAZEL WAU
Surface Erosion Module
Form B-2.1 "Roads Calculation Sheet"

	Z	AA	AB	AC	AD	AE	AF	AG	AH	AI	AJ	AK	AL	AM	AN	AO	AP	AQ	AR	AS	AT	AU
14																	ROAD					
15																	PRISM				5 PERCENT	5 PERCENT
16															ROAD		DELIVERY				INCREASED	INCREASED
17													TableB-8	SURFACE/	PRISM	ROAD	AREA		ROAD	TOTAL	DELIVERY	TOTAL
18	CUTSLOPE				FILLSLOPE				TREAD	TABLE B-9			TRAFFIC/	TRAFFIC	TOTAL	PRISM	INCREASED	EROSION	AREA	DELIVERED	EROSION	DELIVERED
19	EROSION	FILLSLOPE	FILLSLOPE	FILLSLOPE	EROSION	TREAD	SURFACING	SURFACE	EROSION	TRAFFIC		PRECIP	PRECIP	TREAD	EROSION	DELIVERY	5 PERCENT	RATE	ACRES	SEDIMENT	RATE	SEDIMENT
20	RATE	PORTION	VEG %	VEG FACTOR	RATE	PORTION	TYPE	FACTOR	RATE	TYPE	TRAFFIC	ZONE	FACTOR	RATE	RATE	AREA	(AO+.05)**	AN*AO	P/43560	AQ*AR	AN*AP	AT*AR
21	W*Y	(R/100)*V			AA*AC	(S/100)*V			AE*AG					AH*AL	Z+AD+AM							
22	T/A RP/YR*	T/A RP/YR*	%%%		T/A RP/YR*	T/A RP/YR*			T/A RP/YR*			millimeters		T/A RP/YR*	T/A RP/YR*	%%%	%%%	T/A RP/YR*	AC	US TONS/YR	T/A RP/YR*	US TONS/YR
58	0.70	2.73	>80	0.18	0.49	3.41	>6" GRAVEL	0.2	0.68	NONE	6A	1200-3000	0.05	0.03	1.22	0.05	0.1	0.06	4.47	0.27	0.12	0.55
59	0.32	2.14	>80	0.18	0.39	6.07	>6" GRAVEL	0.2	1.21	NONE	6A	1200-3000	0.05	0.06	0.77	0.1	0.15	0.08	0.26	0.02	0.12	0.03
60	0.32	2.14	>80	0.18	0.39	6.07	>6" GRAVEL	0.2	1.21	NONE	6A	1200-3000	0.05	0.06	0.77	0.1	0.15	0.08	0.37	0.03	0.12	0.04
61	0.70	2.73	>80	0.18	0.49	3.41	>6" GRAVEL	0.2	0.68	NONE	6A	1200-3000	0.05	0.03	1.22	0.05	0.1	0.06	5.37	0.33	0.12	0.65
62	0.70	2.73	>80	0.18	0.49	3.41	>6" GRAVEL	0.2	0.68	LIGHT	6I	1200-3000	1	0.68	1.87	0.2	0.25	0.37	1.44	0.54	0.47	0.67
63	0.70	2.73	>80	0.18	0.49	3.41	>6" GRAVEL	0.2	0.68	NONE	6A	1200-3000	0.05	0.03	1.22	0.05	0.1	0.06	2.25	0.14	0.12	0.27
64	0.52	2.58	>80	0.18	0.46	4.52	>6" GRAVEL	0.2	0.90	NONE	6A	1200-3000	0.05	0.05	1.03	0.1	0.15	0.10	0.59	0.06	0.15	0.09
65	0.70	2.73	>80	0.18	0.49	3.41	>6" GRAVEL	0.2	0.68	LIGHT	6I	1200-3000	1	0.68	1.87	0.2	0.25	0.37	4.50	1.68	0.47	2.10
66	0.70	2.73	>80	0.18	0.49	3.41	>6" GRAVEL	0.2	0.68	LIGHT	6I	1200-3000	1	0.68	1.87	0.2	0.25	0.37	0.66	0.25	0.47	0.31
67	1.80	6.67	>80	0.18	1.20	13.33	>6" GRAVEL	0.2	2.67	LIGHT	6I	1200-3000	1	2.67	5.67	0.2	0.25	1.13	1.25	1.42	1.42	1.77
68	0.70	2.73	>80	0.18	0.49	3.41	>6" GRAVEL	0.2	0.68	LIGHT	6I	1200-3000	1	0.68	1.87	0.2	0.25	0.37	3.26	1.22	0.47	1.52
69	0.70	2.73	>80	0.18	0.49	3.41	>6" GRAVEL	0.2	0.68	LIGHT	6I	1200-3000	1	0.68	1.87	0.2	0.25	0.37	3.08	1.15	0.47	1.44
70	0.83	2.31	>80	0.18	0.42	23.08	>6" GRAVEL	0.2	4.62	MOD	6S	1200-3000	4	18.46	19.71	0.2	0.25	3.94	1.20	4.73	4.93	5.91
71	3.98	12.63	>80	0.18	2.27	25.26	>6" GRAVEL	0.2	5.05	MOD	6S	1200-3000	4	20.21	26.46	0.2	0.25	5.29	2.76	14.59	6.62	18.23
72	2.40	11.11	>80	0.18	2.00	35.56	>6" GRAVEL	0.2	7.11	MOD	6S	1200-3000	4	28.44	32.84	0.2	0.25	6.57	0.86	5.66	8.21	7.07
73	1.62	9.00	>80	0.18	1.62	42.00	>6" GRAVEL	0.2	8.40	LIGHT	6I	1200-3000	1	8.40	11.64	0	0.05	0.00	0.28	0.00	0.58	0.16
74	1.62	9.00	>80	0.18	1.62	42.00	>6" GRAVEL	0.2	8.40	LIGHT	6I	1200-3000	1	8.40	11.64	0	0.05	0.00	0.15	0.00	0.58	0.09
75	3.16	19.02	>80	0.18	3.42	23.41	>6" GRAVEL	0.2	4.68	LIGHT	6I	1200-3000	1	4.68	11.27	0.2	0.25	2.25	0.67	1.52	2.82	1.90
76	3.98	12.63	>80	0.18	2.27	25.26	>6" GRAVEL	0.2	5.05	MOD	6S	1200-3000	4	20.21	26.46	0.2	0.25	5.29	0.34	1.79	6.62	2.23
77	3.16	19.02	>80	0.18	3.42	23.41	>6" GRAVEL	0.2	4.68	LIGHT	6I	1200-3000	1	4.68	11.27	0.2	0.25	2.25	1.92	4.34	2.82	5.42
78	0.94	3.91	>80	0.18	0.70	20.87	>6" GRAVEL	0.2	4.17	LIGHT	6I	1200-3000	1	4.17	5.82	0.1	0.15	0.58	0.63	0.37	0.87	0.55
79	1.71	8.08	>80	0.18	1.45	17.31	>6" GRAVEL	0.2	3.46	LIGHT	6I	1200-3000	1	3.46	6.62	0.3	0.35	1.99	0.30	0.60	2.32	0.70
80	1.71	8.08	>80	0.18	1.45	17.31	>6" GRAVEL	0.2	3.46	LIGHT	6I	1200-3000	1	3.46	6.62	0.3	0.35	1.99	2.13	4.23	2.32	4.94
81	0.94	3.91	>80	0.18	0.70	20.87	>6" GRAVEL	0.2	4.17	LIGHT	6I	1200-3000	1	4.17	5.82	0.1	0.15	0.58	0.24	0.14	0.87	0.21
82	0.94	3.91	>80	0.18	0.70	20.87	>6" GRAVEL	0.2	4.17	LIGHT	6I	1200-3000	1	4.17	5.82	0.1	0.15	0.58	0.26	0.15	0.87	0.23
83	2.40	11.11	>80	0.18	2.00	35.56	>6" GRAVEL	0.2	7.11	MOD	6S	1200-3000	4	28.44	32.84	0.2	0.25	6.57	1.11	7.32	8.21	9.15
84	2.40	11.11	>80	0.18	2.00	35.56	>6" GRAVEL	0.2	7.11	MOD	6S	1200-3000	4	28.44	32.84	0.2	0.25	6.57	2.02	13.24	8.21	16.55
85	1.20	1.75	>80	0.18	0.32	5.00	>6" GRAVEL	0.2	1.00	MOD	6S	1200-3000	4	4.00	5.52	0.1	0.15	0.55	0.70	0.38	0.83	0.58
86																			96.56	167.33		218.57
87																						
88																						
89	3.60	12.00	>80	0.18	2.16	28.00	>6" GRAVEL	0.2	5.60	LIGHT	6I	1200-3000	1	5.60	11.36	0	0.05	0.00	0.87	0.00	0.57	0.50
90	3.60	12.00	>80	0.18	2.16	28.00	>6" GRAVEL	0.2	5.60	LIGHT	6I	1200-3000	1	5.60	11.36	0	0.05	0.00	0.61	0.00	0.57	0.35
91	1.16	7.50	>80	0.18	1.35	16.07	>6" GRAVEL	0.2	3.21	NONE	6A	1200-3000	0.05	0.16	2.67	0.1	0.15	0.27	2.90	0.77	0.40	1.16
92	1.54	11.14	>80	0.18	2.01	10.29	>6" GRAVEL	0.2	2.06	NONE	6A	1200-3000	0.05	0.10	3.65	0.05	0.1	0.18	0.50	0.09	0.37	0.18
93	1.16	7.50	>80	0.18	1.35	16.07	>6" GRAVEL	0.2	3.21	NONE	6A	1200-3000	0.05	0.16	2.67	0.05	0.1	0.13	0.31	0.04	0.27	0.08
94	2.83	17.14	>80	0.18	3.09	27.14	>6" GRAVEL	0.2	5.43	MOD	6S	1200-3000	4	21.71	27.63	0.2	0.25	5.53	0.74	4.07	6.91	5.08
95																			5.93	4.97		7.35
96																						
97																						
98	6.66	19.50	>80	0.18	3.51	22.50	>6" GRAVEL	0.2	4.50	NONE	6A	1200-3000	0.05	0.23	10.40	0.1	0.15	1.04	0.98	1.02	1.56	1.53
99	1.54	8.57	>80	0.18	1.54	42.86	ASPHALT	0.03	1.29	MOD	AS	1200-3000	4	5.14	8.23	0.05	0.1	0.41	1.00	0.41	0.82	0.82
100	1.54	8.57	>80	0.18	1.54	42.86	ASPHALT	0.03	1.29	MOD	AS	1200-3000	4	5.14	8.23	0.05	0.1	0.41	2.40	0.99	0.82	1.97
101	7.16	11.61	>80	0.18	2.09	29.03	>6" GRAVEL	0.2	5.81	LIGHT	6I	1200-3000	1	5.81	15.06	0.05	0.1	0.75	0.22	0.16	1.51	0.33
102	7.16	11.61	>80	0.18	2.09	29.03	>6" GRAVEL	0.2	5.81	LIGHT	6I	1200-3000	1	5.81	15.06	0.05	0.1	0.75	0.86	0.65	1.51	1.29
103	7.16	11.61	>80	0.18	2.09	29.03	>6" GRAVEL	0.2	5.81	LIGHT	6I	1200-3000	1	5.81	15.06	0.05	0.1	0.75	1.90	1.43	1.51	2.86
104	7.16	11.61	>80	0.18	2.09	29.03	>6" GRAVEL	0.2	5.81	LIGHT	6I	1200-3000	1	5.81	15.06	0.05	0.1	0.75	2.64	1.99	1.51	3.97
105	7.16	11.61	>80	0.18	2.09	29.03	>6" GRAVEL	0.2	5.81	LIGHT	6I	1200-3000	1	5.81	15.06	0.05	0.1	0.75	1.02	0.77	1.51	1.54

PART IV: HAZEL WAU
Surface Erosion Module
Form B-2.1 "Roads Calculation Sheet"

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y
14				T/A RP/YR*	**																				
15				is tons/acre of	means																				
16				road prism/year	generally																				
17										"TYPE"	"TYPE"	"TYPE"				TOTAL						TableB-5			
18										CUTSLOPE	FILLSLOPE	TREAD				ROAD						BASIC			TableB-6
19					ROAD	ROAD	ROAD	ROAD	"TYPE"	MAP	MAP	MAP	CUTSLOPE	FILLSLOPE	TREAD	PRISM	AREA	AREA	AREA	ROAD		EROSION	CUTSLOPE	CUTSLOPE	CUTSLOPE
20			WAU	SUBBASIN	SEGMENT	SLOPE	LENGTH	"TYPE"	METHOD	DISTANCE	DISTANCE	DISTANCE	AREA	AREA	AREA	AREA	CUTSLOPE	FILLSLOPE	TREAD	AGE	GEOLOGY	RATE	PORTION	VEG	VEG FACTOR
21		EQUATION											G*J	G*K	G*L	M+N+O	{M/P}*100	{N/P}*100	{O/P}*100				{Q/100}*U		
22		UNITS				%%%	feet			feet	feet	feet	feet^2	feet^2	feet^2	feet^2	%%%	%%%	%%%			T/A RP/YR*	T/A RP/YR*	%%%	
106			Hazel	MT HIGGINS	195	0.5	1220	198-203-230-235-240	1	10	6	15	12200	7320	18300	37820	32.26	19.35	48.39	>2 YRS	HIWTHRDSED	60	19.35	70	0.37
107			Hazel	MT HIGGINS	196	1.7	353	198-203-230-235-240	1	10	6	15	3530	2118	5295	10943	32.26	19.35	48.39	>2 YRS	HIWTHRDSED	60	19.35	70	0.37
108			Hazel	MT HIGGINS	197	3	1856	198-203-230-235-240	1	10	6	15	18560	11136	27840	57536	32.26	19.35	48.39	>2 YRS	HIWTHRDSED	60	19.35	70	0.37
109			Hazel	MT HIGGINS	198	1	2992	198-203-230-235-240	1	10	6	15	29920	17952	44880	92752	32.26	19.35	48.39	>2 YRS	HIWTHRDSED	60	19.35	70	0.37
110			Hazel	MT HIGGINS	199	13.3	542	224-238	1	15	10	15	8130	5420	8130	21680	37.50	25.00	37.50	>2 YRS	HIWTHRDSED	60	22.50	70	0.37
111			Hazel	MT HIGGINS	200	4.8	272	198-203-230-235-240	1	10	6	15	2720	1632	4080	8432	32.26	19.35	48.39	>2 YRS	HIWTHRDSED	60	19.35	70	0.37
112			Hazel	MT HIGGINS	201	0.8	539	198-203-230-235-240	1	10	6	15	5390	3234	8085	16709	32.26	19.35	48.39	>2 YRS	HIWTHRDSED	60	19.35	70	0.37
113			Hazel	MT HIGGINS	202	1.9	1846	8-60-125-254-258	5	11	12	19	20306	22152	35074	77532	26.19	28.57	45.24	>2 YRS	HIWTHRDSED	60	15.71	>80	0.18
114			Hazel	MT HIGGINS	203	2.2	1592	198-203-230-235-240	1	10	6	15	15920	9552	23880	49352	32.26	19.35	48.39	>2 YRS	HIWTHRDSED	60	19.35	70	0.37
115			Hazel	MT HIGGINS	204	2.9	2562	198-203-230-235-240	1	10	6	15	25620	15372	38430	79422	32.26	19.35	48.39	>2 YRS	HIWTHRDSED	60	19.35	70	0.37
116			Hazel	MT HIGGINS	205	1.5	1559	247	1	12	13	15	18708	20267	23385	62360	30.00	32.50	37.50	>2 YRS	HIWTHRDSED	60	18.00	50	0.37
117			Hazel	MT HIGGINS	206	3.7	5927	247	1	12	13	15	71124	77051	88905	237080	30.00	32.50	37.50	>2 YRS	HIWTHRDSED	60	18.00	50	0.37
118			Hazel	MT HIGGINS	207	7.4	2459	207	3	12	11	15	29508	27049	36885	93442	31.58	28.95	39.47	>2 YRS	MODWTHRDRK	30	9.47	>80	0.18
119			Hazel	MT HIGGINS	208	8.8	3133	208	1	15	5	17	46995	15665	53261	115921	40.54	13.51	45.95	>2 YRS	METAMORPH	10	4.05	70	0.37
120			Hazel	MT HIGGINS	211	14.1	797	213	3	10	6	18	7970	4782	14346	27098	29.41	17.65	52.94	>2 YRS	SCHIST	60	17.65	>80	0.18
121			Hazel	MT HIGGINS	212	7.2	1516	208	1	15	5	17	22740	7580	25772	56092	40.54	13.51	45.95	>2 YRS	METAMORPH	10	4.05	70	0.37
122			Hazel	MT HIGGINS	213	3.6	2059	213	1	10	6	18	20590	12354	37062	70006	29.41	17.65	52.94	>2 YRS	SCHIST	60	17.65	>80	0.18
123			Hazel	MT HIGGINS	215	7.9	2895	213	3	10	6	18	28950	17370	52110	98430	29.41	17.65	52.94	>2 YRS	SCHIST	60	17.65	>80	0.18
124			Hazel	MT HIGGINS	216	5.9	1119	8-60-125-254-258	5	11	12	19	12309	13428	21261	46998	26.19	28.57	45.24	>2 YRS	HIWTHRDSED	60	15.71	>80	0.18
125			Hazel	MT HIGGINS	217	6.9	911	207	3	12	11	15	10932	10021	13665	34618	31.58	28.95	39.47	>2 YRS	MODWTHRDRK	30	9.47	>80	0.18
126			Hazel	MT HIGGINS	218	2.1	2967	219	1	2	2	10	5934	5934	29670	41538	14.29	14.29	71.43	>2 YRS	MODWTHRDRK	30	4.29	>80	0.18
127			Hazel	MT HIGGINS	219	11.4	723	219	1	2	2	10	1446	1446	7230	10122	14.29	14.29	71.43	>2 YRS	MODWTHRDRK	30	4.29	>80	0.18
128			Hazel	MT HIGGINS	220	17.1	548	219	3	2	2	10	1096	1096	5480	7672	14.29	14.29	71.43	>2 YRS	MODWTHRDRK	30	4.29	>80	0.18
129			Hazel	MT HIGGINS	221	5	1247	219	3	2	2	10	2494	2494	12470	17458	14.29	14.29	71.43	>2 YRS	MODWTHRDRK	30	4.29	>80	0.18
130			Hazel	MT HIGGINS	222	3.5	239	250	1	12	8	16	2868	1912	3824	8604	33.33	22.22	44.44	>2 YRS	SEDROCK	30	10.00	>80	0.18
131			Hazel	MT HIGGINS	223	5	1375	250	1	12	8	16	16500	11000	22000	49500	33.33	22.22	44.44	>2 YRS	SEDROCK	30	10.00	>80	0.18
132			Hazel	MT HIGGINS	224	10.3	4587	224-238	1	15	10	15	68805	45870	68805	183480	37.50	25.00	37.50	>2 YRS	HIWTHRDSED	60	22.50	70	0.37
133			Hazel	MT HIGGINS	225	7.5	221	224-238	1	15	10	15	3315	2210	3315	8840	37.50	25.00	37.50	>2 YRS	HIWTHRDSED	60	22.50	70	0.37
134			Hazel	MT HIGGINS	226	5	874	198-203-230-235-240	1	10	6	15	8740	5244	13110	27094	32.26	19.35	48.39	>2 YRS	HIWTHRDSED	60	19.35	70	0.37
135			Hazel	MT HIGGINS	227	0.3	4091	198-203-230-235-240	1	10	6	15	40910	24546	61365	126821	32.26	19.35	48.39	>2 YRS	HIWTHRDSED	60	19.35	70	0.37
136			Hazel	MT HIGGINS	228	11.4	457	224-238	1	15	10	15	6855	4570	6855	18280	37.50	25.00	37.50	>2 YRS	HIWTHRDSED	60	22.50	70	0.37
137			Hazel	MT HIGGINS	229	8.9	417	224-238	1	15	10	15	6255	4170	6255	16680	37.50	25.00	37.50	>2 YRS	HIWTHRDSED	60	22.50	70	0.37
138			Hazel	MT HIGGINS	230	0.7	2889	198-203-230-235-240	1	10	6	15	28890	17334	43335	89559	32.26	19.35	48.39	>2 YRS	HIWTHRDSED	60	19.35	70	0.37
139			Hazel	MT HIGGINS	231	0.7	617	198-203-230-235-240	1	10	6	15	6170	3702	9255	19127	32.26	19.35	48.39	>2 YRS	HIWTHRDSED	60	19.35	70	0.37
140			Hazel	MT HIGGINS	232	1.7	418	198-203-230-235-240	1	10	6	15	4180	2508	6270	12958	32.26	19.35	48.39	>2 YRS	HIWTHRDSED	60	19.35	70	0.37
141			Hazel	MT HIGGINS	233	5.6	950	198-203-230-235-240	1	10	6	15	9500	5700	14250	29450	32.26	19.35	48.39	>2 YRS	HIWTHRDSED	60	19.35	70	0.37
142			Hazel	MT HIGGINS	234	5.7	1747	198-203-230-235-240	1	10	6	15	17470	10482	26205	54157	32.26	19.35	48.39	>2 YRS	HIWTHRDSED	60	19.35	70	0.37
143			Hazel	MT HIGGINS	235	4.8	2511	198-203-230-235-240	1	10	6	15	25110	15066	37665	77841	32.26	19.35	48.39	>2 YRS	HIWTHRDSED	60	19.35	70	0.37
144			Hazel	MT HIGGINS	236	6.5	977	198-203-230-235-240	1	10	6	15	9770	5862	14655	30287	32.26	19.35	48.39	>2 YRS	HIWTHRDSED	60	19.35	70	0.37
145			Hazel	MT HIGGINS	237	20	447	224-238	3	15	10	15	6705	4470	6705	17880	37.50	25.00	37.50	>2 YRS	HIWTHRDSED	60	22.50	70	0.37
146			Hazel	MT HIGGINS	238	10.9	3352	224-238	1	15	10	15	50280	33520	50280	134080	37.50	25.00	37.50	>2 YRS	HIWTHRDSED	60	22.50	70	0.37
147			Hazel	MT HIGGINS	239	6	2465	198-203-230-235-240	1	10	6	15	24650	14790	36975	76415	32.26	19.35	48.39	>2 YRS	HIWTHRDSED	60	19.35	70	0.37
148			Hazel	MT HIGGINS	240	0.4	1255	198-203-230-235-240	1	10	6	15	12550	7530	18825	38905	32.26	19.35	48.39	>2 YRS	HIWTHRDSED	60	19.35	70	0.37
149			Hazel	MT HIGGINS	241	0.4	1412	198-203-230-235-240	1	10	6	15	14120	8472	21180	43772	32.26	19.35	48.39	>2 YRS	HIWTHRDSED	60	19.35	70	0.37
150			Hazel	MT HIGGINS	242	6.6	4517	242	1	9	8	14	40653	36136	63238	140027	29.03	25.81	45.16	>2 YRS	METAMORPH	10	2.90	>80	0.18
151			Hazel	MT HIGGINS	243	4.8	984	242	1	9	8	14	8856	7872	13776	30504	29.03	25.81	45.16	>2 YRS	METAMORPH	10	2.90	>80	0.18
152			Hazel	MT HIGGINS	244	5	401	242	1	9	8	14	3609	3208	5614	12431	29.03	25.81	45.16	>2 YRS	METAMORPH	10	2.90	>80	0.18
153			Hazel	MT HIGGINS	245	15.1	1016	245	1	5	6	17	5080	6096	17272	28448	17.86	21.43	60.71	>2 YRS	METAMORPH	10	1.79	70	0.37

PART IV: HAZEL WAU
Surface Erosion Module
Form B-2.1 "Roads Calculation Sheet"

	Z	AA	AB	AC	AD	AE	AF	AG	AH	AI	AJ	AK	AL	AM	AN	AO	AP	AQ	AR	AS	AT	AU
14																						
15																						
16																	ROAD					
17															ROAD		PRISM				5 PERCENT	5 PERCENT
18	CUTSLOPE				FILLSLOPE				TREAD	TABLE B-9			TableB-8	SURFACE/	PRISM	ROAD	DELIVERY				INCREASED	INCREASED
19	EROSION	FILLSLOPE	FILLSLOPE	FILLSLOPE	EROSION	TREAD	SURFACING	SURFACE	EROSION	TRAFFIC		PRECIP	TRAFFIC/ PRECIP	TRAFFIC TREAD	TOTAL EROSION	PRISM DELIVERY	AREA INCREASED	EROSION	ROAD AREA	TOTAL DELIVERED	DELIVERY EROSION	TOTAL DELIVERED
20	RATE	PORTION	VEG %	VEG FACTOR	RATE	PORTION	TYPE	FACTOR	RATE	TYPE	TRAFFIC	ZONE	FACTOR	RATE	RATE	AREA	5 PERCENT	RATE	ACRES	SEDIMENT	RATE	SEDIMENT
21	W*Y	(R/100)*V			AA*AC	(S/100)*V			AE*AG					AH*AL	Z+AD+AM		(AO+.05)**	AN*AO	P/43560	AQ*AR	AN*AP	AT*AR
22	T/A RP/YR*	T/A RP/YR*	%%%		T/A RP/YR*	T/A RP/YR*			T/A RP/YR*			millimeters		T/A RP/YR*	T/A RP/YR*	%%%	%%%	T/A RP/YR*	AC	US TONS/YR	T/A RP/YR*	US TONS/YR
106	7.16	11.61	>80	0.18	2.09	29.03	>6" GRAVEL	0.2	5.81	LIGHT	6I	1200-3000	1	5.81	15.06	0.05	0.1	0.75	0.87	0.65	1.51	1.31
107	7.16	11.61	>80	0.18	2.09	29.03	>6" GRAVEL	0.2	5.81	LIGHT	6I	1200-3000	1	5.81	15.06	0.05	0.1	0.75	0.25	0.19	1.51	0.38
108	7.16	11.61	>80	0.18	2.09	29.03	>6" GRAVEL	0.2	5.81	LIGHT	6I	1200-3000	1	5.81	15.06	0.05	0.1	0.75	1.32	0.99	1.51	1.99
109	7.16	11.61	>80	0.18	2.09	29.03	>6" GRAVEL	0.2	5.81	LIGHT	6I	1200-3000	1	5.81	15.06	0.05	0.1	0.75	2.13	1.60	1.51	3.21
110	8.33	15.00	>80	0.18	2.70	22.50	>6" GRAVEL	0.2	4.50	LIGHT	6I	1200-3000	1	4.50	15.53	0.2	0.25	3.11	0.50	1.55	3.88	1.93
111	7.16	11.61	>80	0.18	2.09	29.03	>6" GRAVEL	0.2	5.81	LIGHT	6I	1200-3000	1	5.81	15.06	0.05	0.1	0.75	0.19	0.15	1.51	0.29
112	7.16	11.61	>80	0.18	2.09	29.03	>6" GRAVEL	0.2	5.81	LIGHT	6I	1200-3000	1	5.81	15.06	0.05	0.1	0.75	0.38	0.29	1.51	0.58
113	2.83	17.14	>80	0.18	3.09	27.14	>6" GRAVEL	0.2	5.43	MOD	6S	1200-3000	4	21.71	27.63	0.2	0.25	5.53	1.78	9.84	6.91	12.29
114	7.16	11.61	>80	0.18	2.09	29.03	>6" GRAVEL	0.2	5.81	LIGHT	6I	1200-3000	1	5.81	15.06	0.05	0.1	0.75	1.13	0.85	1.51	1.71
115	7.16	11.61	>80	0.18	2.09	29.03	>6" GRAVEL	0.2	5.81	LIGHT	6I	1200-3000	1	5.81	15.06	0.05	0.1	0.75	1.82	1.37	1.51	2.75
116	6.66	19.50	>80	0.18	3.51	22.50	>6" GRAVEL	0.2	4.50	NONE	6A	1200-3000	0.05	0.23	10.40	0.1	0.15	1.04	1.43	1.49	1.53	2.23
117	6.66	19.50	>80	0.18	3.51	22.50	>6" GRAVEL	0.2	4.50	NONE	6A	1200-3000	0.05	0.23	10.40	0.1	0.15	1.04	5.44	5.66	1.56	8.49
118	1.71	8.68	>80	0.18	1.56	11.84	>6" GRAVEL	0.2	2.37	MOD	6S	1200-3000	4	9.47	12.74	0.1	0.15	1.27	2.15	2.73	1.91	4.10
119	1.50	1.35	>80	0.18	0.24	4.59	>6" GRAVEL	0.2	0.92	MOD	6S	1200-3000	4	3.68	5.42	0.1	0.15	0.54	2.66	1.44	0.81	2.16
120	3.18	10.59			0.00	31.76	>6" GRAVEL	0.2	6.35	MOD	6S	1200-3000	4	25.41	28.59	0.2	0.25	5.72	0.62	3.56	7.15	4.45
121	1.50	1.35	>80	0.18	0.24	4.59	>6" GRAVEL	0.2	0.92	MOD	6S	1200-3000	4	3.68	5.42	0.1	0.15	0.54	1.29	0.70	0.81	1.05
122	3.18	10.59	>80	0.18	1.91	31.76	>6" GRAVEL	0.2	6.35	MOD	6S	1200-3000	4	25.41	30.49	0.2	0.25	6.10	1.61	9.80	7.62	12.25
123	3.18	10.59	>80	0.18	1.91	31.76	>6" GRAVEL	0.2	6.35	MOD	6S	1200-3000	4	25.41	30.49	0.2	0.25	6.10	2.26	13.78	7.62	17.23
124	2.83	17.14	>80	0.18	3.09	27.14	>6" GRAVEL	0.2	5.43	MOD	6S	1200-3000	4	21.71	27.63	0.2	0.25	5.53	1.08	5.96	6.91	7.45
125	1.71	8.68	>80	0.18	1.56	11.84	>6" GRAVEL	0.2	2.37	MOD	6S	1200-3000	4	9.47	12.74	0.1	0.15	1.27	0.79	1.01	1.91	1.52
126	0.77	4.29	>80	0.18	0.77	21.43	>6" GRAVEL	0.2	4.29	LIGHT	6I	1200-3000	1	4.29	5.83	0	0.05	0.00	0.95	0.00	0.29	0.28
127	0.77	4.29	>80	0.18	0.77	21.43	>6" GRAVEL	0.2	4.29	NONE	6A	1200-3000	0.05	0.21	1.76	0.05	0.1	0.09	0.23	0.02	0.18	0.04
128	0.77	4.29	>80	0.18	0.77	21.43	>6" GRAVEL	0.2	4.29	NONE	6A	1200-3000	0.05	0.21	1.76	0.05	0.1	0.09	0.18	0.02	0.18	0.03
129	0.77	4.29	>80	0.18	0.77	21.43	>6" GRAVEL	0.2	4.29	NONE	6A	1200-3000	0.05	0.21	1.76	0.05	0.1	0.09	0.40	0.04	0.18	0.07
130	1.80	6.67	>80	0.18	1.20	13.33	>6" GRAVEL	0.2	2.67	LIGHT	6I	1200-3000	1	2.67	5.67	0.2	0.25	1.13	0.20	0.22	1.42	0.28
131	1.80	6.67	>80	0.18	1.20	13.33	>6" GRAVEL	0.2	2.67	LIGHT	6I	1200-3000	1	2.67	5.67	0.2	0.25	1.13	1.14	1.29	1.42	1.61
132	8.33	15.00	>80	0.18	2.70	22.50	>6" GRAVEL	0.2	4.50	LIGHT	6I	1200-3000	1	4.50	15.53	0.2	0.25	3.11	4.21	13.08	3.88	16.35
133	8.33	15.00	>80	0.18	2.70	22.50	>6" GRAVEL	0.2	4.50	LIGHT	6I	1200-3000	1	4.50	15.53	0.2	0.25	3.11	0.20	0.63	3.88	0.79
134	7.16	11.61	>80	0.18	2.09	29.03	>6" GRAVEL	0.2	5.81	LIGHT	6I	1200-3000	1	5.81	15.06	0.05	0.1	0.75	0.62	0.47	1.51	0.94
135	7.16	11.61	>80	0.18	2.09	29.03	>6" GRAVEL	0.2	5.81	LIGHT	6I	1200-3000	1	5.81	15.06	0.05	0.1	0.75	2.91	2.19	1.51	4.38
136	8.33	15.00	>80	0.18	2.70	22.50	>6" GRAVEL	0.2	4.50	LIGHT	6I	1200-3000	1	4.50	15.53	0.2	0.25	3.11	0.42	1.30	3.88	1.63
137	8.33	15.00	>80	0.18	2.70	22.50	>6" GRAVEL	0.2	4.50	LIGHT	6I	1200-3000	1	4.50	15.53	0.2	0.25	3.11	0.38	1.19	3.88	1.49
138	7.16	11.61	>80	0.18	2.09	29.03	>6" GRAVEL	0.2	5.81	LIGHT	6I	1200-3000	1	5.81	15.06	0.05	0.1	0.75	2.06	1.55	1.51	3.10
139	7.16	11.61	>80	0.18	2.09	29.03	>6" GRAVEL	0.2	5.81	LIGHT	6I	1200-3000	1	5.81	15.06	0.05	0.1	0.75	0.44	0.33	1.51	0.66
140	7.16	11.61	>80	0.18	2.09	29.03	>6" GRAVEL	0.2	5.81	LIGHT	6I	1200-3000	1	5.81	15.06	0.05	0.1	0.75	0.30	0.22	1.51	0.45
141	7.16	11.61	>80	0.18	2.09	29.03	>6" GRAVEL	0.2	5.81	LIGHT	6I	1200-3000	1	5.81	15.06	0.05	0.1	0.75	0.68	0.51	1.51	1.02
142	7.16	11.61	>80	0.18	2.09	29.03	>6" GRAVEL	0.2	5.81	LIGHT	6I	1200-3000	1	5.81	15.06	0.05	0.1	0.75	1.24	0.94	1.51	1.87
143	7.16	11.61	>80	0.18	2.09	29.03	>6" GRAVEL	0.2	5.81	LIGHT	6I	1200-3000	1	5.81	15.06	0.05	0.1	0.75	1.79	1.35	1.51	2.69
144	7.16	11.61	>80	0.18	2.09	29.03	>6" GRAVEL	0.2	5.81	LIGHT	6I	1200-3000	1	5.81	15.06	0.05	0.1	0.75	0.70	0.52	1.51	1.05
145	8.33	15.00	>80	0.18	2.70	22.50	>6" GRAVEL	0.2	4.50	LIGHT	6I	1200-3000	1	4.50	15.53	0.2	0.25	3.11	0.41	1.27	3.88	1.59
146	8.33	15.00	>80	0.18	2.70	22.50	>6" GRAVEL	0.2	4.50	LIGHT	6I	1200-3000	1	4.50	15.53	0.2	0.25	3.11	3.08	9.56	3.88	11.95
147	7.16	11.61	>80	0.18	2.09	29.03	>6" GRAVEL	0.2	5.81	LIGHT	6I	1200-3000	1	5.81	15.06	0.05	0.1	0.75	1.75	1.32	1.51	2.64
148	7.16	11.61	>80	0.18	2.09	29.03	>6" GRAVEL	0.2	5.81	LIGHT	6I	1200-3000	1	5.81	15.06	0.05	0.1	0.75	0.89	0.67	1.51	1.34
149	7.16	11.61	>80	0.18	2.09	29.03	>6" GRAVEL	0.2	5.81	LIGHT	6I	1200-3000	1	5.81	15.06	0.05	0.1	0.75	1.00	0.76	1.51	1.51
150	0.52	2.58	>80	0.18	0.46	4.52	>6" GRAVEL	0.2	0.90	NONE	6A	1200-3000	0.05	0.05	1.03	0.1	0.15	0.10	3.21	0.33	0.15	0.50
151	0.52	2.58	>80	0.18	0.46	4.52	>6" GRAVEL	0.2	0.90	NONE	6A	1200-3000	0.05	0.05	1.03	0.1	0.15	0.10	0.70	0.07	0.15	0.11
152	0.52	2.58	>80	0.18	0.46	4.52	>6" GRAVEL	0.2	0.90	NONE	6A	1200-3000	0.05	0.05	1.03	0.1	0.15	0.10	0.29	0.03	0.15	0.04
153	0.66	2.14	>80	0.18	0.39	6.07	>6" GRAVEL	0.2	1.21	NONE	6A	1200-3000	0.05	0.06	1.11	0	0.05	0.00	0.65	0.00	0.06	0.04

PART IV: HAZEL WAU
Surface Erosion Module
Form B-2.1 "Roads Calculation Sheet"

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y
14				T/A RP/YR*	**																				
15				is tons/acre of	means																				
16				road prism/year	generally																				
17										"TYPE"	"TYPE"	"TYPE"													
18										CUTSLOPE	FILLSLOPE	TREAD				TOTAL						TableB-5			
19					ROAD	ROAD	ROAD	ROAD	"TYPE"	MAP	MAP	MAP	CUTSLOPE	FILLSLOPE	TREAD	ROAD	AREA	AREA	AREA	ROAD		BASIC			TableB-6
20			WAU	SUBBASIN	SEGMENT	SLOPE	LENGTH	"TYPE"	METHOD	DISTANCE	DISTANCE	DISTANCE	AREA	AREA	AREA	PRISM	CUTSLOPE	FILLSLOPE	TREAD	AGE	GEOLOGY	EROSION	CUTSLOPE	CUTSLOPE	CUTSLOPE
21		EQUATION											G*J	G*K	G*L	M+N+O	{M/P}*100	{N/P}*100	{O/P}*100			RATE	PORTION {Q/100}*U	VEG	VEG FACTOR
22		UNITS				%%%	feet			feet	feet	feet	feet^2	feet^2	feet^2	feet^2	%%%	%%%	%%%			T/A RP/YR*	T/A RP/YR*	%%%	
154			Hazel	MT HIGGINS	246	7.1	1525	246	1	13	13	15	19825	19825	22875	62525	31.71	31.71	36.59	>2 YRS	SEDROCK	30	9.51	70	0.37
155			Hazel	MT HIGGINS	247	0.8	15171	247	1	12	13	15	182052	197223	227565	606840	30.00	32.50	37.50	>2 YRS	HIWTHRDSED	60	18.00	50	0.37
156			Hazel	MT HIGGINS	248	5.6	4845	242	2	9	8	14	43605	38760	67830	150195	29.03	25.81	45.16	>2 YRS	METAMORPH	10	2.90	>80	0.18
157			Hazel	MT HIGGINS	249	9.2	2987	242	3	9	8	14	26883	23896	41818	92597	29.03	25.81	45.16	>2 YRS	METAMORPH	10	2.90	>80	0.18
158			Hazel	MT HIGGINS	250	1.5	4318	250	1	12	8	16	51816	34544	69088	155448	33.33	22.22	44.44	>2 YRS	SEDROCK	30	10.00	>80	0.18
159			Hazel	MT HIGGINS	251	9.1	599	224-238	1	15	10	15	8985	5990	8985	23960	37.50	25.00	37.50	>2 YRS	HIWTHRDSED	60	22.50	70	0.37
160			Hazel	MT HIGGINS	252	4	266	242	2	9	8	14	2394	2128	3724	8246	29.03	25.81	45.16	>2 YRS	METAMORPH	10	2.90	>80	0.18
161			Hazel	MT HIGGINS	253	10.3	2027	262	6	20	18	17	40540	36486	34459	111485	36.36	32.73	30.91	>2 YRS	SCHIST	60	21.82	>80	0.18
162			Hazel	MT HIGGINS	274	4.1	3143	260-263	6	13	14	18	40859	44002	56574	141435	28.89	31.11	40.00	>2 YRS	SCHIST	60	17.33	>80	0.18
163			Hazel	MT HIGGINS	275	5.6	1559	242	1	9	8	14	14031	12472	21826	48329	29.03	25.81	45.16	>2 YRS	METAMORPH	10	2.90	>80	0.18
164			Hazel	MT HIGGINS	311	0.1	3916	198-203-230-235-240	1	10	6	15	39160	23496	58740	121396	32.26	19.35	48.39	>2 YRS	HIWTHRDSED	60	19.35	70	0.37
165			Hazel	MT HIGGINS	312	7.9	612	224-238	1	15	10	15	9180	6120	9180	24480	37.50	25.00	37.50	>2 YRS	HIWTHRDSED	60	22.50	70	0.37
166			Hazel	MT HIGGINS	313	8	498	224-238	1	15	10	15	7470	4980	7470	19920	37.50	25.00	37.50	>2 YRS	HIWTHRDSED	60	22.50	70	0.37
167			Hazel	MT HIGGINS	314	11.4	1259	224-238	1	15	10	15	18885	12590	18885	50360	37.50	25.00	37.50	>2 YRS	HIWTHRDSED	60	22.50	70	0.37
168			Hazel	MT HIGGINS	324	9	2009	124	5	6	5	16	12054	10045	32144	54243	22.22	18.52	59.26	>2 YRS	HIWTHRDSED	60	13.33	>80	0.18
169		TOTALS					140266																		
170																									
171																									
172			Hazel	ROLLINS CK	31	4.2	3260	138	3	4	4	19	13040	13040	61940	88020	14.81	14.81	70.37	>2 YRS	MODWTHRDRK	30	4.44	70	0.37
173			Hazel	ROLLINS CK	45	5.5	950	242	6	9	8	14	8550	7600	13300	29450	29.03	25.81	45.16	>2 YRS	METAMORPH	10	2.90	>80	0.18
174			Hazel	ROLLINS CK	46	17.5	718	245	6	5	6	17	3590	4308	12206	20104	17.86	21.43	60.71	>2 YRS	METAMORPH	10	1.79	>80	0.18
175			Hazel	ROLLINS CK	47	10.6	801	245	3	5	6	17	4005	4806	13617	22428	17.86	21.43	60.71	>2 YRS	METAMORPH	10	1.79	>80	0.18
176			Hazel	ROLLINS CK	48	11.7	694	245	3	5	6	17	3470	4164	11798	19432	17.86	21.43	60.71	>2 YRS	METAMORPH	10	1.79	>80	0.18
177			Hazel	ROLLINS CK	49	17.8	2504	245	6	5	6	17	12520	15024	42568	70112	17.86	21.43	60.71	>2 YRS	METAMORPH	10	1.79	>80	0.18
178			Hazel	ROLLINS CK	50	5.5	1425	242	6	9	8	14	12825	11400	19950	44175	29.03	25.81	45.16	>2 YRS	METAMORPH	10	2.90	>80	0.18
179			Hazel	ROLLINS CK	51	17.1	493	245	6	5	6	17	2465	2958	8381	13804	17.86	21.43	60.71	>2 YRS	METAMORPH	10	1.79	>80	0.18
180			Hazel	ROLLINS CK	53	11.4	1207	245	3	5	6	17	6035	7242	20519	33796	17.86	21.43	60.71	>2 YRS	METAMORPH	10	1.79	>80	0.18
181			Hazel	ROLLINS CK	58	0.7	833	242	6	9	8	14	7497	6664	11662	25823	29.03	25.81	45.16	>2 YRS	METAMORPH	10	2.90	>80	0.18
182			Hazel	ROLLINS CK	73	0.5	791	125	1	5	12	17	3955	9492	13447	26894	14.71	35.29	50.00	>2 YRS	HIWTHRDSED	60	8.82	>80	0.18
183			Hazel	ROLLINS CK	74	3	566	83	1	3	3	14	1698	1698	7924	11320	15.00	15.00	70.00	>2 YRS	HIWTHRDSED	60	9.00	>80	0.18
184			Hazel	ROLLINS CK	78	1.3	619	242	6	9	8	14	5571	4952	8666	19189	29.03	25.81	45.16	>2 YRS	METAMORPH	10	2.90	>80	0.18
185			Hazel	ROLLINS CK	82	6.4	3817	83	1	3	3	14	11451	11451	53438	76340	15.00	15.00	70.00	>2 YRS	HIWTHRDSED	60	9.00	>80	0.18
186			Hazel	ROLLINS CK	83	0.2	4992	83	1	3	3	14	14976	14976	69888	99840	15.00	15.00	70.00	>2 YRS	HIWTHRDSED	60	9.00	>80	0.18
187			Hazel	ROLLINS CK	84	2.5	1020	83	2	3	3	14	3060	3060	14280	20400	15.00	15.00	70.00	>2 YRS	HIWTHRDSED	60	9.00	>80	0.18
188			Hazel	ROLLINS CK	86	2.8	566	83	1	3	3	14	1698	1698	7924	11320	15.00	15.00	70.00	>2 YRS	HIWTHRDSED	60	9.00	>80	0.18
189			Hazel	ROLLINS CK	99	0.4	1627	83	1	3	3	14	4881	4881	22778	32540	15.00	15.00	70.00	>2 YRS	HIWTHRDSED	60	9.00	>80	0.18
190			Hazel	ROLLINS CK	100	0.4	1308	83	1	3	3	14	3924	3924	18312	26160	15.00	15.00	70.00	>2 YRS	HIWTHRDSED	60	9.00	>80	0.18
191			Hazel	ROLLINS CK	101	1.1	709	83	1	3	3	14	2127	2127	9926	14180	15.00	15.00	70.00	>2 YRS	HIWTHRDSED	60	9.00	>80	0.18
192			Hazel	ROLLINS CK	102	0.3	2595	83	1	3	3	14	7785	7785	36330	51900	15.00	15.00	70.00	>2 YRS	HIWTHRDSED	60	9.00	>80	0.18
193			Hazel	ROLLINS CK	103	1.1	2939	125	1	5	12	17	14695	35268	49963	99926	14.71	35.29	50.00	>2 YRS	HIWTHRDSED	60	8.82	>80	0.18
194			Hazel	ROLLINS CK	109	4.8	1107	83	1	3	3	14	3321	3321	15498	22140	15.00	15.00	70.00	>2 YRS	HIWTHRDSED	60	9.00	>80	0.18
195			Hazel	ROLLINS CK	112	1.1	1167	83	2	3	3	14	3501	3501	16338	23340	15.00	15.00	70.00	>2 YRS	HIWTHRDSED	60	9.00	>80	0.18
196			Hazel	ROLLINS CK	113	0.4	3284	125	1	5	12	17	16420	39408	55828	111656	14.71	35.29	50.00	>2 YRS	HIWTHRDSED	60	8.82	>80	0.18
197			Hazel	ROLLINS CK	116	0.9	612	83	1	3	3	14	1836	1836	8568	12240	15.00	15.00	70.00	>2 YRS	HIWTHRDSED	60	9.00	>80	0.18
198			Hazel	ROLLINS CK	119	7.5	709	138	1	4	4	19	2836	2836	13471	19143	14.81	14.81	70.37	>2 YRS	MODWTHRDRK	30	4.44	70	0.37
199			Hazel	ROLLINS CK	120	8	838	138	1	4	4	19	3352	3352	15922	22626	14.81	14.81	70.37	>2 YRS	MODWTHRDRK	30	4.44	70	0.37
200			Hazel	ROLLINS CK	124	11.7	4163	124	1	6	5	16	24978	20815	66608	112401	22.22	18.52	59.26	>2 YRS	HIWTHRDSED	60	13.33	>80	0.18
201			Hazel	ROLLINS CK	125	3.3	2118	125	1	5	12	17	10590	25416	36006	72012	14.71	35.29	50.00	>2 YRS	HIWTHRDSED	60	8.82	>80	0.18

PART IV: HAZEL WAU
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Form B-2.1 "Roads Calculation Sheet"

	Z	AA	AB	AC	AD	AE	AF	AG	AH	AI	AJ	AK	AL	AM	AN	AO	AP	AQ	AR	AS	AT	AU
14																						
15																						
16																	ROAD					
17															ROAD		PRISM				5 PERCENT	5 PERCENT
18	CUTSLOPE				FILLSLOPE				TREAD	TABLE B-9			TableB-8	SURFACE/	PRISM	ROAD	DELIVERY				INCREASED	INCREASED
19	EROSION	FILLSLOPE	FILLSLOPE	FILLSLOPE	EROSION	TREAD	SURFACING	SURFACE	EROSION	TRAFFIC		PRECIP	TRAFFIC/ PRECIP	TRAFFIC TREAD	TOTAL EROSION	PRISM DELIVERY	AREA INCREASED		ROAD AREA	TOTAL DELIVERED	DELIVERY EROSION	TOTAL DELIVERED
20	RATE	PORTION	VEG %	VEG FACTOR	RATE	PORTION	TYPE	FACTOR	RATE	TYPE	TRAFFIC	ZONE	FACTOR	RATE	RATE	AREA	5 PERCENT	EROSION RATE	ACRES	SEDIMENT	RATE	SEDIMENT
21	W*Y	(R/100)*V			AA*AC	(S/100)*V			AE*AG					AH*AL	Z+AD+AM		(AO+.05)**	/AN*AO	P/43560	AQ*AR	AH*AP	AT*AR
22	T/A RP/YR*	T/A RP/YR*	%%%		T/A RP/YR*	T/A RP/YR*			T/A RP/YR*			millimeters		T/A RP/YR*	T/A RP/YR*	%%%	%%%	T/A RP/YR*	AC	US TONS/YR	T/A RP/YR*	US TONS/YR
154	3.52	9.51	>80	0.18	1.71	10.98	>6" GRAVEL	0.2	2.20	NONE	6A	1200-3000	0.05	0.11	5.34	0.1	0.15	0.53	1.44	0.77	0.80	1.15
155	6.66	19.50	>80	0.18	3.51	22.50	>6" GRAVEL	0.2	4.50	NONE	6A	1200-3000	0.05	0.23	10.40	0.1	0.15	1.04	13.93	14.48	1.56	21.72
156	0.52	2.58	>80	0.18	0.46	4.52	>6" GRAVEL	0.2	0.90	LIGHT	6I	1200-3000	1	0.90	1.89	0.1	0.15	0.19	3.45	0.65	0.28	0.98
157	0.52	2.58	>80	0.18	0.46	4.52	>6" GRAVEL	0.2	0.90	LIGHT	6I	1200-3000	1	0.90	1.89	0.1	0.15	0.19	2.13	0.40	0.28	0.60
158	1.80	6.67	>80	0.18	1.20	13.33	>6" GRAVEL	0.2	2.67	LIGHT	6I	1200-3000	1	2.67	5.67	0.2	0.25	1.13	3.57	4.04	1.42	5.06
159	8.33	15.00	>80	0.18	2.70	22.50	>6" GRAVEL	0.2	4.50	LIGHT	6I	1200-3000	1	4.50	15.53	0.2	0.25	3.11	0.55	1.71	3.88	2.13
160	0.52	2.58	>80	0.18	0.46	4.52	>6" GRAVEL	0.2	0.90	LIGHT	6I	1200-3000	1	0.90	1.89	0.1	0.15	0.19	0.19	0.04	0.28	0.05
161	3.93	19.64	>80	0.18	3.53	18.55	>6" GRAVEL	0.2	3.71	LIGHT	6I	1200-3000	1	3.71	11.17	0.3	0.35	3.35	2.56	8.58	3.91	10.01
162	3.12	18.67	>80	0.18	3.36	24.00	>6" GRAVEL	0.2	4.80	NONE	6A	1200-3000	0.05	0.24	6.72	0.1	0.15	0.67	3.25	2.18	1.01	3.27
163	0.52	2.58	>80	0.18	0.46	4.52	>6" GRAVEL	0.2	0.90	NONE	6A	1200-3000	0.05	0.05	1.03	0.1	0.15	0.10	1.11	0.11	0.15	0.17
164	7.16	11.61	>80	0.18	2.09	29.03	>6" GRAVEL	0.2	5.81	LIGHT	6I	1200-3000	1	5.81	15.06	0.05	0.1	0.75	2.79	2.10	1.51	4.20
165	8.33	15.00	>80	0.18	2.70	22.50	>6" GRAVEL	0.2	4.50	LIGHT	6I	1200-3000	1	4.50	15.53	0.2	0.25	3.11	0.56	1.74	3.88	2.18
166	8.33	15.00	>80	0.18	2.70	22.50	>6" GRAVEL	0.2	4.50	LIGHT	6I	1200-3000	1	4.50	15.53	0.2	0.25	3.11	0.46	1.42	3.88	1.77
167	8.33	15.00	>80	0.18	2.70	22.50	>6" GRAVEL	0.2	4.50	LIGHT	6I	1200-3000	1	4.50	15.53	0.2	0.25	3.11	1.16	3.59	3.88	4.49
168	2.40	11.11	>80	0.18	2.00	35.56	>6" GRAVEL	0.2	7.11	MOD	6S	1200-3000	4	28.44	32.84	0.3	0.35	9.85	1.25	12.27	11.50	14.31
169																			110.13	164.99		232.21
170																						
171																						
172	1.64	4.44	70	0.37	1.64	21.11	>6" GRAVEL	0.2	4.22	LIGHT	6I	1200-3000	1	4.22	7.51	0.05	0.1	0.38	2.02	0.76	0.75	1.52
173	0.52	2.58	>80	0.18	0.46	4.52	>6" GRAVEL	0.2	0.90	NONE	6A	1200-3000	0.05	0.05	1.03	0.1	0.15	0.10	0.68	0.07	0.15	0.10
174	0.32	2.14	>80	0.18	0.39	6.07	>6" GRAVEL	0.2	1.21	NONE	6A	1200-3000	0.05	0.06	0.77	0.1	0.15	0.08	0.46	0.04	0.12	0.05
175	0.32	2.14	>80	0.18	0.39	6.07	>6" GRAVEL	0.2	1.21	NONE	6A	1200-3000	0.05	0.06	0.77	0.1	0.15	0.08	0.51	0.04	0.12	0.06
176	0.32	2.14	>80	0.18	0.39	6.07	>6" GRAVEL	0.2	1.21	NONE	6A	1200-3000	0.05	0.06	0.77	0.1	0.15	0.08	0.45	0.03	0.12	0.05
177	0.32	2.14	>80	0.18	0.39	6.07	>6" GRAVEL	0.2	1.21	NONE	6A	1200-3000	0.05	0.06	0.77	0.1	0.15	0.08	1.61	0.12	0.12	0.19
178	0.52	2.58	>80	0.18	0.46	4.52	>6" GRAVEL	0.2	0.90	NONE	6A	1200-3000	0.05	0.05	1.03	0.1	0.15	0.10	1.01	0.10	0.15	0.16
179	0.32	2.14	>80	0.18	0.39	6.07	>6" GRAVEL	0.2	1.21	NONE	6A	1200-3000	0.05	0.06	0.77	0.1	0.15	0.08	0.32	0.02	0.12	0.04
180	0.32	2.14	>80	0.18	0.39	6.07	>6" GRAVEL	0.2	1.21	NONE	6A	1200-3000	0.05	0.06	0.77	0.1	0.15	0.08	0.78	0.06	0.12	0.09
181	0.52	2.58	>80	0.18	0.46	4.52	>6" GRAVEL	0.2	0.90	NONE	6A	1200-3000	0.05	0.05	1.03	0.1	0.15	0.10	0.59	0.06	0.15	0.09
182	1.59	21.18	>80	0.18	3.81	30.00	>6" GRAVEL	0.2	6.00	MOD	6S	1200-3000	4	24.00	29.40	0.2	0.25	5.88	0.62	3.63	7.35	4.54
183	1.62	9.00	>80	0.18	1.62	42.00	>6" GRAVEL	0.2	8.40	LIGHT	6I	1200-3000	1	8.40	11.64	0	0.05	0.00	0.26	0.00	0.58	0.15
184	0.52	2.58	>80	0.18	0.46	4.52	>6" GRAVEL	0.2	0.90	NONE	6A	1200-3000	0.05	0.05	1.03	0.1	0.15	0.10	0.44	0.05	0.15	0.07
185	1.62	9.00	>80	0.18	1.62	42.00	>6" GRAVEL	0.2	8.40	LIGHT	6I	1200-3000	1	8.40	11.64	0	0.05	0.00	1.75	0.00	0.58	1.02
186	1.62	9.00	>80	0.18	1.62	42.00	>6" GRAVEL	0.2	8.40	LIGHT	6I	1200-3000	1	8.40	11.64	0	0.05	0.00	2.29	0.00	0.58	1.33
187	1.62	9.00	>80	0.18	1.62	42.00	>6" GRAVEL	0.2	8.40	NONE	6A	1200-3000	0.05	0.42	3.66	0.05	0.1	0.18	0.47	0.09	0.37	0.17
188	1.62	9.00	>80	0.18	1.62	42.00	>6" GRAVEL	0.2	8.40	LIGHT	6I	1200-3000	1	8.40	11.64	0	0.05	0.00	0.26	0.00	0.58	0.15
189	1.62	9.00	>80	0.18	1.62	42.00	>6" GRAVEL	0.2	8.40	LIGHT	6I	1200-3000	1	8.40	11.64	0	0.05	0.00	0.75	0.00	0.58	0.43
190	1.62	9.00	>80	0.18	1.62	42.00	>6" GRAVEL	0.2	8.40	LIGHT	6I	1200-3000	1	8.40	11.64	0	0.05	0.00	0.60	0.00	0.58	0.35
191	1.62	9.00	>80	0.18	1.62	42.00	>6" GRAVEL	0.2	8.40	LIGHT	6I	1200-3000	1	8.40	11.64	0	0.05	0.00	0.33	0.00	0.58	0.19
192	1.62	9.00	>80	0.18	1.62	42.00	>6" GRAVEL	0.2	8.40	LIGHT	6I	1200-3000	1	8.40	11.64	0	0.05	0.00	1.19	0.00	0.58	0.69
193	1.59	21.18	>80	0.18	3.81	30.00	>6" GRAVEL	0.2	6.00	MOD	6S	1200-3000	4	24.00	29.40	0.2	0.25	5.88	2.29	13.49	7.35	16.86
194	1.62	9.00	>80	0.18	1.62	42.00	>6" GRAVEL	0.2	8.40	LIGHT	6I	1200-3000	1	8.40	11.64	0	0.05	0.00	0.51	0.00	0.58	0.30
195	1.62	9.00	>80	0.18	1.62	42.00	>6" GRAVEL	0.2	8.40	NONE	6A	1200-3000	0.05	0.42	3.66	0.05	0.1	0.18	0.54	0.10	0.37	0.20
196	1.59	21.18	>80	0.18	3.81	30.00	>6" GRAVEL	0.2	6.00	MOD	6S	1200-3000	4	24.00	29.40	0.2	0.25	5.88	2.56	15.07	7.35	18.84
197	1.62	9.00	>80	0.18	1.62	42.00	>6" GRAVEL	0.2	8.40	LIGHT	6I	1200-3000	1	8.40	11.64	0	0.05	0.00	0.28	0.00	0.58	0.16
198	1.64	4.44	70	0.37	1.64	21.11	>6" GRAVEL	0.2	4.22	LIGHT	6I	1200-3000	1	4.22	7.51	0.05	0.1	0.38	0.44	0.17	0.75	0.33
199	1.64	4.44	70	0.37	1.64	21.11	>6" GRAVEL	0.2	4.22	LIGHT	6I	1200-3000	1	4.22	7.51	0.05	0.1	0.38	0.52	0.20	0.75	0.39
200	2.40	11.11	>80	0.18	2.00	35.56	>6" GRAVEL	0.2	7.11	MOD	6S	1200-3000	4	28.44	32.84	0.2	0.25	6.57	2.58	16.95	8.21	21.19
201	1.59	21.18	>80	0.18	3.81	30.00	>6" GRAVEL	0.2	6.00	MOD	6S	1200-3000	4	24.00	29.40	0.2	0.25	5.88	1.65	9.72	7.35	12.15

PART IV: HAZEL WAU
Surface Erosion Module
Form B-2.1 "Roads Calculation Sheet"

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y
14				T/A RP/YR*	**																				
15				is tons/acre of	means																				
16				road prism/year	generally																				
17										"TYPE"	"TYPE"	"TYPE"				TOTAL						TableB-5			
18										CUTSLOPE	FILLSLOPE	TREAD				ROAD						BASIC			TableB-6
19					ROAD	ROAD	ROAD	ROAD	"TYPE"	MAP	MAP	MAP	CUTSLOPE	FILLSLOPE	TREAD	PRISM	AREA	AREA	AREA	ROAD		EROSION	CUTSLOPE	CUTSLOPE	CUTSLOPE
20			WAU	SUBBASIN	SEGMENT	SLOPE	LENGTH	"TYPE"	METHOD	DISTANCE	DISTANCE	DISTANCE	AREA	AREA	AREA	AREA	CUTSLOPE	FILLSLOPE	TREAD	AGE	GEOLOGY	RATE	PORTION	VEG	VEG FACTOR
21		EQUATION											G*J	G*K	G*L	M+N+O	{M/P}*100	{N/P}*100	{O/P}*100				{Q/100}*U		
22		UNITS				%%%	feet			feet	feet	feet	feet^2	feet^2	feet^2	feet^2	%%%	%%%	%%%			T/A RP/YR*	T/A RP/YR*	%%%	
202			Hazel	ROLLINS CK	126	17.7	908	126	1	5	5	14	4540	4540	12712	21792	20.83	20.83	58.33	>2 YRS	HIWTHRDSED	60	12.50	>80	0.18
203			Hazel	ROLLINS CK	127	1	3232	125	1	5	12	17	16160	38784	54944	109888	14.71	35.29	50.00	>2 YRS	HIWTHRDSED	60	8.82	>80	0.18
204			Hazel	ROLLINS CK	128	1.9	1351	83	1	3	3	14	4053	4053	18914	27020	15.00	15.00	70.00	>2 YRS	HIWTHRDSED	60	9.00	>80	0.18
205			Hazel	ROLLINS CK	130	1.9	559	83	1	3	3	14	1677	1677	7826	11180	15.00	15.00	70.00	>2 YRS	HIWTHRDSED	60	9.00	>80	0.18
206			Hazel	ROLLINS CK	133	4.7	838	138	3	4	4	19	3352	3352	15922	22626	14.81	14.81	70.37	>2 YRS	MODWTHRDRK	30	4.44	70	0.37
207			Hazel	ROLLINS CK	134	16.5	1092	141	1	10	13	12	10920	14196	13104	38220	28.57	37.14	34.29	>2 YRS	MODWTHRDRK	30	8.57	>80	0.18
208			Hazel	ROLLINS CK	136	10.8	1415	141	3	10	13	12	14150	18395	16980	49525	28.57	37.14	34.29	>2 YRS	MODWTHRDRK	30	8.57	>80	0.18
209			Hazel	ROLLINS CK	138	7.5	3971	138	1	4	4	19	15884	15884	75449	107217	14.81	14.81	70.37	>2 YRS	MODWTHRDRK	30	4.44	70	0.37
210			Hazel	ROLLINS CK	139	7.3	639	138	1	4	4	19	2556	2556	12141	17253	14.81	14.81	70.37	>2 YRS	MODWTHRDRK	30	4.44	70	0.37
211			Hazel	ROLLINS CK	140	12.7	3098	140	1	17	6	16	52666	18588	49568	120822	43.59	15.38	41.03	>2 YRS	MODWTHRDRK	30	13.08	85	0.18
212			Hazel	ROLLINS CK	141	21.8	1084	141	1	10	13	12	10840	14092	13008	37940	28.57	37.14	34.29	>2 YRS	MODWTHRDRK	30	8.57	>80	0.18
213			Hazel	ROLLINS CK	142	15.5	2185	148	1	13	18	21	28405	39330	45885	113620	25.00	34.62	40.38	>2 YRS	SEDROCK	30	7.50	75	0.37
214			Hazel	ROLLINS CK	143	20.6	1113	144	3	19	22	16	21147	24486	17808	63441	33.33	38.60	28.07	>2 YRS	SEDROCK	30	10.00	75	0.37
215			Hazel	ROLLINS CK	144	11	3357	144	1	19	22	16	63783	73854	53712	191349	33.33	38.60	28.07	>2 YRS	SEDROCK	30	10.00	75	0.37
216			Hazel	ROLLINS CK	145	13.4	9131	145	1	14	33	15	127834	301323	136965	566122	22.58	53.23	24.19	>2 YRS	SEDROCK	30	6.77	15	0.63
217			Hazel	ROLLINS CK	146	5.6	3872	146	1	12	15	19	46464	58080	73568	178112	26.09	32.61	41.30	>2 YRS	SEDROCK	30	7.83	40	0.53
218			Hazel	ROLLINS CK	147	0.9	1609	242	6	9	8	14	14481	12872	22526	49879	29.03	25.81	45.16	>2 YRS	METAMORPH	10	2.90	>80	0.18
219			Hazel	ROLLINS CK	148	16.4	3132	148	1	13	18	21	40716	56376	65772	162864	25.00	34.62	40.38	>2 YRS	SEDROCK	30	7.50	75	0.37
220			Hazel	ROLLINS CK	149	6.2	6017	132	6	6	7	15	36102	42119	90255	168476	21.43	25.00	53.57	>2 YRS	MODWTHRDRK	30	6.43	>80	0.18
221			Hazel	ROLLINS CK	150	3.9	1207	242	6	9	8	14	10863	9656	16898	37417	29.03	25.81	45.16	>2 YRS	METAMORPH	10	2.90	>80	0.18
222			Hazel	ROLLINS CK	151	14.3	1039	141	3	10	13	12	10390	13507	12468	36365	28.57	37.14	34.29	>2 YRS	MODWTHRDRK	30	8.57	>80	0.18
223			Hazel	ROLLINS CK	152	8.3	1400	245	3	5	6	17	7000	8400	23800	39200	17.86	21.43	60.71	>2 YRS	METAMORPH	10	1.79	>80	0.18
224			Hazel	ROLLINS CK	153	2.9	3862	132	6	6	7	15	23172	27034	57930	108136	21.43	25.00	53.57	>2 YRS	MODWTHRDRK	30	6.43	>80	0.18
225			Hazel	ROLLINS CK	154	19.2	597	141	1	10	13	12	5970	7761	7164	20895	28.57	37.14	34.29	>2 YRS	MODWTHRDRK	30	8.57	>80	0.18
226			Hazel	ROLLINS CK	155	1.2	2708	132	6	6	7	15	16248	18956	40620	75824	21.43	25.00	53.57	>2 YRS	MODWTHRDRK	30	6.43	>80	0.18
227			Hazel	ROLLINS CK	156	6.6	5811	132	6	6	7	15	34866	40677	87165	162708	21.43	25.00	53.57	>2 YRS	MODWTHRDRK	30	6.43	>80	0.18
228			Hazel	ROLLINS CK	157	10	4368	141	3	10	13	12	43680	56784	52416	152880	28.57	37.14	34.29	>2 YRS	MODWTHRDRK	30	8.57	>80	0.18
229			Hazel	ROLLINS CK	158	17.5	1512	148	1	13	18	21	19656	27216	31752	78624	25.00	34.62	40.38	>2 YRS	SEDROCK	30	7.50	75	0.37
230			Hazel	ROLLINS CK	159	6.2	1058	146	1	12	15	19	12696	15870	20102	48668	26.09	32.61	41.30	>2 YRS	SEDROCK	30	7.83	40	0.53
231			Hazel	ROLLINS CK	160	13.3	653	145	1	14	33	15	9142	21549	9795	40486	22.58	53.23	24.19	>2 YRS	SEDROCK	30	6.77	15	0.63
232			Hazel	ROLLINS CK	161	7.7	1990	145	1	14	33	15	27860	65670	29850	123380	22.58	53.23	24.19	>2 YRS	SEDROCK	30	6.77	15	0.63
233			Hazel	ROLLINS CK	162	8.6	1456	145	1	14	33	15	20384	48048	21840	90272	22.58	53.23	24.19	>2 YRS	SEDROCK	30	6.77	15	0.63
234			Hazel	ROLLINS CK	163	6.7	3651	132	6	6	7	15	21906	25557	54765	102228	21.43	25.00	53.57	>2 YRS	MODWTHRDRK	30	6.43	>80	0.18
235			Hazel	ROLLINS CK	164	0.3	1815	132	6	6	7	15	10890	12705	27225	50820	21.43	25.00	53.57	>2 YRS	MODWTHRDRK	30	6.43	>80	0.18
236			Hazel	ROLLINS CK	165	2.1	1493	132	6	6	7	15	8958	10451	22395	41804	21.43	25.00	53.57	>2 YRS	MODWTHRDRK	30	6.43	>80	0.18
237			Hazel	ROLLINS CK	166	9.7	2077	141	3	10	13	12	20770	27001	24924	72695	28.57	37.14	34.29	>2 YRS	MODWTHRDRK	30	8.57	>80	0.18
238			Hazel	ROLLINS CK	167	7.5	2298	145	1	14	33	15	32172	75834	34470	142476	22.58	53.23	24.19	>2 YRS	SEDROCK	30	6.77	15	0.63
239			Hazel	ROLLINS CK	168	5.6	5216	132	6	6	7	15	31296	36512	78240	146048	21.43	25.00	53.57	>2 YRS	MODWTHRDRK	30	6.43	>80	0.18
240			Hazel	ROLLINS CK	169	0.7	848	132	6	6	7	15	5088	5936	12720	23744	21.43	25.00	53.57	>2 YRS	MODWTHRDRK	30	6.43	>80	0.18
241			Hazel	ROLLINS CK	170	3.3	1214	132	6	6	7	15	7284	8498	18210	33992	21.43	25.00	53.57	>2 YRS	MODWTHRDRK	30	6.43	>80	0.18
242			Hazel	ROLLINS CK	171	12.1	619	141	3	10	13	12	6190	8047	7428	21665	28.57	37.14	34.29	>2 YRS	MODWTHRDRK	30	8.57	>80	0.18
243			Hazel	ROLLINS CK	174	13.2	1759	145	1	14	33	15	24626	58047	26385	109058	22.58	53.23	24.19	>2 YRS	SEDROCK	30	6.77	15	0.63
244			Hazel	ROLLINS CK	305	10	1077	138	1	4	4	19	4308	4308	20463	29079	14.81	14.81	70.37	>2 YRS	MODWTHRDRK	30	4.44	70	0.37
245			Hazel	ROLLINS CK	306	10	379	138	1	4	4	19	1516	1516	7201	10233	14.81	14.81	70.37	>2 YRS	MODWTHRDRK	30	4.44	70	0.37
246			Hazel	ROLLINS CK	307	0.5	1110	132	6	6	7	15	6660	7770	16650	31080	21.43	25.00	53.57	>2 YRS	MODWTHRDRK	30	6.43	>80	0.18
247			Hazel	ROLLINS CK	309	7.6	1821	245	3	5	6	17	9105	10926	30957	50988	17.86	21.43	60.71	>2 YRS	METAMORPH	10	1.79	>80	0.18
248			Hazel	ROLLINS CK	310	2.5	578	146	2	12	15	19	6936	8670	10982	26588	26.09	32.61	41.30	>2 YRS	SEDROCK	30	7.83	40	0.53
249			Hazel	ROLLINS CK	323	2	2893	138	3	4	4	19	11572	11572	54967	78111	14.81	14.81	70.37	>2 YRS	MODWTHRDRK	30	4.44	70	0.37

PART IV: HAZEL WAU
Surface Erosion Module
Form B-3.1 "Road Field Form"

FORMB-3.XLS

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1															
2															
3													ROAD		
4													PRISM		
5												ROAD	DELIVERY		
6												PRISM	AREA		
7			ROAD	ROAD	ROAD	AREA	AREA	AREA	CUTSLOPE	FILLSLOPE	FILLSLOPE	DELIVERY	INCREASED		
8	WAU	SUBBASIN	SEGMENT	SLOPE	"TYPE"	CUTSLOPE	FILLSLOPE	TREAD	VEG	VEG %	VEG FACTOR	AREA	5 PERCENT		
9				%%%		%%%	%%%	%%%	%%%	%%%		%%%	%%%		
10	Hazel	BROOKS CK	1	1.9	1	12.50	12.50	75.00	>80	>80	0.18	0.05	0.1		
11	Hazel	BROOKS CK	2	1.9	175	14.29	14.29	71.43	>80	>80	0.18	0.05	0.1		
12	Hazel	BROOKS CK	3	1.3	14	29.27	31.71	39.02	>80	>80	0.18	0.2	0.25		
13	Hazel	BROOKS CK	4	5.8	14	29.27	31.71	39.02	>80	>80	0.18	0.2	0.25		
14	Hazel	BROOKS CK	5	8.5	13	28.57	22.86	48.57	70	>80	0.18	0.1	0.15		
15	Hazel	BROOKS CK	8	5.5	8	36.84	21.05	42.11	>80	>80	0.18	0.2	0.25		
16	Hazel	BROOKS CK	9	2.7	9	15.38	7.69	76.92	>80	>80	0.18	0.2	0.25		
17	Hazel	BROOKS CK	10	11	29	17.39	13.04	69.57	>80	>80	0.18	0.1	0.15		
18	Hazel	BROOKS CK	11	1.5	32	15.38	26.92	57.69	75	>80	0.18	0.3	0.35		
19	Hazel	BROOKS CK	12	6.7	32	15.38	26.92	57.69	75	>80	0.18	0.3	0.35		
20	Hazel	BROOKS CK	13	10	13	28.57	22.86	48.57	70	>80	0.18	0.1	0.15		
21	Hazel	BROOKS CK	14	2.6	14	29.27	31.71	39.02	>80	>80	0.18	0.2	0.25		
22	Hazel	BROOKS CK	15	10	13	28.57	22.86	48.57	70	>80	0.18	0.1	0.15		
23	Hazel	BROOKS CK	16	1.9	14	29.27	31.71	39.02	>80	>80	0.18	0.2	0.25		
24	Hazel	BROOKS CK	17	5.1	32	15.38	26.92	57.69	75	>80	0.18	0.3	0.35		
25	Hazel	BROOKS CK	18	7.5	29	17.39	13.04	69.57	>80	>80	0.18	0.1	0.15		
26	Hazel	BROOKS CK	19	4.6	32	15.38	26.92	57.69	75	>80	0.18	0.3	0.35		
27	Hazel	BROOKS CK	20	14.4	29	17.39	13.04	69.57	>80	>80	0.18	0.1	0.15		
28	Hazel	BROOKS CK	21	0.1	9	15.38	7.69	76.92	>80	>80	0.18	0.2	0.25		
29	Hazel	BROOKS CK	22	10	22	13.64	13.64	72.73	>80	>80	0.18	0	0.05		
30	Hazel	BROOKS CK	23	1	32	15.38	26.92	57.69	75	>80	0.18	0.05	0.1		
31	Hazel	BROOKS CK	24	14.1	29	17.39	13.04	69.57	>80	>80	0.18	0.1	0.15		
32	Hazel	BROOKS CK	25	10.3	29	17.39	13.04	69.57	>80	>80	0.18	0.1	0.15		
33	Hazel	BROOKS CK	26	15.3	28	29.03	29.03	41.94	75	75	0.37	0	0.05		
34	Hazel	BROOKS CK	27	4.5	32	15.38	26.92	57.69	75	>80	0.18	0.1	0.15		
35	Hazel	BROOKS CK	28	18	28	25.00	28.57	46.43	75	75	0.37	0.2	0.25		

PART IV: HAZEL WAU
Surface Erosion Module
Form B-3.1 "Road Field Form"

FORMB-3.XLS

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
3													ROAD		
4													PRISM		
5												ROAD	DELIVERY		
6												PRISM	AREA		
7			ROAD	ROAD	ROAD	AREA	AREA	AREA	CUTSLOPE	FILLSLOPE	FILLSLOPE	DELIVERY	INCREASED		
8	WAU	SUBBASIN	SEGMENT	SLOPE	"TYPE"	CUTSLOPE	FILLSLOPE	TREAD	VEG	VEG %	VEG FACTOR	AREA	5 PERCENT		
9				%%%		%%%	%%%	%%%	%%%	%%%		%%%	%%%		
260	Hazel	SEGELSEN CK	257	4	178	14.29	14.29	71.43	>80	>80	0.18	0.1	0.15		
261	Hazel	SEGELSEN CK	258	3	254-258	28.57	32.14	39.29	75	>80	0.18	0.25	0.3		
262	Hazel	SEGELSEN CK	259	12	259	22.86	34.29	42.86	>80	>80	0.18		0.05		
263	Hazel	SEGELSEN CK	260	0.2	260-263	28.89	31.11	40.00	>80	>80	0.18	0.1	0.15		
264	Hazel	SEGELSEN CK	261	11.4	262	36.36	32.73	30.91	>80	>80	0.18	0.3	0.35		
265	Hazel	SEGELSEN CK	262	11.2	262	36.36	32.73	30.91	>80	>80	0.18	0.3	0.35		
266	Hazel	SEGELSEN CK	263	0.2	260-263	28.89	31.11	40.00	>80	>80	0.18	0.1	0.15		
267	Hazel	SEGELSEN CK	264	4.1	264	40.48	26.19	33.33	75	>80	0.18	0.3	0.35		
268	Hazel	SEGELSEN CK	265	3.3	264	40.48	26.19	33.33	75	>80	0.18	0.3	0.35		
269	Hazel	SEGELSEN CK	266	1.3	210	20.41	30.61	48.98	>80	>80	0.18	0	0.05		
270	Hazel	SEGELSEN CK	267	3.1	144	33.33	38.60	28.07	75	>80	0.18	0.2	0.25		
271	Hazel	SEGELSEN CK	268	6.9	260-263	28.89	31.11	40.00	>80	>80	0.18	0.1	0.15		
272	Hazel	SEGELSEN CK	269	14.7	262	36.36	32.73	30.91	>80	>80	0.18	0.3	0.35		
273	Hazel	SEGELSEN CK	270	12.3	262	36.36	32.73	30.91	>80	>80	0.18	0.3	0.35		
274	Hazel	SEGELSEN CK	271	3.3	260-263	28.89	31.11	40.00	>80	>80	0.18	0.1	0.15		
275	Hazel	SEGELSEN CK	272	6.5	260-263	28.89	31.11	40.00	>80	>80	0.18	0.1	0.15		
276	Hazel	SEGELSEN CK	273	0.2	260-263	28.89	31.11	40.00	>80	>80	0.18	0.1	0.15		
277	Hazel	SEGELSEN CK	276	6.7	250	33.33	22.22	44.44	>80	>80	0.18	0.2	0.25		
278	Hazel	SEGELSEN CK	277	6.7	250	33.33	22.22	44.44	>80	>80	0.18	0.2	0.25		
279	Hazel	SEGELSEN CK	278	8.1	145	22.58	53.23	24.19	15	55	0.37	0.2	0.25		
280	Hazel	SEGELSEN CK	279	8.7	145	22.58	53.23	24.19	15	55	0.37	0.2	0.25		
281	Hazel	SEGELSEN CK	280	3.6	264	40.48	26.19	33.33	75	>80	0.18	0.3	0.35		
282	Hazel	SEGELSEN CK	281	6.9	260-263	28.89	31.11	40.00	>80	>80	0.18	0.1	0.15		
283	Hazel	SEGELSEN CK	282	10	262	36.36	32.73	30.91	>80	>80	0.18	0.3	0.35		
284	Hazel	SEGELSEN CK	283	9.4	262	36.36	32.73	30.91	>80	>80	0.18	0.3	0.35		
285	Hazel	SEGELSEN CK	284	3.3	264	40.48	26.19	33.33	75	>80	0.18	0.3	0.35		
286	Hazel	SEGELSEN CK	285	5	264	40.48	26.19	33.33	75	>80	0.18	0.3	0.35		
287	Hazel	SEGELSEN CK	286	1.6	250	33.33	22.22	44.44	>80	>80	0.18	0.2	0.25		

PART IV: HAZEL WAU
Surface Erosion Module
Form B-3.1 "Road Field Form"

FORMB-3.XLS

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
3													ROAD		
4													PRISM		
5												ROAD	DELIVERY		
6												PRISM	AREA		
7			ROAD	ROAD	ROAD	AREA	AREA	AREA	CUTSLOPE	FILLSLOPE	FILLSLOPE	DELIVERY	INCREASED		
8	WAU	SUBBASIN	SEGMENT	SLOPE	"TYPE"	CUTSLOPE	FILLSLOPE	TREAD	VEG	VEG %	VEG FACTOR	AREA	5 PERCENT		
9				%%%		%%%	%%%	%%%	%%%	%%%		%%%	%%%		
288	Hazel	SEGELSEN CK	287	20	148	25.00	34.62	40.38	75	75	0.37	0.2	0.25		
289	Hazel	SEGELSEN CK	288	10	262	36.36	32.73	30.91	>80	>80	0.18	0.3	0.35		
290	Hazel	SEGELSEN CK	289	3.8	250	33.33	22.22	44.44	>80	>80	0.18	0.2	0.25		
291	Hazel	SEGELSEN CK	290	6.3	9	15.38	7.69	76.92	>80	>80	0.18	0.2	0.25		
292	Hazel	SEGELSEN CK	291	0.5	9	15.38	7.69	76.92	>80	>80	0.18	0.2	0.25		
293	Hazel	SEGELSEN CK	292	0.5	32	15.38	26.92	57.69		>80	0.18	0.3	0.35		
294	Hazel	SEGELSEN CK	293	0.5	32	15.38	26.92	57.69	75	>80	0.18	0.3	0.35		
295	Hazel	SEGELSEN CK	294	16.7	28	29.03	29.03	41.94	75	75	0.37	0.2	0.25		
296	Hazel	SEGELSEN CK	295	16.7	148	25.00	34.62	40.38	75	75	0.37	0.2	0.25		
297	Hazel	SEGELSEN CK	296	4.3	264	40.48	26.19	33.33	75	>80	0.18	0.3	0.35		
298	Hazel	SEGELSEN CK	297	6.4	32	15.38	26.92	57.69	75	>80	0.18	0.3	0.35		
299	Hazel	SEGELSEN CK	315	0.3	175	14.29	14.29	71.43	>80	>80	0.18	0.05	0.1		
300	Hazel	SEGELSEN CK	316	0.1	178	14.29	14.29	71.43	>80	>80	0.18	0.1	0.15		
301	Hazel	SEGELSEN CK	317	8.3	145	22.58	53.23	24.19	15	55	0.37	0.2	0.25		
302	Hazel	SEGELSEN CK	318	5	264	40.48	26.19	33.33	75	>80	0.18	0.3	0.35		
303	Hazel	SEGELSEN CK	319	2.8	250	33.33	22.22	44.44	>80	>80	0.18	0.2	0.25		
304	Hazel	SEGELSEN CK	320	5.3	32	15.38	26.92	57.69	75	>80	0.18	0.3	0.35		
305	Hazel	SEGELSEN CK	321	2.8	178	14.29	14.29	71.43	>80	>80	0.18	0.1	0.15		
306	Hazel	SEGELSEN CK	322	6.7	260-263	28.89	31.11	40.00	>80	>80	0.18	0.1	0.15		
307															
308															
309															
310	Hazel	WHITMAN BENCH	6	12	29-138	15.38	15.38	69.23	75	75	0.37	0.05	0.1		
311	Hazel	WHITMAN BENCH	7	9.6	29-138	15.38	15.38	69.23	75	75	0.37	0.05	0.1		
312	Hazel	WHITMAN BENCH	60	1	60	13.04	13.04	73.91	>80	>80	0.18	0.05	0.1		
313	Hazel	WHITMAN BENCH	61	9	61	38.46	33.33	28.21	>80	>80	0.18	0.1	0.15		
314	Hazel	WHITMAN BENCH	62	8.4	60	13.04	13.04	73.91	>80	>80	0.18	0.05	0.1		
315	Hazel	WHITMAN BENCH	63	4.3	63	15.79	15.79	68.42	>80	>80	0.18	0	0.05		

PART IV: HAZEL WAU
Surface Erosion Module
Form B-3.1 "Road Field Form"

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
3													ROAD		
4													PRISM		
5												ROAD	DELIVERY		
6												PRISM	AREA		
7			ROAD	ROAD	ROAD	AREA	AREA	AREA	CUTSLOPE	FILLSLOPE	FILLSLOPE	DELIVERY	INCREASED		
8	WAU	SUBBASIN	SEGMENT	SLOPE	"TYPE"	CUTSLOPE	FILLSLOPE	TREAD	VEG	VEG %	VEG FACTOR	AREA	5 PERCENT		
9				%%%		%%%	%%%	%%%	%%%	%%%		%%%	%%%		
316	Hazel	WHITMAN BENCH	64	1	63	15.79	15.79	68.42	>80	>80	0.18	0	0.05		
317	Hazel	WHITMAN BENCH	65	6.7	63	15.79	15.79	68.42	>80	>80	0.18	0	0.05		
318	Hazel	WHITMAN BENCH	66	1.3	63	15.79	15.79	68.42	>80	>80	0.18	0	0.05		
319	Hazel	WHITMAN BENCH	67	6.7	63	15.79	15.79	68.42	>80	>80	0.18	0	0.05		
320	Hazel	WHITMAN BENCH	68	4	63	15.79	15.79	68.42	>80	>80	0.18	0	0.05		
321	Hazel	WHITMAN BENCH	69	22	71	15.00	15.00	70.00	>80	>80	0.18	0	0.05		
322	Hazel	WHITMAN BENCH	70	1	63	15.79	15.79	68.42	>80	>80	0.18	0	0.05		
323	Hazel	WHITMAN BENCH	71	24	71	15.00	15.00	70.00	>80	>80	0.18	0	0.05		
324	Hazel	WHITMAN BENCH	72	0.5	60	13.04	13.04	73.91	>80	>80	0.18	0.05	0.1		
325	Hazel	WHITMAN BENCH	75	2	63	15.79	15.79	68.42	>80	>80	0.18	0	0.05		
326	Hazel	WHITMAN BENCH	76	1.5	63	15.79	15.79	68.42	>80	>80	0.18	0	0.05		
327	Hazel	WHITMAN BENCH	77	1.3	63	15.79	15.79	68.42	>80	>80	0.18	0	0.05		
328	Hazel	WHITMAN BENCH	79	4	63	15.79	15.79	68.42	>80	>80	0.18	0	0.05		
329	Hazel	WHITMAN BENCH	80	13.3	61	38.46	33.33	28.21	>80	>80	0.18	0	0.05		
330	Hazel	WHITMAN BENCH	81	2.5	60	13.04	13.04	73.91	>80	>80	0.18	0.05	0.1		
331	Hazel	WHITMAN BENCH	87	1.3	63	15.79	15.79	68.42	>80	>80	0.18	0	0.05		
332	Hazel	WHITMAN BENCH	88	2.5	63	15.79	15.79	68.42	>80	>80	0.18	0	0.05		
333	Hazel	WHITMAN BENCH	89	13.5	61	40.00	32.50	27.50	>80	>80	0.18	0	0.05		
334	Hazel	WHITMAN BENCH	90	0.2	63	15.79	15.79	68.42	>80	>80	0.18	0	0.05		
335	Hazel	WHITMAN BENCH	91	2	63	15.79	15.79	68.42	>80	>80	0.18	0	0.05		
336	Hazel	WHITMAN BENCH	92	0.7	63	15.79	15.79	68.42	>80	>80	0.18	0	0.05		
337	Hazel	WHITMAN BENCH	93	0.1	175	14.29	14.29	71.43	>80	>80	0.18	0.05	0.1		
338	Hazel	WHITMAN BENCH	94	4.5	63	15.79	15.79	68.42	>80	>80	0.18	0	0.05		
339	Hazel	WHITMAN BENCH	95	1.25	63	15.79	15.79	68.42	>80	>80	0.18	0	0.05		
340	Hazel	WHITMAN BENCH	96	1.4	63	15.79	15.79	68.42	>80	>80	0.18	0	0.05		
341	Hazel	WHITMAN BENCH	97	15.8	71	15.00	15.00	70.00	>80	>80	0.18	0	0.05		
342	Hazel	WHITMAN BENCH	98	2	175	14.29	14.29	71.43	>80	>80	0.18	0.05	0.1		
343	Hazel	WHITMAN BENCH	110	10	61	38.46	33.33	28.21	>80	>80	0.18	0.1	0.15		

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Surface Erosion Module
Form B-3.1 "Road Field Form"

FORMB-3.XLS

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
3													ROAD		
4													PRISM		
5												ROAD	DELIVERY		
6												PRISM	AREA		
7			ROAD	ROAD	ROAD	AREA	AREA	AREA	CUTSLOPE	FILLSLOPE	FILLSLOPE	DELIVERY	INCREASED		
8	WAU	SUBBASIN	SEGMENT	SLOPE	"TYPE"	CUTSLOPE	FILLSLOPE	TREAD	VEG	VEG %	VEG FACTOR	AREA	5 PERCENT		
9				%%%		%%%	%%%	%%%	%%%	%%%		%%%	%%%		
344	Hazel	WHITMAN BENCH	111	7.7	29-138	15.38	15.38	69.23	75	75	0.37	0.05	0.1		
345	Hazel	WHITMAN BENCH	298	13.8	29-138	15.38	15.38	69.23	75	75	0.37	0.05	0.1		
346	Hazel	WHITMAN BENCH	299	25	28	29.03	29.03	41.94	75	75	0.37	0.2	0.25		
347	Hazel	WHITMAN BENCH	300	20	28	29.03	29.03	41.94	75	75	0.37	0.2	0.25		
348	Hazel	WHITMAN BENCH	301	10	29-138	15.38	15.38	69.23	75	75	0.37	0.1	0.15		
349	Hazel	WHITMAN BENCH	302	26	28	29.03	29.03	41.94	75	75	0.37	0.2	0.25		
350	Hazel	WHITMAN BENCH	303	10.7	29-138	15.38	15.38	69.23	75	75	0.37	0.1	0.15		
351	Hazel	WHITMAN BENCH	304	5	63	15.79	15.79	68.42	>80	>80	0.18	0	0.05		
352	Hazel	WHITMAN BENCH	325	4.2	63	15.79	15.79	68.42	>80	>80	0.18	0	0.05		
353	Hazel	WHITMAN BENCH	326	2.9	63	15.79	15.79	68.42	>80	>80	0.18	0	0.05		

PART IV: HAZEL WAU
Surface Erosion Module
Form B-3.1 "Road Field Form"

FORMB-3.XLS

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
3													ROAD		
4													PRISM		
5												ROAD	DELIVERY		
6												PRISM	AREA		
7			ROAD	ROAD	ROAD	AREA	AREA	AREA	CUTSLOPE	FILLSLOPE	FILLSLOPE	DELIVERY	INCREASED		
8	WAU	SUBBASIN	SEGMENT	SLOPE	"TYPE"	CUTSLOPE	FILLSLOPE	TREAD	VEG	VEG %	VEG FACTOR	AREA	5 PERCENT		
9				%%%		%%%	%%%	%%%	%%%	%%%		%%%	%%%		
36	Hazel	BROOKS CK	29	12.2	29	17.39	13.04	69.57	>80	>80	0.18	0.1	0.15		
37	Hazel	BROOKS CK	30	7.1	29	17.39	13.04	69.57	>80	>80	0.18	0.1	0.15		
38	Hazel	BROOKS CK	32	5.6	32	15.38	26.92	57.69	75	>80	0.18	0.3	0.35		
39	Hazel	BROOKS CK	33	5	32	15.38	26.92	57.69	75	>80	0.18	0.3	0.35		
40	Hazel	BROOKS CK	34	2.5	32	15.38	26.92	57.69	75	>80	0.18	0.05	0.1		
41	Hazel	BROOKS CK	35	4.2	32	15.38	26.92	57.69	75	>80	0.18	0.3	0.35		
42	Hazel	BROOKS CK	36	4.1	36	38.64	27.27	34.09	>80	>80	0.18	0.2	0.25		
43	Hazel	BROOKS CK	37	3.4	36	38.64	27.27	34.09	>80	>80	0.18	0.2	0.25		
44	Hazel	BROOKS CK	38	21	245	17.86	21.43	60.71	>80	>80	0.18	0.1	0.15		
45	Hazel	BROOKS CK	39	3.2	36	38.64	27.27	34.09	>80	>80	0.18	0.05	0.1		
46	Hazel	BROOKS CK	40	16.8	245	17.86	21.43	60.71	>80	>80	0.18	0.1	0.15		
47	Hazel	BROOKS CK	41	15	245	17.86	21.43	60.71	>80	>80	0.18	0.1	0.15		
48	Hazel	BROOKS CK	42	5.3	36	38.64	27.27	34.09	>80	>80	0.18	0.05	0.1		
49	Hazel	BROOKS CK	43	6.8	36	38.64	27.27	34.09	>80	>80	0.18	0.2	0.25		
50	Hazel	BROOKS CK	44	5.6	36	38.64	27.27	34.09	>80	>80	0.18	0.05	0.1		
51	Hazel	BROOKS CK	52	10	242	29.03	25.81	45.16	>80	>80	0.18	0.1	0.15		
52	Hazel	BROOKS CK	54	8	36	38.64	27.27	34.09	>80	>80	0.18	0.2	0.25		
53	Hazel	BROOKS CK	55	3.3	36	38.64	27.27	34.09	>80	>80	0.18	0.2	0.25		
54	Hazel	BROOKS CK	56	0.5	250	33.33	22.22	44.44	>80	>80	0.18	0.2	0.25		
55	Hazel	BROOKS CK	57	11.1	36	38.64	27.27	34.09	>80	>80	0.18	0.2	0.25		
56	Hazel	BROOKS CK	59	4	36	38.64	27.27	34.09	>80	>80	0.18	0.2	0.25		
57	Hazel	BROOKS CK	85	0.9	9	15.38	7.69	76.92		>80	0.18	0.2	0.25		
58	Hazel	BROOKS CK	104	1.7	8	36.84	21.05	42.11	>80	>80	0.18	0.2	0.25		
59	Hazel	BROOKS CK	105	8	124	22.22	18.52	59.26	>80	>80	0.18	0.2	0.25		
60	Hazel	BROOKS CK	106	16	71	15.00	15.00	70.00	>80	>80	0.18	0	0.05		
61	Hazel	BROOKS CK	107	16.2	71	15.00	15.00	70.00	>80	>80	0.18	0	0.05		
62	Hazel	BROOKS CK	108	6.7	14	29.27	31.71	39.02	>80	>80	0.18	0.2	0.25		
63	Hazel	BROOKS CK	114	1.2	8	36.84	21.05	42.11	>80	>80	0.18	0.2	0.25		

PART IV: HAZEL WAU
Surface Erosion Module
Form B-3.1 "Road Field Form"

FORMB-3.XLS

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
3													ROAD		
4													PRISM		
5												ROAD	DELIVERY		
6												PRISM	AREA		
7			ROAD	ROAD	ROAD	AREA	AREA	AREA	CUTSLOPE	FILLSLOPE	FILLSLOPE	DELIVERY	INCREASED		
8	WAU	SUBBASIN	SEGMENT	SLOPE	"TYPE"	CUTSLOPE	FILLSLOPE	TREAD	VEG	VEG %	VEG FACTOR	AREA	5 PERCENT		
9				%%%		%%%	%%%	%%%	%%%	%%%		%%%	%%%		
64	Hazel	BROOKS CK	115	0.1	14	29.27	31.71	39.02	>80	>80	0.18	0.2	0.25		
65	Hazel	BROOKS CK	117	11.7	29	17.39	13.04	69.57	>80	>80	0.18	0.1	0.15		
66	Hazel	BROOKS CK	118	4	32	15.38	26.92	57.69	75	>80	0.18	0.3	0.35		
67	Hazel	BROOKS CK	121	1.2	32	15.38	26.92	57.69	75	>80	0.18	0.3	0.35		
68	Hazel	BROOKS CK	122	13.3	29	17.39	13.04	69.57	>80	>80	0.18	0.1	0.15		
69	Hazel	BROOKS CK	123	12.5	29	17.39	13.04	69.57	>80	>80	0.18	0.1	0.15		
70	Hazel	BROOKS CK	308	11	124	22.22	18.52	59.26	>80	>80	0.18	0.2	0.25		
71	Hazel	BROOKS CK	327	7.5	124	22.22	18.52	59.26	>80	>80	0.18	0.2	0.25		
72	Hazel	BROOKS CK	329	1.3	208-209	32.50	17.50	50.00	75	>80	0.18	0.1	0.15		
73															
74															
75															
76	Hazel	DICKS CK	129	6.2	131	33.33	20.00	46.67	>80	>80	0.18	0	0.05		
77	Hazel	DICKS CK	131	0.6	131	33.33	20.00	46.67	>80	>80	0.18	0	0.05		
78	Hazel	DICKS CK	132	2.9	132	21.43	25.00	53.57	>80	>80	0.18	0.1	0.15		
79	Hazel	DICKS CK	135	26	141	28.57	37.14	34.29	>80	>80	0.18	0.05	0.1		
80	Hazel	DICKS CK	137	10.8	132	21.43	25.00	53.57	>80	>80	0.18	0.05	0.1		
81	Hazel	DICKS CK	172	2.9	8-60-125-254-258	26.19	28.57	45.24	>80	>80	0.18	0.2	0.25		
82															
83															
84															
85	Hazel	MT HIGGINS	173	5.33	247	30.00	32.50	37.50	50	>80	0.18	0.1	0.15		
86	Hazel	MT HIGGINS	176	0.2	175	14.29	14.29	71.43	>80	>80	0.18	0.05	0.1		
87	Hazel	MT HIGGINS	177	0.7	175	14.29	14.29	71.43	>80	>80	0.18	0.05	0.1		
88	Hazel	MT HIGGINS	190	3	198-203-230-235-240	32.26	19.35	48.39	70	>80	0.18	0.05	0.1		
89	Hazel	MT HIGGINS	191	0.5	198-203-230-235-240	32.26	19.35	48.39	70	>80	0.18	0.05	0.1		
90	Hazel	MT HIGGINS	192	1	198-203-230-235-240	32.26	19.35	48.39	70	>80	0.18	0.05	0.1		
91	Hazel	MT HIGGINS	193	0.3	198-203-230-235-240	32.26	19.35	48.39	70	>80	0.18	0.05	0.1		

PART IV: HAZEL WAU
Surface Erosion Module
Form B-3.1 "Road Field Form"

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
3													ROAD		
4													PRISM		
5												ROAD	DELIVERY		
6												PRISM	AREA		
7			ROAD	ROAD	ROAD	AREA	AREA	AREA	CUTSLOPE	FILLSLOPE	FILLSLOPE	DELIVERY	INCREASED		
8	WAU	SUBBASIN	SEGMENT	SLOPE	"TYPE"	CUTSLOPE	FILLSLOPE	TREAD	VEG	VEG %	VEG FACTOR	AREA	5 PERCENT		
9				%%%		%%%	%%%	%%%	%%%	%%%		%%%	%%%		
92	Hazel	MT HIGGINS	194	1	198-203-230-235-240	32.26	19.35	48.39	70	>80	0.18	0.05	0.1		
93	Hazel	MT HIGGINS	195	0.5	198-203-230-235-240	32.26	19.35	48.39	70	>80	0.18	0.05	0.1		
94	Hazel	MT HIGGINS	196	1.7	198-203-230-235-240	32.26	19.35	48.39	70	>80	0.18	0.05	0.1		
95	Hazel	MT HIGGINS	197	3	198-203-230-235-240	32.26	19.35	48.39	70	>80	0.18	0.05	0.1		
96	Hazel	MT HIGGINS	198	1	198-203-230-235-240	32.26	19.35	48.39	70	>80	0.18	0.05	0.1		
97	Hazel	MT HIGGINS	199	13.3	224-238	37.50	25.00	37.50	70	>80	0.18	0.2	0.25		
98	Hazel	MT HIGGINS	200	4.8	198-203-230-235-240	32.26	19.35	48.39	70	>80	0.18	0.05	0.1		
99	Hazel	MT HIGGINS	201	0.8	198-203-230-235-240	32.26	19.35	48.39	70	>80	0.18	0.05	0.1		
100	Hazel	MT HIGGINS	202	1.9	8-60-125-254-258	26.19	28.57	45.24	>80	>80	0.18	0.2	0.25		
101	Hazel	MT HIGGINS	203	2.2	198-203-230-235-240	32.26	19.35	48.39	70	>80	0.18	0.05	0.1		
102	Hazel	MT HIGGINS	204	2.9	198-203-230-235-240	32.26	19.35	48.39	70	>80	0.18	0.05	0.1		
103	Hazel	MT HIGGINS	205	1.5	247	30.00	32.50	37.50	50	>80	0.18	0.1	0.15		
104	Hazel	MT HIGGINS	206	3.7	247	30.00	32.50	37.50	50	>80	0.18	0.1	0.15		
105	Hazel	MT HIGGINS	207	7.4	207	31.58	28.95	39.47	>80	>80	0.18	0.1	0.15		
106	Hazel	MT HIGGINS	208	8.8	208	40.54	13.51	45.95	70	>80	0.18	0.1	0.15		
107	Hazel	MT HIGGINS	211	14.1	213	29.41	17.65	52.94	>80			0.2	0.25		
108	Hazel	MT HIGGINS	212	7.2	208	40.54	13.51	45.95	70	>80	0.18	0.1	0.15		
109	Hazel	MT HIGGINS	213	3.6	213	29.41	17.65	52.94	>80	>80	0.18	0.2	0.25		
110	Hazel	MT HIGGINS	215	7.9	213	29.41	17.65	52.94	>80	>80	0.18	0.2	0.25		
111	Hazel	MT HIGGINS	216	5.9	8-60-125-254-258	26.19	28.57	45.24	>80	>80	0.18	0.2	0.25		
112	Hazel	MT HIGGINS	217	6.9	207	31.58	28.95	39.47	>80	>80	0.18	0.1	0.15		
113	Hazel	MT HIGGINS	218	2.1	219	14.29	14.29	71.43	>80	>80	0.18	0	0.05		
114	Hazel	MT HIGGINS	219	11.4	219	14.29	14.29	71.43	>80	>80	0.18	0.05	0.1		
115	Hazel	MT HIGGINS	220	17.1	219	14.29	14.29	71.43	>80	>80	0.18	0.05	0.1		
116	Hazel	MT HIGGINS	221	5	219	14.29	14.29	71.43	>80	>80	0.18	0.05	0.1		
117	Hazel	MT HIGGINS	222	3.5	250	33.33	22.22	44.44	>80	>80	0.18	0.2	0.25		
118	Hazel	MT HIGGINS	223	5	250	33.33	22.22	44.44	>80	>80	0.18	0.2	0.25		
119	Hazel	MT HIGGINS	224	10.3	224-238	37.50	25.00	37.50	70	>80	0.18	0.2	0.25		

PART IV: HAZEL WAU
Surface Erosion Module
Form B-3.1 "Road Field Form"

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
3													ROAD		
4													PRISM		
5												ROAD	DELIVERY		
6												PRISM	AREA		
7			ROAD	ROAD	ROAD	AREA	AREA	AREA	CUTSLOPE	FILLSLOPE	FILLSLOPE	DELIVERY	INCREASED		
8	WAU	SUBBASIN	SEGMENT	SLOPE	"TYPE"	CUTSLOPE	FILLSLOPE	TREAD	VEG	VEG %	VEG FACTOR	AREA	5 PERCENT		
9				%%%		%%%	%%%	%%%	%%%	%%%		%%%	%%%		
120	Hazel	MT HIGGINS	225	7.5	224-238	37.50	25.00	37.50	70	>80	0.18	0.2	0.25		
121	Hazel	MT HIGGINS	226	5	198-203-230-235-240	32.26	19.35	48.39	70	>80	0.18	0.05	0.1		
122	Hazel	MT HIGGINS	227	0.3	198-203-230-235-240	32.26	19.35	48.39	70	>80	0.18	0.05	0.1		
123	Hazel	MT HIGGINS	228	11.4	224-238	37.50	25.00	37.50	70	>80	0.18	0.2	0.25		
124	Hazel	MT HIGGINS	229	8.9	224-238	37.50	25.00	37.50	70	>80	0.18	0.2	0.25		
125	Hazel	MT HIGGINS	230	0.7	198-203-230-235-240	32.26	19.35	48.39	70	>80	0.18	0.05	0.1		
126	Hazel	MT HIGGINS	231	0.7	198-203-230-235-240	32.26	19.35	48.39	70	>80	0.18	0.05	0.1		
127	Hazel	MT HIGGINS	232	1.7	198-203-230-235-240	32.26	19.35	48.39	70	>80	0.18	0.05	0.1		
128	Hazel	MT HIGGINS	233	5.6	198-203-230-235-240	32.26	19.35	48.39	70	>80	0.18	0.05	0.1		
129	Hazel	MT HIGGINS	234	5.7	198-203-230-235-240	32.26	19.35	48.39	70	>80	0.18	0.05	0.1		
130	Hazel	MT HIGGINS	235	4.8	198-203-230-235-240	32.26	19.35	48.39	70	>80	0.18	0.05	0.1		
131	Hazel	MT HIGGINS	236	6.5	198-203-230-235-240	32.26	19.35	48.39	70	>80	0.18	0.05	0.1		
132	Hazel	MT HIGGINS	237	20	224-238	37.50	25.00	37.50	70	>80	0.18	0.2	0.25		
133	Hazel	MT HIGGINS	238	10.9	224-238	37.50	25.00	37.50	70	>80	0.18	0.2	0.25		
134	Hazel	MT HIGGINS	239	6	198-203-230-235-240	32.26	19.35	48.39	70	>80	0.18	0.05	0.1		
135	Hazel	MT HIGGINS	240	0.4	198-203-230-235-240	32.26	19.35	48.39	70	>80	0.18	0.05	0.1		
136	Hazel	MT HIGGINS	241	0.4	198-203-230-235-240	32.26	19.35	48.39	70	>80	0.18	0.05	0.1		
137	Hazel	MT HIGGINS	242	6.6	242	29.03	25.81	45.16	>80	>80	0.18	0.1	0.15		
138	Hazel	MT HIGGINS	243	4.8	242	29.03	25.81	45.16	>80	>80	0.18	0.1	0.15		
139	Hazel	MT HIGGINS	244	5	242	29.03	25.81	45.16	>80	>80	0.18	0.1	0.15		
140	Hazel	MT HIGGINS	245	15.1	245	17.86	21.43	60.71	70	>80	0.18	0	0.05		
141	Hazel	MT HIGGINS	246	7.1	246	31.71	31.71	36.59	70	>80	0.18	0.1	0.15		
142	Hazel	MT HIGGINS	247	0.8	247	30.00	32.50	37.50	50	>80	0.18	0.1	0.15		
143	Hazel	MT HIGGINS	248	5.6	242	29.03	25.81	45.16	>80	>80	0.18	0.1	0.15		
144	Hazel	MT HIGGINS	249	9.2	242	29.03	25.81	45.16	>80	>80	0.18	0.1	0.15		
145	Hazel	MT HIGGINS	250	1.5	250	33.33	22.22	44.44	>80	>80	0.18	0.2	0.25		
146	Hazel	MT HIGGINS	251	9.1	224-238	37.50	25.00	37.50	70	>80	0.18	0.2	0.25		
147	Hazel	MT HIGGINS	252	4	242	29.03	25.81	45.16	>80	>80	0.18	0.1	0.15		

PART IV: HAZEL WAU
Surface Erosion Module
Form B-3.1 "Road Field Form"

FORMB-3.XLS

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
3													ROAD		
4													PRISM		
5												ROAD	DELIVERY		
6												PRISM	AREA		
7			ROAD	ROAD	ROAD	AREA	AREA	AREA	CUTSLOPE	FILLSLOPE	FILLSLOPE	DELIVERY	INCREASED		
8	WAU	SUBBASIN	SEGMENT	SLOPE	"TYPE"	CUTSLOPE	FILLSLOPE	TREAD	VEG	VEG %	VEG FACTOR	AREA	5 PERCENT		
9				%%%		%%%	%%%	%%%	%%%	%%%		%%%	%%%		
148	Hazel	MT HIGGINS	253	10.3	262	36.36	32.73	30.91	>80	>80	0.18	0.3	0.35		
149	Hazel	MT HIGGINS	311	0.1	198-203-230-235-240	32.26	19.35	48.39	70	>80	0.18	0.05	0.1		
150	Hazel	MT HIGGINS	312	7.9	224-238	37.50	25.00	37.50	70	>80	0.18	0.2	0.25		
151	Hazel	MT HIGGINS	313	8	224-238	37.50	25.00	37.50	70	>80	0.18	0.2	0.25		
152	Hazel	MT HIGGINS	314	11.4	224-238	37.50	25.00	37.50	70	>80	0.18	0.2	0.25		
153	Hazel	MT HIGGINS	324	9	124	22.22	18.52	59.26	>80	>80	0.18	0.3	0.35		
154	Hazel	MT. HIGGINS	274	4.1	260-263	28.89	31.11	40.00	>80	>80	0.18	0.1	0.15		
155	Hazel	MT. HIGGINS	275	5.6	242	29.03	25.81	45.16	>80	>80	0.18	0.1	0.15		
156															
157															
158															
159	Hazel	ROLLINS CK	31	4.2	138	14.81	14.81	70.37	70	70	0.37	0.05	0.1		
160	Hazel	ROLLINS CK	45	5.5	242	29.03	25.81	45.16	>80	>80	0.18	0.1	0.15		
161	Hazel	ROLLINS CK	46	17.5	245	17.86	21.43	60.71	>80	>80	0.18	0.1	0.15		
162	Hazel	ROLLINS CK	47	10.6	245	17.86	21.43	60.71	>80	>80	0.18	0.1	0.15		
163	Hazel	ROLLINS CK	48	11.7	245	17.86	21.43	60.71	>80	>80	0.18	0.1	0.15		
164	Hazel	ROLLINS CK	49	17.8	245	17.86	21.43	60.71	>80	>80	0.18	0.1	0.15		
165	Hazel	ROLLINS CK	50	5.5	242	29.03	25.81	45.16	>80	>80	0.18	0.1	0.15		
166	Hazel	ROLLINS CK	51	17.1	245	17.86	21.43	60.71	>80	>80	0.18	0.1	0.15		
167	Hazel	ROLLINS CK	53	11.4	245	17.86	21.43	60.71	>80	>80	0.18	0.1	0.15		
168	Hazel	ROLLINS CK	58	0.7	242	29.03	25.81	45.16	>80	>80	0.18	0.1	0.15		
169	Hazel	ROLLINS CK	73	0.5	125	14.71	35.29	50.00	>80	>80	0.18	0.2	0.25		
170	Hazel	ROLLINS CK	74	3	83	15.00	15.00	70.00	>80	>80	0.18	0	0.05		
171	Hazel	ROLLINS CK	78	1.3	242	29.03	25.81	45.16	>80	>80	0.18	0.1	0.15		
172	Hazel	ROLLINS CK	82	6.4	83	15.00	15.00	70.00	>80	>80	0.18	0	0.05		
173	Hazel	ROLLINS CK	83	0.2	83	15.00	15.00	70.00	>80	>80	0.18	0	0.05		
174	Hazel	ROLLINS CK	84	2.5	83	15.00	15.00	70.00	>80	>80	0.18	0.05	0.1		
175	Hazel	ROLLINS CK	86	2.8	83	15.00	15.00	70.00	>80	>80	0.18	0	0.05		

PART IV: HAZEL WAU
Surface Erosion Module
Form B-3.1 "Road Field Form"

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
3													ROAD		
4													PRISM		
5												ROAD	DELIVERY		
6												PRISM	AREA		
7			ROAD	ROAD	ROAD	AREA	AREA	AREA	CUTSLOPE	FILLSLOPE	FILLSLOPE	DELIVERY	INCREASED		
8	WAU	SUBBASIN	SEGMENT	SLOPE	"TYPE"	CUTSLOPE	FILLSLOPE	TREAD	VEG	VEG %	VEG FACTOR	AREA	5 PERCENT		
9				%%%		%%%	%%%	%%%	%%%	%%%		%%%	%%%		
176	Hazel	ROLLINS CK	99	0.4	83	15.00	15.00	70.00	>80	>80	0.18	0	0.05		
177	Hazel	ROLLINS CK	100	0.4	83	15.00	15.00	70.00	>80	>80	0.18	0	0.05		
178	Hazel	ROLLINS CK	101	1.1	83	15.00	15.00	70.00	>80	>80	0.18	0	0.05		
179	Hazel	ROLLINS CK	102	0.3	83	15.00	15.00	70.00	>80	>80	0.18	0	0.05		
180	Hazel	ROLLINS CK	103	1.1	125	14.71	35.29	50.00	>80	>80	0.18	0.2	0.25		
181	Hazel	ROLLINS CK	109	4.8	83	15.00	15.00	70.00	>80	>80	0.18	0	0.05		
182	Hazel	ROLLINS CK	112	1.1	83	15.00	15.00	70.00	>80	>80	0.18	0.05	0.1		
183	Hazel	ROLLINS CK	113	0.4	125	14.71	35.29	50.00	>80	>80	0.18	0.2	0.25		
184	Hazel	ROLLINS CK	116	0.9	83	15.00	15.00	70.00	>80	>80	0.18	0	0.05		
185	Hazel	ROLLINS CK	119	7.5	138	14.81	14.81	70.37	70	70	0.37	0.05	0.1		
186	Hazel	ROLLINS CK	120	8	138	14.81	14.81	70.37	70	70	0.37	0.05	0.1		
187	Hazel	ROLLINS CK	124	11.7	124	22.22	18.52	59.26	>80	>80	0.18	0.2	0.25		
188	Hazel	ROLLINS CK	125	3.3	125	14.71	35.29	50.00	>80	>80	0.18	0.2	0.25		
189	Hazel	ROLLINS CK	126	17.7	126	20.83	20.83	58.33	>80	>80	0.18	0.2	0.25		
190	Hazel	ROLLINS CK	127	1	125	14.71	35.29	50.00	>80	>80	0.18	0.2	0.25		
191	Hazel	ROLLINS CK	128	1.9	83	15.00	15.00	70.00	>80	>80	0.18	0	0.05		
192	Hazel	ROLLINS CK	130	1.9	83	15.00	15.00	70.00	>80	>80	0.18	0	0.05		
193	Hazel	ROLLINS CK	133	4.7	138	14.81	14.81	70.37	70	70	0.37	0.05	0.1		
194	Hazel	ROLLINS CK	134	16.5	141	28.57	37.14	34.29	>80	>80	0.18	0	0.05		
195	Hazel	ROLLINS CK	136	10.8	141	28.57	37.14	34.29	>80	>80	0.18	0	0.05		
196	Hazel	ROLLINS CK	138	7.5	138	14.81	14.81	70.37	70	70	0.37	0.05	0.1		
197	Hazel	ROLLINS CK	139	7.3	138	14.81	14.81	70.37	70	70	0.37	0.05	0.1		
198	Hazel	ROLLINS CK	140	12.7	140	43.59	15.38	41.03	85	>80	0.18	0.2	0.25		
199	Hazel	ROLLINS CK	141	21.8	141	28.57	37.14	34.29	>80	>80	0.18	0	0.05		
200	Hazel	ROLLINS CK	142	15.5	148	25.00	34.62	40.38	75	75	0.37	0.1	0.15		
201	Hazel	ROLLINS CK	143	20.6	144	33.33	38.60	28.07	75	>80	0.18	0.2	0.25		
202	Hazel	ROLLINS CK	144	11	144	33.33	38.60	28.07	75	>80	0.18	0.2	0.25		
203	Hazel	ROLLINS CK	145	13.4	145	22.58	53.23	24.19	15	15	0.77	0.05	0.1		

PART IV: HAZEL WAU
Surface Erosion Module
Form B-3.1 "Road Field Form"

FORMB-3.XLS

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
3													ROAD		
4													PRISM		
5												ROAD	DELIVERY		
6												PRISM	AREA		
7			ROAD	ROAD	ROAD	AREA	AREA	AREA	CUTSLOPE	FILLSLOPE	FILLSLOPE	DELIVERY	INCREASED		
8	WAU	SUBBASIN	SEGMENT	SLOPE	"TYPE"	CUTSLOPE	FILLSLOPE	TREAD	VEG	VEG %	VEG FACTOR	AREA	5 PERCENT		
9				%%%		%%%	%%%	%%%	%%%	%%%		%%%	%%%		
204	Hazel	ROLLINS CK	146	5.6	146	26.09	32.61	41.30	40	40	0.53	0.05	0.1		
205	Hazel	ROLLINS CK	147	0.9	242	29.03	25.81	45.16	>80	>80	0.18	0.1	0.15		
206	Hazel	ROLLINS CK	148	16.4	148	25.00	34.62	40.38	75	75	0.37	0.1	0.15		
207	Hazel	ROLLINS CK	149	6.2	132	21.43	25.00	53.57	>80	>80	0.18	0.1	0.15		
208	Hazel	ROLLINS CK	150	3.9	242	29.03	25.81	45.16	>80	>80	0.18	0.1	0.15		
209	Hazel	ROLLINS CK	151	14.3	141	28.57	37.14	34.29	>80	>80	0.18	0	0.05		
210	Hazel	ROLLINS CK	152	8.3	245	17.86	21.43	60.71	>80	>80	0.18	0.1	0.15		
211	Hazel	ROLLINS CK	153	2.9	132	21.43	25.00	53.57	>80	>80	0.18	0.1	0.15		
212	Hazel	ROLLINS CK	154	19.2	141	28.57	37.14	34.29	>80	>80	0.18	0	0.05		
213	Hazel	ROLLINS CK	155	1.2	132	21.43	25.00	53.57	>80	>80	0.18	0.1	0.15		
214	Hazel	ROLLINS CK	156	6.6	132	21.43	25.00	53.57	>80	>80	0.18	0.1	0.15		
215	Hazel	ROLLINS CK	157	10	141	28.57	37.14	34.29	>80	>80	0.18	0	0.05		
216	Hazel	ROLLINS CK	158	17.5	148	25.00	34.62	40.38	75	75	0.37	0.1	0.15		
217	Hazel	ROLLINS CK	159	6.2	146	26.09	32.61	41.30	40	40	0.53	0.05	0.1		
218	Hazel	ROLLINS CK	160	13.3	145	22.58	53.23	24.19	15	15	0.77	0.05	0.1		
219	Hazel	ROLLINS CK	161	7.7	145	22.58	53.23	24.19	15	15	0.77	0.05	0.1		
220	Hazel	ROLLINS CK	162	8.6	145	22.58	53.23	24.19	15	15	0.77	0.05	0.1		
221	Hazel	ROLLINS CK	163	6.7	132	21.43	25.00	53.57	>80	>80	0.18	0.1	0.15		
222	Hazel	ROLLINS CK	164	0.3	132	21.43	25.00	53.57	>80	>80	0.18	0.1	0.15		
223	Hazel	ROLLINS CK	165	2.1	132	21.43	25.00	53.57	>80	>80	0.18	0.1	0.15		
224	Hazel	ROLLINS CK	166	9.7	141	28.57	37.14	34.29	>80	>80	0.18	0	0.05		
225	Hazel	ROLLINS CK	167	7.5	145	22.58	53.23	24.19	15	15	0.77	0.05	0.1		
226	Hazel	ROLLINS CK	168	5.6	132	21.43	25.00	53.57	>80	>80	0.18	0.1	0.15		
227	Hazel	ROLLINS CK	169	0.7	132	21.43	25.00	53.57	>80	>80	0.18	0.1	0.15		
228	Hazel	ROLLINS CK	170	3.3	132	21.43	25.00	53.57	>80	>80	0.18	0.1	0.15		
229	Hazel	ROLLINS CK	171	12.1	141	28.57	37.14	34.29	>80	>80	0.18	0	0.05		
230	Hazel	ROLLINS CK	174	13.2	145	22.58	53.23	24.19	15	15	0.77	0.05	0.1		
231	Hazel	ROLLINS CK	305	10	138	14.81	14.81	70.37	70	70	0.37	0.05	0.1		

PART IV: HAZEL WAU
Surface Erosion Module
Form B-3.1 "Road Field Form"

FORMB-3.XLS

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
3													ROAD		
4													PRISM		
5												ROAD	DELIVERY		
6												PRISM	AREA		
7			ROAD	ROAD	ROAD	AREA	AREA	AREA	CUTSLOPE	FILLSLOPE	FILLSLOPE	DELIVERY	INCREASED		
8	WAU	SUBBASIN	SEGMENT	SLOPE	"TYPE"	CUTSLOPE	FILLSLOPE	TREAD	VEG	VEG %	VEG FACTOR	AREA	5 PERCENT		
9				%%%		%%%	%%%	%%%	%%%	%%%		%%%	%%%		
232	Hazel	ROLLINS CK	306	10	138	14.81	14.81	70.37	70	70	0.37	0.05	0.1		
233	Hazel	ROLLINS CK	307	0.5	132	21.43	25.00	53.57	>80	>80	0.18	0.1	0.15		
234	Hazel	ROLLINS CK	309	7.6	245	17.86	21.43	60.71	>80	>80	0.18	0.1	0.15		
235	Hazel	ROLLINS CK	310	2.5	146	26.09	32.61	41.30	40	40	0.53	0.2	0.25		
236	Hazel	ROLLINS CK	323	2	138	14.81	14.81	70.37	70	70	0.37	0.05	0.1		
237	Hazel	ROLLINS CK	328	0.3	83	15.00	15.00	70.00		>80	0.18	0	0.05		
238															
239															
240															
241	Hazel	SEGELSEN CK	175	1.8	175	14.29	14.29	71.43	>80	>80	0.18	0.05	0.1		
242	Hazel	SEGELSEN CK	178	1.4	178	14.29	14.29	71.43	>80	>80	0.18	0.1	0.15		
243	Hazel	SEGELSEN CK	179	0.2	178	14.29	14.29	71.43	>80	>80	0.18	0.1	0.15		
244	Hazel	SEGELSEN CK	180	3.7	178	14.29	14.29	71.43	>80	>80	0.18	0.1	0.15		
245	Hazel	SEGELSEN CK	181	6	178	14.29	14.29	71.43	>80	>80	0.18	0.1	0.15		
246	Hazel	SEGELSEN CK	182	2	178	14.29	14.29	71.43	>80	>80	0.18	0.1	0.15		
247	Hazel	SEGELSEN CK	183	3.3	178	14.29	14.29	71.43	>80	>80	0.18	0.1	0.15		
248	Hazel	SEGELSEN CK	184	1.8	178	14.29	14.29	71.43	>80	>80	0.18	0.1	0.15		
249	Hazel	SEGELSEN CK	185	1.7	178	14.29	14.29	71.43	>80	>80	0.18	0.1	0.15		
250	Hazel	SEGELSEN CK	186	3.3	178	14.29	14.29	71.43	>80	>80	0.18	0.1	0.15		
251	Hazel	SEGELSEN CK	187	4.4	178	14.29	14.29	71.43	>80	>80	0.18	0.1	0.15		
252	Hazel	SEGELSEN CK	188	10	188	37.84	21.62	40.54	5	5	1	0	0.05		
253	Hazel	SEGELSEN CK	189	0.2	178	14.29	14.29	71.43	>80	>80	0.18	0.1	0.15		
254	Hazel	SEGELSEN CK	209	1.3	209	26.83	19.51	53.66	>80	>80	0.18	0	0.05		
255	Hazel	SEGELSEN CK	210	8.1	210	20.75	33.96	45.28	>80	>80	0.18	0	0.05		
256	Hazel	SEGELSEN CK	214	12	210	20.75	33.96	45.28	>80	>80	0.18	0	0.05		
257	Hazel	SEGELSEN CK	254	4.9	254-258	28.57	32.14	39.29	75	>80	0.18	0.25	0.3		
258	Hazel	SEGELSEN CK	255	3.3	178	14.29	14.29	71.43	>80	>80	0.18	0.1	0.15		
259	Hazel	SEGELSEN CK	256	15.5	259	22.86	34.29	42.86	>80	>80	0.18		0.05		

PART IV: HAZEL WAU
Surface Erosion Module
Form B-3.2 "Road Segment Sampling Notes"

	A	B	C	D	E	F	G	H	I	J	K	L	M
1													
2													
3													
4													
5													
6													
7													
8			CUTSLOPE		FILLSLOPE					ROAD		ROAD PRISM	
9		CLINOMETER	SLOPE OR	CLINOMETER	SLOPE OR	ROAD				TREAD	DITCH	SLOPE	
10	ROAD	READING	HORIZONTAL	READING	HORIZONTAL	TREAD	X-SECTIONAL	CUTSLOPE	FILLSLOPE	SURFACING	DELIVERING	TO/AWAY FROM	
11	SEGMENT	*CUTSLOPE	DISTANCE	*FILLSLOPE	DISTANCE	WIDTH	PRISM	DENSITY	DENSITY	DEPTH	TO WATER?	DITCH?	COMMENTS
12		*% / DEGREES*	*FEET*	*% / DEGREES*	*FEET*	*FEET*	*DESIGN*	*%%%*	*%%%*		*Yes, Distance[ft]/No*	*To/Away or Other*	
13													
14													
15	8	65 / 33	14	45 / 24	8	16	Insloped, ditched	85	85	> 6 Inches	Yes, 400'	Both	Water flows down tracks in road tread
16	9	0 / 0	4	0 / 0	2	20	Flatsloped, ditched	80	80	> 6 Inches	Yes, 310'	Both	Water flows down tracks in road tread
17	13	40 / 21	10	45 / 24	8	17	Insloped, ditched	70	80	> 6 Inches	Yes, 650'	To	
18	14	60 / 31	12	45 / 24	13	16	Insloped, ditched	80	80	> 6 Inches	Yes, 490'	To	
19	22	0 / 0	3	0 / 0	3	16	Flatsloped, ditched	80	80	> 6 Inches	No	Flat	Road waterbarred, but culvert on Type 4/5 not pulled.
20	28	70 / 35	9	50 / 26	9	13	Insloped, ditched	75	75	> 6 Inches	Yes, 295'	Away	
21	29	0 / 0	4	0 / 0	3	16	Flatsloped, ditched	80	80	> 6 Inches	Yes, 300'	To	Road follows topographic contours
22	32	20 / 11	4	50 / 26	7	15	Flatsloped, ditched	75	80	> 6 Inches	Yes, 150'	Flat	Some streams flow down ditch to next cross-drain, much flowing H20 here!!!
23	36	65 / 33	17	35 / 19	12	15	Insloped, ditched	85	85	> 6 Inches	Yes, 442'	To	
24	60	0 / 0	3	0 / 0	3	17	Flatsloped, ditched	85	85	> 6 Inches	Yes, 100'	Flat	
25	61	65 / 33	16	45 / 24	13	11	Outsloped, ditched	80	80	> 6 Inches	Yes, 220'	Away	
26	63	0 / 0	3	0 / 0	3	13	Flatsloped, ditched	90	90	> 6 Inches	No	Flat	No delivery seen
27	71	0 / 0	3	0 / 0	3	14	Flatsloped, no ditch	90	90	> 6 Inches	No	Flat	Orphan road
28	83	0 / 0	3	0 / 0	3	14	Flatsloped, ditched	85	85	> 6 Inches	No	Both	Ditch caused by road surfacing only
29	106	0 / 0	2	0 / 0	2	12	Flatsloped, ditched	75	85	> 6 Inches	No	Both	Parallel stream about 200' away
30	109	60 / 31	23	20 / 11	5	15	Insloped, ditched	80	80	> 6 Inches	No	To	
31	124	80 / 37	6	90 / 14	5	16	Insloped, ditched	80	80	> 6 Inches	Yes, 730'	To	
32	125	25 / 14	5	25 / 14	12	17	Insloped, ditched	80	80	> 6 Inches	Yes, 200'	Both	Delivery from both sides of road
33	126	20 / 11	5	20 / 11	5	14	Insloped, ditched	80	80	> 6 Inches	Yes, 365'	To	
34	131	65 / 33	10	30 / 16	6	14	Insloped, ditched	80	80	> 6 Inches	No	Flat	
35	132	55 / 28	6	65 / 33	7	15	Insloped, ditched	85	85	> 6 Inches	Yes, 465'	Flat	Bridge taken out, toad not accessible by vehicle
36	138	0 / 0	4	0 / 0	4	19	Flatsloped, ditched	70	70	> 6 Inches	No	Flat	Delivery within 200' of H20
37	140	50 / 27	17	60 / 31	6	16	Flatsloped, ditched	85	85	> 6 Inches	Yes, 390'	Both	
38	141	70 / 35	10	35 / 12	13	12	Railroad Grade	85	85	> 6 Inches	No	No Ditch	Railroad Grade
39	144	80 / 37	19	50 / 26	22	16	Flatsloped, ditched	75	85	> 6 Inches	Yes, 485'	Both	
40	145	115 / 48	14	70 / 35	33	15	Insloped, ditched	15	55	> 6 Inches	No	To	Waterbarred at good frequency by recent abandonment work
41	146	110 / 47	12	95 / 43	15	19	Outsloped, ditched	40	85	> 6 Inches	Yes, 405'	Away	3 Sidecast failures seen, one stream diverted down road tread, waterbars excavated
42	148	80 / 10	13	65 / 33	18	21	Insloped, ditched	75	75	> 6 Inches	Yes, 216'	To	Waterbars have been excavated
43	175	0 / 0	4	0 / 0	4	20	Crowned, no ditch	80	80	> 6 Inches	No	Away	
44	178	0 / 0	3	0 / 0	3	15	Flatsloped, ditched	80	80	> 6 Inches	No	Away	Road parallels type 4, 10% delivery rule
45	188	80 / 38	14	60 / 31	8	15	Insloped, ditched	5	5	> 6 Inches	No	To	Newer road
46	198	95 / 43	8	0 / 0	2	12	Flatsloped, ditched	75	85	> 6 Inches	No	Flat	Road tread delivers runoff for 300'

PART IV: HAZEL WAU
Surface Erosion Module
Form B-3.2 "Road Segment Sampling Notes"

	A	B	C	D	E	F	G	H	I	J	K	L	M
8			CUTSLOPE		FILLSLOPE					ROAD		ROAD PRISM	
9		CLINOMETER	SLOPE OR	CLINOMETER	SLOPE OR	ROAD				TREAD	DITCH	SLOPE	
10	ROAD	READING	HORIZONTAL	READING	HORIZONTAL	TREAD	X-SECTIONAL	CUTSLOPE	FILLSLOPE	SURFACING	DELIVERING	TO/AWAY FROM	
11	SEGMENT	*CUTSLOPE	DISTANCE	*FILLSLOPE	DISTANCE	WIDTH	PRISM	DENSITY	DENSITY	DEPTH	TO WATER?	DITCH?	COMMENTS
12		*% / DEGREES*	*FEET*	*% / DEGREES*	*FEET*	*FEET*	*DESIGN*	*%%%*	*%%%*		*Yes, Distance[ft]/No*	*To/Away or Other*	
47	203	0 / 0	3	0 / 0	3	13	Flatsloped, ditched	80	80	> 6 Inches	Yes, 100'	Flat	
48	207	60 / 31	12	50 / 26	11	15	Outsloped, ditched	80	80	> 6 Inches	Yes, 440'	Away	
49	208	70 / 35	15	25 / 14	5	17	Flatsloped, no ditch	70	80	> 6 Inches	Yes, 215'	Both	Runoff down road tread
50	209	50 / 26	11	65 / 33	8	22	Insloped, ditched	80	80	> 6 Inches	No	To	
51	210	35 / 19	11	65 / 33	18	24	Outsloped, ditched	80	80	> 6 Inches	No	Away	
52	213	50 / 26	10	30 / 16	6	18	Insloped, ditched	80	80	> 6 Inches	Yes, 460'	To	
53	219	0 / 0	2	0 / 0	2	10	Flatsloped, no ditch	85	85	> 6 Inches	No	Flat	Ridgetop road
54	224	65 / 33	11	25 / 14	6	14	Outsloped, ditched	70	80	> 6 Inches	Yes, 380'	Away	
55	230	60 / 31	3	0 / 0	3	14	Flatsloped, ditched	75	80	> 6 Inches	No	Flat	No delivery seen
56	235	65 / 33	11	45 / 24	16	17	Flatsloped, ditched	80	85	> 6 Inches	Yes, 100'	Flat	
57	238	60 / 31	18	20 / 11	14	15	Flatsloped, ditched	65	80	> 6 Inches	Yes, 240'	To	Road follows topographic contours
58	240	65 / 33	14	25 / 14	5	21	Insloped, ditched	30	70	> 6 Inches	Yes, 175'	To	Culvert on Type 4 pulled
59	242	110 / 47	9	80 / 38	8	14	Insloped, ditched	100	100	> 6 Inches	Yes, 510'	To	
60	245	65 / 33	5	70 / 35	16	17	Flatsloped, ditched	100	100	> 6 Inches	No	Flat	Road waterbarred, abandoned
61	246	110 / 47	13	80 / 38	13	246	Insloped, ditched	70	100	> 6 Inches	Yes, 325'	To	
62	247	120 / 50	12	80 / 38	13	15	Insloped, ditched	50	100	> 6 Inches	Yes, 180'	To	
63	250	70 / 35	12	60 / 31	8	16	Flatsloped, no ditch	80	80	> 6 Inches	Yes, 410'	Flat	
64	254	75 / 36	12	70 / 35	24	22	Insloped, ditched	70	80	> 6 Inches	Yes, 910'	To	
65	258	90 / 42	20	60 / 31	12	21	Flatsloped, ditched	80	80	> 6 Inches	Yes, 310'	Flat	
66	259	60 / 31	8	65 / 33	12	15	Flatsloped, ditched	80	80	> 6 Inches	No	Flat	Runoff down 1000' of road tread, a problem
67	260	80 / 38	13	60 / 31	18	16	Flatsloped, ditched	80	80	> 6 Inches	Yes, 150'	Flat	Stream crossing not culverted, crosses road tread
68	262	80 / 38	20	70 / 35	18	17	Flatsloped, ditched	80	80	> 6 Inches	Yes, 340'	Flat	Road tread delivers runoff for 300'
69	263	80 / 38	13	20 / 11	10	20	Flatsloped, ditched	80	80	> 6 Inches	Yes, 195'	Flat	Stream crossing not culverted, crosses road tread
70	264	65 / 33	17	30 / 16	11	14	Flatsloped, ditched	75	80	> 6 Inches	Yes, 380'	Both	Road tread delivers much runoff
71													
72		NOTE:											
73		Where Cutslopes &	Fillslope width										
74		measured zero, cutslope/	Fillslope width										
75		is 20% of road tread	width in order										
76		better approximate	cutslope/fillslope										
77		width of entire	road segment										