JIMMYCOMELATEY CREEK-LOWER SEQUIM BAY ESTUARY RESTORATION PROJECT:

CHANNEL DESIGN FOR REALIGNMENT OF THE JIMMYCOMELATELY CREEK CHANNEL

Graphic by Pam Edens

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EXECUTIVE SUMMARY

In contrast to the network of structurally and functionally connected habitats that historically occurred in Jimmycomelately Creek (JCL) and the Lower Sequim Bay Estuary (the estuary), the existing habitats are fragmented and not properly functioning. A century of logging, road development, commercial development, railroad construction, dredging, wetland drainage and fill, diking, native vegetation removal, introduction of exotic species, agriculture, residential development, and stream relocation and channelization have resulted in direct loss of wetlands and other historic riverine and estuarine habitats. These human activities have also contributed to reduced floodplain function and the present dysfunctional condition of JCL, Dean Creek, and the Lower Sequim Bay Estuary.

This dysfunctional condition:

(1) limits the ability of JCL and the estuary to provide optimal feeding, rearing, and breeding habitats in support of critical biological resources, including ESA-listed summer chum salmon, other anadromous fish species, shellfish, shorebirds, and waterfowl;
(2) places property owners and local, state, and tribal infrastructure at recurring risk of flood damage; and
(3) highlights the urgent need to develop and implement integrated restoration actions in JCL and the estuary.

One of the compelling reasons for moving forward with restoring JCL and the estuary is that the dysfunctional area is mostly contained within the project area, which is surrounded by functioning habitat. Good salt marsh or nearshore habitat exists both east and west of the project area and the freshwater channel condition upstream of the project area is in fairly good condition.

The vision of the many partners in the Jimmycomelately Creek-Lower Sequim Bay Estuary Restoration Project (JCL-Estuary Restoration Project) is to: realign Jimmycomelately Creek into one of its historic, sinuous channels and restore functional connection with the floodplain; integrate this channel realignment with improvements in, and restoration of, the estuary functions; and reestablish the pre-disturbance linkage between the fluvial and tidal energy regimes. This vision has been dubbed: "a vision of undevelopment."

This report describes the lengthy, iterative process and analytical approach by which the Jimmycomelately Technical Group (JTG), comprised of multiple entities and individuals, arrived at a final plan for realigning Jimmycomelately Creek. This report is intended to serve as a

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narrative record of the channel design process from early conceptual designs to the constructed channel. Greater detail is contained in the project drawings, engineer's calculations, and other attachments to this report. The project partners also completed a Biological Evaluation (BE) to facilitate ESA consultation for the channel realignment (Jimmycomelately Technical Group 2002).

A subsequent post-construction report will include "as-built" drawings and a discussion of the many lessons learned on the channel construction. These "lessons learned" will span the range of technical, financial, social, and political challenges that are faced in a project of this scope and duration.

The reader will notice that the verb tense in not consistent throughout this report. The authors apologize for this inconsistency, but switching verb tenses was necessary to reflect that some of the restoration actions being described had already been implemented (as of September 2003) and others were planned for the future. For example, Section 3.0 uses both past tense and future tense because most of the JCL channel construction has already been completed, but there are remaining tasks (such as further wood and gravel placement) that remain to be completed in the future. Sections 4.0 and 5.0 are written in future tense because the new JCL bride has not yet been constructed and the channel plug and JCL stream diversion have not yet happened. In contrast, Section 6.0 is written in past tense because the sediment and erosion control measures for the channel construction have already been implemented. Sections 7.0 and 8.0 switch back to future tense because permitting and monitoring will extend well into the future.

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ACKNOWLEDGMENTS

This report evolved out of an executive summary prepared by Sam Gibboney for the U.S. Army Corps of Engineers, Seattle District, at the time the project partners applied for permits for the JCL channel realignment. Dave Shreffler coordinated production of this report and was the lead author. Byron Rot of the Jamestown S'Kallam Tribe wrote several sections of this report, provided valuable guidance for its production, and administered the grant that funded this report. Rich Geiger of Clallam Conservation District was the lead engineer on the project and he shepherded the channel realignment from conceptual ideas to final drawings; this effort involved substantial "herding" of biologists.

The authors extend our gratitude to Steve Allison, Pat Crain, Joel Freudenthal, David Garlington, Sam Gibboney, Jerry Gorsline, Joe Holtrop, Randy Johnson, Cathy Lear, John McLaughlin, Linda Newberry, Ralph Thomas Rogers, Mark Storm, and Carl Ward for their invaluable assistance in developing the channel designs. Lyn Muench deserves special recognition for, although she did not get directly involved in the channel design process, she is the "institutional memory" for the JCL-Estuary Restoration Project, having worked on it since 1990. She also has an exceptional gift for getting grants funded.

Special thanks to Joel Freudenthal for his often repeated mixed metaphor, "*The proof won't be in the pudding, until you run it up the flagpole*."

We also wish to acknowledge Bob Barnard and Chris Byrnes of WDFW, Tim Abbe (fluvial geomorphologist) of Herrera Environmental Consultants (formerly of Phillip Williams and Associates), and Jack Orsborn (consulting engineer) for their rigorous peer reviews of several iterations of the channel design drawings.

It is our sincere hope that the vision and dedication of the many participants in this restoration planning effort will ensure long-term success for the whole community of people, flora, and fauna that inhabit the Jimmycomelately Watershed.

CHANNEL DESIGN FOR REALIGNMENT OF THE JIMMYCOMELATELY CREEK CHANNEL

1.0 INTRODUCTION

1.1 Purpose of this Report

This report describes the process by which the Jimmycomelately Technical Group (JTG), a group of technical staff from many different entities (see Section 1.3), arrived at final engineering plans for realigning Jimmycomelately Creek into a new channel. Dave Shreffler of Shreffler Environmental, working collaboratively with Byron Rot of the Jamestown S'Klallam Tribe (JKT), Rich Geiger, Professional Engineer serving Conservation Districts in Clallam, Mason, Jefferson, and Kitsap Counties, and Sam Gibboney of Sam Gibboney Engineering and Management Services, developed this summary report at the request of the Jamestown S'Klallam Tribe (JKT).

As indicated in Section 1.2 below, channel realignment is only one phase of the multi-phased Jimmycomelately Creek-Lower Sequim Bay Estuary Restoration Project (JCL-Estuary Restoration Project). Realignment of the JCL channel will be integrated with estuary restoration, bridge construction, and other project elements.

1.2 Project Location, Phases, and Timeline

A map showing the location of the project area is shown in Figure 1.1. The project is located in Blyn, Washington in Clallam County (Township 29N, Range 3 W, Section 12). The channel realignment begins approximately 1,700 feet south of Highway 101 and extends north for approximately 2,800 feet to Sequim Bay.

The overall project consists of four major phases (Jimmycomelately Technical Group 2002):

1. Realignment of the Jimmycomelately Creek channel and revegetation of the new stream corridor and buffer
2. Restoration of the Lower Sequim Bay Estuary
3. Construction of a new Highway 101 bridge for the realigned Jimmycomelately Creek
4. Diversion of the existing JCL flow into the new stream channel and connection of the new channel to the estuary.

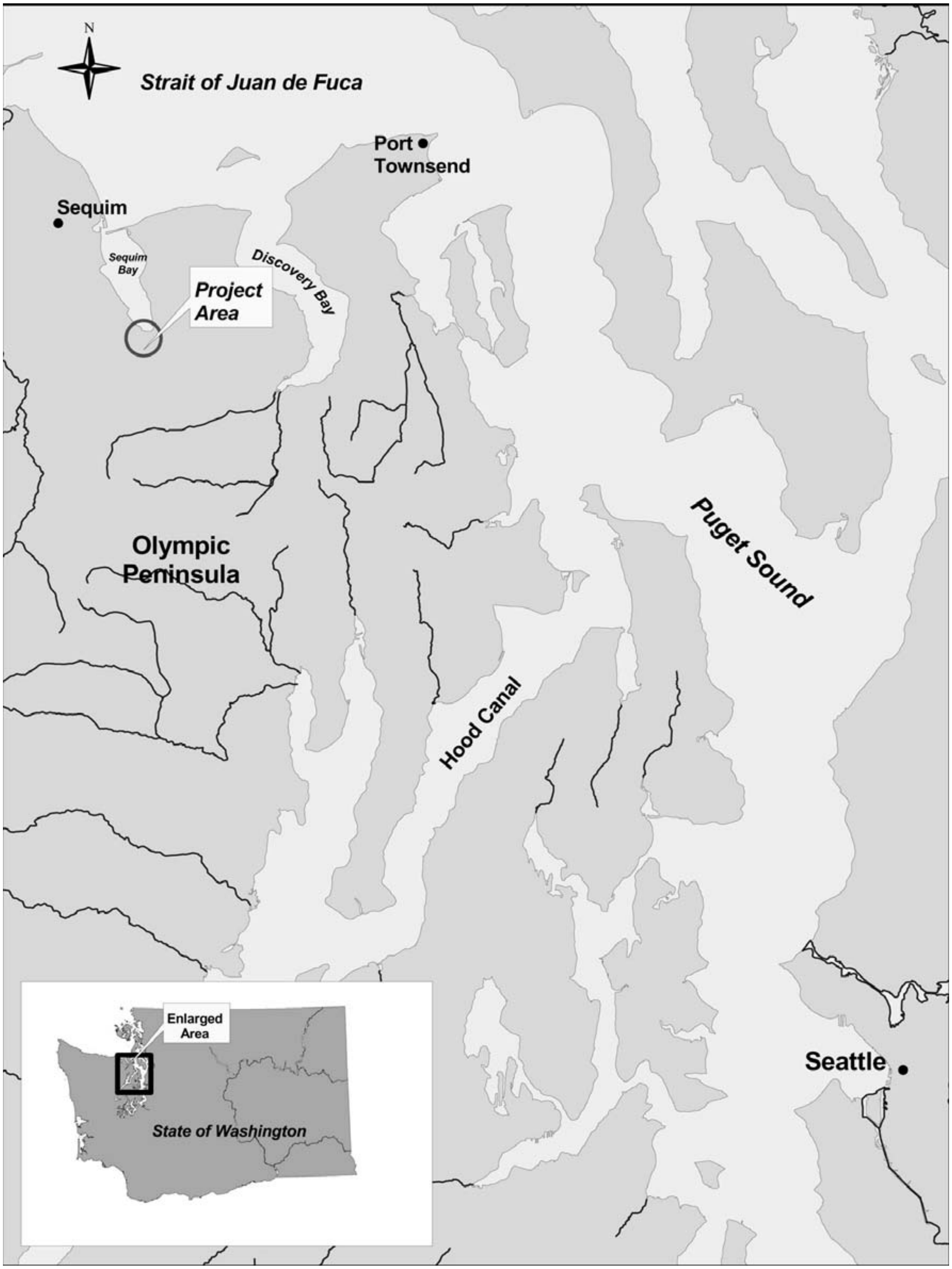

Figure 1.1 Location of the Jimmycomelately Creek-Lower Sequim Bay Estuary Restoration Project (JCL-Estuary Restoration Project). Graphic by Pam Edens.

Approximate locations of the four project phases are shown in Figure 1.2. Channel construction began in July 2002; below is the current (April 2003) timeline. Clallam Conservation District (CCD), Jamestown S'Klallam Tribe (JKT), and U.S. Fish and Wildlife Service are partnering on implementing this phase of the JCL project. Rich Geiger (CCD) is the project engineer, Sam Gibboney (JKT) is the project inspector, Byron Rot (JKT) is the site biologist, and Alan Gray is the primary excavator operator (USFWS). Clallam Conservation District, Kitsap Conservation District, and Washington Department of Transportation also contributed project inspection and surveying services during the summer of 2002. This report will not detail construction activities or show "as-built" drawings. Those will become available in a separate report following the completion of channel construction.

Funding agencies for channel construction include: Department of Ecology Clean Water Fund (CCD), Bureau of Indian Affairs Watershed Restoration Funding Program (JKT), U.S. Forest Service Olympic Title II RAC (JKT), Pacific Coastal Salmon Recovery (JKT), Department of Natural Resources ALEA (JKT) and USFWS Washington State Ecosystems Conservation Program (JKT). A CCD grant from the Washington State Conservation Commission paid for Rich Geiger's engineering work on the channel.

- Summer 2002: Public bid process for channel construction awarded to Vision Builders, Port Angeles.
- Summer 2002: Channel construction began and continued through October.
- Late May 2003: Channel construction restarted with completion of the channel from station 1+00 to station 27+50 in August 2003 (station 1+00 is 100 ft downstream of the beginning of the channel, while station 27+50 is 2,750 feet downstream of the beginning of the channel and about 300 ft upstream of Hwy 101).
- Winter 2004: Construction of the new bridge for Hwy 101.
- Spring 2004: Construction of the lower channel (station 27+50 to station 34+00) directly upstream, underneath, and downstream of Hwy 101.
- Spring 2004: Construction of the tidal basin at the end of Reach 4, downstream of Hwy 101.
- Summer 2004: Installation of the plug in the existing channel and diversion of the creek into the new channel.

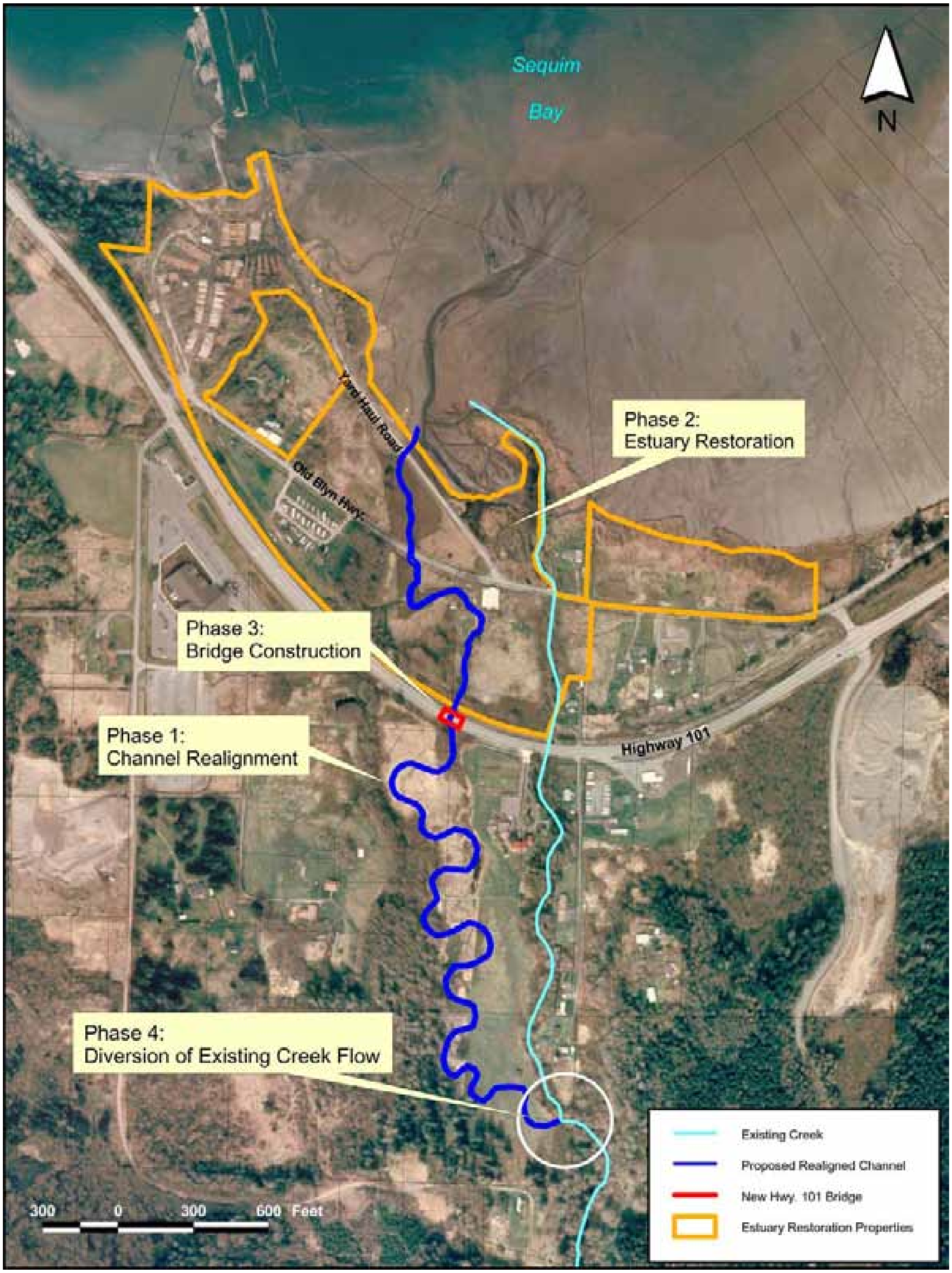

Figure 1.2. Proposed phases of the Jimmycomelately Creek-Lower Sequim Bay Estuary Restoration Project (JCL-Estuary Restoration Project). Graphic by Pam Edens.

1.3 The Jimmycomelately Technical Group (JTG)

While the Jimmycomelately Technical Group had met infrequently prior to 1999, regular channel design meetings were held from August 1999 to January 2002. The members of the JTG "core team" were: Byron Rot (JTG coordinator and senior habitat biologist, JKT), Linda Newberry (former JTG coordinator and JKT watershed planner), Mark Storm and Rich Geiger (engineers, Clallam Conservation District), Steve Allison and Joe Holtrop (biologist and environmental planner, Clallam Conservation District), Joel Freudenthal (habitat biologist, formerly of Callam County Department of Community Development), John McLaughlin (landowner), Randy Johnson (biologist, Washington Department of Fish and Wildlife), Dave Shreffler (biologist, Shreffler Environmental, under contract to JKT), Sam Gibboney (Sam Gibboney Engineering and Management Services, under contract to JKT), Cathy Lear and Pat Crain (planning biologists, Clallam County Department of Community Development), Carl Ward (biologist, Washington State Department of Transportation), Ralph Thomas Rogers (wetland ecologist, Environmental Protection Agency), and Jerry Gorsline (biologist, Washington Environmental Council). Many other project partners also periodically attended JTG meetings or contributed to design discussions.

1.4 Importance of Landowner Involvement

The importance of landowner involvement to the JCL-Estuary Restoration Project cannot be overstated. Without landowner cooperation and active involvement in the restoration planning process, we would not have been able to consider realigning JCL. It was a discussion between Randy Johnson (WDFW) and John McLaughlin about annual flooding of JCL that initiated the first discussions about the potential for moving JCL into a more appropriate topographic setting at the low point of the valley. From the beginning, the landowners envisioned a "win-win" scenario in which they provided a portion of their properties for the realignment, thereby resolving the flooding concerns and at the same time improving habitat for fish and wildlife.

As frequently noted in the ecological restoration literature, the success or failure of any restoration project often hinges directly on community support and stewardship (National Research Council 1992). The ongoing spirit of cooperation exhibited by JKT and the other landowners, in particular John McLaughlin and Ann Penn, is a hallmark of the JCL-Estuary Restoration Project, and bodes well for the project's long-term success.

1.5 Vision and Goals for the JCL-Estuary Restoration Project

The vision of JKT, Callam County, WDFW, CCD, WSDOT, EPA, USFWS, DNR, local private landowners, and other partners in the JCL-Estuary Restoration Project is to:

- realign Jimmycomelately Creek into one of its historic, sinuous channels and reconnect it with a functional floodplain;
- integrate this channel realignment with improvements in, and restoration of, the estuary functions; and
- re-establish the pre-disturbance linkage between the fluvial and tidal energy regimes.

The overall goal of the Jamestown S'Klallam Tribe for this project is to provide conservation and protection, in perpetuity, of wetlands and creeks in the Jimmycomelately Creek-Sequim Bay watershed, resulting in long-term protection and restoration of fish and shellfish resources to harvestable levels. **If successful, this restoration project will provide measurable benefits to fish, shorebirds, waterfowl, shellfish, and the community.**

Among the five stated goals for the JCL-Estuary Restoration project (see Shreffler 2000), the following are specific to the channel realignment phase of the overall project:

<u>Goal 2</u>: Restore JCL and the estuary as feeding, refuge, and spawning habitat for ESA-listed summer chum salmon, coho salmon, winter steelhead, and sea-run cutthroat trout, as well as habitat for shellfish.

<u>Goal 3</u>: Reduce the existing flood hazards to the local private landowners, and local, state, and tribal infrastructures.

Based on a conceptual model for the channel realignment, which was developed in an earlier planning phase of the project (see Shreffler 2000), JTG determined that to gain the desired ecosystem functions for realigning Jimmycomelately Creek, the existing habitat structure must be changed in the following ways:

1) Restore the natural channel and floodplain configurations of JCL by realigning the creek into one of its historical, sinuous channels;
2) Restore and revegetate the riparian corridor along the realigned JCL with native plants;
3) Restore and revegetate freshwater wetlands along the realigned JCL with native plants;

4) Enhance instream habitat using whole trees with root wads and/or engineered logjams;
5) Remove and improve bridges, culverts, roads, and fill;
6) Improve stormwater management;
7) Implement BMPs for upper watershed human activities that can alter natural stream processes; and
8) Reconnect freshwater and tidal energy processes.

Although salmonids, shorebirds, waterfowl, and shellfish have been identified as the target species groups for restoration, the partners in the project explicitly intend to restore ecosystem functions and processes. Thereby, hopefully, the full range of native species will benefit from the restored and properly functioning JCL-Sequim Bay ecosystem.

1.6 Watershed Description (from Shreffler 2000)

Jimmycomelately Creek is the major tributary flowing into Sequim Bay. The JCL basin comprises an area of 15.4 square miles, with a vertical drop of 2,500 ft over 19.8 miles. Average annual precipitation ranges from approximately 16 inches in the City of Sequim to about 35 inches at Mt. Zion, the highest point in the watershed at 4,273 feet. Average precipitation intensity, which governs the recurrence interval of the peak flood, is 2 inches in 24 hours. The average recurrence interval for this event is 1.85 years and generates a peak flow of 185 cfs in Jimmycomelately Creek (Orsborn and Orsborn 1999). The JCL drainage is predominantly federal and state forestland with 8,935 acres containing timber at least 60 years of age or older. The relatively steep, forested portion of the drainage ends approximately 1.8 miles from saltwater, at which point the river enters a more gently sloping area that was historically old growth, forested wetlands. A cascade at river mile 1.9 prevents coho and chum from migrating any further upstream. Steelhead and sea-run cutthroat trout do pass this cascade.

1.7 Dysfunctional Condition of the Existing JCL Channel (from Shreffler 2000)

In the past, JCL was straightened and moved into an artificial channel, and the current stream flow no longer passes through its historic channel and floodplain location. Dikes, bridges, culverts, and roads have constricted both flood flows and tidal action. Non-native vegetation (e.g. reed canary grass, Himalayan blackberry, and scotch broom) and salt-intolerant vegetation (e.g. willow, alder, cottonwood) have colonized and stabilized the dikes and other associated fill causing further constriction of the narrow, artificial creek channel. Sediment has accumulated in the JCL channel upstream of Highway 101 and in downstream estuary channels. Wetlands have been filled and used as a storage site for an ongoing log yard operation and other fills and roads have been placed in the estuary. Three roads (Highway 101, Old Blyn Highway, Log Deck Road) and a former railroad bed and trestle presently cross the historical JCL estuary. These constrictions have contributed to a cycle of sediment aggradation (build up), flooding, and dredging.

Within the JCL Channel Realignment project area, wetland fill, native vegetation removal, agriculture, and residential development have resulted in direct loss of wetlands and other historic riverine and estuarine habitats. These human activities have also contributed to reduced wetland and floodplain function and the present dysfunctional condition of JCL and lower Sequim Bay estuary. In short, human land use over the past century has degraded and fragmented the historically linked riverine and estuarine habitats.

This dysfunctional condition:

(1) limits the ability of JCL and the estuary to provide optimal feeding, rearing, and breeding habitats in support of critical biological resources, including ESA-listed summer chum salmon, other anadromous fish species, shellfish, shorebirds, and waterfowl;
(2) places property owners and local, state, and tribal infrastructure at a greater risk of flood damage; and
(3) highlights the urgent need to develop and implement integrated restoration actions in JCL and the estuary.

1.8 Key Documents Used in the JCL Channel Design

Restoration of Puget Sound Rivers (Montgomery et al. 2003), which was released subsequent to the completion of our final JCL channel design, highlights the need for solid understanding of fluvial processes and aquatic ecology in order to predict both river and salmonid response to restoration projects. According to the authors, stream channel restoration requires an understanding of not only the structure and function of stream corridor ecosystems, but also the physical, chemical, and biological processes that shape them. This philosophy mirrors that of the JTG as we worked collaboratively for two years on the channel design.

The following is a selected list of key documents that were especially helpful to JTG in the JCL channel design process:

- Abbe, T.B. and D.R. Montgomery. 1996. Large wood debris jams, channel hydraulics and habitat formation in large rivers. *Regulated Rivers: Research and Management* (12): 201-221.

- Chang, H. F. 1988. *Fluvial Processes in River Engineering.* John Wiley and Sons, New York.

- Federal Interagency Stream Restoration Working Group. 1998. *Stream Corridor Restoration: Principles, Processes, and Practices.*

- Inter-Fluve, Inc. 2001. *Channel Design* (Draft). Draft White Paper Prepared by Inter-Fluve, Inc. for Washington State Department of Transportation, Olympia, Washington.

- Kondolf, G.M., and M.G. Wolman. 1993. The sizes of salmonid spawning gravels. *Water Resources Research* 29:2275-2285.

- Leopold, L.B. and M.G. Wolman. 1964. *Fluvial Processes in Geomorphology*. W.H. Freeman and Sons, San Francisco.

- Montgomery, D.R., J.M. Buffington, N.P. Peterson, D. Schuett-Hames, T.P. Quinn. 1996. Stream-bed scour, egg burial depths, and the influence of salmonid spawning on bed surface mobility and embryo survival. *Canadian Journal of Fisheries and Aquatic Sciences* 53: 1061-1070.

- Montgomery, D.R., J.M Buffington, R.D. Smith, K.M. Schmidt, and G. Pess. 1995. Pool spacing in forest channels. *Water Resources Research* 31(4): 1097-1105.

- Rosgen, D.L. 1996. *Applied River Morphology*. Wildland Hydrology, Pagosa Springs, Colorado.

2.0 HISTORY OF THE JCL CHANNEL DESIGN PROCESS

2.1 Choosing the Channel Realignment Location

JTG initially contemplated two major pathways (Path A and Path B) for realignment of JCL, with six alternatives for Path A and two for Path B (Figure 2.1). Several members of the design team felt that another potential channel course was a channel exiting the present channel upstream of Path A. This pathway was discarded and not considered any further due to the presence of a residence near the channel location. Several meetings were held discussing the pros and cons of each alternative. The major difference between the two pathways was where the channel flowed historically under the present day Highway 101. All of the Path A realignments transit under Highway 101 through the small existing stream along the eastern edge of the Penn properties. All of the Path B realignments transit under Highway 101 further east of the Path A realignments, at the location of what JTG believed to be the historical JCL estuary.

Before making a final decision on the optimal location for the realigned creek, JTG looked at historical maps and photos, and consulted with potentially affected landowners and long-time watershed residents. Inspection of historical U.S. Coast and Geodetic Survey maps (1870, 1914, 1926) indicated that the JCL channel naturally migrated across the alluvial fan, prior to the time that roads, Highway 101, dikes, and railroads constricted the channel movements. By 1926, the JCL channel had been moved, straightened, and diked into its current location. Extensive analysis of historical maps (1870, 1914, 1926) and photos (1908, 1942, 1957, 1971, 1995, 1999, 2000) led to the important conclusion that the new JCL creek channel should be realigned into the existing lower Sequim Bay tidal channel, which is a well-developed estuarine feature that appears on every available historical map and photo dating back to 1870 (see Figure 2, Shreffler 2000).

After further examining our 2-ft contour topographic maps and considering soil types, the team felt the most likely old channel position under Highway 101 was Path B. To increase channel length and decrease slope, JTG subsequently decided to move the upstream end of the realigned channel to Path A. Thus the final channel location in the valley was a combination of Paths A and B.

In light of all the available maps and photos, this proposed location for rerouting JCL through its historical floodplain and into the existing tidal channel made the most sense in terms of restoring

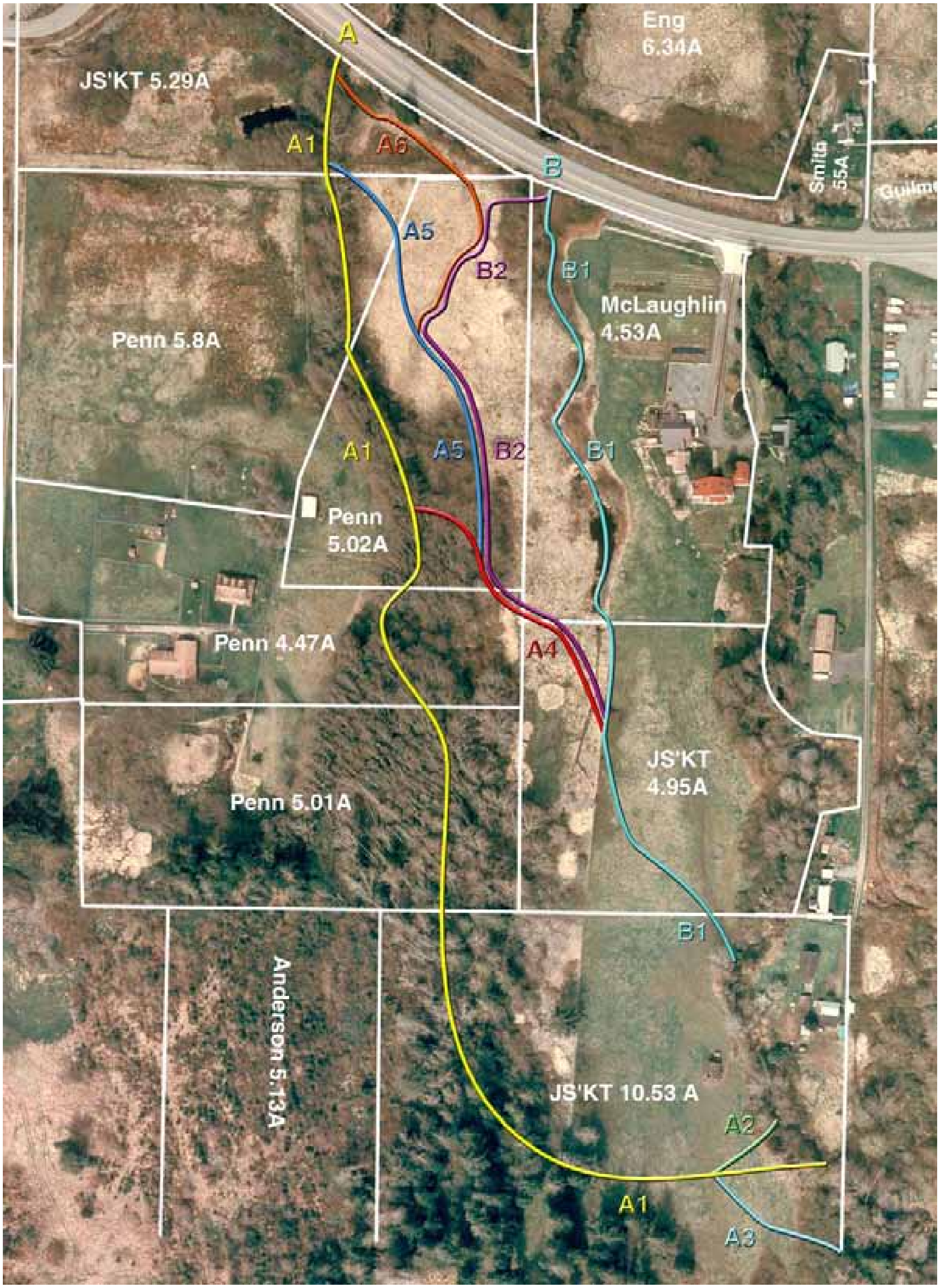

Figure 2.1. Possible locations for realignment of the JCL creek channel (graphic by Randy Johnson).

"a functioning, self-regulating system that is integrated with the ecological landscape in which it occurs." The proposed channel location also takes into account the constraints of property ownership and the need to work with willing landowners. JTG's next step was to collect field data to help in determining the precise configuration of the realigned channel and floodplain.

2.2 Field Data Collected to Support the Channel Design Process

For early planning purposes, several pieces of information were crucial. Clallam County contracted with Walker and Associates to take aerial photos and create a fine-scale contour map. The result was a 2-ft contour map for both the project area, and also for our estuary reference site, Salmon Creek. This data, both in photographic and 3-dimensional AutoCAD format, was invaluable for conceptual channel (and estuary) design work.

For the channel design itself, several pieces of information were collected:

1. Spawning gravel—Salmon Creek was used as a reference site, because it has the only relatively stable summer chum run in the Strait of Juan de Fuca. Wolman pebble counts (100 pebbles) were collected at 12 cross sections from approximately the old railroad grade in the estuary to an area about 3,000 ft upstream.
2. Sediment—JCL gravel at the downstream end of gravel bars was sieved to determine the range and concentration of sediment sizes; this information was then used for sediment transport calculations.
3. Soil pits—Test pits were excavated throughout the project area to understand soil types and depth to the gravel layer.
4. Wetland delineation—A delineation of the project area determined the boundaries between wetlands and upland areas, and where invasive species existed. This information was used to develop the revegetation plan.
5. Other—JTG used historical photos and old maps to support the decision to move the channel itself. The Soil Survey of Clallam County Area, Washington was used as a background reference.

2.3 Evolution of the Channel Design

A diagram depicting the evolution of the channel design and major milestones in the design process is shown in Figure 2.2. The process began with Mark Storm's concept for a fluvial channel (Design 1; see Figure 2.3). That conceptual design led to two new design ideas:

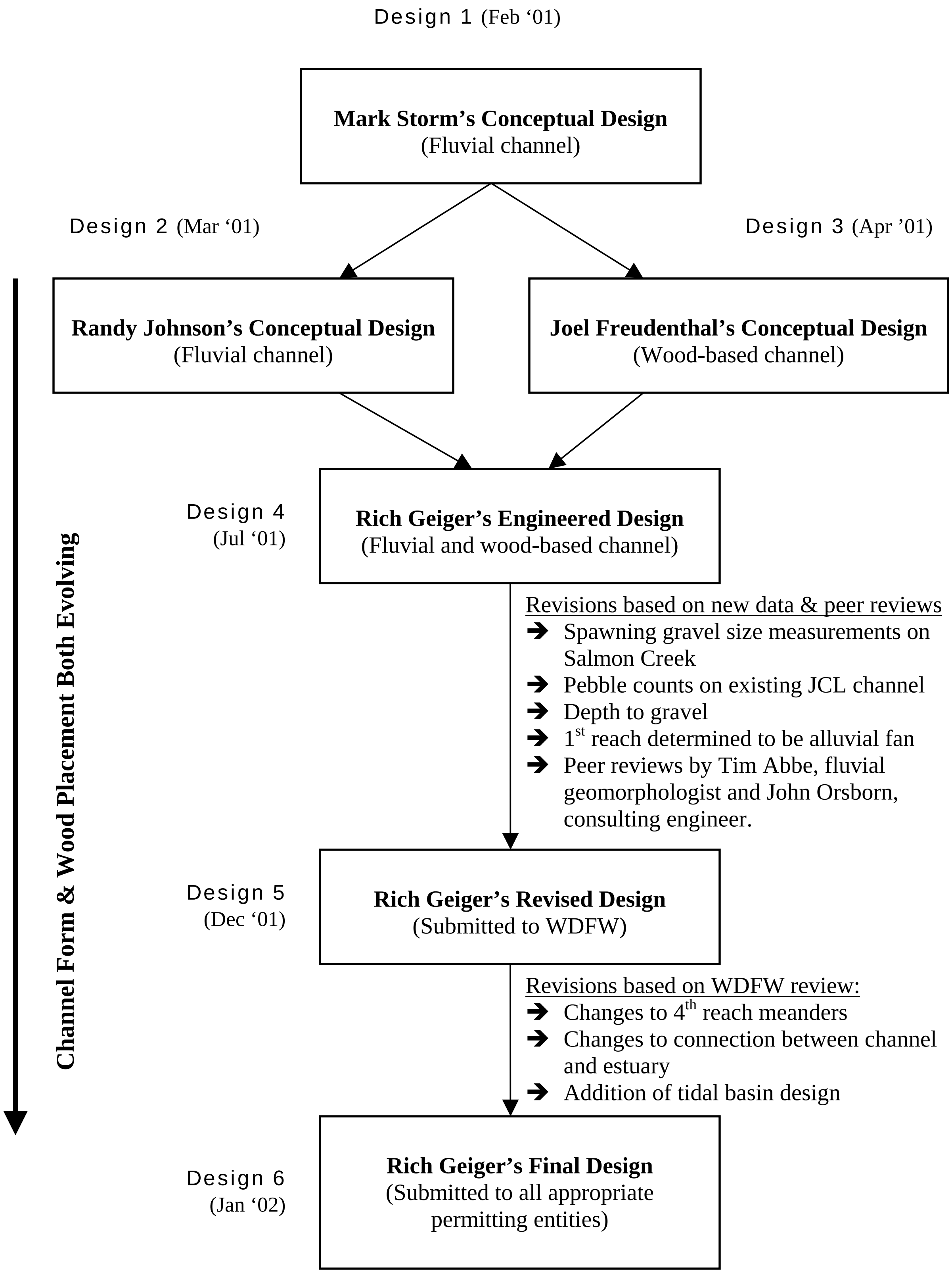

Figure 2.2. Evolution of the channel design and major milestones in the design process for the Jimmcomelately Creek realignment.

Heading

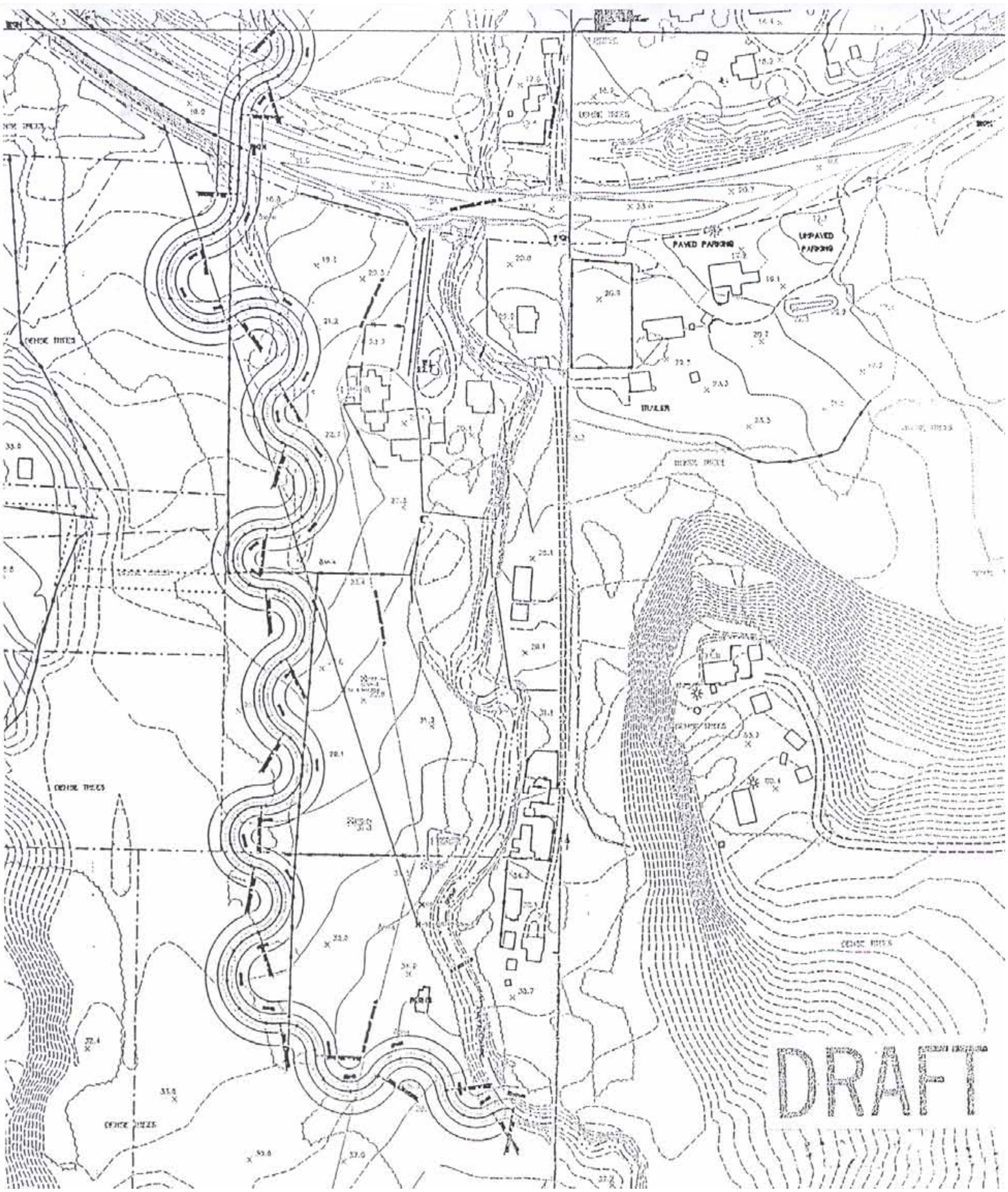

Figure 2.3 Mark Storm's conceptual channel design, February 2001.

Randy Johnson's fluvial channel (Design 2; see Figure 2.4) and Joel Freudenthal's wood-based channel (Design 3; see Figure 2.5). After Mark Storm left the Conservation District, Rich Geiger joined the project as the design engineer and combined elements of Johnson's fluvial channel and Freudenthal's wood-based channel into a new design (Design 4, see Figure 2.6). CCD re-surveyed much of the proposed site for the JCL realignment prior to Rich Geiger doing his first design (Design 4). Embedded into Design 4 were several pieces of information: 1) target spawning gravel size for JCL summer chum collected from Salmon Creek; 2) pebble counts from the existing JCL channel just upstream of the project area; 3) depth to gravel from soil pits excavated at the site; 4) the decision by JTG that the first reach of the proposed realignment would function as an alluvial fan; 5) the benefits of locating the channel so that the existing riparian community could be left intact on the west bank of the floodplain; and 6) a design for LWD placement in the channel and floodplain.

Design 4 was then peer reviewed by Tim Abbe, fluvial geomorphologist, and Jack Orsborn, consulting engineer, and their suggestions were incorporated into Design 5, which was submitted to WDFW for permit review (see Figure 2.7). WDFW asked to see two changes to Design 5: 1) reconfiguration of the meanders in the third reach depicted in Design 4; and 2) drawings depicting how the realigned channel would connect to the estuary. Based on a recommendation by Tim Abbe, Rich Geiger added a design for a tidal channel basin to facilitate tidal flushing of riverine sediment out into the estuary. The tidal basin was located where sediment would be expected to deposit in the absence of tidal energy. The tidal basin fulfilled item #2 on WDFW's list and was the final design piece needed to fully connect the channel design to the estuary.

The final design change split Reach 3 into two reaches, with the lowermost reach tidally influenced and much narrower and deeper, mimicking tidal channels from our reference sites. These changes resulted in Design 6 (see Figure 2.8), the final channel design that was submitted to the appropriate agencies for all necessary permits, certifications, concurrences or determinations (see Section 7.0). Details of the final channel design are discussed in the following section and complete drawings are in Attachment A – Final Channel Drawings.

Figure 2.4 Randy Johnson's conceptual channel design, March 2001.

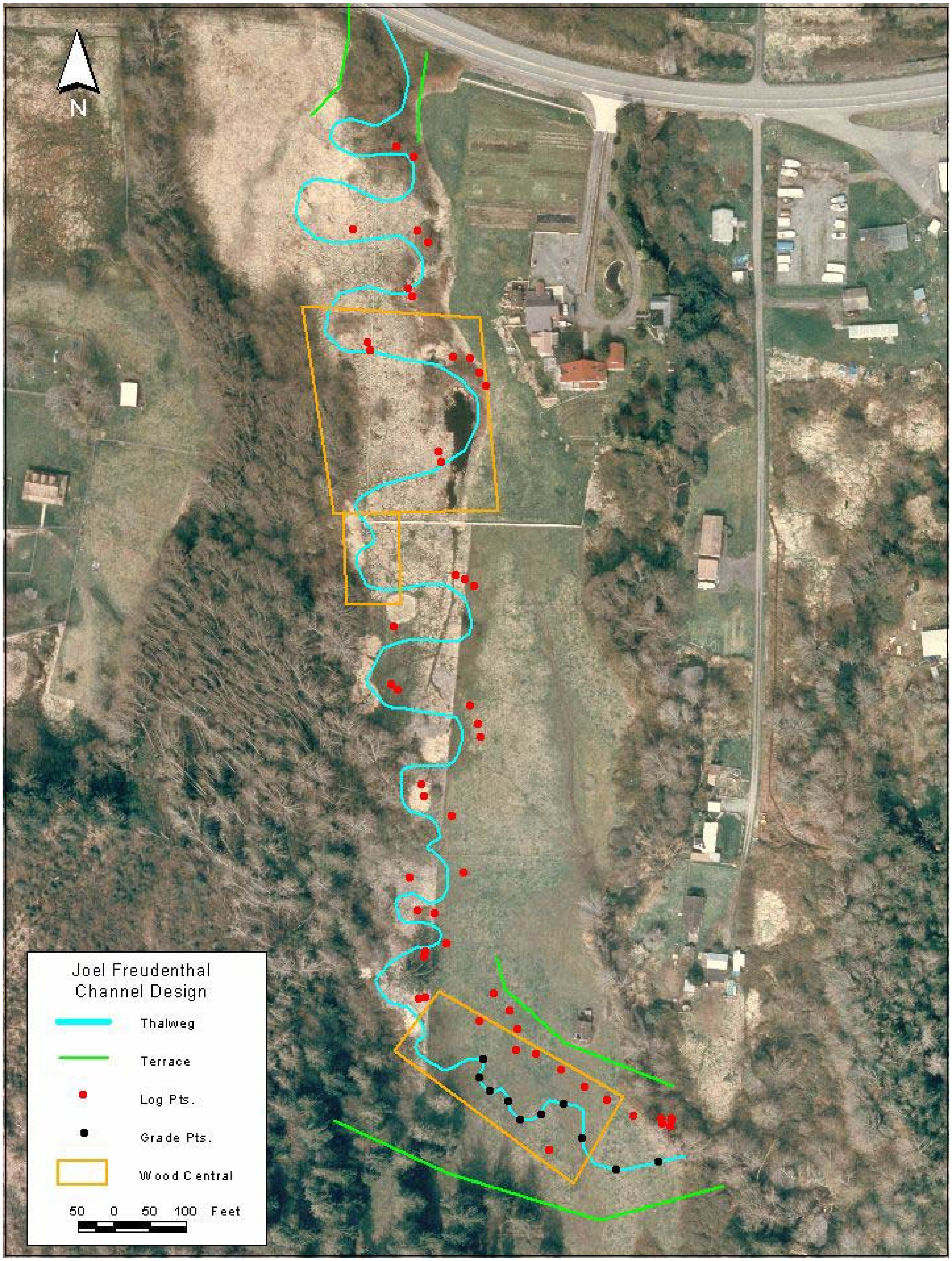

Figure 2.5 Joel Freudenthal's conceptual channel design, April 2001.

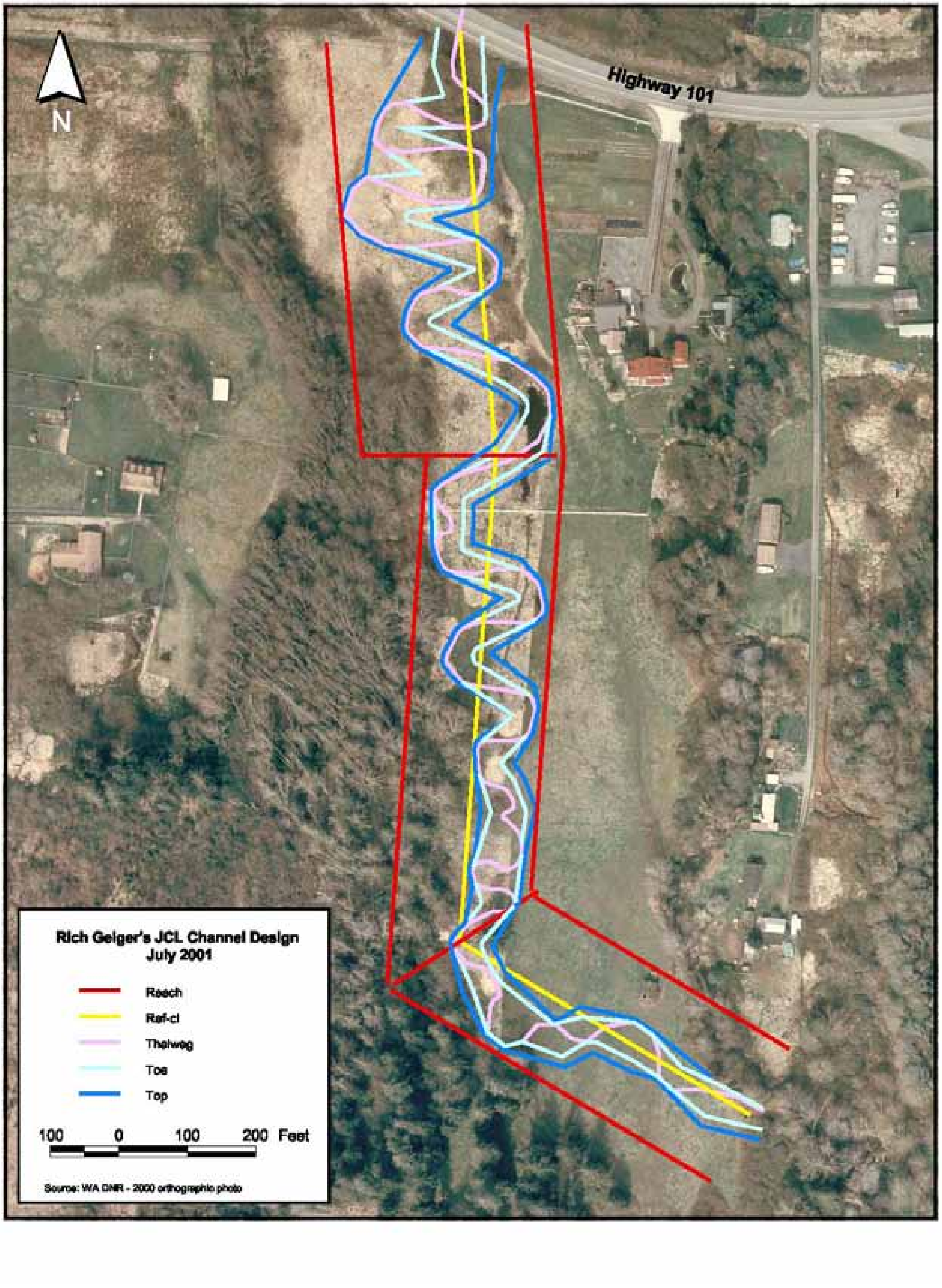

Figure 2.6 Rich Geiger's first channel design, July 2001.

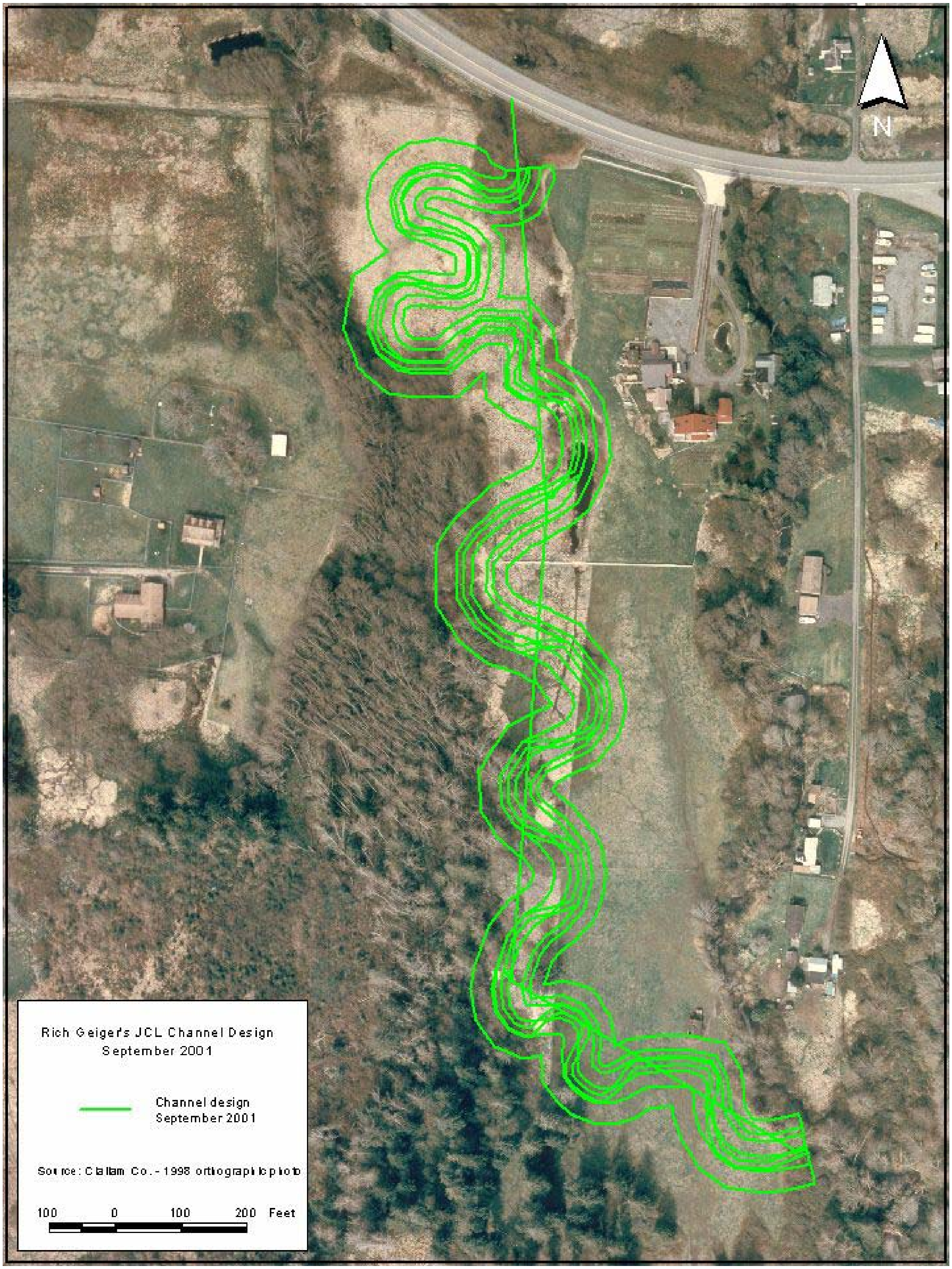

Figure 2.7 Rich Geiger's second channel design, September 2001.

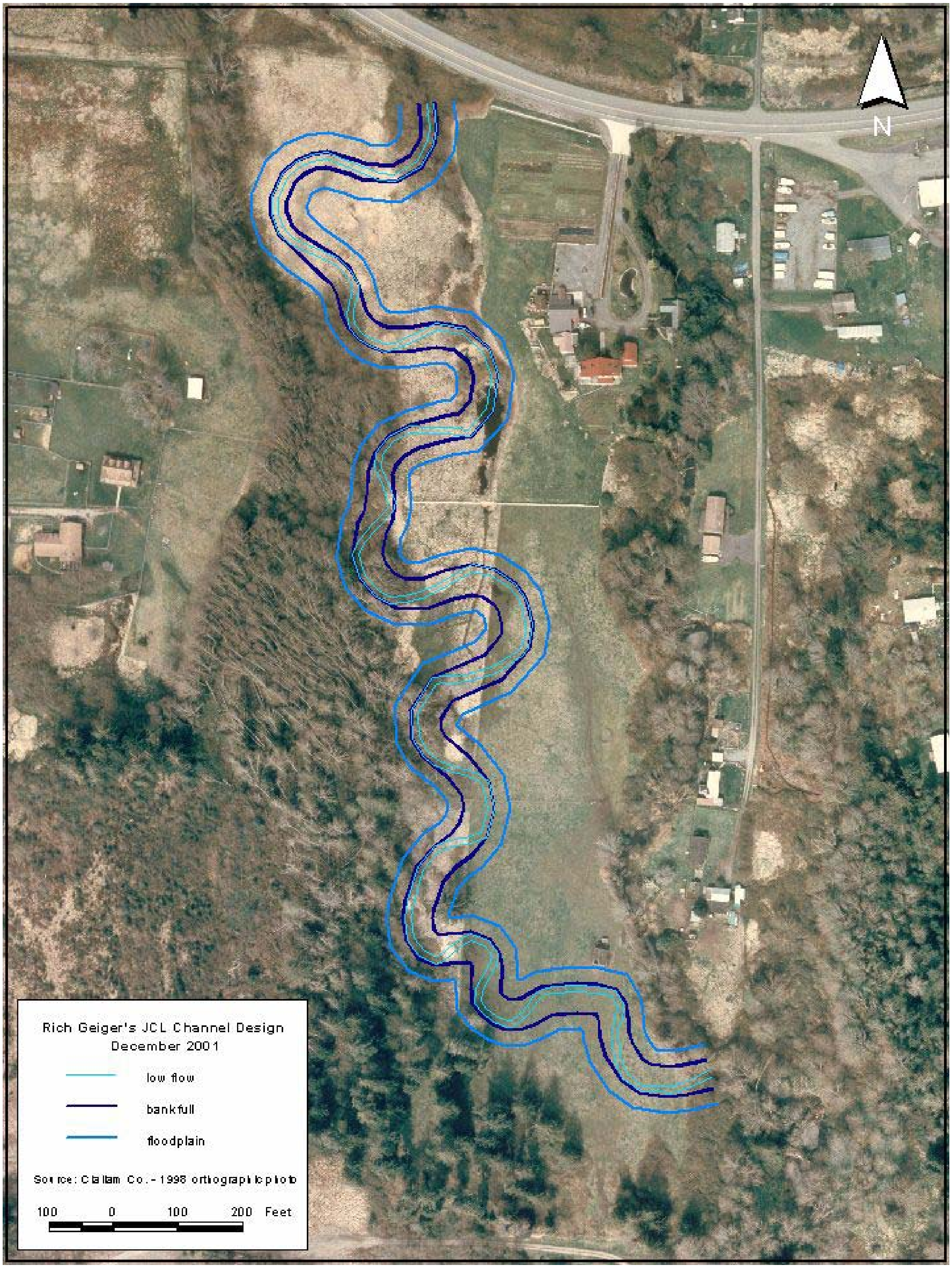

Figure 2.8 Rich Geiger's final channel design, December 2001.

3.0 THE FINAL CHANNEL DESIGN

3.1 Channel and Floodplain Characteristics

A new stream channel will be constructed in an area roughly 1,700 feet long and 350 feet wide, located to the west of the current, artificially-constructed stream channel. The constructed channel will be 3,490 ft long. Channel realignment upstream of Highway 101 will require the excavation of approximately 53,000 yd^3 of material from degraded wetland and upland areas. The channel is designed to meander naturally in a stable fluvial manner both in the freshwater channel and in the intertidal area. Over time, as the channel meanders through its floodplain, the LWD placed in the channel will increasingly control channel form and process (see Section 3.6). Thus the channel will evolve from a fluvial channel in which LWD forms fish habitat into a channel that contains both wood-forced and fluvial-forced habitat.

The design is for a low-flow meandering channel set within the 2-year peak flow channel, which is set within an excavated floodplain that will contain the 100-year flow. The channel design consists of four reaches; reach 4 is tidally influenced and extends under Highway 101 to the outlet of the tidal basin, just below the old railroad grade (Table 3.1).

Table 3.1. Physical characteristics of the JCL channel realignment.

Reach number (upstream to downstream)	Length (ft)	Slope (%)	2 year channel width (ft)	2 year channel depth (ft)	100 year floodplain width (ft)	Sinuosity
1	660	0.68 to 1.08	45	1.0	100	1.26
2	1000	1.00	45	1.1	100	1.70
3	670	0.83	36	1.4	100	1.52
4	760	0.6	22	1.8	85	1.37

The existing channel has responded to the bank armoring and straightening imposed upon it by bed degradation (downcutting) in the upper portion of the project area and bed aggradation (deposition) below Highway 101. The bed has aggraded approximately six feet in the vicinity of Old Blyn Highway during the past 20 years. The bed degradation extends a hundred feet or so upstream of the project area and is halted by a large log jam that serves as a grade control. JTG is unsure whether bed instability may continue to occur over the short-term just upstream of the project area. Partially to account for the potential of continued incision, the design includes a depositional zone in Reach 1.

Reach 1 will also replicate the alluvial fan that likely existed prior to human manipulation (an alluvial fan is a sediment depositional area that typically occurs in an unconstrained reach directly downstream of where a channel exits a narrow valley). Reach 1 has a 2-year channel width of 45 feet, however inset within this 2-year channel is a 33-ft wide channel that is designed to fill with sediment (see Attachment A – Final Channel Drawings). The initial channel gradient of 0.68% will precipitate sediment 90mm and greater in size to accommodate the incised channel condition upstream. Sediments smaller than 90 mm can be transported downstream in a stable condition. Ultimately the slope of Reach 1 will increase to 1.08% as the 33-ft wide channel fills in, leaving the two year, 45-ft wide channel.

A unique element of this design is the constructed 100-year floodplain. The 100-year floodplain allows the channel to migrate laterally without jeopardizing the design. Most restoration projects consider channel migration a failure (and armor banks with LWD to prevent migration), when in fact channels naturally migrate in response to wood loading and sediment accumulation. The 100-year floodplain is set into the valley floor from 1 ft to 6 ft. If a floodplain was not included in our design, any bank erosion would input large amounts of sediment that could have highly detrimental impacts to the channel and fish habitat.

One question the design group struggled with was why there is a substantial difference between the elevation of the JCL valley floor and the target bed elevation of the stable low gradient channel. In other words, why did we need to dig a new floodplain? In Salmon Creek, the valley floor *is* the floodplain. Why is the same not true for JCL? While portions of the JCL valley have been filled (e.g., wetlands) to facilitate agriculture, the extent of the fill is not large enough to explain the elevation differences. The most likely explanation is a combination of infrastructure and bed degradation. The location of Highway 101 and several residences have limited the length of channel we can construct. It is likely the historical channel was much longer and probably braided. A longer sinuous channel would raise the designed channel bed elevation. Thus, the channel length in combination with the bed degradation at the upstream end of the project resulted in the necessity for us to excavate a floodplain. The constructed floodplain essentially allows the channel to move within a defined, predictable area without endangering existing homes or infrastructure, or compromising ecological functions.

Current channel sinuosity[1] is approximately 1.08 (1.00 is a straight line) compared to a project sinuosity of 1.47. Sinuosity by reach varies between 1.26 and 1.7 (Table 3.1).

The attached tables summarize the engineer's calculations for each reach, as developed by Rich Geiger (see Attachment B – Engineer's Calculations).

3.2 Flow regimes

An examination of peak flows during the 1990's for the Dungeness River shows a higher proportion of flood events when compared to other decades. If these same Dungeness peak flow patterns are applied to JCL, this translates into higher and more frequent peak flows and movement of sediment.

The following are flow estimates[2] for the JCL (Orsborn and Orsborn 1999):

- 2 year peak flow = 185 cfs (also designated as channel-forming flow)
- 50 year peak flow = 645 cfs
- 100 year peak flow = 800 cfs.

The uncertainty of the future, both in terms of regional rainfall patterns and the potential for increased stormwater impacts, provides further support for JTG's decisions to: a) construct a channel that is designed to move (rather than being fixed in place); and b) to scatter LWD throughout the floodplain.

3.3 Soils

The soil profile in the project area varies dramatically from east to west, and from south to north. Soil pits were dug with a backhoe in the vicinity of Reaches 1 and 2. The soil layers were profiled with a handheld soil auger in the vicinity of Reaches 3 and 4.

Soils within the project area (west of the existing JCL channel) are stratified, and mirror the surface slope, sloping down to the west and north. Several "typical" soil profiles were found:

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[1] Sinuosity is the ratio of the length of the 2-yr channel centerline over the valley length.

[2] During the summer of 2002, a continuous monitoring flow gauge was installed in the lower JCL. Over time, this will provide a check to these estimates. The Orsborn estimates were derived by comparing the basin area and rainfall patterns in JCL to the gauged Snow Creek watershed in Discovery Bay.

Soil profile at south and east side of project area:

- 0-1 ft Topsoil
- 1-4 ft Sandy Loam
- 4-5 or 6 ft Gravelly Sand (Gravel up to 2 inches in size)
- below 6 ft Clayey/silty sand

Soil profile at north and west side of project area:

- 0-2 or 3 ft Muck soil (high organic content)
- 2-5 ft Clayey/silty sand
- below 5 ft Sandy gravel

The water table is roughly 8 ft below the surface at the north and east side of the project area, but rises seasonally to the surface at the west and south side of the project area. Approximately 60% of the channel length is in the muck soil profile and 40% in the drier sandy loam profile[3] (see Attachment C – Wetland Area Impacts and Creation Details).

3.4 Sediment Transport

Historical rerouting of the JCL channel, loss of instream channel complexity, and a decrease in tidal energy have reduced the existing channel's ability to route sediment through the system. Increased aggradation levels have likely destabilized spawning grounds, and adult summer chum salmon have been inhibited in their migration to spawning areas due to barriers created by the aggraded creek bed. Since the late 1950s, the Jimmycomelately Creek bed north of Highway 101 has aggraded by 4-6 feet. Based on calculations from aerial photos, the creek mouth has moved 400 feet seaward, with about 1/3 of the movement occurring since 1990.

This rapid rate of sediment aggradation (522 yd^3/yr on average) likely has several sources: 1) Several road related landslides, which delivered to the channel, occurred on Woods Road in the winter of 1996. The unstable areas have been stabilized or culvert outfalls have been tightlined onto the valley floor; 2) Extensive forest harvest that occurred on Forest Service land during the 1980's may have contributed to sediment loading. These areas are now fully revegetated; the canopy is reaching crown closure and root strength is likely returning to stable levels; and 3) Extensive bank armoring that occurred in the project area during the 1950's and thereafter (to prevent channel migration), likely contributed to the rate of bed degradation in the upper project area.

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[3] During the 2002 channel construction in the muck soil profile, we crossed gravel lenses indicating the position of the old channel. Unfortunately, it was impossible to delineate the original channel prior to excavation.

Based on oral accounts of long-time residents, JTG believes that the JCL channel was dredged annually up until approximately the late 1950s. Thereafter, the channel was excavated periodically in the vicinity of the Old Blyn Highway Bridge. Clallam County stopped dredging the lower JCL channel near Old Blyn Highway around the late 1980’s or early 1990’s. The dredging was stopped because it caused bed instability and could have contributed to the decline of summer chum salmon, which spawn primarily below Hwy 101. Since dredging stopped, aggradation in the lower reaches of JCL has been so severe that the bed of JCL downstream of Old Blyn Highway is now “perched,” with the existing creek bed sitting higher than the surrounding land (see Shreffler 2000). With the bed of the creek as the high point in the surrounding floodplain, water flows *away* from the channel between Highway 101 and the mouth. This contributed to the stranding of returning adult summer chum during September 1997.

The stream channel in the upstream end of the project area is deeply incised and can convey the entire 100-year peak flow without overtopping the channel and flowing into the floodplain. Sediment transport calculations for the reach directly upstream of the project area show that this reach is capable of transporting sediment in excess of 200 mm in size, yet pebble counts and bar samples show the maximum sediment size is 120 mm. This means that presently all sediment including the larger sizes (> 200mm) are being transported downstream into the low gradient, diked reach of the stream, causing the dramatic aggradation described above.

Reach-by-reach engineering calculations, sediment transport calculations, and sediment entrainment curves are enclosed in Attachments B, D, and E, respectively.

3.5 Wetland Impacts

Based on wetland mapping performed in spring 2001 by regional wetland ecologist Ralph Thomas Rogers from EPA Region 10 (see Freudenthal 2000), the following areas of wetland impacts have been determined:

- Total wetland excavation area = 5.68 acres [5.08 acres wetland + 0.60 acres mixed upland and wetland]
- Total wetland fill area = 0.09 acres (this fill is necessary to create a dam at the location of the stream diversion; the dam will also function as a planting mound, which will be planted with native vegetation as outlined in the Revegetation Plan, Clallam Conservation District 2001)
- Total new wetland area = 1.06 acres

- Total wetland excavation quantity = 50,800 yd^3
- Total wetland fill quantity = 1,860 yd^3

The stream realignment is strictly restoration, and there is no mitigation component of this project. The entire excavated project area will become wetlands with increased functions and higher values than the existing wetlands, and the project will result in a net gain of 1.06 acres of new wetlands. As a result of the realignment of the JCL channel into its historical floodplain, we expect to see higher overall ratings for the following Washington Department of Ecology functional assessment criteria: water quality (nutrient and sediment entrapment), flood and stormwater desynchronization, groundwater exchange, and support of stream baseflow.

To ensure that onsite colonies of reed canary grass (*Phalaris arundinacea*), Canada thistle (*Cirsium arvense*), and Himalayan blackberry (*Rubus discolor*) do not recolonize the project area, these plants and associated soils were excavated, stockpiled, and treated with herbicide. The treated soils will not be reintroduced into the floodplain (see Revegetation Plan, Clallam Conservation District 2001). The realignment project is also predicted to result in better habitat and functional support of fish (in particular spawning, rearing, and refuge for ESA-listed chum salmon, *Oncorhynchus keta*) and neotropical birds.

3.6 Large Woody Debris Placement and Functions

(See Attachment A – Final Channel Drawings)

Prior to human inhabitation of the Blyn area, Jimmycomelately Creek was likely bordered by a mixture of large, old conifer trees, younger deciduous trees in areas more recently disturbed, and forested wetlands. This forest community would have extended to the edge of tidal influence. Natural recruitment of large woody debris would have contributed to a complex and dynamic channel full of wood, in which pools, riffles, and other habitat features were continually reworked and reformed. It is highly likely that the historic stream channel was controlled by the presence of wood, rather than fluvial function. At present within the project area, the riparian corridor of the existing JCL channel has been reduced or eliminated, stable log jams are functionally nonexistent, and side channels and associated wetlands have been eliminated or cutoff from the main channel. Large woody debris and pool habitat are scarce.

A 1998 habitat survey of the lower 1.7 miles of JCL found wood loading of just one piece of wood every 55 ft (with the majority of LWD above the project area), and 98% of that wood was smaller than 12 inches in diameter (Resources Northwest 1999). Loss of LWD and confinement of the channel by bank hardening has reduced channel complexity, resulting in sediment aggradation, increased peak flows, and increased bed scour. Scour of redds is perhaps the dominant limiting factor for summer chum salmon in the lower reaches of JCL (see Shreffler 2000).

<u>LWD Placement</u>

The restoration objective relative to LWD is to install LWD as both a hydraulic feature of the channel and as a functional habitat because there is unlikely to be any significant LWD recruitment to the realigned JCL channel for at least 20-50 years. By installing LWD into the realigned JCL channel, the JTG hopes to "jumpstart" physical and biological processes within the realigned JCL channel until a healthy riparian corridor has developed and LWD begins to naturally recruit to the system. The realigned JCL channel has a meander pattern that would maintain itself in the absence of LWD. However, LWD is critical to creating flow complexity and to providing habitat for fish. In addition, LWD will be used in the short-term (until streambanks are stabilized by root strength) to stabilize key meander bends where newly exposed wetland soil conditions warrant it. Large woody debris will be placed in the channel, floodplain, and buried to scour depths both in the channel and floodplain to ensure that the stream will interact with LWD at all flow levels and meander patterns.

Over time as the channel migrates it will increasingly become a wood-forced channel as it interacts with buried floodplain LWD and as the riparian forest ages and contributes LWD. Our rationale is that LWD placement decreases risk in the short-term, and, in the mid to long term, the channel will evolve to a condition more representative of pre-European settlement channels. The wood placements shown on the engineering plans are based on recommendations from: JTG; Dr. Tim Abbe (Herrera Environmental Consultants; formerly of Phillip Williams and Associates); and *Hydraulic Guidelines for the Re-introduction and Management of Large Woody Debris in Lowland Rivers* (Gippel et al. 1995).

Wood will be placed at the outside of meander bends and in a "pseudo-random" distribution across the floodplain. Meanders in the low flow channel will be at least partially controlled by snag and logjam placement. Logjams distributed across the floodplain will help to ensure a high sinuosity, no matter how the channel may change through time (e.g., aggradation, avulsions, or shifts in channel position). Wood in the floodplain will be a random arrangement of logs that ranges from the surface to buried to the 100-year scour depth. As the channel meanders, high flows will encounter the wood at different angles. For the existing meander form, long logs will be buried at angle to the flow on the outside of meanders to minimize erosion in the short term. Wood will also be specifically placed to protect infrastructure, such as properties adjacent to the new JCL floodplain and the Highway 101 Bridge.

LWD Functions

In our proposed JCL channel realignment design, LWD is important at all flow stages: at low flows, LWD will maintain a greater range of sediment mobilizing flows because of local hydraulic effects. Large woody debris will improve water quality by keeping fines from settling and will maintain pool depth and quality. At high flows, LWD will minimize channel avulsions and ensure that if avulsions occur, the channel continues to function as designed. The LWD structures shown on the engineering plans are intended to affect channel and floodplain flow in the manner of a heavily forested area. The realigned channel is intended to function as an LWD-influenced alluvial stream that will meander like a natural stream.

LWD will serve the following functions in the realigned JCL channel and floodplain:

- provide refuge from predation and prey sources for juvenile salmonids and resident fish species;
- increase structural diversity in and adjacent to the realigned channel;
- minimize potential negative effects of peak river flows;
- form and maintain pools, riffles, and meanders;
- maintain the physical and ecological integrity of the JCL stream banks;
- maintain water quality; and
- trap logs upstream so they do not present a hazard to Highway 101 Bridge supports.

4.0 BRIDGE DESIGN CONSIDERATIONS

A new bridge will be constructed on Highway 101 to accommodate the realigned JCL channel. The existing creek flows through reinforced concrete, double-box, side-by-side culverts, with each box measuring 8 feet high by 8 feet deep (at time of installation). This culvert is too small to accommodate JCL flood flows. In addition, both the left and right boxes of the culvert are filled with sediment, reducing the culvert depth to <40 inches in the left box, and <50 inches in the right box. The new bridge will be constructed of three 30-ft, pre-cast, pre-stressed concrete slabs supported by four piers. The piers will be placed outside of the anticipated bankfull channel width. Excavation of material in the WSDOT right of way will connect the channel south of Highway 101 to a parcel owned by WSDOT. This parcel is being used by WSDOT as a wetland mitigation banking site for future highway projects in the region. Excavation on this parcel will connect the channel to the historic estuary (see Shreffler 2003). A cross-section of the bridge is shown in Attachment F – Cross Section View of Proposed Bridge Crossing over Proposed Jimmycomelately Creek Channel.

Key design considerations for the bridge were:

- Placement of piers outside the anticipated bankfull width.
- A long enough span (80-85 ft average at base, 115 ft bridge deck) to accommodate flood flows in the realigned JCL channel.
- Raising the elevation of the bridge bottom high enough to accommodate 100-year flood flows in combination with high tides.
- Sediment transport and estimated sediment accumulation rates under the bridge. Based on a conservative deposition rate of 522 yd^3/yr, a channel under the bridge that allows over 2.0 ft of clearance over the 100-year flood event is predicted to pass these flows for at least 30 years without wetting the bridge superstructure. This deposition of 522 yd^3/yr is a worst-case scenario; the realigned channel is designed to convey the expected sediment load beyond the bridge location, and tidal flushing should carry it away into Sequim Bay (see ATTACHMENT G – Estimated Sedimentation Rates for Jimmycomelately Creek and Hwy 101 Bridge).

Although other, less-expensive bridge designs were considered (e.g., Bulb-T, shorter span concrete slab), JTG ultimately decided that the 85-ft, concrete slab bridge design best accommodated the anticipated flood flows. This design also minimizes the number of pilings in the stream channel, thereby allowing better ingress and egress of fish and wildlife.

5.0 STREAM DIVERSION & CHANNEL "PLUG" DESIGN

Before diverting the stream into the new channel, the remainder of the project will need to be completed (bridge construction and estuary channel restoration). The stream diversion is expected to take approximately two weeks, and will be done during July-August to avoid impacting smolts leaving the system (late March-June) or summer chum adults returning to spawn (late August-October). Any fish in the existing channel below the diversion point will be trapped and removed before cutting off flow to the existing channel.

The diversion will be done as follows:

- A sandbag cofferdam will be installed along the left bank of the existing stream channel at the diversion point to prevent sediment from spilling into the stream during excavation of the connection between the new stream channel and the existing stream channel.
- The connection will be excavated to create the new floodplain and channel connection between the existing and the new stream channel. After the connection's streambed and floodplain are excavated to grade, LWD will be placed on the surface and buried. Denuded soils will be stabilized by hydroseeding with a tackifier agent.
- The stream flow will then be diverted into the new stream channel by manually rearranging the sandbag cofferdam along the bank into three cofferdams across from the existing channel. These cofferdams will be placed across the low-flow channel, the bankfull channel, and the floodplain, upstream to downstream, in that order. This will properly connect these three stream features from the existing to the new stream channel, ensuring proper stream function while the remaining earthwork is completed.
- An earthen plug will be constructed in the existing channel. This will require 2,000 cubic yards of fill, compacted in place. This material will be loaded in dump trucks at the stockpile location, using a front-end loader or an excavator. The trucks will then access the streambed at a single access point, and end-dump the material. If necessary, the materials will be sprayed with water to facilitate reaching 95% compaction. After the plug is complete, a planting berm will be constructed over the plug in the old stream channel and planted according to the revegetation plan (Clallam Conservation District 2001).

6.0 SEDIMENT AND EROSION CONTROL PLAN

Temporary sediment and erosion controls (TESC) were installed as needed throughout construction. TESC measures were installed according to the drawing and details attached (see Attachment H – Sediment and Erosion Control Details). Below is a summary of the key TESC features:

- TESC featured the installation of a "Kimble Pipe" at the downstream end of the project, as well as additional drainage pipes. Sand bags filled with pea gravel were placed to surround the Kimble Pipe and form a berm. Sediment-laden waters from the construction site ponded upstream of this berm, allowing the sediments both to settle and to be filtered by the pea gravel sandbags as surface waters flowed out of the site. The berm was installed with a backhoe and excavator, in addition to hand labor. Construction site access was limited to one route and access points were stabilized. A wheel wash area was provided on-site. All TESC measures were installed in conformance with the Department of Ecology State Stormwater Manual.
- The following measures were taken to ensure soil stabilization. After excavation and installation of the rock weirs, the project inspector determined that the exposed soils in the channel were not suitable as streambed materials. Thus, streambed gravels of the appropriate size for salmon spawning were placed in the channel. Denuded soils on the floodplain and slopes up to existing ground were stabilized by hydroseeding with a tackifier agent.
- Construction of the new channel will be allowed to "weather in" for at least one winter before the creek is diverted. This will allow the bank and bed of the creek to stabilize and become more erosion resistant prior to actual diversion. The creek diversion will occur in July-August to avoid impact to migrating smolts and returning adult salmon.

7.0 PERMITS

The JCL-Estuary Restoration Project will take place in phases and will be funded by numerous different sources. Consequently, applications for permits for different elements of the project or combinations of elements may be filed separately. However, an effort has been made to group project elements for permitting efficiency and to insure that potential cumulative impacts are adequately considered. To date, the following groups of elements have been identified as “projects” for permit purposes:

1. The overall Jimmycomelately Creek and Estuary and South Sequim Bay Restoration project including channel realignment, bridge construction, comprehensive estuary restoration, stream diversion, and Olympic Discovery Trail crossing replacement.
2. The Jimmycomelately Creek and Estuary, a subset of the overall project, that includes channel realignment, bridge construction, removal of Old Blyn Highway and the Log Deck Road within the historic estuary channel, stream diversion, and Olympic Discovery Trail crossings replacement.
3. Log Yard Pier Removal.
4. Log Yard, Dean Creek, and RV Park Restoration.
5. Log Yard Pilings Removal
6. Delta Cone Removal.
7. Eng (WSDOT) Property
8. Utility Movement
9. Monitoring and Research
10. Summer Chum Broodstock Recovery Program

The status of permits for elements #1 and #2 are discussed below (all other elements are discussed in Shreffler 2003).

1. The Overall Project

The overall project includes all elements of restoration (channel realignment, bridge, all estuary restoration and associated nearshore work, stream diversion and Olympic Discovery Trail crossing replacement). The following permits or determinations have been issued:

- A Critical Areas Variance was approved September 24, 2001 by Clallam County.

- A modified Mitigated Determination of Non-Significance was issued on September 7, 2001 by Clallam County.

2. The Jimmycomelately Creek and Estuary project including channel realignment, bridge construction, removal of Old Blyn Highway and the Log Deck Road within the historic estuary channel, stream diversion, and Olympic Discovery Trail crossings replacement.

   This combination of elements is fully permitted and has already begun construction. The following permits, certifications, concurrences or determinations have been issued.

   - A Department of the Army Nationwide Permit was issued May 20, 2002. This Department of the Army permit is valid until May 20, 2004. The Bureau of Indian Affairs was determined to be the lead agency responsible for compliance with Section 7 of the Endangered Species Act (ESA), Essential Fish Habitat (EFH) compliance in accordance with the Magnuson-Stevens Act, and Section 106 of the National Historic Preservation Act (NHPA). The following letters of concurrence are on file:

     - ESA – Letters of concurrence from the US Fish and Wildlife Service (USFWS, May 31, 2002) and National Marine Fisheries Service (NMFS, May 1, 2002).
     - EFH – A letter of concurrence was received from the National Marine Fisheries Service (NMFS, May 1, 2002).
     - NHPA – A letter of concurrence was received from the State of Washington Office of Archaeology and Historic Preservation (WA OAHP, May 30, 2002).

   - The Washington State Department of Ecology determined that the proposal is consistent with the conditions for Section 401 Certification and Coastal Zone Management and issued a letter to this effect May 30, 2002.

- A letter was sent (May 9, 2002) to the US Coast Guard providing information for 'Advance Approval' of the project. An individual Coast Guard permit should not be required.

- Hydraulic Project Approval – An HPA was issued on May 28, 2002. Additional plans and specifications for estuarine and nearshore work are required before work can occur below the OHWM. This approval was issued under the streamlined process for fish habitat enhancement projects (RCW 77.55.29). This process entitled the project to exemption from all local permits and fees including Shoreline Management Act review. SEPA and Critical Areas review were completed for the overall project because they contained elements that would not be eligible for this exemption (e.g., the Olympic Discovery Trail).

- A WSDOT General Permit for Use of State Right of Way was issued July 3, 2002. This permit was issued for discharge of treated construction storm water associated with the channel realignment. Future use of the right of way associated with the construction of the bridge and associated channel will need to be coordinated with WSDOT.

- A NPDES Storm Water General Permit for Construction Activity was issued for the channel realignment on July 11, 2002. The bridge construction and removal of Old Blyn Highway and the Log Deck Road will not likely reach the threshold requiring this permit. The Olympic Discovery Trail may require this permit.

8.0 MONITORING

Monitoring will take place during all phases of the channel realignment: pre-project, during construction, and post project. As outlined in the *Jimmycomelately Creek Realignment Monitoring Plan* (Shreffler 2001), monitoring is intended to proceed for a minimum of 10 years post-construction and will focus on ecological processes, habitat conditions and functions, and biological responses. The monitoring plan identifies the following monitoring parameters as essential: hydrology, sediment transport and deposition, channel morphology and topography, water quality, large woody debris, soils, flood conveyance, riparian vegetation establishment, wetland vegetation establishment, invasive vegetation removal, salmonid use, and upland bird use. The monitoring plan includes performance criteria, an adaptive management program, and contingency measures.

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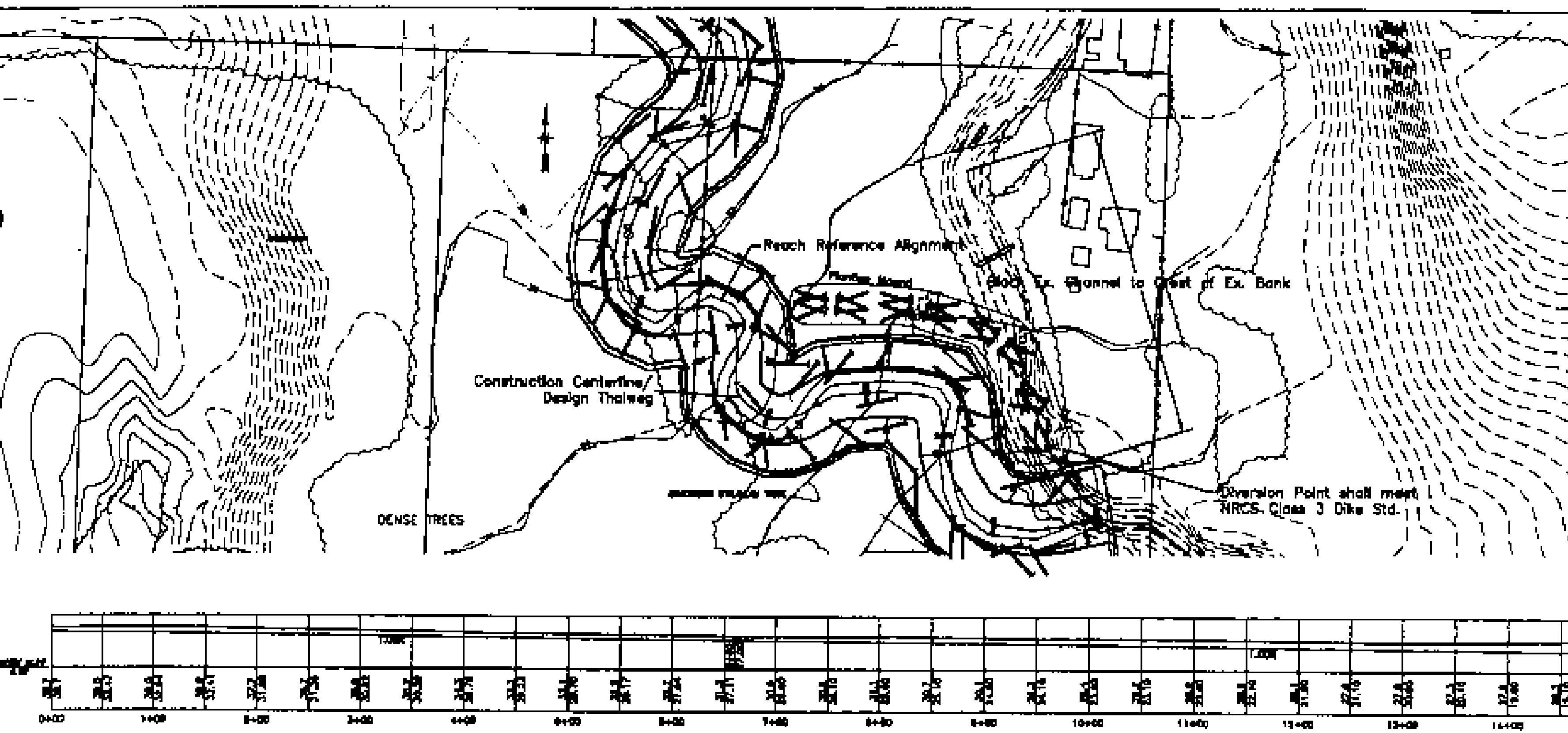
ATTACHMENT A – Final Channel Drawings



Legend:

Individual Log	
Crossed Log Revetment	
Finished Project 2' Contour:	
Finished Project 10' Contour:	
Existing Ground Profile:	
Finished Project Profile:	

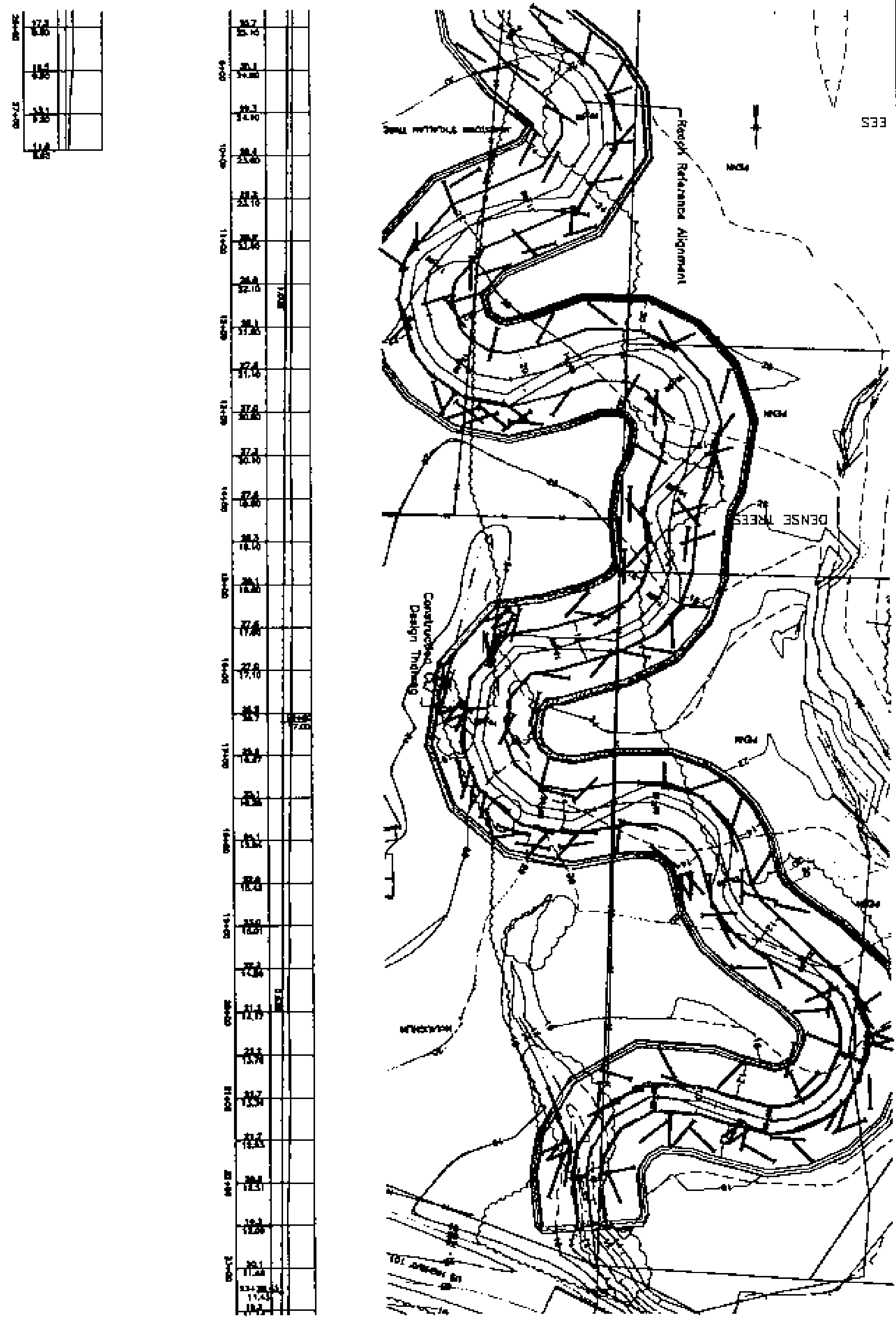
Color Key:

Existing 2' Contour:	
Existing 10' Contour:	

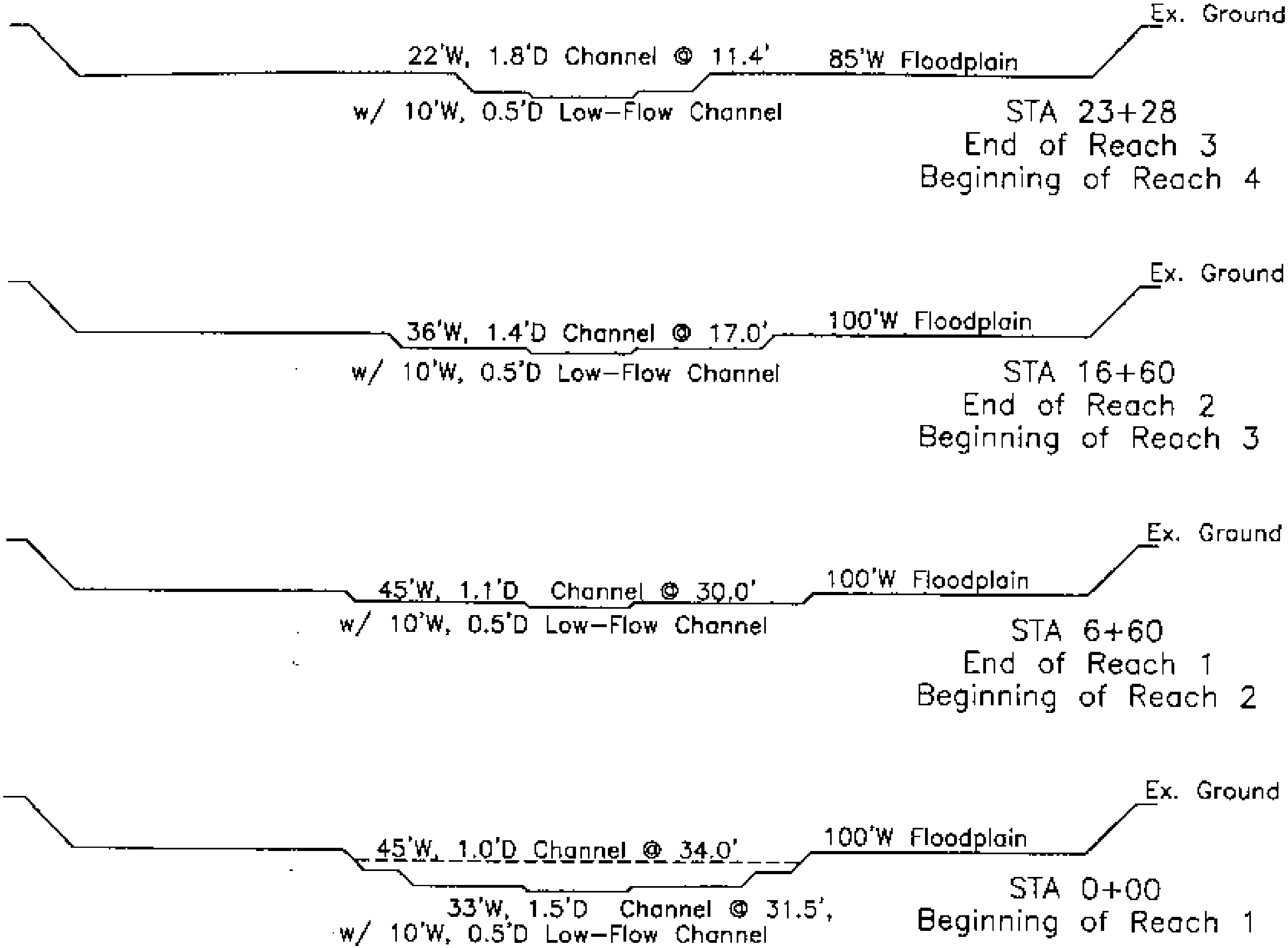
General Notes:

1. Logs are depicted with 40' length for illustration only. Actual structures may require more and/or different-sized logs. Depicted logs are either at surface or buried to 2' below the surface. An additional layer of wood (not depicted) shall be buried 4' to 6' below the surface throughout the stream and floodplain area.
2. Calculated excavation = 60607 cubic yards, total.
3. Finished Project Contours include both calculated elevations within the channel, DTM data, and survey data of existing ground features outside the proposed channel. Datum is per Walker and Associates DTM.
4. Thalweg depths shown do not indicate maximum anticipated scour depths in meander bends. These depths are:
   4' below "Straight-Line" stream grade at mid-meander curve or at 90-degree turning obstruction.
   3' at quarter-meander curve
   LWD structures are to be installed down to indicated thalweg depth. Normal stream thalweg depth is anticipated to be less than full scour depth during a bank-full (2 year) rainfall event.
5. LWD structures shown are intended to affect channel and floodplain flow in the manner of a heavily-forested area. Additional wood may need to be added to achieve minimum wood volume per unit area for adequate hydraulic roughness. Wood volume per unit area should be 0.006 cubic units per square unit of area (minimum). Wood placed in channel can be expected to move during large storm events or deteriorate over time. To ensure the proper hydraulic function of this project, the LWD structures will need to be maintained and additional LWD may need to be placed in the channel to replace losses until adequate, natural LWD resupply is achieved. (Reference for methodology: HYDRAULIC GUIDELINES FOR THE RE-INTRODUCTION AND MANAGEMENT OF LARGE WOODY DEBRIS IN LOWLAND RIVERS, by Abbe, O'Neil, Finlayson, & Schmidt, 1995.)
6. The proper function of this project relies on the proper placement and hydraulic influence of LWD. Should this channel be allowed to meander out of the influence of the LWD structures, or should the amount of LWD in channel fall below the minimum required, it is highly likely that significant erosion, downstream sediment transport, and channel movement will occur.
7. This project is designed to function as an alluvial stream, influenced by LWD, that will meander like a natural stream. The Clallam Conservation District and its agents will not accept any liability for damages caused by subsequent, natural stream meandering.
8. Property lines depicted are approximate and are for illustration only. Accurate determination of property lines in relation to the project area can only be determined by a professional land surveyor, licensed in the State of Washington.

Clallam Conservation District	Designed: RJG / Drawn: RJG	**JimmyComeLately Creek Restoration Project** Plan & Profile for Channel Construction Blyn, Washington	Date 12/18/01 / Sheet No. 1 of 2



Clallam Conservation District	Designed: RJG	JimmyComeLately Creek Restoration Project	Date 12/18/01



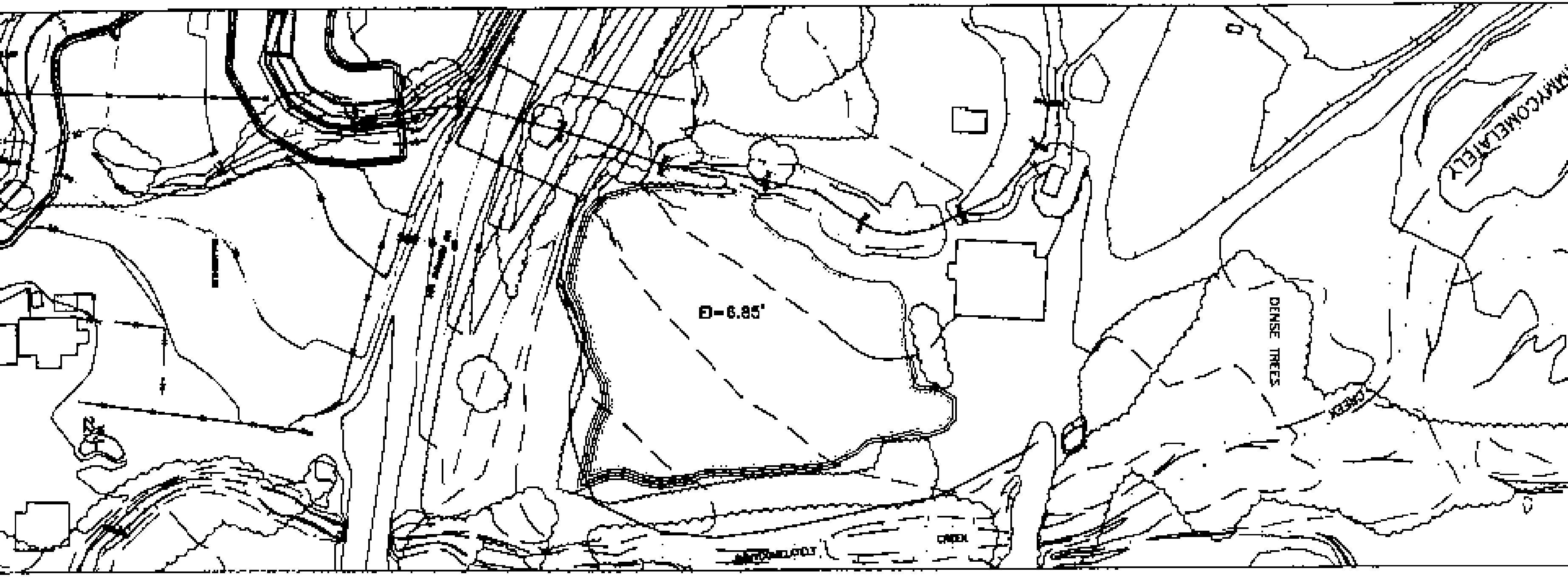
Note: Reach One is designed to allow sediment in excess of 90 mm to percipitate. This will also occur upstream, and is intended to remedy the existing, incised channel condition. This will continue until the channel reaches a depth of 1.0', at which point it will have adequate slope to convey all incoming sediments.

Clallam Conservation District

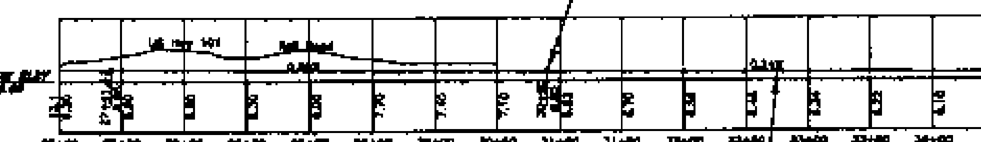
Designed: RJG

JimmyComeLately Creek Restoration Project

Date 12/18/01



End of constructed stream gradient, downstream gradient is existing condition.
Note: To ensure proper tidal flushing, constructed tidal basins must connect with stream channel at or upstream of this point.



MHW = 6.4' per USACE

Clallam Conservation District

Designed:
RJG

JimmyComeLately Creek
Restoration Project

Date
12/18/01

ATTACHMENT B – Engineer's Calculations

Design Parameters: 1st Reach

Slope:	0.0068	Avg. Slope							
Width:	33	Bed Width							
LF Width:	10	LF Area:	5.25	Top Width	11				
LF Depth:	0.5	LF Perim:	11.41	Adjust:	0.41				
S. Slope:	1	d75 n:	Limerinos:	Hey:	Jarrett:				
n:	0.04	0.021292	0.031633	0.055499	0.025174				
O.B. n:	0.1								
d50:	0.069 ft	Scour Depth @2yr Flow:			Scour Depth at 100 yr Flow:				
d75:	0.105 ft	Ds/Do =	3.340974		Width	90	Velocity	1.929943	
d84:	0.131 ft	Depth =	4.543724		Depth	3	Ds/Do =	1.239316	
dmax:	0.295 ft						Depth =	5.403417	

Flow at Depth:

Depth	Velocity	Quantity	Depth	Velocity	Quantity	Depth	Velocity	Quantity
1	3.23937	115.3886	2	4.754975	338.0982	3	5.960265	648.9608
1.1	3.411996	133.234	2.1	4.886451	365.4303	3.1	6.069411	684.4778
1.2	3.578833	152.1253	2.2	5.015151	393.6233	3.2	6.17681	720.7717
1.3	3.740409	172.0348	2.3	5.141223	422.6659	3.3	6.282551	757.8368
1.4	3.89717	192.9377	2.4	5.264805	452.5478	3.4	6.386696	795.6675
1.5	4.049499	214.8116	2.5	5.386019	483.2592	3.5	6.489306	834.2588
1.6	4.197729	237.6363	2.6	5.50498	514.791	3.6	6.590436	873.6059
1.7	4.342149	261.3934	2.7	5.621794	547.1347	3.7	6.69014	913.7041
1.8	4.483016	286.0661	2.8	5.736557	580.2825	3.8	6.788467	954.5492
1.9	4.620557	311.6391	2.9	5.849359	614.2268	3.9	6.885464	996.1371

Design Flow Inputs:

1.36	3.835017	184.4588					
		Stream Q	FP Width	O-Bank V	O-Bank Q	Total Q	Total W
	4.982758	474.9006	50	1.508227	102.5594	577.4601	85.72

Shear Stress:

Density	Hyd Rad	Slope	
62.4	1.40	0.0068	
62.4	1.86	0.0068	
Avg	Critical Shear:		
0.592	0.48		
Bed	Critical Shear		D avg
0.789	0.48		1.51

Is Avg less than critical?
Yes = no sediment transport
No = bed load transport from design channel

Limerinos	Jarrett	Hey	
n =	n =	a =	n =
0.031633	0.055499	6.814736	0.025174
		(8/f)^.5=	
		7.399795	
		f =	
		0.1461	

Design Parameters: 1st Reach, after aggradation

Slope:	0.0106	Avg. Slope							
Width:	45	Bed Width							
LF Width:	10	LF Area:	5.25	Top Width	11				
LF Depth:	0.5	LF Perim:	11.41	Adjust	0.41				
S. Slope:	1		d75 n:	Limerinos:	Hey:	Jarrett			
n:	0.04		0.021292	0.032631	0.068624	0.025637			
O.B. n:	0.1								
d50:	0.069 ft		Scour Depth @2yr Flow:			Scour Depth at 100 yr Flow:			
d75:	0.105 ft		Ds/Do =	3.561957		Width	90	Velocity	1.73913
d84:	0.131 ft		Depth =	3.561957		Depth	3	Ds/Do =	1.214611
dmax:	0.295 ft							Depth =	4.858445

Flow at Depth:

Depth	Velocity	Quantity	Depth	Velocity	Quantity	Depth	Velocity	Quantity
1	3.992894	188.9231	2	5.97241	566.6565	3	7.562504	1094.251
1.1	4.217461	219.1175	2.1	6.145127	613.0645	3.1	7.707211	1154.472
1.2	4.434671	251.1061	2.2	6.314368	660.934	3.2	7.849745	1215.995
1.3	4.645215	284.8455	2.3	6.48032	710.2441	3.3	7.990191	1278.807
1.4	4.849678	320.2851	2.4	6.643154	760.9752	3.4	8.128626	1342.897
1.5	5.048557	357.3868	2.5	6.803024	813.1091	3.5	8.265124	1408.255
1.6	5.242279	396.1143	2.6	6.960071	866.6284	3.6	8.399754	1474.871
1.7	5.431218	436.4344	2.7	7.114427	921.5171	3.7	8.53258	1542.736
1.8	5.615698	478.3164	2.8	7.266212	977.7598	3.8	8.663663	1611.84
1.9	5.79601	521.7325	2.9	7.415537	1035.342	3.9	8.793061	1682.175

Design Flow Inputs:

1	3.992894	188.9231					
		Stream Q	FP Width	O-Bank V	O-Bank Q	Total Q	Total W
	5.80916	540.2519	50	1.534049	76.70244	616.9543	97

Shear Stress:

Density	Hyd Rad	Slope
62.4	1.06	0.0106
62.4	1.5	0.0106

Avg	Critical Shear:	
0.703	0.48	
Bed	Critical Shear	D avg
0.992	0.48	1.11

Is Avg less than critical?
Yes = no sediment transport
No = bed load transport from design channel

Limerinos	Jarrett	Hey	
n =	n =	a =	n =
0.032631	0.068624	7.423361	0.025637
		(8/f)^.5=	
		6.943645	
		f =	
		0.165926	

Design Parameters: 2d Reach

Slope:	0.01	Avg. Slope							
Width:	45	Bed Width							
LF Width:	10	LF Area:	5.25	Top Width	11				
LF Depth:	0.5	LF Perim:	11.41	Adjust:	0.41				
S. Slope:	1		d75 n:	Limerinos:	Hey:	Jarrett:			
n:	0.04		0.021292	0.032307	0.066246	0.025485			
O.B. n:	0.1								
d50:	0.069	ft	Scour Depth @2yr Flow:			Scour Depth at 100 yr Flow:			
d75:	0.105	ft	Ds/Do =	3.536107		Width	90	Velocity	1.736488
d84:	0.131	ft	Depth =	3.889717		Depth	3	Ds/Do =	1.209066
dmax	0.295	ft						Depth =	4.957169

Flow at Depth:

Depth	Velocity	Quantity	Depth	Velocity	Quantity	Depth	Velocity	Quantity
1	3.878241	183.6491	2	5.800917	550.5362	3	7.345354	1062.981
1.1	4.09636	212.9764	2.1	5.968675	595.6116	3.1	7.485905	1121.473
1.2	4.307333	244.0485	2.2	6.133056	642.1066	3.2	7.624346	1181.229
1.3	4.511832	276.8171	2.3	6.294244	690.0008	3.3	7.760759	1242.237
1.4	4.710424	311.2391	2.4	6.452402	739.2752	3.4	7.89522	1304.487
1.5	4.903592	347.2755	2.5	6.607681	789.9121	3.5	8.027798	1367.969
1.6	5.091752	384.891	2.6	6.760219	841.8947	3.6	8.158562	1432.672
1.7	5.275265	424.0533	2.7	6.910143	895.2073	3.7	8.287574	1498.588
1.8	5.454448	464.7327	2.8	7.057569	949.8351	3.8	8.414894	1565.708
1.9	5.629563	506.9021	2.9	7.202606	1005.764	3.9	8.540576	1634.023

Design Flow Inputs:

1.1	4.09636	212.9764					
		Stream Q	FP Width	O-Bank V	O-Bank Q	Total Q	Total W
	5.7963	594.8743	50	1.587747	87.3261	682.2004	97.2

Shear Stress:

Density	Hyd Rad	Slope
62.4	1.15	0.01
62.4	1.6	0.01

Avg	Critical Shear:	
0.720	0.48	
Bed	**Critical Shear**	**D avg**
0.998	0.48	1.21

Is Avg less than critical?
Yes = no sediment transport
No = bed load transport from design channel

Limerinos	Jarrett	Hey	
n =	n =	a =	n =
0.032307	0.066246	7.234492	0.025485
		(8/f)^.5=	
		7.081068	
		f =	
		0.159548	

Design Parameters: 3rd Reach

Slope:	0.0083	Avg. Slope							
Width:	36	Bed Width							
LF Width:	10	LF Area:	5.25	Top Width	11				
LF Depth:	0.5	LF Perim:	11.41	Adjust:	0.41				
S. Slope:	1	d75 n:		Limerinos:	Hey:	Jarrett:			
n:	0.04		0.021292	0.031951	0.060767	0.02532			
O.B. n:	0.1								
d50:	0.069 ft	Scour Depth @2yr Flow:				Scour Depth at 100 yr Flow:			
d75:	0.105 ft	Ds/Do =	3.443716			Width	90	Velocity	1.879964
d84:	0.131 ft	Depth =	4.201334			Depth	3	Ds/Do =	1.235266
dmax	0.295 ft							Depth =	5.212821

Flow at Depth:

Depth	Velocity	Quantity	Depth	Velocity	Quantity	Depth	Velocity	Quantity
1	3.564875	137.1504	2	5.262901	405.2305	3	6.617139	779.4553
1.1	3.758055	158.6162	2.1	5.410448	438.1399	3.1	6.739924	822.1961
1.2	3.944801	181.3459	2.2	5.55492	472.0855	3.2	6.860792	865.8678
1.3	4.125703	205.3053	2.3	5.696483	507.0531	3.3	6.97982	910.4629
1.4	4.301263	230.4641	2.4	5.835286	543.03	3.4	7.097077	955.9744
1.5	4.471908	256.7948	2.5	5.971469	580.0039	3.5	7.212628	1002.396
1.6	4.63801	284.2727	2.6	6.105155	617.9634	3.6	7.326536	1049.721
1.7	4.799891	312.875	2.7	6.236463	656.898	3.7	7.438858	1097.944
1.8	4.957836	342.5812	2.8	6.365497	696.7976	3.8	7.549649	1147.059
1.9	5.112098	373.3722	2.9	6.492359	737.653	3.9	7.658962	1197.061

Design Flow Inputs:

1.22	3.981431	186.0404					
		Stream Q	FP Width	O-Bank V	O-Bank Q	Total Q	Total W
	5.370734	495.7467	50	1.549882	94.54278	590.2894	88.44

Shear Stress:

Density	Hyd Rad	Slope
62.4	1.27	0.0083
62.4	1.72	0.0083

Avg	Critical Shear:	
0.656	0.48	
Bed	**Critical Shear**	**D avg**
0.891	0.48	1.36

Is Avg less than critical?
Yes = no sediment transport
No = bed load transport from design channel

Limerinos	Jarrett	Hey	
n =	n =	a =	n =
0.031951	0.060767	7.017331	0.02532
		(8/f)^.5=	
		7.243581	
		f =	
		0.15247	

Design Parameters: 4th Reach

Slope:	0.006	Avg. Slope						
Width:	22	Bed Width						
LF Width:	10	LF Area:	5.25	Top Width	11			
LF Depth:	0.5	LF Perim:	11.41	Adjust:	0.41			
S. Slope:	1		d75 n:	Limerinos:	Hey:	Jarrett:		
n:	0.04		0.021292	0.030958	0.051043	0.024869		
O.B. n:	0.1							
d50:	0.069 ft		Scour Depth @2yr Flow:			Scour Depth at 100 yr Flow:		
d75:	0.105 ft		Ds/Do =	3.283905		Width	90 Velocity	2.141328
d84:	0.131 ft		Depth =	5.911029		Depth	3 Ds/Do =	1.262374
dmax:	0.295 ft						Depth =	6.059397

Flow at Depth:

Depth	Velocity	Quantity	Depth	Velocity	Quantity	Depth	Velocity	Quantity
1	3.110219	76.78504	2	4.421562	217.485	3	5.451688	414.1266
1.1	3.260373	88.09609	2.1	4.534477	234.7399	3.1	5.544436	436.6626
1.2	3.405335	100.0545	2.2	4.644873	252.543	3.2	5.635643	459.7083
1.3	3.545557	112.6449	2.3	4.752886	270.8888	3.3	5.725372	483.2613
1.4	3.681428	125.8536	2.4	4.858643	289.7721	3.4	5.813683	507.3197
1.5	3.813285	139.6683	2.5	4.96226	309.1884	3.5	5.900633	531.8815
1.6	3.941423	154.0781	2.6	5.063842	329.1333	3.6	5.986273	556.9449
1.7	4.066101	169.0732	2.7	5.163489	349.6031	3.7	6.070653	582.5084
1.8	4.18755	184.6446	2.8	5.26129	370.594	3.8	6.153821	608.5706
1.9	4.305975	200.7843	2.9	5.35733	392.1028	3.9	6.235821	635.1303

Design Flow Inputs:

1.8	4.18755	184.6446					
		Stream Q	FP Width	O-Bank V	O-Bank Q	Total Q	Total W
	4.84078	430.4422	50	1.707826	153.7043	584.1465	75.6

Shear Stress:

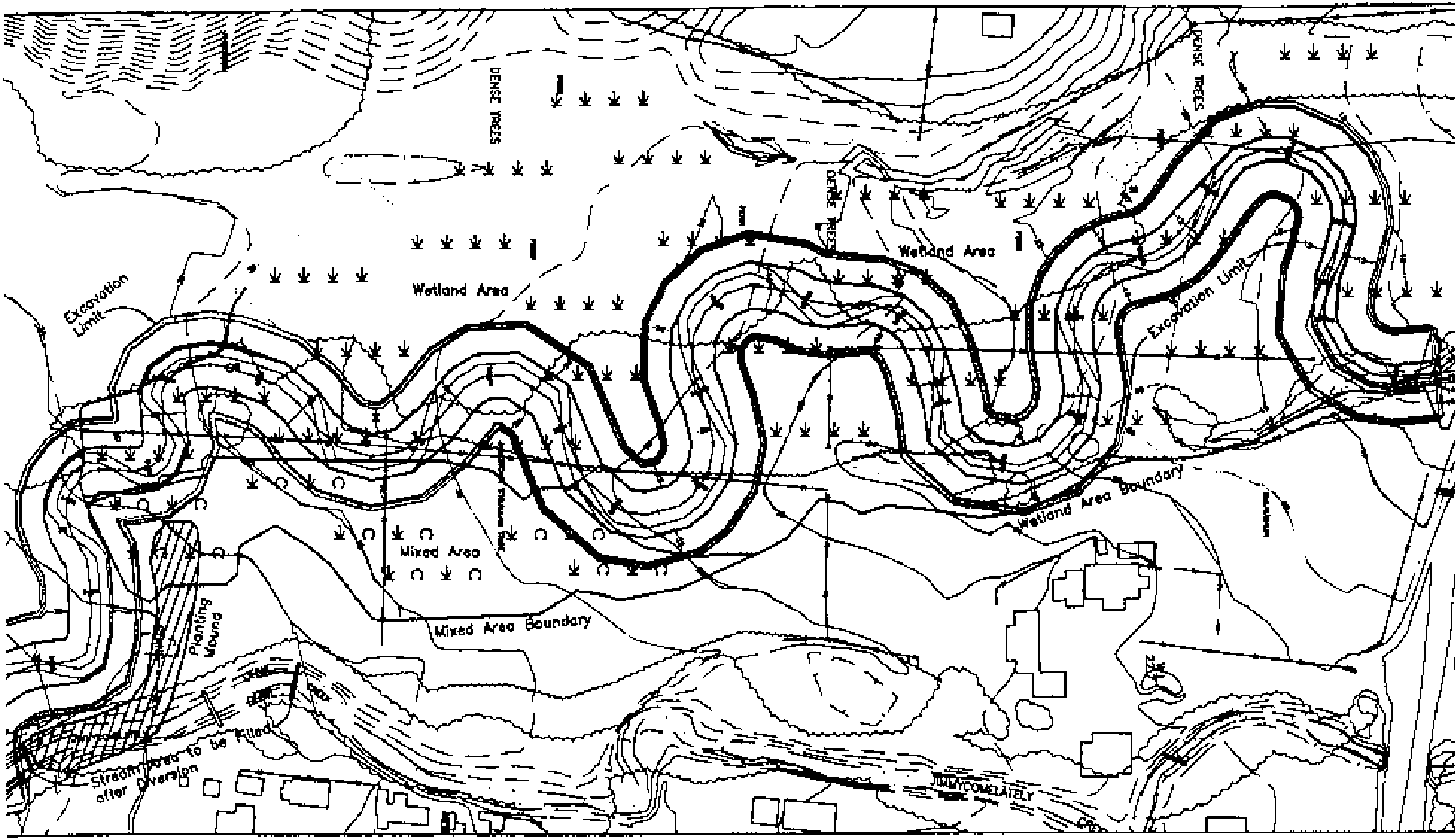
Density	Hyd Rad	Slope
62.4	1.75	0.006
62.4	2.3	0.006

Avg	Critical Shear:	
0.655	0.48	
Bed	**Critical Shear**	**D avg**
0.861	0.48	2.03

Is Avg less than critical?
Yes = no sediment transport
No = bed load transport from design channel

Limerinos	Jarrett	Hey	
n =	n =	a =	n =
0.030958	0.051043	6.348323	0.024869
		(8/f)^.5=	
		7.777837	
		f =	
		0.132243	

ATTACHMENT C – Wetland Area Impacts and Creation Details



Legend:

Wetland: ⚘ ⚘ ⚘ ⚘

Mixed Upland and Wetland: ⚘ ∩ ⚘ ∩

Total Wetland Exc. Area: 5.08 Ac. Wetland, 0.60 Ac. Mixed, 5.68 Ac. Total
Total Wetland Fill Area: 0.09 Ac.
Total New Wetland Area: 1.06 Ac.

Total Wetland Exc. Qty: Approx. 30800 CY
Total Wetland Fill Qty: Approx. 1860 CY

Note: Entire Excavated Project Area will become a wetland area with higher values and increased functions.

Clallam Conservation District

Designed: RJG

Drawn: RJG

JimmyComeLately Creek Restoration Project

Wetland Area Impact & Creation Details

Blyn, Washington

Date: 12/18/01

Sheet No. 1 of 1

ATTACHMENT D – Sediment Transport Calculations

Sediment transport calculations

The sediment from the existing JCL channel was sieve sampled at the downstream end of a bar (Table D1) and a Wolman pebble count was collected at several riffles (Table D2); all samples were approximately 100 meters upstream of the project area.

Table D1. Sieve bar sample

Bar sample sieve sizes (mm)	Percent passing
0.85	5.2
1.18	8.4
2	20.6
4	26
8	42.3
16	66.4
50	71.7
63	84.7

Table D2. Wolman pebble count in a riffle

Pebble size (mm)	Riffle pebble count (%)	Cumulative count (%)
0.125 – 0.25	12	12
5.7 – 8	3	15
8 – 11.3	7	22
11.3 – 16	8	30
16 – 22.6	13	43
22.6 – 32	10	53
32 – 45	11	64
45 – 64	13	77
64 – 90	10	87
90 – 128	8	95
128 - 180	5	100

We used the Shields equation to calculate the magnitude of shear stress needed to mobilize the D_{50} sediment size (50% of the sediment particles are finer) in the existing channel. The Natural Resource Conservation Service (NRCS) recommends using the Shields equation for gravel-bedded streams of similar basin area and gradient to Jimmycomelately Creek. A WDFW engineer also recommended its use.

We also used the Shields equation along with the entrainment calculation (shown below) to determine whether the channel bed may be degrading in the upper end of the project area. Based upon the calculations, the channel bed was clearly degrading. This lead to incorporating an alluvial fan into reach 1.

Entrainment calculation We used the Critical Dimensionless Shear Stress equation to compute the bankfull mean depth required to mobilize the largest particle found on our bar sieve sample.

Critical Dimensionless Shear Stress:

$\tau_{ci} = 0.0834(D_{50}/Ds_{50})^{-0.872}$

$\tau_{ci} = 0.042$

Required mean bankfull depth = (τ_{ci} x 1.65 x $D_{100(\text{bar in feet})}$/Slope)

- $D_{100(\text{bar})} = 0.394$ ft
- Slope = 0.0159 (bankfull water surface slope at riffle)

Required mean bankfull depth = 1.267 ft

Our measured bankfull depth was 1.58 ft. Since this is greater than the depth required to mobilize the largest particle found in the bar sieve, it would support the field observations that the bed is degrading. To validate this finding, sediment transport was also examined using the Shields equation. The below calculation shows there is excess energy to move the largest bar particles.

- Bankfull Shear Stress =τ_c= γRS

where γ=density of water, R=channel hydraulic radius (approximated by width x depth), and S = slope.

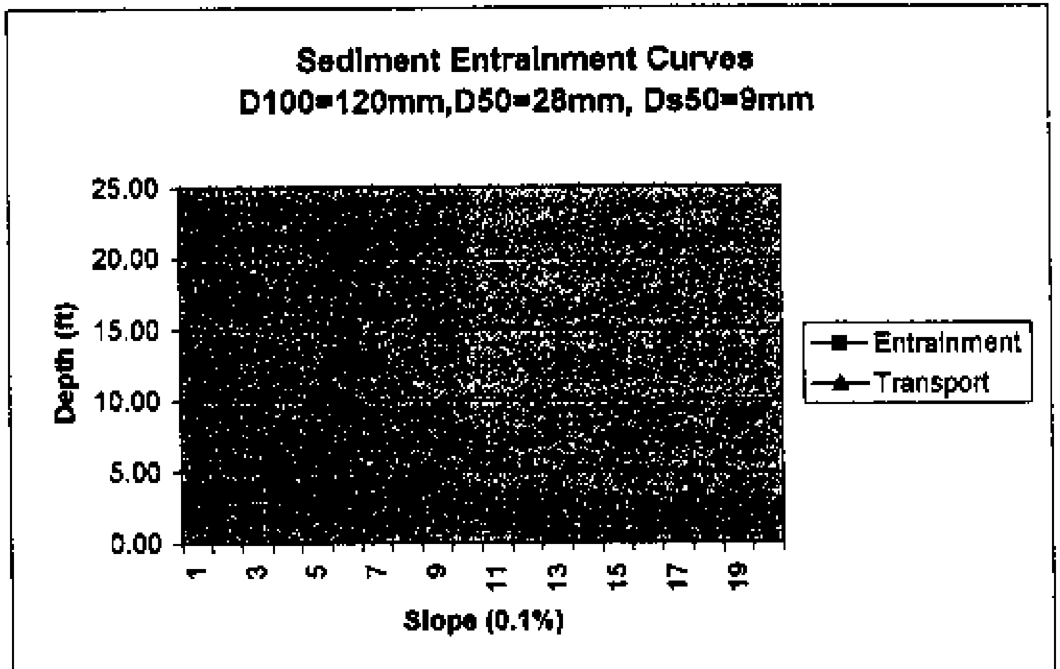
- $D_{100(\text{bar})}$: 120 mm
- $\tau_c = 1.22$ lb/ft^2
- per the Shields diagram, $D_{100(\text{bar})}$= 0.67 lb/ft^2

ATTACHMENT E – Entrainment Curves

Sediment Entrainment Curves

d50 =	28			
ds50 =	9			
tci =	0.031028			
Di = (mm)	120	Crit Shear	0.67	lbs/sf
Di = (ft)	0.393701	Density	62.4	lbs/cf
tcix1.65xD	0.020156			

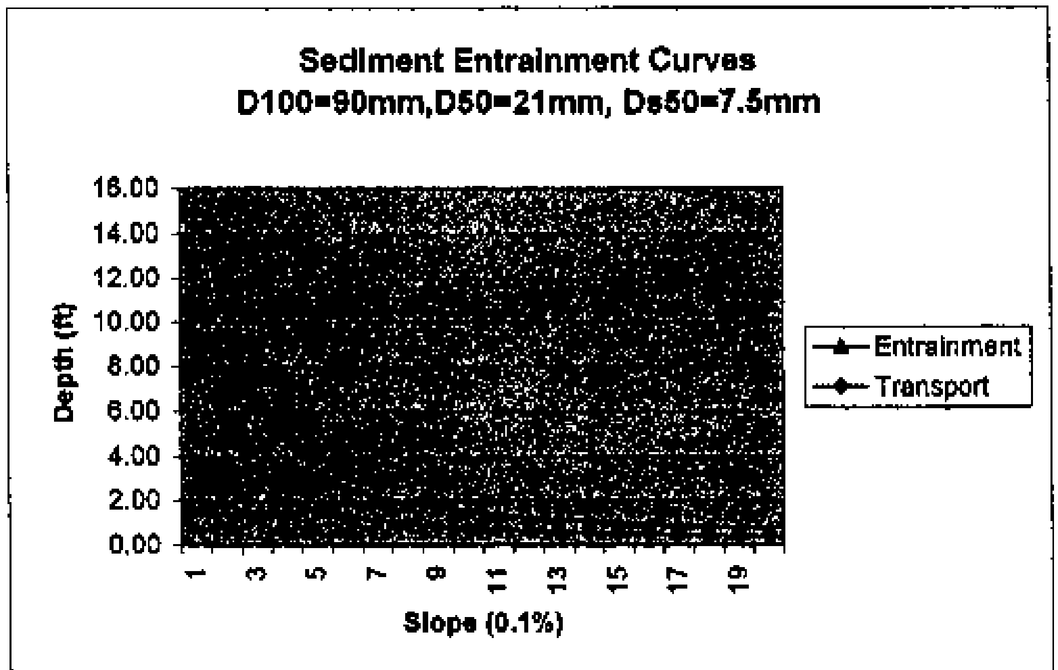
Slope	Depth	Transport
0.001	20.16	10.74
0.002	10.08	5.37
0.003	6.72	3.58
0.004	5.04	2.68
0.005	4.03	2.15
0.006	3.36	1.79
0.007	2.88	1.53
0.008	2.52	1.34
0.009	2.24	1.19
0.01	2.02	1.07
0.011	1.83	0.98
0.012	1.68	0.89
0.013	1.55	0.83
0.014	1.44	0.77
0.015	1.34	0.72
0.016	1.26	0.67
0.017	1.19	0.63
0.018	1.12	0.60
0.019	1.06	0.57
0.02	1.01	0.54



Sediment Entrainment Curves

d50 =	21		
ds50 =	7.5		
tcl =	0.034014		
DI = (mm)	90	Crit Shear	0.48 lbs/sf
DI = (ft)	0.295276	Density	62.4 lbs/cf
tcix1.65xD	0.015117		

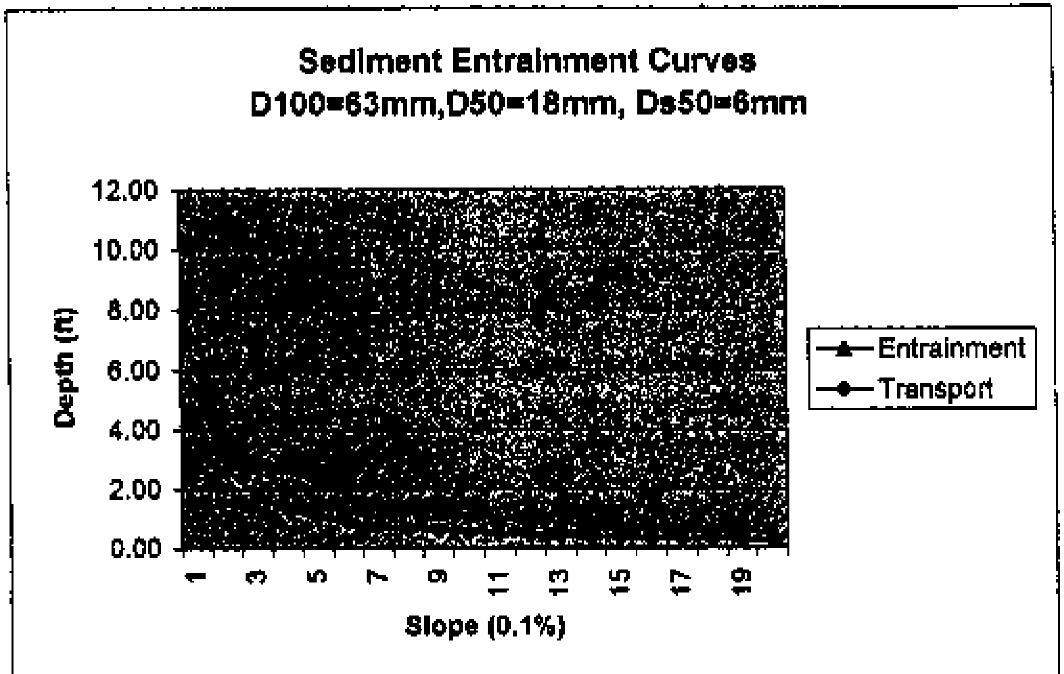
Slope	Depth	Transport
0.001	15.12	7.69
0.002	7.56	3.85
0.003	5.04	2.56
0.004	3.78	1.92
0.005	3.02	1.54
0.006	2.52	1.28
0.007	2.16	1.10
0.008	1.89	0.96
0.009	1.68	0.85
0.01	1.51	0.77
0.011	1.37	0.70
0.012	1.26	0.64
0.013	1.16	0.59
0.014	1.08	0.55
0.015	1.01	0.51
0.016	0.94	0.48
0.017	0.89	0.45
0.018	0.84	0.43
0.019	0.80	0.40
0.02	0.76	0.38



Sediment Entrainment Curves

d50 =	18		
ds50 =	6		
tci =	0.032028		
Di = (mm)	63	Crit Shear	0.33 lbs/sf
Di = (ft)	0.206693	Density	62.4 lbs/cf
tcix1.65xD	0.010923		

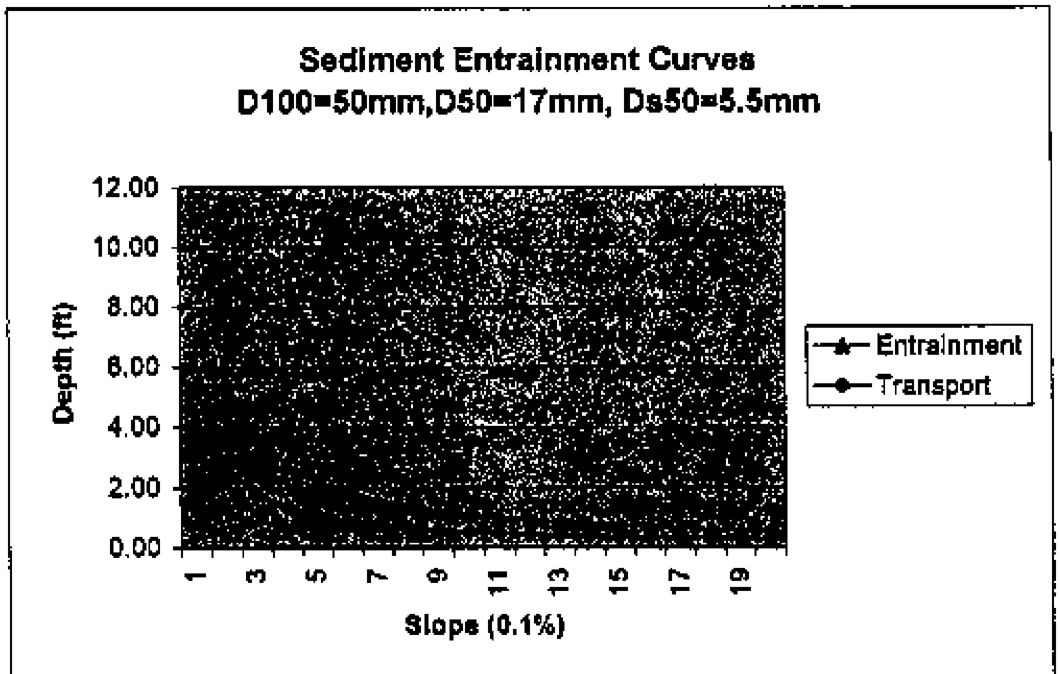
Slope	Depth	Transport
0.001	10.92	5.29
0.002	5.46	2.64
0.003	3.64	1.76
0.004	2.73	1.32
0.005	2.18	1.06
0.006	1.82	0.88
0.007	1.56	0.76
0.008	1.37	0.66
0.009	1.21	0.59
0.01	1.09	0.53
0.011	0.99	0.48
0.012	0.91	0.44
0.013	0.84	0.41
0.014	0.78	0.38
0.015	0.73	0.35
0.016	0.68	0.33
0.017	0.64	0.31
0.018	0.61	0.29
0.019	0.57	0.28
0.02	0.55	0.26



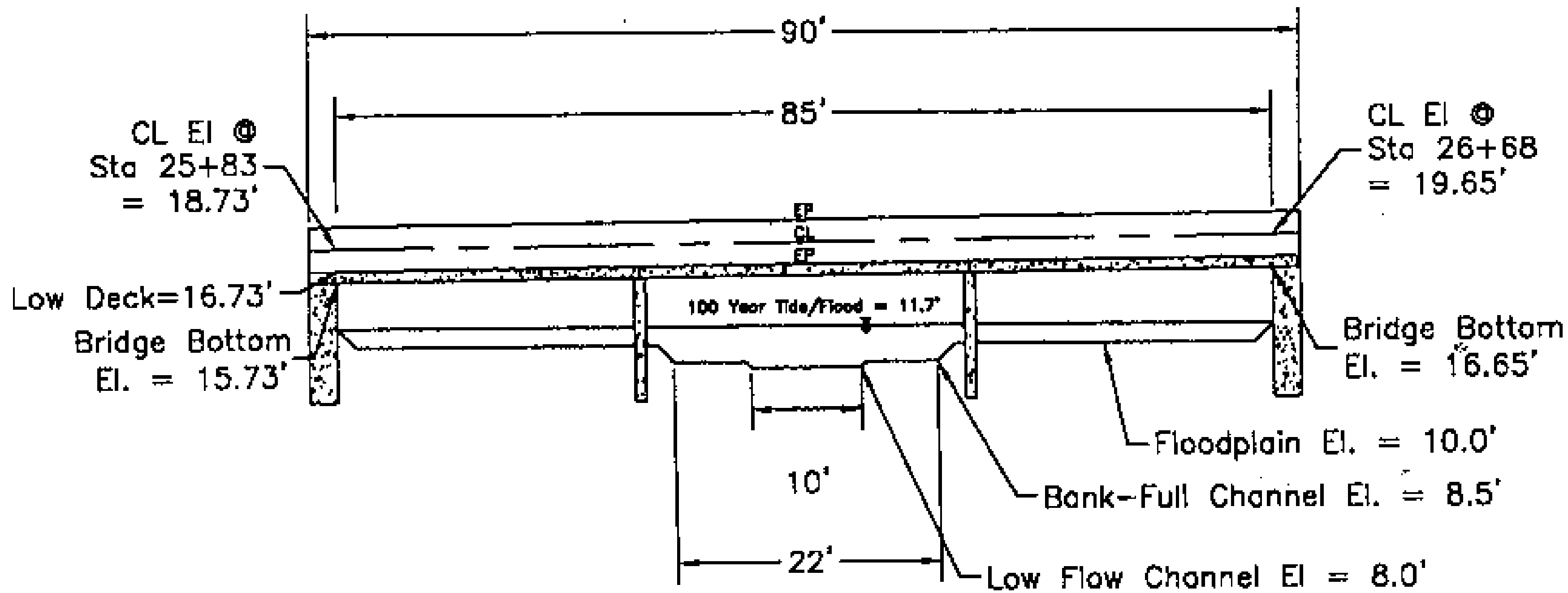
Sediment Entrainment Curves

d50 =	17			
ds50 =	5.5			
tci =	0.031205			
Di = (mm)	50	Crit Shear	0.3	lbs/sf
Di = (ft)	0.164042	Density	62.4	lbs/cf
tcix1.65xD	0.008446			

Slope	Depth	Transport
0.001	8.45	4.81
0.002	4.22	2.40
0.003	2.82	1.60
0.004	2.11	1.20
0.005	1.69	0.96
0.006	1.41	0.80
0.007	1.21	0.69
0.008	1.06	0.60
0.009	0.94	0.53
0.01	0.84	0.48
0.011	0.77	0.44
0.012	0.70	0.40
0.013	0.65	0.37
0.014	0.60	0.34
0.015	0.56	0.32
0.016	0.53	0.30
0.017	0.50	0.28
0.018	0.47	0.27
0.019	0.44	0.25
0.02	0.42	0.24



ATTACHMENT F – Cross Section View of Proposed Bridge Crossing over Proposed Jimmycomelately Creek Channel



Notes:
1. Scale: 1"=10.0'
2. Bridge Type depicted is Precast, Prestressed 1'-0" Slab (3 ea. @ 30') per WSDOT Standard Plans
3. Channel Elevations are shown at the downstream end of the Bridge, elevations at upstream end are 0.3' higher.
4. View is looking from North to South, East is Left and West is Right.

Cross Section View of Proposed Bridge Crossing over Proposed JimmyComeLately Creek Channel
Scale: 1" = 15'

JimmyComeLately Stream Restoration Project
Applicant: JimmyComeLately Executive Committee
Agent: Sam Gibboney
Corps Application #: 2001-2-00937

Drawn By: RJG Date: 3/20/02

Clallam Conservation District

Designed: RJG
Drawn: RJG

JimmyComeLately Creek
Remeander Project
Proposed US 101 Bridge Cross Section
Blyn, Washington

Date: 3/20/02
Sheet No. 1 of 1

ATTACHMENT G – Estimated Sedimentation Rates for Jimmycomelately Creek and Hwy 101 Bridge

Estimated Sedimentation Rates for Jimmycomelately Creek and Hwy 101 Bridge

The approximate amount of sediment transported by Jimmycomelately Creek between 1957 and 1999 was calculated by using aerial photos to trace the 1957 and 1999 shoreline. Then a Digital Terrain Model (DTM) was used to estimate the amount of aggradation at the mouth by comparing 1957 and 1999 contours. This yielded 20,429 yd^3 of deposited sediment.

Table G1. Volume of sediment accumulated at the mouth of Jimmycomelately Creek.

Elevation (ft)	Area (ft^2)	Volume (yd^3)
4	152,404	
6	134,630	10,631
8	60,554	7,226
10	8,800	2,569
	Total volume	20,429

Added to this is 1477 yd^3 of sediment in the existing channel, totaling 21,906 yd^3, or 522 yd^3/yr. The actual sediment volume transported is somewhat underestimated since Clallam County periodically dredged the channel around the Old Blyn Hwy bridge. But that dredging was localized and not considered significant.

While large-scale sediment movement is episodic, we believe that several contributions to this aggradation will be reduced. In the winter storms of 1996, a large landslide on Woods Rd delivered a large quantity of sediment about 1 mile upstream of the project area. Caused by a failed culvert, the road has been substantially improved. Second, bed degradation in the upper project area should stop as a result of the new channel. Finally, the Forest Service logged significant portions of their land in the 1980's, the planted trees are reaching crown closure and root strength is likely increasing to stabilize slopes.

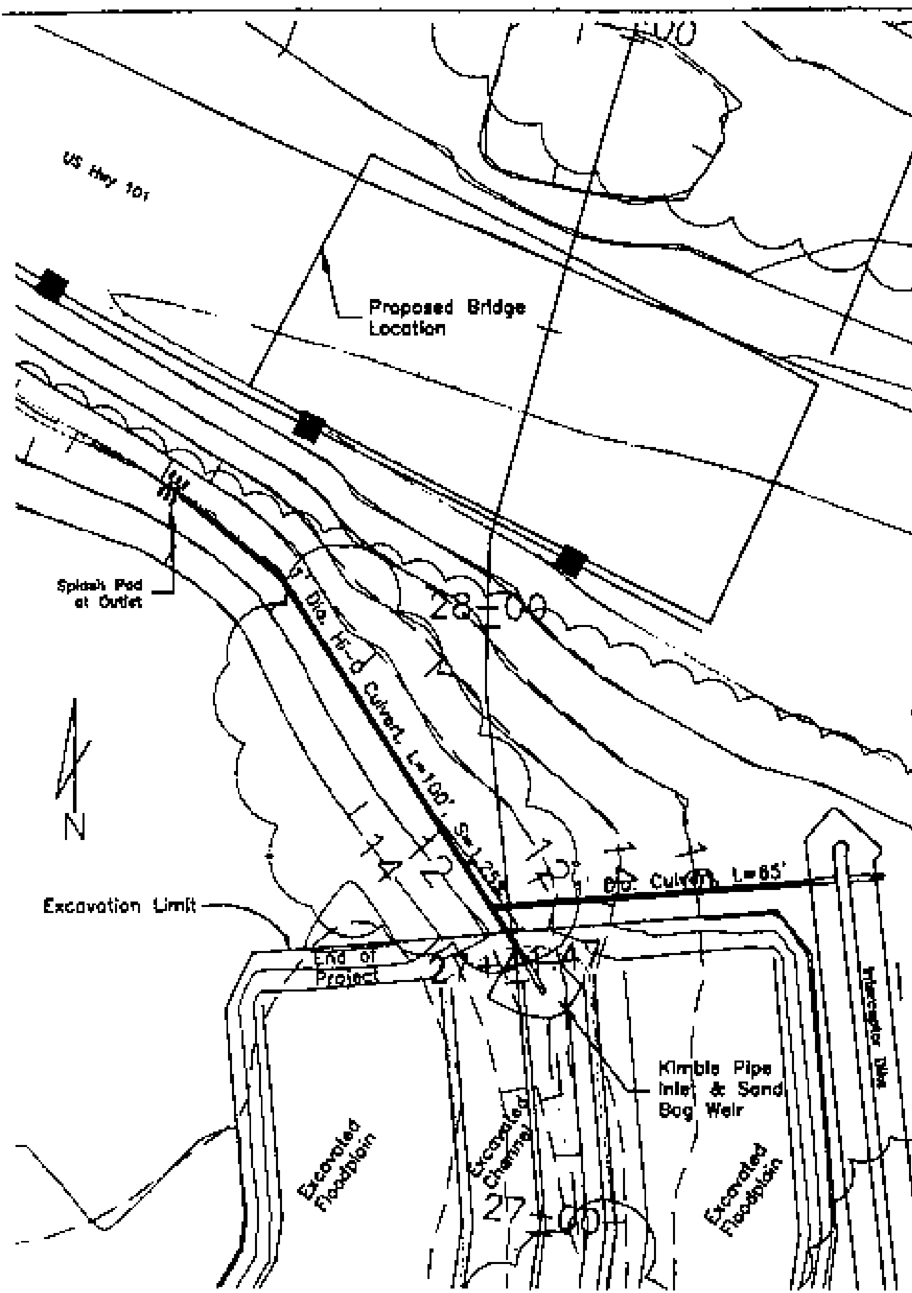
How will the channel design mitigate potential aggradation under the new Hwy 101 bridge? Reach 1 of the channel has been intentionally flattened to cause deposition of material (like an alluvial fan) up to 90mm in size. Several log bed controls will be placed in the new channel to prevent bed degradation. Finally the tidal basin downstream of Hwy 101 is designed to flush sediment into the bay at the point where aggradation at the mouth is predicted to occur. The tidal basin design and sizing mimics a similar basin found in other functioning estuaries, such as our reference site Salmon Creek.

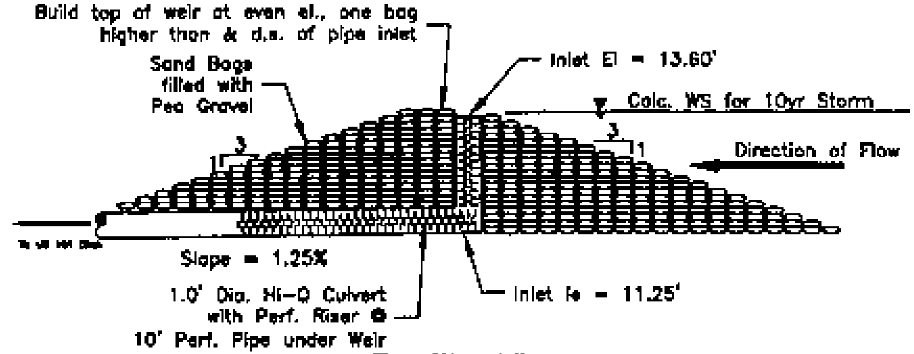
However, assuming for some reason tidal flushing does not work, then the bridge would pass 100 year flow events for 30 years (assuming at least 2 ft clearance under the bridge over 100 year flows, Table G2).

Table G2. Years for the new channel to aggrade under the bridge assuming no tidal flushing.

Deposition Area	Available volume (yd^3)	Years to fill	Total years	Rise in channel under bridge (ft)
Upper reach	2289	4.4	4.4	0.0
Active channel in meander belt	7203	13.8	18.2	1.0
Deposition in floodplain	5296	10.2	28.4	2.0

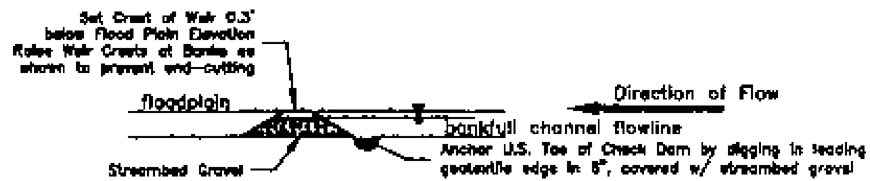
ATTACHMENT H – Sediment and Erosion Control Details





Profile View
Kimble Pipe with Sand Bag Weir for Settlement and Filtration

Kimble Pipe shall remain in place until excavated area is stabilized.



Profile View
Geotextile–Wrapped Check Dam

Space Check Dams so toe of U.S. Dam is at the crest elevation of the D.S. Dam

Cross Section View
Interceptor Dike

Place Interceptor Dike along East Edge of the Project to prevent surface runoff from flowing into excavated area. Dike shall remain in place until excavated area is stabilized.

Straw Cover/Hydroseed Mulch

Place Straw Cover on exposed soils on or above the floodplain. Straw will be placed to a depth of approx. 3", or 120 bales/acre. If possible, spray hydroseed & mulch with tackifier vs. placing straw cover

Clallam Conservation District	Designed: RJG	**JimmyComeLately Creek Restoration Project** Sediment and Erosion Control Details Blyn, Washington	Date 12/18/01
	Drawn RJG		Sheet No. 1 of 1