Report to the Salmon Recovery Funding Board On the Engineered Log Jam (ELJ) Workshop

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BACKGROUND

Engineered log jams (ELJs) are experimental in-stream flow control structures based on the architecture of naturally occurring stable log jams in large river systems. ELJs are permanent structures that are designed to mimic natural log jams, contain key pieces of wood large enough to alter the course of the river channel, and capture additional wood.

They attempt to meet traditional engineering standards, incorporate human objectives such as bank protection, while providing greater fisheries habitat value. ELJs remain an experimental technology that requires comprehensive geomorphic and hydraulic engineering analysis to determine the necessary wood debris characteristics and size, position, spacing and type of ELJ structure appropriate for particular sites and objectives (Abbe, 1999). Inappropriate design and application of ELJs can increase the likelihood of unanticipated impacts.

In the Early Action 1999 and Early 2000 grant cycles, the Salmon Recovery Funding Board (SRFB) funded three projects described as ELJs around Western Washington. The ELJ project funded in the Early Action 1999 cycle was: 99-1313, Lower Elwha Klallam Tribe (Elwha River). The two ELJ projects funded in the Early 2000 cycle were: 00-1136, Lummi Indian Nation (South Fork Nooksack River); and 00-1072, Thurston Conservation District (Deschutes River). The Board recognized the fact that these types of projects utilize experimental technology and would require close monitoring to determine their benefits to salmon. The Board requested SRFB staff to convene a workshop to help define the direction of current and future monitoring associated with ELJ projects.

The SRFB staff sponsored a workshop with ELJ and Large Woody Debris (LWD) experts from around the state. The objectives of the workshop were to identify the following:

1) Who is working on large river wood projects, exchange scientific information, and identify data needs for these projects;
2) Help develop consistent monitoring programs for the Early Action 1999 and the two Early 2000 projects;
3) Next steps for filling data needs and for developing a monitoring program on a statewide scale; and,
4) Develop a report documenting workshop outcomes, such as techniques, potential fish benefits and monitoring programs for the SRFB and other funding agencies to utilize for future wood projects.

On August 24, 2000, the SRFB staff, along with staff from the Washington Department of Fish & Wildlife (WDFW) and the National Marine Fisheries Service (NMFS) held a workshop in Olympia, Washington to bring ELJ and large woody debris (LWD) experts together to address the preceding four objectives.

The workshop had an attendance of 45 people representing scientists, educators, policy analysts and program managers, from both the private and public sector (see appendix 1). The workshop was organized as a facilitated roundtable presentation and open discussion. Seven presenters having expertise with ELJs, LWD placement, river morphology, and fisheries biology led the meeting by giving an overview of design and construction techniques, stream channel responses, and biological responses for their individual projects. The seven presenters and their topics were:

- Dave Montgomery, Ph.D., Geologist, University of Washington
  History of ELJs

- Tim Abbe, Ph.D., Geologist, Phil Williams and Associates
  Post-Construction Wood Budget Monitoring (North Fork Stillaguamish River)

- Allen Lebovitz M.S., Ecologist, Coastal Watersheds Consulting
  Watershed-Scale Large Woody Debris (LWD) Delivery (Bear & Palix Rivers)

- Roger Nichols B.S., Geologist, U.S. Forest Service
  Channel Stability & Fish Habitat (Nooksack, Skagit, Stillaguamish Rivers)

- Tracy Drury M.S., Civil Engineer, Geo Engineers
  Post-Construction Topographic Changes (North Fork Stillaguamish River)

- Roger Peters, PhD., Fisheries Biologist, U.S. Fish & Wildlife Service
  Using Fish to Monitor LWD

- George Pess M.S., Stream Ecologist, National Marine Fisheries Service
  Post-Construction Biological Monitoring (North Fork Stillaguamish River)

An open discussion followed the roundtable presentations regarding the necessary methodologies to monitor ELJ projects. Topics included what type of pre- and post-project design and geomorphic, engineering and biological information is necessary to adequately design, construct, and monitor an ELJ project. These methodologies were applied to the three SRFB-funded ELJ projects, and their monitoring plans, to ensure consistent monitoring. A specific recommendation for additional monitoring was provided for each project.

At the end of this report is a set of general ELJ conclusions and recommendations to the SRFB.

WORKSHOP OBJECTIVES RESULTS

- *Objective #1:*

Identify who is working on large river wood projects, exchange scientific information and identify data needs for these projects.

Groups working on large river ELJ projects

Lummi Tribe; Nooksack River.
Stillaguamish Tribe/Washington Trout; Stillaguamish River.
Thurston Conservation District; Deschutes River.
Lower Elwha Klallam Tribe; Elwha River.
Private Landowner/U.S. Forest Service; Cowlitz River.
U.S. Forest Service; Chewauck River.

Groups working on large wood placement & bank stabilization projects

U.S. Forest Service; Nooksack, Skagit, Stillaguamish Rivers, and tributaries.
U.S. Army Corp of Engineers; Green River.
Washington Department of Fish & Wildlife; Quilcene River.
Jamestown S'Klallam Tribe; Dungeness River.
Coastal Watershed Consulting; Bear and Palix Rivers

Exchange Scientific Information

As a result of the workshop, an ELJ/Large Wood Placement interest group e-mail list has been formed and will be updated frequently.

Data Needs

First, project objectives need to be clearly defined. This can help assist in defining direct or indirect biological and physical benefits. Once this is accomplished the data needs necessary for large river ELJ projects can be organized into two categories: pre and post-project. See the following table.

Project Objectives	Pre-Project		Post-Project	Information Gathering Techniques
Design & Geomorphic	Both historic and current data should be compiled at a reach and watershed scale for the following questions: • What is the relative sediment supply (increasing and/or decreasing)? • What are the hydrologic conditions (increasing and/or decreasing flood frequencies)? • What is the wood supply/delivery (increasing and/or decreasing)? These could be qualitative or quantitative statements and should include the status of riparian conditions. • What are the current wood characteristics (frequency, size, species, distribution & location)? • What are the human safety factors (quantitative or qualitative statements)? • Where is the channel migration zone and what is the magnitude and frequency of movement? • What are the change(s) in land-use? What is the location, quantity, and type of hydro-modification that occurs upstream, downstream, and within the project reach?		Data should be complied at a site and reach scale for the following questions: • Are all the original objectives being met? • How does the short & long term stability of the ELJ affect the site, and the upstream and downstream channel conditions? This may include positive and/or negative responses to the following: sediment storage and routing, flood storage and routing, connection & creation of side-channels, wood storage and routing.	The following is a list of pre-project and post-project techniques: • Aerial photos analysis of historic channel shifts and identify the channel migration zone; • Topographic maps to determine elevations at the site and reach scale (survey); • Wood tagging and tracking to determine the frequency and magnitude of potential wood movement and accumulations; • Discharge estimates from a nearby gage station (discharge); • Oblique photos to show pre and post project conditions.
Design & Geomorphic	Both historic and current data should be compiled at a site scale for the following questions:			

Project Objectives	Pre-Project		Post-Project	Information Gathering Techniques
Geomorphic	• Have longitudinal profiles been developed? • Have cross-sections been taken? • Have photo points been taken? • What are the riparian conditions (wood counts)?What are the human safety factors? • What are the flow characteristics?		• As built drawings.	
Engineering	The following questions should be answered when designing ELJs: • What type of natural jams are you trying to emulate? • What is the design and stability of your key members of the ELJ? • How do potential changes in channel conditions affect recreational use of and public infrastructure within the stream reach? • What is the risk of catastrophic failure of the ELJ?		Data should be compiled at a site and reach scale for the following questions: • Are all the original objectives being met? • What is the short & long term stability of the ELJ(s)? • How is recreational use and public infrastructure affected by the short & long term stability of the ELJ(s)?	• Hydraulic modeling (site & reach specific); • Cross-sections [pre-project, as-built, post-project, • Long-term post-project change in channel conditions (see topographic and geomorphic surveys above)].

Project Objectives	Pre-Project		Post-Project	Information Gathering Techniques
Biological	Both historic and current data should be compiled at a reach and watershed scale for the following questions: • Has the habitat been inventoried and mapped (reach only)? • What is the general fish use, by species and life stage(s)? Is this existing data or gathered data? Both historic and current data should be compiled at a site scale for the following questions: • Where do fish spawn and rear within project site? • What is the biological hypothesis? • How does project benefit fish survival?		Data should be compiled at a site and reach scale for the following questions: • Are all the original objectives being met? • How does the short & long term stability of the ELJ(s) affect fish usage, and aquatic (primary productivity) and riparian conditions? • How does the short & long-term stability of the ELJ(s) affect habitat conditions? • How does the short & long term stability of the ELJ(s) affect nutrient storage and routing?	• In-stream habitat surveys (maps referenced to benchmarks); • Juvenile and adult fish surveys (snorkel, observations – carcass counts, redd surveys, adult counts); • Benthic sampling; riparian habitat surveys (inventory changes and responses).

Objective #2:
Identify and develop consistent monitoring programs for one Early Action 1999 and two Early 2000 SRFB projects.

Each of the following SRFB-funded ELJ projects already identifies the majority of design and geomorphic, engineering and biological data gathering tasks outlined in the table above. Each project needs funding to do the additional type of monitoring recommended.

99-1313R, 99-1654R, 00-1073R; Lower Elwha Klallam Tribe (Elwha River)
Project Objectives:
1) Protect Hunt Road side channel.
2) Stabilize opening of side channel to allow 30-40% of river quantity.
3) Increase habitat complexity for adult & juvenile salmon.
4) Reduce streambank erosion.
5) Improve riparian vegetation.
6) Maintain natural channel processes.

Pre-Project (Design & Geomorphic, Engineering and Biological):
1) Channel migration analysis (site and reach)
2) Site scale topographic maps.
3) Quantitative habitat (stream) surveys (site and reach).

Post-Project (Design & Geomorphic, Engineering and Biological):
1) Juvenile and adult snorkel surveys.
2) Wood budget surveys.
3) Channel migration analysis.
4) Macro-invertebrate, primary productivity (food for fish).

Recommendations for Additional Monitoring:
1) (Monitoring entity) Riparian surveys.
2) Topographic surveys (bank erosion).
3) Discharge (or surrogate) flow rate measurement in Hunts road side-channel.
4) (Monitoring entity) Carcasses.

97-1299C, 99-1367R; Washington Trout (North Fork Stillaguamish River)
Project Objectives:
1) Increase quantity and quality of holding pool habitat.
2) Increase quantity and quality of off-channel habitat.
3) Redistribute holding adult fish from C-Post bridge (poaching hole).
4) Increase habitat complexity for adult & juvenile salmon.
5) Reduce bank erosion.
6) Improve riparian vegetation.

Pre-Project (Design & Geomorphic, Engineering and Biological):
1) Channel migration analysis (site and reach)
2) Site scale topographic maps.
3) Quantitative habitat (stream) surveys (site and reach).

Post-Project (Design & Geomorphic, Engineering and Biological):
1) Juvenile and adult snorkel surveys.
2) Habitat surveys.
3) Wood budget surveys.
4) Riparian and ELJ revegetation surveys.
5) Channel migration analysis.
6) Macro-invertebrate, primary productivity (food for fish).

99-1708R, 00-1136R; Lummi Indian Nation (South Fork Nooksack River)

Project Objectives:
1) Improve pool quality.
2) Improve bank stability.
3) Increase channel structure & complexity.
4) Reduce sediment delivery.

Pre-Project (Design & Geomorphic, Engineering and Biological):
1) See the following report:
   Abbe, Tim B. 1999. Engineered Log Jam Habitat Enhancement Report. Site Conditions, Geomorphic Analysis, Project Objectives and Design Proposal. South Fork Nooksack River, RM 19.7-21.0, Skagit County, Washington. Prepared for the Lummi Indian, Department of Natural Resources.

Post-Project (Design & Geomorphic, Engineering and Biological):
1) Snorkel surveys, spawner & juvenile surveys.
2) Cross-sections per U.S. Army Corp of Engineers and Timber Fish & Wildlife protocols.
3) Longitudinal profiles.
4) Pebble counts.
5) Wood tagging (following NF Stillaguamish project protocols)
6) Five-year duration.
7) Habitat (stream) surveys.

Recommendations for Additional Monitoring:
1) Oblique photo-monitoring (on-the-ground)
2) Aerial photos for channel response monitoring.
3) (Monitoring entity) macro-invertebrate primary productivity (food for fish), carcasses.
4) (Monitoring entity) riparian surveys?

00-1072;Thurston Conservation District (Deschutes River)

Project Objectives:
1) Increase habitat diversity.
2) Reduce streambank erosion.
3) Re-establish riparian vegetation.
4) Lower water temperature.

Pre-Project (Design & Geomorphic, Engineering and Biological):

See recommendation below.

Post-Project (Design & Geomorphic, Engineering and Biological):
1) Water quality – temperature, dissolved oxygen (DO), turbidity, nutrients.
2) Shift in channel morphology – How?
3) Reach and geo-reference (?) survey – TFW protocols?
4) Photo points.
5) Plant density and vigor.
6) Habitat surveys.

Recommendations for Additional Monitoring:
1) Design report for pre-project.
2) Define channel morphology and reach survey, and how monitored. This should include channel cross-sections and longitudinal profiles.
3) Pebble counts.
4) Monitoring duration needs to be long-term due to re-establishing riparian vegetation and water quality effects.
5) Monitoring plan should not change unless objectives change before monitoring plan is implemented.

Objective #3:
Identify next steps for filling data needs & for developing statewide monitoring program.

See conclusions & recommendations section at the end of report.

Objective #4:
Develop a report documenting workshop outcomes – techniques, fish benefits and monitoring programs – for SRFB & other funding agencies for future wood projects.

Reflected throughout report.

CONCLUSIONS & RECOMMENDATIONS TO THE SRFB

Conclusions:

1) Engineered log jams (ELJs) are experimental in-stream flow control structures based on the architecture of naturally occurring stable log jams in large river systems. ELJs are permanent structures that are designed to mimic natural log jams, contain key pieces of wood large enough to alter the course of the river channel, and capture additional wood. ELJs in large rivers need to be designed/monitored more comprehensively than what historically has been done for large woody debris (LWD) placement in smaller streams. ELJs should be approached in the same manner as a bridge or small dam structure. Few people currently have the appropriate background and experience to design and build ELJs as defined above.

2) Project proponents should identify a need(s) for ELJs that relate to specific objectives. The stated project objectives should be used to define the specific ELJ monitoring regime. The ELJ design needs to be site and objective specific.

3) There is a need for geomorphic, biological and engineering analysis for these projects. The reach-level assessment is crucial for developing effective projects, and the formal stability analysis adds an engineered dimension. Pre-project information and assessments are crucial for adequate ELJ project design. Stream reach and/or basin level data and analysis of certain elements are necessary. Public safety (risk to public infrastructure and recreation use impairment) needs to be considered and addressed during project planning and design.

   The Natural Resource Conservation Service (NRCS) guidance document, which is currently in development, will provide good direction on types and placement of structures.

4) ELJ project design and construction should be fully documented.

5) There are no short-term monitoring solutions to evaluate ELJ effectiveness and function. Existing monitoring funding is too short to meet the time frame required to evaluate the project.

6) Fish response to ELJ projects should be described in terms of biological significance rather than just statistical significance (Peters et al. 1998).

Recommendations:

1) Use the definition of an ELJ as stated in #1 of conclusions above.

2) Project proponents need to make sure objectives are clear. Proponents also need to clearly define the project-specific ELJ monitoring.

3) Pre-project information and assessments are crucial for adequate ELJ project design. Reach and/or basin level data and analysis of certain elements is necessary. ELJ design should follow the NRCS guidance document, once the document is finalized. ELJ design should be site and objective specific. ELJ project design and construction should be fully documented.

   It is important to note that since ELJs are an experimental technology, it should not be assumed the same design can be used everywhere. Two keys to the design process are (1) reach analysis & quantitative geomorphic assessment, and (2) design individually for the appropriate reach.

   The design process involves choosing what kind of natural jam type you want to emulate; analyzing the stability of the key members and their mechanics, and incorporating those into a design for overall structure and stability that can be integrated back into the local context. Watershed-scale information also needs to be used to help define how upstream inputs such as sediment, wood, and water will potentially affect ELJ stability. Two examples of the design process include the North Fork Stillaguamish and the South Fork Nooksack. ELJ construction and monitoring should also attempt to quantitatively answer the data needs outlined in objective #1, but they need to tailored to the specific objectives defined by the project proponent. Questions in objective #1 can help tailor future monitoring efforts.

4) The ELJ structure(s), the channel response to the structure(s), and the biological response to structure(s) should be monitored.

5) Monitoring funding should match the timeline to evaluate the project's objectives. A strategic long-term approach to monitoring is needed. There are no short-term monitoring solutions to evaluate ELJ effectiveness and function, because physical and biological response can take many years to occur in order to have significant measurable results.

   Workshop attendees recommend that monitoring needs to occur on a minimum time-scale of 10 years, and needs to be adequately funded on a level that allows it to proceed so it is not subject to changes in policy focus. This is consistent with the SRFB Landowner Agreement (LOA), which outlines monitoring and stewardship roles of the project sponsors and the landowners over a 10-year period. Attendees brought up the example of using the federal dam safety program as an analog. SRFB should require and fund monitoring the full term of agreement (5 years). The SRFB should also require annual data reporting and a final report at the end of the project agreement (5th year).

6) An independent group or organization needs to be formed to help define long-term monitoring strategies and techniques. We define long-term monitoring to mean a minimum of 10 years. We believe that a dedicated budget will be necessary for program success.

   This independent entity can help the project proponent design and implement monitoring of individual ELJ projects, and determine what larger-scale questions need to be answered which go beyond the individual project. For example, the project-scale cannot answer the question of what risks to the public do large-scale river projects pose, or what are the regional fish benefits to such projects. Such an organization can act as a clearinghouse for data developed on the design and effectiveness of ELJs.

APPENDIX 1:
Engineered Log Jam Workshop Participants
August 24, 2000

Allen Lebovitz, Coastal Watersheds Consulting
Bob Newman, Washington Department of Ecology
Brad Johnson, Asotin County Conservation District
Bruce Heiner, Washington Department of Fish & Wildlife
Carolyn Adams, Natural Resource Conservation Service – Watershed Science Institute
Craig Olds, Washington Department of Fish & Wildlife
Dave Lucas, Snohomish County Surface Water Management
Dick Sass, Snohomish County Public Works
Fred Goetz, U.S. Army Corp of Engineers
Fred Seavey, U.S. Fish & Wildlife Service
George Pess, National Marine Fisheries Service
Gregg Dunphy, Lummi Natural Resources
Gwill Ging, U.S. Fish & Wildlife Service
Jake Jacobsen, Snohomish County Surface Water Management
Jeff Davis, Kitsap County
Jeff Rudolph, Pierce County Department of Public Works
John Cambalik, North Olympic Peninsula Lead Entity Group
John Engel, Snohomish County Surface Water Management
John Gretturburger, U.S. Fish & Wildlife Service
John Mcyer, Olympic National Park
Justin Maschhoff, ELWd Systems
Kay Caromile, Washington Department of Fish & Wildlife
Keith Binkley, Inter-Fluve
Kevin Bauersfeld, Washington Department of Fish & Wildlife
Marc Duboiski, Salmon Recovery Funding Board
Mike Maudlin, Lummi Natural Resources
Mike McHenry, Lower Elwha Klallam Tribe
Mike McHugh, Tulalip Tribes
Mike Ramsey, Salmon Recovery Funding Board
Milt Holter, Lummi Natural Resources
Paul Nelson, Kitsap County
Rod Thompson, Washington Department of Ecology
Roger Nichols, U.S. Forest Service
Roger Peters, U.S Fish & Wildlife Service
Scott Craig, U.S. Fish & Wildlife Service
Stephen Metzler, Tulalip Natural Resources
Ted Parker, Snohomish County
Tracy Drury, Geo Engineers

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