Green River Fish Habitat Restoration Project – Zone 1
King County, Washington

• Presenters

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Project Owner: U.S. Army Corps of Engineers
Seattle District

Local Sponsor: Tacoma Public Utilities

Project Design Team: TETRA TECH, INC.
GeoEngineers, Inc.
Pacific Geomatic Services, Inc.
Green River Fish Habitat Restoration Project – Zone 1
King County, Washington

- Introduction / Overview
- Site Assessment
- Sediment Design Analysis Concepts
- Construction
- Post Project Monitoring

Location Map
Problem Statement: Watershed Degradation

- Green River Watershed Degradation
- Channel and Floodplain Response

![Channel incision / bed armoring](image1.jpg)

![Encroachment & Loss of Floodplain Connectivity](image2.jpg)

Project Overview and Timeline

- Howard Hanson Dam
  - Additional Water Storage Project
- Endangered Species Act
- Biological Opinion
- Mitigation Implementation

- Fish Passage
- D/S Passage of LWD
- D/S Gravel Augmentation
- Sediment Management Plan
- Refine Water Operations Management
- Additional Restoration Measures
  - ELJs
  - Sidechannel/Slough/Floodplain
  - Culvert Replacements
- Monitoring

![Howard Hanson Dam](image3.jpg)
Site Investigation

- Assess Site Characteristics
- Develop Site Specific Design Criteria and Restoration Goals
- Identify Restoration Project Locations
  - Gravel Nourishment Berms
  - Engineered Log Jams
  - Large Wood Debris (Loose Wood)

Site Assessment

- Geology
- Anthropogenic Influences
- Channel-Floodplain Morphology
- Sediment Sources and Transport
- Physical Habitat
Design Concepts and Restoration Goals

- Integration of Gravel Nourishment, ELJ and LWD
- Gravel
- ELJs
- Large Woody Debris
- Identified two potential restoration zones

Restoration Zone 1
Restoration Feature Locations

- Gravel in Sediment Loading Zones
- ELJs in Sediment Deposition Zones
Sediment Transport Analysis & Design
Gravel Nourishment

- Hydrology and Hydraulics
- Gravel Nourishment Sediment Transport Analysis

Sediment Transport Design & Analysis - ELJs

- Hydrology and Hydraulics
- ELJ Scour and Ballast Material Transport Analysis
Gravel Nourishment Construction

Gravel Nourishment Construction - 2003
Gravel Nourishment Construction - 2003

[Image of gravel nourishment construction]

Gravel Nourishment Construction - 2003

[Image of gravel nourishment construction]
Gravel Nourishment, LWD Placement - 2004

Gravel Nourishment, LWD Placement - 2004
Engineered Log Jam Construction - 2003

Engineered Log Jam Construction - 2003
Engineered Log Jam Construction - 2004

Design and Construction Lessons Learned

- Construction Cost Information
- In Water Construction BMPs Needed vs. Upland BMPs
- Zero-rise Flood Regulation Conflicts w/ Several Restoration Objectives
- Assess Risk as Part of Design
- Channel Disturbance of Armor Layer Excavation
- Numerical Modeling Recommendations
  - HEC-6 Gravel
  - 2D FEM for ELJ Design
Monitoring study overview

• Ongoing through 2013

• Physical
  – High Flow
  – Low Flow

• Biological
  – Redd maps, ELJ usage
  – Compare with control sites

• Adaptive Management
Green River Average Daily Discharge near Palmer WY 2004, WY 1999

Effect of First High Flow on Gravel Berms

Sept. 2003 – As Built Aerial
1 Nov. 2003 – Post Flood Aerial
Lower Gravel Loading Zone
Before Construction

After Construction
After year 1

After Construction
After year 1

ELJ 2 after construction
After construction

First year of fish use, November 2003
ELJ 2 High Flow Photos

First High Flow
22-Oct 2003, 2200 cfs

Nov. 18, 2003
4,300 cfs

Jan. 29, 2004
6,600 cfs
ELJ 1 High Flow Photos

Nov. 18, 2003 - 4300 cfs

Jan. 29, 2004 – 6,600 cfs
ELJ 1 Scour Hole Development

After Construction

After Year 1

ELJ1 Time Sequence – Before/During/After
Gravel Patch Mapping

- Gravel patch mapping from RM 59-60 in August 2004 by USACE
- Hand drawn on aerial photos, digitized in GIS
Nourishment Gravel Sorting

Downstream of ELJs  Upstream of ELJs
Gravel deposit upstream of ELJs

Grain size plots
Before and After near ELJs

Before D50 = 4.5”  After d50 = 1.5”
Chinook Redd Surveys

- Project Reach RM 59.2-60
- Control Reach RM 57.6-59.2
- Mapped by wading and GPS

Chinook redd maps October 2003-04 by R2 Inc.

Redd Count Summary

- Increased number of reds in restoration reach

Yellow – 2003 spawning redds
Red – 2004 spawning redds
Year 1 - Major Findings

- Gravel erosion rates
- Transport, storage reaches
- Channel disturbance
- Flood elevations
- Grain size reduction
- Spawning area
### Year 1 - Major Findings

- Overtopping
- Scour hole development
- ELJs are creating geomorphic change:
  - Increased split flow and local erosion
  - Gravel storage
  - Gravel sorting
  - Supplying gravel to side channel
- ELJs are providing habitat (cover, juvenile food?)

### Year 1 - Major Findings

- Spawning area increasing
- Increase in side channel use
- Redd counts increasing in treated reach more than control reach
Future Studies?

- Sediment routing model
- Redd Stability and Scour
- Gravel and LWD tracking

Thank you. Questions?

For more info

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