Restoration Goal
Technical Feedback
San Joaquin River Restoration Program
November 17, 2009
CSU Stanislaus, Turlock, CA

Agenda

• Introductions
• NMFS Public draft Recovery Plan for Central Valley Salmon and Steelhead
• Background
• Models and Analytic Tools
  – Hydrology
  – Temperature
  – Flood Hydraulics
  – Sediment
  – Vegetation
  – Groundwater
  – 2D Hydraulics
  – Fisheries
• Comments and Questions
• Next Meeting
Settlement Background

- **1988** – Lawsuit challenging renewal of the long-term Friant Division contracts
- **2004** – Federal Judge rules Reclamation violated Section 5937 of the Fish and Game Code
- **2005** – Settlement negotiations reinitiated to avoid remedy phase
- **2006** – Settlement Agreement signed and implementation begins
- **2009** – Federal legislation enacted

Settlement Goals

- **Restoration Goal**
  - To restore and maintain fish populations in “good condition” in the main stem of the San Joaquin River below Friant Dam to the confluence of the Merced River, including naturally reproducing and self-sustaining populations of salmon and other fish.

- **Water Management Goal**
  - To reduce or avoid adverse water supply impacts to all of the Friant Division long-term contractors that may result from the Interim Flows and Restoration Flows provided for in the Settlement.
• 150 miles of River
• Historically Different Reaches
• Water Supply Infrastructure
• Flood Control Bypasses
• Urban Areas
• Historically Disconnected Reaches

Restoration Releases at Friant Dam

- Wet (over 2500 TAF Inflow, 673.5 TAF Release)
- Normal-Wet (1450-2500 TAF Inflow, 400.3-547.4 TAF Release)
- Normal-Dry (930-1450 TAF Inflow, 330.3-400.3 TAF Release)
- Dry (670-930 TAF Inflow, 272.3-330.3 TAF Release)
- Critical-High (400-670 TAF Inflow, 187.8 TAF Release)
- Critical-Low (0-400 TAF Inflow, 116.8 TAF Release)
Context for Today

- SJRRP Components
  - WY2010 Interim Flows EA/IS
  - Operations
  - Program EIS/EIR
  - Fish Management Plan
  - Restoration Flow Guidelines
  - Site-Specific Projects
  - Water Management Actions

- Today
  - Modeling and Analysis Tools for the SJRRP
Introduction to Modeling Subgroup

- Model Selection
- Common Sources
- Information Exchange
- Consistent Assumptions

Water Supply: CalSim
Water Supply Model Overview

- Water Supply for the California Central Valley (CVP and SWP) under alternative:
  - Land Uses (e.g. 2030 Level of Development)
  - Infrastructure Developments (e.g. Temperance Flats)
  - New Water Supply Policies (e.g. SJRRP)

- Mass-Balance Accounting
  - Monthly Volumes
  - Historic Hydrologic Conditions (Oct 1921 – Sep 2003)
  - Simplifications of Water Quality and Delta Conditions
**Water Supply Model: Starting Point for SJRRP**

**Water Supply Model: Infrastructure Updates to CalSim for SJRRP**

**Infrastructure**

- Inclusion of Mendota Pool Bypass
- Inclusion of Friant-Kern Canal reaches
- Inclusion of groundwater facilities to receive Paragraph 16(b) water
- Inclusion of Pumping Station on Lower San Joaquin River
Water Supply Model: Operational Updates to CalSim for SJRRP

Operational Rules
- Operation of SJRRP releases by year type
- Operation of SJRRP recapture:
  - Along the San Joaquin River
  - In the Delta
- Operation of Paragraph 16(b) Water

Use of Water Supply Model Results
- Diversions at Friant Dam
  - Basis for Deliveries to Friant Long-Term Contractors (Class 1 & 2) and Others
  - Basis for evaluating Paragraph 16(a) & (b) water
  - Basis for Groundwater Pumping in Friant and Other Districts
- Releases at Friant Dam
  - Frame Overall Operations within Restoration Area
  - Used in assessing Delta Pumping Conditions
Alternatives Formulation: CalSim Evaluations

Purpose of CalSim runs

• Understand range of operations for Friant Dam
• Understand implications to CVP and SWP supplies
• Understand range of recapture for potential recirculation to Friant

Evaluations Exist for:

1. Baseline
2. 1 SJRRP Alternative: *Friant Dam Operations are identical for Alternatives A, B & C*
3. Supplemental analyses to bracket range of operations

CalSim Baseline & SJRRP Alternative
CalSim Supplemental Analyses

1. “Stair-step” Release Requirement
2. SJRRP without Paragraph 16 water
3. Flexible Flow shifts (forward & backward)
4. Full 10% Buffer Flows
5. Capacity limitations in Restoration Area, no Mendota Bypass
6. Restored Friant-Kern Canal capacity
7. Wanger Bookend on OMR Requirement in Delta (-750 cfs)

Hydrology and Temperature
Monthly to Daily Conversion

Purpose: Develop a set of daily Millerton Reservoir operations suitable for use in San Joaquin River routing and temperature modeling.

Uses the Daily Millerton Reservoir Model

Developed for USJRBSI

Monthly boundary conditions from CalSim interpolated to convert to daily

Perform a simplified daily routing

Water Operations – Daily Millerton Reservoir Model

How it works
- Start with initial storage plus SJR Inflow
- Madera and FKC diversion (CalSim)
- SJR Minimum Release (CalSim)
- SJR Snowmelt Pre-release (CalSim)
- Fill Conservation Storage
- “Flood” release to Madera, FKC up to capacity limits
- “Flood” release to SJR up to 8,000 CFS channel capacity
- Fill Flood Control Storage
- “Flood” spill to SJR
Water Operations – Daily Millerton Reservoir Model Results

Final results are a set of daily Millerton Reservoir operations

San Joaquin River Release Routing Example

Daily – CalSim Millerton Reservoir Release Comparison

Annual operations match well

Magnitude different from monthly to daily boundary condition process. Higher peaks in daily release is expected.
Daily – Historical Millerton Reservoir Release Comparison

Not expected to match exactly.

Timing of peaks matches very well.

Temperature – Millerton Reservoir

Purpose: Simulate San Joaquin River Release Temperature

- 2-D Reservoir Temperature Model based on CE-QUAL-W2
- Developed in support of USJRBSI
- Hourly time step from 1980 through 2003
Temperature – Millerton Reservoir

- How it works
  - Computes temperature profile at dam
  - Use profile to compute release temperatures

Temperature – Millerton Reservoir

- Release Temperatures
  - High, short spikes in maximum temperatures due to spills
  - Seasonal increase in Oct-Dec due to reduction in Cold Water Pool
Temperature – San Joaquin River
Millerton Reservoir to Merced River

• Purpose – Route daily flows and simulate San Joaquin River water temperatures
  • 1-D River Temperature Model based on HEC5Q
  • Hourly time step
  • 1980 through 2003

How it works
HEC-5 routes flow through the system
• Flow splits at
  – Chowchilla Bypass
  – Mendota Bypass (With Project Only)
  – Sand Slough
  – Mariposa Bypass
• HEC-5Q simulates temperatures of the flows
Several sets of sensitivity studies were performed to frame the system temperature response.

- Millerton release temperature w/wo restoration
- SJR temperatures at different flow rates
- Potential effects of increased riparian vegetation and channel modification on SJR temperatures

* No Mendota Bypass in sensitivity modeling
**Temperature – Sensitivity Studies**

*Flow Rate Impact on Temperature*

Median of simulated temperatures in San Joaquin River (August)

**Temperature – Riparian and Channel Modification Impacts**

*Increased Riparian Impacts*

Reduces peak summer temperatures 3 -5 degrees but still at or over 80 F

Maintains biologically better temperatures 2-5 weeks later in the year.

Plots at Gravelly Ford, approximately 40 miles downstream of Millerton Lake
Temperature – Major Conclusions

• Ambient conditions are a very important factor in water temperatures. (It gets hot there!)

• Flow is more effective in maintaining cooler water temperatures than release temperature

• Equilibrium temperature is relatively independent from the flow.

• Equilibrium temperature is usually attained in Reach 5 in winter/spring, reach 2B in summer and Reach 2A in the fall.

• Riparian shading and channel modifications have limited potential for significant cooling in the Restoration Area.

Unsteady Flow (UNET) Modeling for Flood Damage Analysis

California Department of Water Resources and Tetra Tech, Inc.
General Description of UNET Model

- Model Capabilities:
  - Routes flood hydrographs through network of channels and storage areas.
  - Flow diversions.
  - Hydraulic structures (bridges, weirs, etc.).
  - Levee overtopping and failures.
- Original UNET model developed for Sacramento and San Joaquin River Basins Comprehensive Study (Comp Study, USACE, 2001b).
- Comp Study Model geometry based on 1998 (in-channel) and 2000 (overbank) topography.

Model Input

- Model geometry and network connectivity.
- Upstream and tributary inflow hydrographs for various storm events (6) and storm centerings (5).
- Downstream and internal boundary conditions.
- Hydraulic roughness (Manning’s n-value).
- Diversion structure operating criteria.
- Levee information (alignment, top of levee elevation, likely failure point, breach elevation).
Levees: Likely Failure Points (LFPs)

<table>
<thead>
<tr>
<th>Subreach</th>
<th>Number of LFPs</th>
<th>U/S LFP RM</th>
<th>D/S LFP RM</th>
<th>Average LFPs Spacing (miles)</th>
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<tbody>
<tr>
<td>Subreach 2A</td>
<td>14</td>
<td>224.0</td>
<td>216.9</td>
<td>0.5</td>
</tr>
<tr>
<td>Subreach 2B</td>
<td>0</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
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<td>Subreach 3</td>
<td>23</td>
<td>202.0</td>
<td>182.4</td>
<td>0.9</td>
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<tr>
<td>Subreach 4A</td>
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<td>182.3</td>
<td>169.0</td>
<td>0.7</td>
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<tr>
<td>Subreach 4B1</td>
<td>2</td>
<td>149.4</td>
<td>149.1</td>
<td>0.3</td>
</tr>
<tr>
<td>Subreach 4B2</td>
<td>9</td>
<td>147.1</td>
<td>136.4</td>
<td>1.2</td>
</tr>
</tbody>
</table>

• Revised operating criteria at Chowchilla Bifurcation Structure and San Joaquin River Control Structure.

• Phase I Settlement Agreement.
  – Setback levees in Reach 2B (above Bypass Channel).
  – 475 cfs main-channel capacity in Reach 4B.
  – No levee strengthening required.

• Phase II Settlement Agreement.
  – Same as Phase I plus setback levees in Reach 4B.
  – Strengthened levees at two locations in Reach 4B.
Operating Rules: Bifurcation Structure

*Rules modified when flow in Subreach 3 would exceed 4,500 cfs capacity

Operating Rules: San Joaquin River Control Structure at Sand Slough

Adaptive Practice

(Phase I)

Adaptive Practice

(Phase II)
## Model Scenarios

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Geometry</th>
<th>Operating Rules</th>
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<tbody>
<tr>
<td>1</td>
<td>Without-Project Conditions</td>
<td>Flood Control Manual</td>
</tr>
<tr>
<td>2</td>
<td>Without-Project Conditions</td>
<td>Historical Practice</td>
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<td>3</td>
<td>Phase I Settlement Agreement</td>
<td>Flood Control Manual</td>
</tr>
<tr>
<td>4</td>
<td>Phase I Settlement Agreement</td>
<td>Adaptive Practice (Phase I)</td>
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<td>5</td>
<td>Phase II Settlement Agreement</td>
<td>Flood Control Manual</td>
</tr>
<tr>
<td>6</td>
<td>Phase II Settlement Agreement</td>
<td>Adaptive Practice (Phase II)</td>
</tr>
</tbody>
</table>

## Model Runs

- 6 scenarios, 6 storm events, 5 storm centerings = 180 finite channel runs.
- Additional 180 infinite channel runs.
- Approximately 20-day long simulations.
- 15-minute computer run time for each simulation.
Effects of project in Reach 2B: Historical/Adaptive Practice Operating Rules (100-year Event, Friant Storm Centering)

Effects of project in Reach 4B1: Flood Control Manual Operating Rules (100-year Event, Friant Storm Centering)
Effects of project in Reach 4B1: Historical/Adaptive Practice Operating Rules (100-year Event, Friant Storm Centering)

Model Results

Effects of project in Reach 4B2: Historical/Adaptive Practice Operating Rules (100-year Event, Friant Storm Centering)
Stage-Frequency Curves for FDA

Model results used to develop maximum stage-frequency curves for input to Flood Damage Analysis.

Sediment Transport Modeling
Sediment Monitoring

- Bed Material Size
  - Pebble Counts
  - Volumetric Samples
  - Photographic techniques

Photographic Techniques
Sediment Monitoring

• Suspended and Bedload Transport
  – 5 locations for main stem sampling from bridge, cableway, boat or wading
  • HW 41, Skaggs Bridge, Gravelly Ford, below Chowchilla, below Mendota Dam

Sediment Transport Modeling

• Model Objectives
  – Assess impact of Project alternatives on the sediment transport in San Joaquin River from Friant Dam to Merced River
    • Changes to river bed material
    • Changes to bed elevation
    • Changes to river planform
    • Assess gravel mobilization
      • Input to vegetation/fish habitat analysis
  – Support channel and floodplain design
Sediment Transport Modeling

• Methods
  – Geomorphic studies
    • Analysis of aerial photographs
    • Analysis of historical accounts and data
  – Mobilization studies in Reach 1
    • Compute flows at which sediment is mobilized in Reach 1
    • Use 1D and 2D hydraulic models (HEC-RAS and SRH-2D)
  – One-Dimensional Sediment transport modeling
    • Compute changes to bed elevation and bed material throughout project reach
    • Use SRH-1D

Application to San Joaquin

• Data Used
  – Aerial photographs, site visits
  – Daily average flow predictions – generated using CALSIM II and a daily submodel
  – Cross section geometry – 1998 survey of the COE. HEC-RAS model from Mussetter Engineering
  – Bed material – bulk surface and subsurface samples collected in all reaches where access was possible
  – Sediment loads – none available

Modeling is not done independent of other analyses
Geomorphology:
Changes since Friant Dam in Reach 1

• Analyzed 1938 and 2007 photos
• Width reduction and channel narrowing due to reduced flows, channel incision, and vegetation encroachment
• Reduction in channel complexity – fewer side channels, less variability

Hydrology: Changes Due to SJRRP

• Initial flow estimate show that, on average, the frequency of flows greater than 8,000 cfs are decreased because Friant spills less often under the SJRRP than under Baseline Conditions
Incipient Motion and Mobilization

Exceedance of Shield's number of 0.045 in Project Reaches 1a and 1b

Incipient Motion and Mobilization of Riffles

Reach 1a

Relative number of sites mobilized

Reference Shear

- Historical
- Baseline
- Alt A
2D Incipient Motion Analysis

- Work by Tt-MEI
- Grain Shear Stress
  Computed from SRH-2D Results
- Riffle gradations from field sampling

Riffle 43 4500 cfs

\[ D_{50} = 39.4 \text{ mm} \]
\[ D_{84} = 100.0 \text{ mm} \]
\% Sand = 3.8%

Sediment Transport Modeling

- SRH-1D: numerical model to predict erosion and deposition

User's Manual for SRH-1D V2.2
Sedimentation and River Hydraulics - One-Dimensional, Version 2.2
Erosion and Deposition: Friant to Mendota

Erosion and Deposition: Mendota to Merced
Application to Reach 4B

Current Erosion in lower Eastside Bypass and Reach 5

Degradation in San Joaquin – Reach 5

Degradation in Eastside Bypass
Summary

• Reach 1
  – project is likely to reduce the period of time the flows are above 2000 cfs, and therefore reduce the sediment transport in Reach 1
  – bed will remain stable with or without project
• Reach 2
  – slightly more erosion is predicted in Reach 2a with project
  – deposition possible in reach 2b with or without project, potentially slightly more under with project
• Reach 3 and 4a
  – relatively stable with some increase erosion possible under project conditions
• Reach 4b1
  – some slight deposition in upstream portion if max flow is 475 cfs
  – erosion is likely throughout reach if max flow is 4500 cfs
• Reach 4b2 and 5
  – continue to degrade with or without project
• Eastside bypass
  – Overall, will to continue to degrade with or without project
San Joaquin River Vegetation Studies

- Predict Hydraulic Capacity
- Regenerate native cottonwood-willow communities
- Restrain the spread of invasive riparian vegetation
- Vegetation to aid fisheries

To predict changes in vegetation for estimating future hydraulic capacity with HECRAS,

**MEI-Tt and EDAW based future vegetation conditions on modeled 350 cfs and 1500 cfs inundation maps.**
Vegetation zones designated by Maximum and Mature density

Roughness applied across vegetation zones

Manning's n-value is reduced from 0.2 to 0.1 when representing mature vegetation density.

Slide provided by MEI/Tt
SRH-1D is the base model for SRH-1DV

- **Hydraulics:**
  Step-backwater model with steady or unsteady flow capability, computes water surface elevation and hydraulic parameters at specified time steps
- **Sediment transport:** is computed at the specified time step for 10 grain sizes at each cross-section providing erosion and deposition, and substrate predictions

Since 1999, the Sedimentation and River Hydraulics Group (SRHG) at Reclamation’s Technical Service Center has used 1D models to study linkages between management actions, flow regime, sediment transport, riparian vegetation and species habitat in river environments.

**Platte River**- SedVeg-Gen3 for avian habitat, forage fish habitat, native vegetation and river morphology studies (fully braided river)

**Sacramento River**- SRH-1DV for native vegetation studies

**San Joaquin River**- SRH-1DV for native vegetation, invasive vegetation and hydraulic capacity studies.

Dr. Blair Greimann is the author of SRH-1DV vegetation code with Dr. Victor Huang also supporting code development.
Physical Processes
In addition to hydraulic and sediment transport computations, estimates groundwater elevation based on river water surface elevation, and specified soil permeability.

Ecological Processes
Germination, growth and mortality of native vegetation
Germination, growth and mortality of invasive vegetation

Vegetation Types
Selected as: species of interest, representative of a community, or geomorphically significant.

-Natives:
• Fremont cottonwood
• Gooding's black willow
• Narrow-leaf willow

-Invasives:
• Red sesbania
• Giant reed (Arundo)

-For computations:
• dry land grass
• no-grow areas
1D models represent ground surface with cross sections and flow in one direction—downstream.

San Joaquin River studies uses 300 cross sections with approximately 80 points per cross section.

Every point can potentially support all six plant types or a no-grow designation.

In addition to flow and sediment transport computations, SRH-1DV can track: age, root growth, stem growth, canopy growth, growth seasons, germination periods, seed viability, distance to groundwater, capillary fringe, and mortality (removal) due to scour, desiccation, inundation, competition, shading, and senescence.

for:
  each plant type,
  at every point,
  at every cross section,
  on every flow day,
  in modeled reach for the period of study.
Systemwide General Results
Relative comparison of alternatives
Total Area of Vegetation and Mortalities

Native Baseline | Native Alternative A | Invasives Baseline | Invasives Alternative A

Area (sft)

Once established, invasive vegetation persists as a thin ribbon of coverage along the river bank
Systemwide Reach Results - Relative Comparison of Alternatives

Average Native Vegetation Width for Baseline and Alternative A flow regimes.

- Confirmed relation between Mendota Pool water surface, groundwater elevation, root depth, and persistent vegetation in Reach 2B
- Detected sensitive threshold in Reach 4A between vegetation establishment in overbank areas, Program flows and typical root growth depths.
Systemwide Reach Results – Native Vegetation Mortality

Reach Average Plant Productivity Width (Plant Productivity Area/Reach Length, ft)

Series of sensitivity studies- examples: root growth rates, groundwater conductivity, historical flows
General analysis of Levee Setbacks in Reach 2B

Results to date available in PEIS/R

- Appendix N- Summary of Geomorphology, Sediment Transport and Vegetation
- Appendix N, Attachment 6- SRH-IDV vegetation modeling
Future Directions - Analysis

- Aid Design of Reach 4B1
- Automated predictions of channel resistance for computations of future hydraulic capacity
- Continue alternatives analysis for:
  - expansion of native vegetation
  - restraint of invasive vegetation

Potential Applications:
- test vegetation removal strategies for conveyance and control of invasive vegetation
- provide support to fisheries habitat studies

Associated Model Development

Model verification
- Spread of invasives using 2000 mapping, 2008 invasive mapping, 2010 spring flows field review
- Elevation establishment and mortality (dessication, scour, inundation) using vegetation monitoring cross sections, SAIC reports (2002, 2003) and 2010 field reviews

Expand model capabilities
- link vegetation growth or removal to channel resistance (hydraulic capacity)
- add large-scale vegetation density capabilities
- add function relating Fremont cottonwood and Gooding’s black willow seed release to temperature (Stillwater Science, 2006)
Groundwater

Hydrograph

Reach 4A; 1-2 miles from SJ River; alfalfa
The hydrographs & water-table maps are being used for:

- Development of monitoring thresholds
- Identification of areas likely susceptible to seepage impacts
- Analysis of water-table response to local precipitation
- Model calibration
Groundwater

Texture of aquifer sediments is important:

• Shallow silt & clay = drainage problem
• More sand = more connected to river and to local pumping
• Texture distribution greatly influences groundwater flow

→ The more we know about texture, the better

We know a little bit about texture now, but need better resolution.
Incorporation of more (and better) texture data:
- Improved texture distribution
- Improved simulation models
- Improved prediction of impacts

USGS Central Valley Hydrologic Model
- Published, public domain
- Water budget built in
- Simulates
  - Surface water
  - Agriculture
  - Subsidence
  - Etc.
Groundwater

USGS Central Valley model, spatially refined, will be used to:

• Help guide groundwater monitoring
• Predict impacts under various conditions
• Test the effectiveness of potential actions for avoiding impacts
• Quantify seepage losses and distribution

2D Hydraulics
### 2D Hydraulics

**Purpose**

- Provides input for habitat evaluation
- Provides input for analysis of potential morphology responses

**Why 2D?**

- Lateral and longitudinal flow patterns
- Helps in the analysis of floodplain processes
- More dependable local velocities and shear stresses for designs

**Model Objectives**

- Provide high-resolution hydraulic information to help assess aquatic and riparian habitat conditions
- Increase understanding of the levee capacities and potential improvements to design
2D Hydraulics

• **Reclamation’s SRH-2D model (Lai, 2006)**
  - Two-dimensional, depth-averaged model that simulates hydraulics

• **Model Progress**
  - Reach 1A & 2B: preliminary model developed and calibrated
  - Reach 1B, 2A, & 4B: mesh developed; models require calibration

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**Input:**

- Topography & bathymetry obtained from hydrographic and photogrammetric surveys
- Channel roughness polygons – (7 Zones)
- Development of a computational mesh
- Flow boundary conditions – Steady State
2D Hydraulics

- **Surface Development**
  - Hydrographic and photogrammetric surveys
  - Final models will incorporate new LiDAR

Example from Reach 2B

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**Computational Mesh (1A)**

- Structured main channel mesh
  - 10-20 ft laterally
  - 20-50 ft longitudinally
- Unstructured floodplain
- Control lines along major breaks:
  - Overbank points;
  - Drop structures;
  - Side channel entrances;
2D Hydraulics

Roughness Zones

- Light blue = main channel
- light green = light vegetation
- dark green = heavy vegetation
- gray = levee.

Sample Mesh

(2B)

25–30 ft laterally
40–45 ft longitudinally
2D Hydraulics

- Model Output:
  - Water Surface Elevation
  - Water Depth
  - Velocity (Vector & Magnitude)
  - Froude Number
  - Bed Shear – For sediment incipient motion analysis

Sample Results
IA-01

Approximately 1-mile
Sample Results
Depth (m)

Sample Results
Velocity

2D Hydraulics

2D Hydraulics

Example Habitat

Example Habitat Distribution using Froude Number Criteria:

- Pools: \( 0.0 < Fr < 0.09 \)
- Glides: \( 0.09 < Fr < 0.42 \)
- Riffles: \( Fr > 0.42 \)

Based on (Hilldale & Mooney, 2007. Identifying Stream Habitat Features With a Two-Dimensional Hydraulic Model, USBR, Tech Series No. TS-YSS-12) where they found good correspondence between the Froude No. and the different habitat on the Yakima River in Washington.
Lateral Variability Across Channel

Example Results Reach 2B

- Depth and Velocity Distribution Plots
  - Quantify total areas within specified ranges
  - Useful for habitat suitability analyses

Velocity Distribution at a Flow of 1357 cfs

Depth Distribution at a Flow of 1357 cfs
2D Hydraulics

Additional 2D Applications

- Vegetation: input for simulating establishment and mortality of riparian species
- Provides input for analysis of sediment dynamics; bar formation and riffle erosion
- Roughness: variability in lateral roughness based on vegetation and sediment dynamics
- Levee Design: sensitivity studies for impacts of changing height or location, or both

Fisheries

Using the Ecosystem Diagnosis & Treatment Model to help guide fish restoration actions

Shannon Brewer, FMWG
Fisheries – Unique Challenges

Fisheries – Adaptive Management

Diagram:
- Define Problem
- Review Process
- Assess Evaluate Adopt
- Develop Conceptual Models
- Develop Quantitative Models
- Develop & Review Potential Actions
- Monitor Evaluate
- Monitor
- Targeted Study
- Small-Scale Implementation
- Full Implementation
- Continue
- Monitor & Evaluate
- Continue
Fisheries – EDT & Adaptive Management

Create Vision

FMWG

Define the Ecosystem

Monitor

Diagnose Limiting Factors

Implement

EDT analysis

Management Actions

Analyse Treatments

Populations Models

HEC-**

Raw Data

IBM

Statistical Analyses

HSI

EDT Framework

Operational

Information in EDT
EDT overview

• Rule-based model
• multiple-stage Beverton-Holt production model
• First, life stage performance benchmarks are defined (and adjusted for existing conditions)
• A rules set is created - describes the habitat needs of the species of interest (declining from benchmark performance)
• Life-history trajectories - how environmental conditions are experienced by the fish
• Performance is compared under “template” and “patient” conditions and is the basis of a “diagnosis” of factors limiting the population

EDT overview

• Provides a process for moving forward with restoration actions, even when faced with uncertainty
• Analytical model- links actions to desired outcomes

“Template”

Provides a basis for conclusions about the limitations of the system (or a particular action)
EDT - geometry

Focal species life-history experience
EDT Diagnostic Landscape

Relative Survival Experienced by Yearling Coho in Johnson Creek

Current vs. Template

How will FMWG use EDT

Assist with the assessment of restoration alternatives

Identify key uncertainties, data needs, and testable hypotheses

Evaluate & refine our conceptual model
Geographic area report – one strategy for prioritization

San Joaquin Spring Chinook
Protection and Restoration Strategic Priority Summary

<table>
<thead>
<tr>
<th>Geographic area priority</th>
<th>Attribute class priority for restoration</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Channel Mobility</td>
</tr>
<tr>
<td>Upper Reach</td>
<td>O</td>
</tr>
<tr>
<td>Lower Reach</td>
<td>O</td>
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<tr>
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<td>O</td>
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<tr>
<td>Lower Reach</td>
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Key to strategic priority (corresponding Benefit Category letter also shown):
- A: High
- B: Medium
- C: Low
- D: E: Indirect or General

Note: "Channel stability" applies to freshwater areas only.

EDT summary
Restoration possibilities

Possible restoration alternative

Next steps

- Complete baseline model (current versus template)
- Identify list of alternatives and data necessary to evaluate those alternatives
- Implement
- Monitor

Adapt Plans, Goals, & Objectives

Revisit EDT
Possible evaluations using EDT

• Spatial extent of floodplain (2B, 4B, 5)

• 4B flows (how much Q in bypass versus channel)

• Compare to our conceptual model - Is one factor really more important than another?

Next Meeting

• January

• Potential Future Meeting Topics
  – Program EIS/R