Sediment Analysis for Restoration Projects

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Sediment Analysis for Restoration Projects

1. An Eco-Geomorph Story.
2. Examples of Restoration Study Sediment Modeling

Reservoirs:
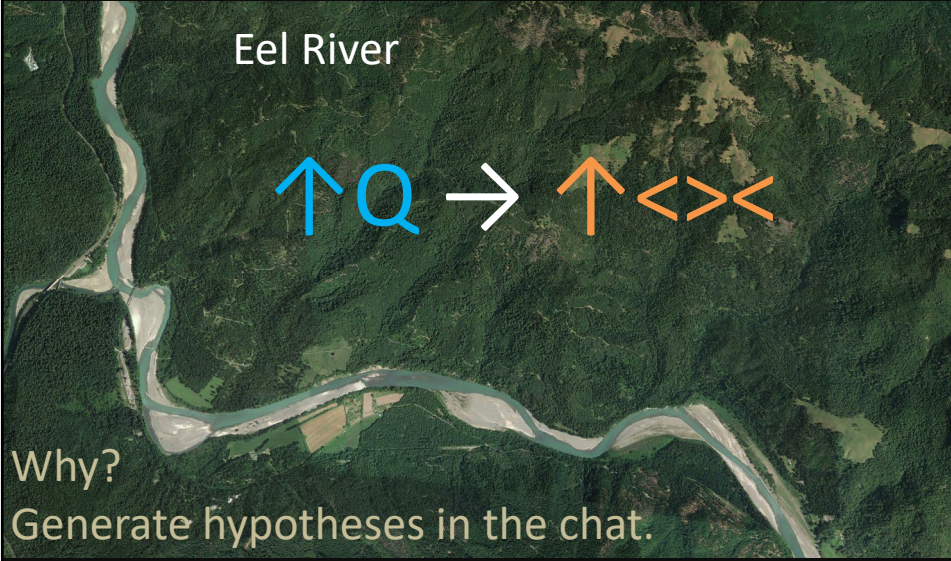i.   Reservoir Flushing/Routing – Lewis and Clark/Fall Creek
ii. Dam Removal – Springville and Snake

Channels:
iii . Deposition and Fish Passage – Yellowstone
iv.   Substrate Augmentation/Channel Modification – Koot
iv.   Bar Building - Missouri
v.   Bank Source Management – Queensland/Goodwin

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An Eco-geomorphologic Story (Power *et al*).

Eel River

↑Q → ↑<><

Why?
Generate hypotheses in the chat.

Power, M.E. 2001. Controls on food webs in gravel-bedded rivers: the importance of the gravel bed habitat to trophic dynamics. Pages 405-422 *in* Mosley, M. P. editor. Gravel-Bed Rivers V, New Zealand Hydrological Society, Wellington, New Zealand (ISBN 0-473-07486-9).

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An Eco-geomorphologic Story (Power *et al*).

-Non-linear/Threshold
-Threshold corresponded to significant gravel transport

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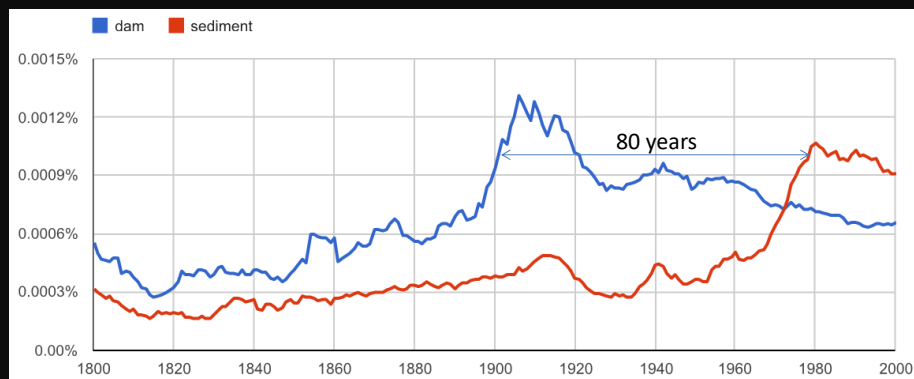   ii. Dam Removal – Springville and Snake

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Google n-gram

Measures the relative occurrence of words in books over the last 200 years.

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Reservoir Management
Sluicing – Lewis and Clark Reservoir

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Sluicing – Lewis and Clark Reservoir
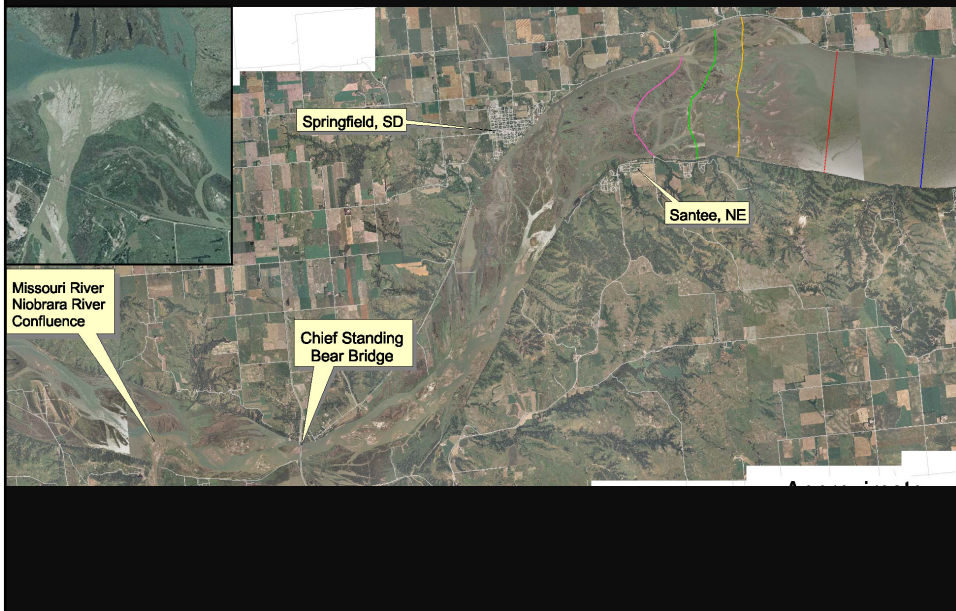
10

Sluicing – Lewis and Clark Reservoir

Implement unsteady sediment transport in HEC-RAS including operational rules.


```
2    'Pool Stage' = Cross Sections:WS Elevation(Missouri River,Missouri,811.076
3    'RunTime' = Time:Hour of Simulation(Beginning of time step)  Get Sim Value
4    !
5    !
6    Structure.Total Flow (Desired) = 60000   Set Operational Param
7    !
8    !  Start to fill after 11 total days of run time
9    If ('RunTime' > 246) And ('Pool Stage' < 1205) Then   Comment
10       Structure.Total Flow (Desired) = 5000
11   ElseIf ('RunTime' > 246) And ('Pool Stage' >= 1205) Then  Branch (If/Else)
12       Structure.Total Flow (Desired) = 30000
13   End If
```

Allows complex, automatic, sediment reservoir modeling.

Reservoirs can now be included as part of regional sediment system models
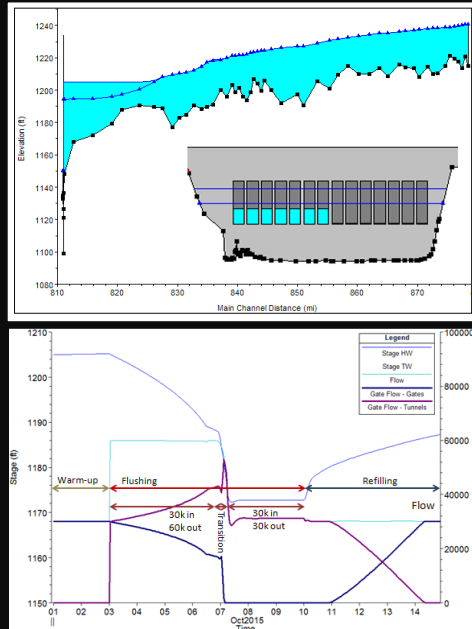
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Sluicing – Lewis and Clark Reservoir
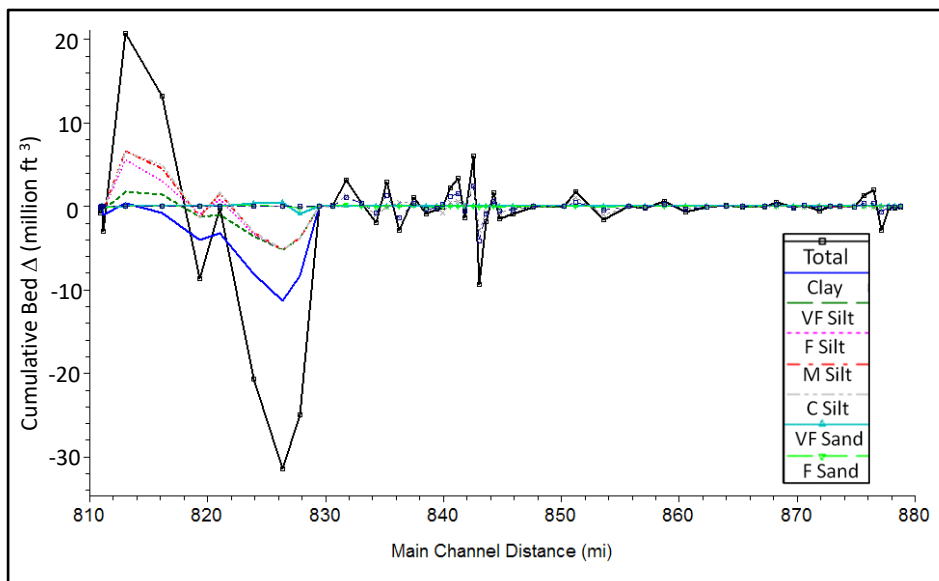
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Spencer Reservoir Validation

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Operating on Sediment Variables

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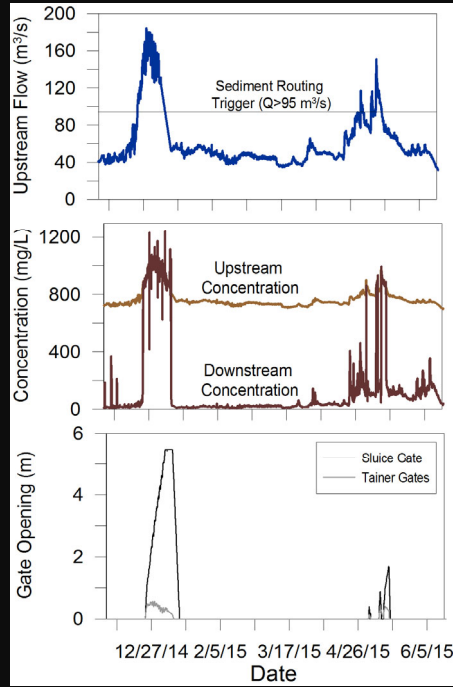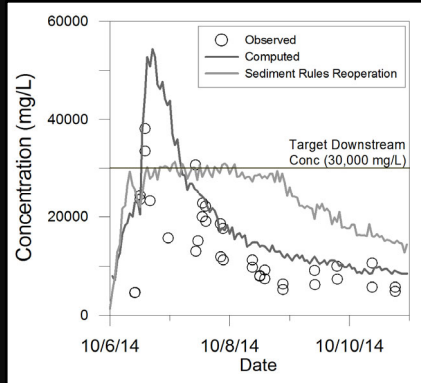
Map by Jim Crain - NWP

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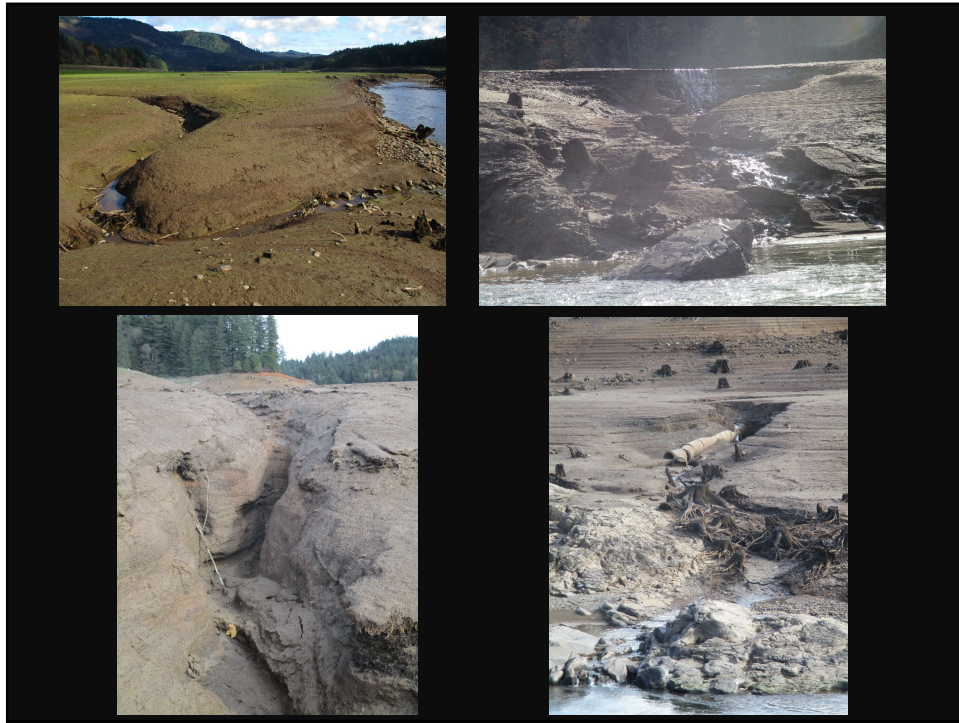
18
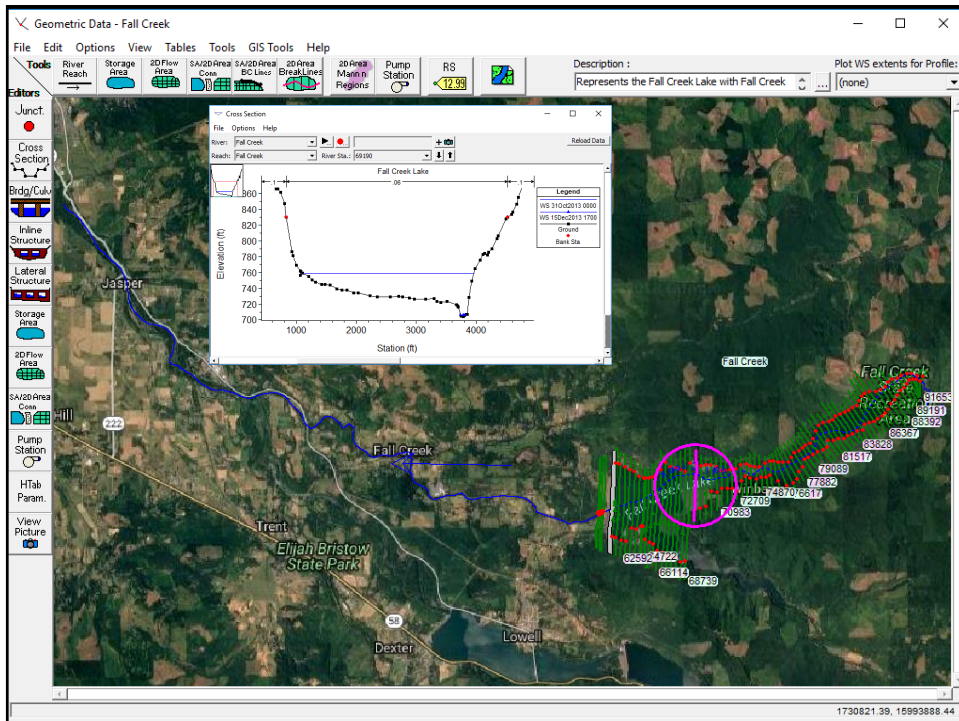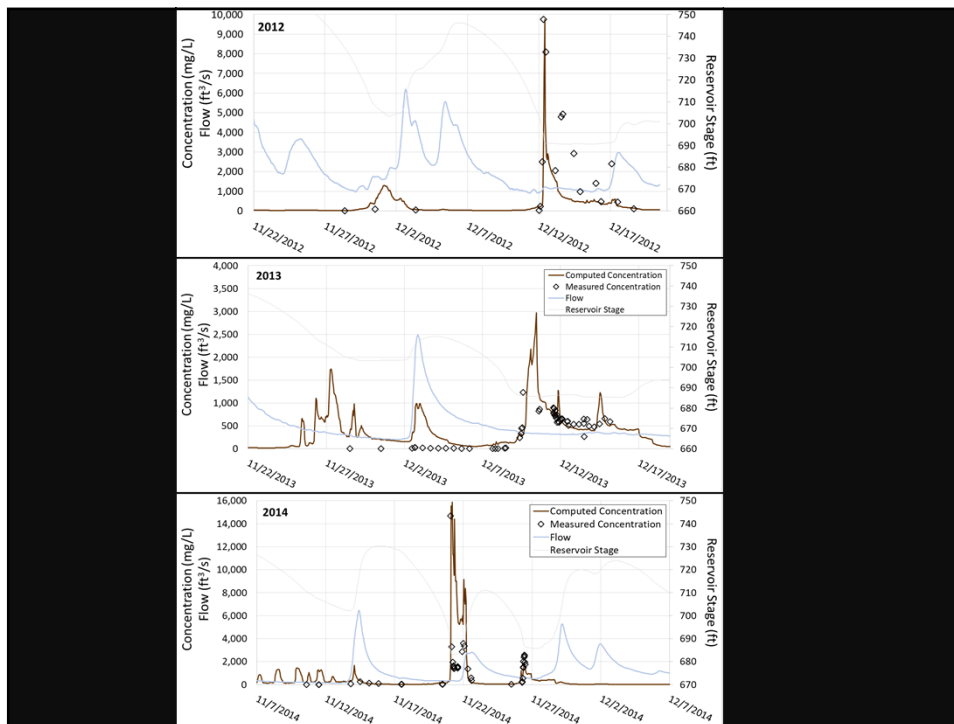
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How Much Analysis?

In the guideline, the probability of reservoir sediment release is classified as negligible, small, medium, or large depending on the ratio of the reservoir sediment mass (γV_{res}) to the mean annual load or capacity of the river (Q_s)

Negligible Probability $\qquad \frac{\gamma(V_{res})}{Q_s} < 0.1$

Small Probability $\qquad 0.1 \le \frac{\gamma(V_{res})}{Q_s} < 1$

Medium Probability $\qquad 1 \le \frac{\gamma(V_{res})}{Q_s} < 10$

Large Probability $\qquad 10 \le \frac{\gamma(V_{res})}{Q_s}$

From the Subcommittee on Sedimentation (SOS) Dam Removal Guidelines.
See: Randle, T.J., and Bountry, J.A., (2015) "Progress on Dam Removal Analysis Guidelines for Sediment," *Proceedings SedHyd, Interagency Sediment Conference.*

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How Much Analysis?
Sediment Impact Risk & Analysis Tools

Negligible	Small	Medium	Large
Simple computations	Sediment wave model	Sediment transport capacity	1D or 2D sediment model, laboratory model, field test

← Establish conceptual model →
← Total stream power calculations →
← Geomorphic Analysis →

Slide from Tim Randle, US Bureau of Reclamation
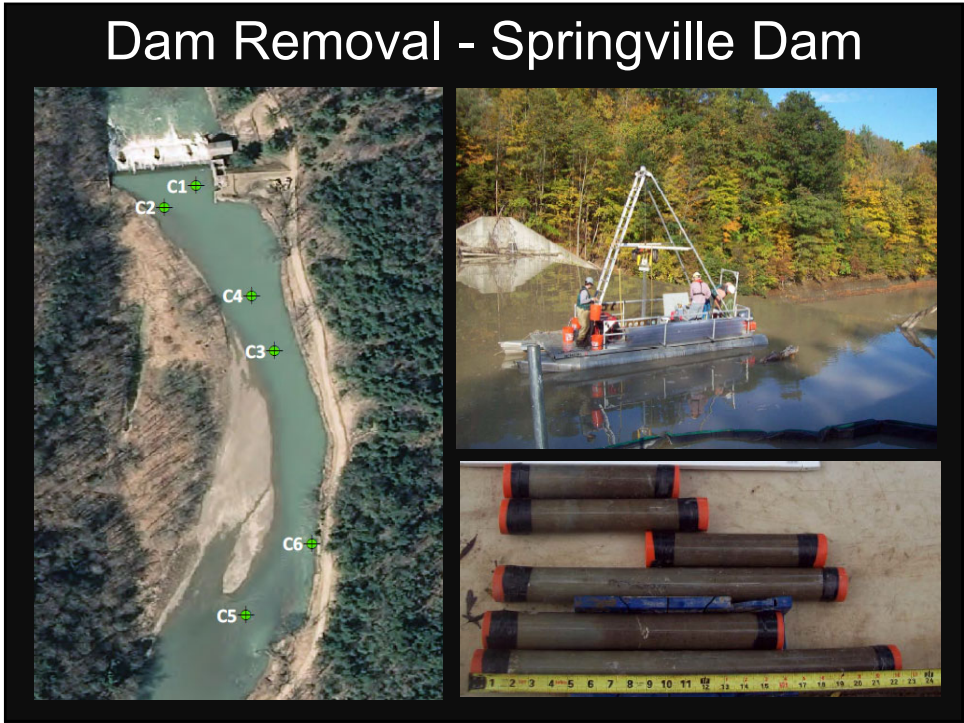
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Rivers Respond Fast
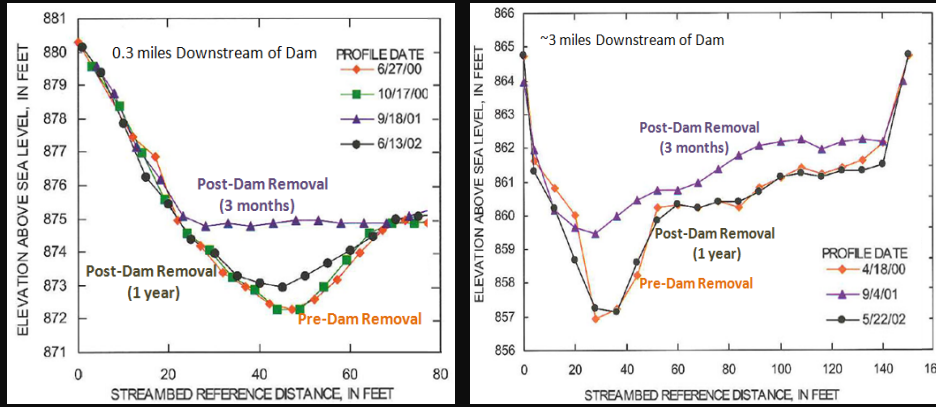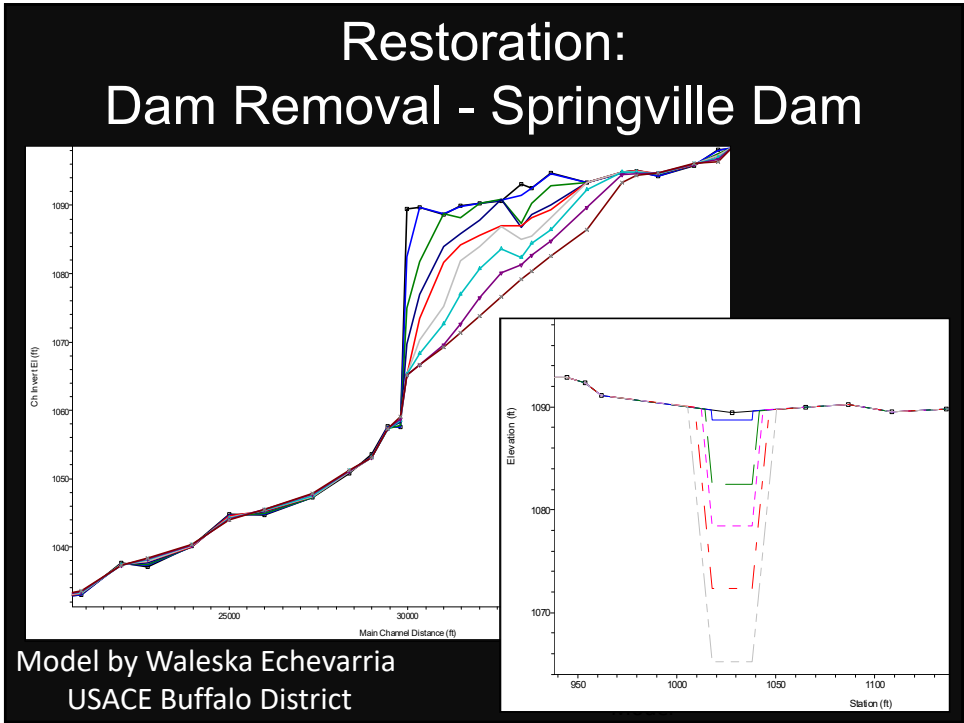
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Restoration:
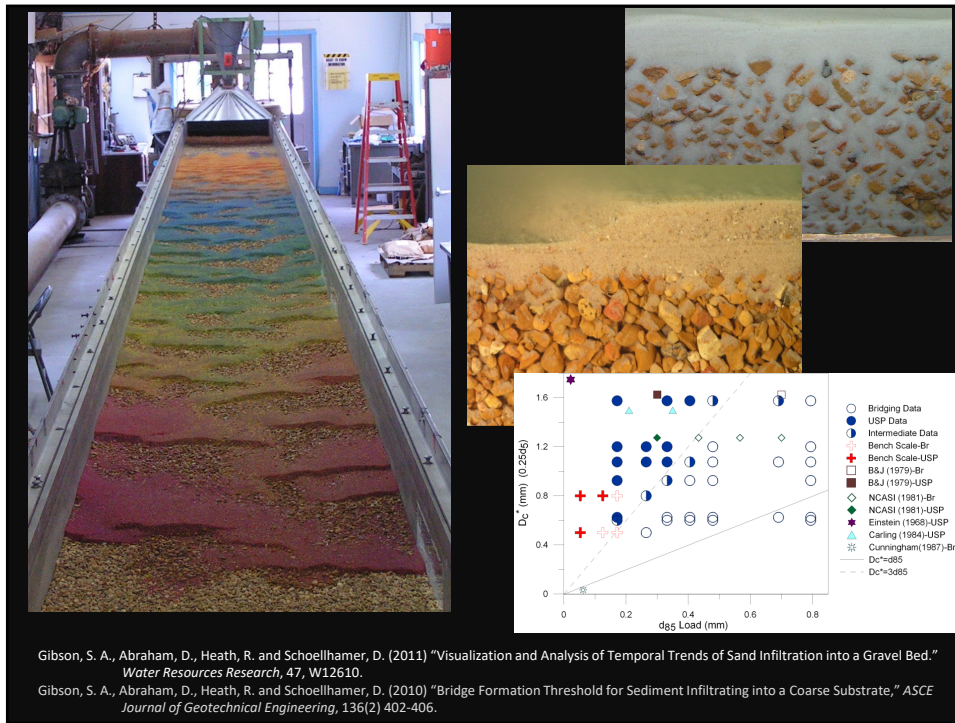Dam Removal - Springville Dam

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Dam Removal - Springville Dam

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Restoration:
Dam Removal - Springville Dam

Model by Waleska Echevarria
USACE Buffalo District

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Gibson, S. A., Abraham, D., Heath, R. and Schoellhamer, D. (2011) "Visualization and Analysis of Temporal Trends of Sand Infiltration into a Gravel Bed." *Water Resources Research*, 47, W12610.
Gibson, S. A., Abraham, D., Heath, R. and Schoellhamer, D. (2010) "Bridge Formation Threshold for Sediment Infiltrating into a Coarse Substrate," *ASCE Journal of Geotechnical Engineering*, 136(2) 402-406.

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Snake River Dam Removal

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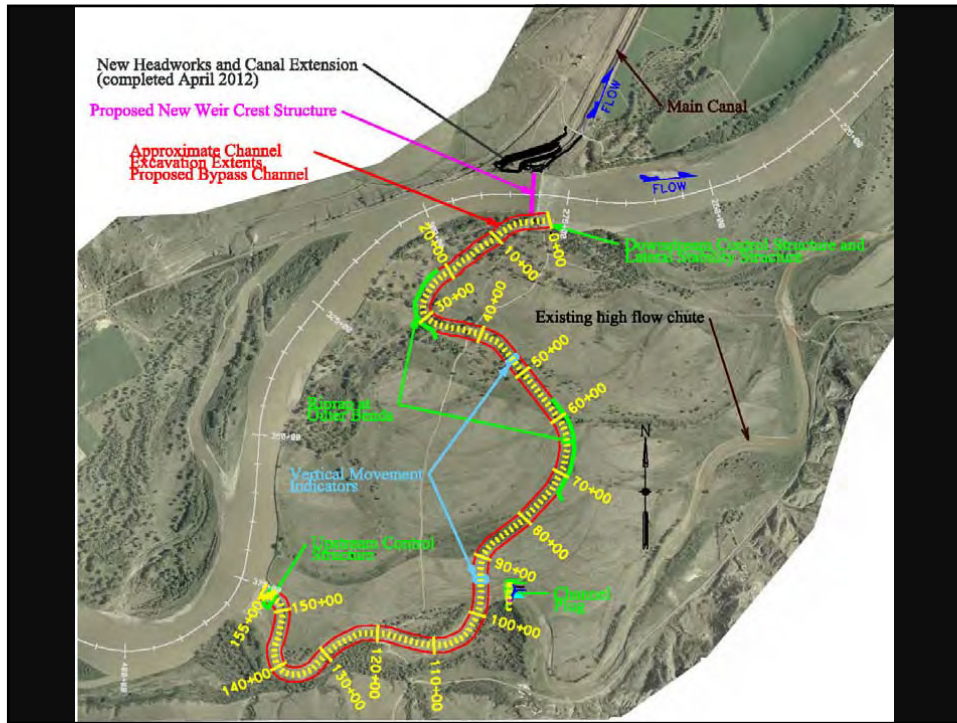   ii. Dam Removal - Springville

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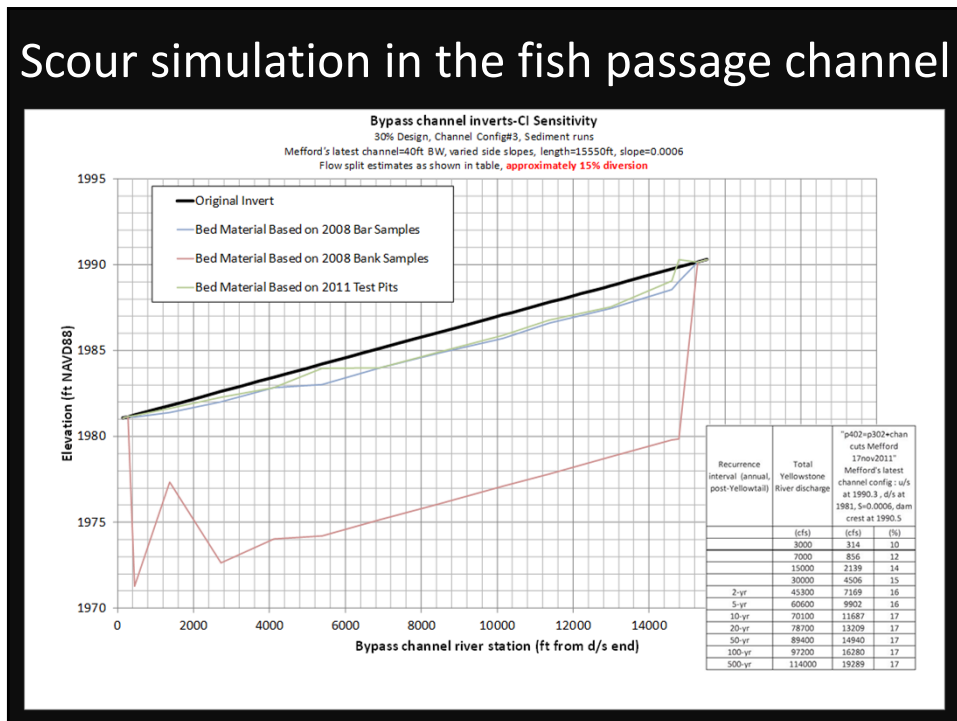
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Fish Passage:
Lower Yellowstone Irrigation Project

Model by Curtis Miller
USACE Omaha District

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Scour simulation in the fish passage channel
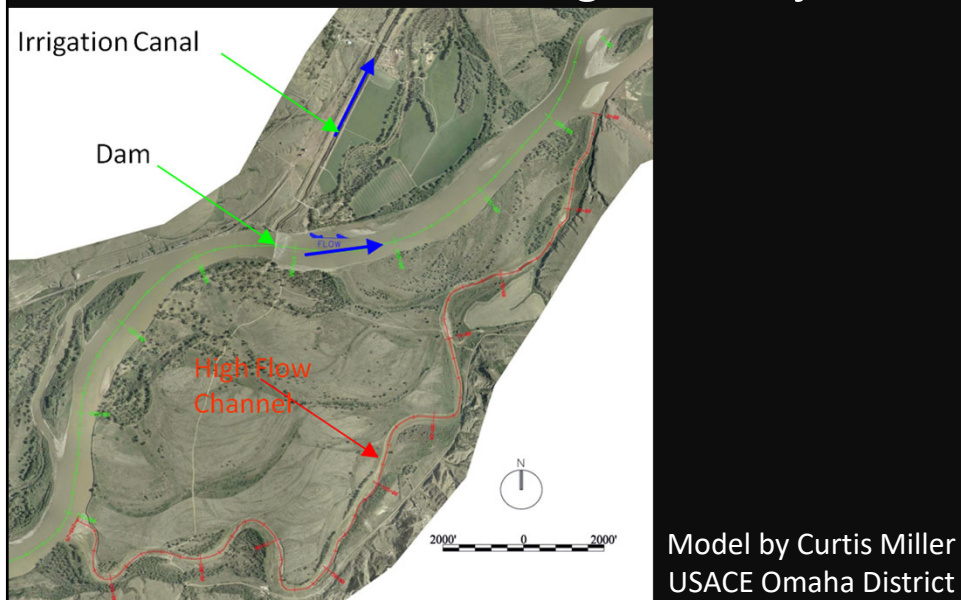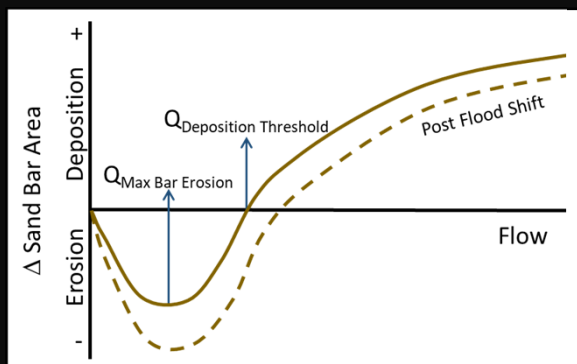
36

Building Sand Bars (Missouri)
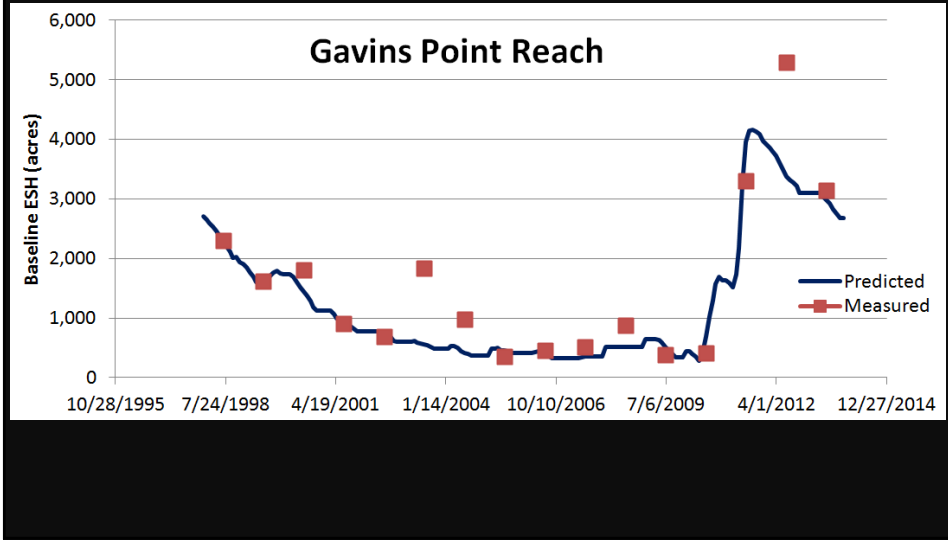
Threatened and Endangered Species of the Missouri River Basin

37

Building Sand Bars (Missouri)

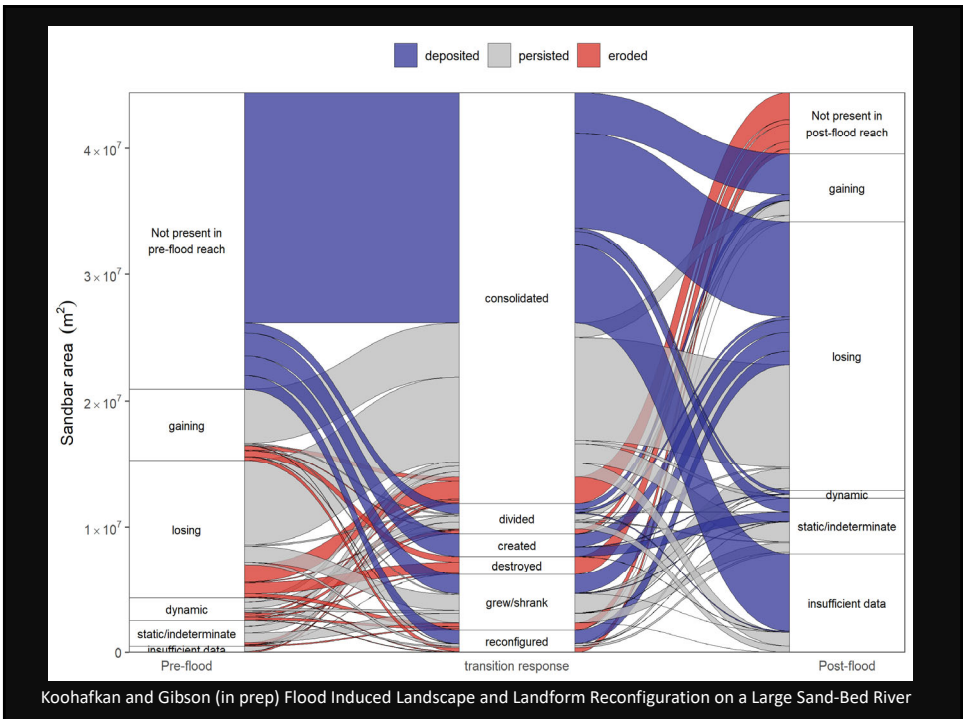Threatened and Endangered Species of the Missouri River Basin
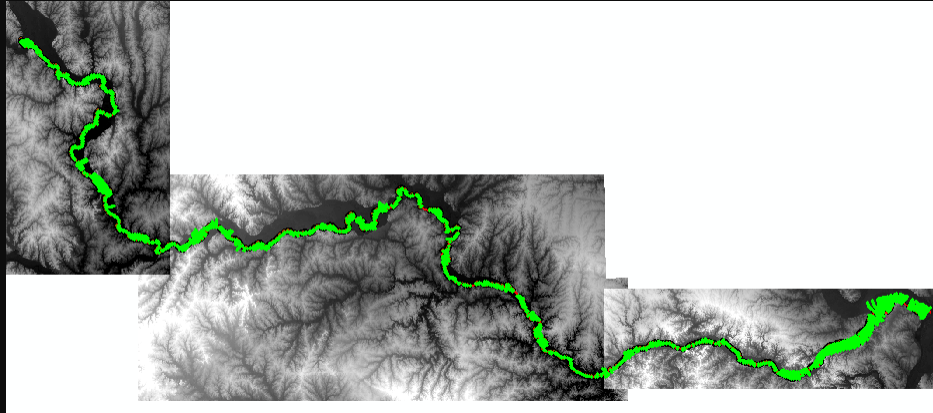

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Bar Building on the Missouri

Gavins Point Reach

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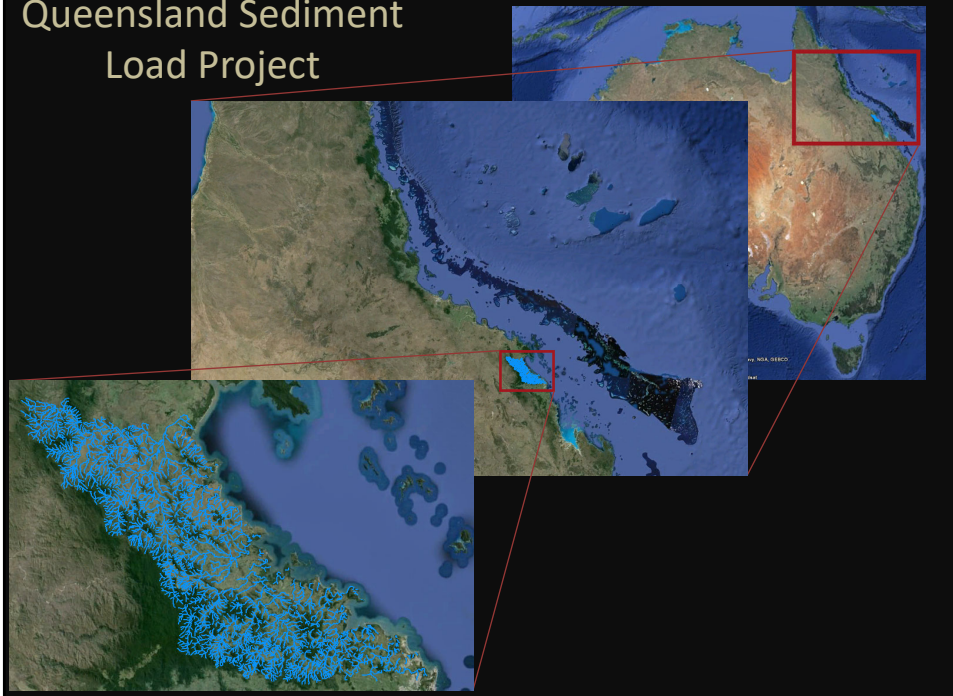Koohafkan and Gibson (in prep) Flood Induced Landscape and Landform Reconfiguration on a Large Sand-Bed River

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Missouri Sediment Model

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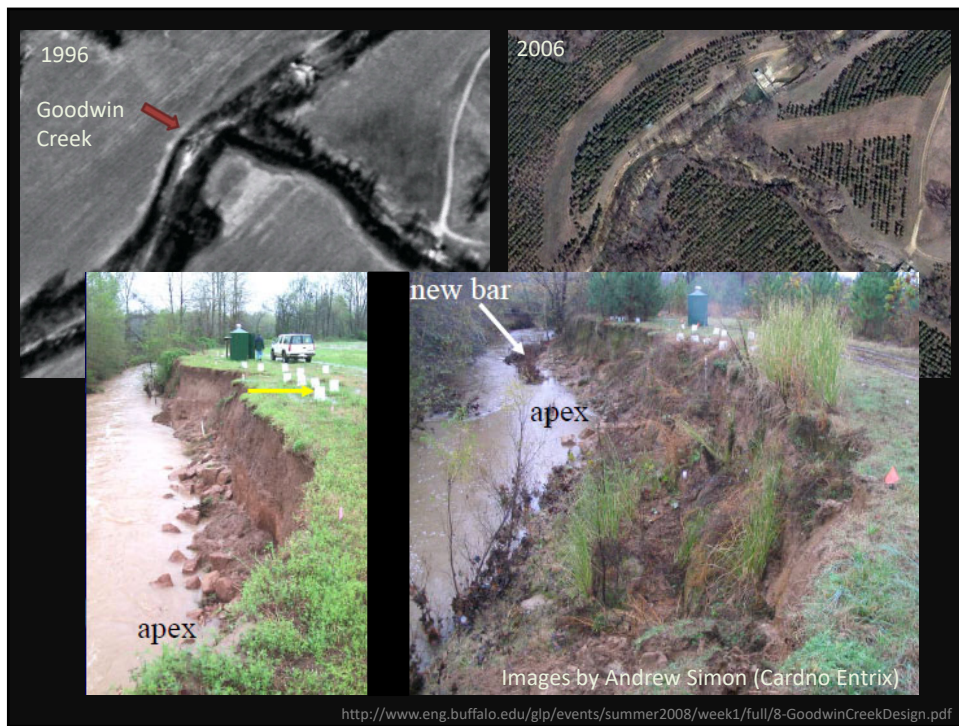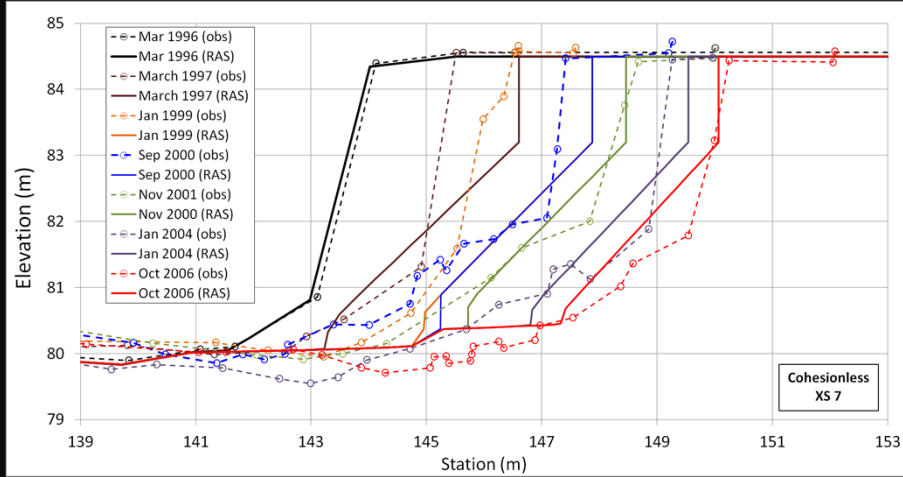

Queensland Sediment Load Project

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