



US Army Corps  
Of Engineers  
Portland District



Pacific Northwest  
NATIONAL LABORATORY

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# A Geoscientific Database for the Columbia Estuary Ecosystem Restoration Program

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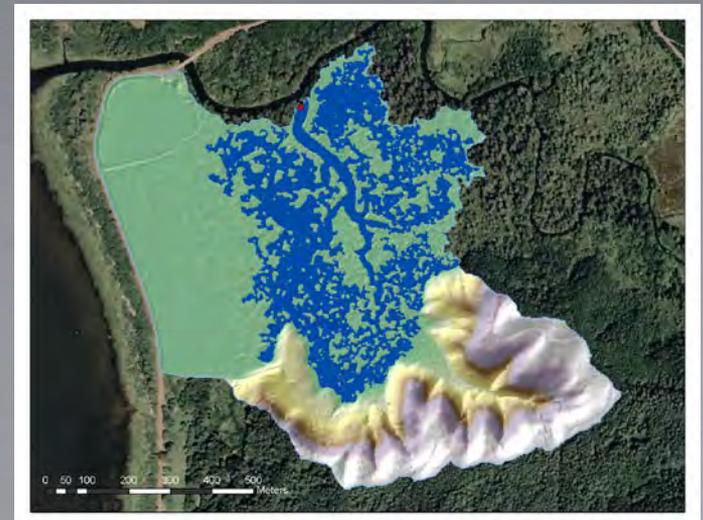
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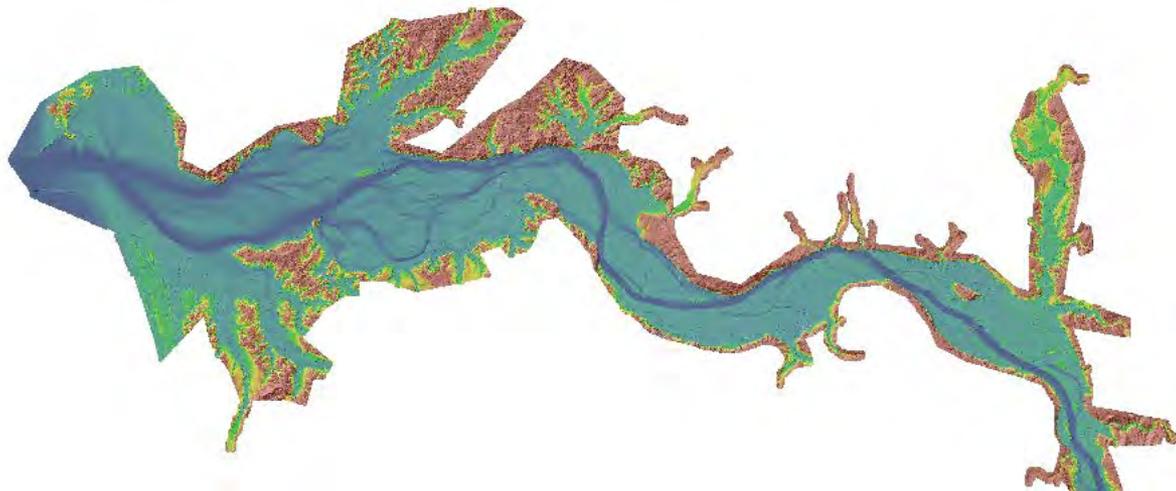




- In 2010, the BiOp RME Workgroup Recommendations Report (May 2010) identified gaps in coverage of the 2008 FCRPS BiOp:
  - Habitat restoration and associated RME in the LCRE is being carried out by multiple agencies and entities, but there is no central, accessible, regional database
  - Data integration, assessment, evaluation and synthesis for BiOp 2013 and 2016 comprehensive reporting poses a significant scientific challenge, which must be met to inform adaptive management and restoration prioritization

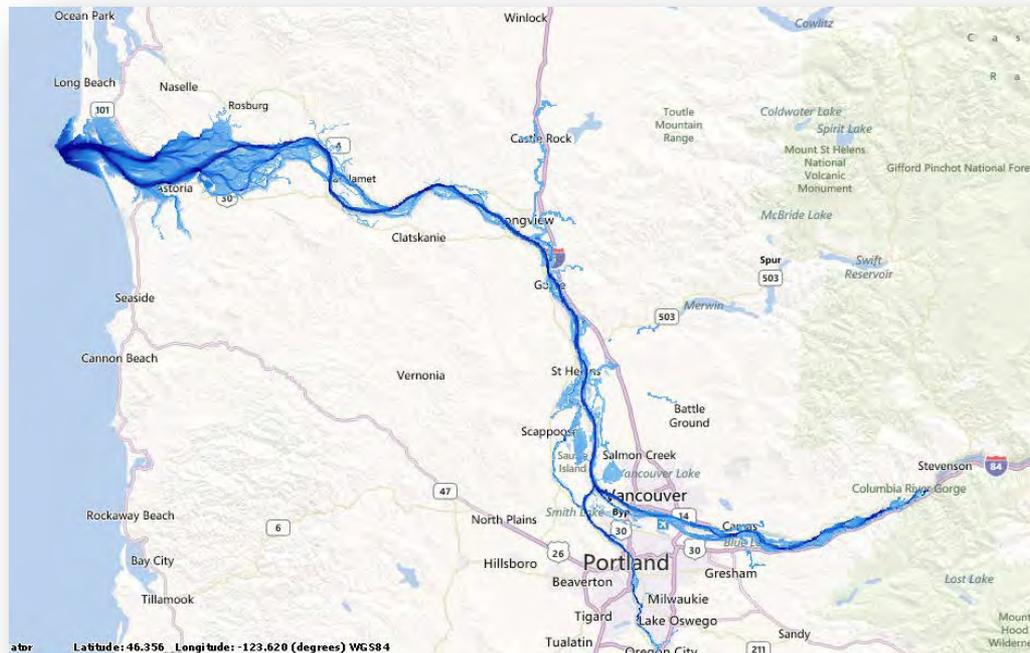


- In 2011, the Independent Scientific Review Panel (ISRP) expressed concern that Research, Monitoring and Evaluation (RME) and project development in the LCRE did not appear to be well-coordinated or well-organized.
- In 2012, the Corps initiated EST-P-12-1: Synthesis and Evaluation of Research, Monitoring and Evaluation in the Lower Columbia River and Estuary: → “Oncor”





- Develop an estuary-wide data management and information discovery/retrieval system for research, monitoring and evaluation studies and restoration project development using a web-accessible geospatial database



# 2012-2014 Objectives



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	2012	2013	2014
	Coordination and establish prototype database	Refine database applications	Transfer to Regional Entity
Objective 1 Coordinate	Stakeholder input and guidance during design.	Stakeholder review and feedback on prototype database.	Stakeholder coordination for eventual transfer of technology.
Objective 2 Develop	Develop estuary data model and prototype database (PNNL-collected data); Refine data model, analytical questions and outputs; identify relevant and compatible data systems.	Use regionally available datasets; Normalize available data to support meta analysis; Link to other compatible data systems (example, PNAMP)	Finalize geospatial database management and analysis system (e.g., restoration accounting metrics, etc.)
Objective 3 Apply	Perform preliminary analysis.	Perform preliminary analysis. Integrate with outside systems. Apply results.	Analyze data. Integrate with outside systems. Apply results.



- Incremental rollout of Oncor database to show real progress and get community/stakeholder feedback
- Facilitate data sharing among researchers and restoration practitioners
- Paradigm shift from project-specific data to data categories/themes, though data pedigree is maintained
- Tie-in to other relevant regional databases
- Publically accessible (web-based) "engine" for future comprehensive analysis



- Build the most comprehensive and scalable data model that we can
- Disseminate as much data as possible while maintaining data integrity, pedigree, and appropriate data use
- Build capability to access same set of data through multiple avenues
- Database allows integrated analysis across habitat capacity/quality and function as well as across projects
- LCRE database provides an organized and documented archive for users to download data as appropriate

# Coordination and Outreach



Avenue	Composition	Frequency	Purpose
<b>A</b>	Regional, general: LCREP Science Work Group	Quarterly	Awareness, feedback
<b>B</b>	Regional, data technologists	Quarterly	Technical coordination, logistics
<b>C</b>	Corps/BPA/LCREP	Monthly	Programmatic coordination

- Two presentations given to the Lower Columbia River Estuary Partnership (LCREP) Science Workgroup
  - May 2012 – Project Intro and Overview
  - Sep 2012 – Database Details and Live Demo



## ➤ “Top-Down Approach”

### ➤ CEERP Management Objectives

Analysis Questions	Obj. 1. Increase the capacity and quality of estuarine and tidal-fluvial ecosystems	Obj. 2. Increase the opportunity for access by aquatic organisms to and for export of materials from shallow water habitats	Obj. 3. Improve ecosystem realized functions
At estuary-wide or landscape scales, are cumulative restoration activities in the LCRE resulting in increased XXX compared to 2000 levels?	XXX = percentage of cover for native plant species, net ecosystem improvement	XXX = habitat connectivity, total floodplain wetted area, total physical habitat opportunity, total realized habitat opportunity	XXX = mean survival rate, early life history diversity, genetic stock diversity, mean growth rate, total realized habitat utilization
At the site-scale, is a restoration activity in the LCRE resulting in increased XXX compared to a control site, or a positive trajectory of XXX toward that at a reference site?	XXX = reduction in mean water temperature, dissolved oxygen, channel x-sec, sediment accretion, prey production, macro-detritus export, nutrient export, plant similarity index	XXX = salmon presence/absence, salmon density, fish community structure—richness, fish community structure—species diversity	XXX = growth rate, fish condition, total realized habitat utilization



## ➤ “Bottom-Up Approach”

- Adaptive Mgmt → Analysis Question → CEERP Obj.
  - Strategize (program plan) and Decide (project prioritization)
  - Act (project design, program tracking)
  - Monitor/Research (data) and Synthesize & Evaluate (roll-up)
- Example...

# Analysis Approach

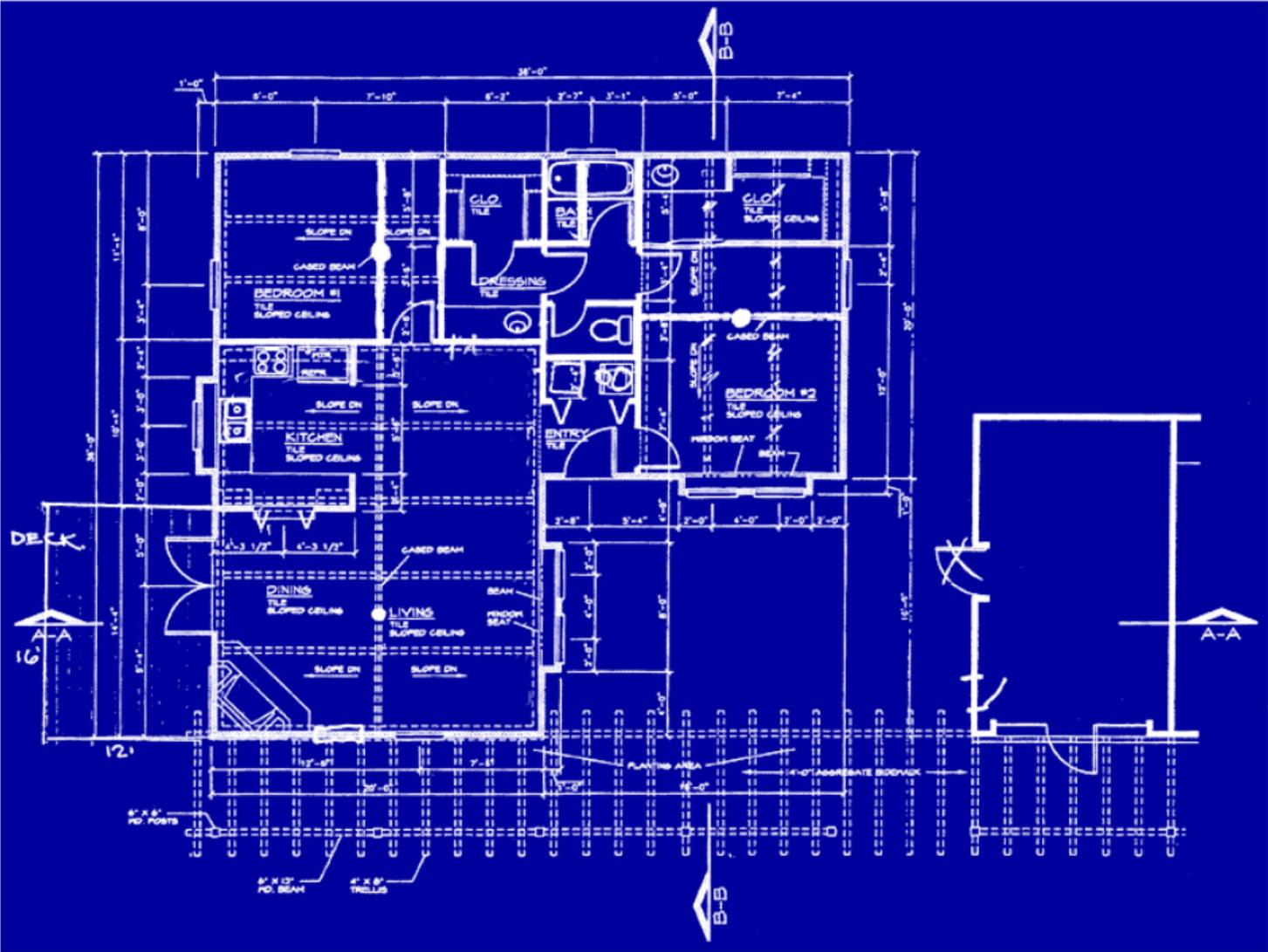


**Oncor Datasets:** Hydro (H), Elevation (E), Water Quality (WQ), Water Properties (WP), Vegetation(V), Fish (F), Invertebrates (I), and Estuary-wide (EW)

Adaptive Management Phase	Analysis Questions	Obj 1	Obj 2	Obj 3
<b>Strategize (program plan) and Decide (project prioritization)</b>	Which restoration actions are most effective at improving habitat opportunity and capacity for juvenile salmon through increased habitat connectivity, flood attenuation, sediment trapping, nutrient processing, export of marsh <u>macrodetritus</u> , and other ecosystem functions?	All	F	F, EW
	How does the type of action affect “after” structure, process, and function (water temperature, D.O., fish presence, fish condition, etc.)	All		F,
	What is the usage of LCRE habitats by <u>salmonid</u> life history type, i.e., which habitats are most important and why? Do salmon stocks or species have fidelity to specific cover type (marsh, shrub, <u>tree</u> )?			V, F
	What is the change in LCRE habitats relative to historical conditions (pre-development in 1900s)?	E, V, EW		
	Do certain river positions or cover types generally produce greater capacity, quality, or function?	H, E, V, EW		F
<b>Act (project design, program tracking)</b>	Does the spatial organization of restoration projects have non-linear effects (e.g., amounts, synergies, thresholds, cumulative effects) on salmon use, survival, production, and life history diversity for stocks using those areas?		F, EW	F, EW



## A Data Model = Architectural Blueprint





- Carefully designed in order to support managed and unmanaged data using the same toolset to provide the users with a seamless experience.
- Managed data are layers/tables that reside local to database, while unmanaged (also called “virtual layers”) are data served by websites owned by other organizations.
- Designed specifically with managers and researchers in mind, to quickly retrieve data by Region, Site, Analysis Question, Data Event (deployment), Data type, Collection type (sensor), Location, Proximal location, etc.
- Supports the use of spatial tools to select sites or data in proximity to non-managed features (e.g. select sites and data within 5 miles of a particular USGS gaging station).

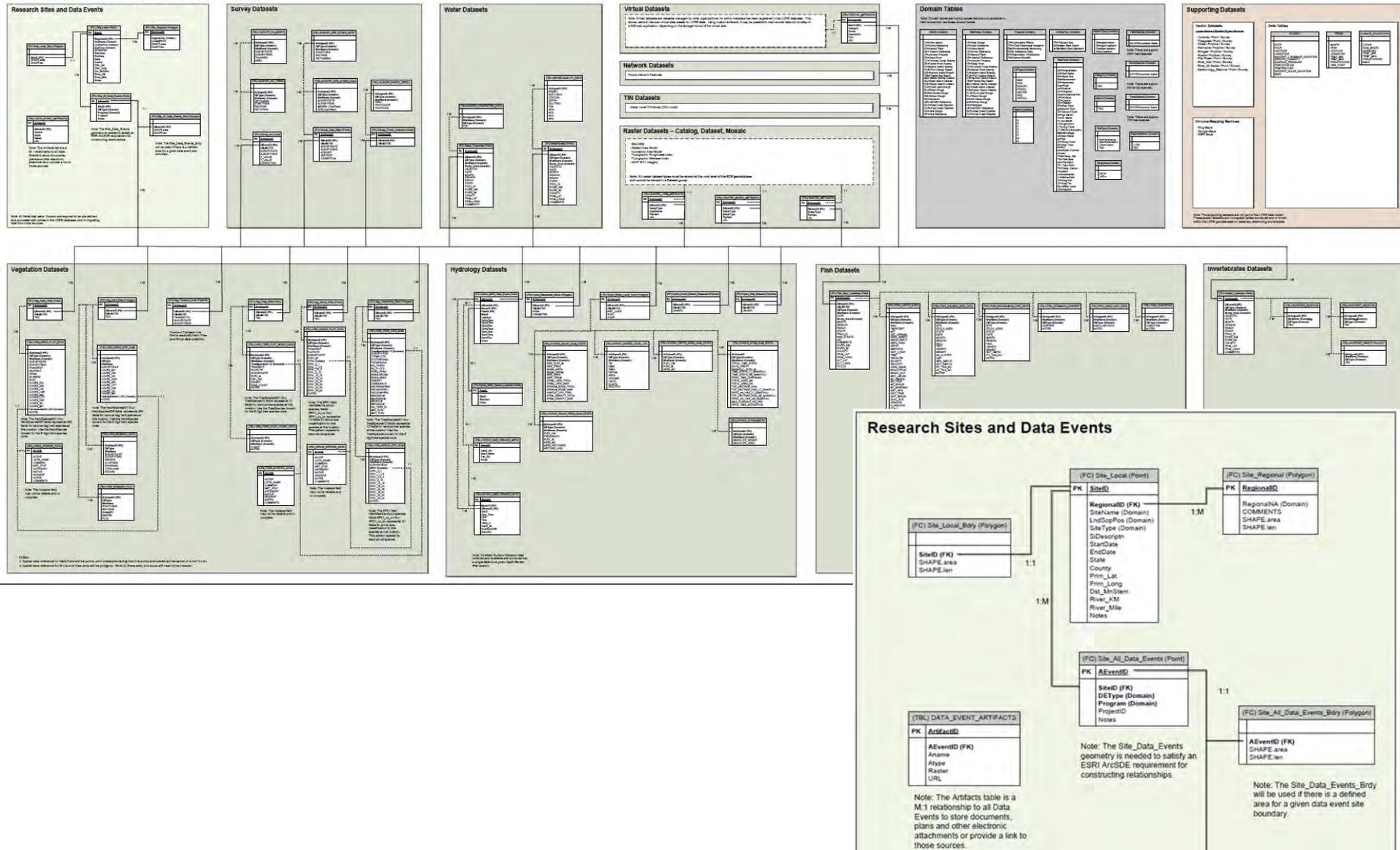
# Estuary Data Model



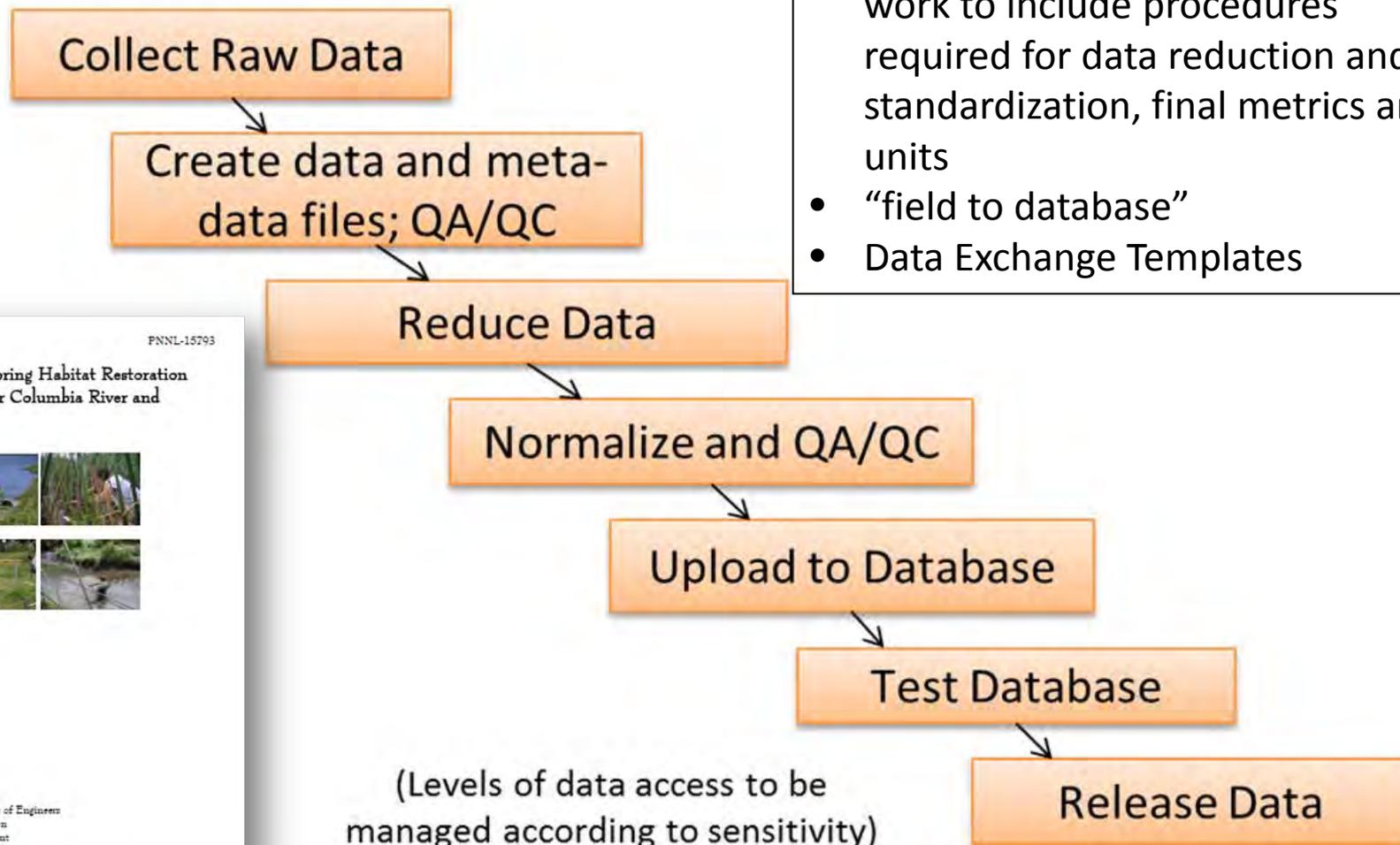
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Lower Columbia River Estuary (LCRE) Data Model - Draft v13



# Data Workflow / Reduction Protocols



- Expand the Roegner et al. (2009) work to include procedures required for data reduction and standardization, final metrics and units
- “field to database”
- Data Exchange Templates

PNNL-15793

### Protocols for Monitoring Habitat Restoration Projects in the Lower Columbia River and Estuary

G. C. Roegner  
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A. B. Borde  
R. M. Thom  
E. M. Dawley  
A. H. Whiting  
S. A. Zimmerman  
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Final Report  
April 25, 2008

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Contract DE-AC05-76RL01830



- The Oncor data portal is a rich internet application designed to give users an easy and intuitive method for discovering, visualizing, and retrieving scientific data that have been collected by multiple organizations
- Ability to serve public or secure web services through a single portal
- Data services may be consumed by multiple software clients, including web applications and desktop GIS software

# Oncor Data Portal



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gisx.pnl.gov/lcre/

Lower Columbia River Estuary Science Portal  
Hosted by PNNL

- More...
- Roads
- Aerial
- Hybrid
- Depth Locations
- Data Layers
  - Estuary Features
  - Kandoll Farm Base
  - Kandoll Farm Veg
  - Kandoll Farm Wetted Areas
  - Kandoll Farm Inundation
    - Cumulative Frequency
    - Topographic Roughness
    - Wetness Index
  - Estuary Coverages
- Bathymetry
  - Zoom to
  - Transparency
  - Move up
  - Move down
  - Description

WSE Example

Select sampling event to view data.  
3/07/06 to 4/18/07

Temperature (C) | Depth/Elevation (m)

Sample Date

Temperature | Depth | Elevation

Records: 100

Site	Sensor	Date	Temp	Depth	Elev
KF	867607	3/7/2006 05:0	8.481	0.866	0.791
KF	867607	3/7/2006 05:3	8.481	1.024	0.948
KF	867607	3/7/2006 06:0	8.481	1.199	1.124
KF	867607	3/7/2006 06:3	8.481	1.416	1.341
KF	867607	3/7/2006 07:0	8.481	1.543	1.468

500 m | 1000 ft

Latitude: 46.325 Longitude: -123.674 (degrees) WGS84

# Oncor Data Portal



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gisx.pnl.gov/lcre/

Center for Internation... Wind Map Myriax Eonfusion Web... PM Product Datasheets GeoTrells - Fast Geop... GIS Pasture Competition | ... AboutHydrology: Qua... PNNL Data BSA-Ads Journal\_Citation\_Rep... Biofuels Hydro

### Lower Columbia River Estuary Scientific Data Portal

Hosted by PNNL

Layers Roads Aerial Hybrid

Query Form Results Table Results Chart

Show these attributes...

- Site ID number
- Site Name
- Decimal latitude
- Decimal longitude
- Date
- Value

124 Query Results

Temperature, water, degrees Celsius Max Export Grid (.xls)

Site ID number	Date	Value
454705122451400	Wed Mar 28 17:00:00 GMT-0700 2012	8.20
454705122451400	Thu Mar 29 17:00:00 GMT-0700 2012	7.41
454705122451400	Fri Mar 30 17:00:00 GMT-0700 2012	7.06
454705122451400	Sat Mar 31 17:00:00 GMT-0700 2012	7.45
454705122451400	Sun Apr 1 17:00:00 GMT-0700 2012	7.39
454705122451400	Mon Apr 2 17:00:00 GMT-0700 2012	7.32
454705122451400	Tue Apr 3 17:00:00 GMT-0700 2012	7.60
454705122451400	Wed Apr 4 17:00:00 GMT-0700 2012	7.98
454705122451400	Thu Apr 5 17:00:00 GMT-0700 2012	9.38
454705122451400	Fri Apr 6 17:00:00 GMT-0700 2012	9.78
454705122451400	Sat Apr 7 17:00:00 GMT-0700 2012	9.67
454705122451400	Sun Apr 8 17:00:00 GMT-0700 2012	12.30
454705122451400	Mon Apr 9 17:00:00 GMT-0700 2012	13.88
454705122451400	Tue Apr 10 17:00:00 GMT-0700 2012	13.79
454705122451400	Wed Apr 11 17:00:00 GMT-0700 2012	13.60
454705122451400	Thu Apr 12 17:00:00 GMT-0700 2012	14.59
454705122451400	Fri Apr 13 17:00:00 GMT-0700 2012	14.08
454705122451400	Sat Apr 14 17:00:00 GMT-0700 2012	15.61
454705122451400	Sun Apr 15 17:00:00 GMT-0700 2012	15.56
454705122451400	Mon Apr 16 17:00:00 GMT-0700 2012	15.19
454705122451400	Tue Apr 17 17:00:00 GMT-0700 2012	11.12
454705122451400	Wed Apr 18 17:00:00 GMT-0700 2012	10.44
454705122451400	Thu Apr 19 17:00:00 GMT-0700 2012	10.33
454705122451400	Fri Apr 20 17:00:00 GMT-0700 2012	12.00
454705122451400	Sat Apr 21 17:00:00 GMT-0700 2012	13.96

Restore Clear All

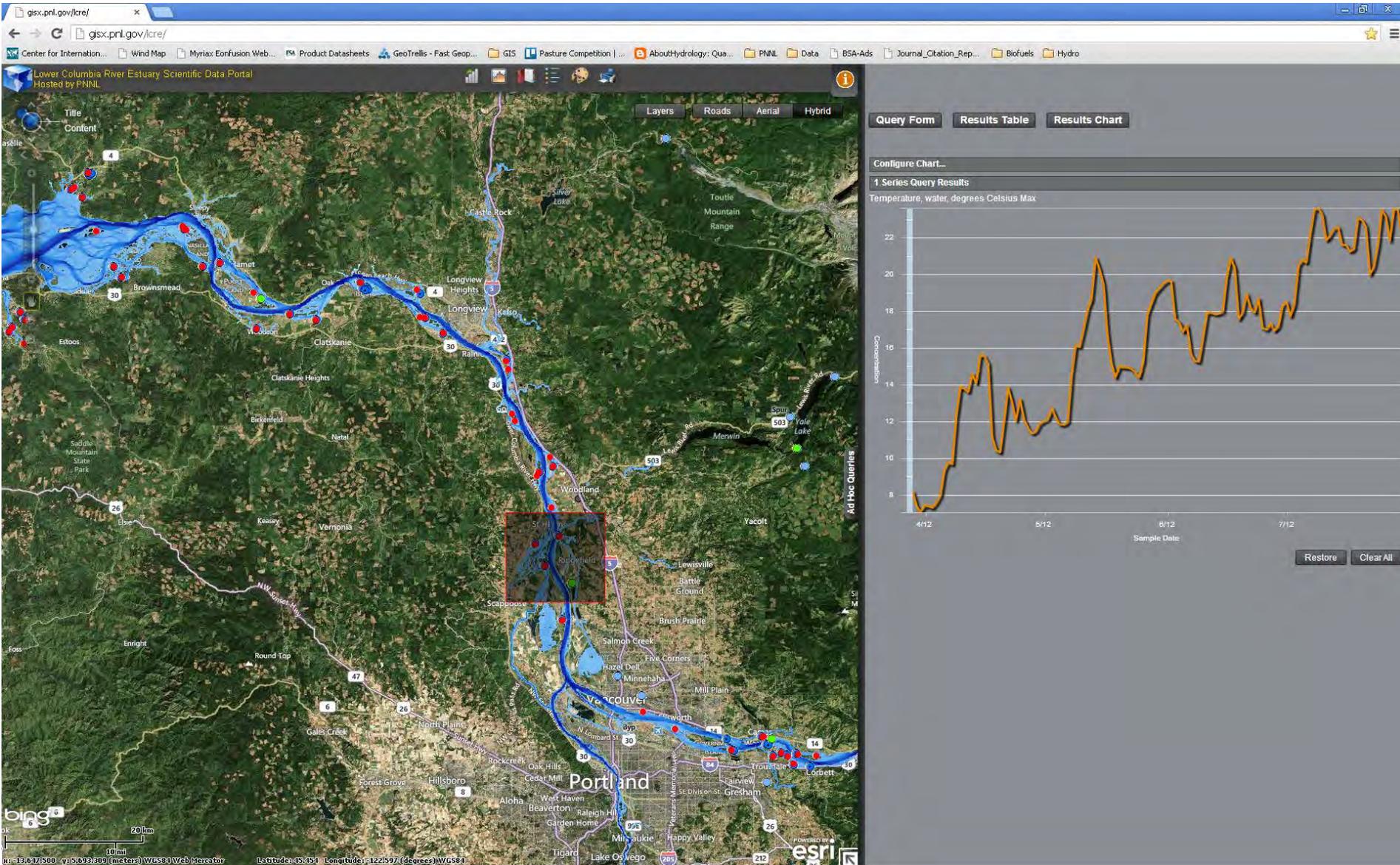
Map coordinates: 46°18'23.17N 123°05'05.20W (meters) WGS84 Web Mercator Longitude: 46.308 Longitude: -123.077 (degrees) WGS84

# Oncor Data Portal



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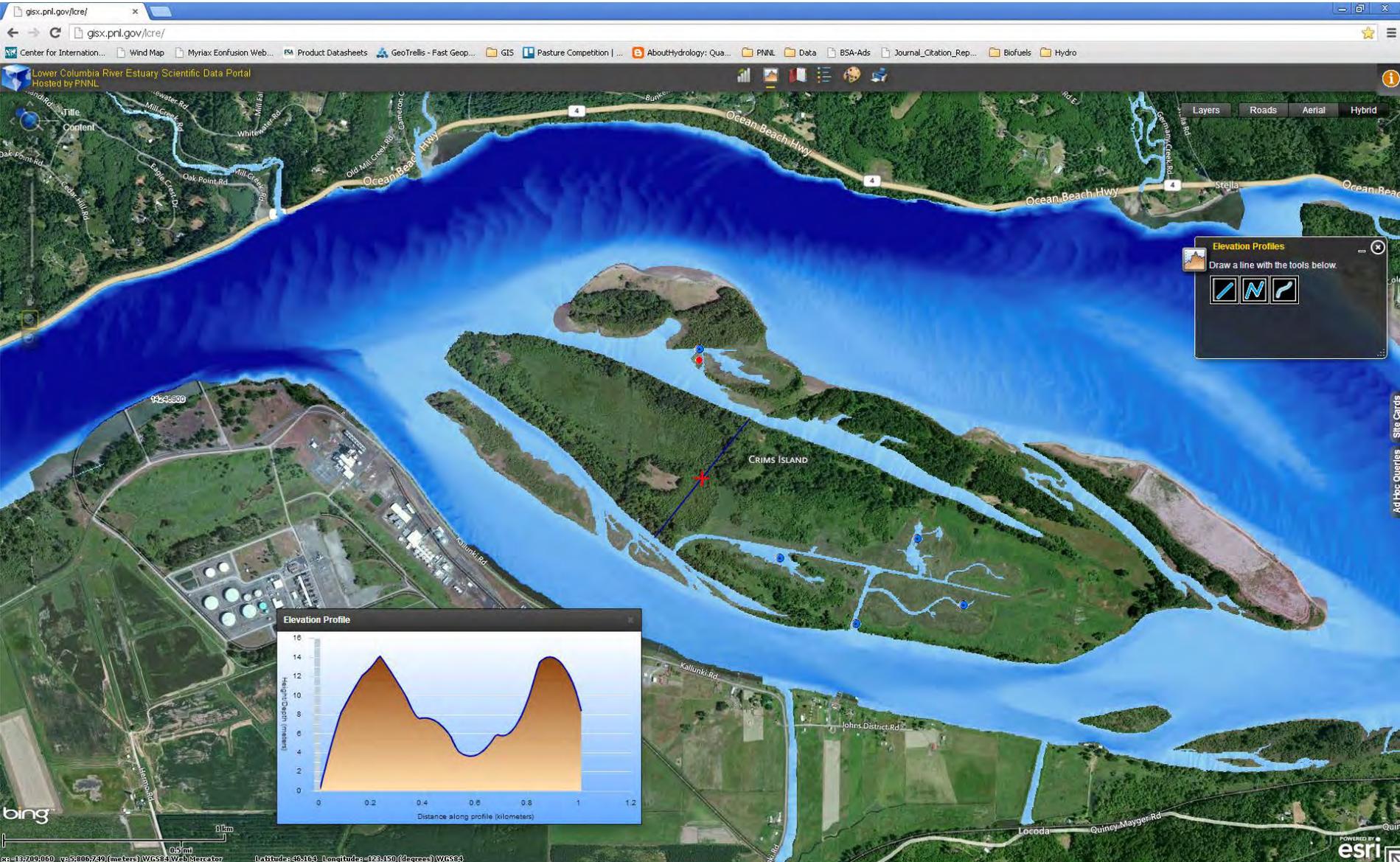


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