

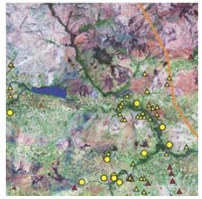

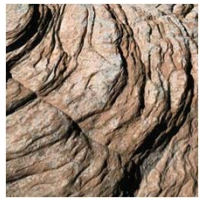
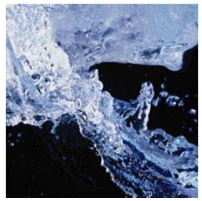

# A GIS-Based Approach to Quantifying Pesticide Use Site Proximity to Salmonid Habitat


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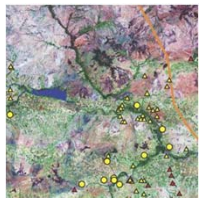

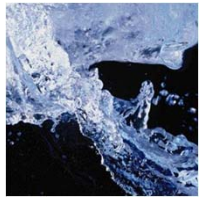





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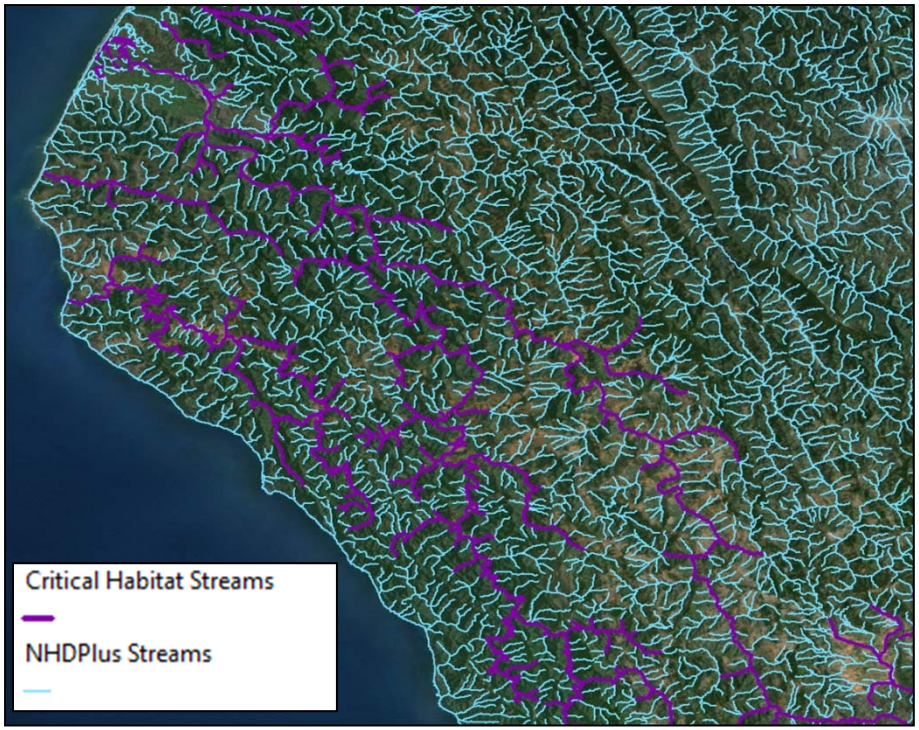
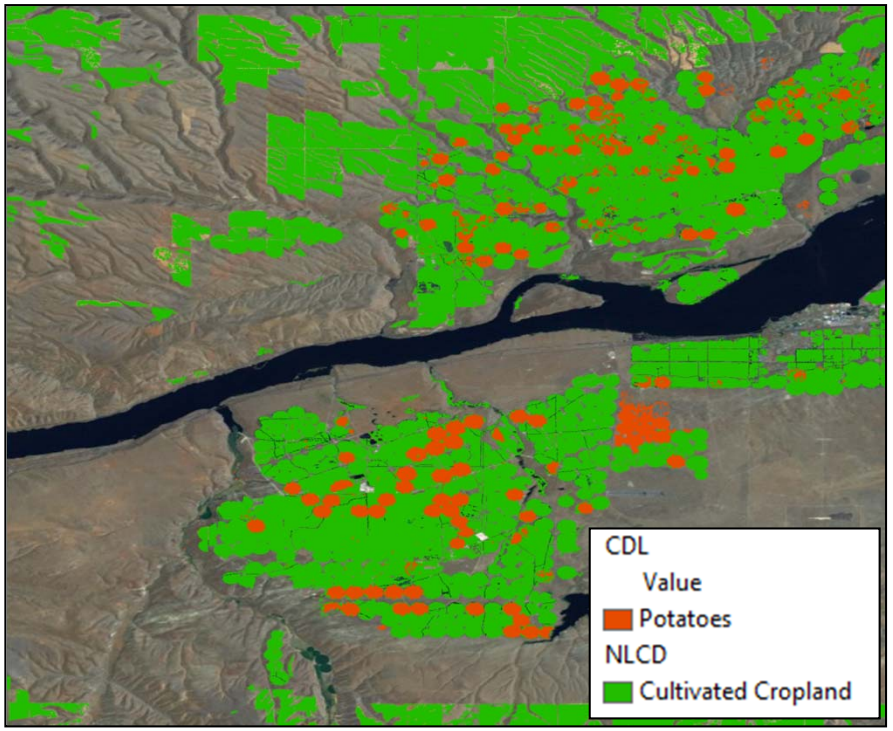
# Background: Recent Biological Opinions

- Since 2008, the National Marine Fisheries Service (NMFS) has issued four biological opinions (BiOps) concerning the effects of pesticide use on salmonids in the Pacific Northwest and California.
- Several of these opinions have proposed no-application buffers and setbacks from salmonid habitat in the Pacific Northwest.
- The size of these proposed buffers has ranged from:
  - Up to 600 ft. for ground application
  - Up to 1,000 ft. for aerial applications

# Background: Motivation

- A critical step in understanding potential exposure of endangered and threatened salmonids to pesticide is to quantify the extent of potential use sites within close proximity to their habitats.
- Generalization of foundational datasets for such an analysis can lead to overestimation of potential exposure.



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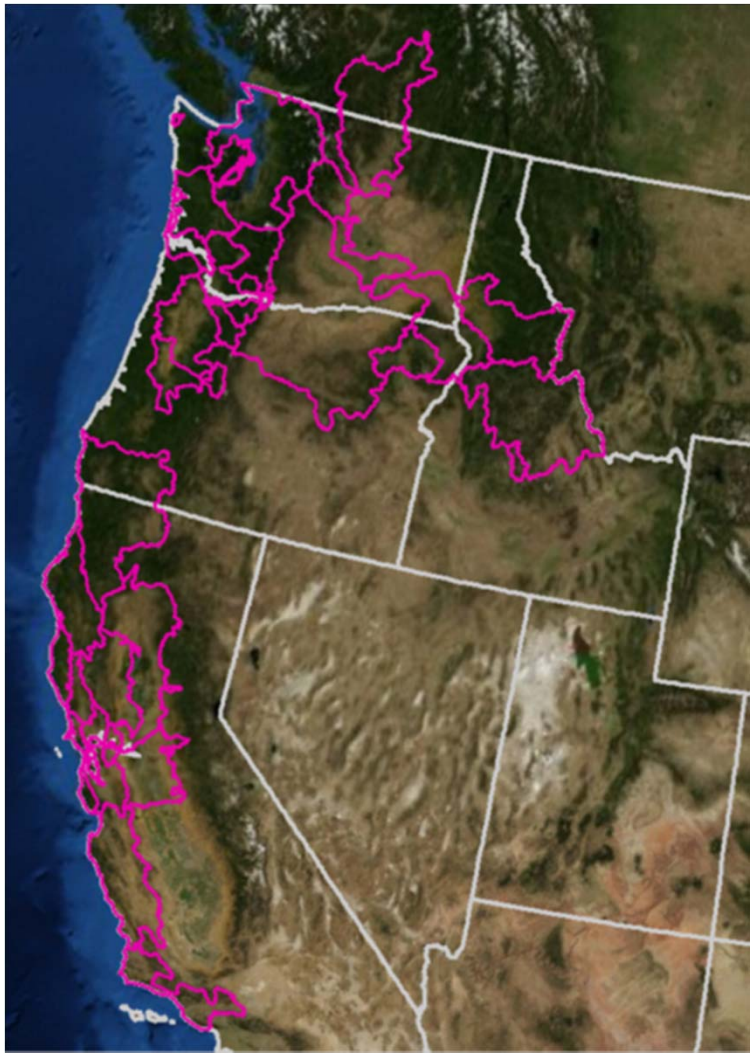
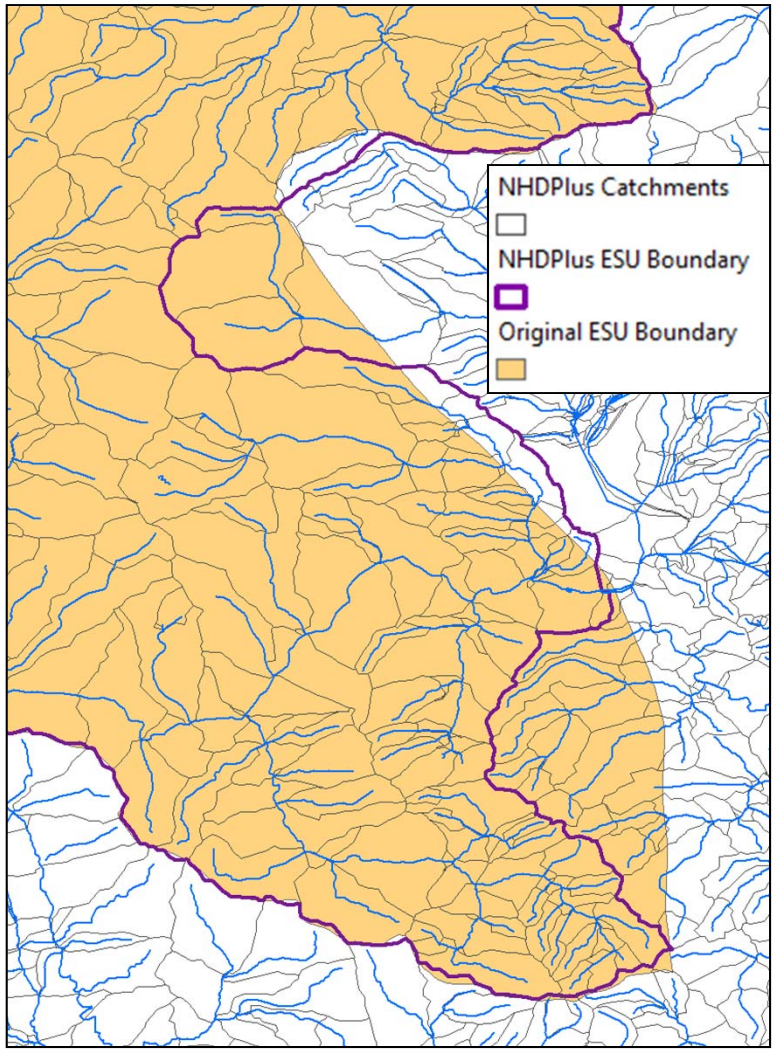
# Background: Objectives

- Apply a spatial analysis approach to refine the assessment of potential pesticide use site proximity to salmonid habitat areas across the 28 threatened and endangered Evolutionary Significant Units (ESUs) and Distinct Population Segments (DPSs).
- Design the spatial analysis approach to:
  - Utilize the best available spatial datasets of habitat areas and potential use sites
  - Allow a flexible assessment of potential use site proximity that provides for
    - Crop specific analysis
    - Variable proximity distance assessments



# Datasets: ESU/DPS Boundaries

- The study area was limited to the threatened and endangered ESUs/DPSs for five different salmonid species (chinook, steelhead, sockeye, coho, and chum) in Washington, Oregon, Idaho, and California.
- ESU/DPS boundaries were obtained from the NMFS.
- To allow for consistent spatial integration with the latest hydrography datasets, the ESU/DPS boundaries from NMFS were adjusted to conform with USGS NHDPlus catchment boundaries.




**Chinook CA Coastal ESU**



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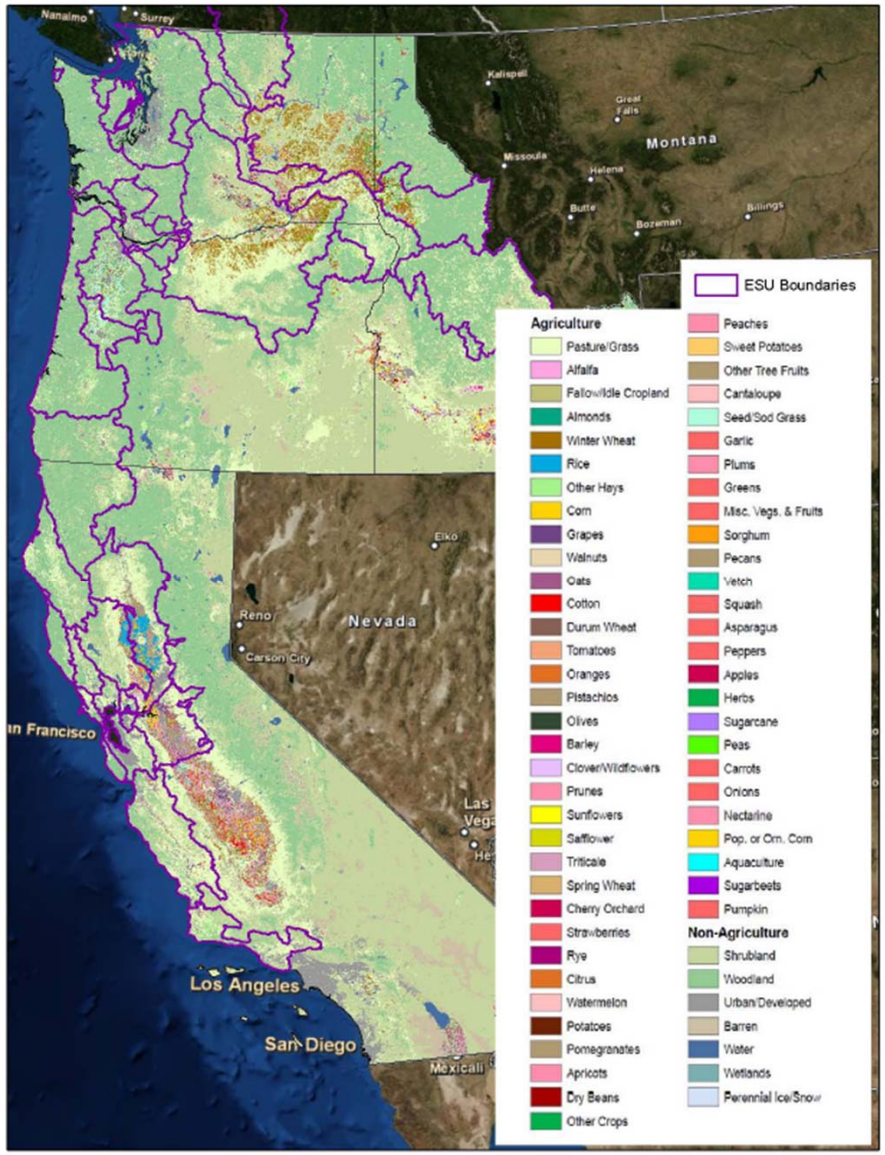
# Datasets: Potential Pesticide Use Sites

- Potential pesticide use sites were estimated based on the specific crops that the pesticide of interest is labeled for.
- The 2009 Cropland Data Layer (CDL) developed by USDA/NASS was used to identify the labeled crop areas.
  - 56-meter resolution
  - Over 200 different crop/land cover classifications
- CDL from 2007 was also used for a portion of the assessment to evaluate the temporal variability in the proximity assessment.



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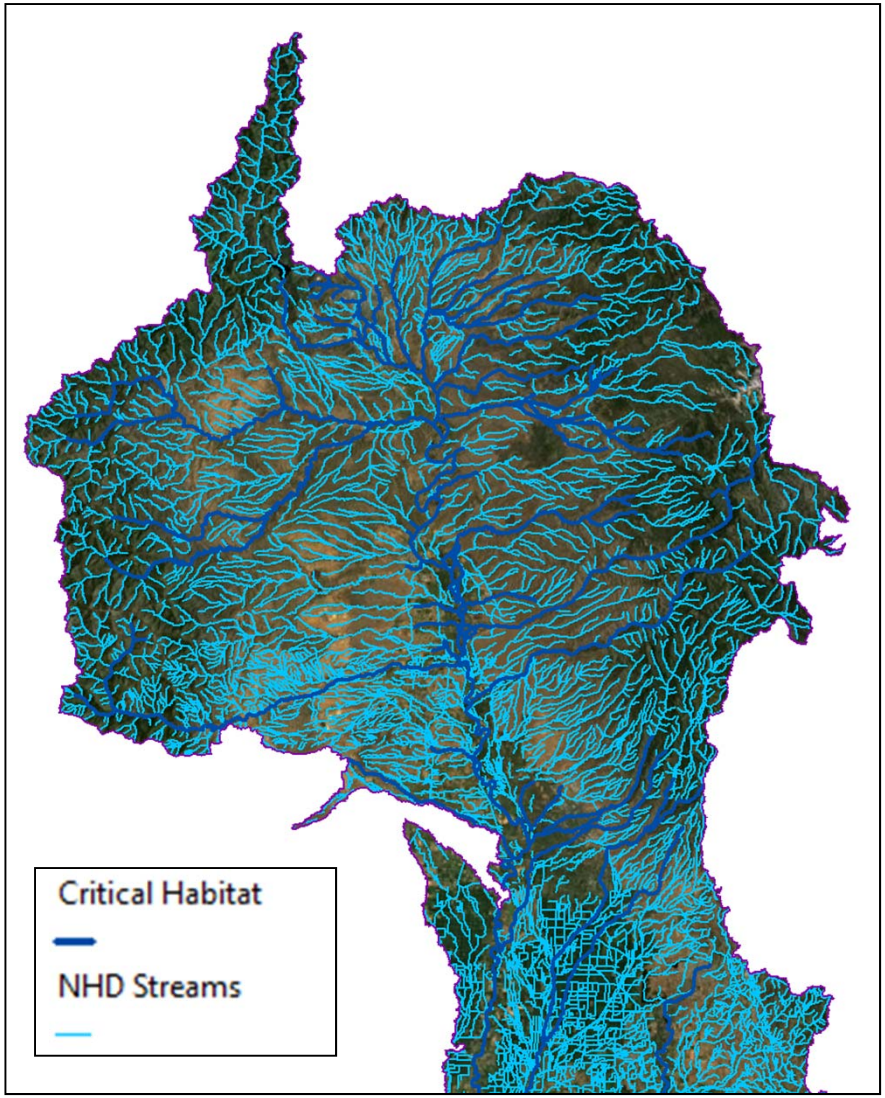
# Datasets: Salmonid Habitat, Critical Habitat Areas

- Critical Habitat Areas Definition:

  "… habitat areas occupied by salmon and steelhead as based on observation or the professional judgment of biologists familiar with the watershed as well as a few areas currently unoccupied but considered essential for the conservation of an ESU." (National Marine Fisheries Service, 2010)

- Critical Habitat Areas: NMFS has designated certain water bodies as critical habitat for 26 of the 28 threatened/endangered salmon ESU/DPSs; 21 of the 28 have digitized spatial data available.




Steelhead CA Central Valley DPS



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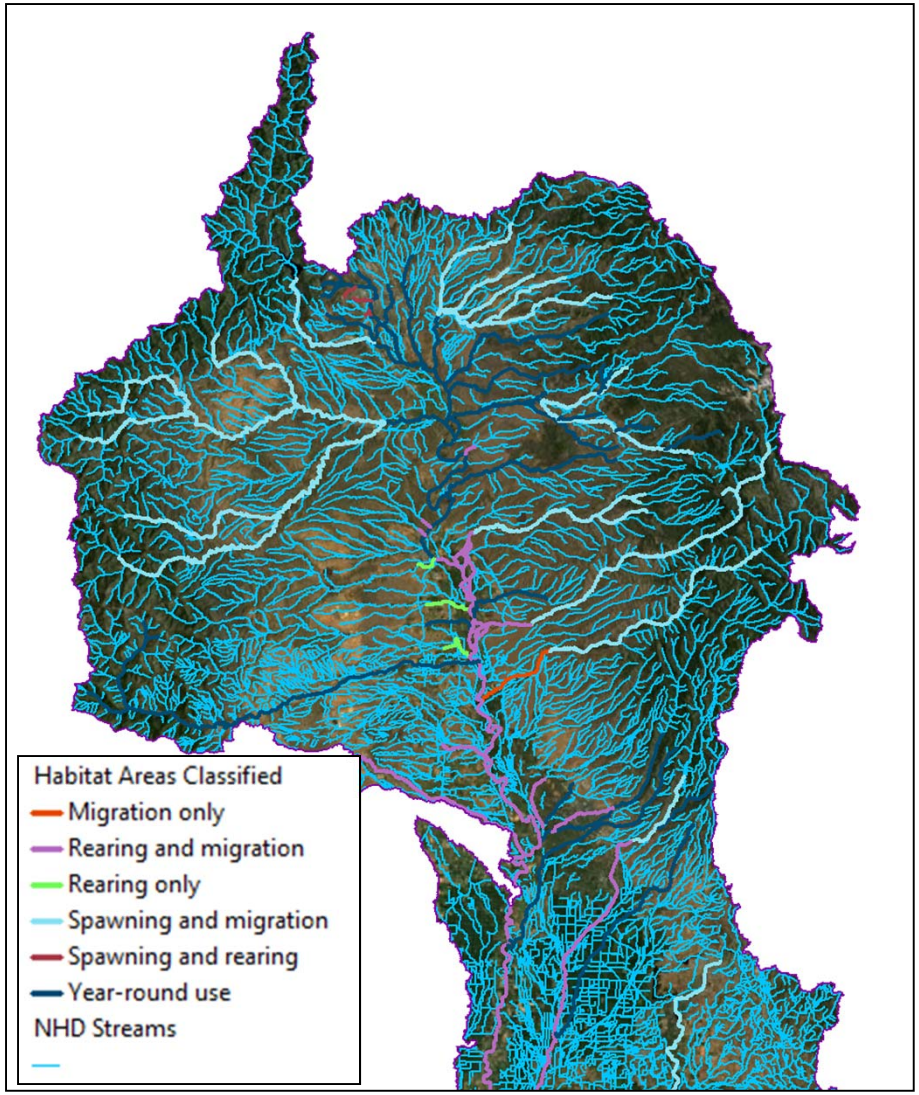
# Datasets: Salmonid Habitat, Primary Constituent Elements & Habitat Areas

- NMFS has designated certain freshwater and estuarine water bodies as Primary Constituent Elements (PCEs) & habitat areas within the ESUs/DPSs (see http://www.nwr.noaa.gov/Salmon-Habitat/Critical-Habitat/CH-GIS-Data.cfm for description).
- This data has been classified into specific habitat types in 26 of the ESUs, which includes the following designations:
  - Spawning
  - Rearing
  - Migrating




**Steelhead CA Central Valley DPS**



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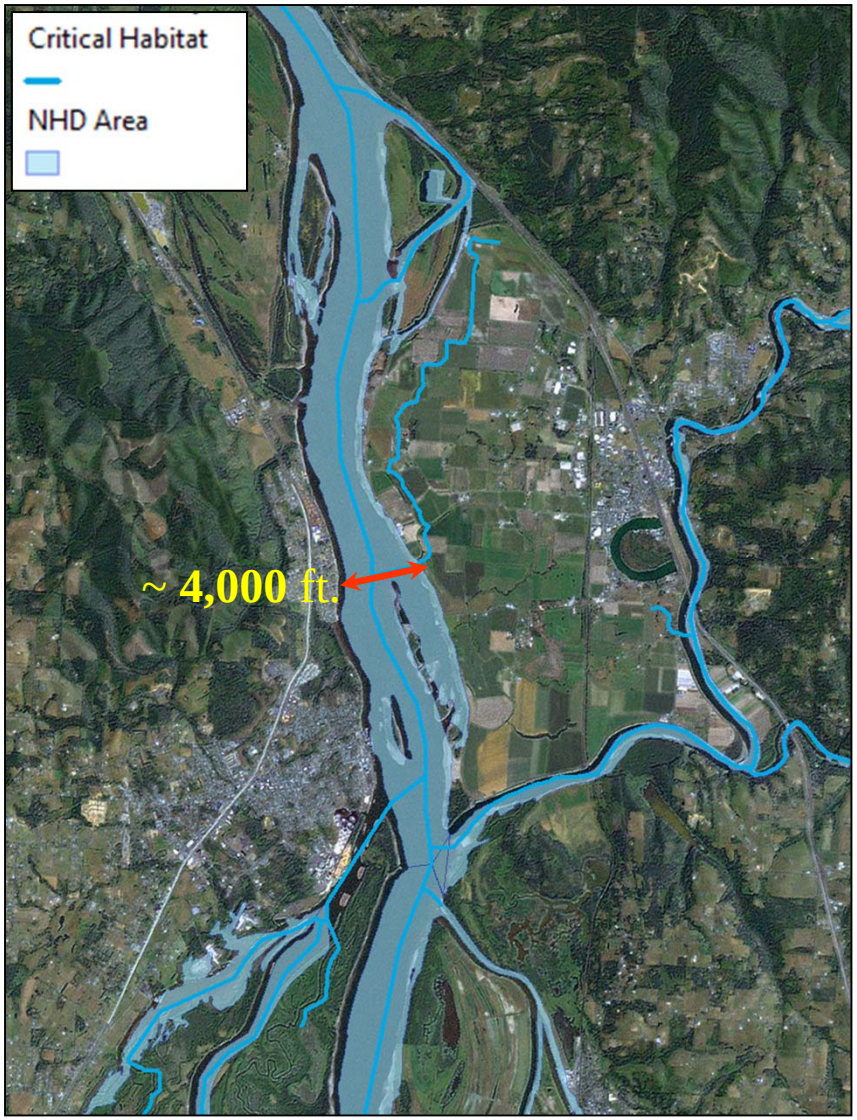
# Datasets: Salmonid Habitat, Incorporation of NHDPlus

- NHDPlus contains both linear (narrow streams and rivers) and area hydrologic features (wide rivers, ponds, and impoundments)
- The Critical Habitat Area and Primary Constituent Element/habitat area datasets represent all freshwater bodies as linear features.
- NHDPlus area features were used to improve the spatial representation of the CHA and PCE linear features.
- This update gave a more accurate and conservative estimation of proximity to habitat.




Chinook Lower Columbia ESU



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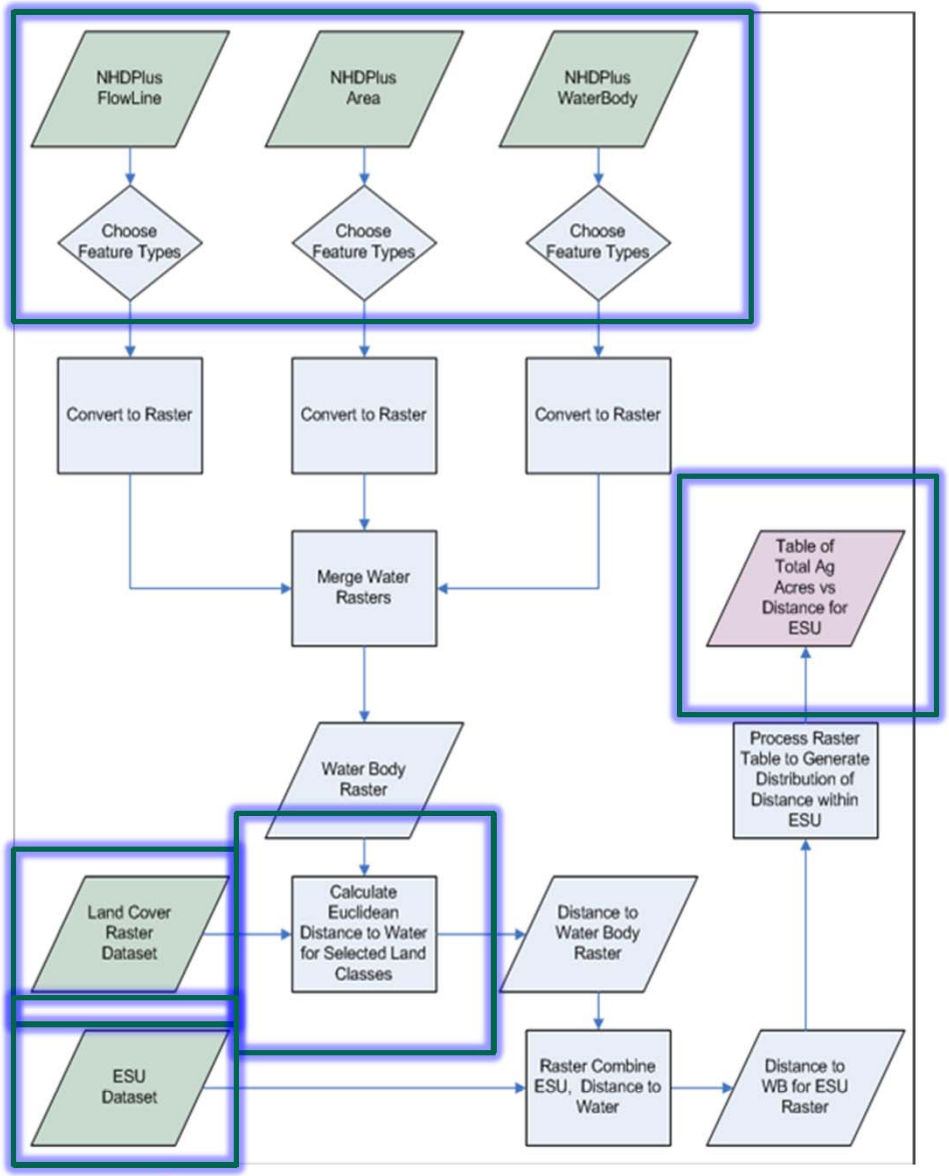
# Spatial Analysis: Methodology

- Allow the selection of water body classes in the analysis based on a feature attribute or use a pre-built water body raster dataset.
- Allow use of any raster dataset to represent potential pesticide use sites.
- For each potential use site pixel, determine the closest distance to a surface water body of interest using a Euclidean distance calculation.
- Process ESUs independently.
- Generate cumulative distribution functions of cultivated cropland area as a function of distance.

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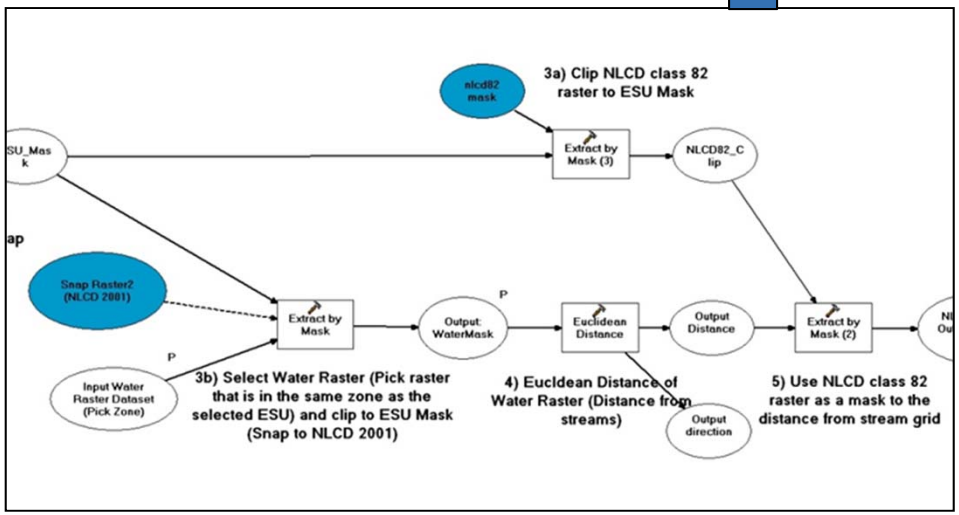
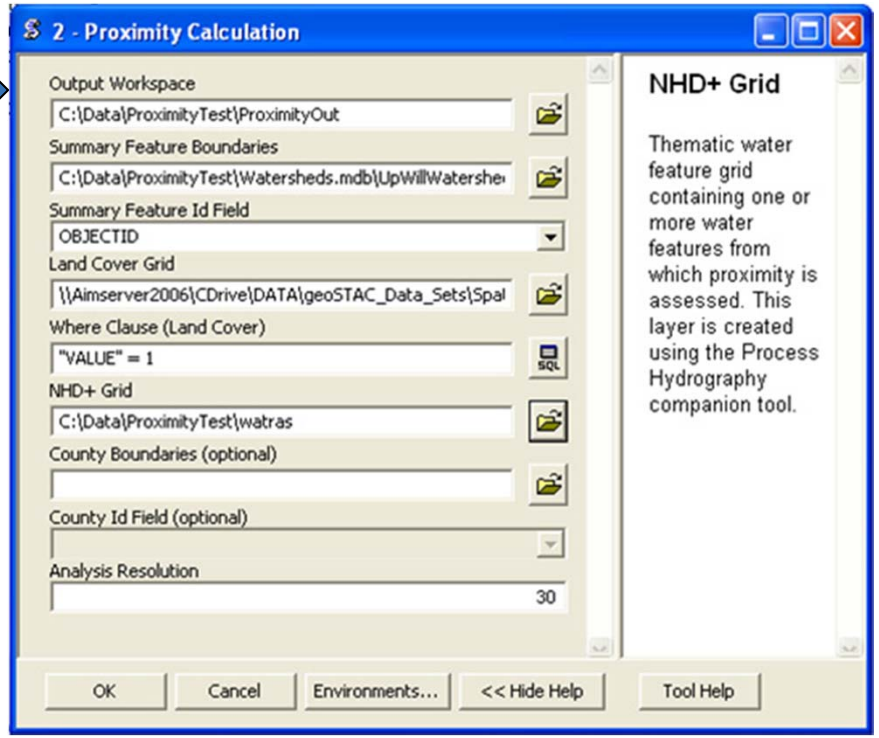
# Spatial Analysis: Implementation

- The spatial analysis methodology was built using ArcGIS Model Builder.
- The model was then converted to and customized as a python script tool, then further modified to allow it to be run from a “batch file” to support continuous execution of numerous scenarios.



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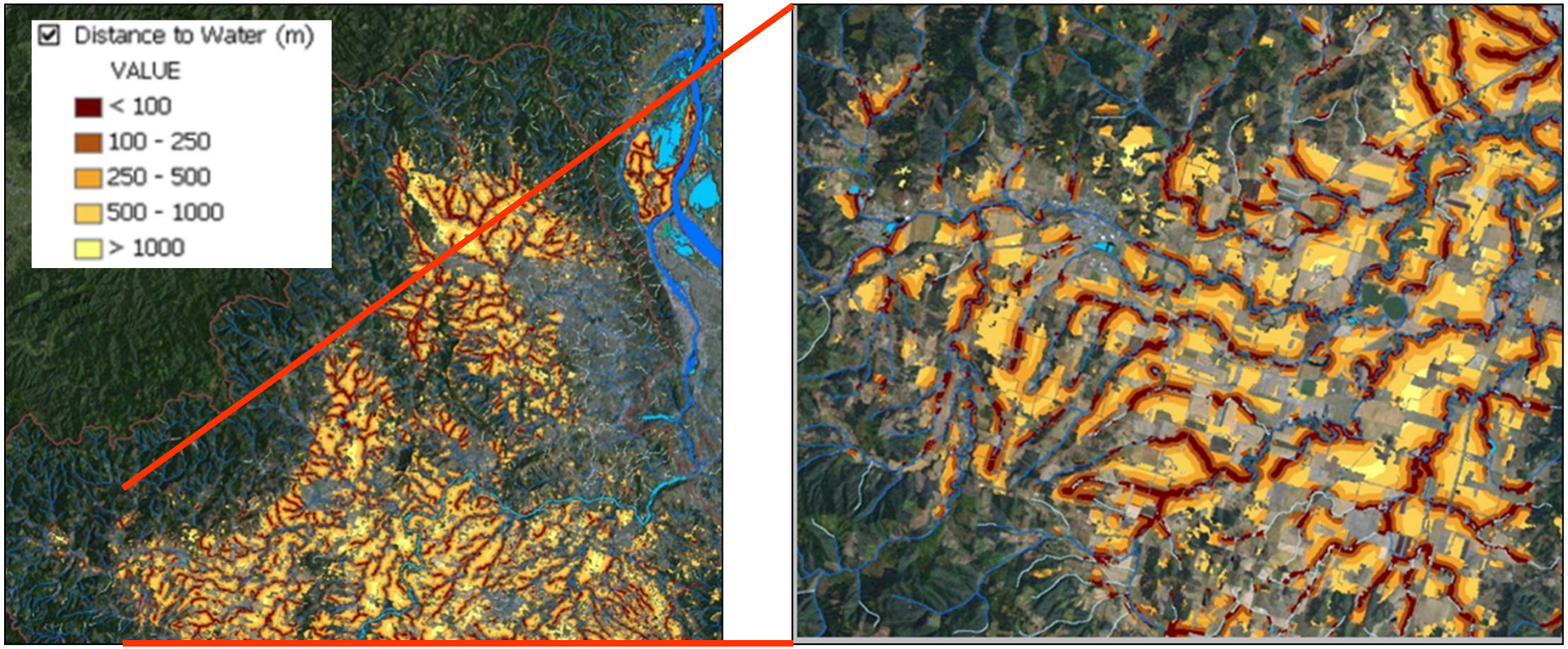
# Spatial Analysis: Spatial Outputs

- GIS raster datasets of input water body features and the proximity to water for all potential pesticide use sites of interest are generated as output.
- Output resolution is equal to the input potential use site resolution (28-meters in this study)



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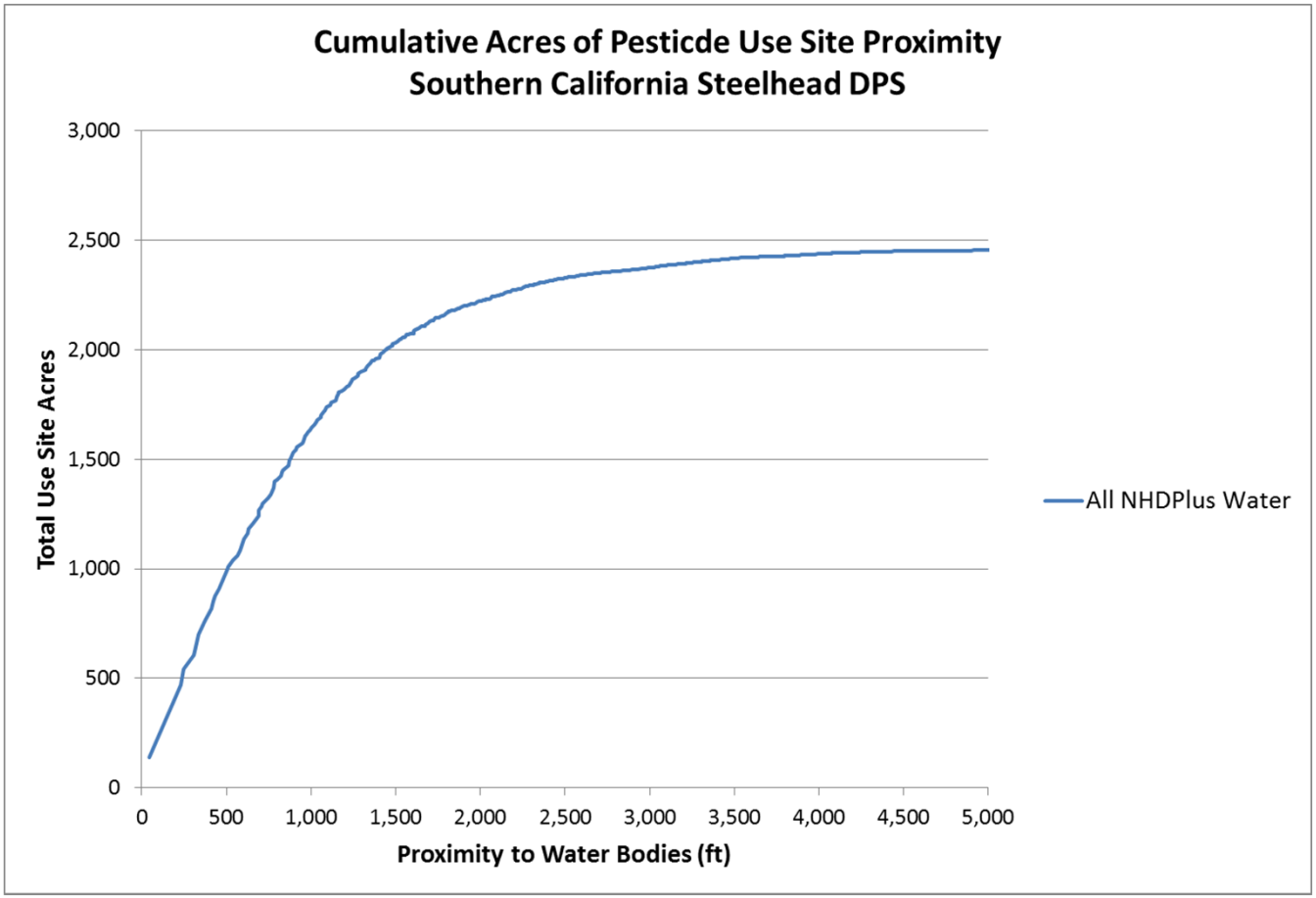
# Spatial Analysis: Tabular Outputs

- Cumulative distribution functions of potential pesticide use site proximity to water bodies allow an assessment of acreage at any buffer distance of interest.

- The analysis provides total acreage, incremental acreage, and an understanding of the structure of the spatial variability of use site proximity to water / habitat across an entire ESU.



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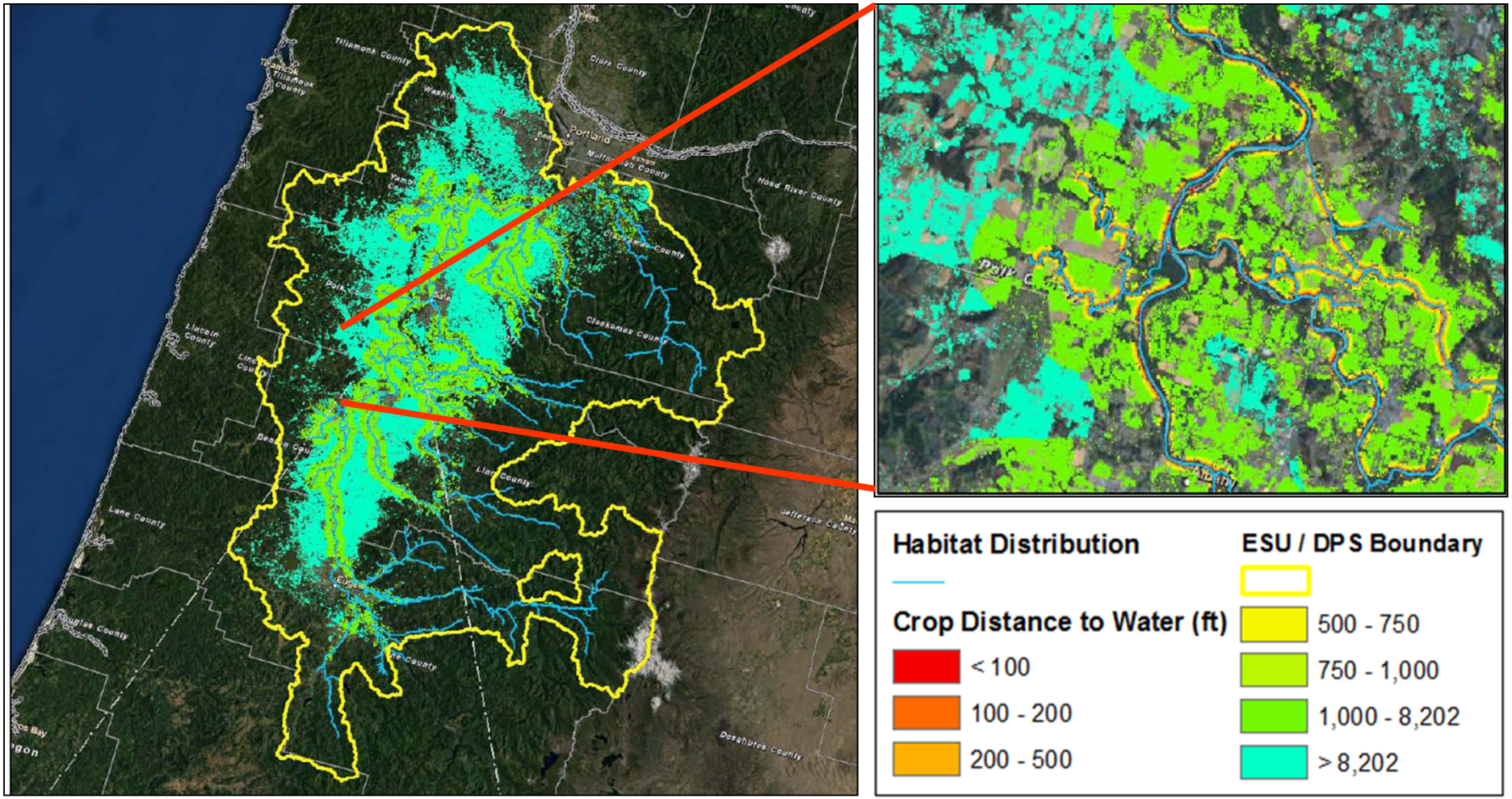
# Assessment Results: Upper Willamette Chinook ESU

- For the ESUs/DPSs with high acreage of potential use sites, the majority of the acreage was greater than 2,500 m. (8,200 ft.) beyond salmonid habitat areas.



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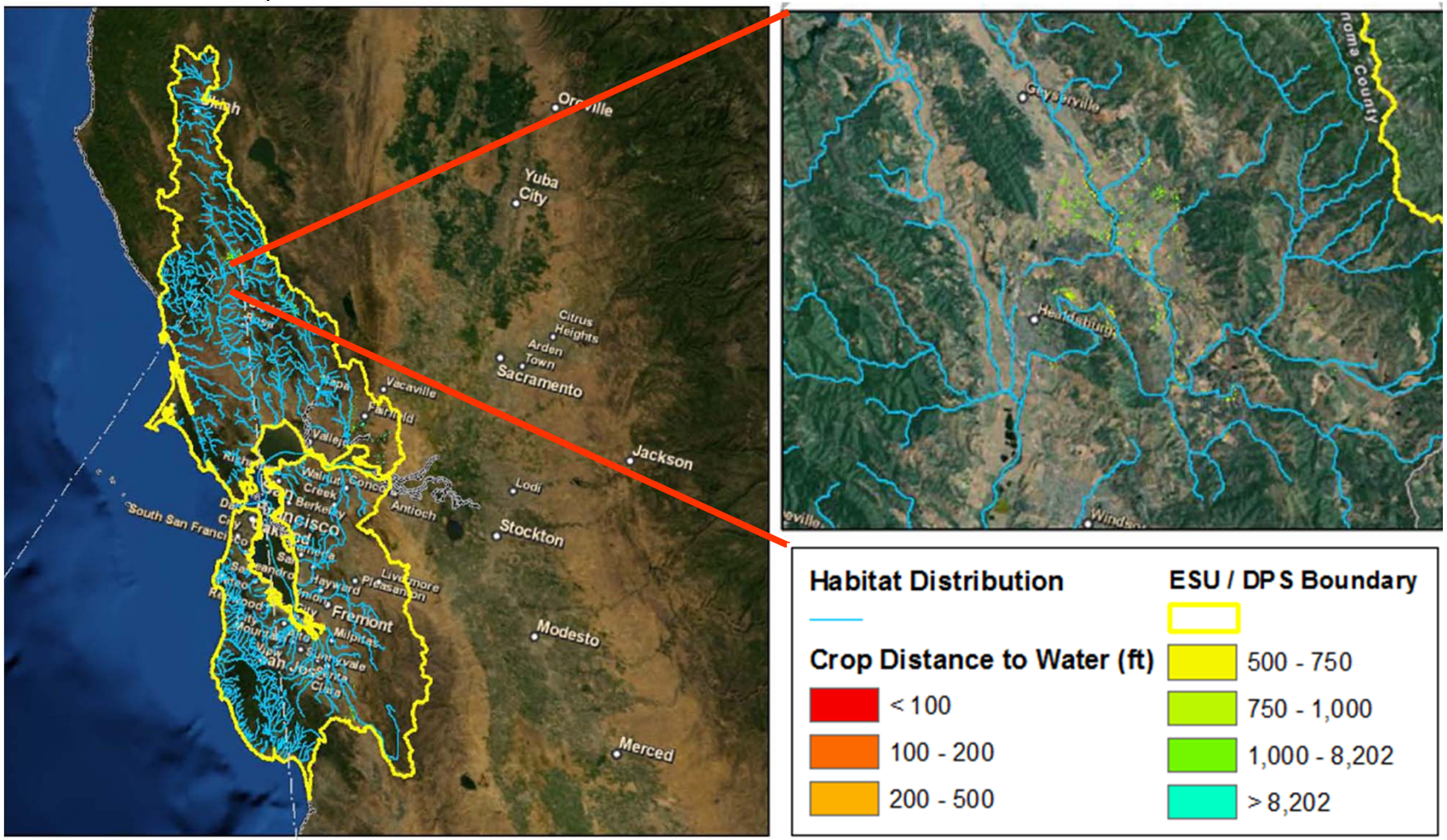
# Assessment Results: Central California Coast Steelhead DPS

- Several ESUs/DPSs had very small potential use site areas … less than 0.1% of the area within 2,500 m of salmonid habitat.



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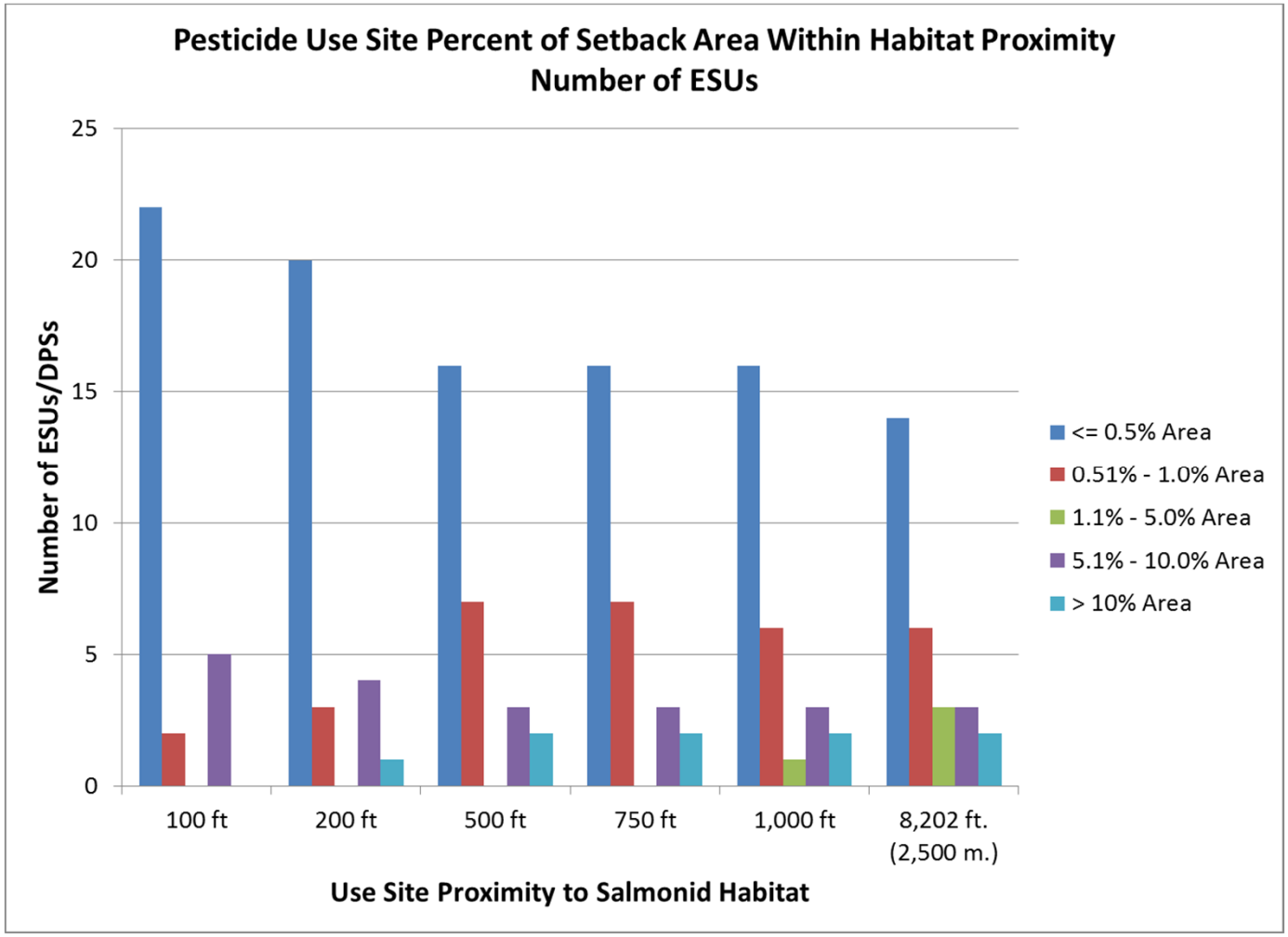
# Assessment Results: Summary of Potential Use Site Proximity, All ESUs

- For the majority of ESUs and the pesticide of interest, potential use sites represent less than 1% of the area within 2,500 m. from salmonid habitat.



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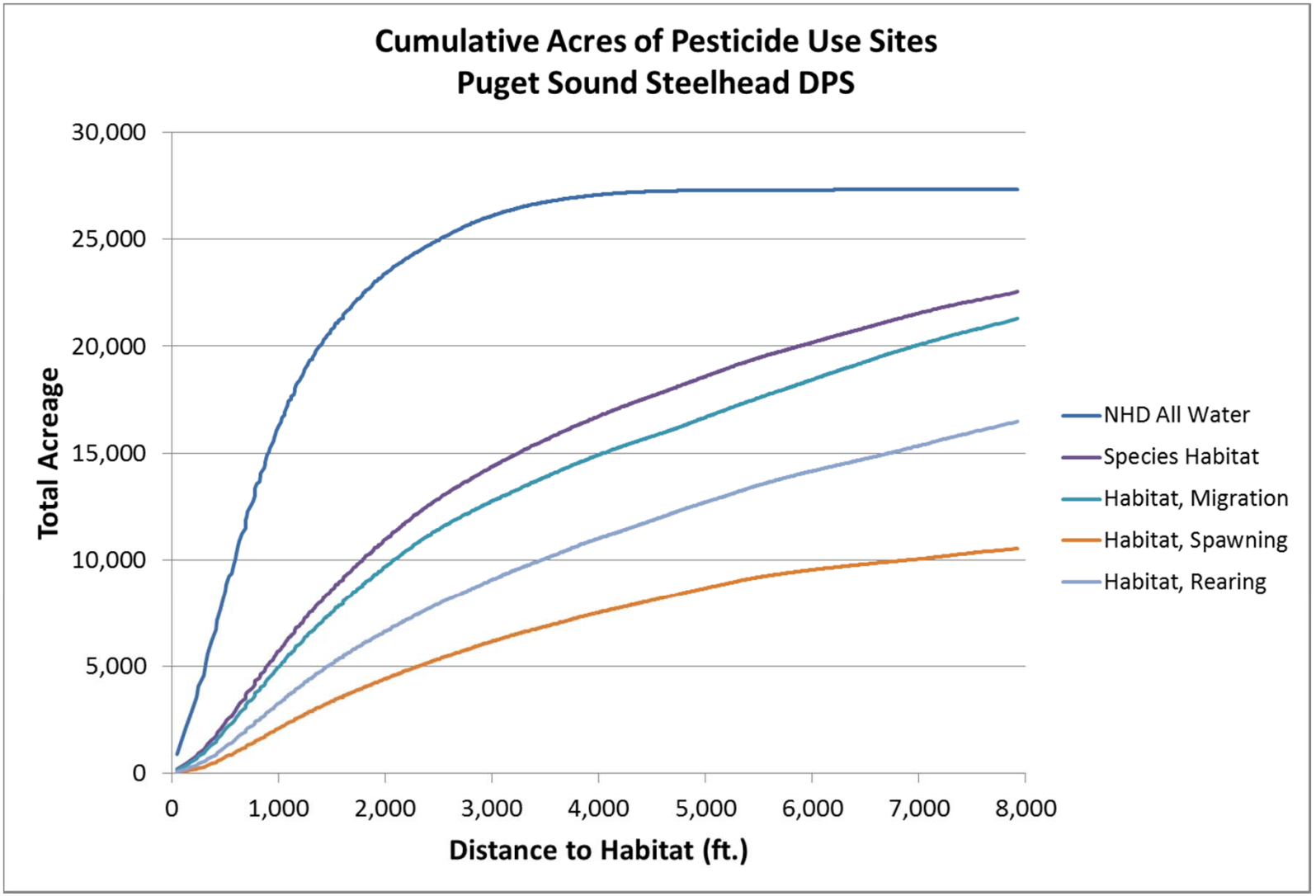
# Assessment Results: Cumulative Distribution by Habitat Classification

- The proximity of potential use sites to different habitats was assessed by ESU.



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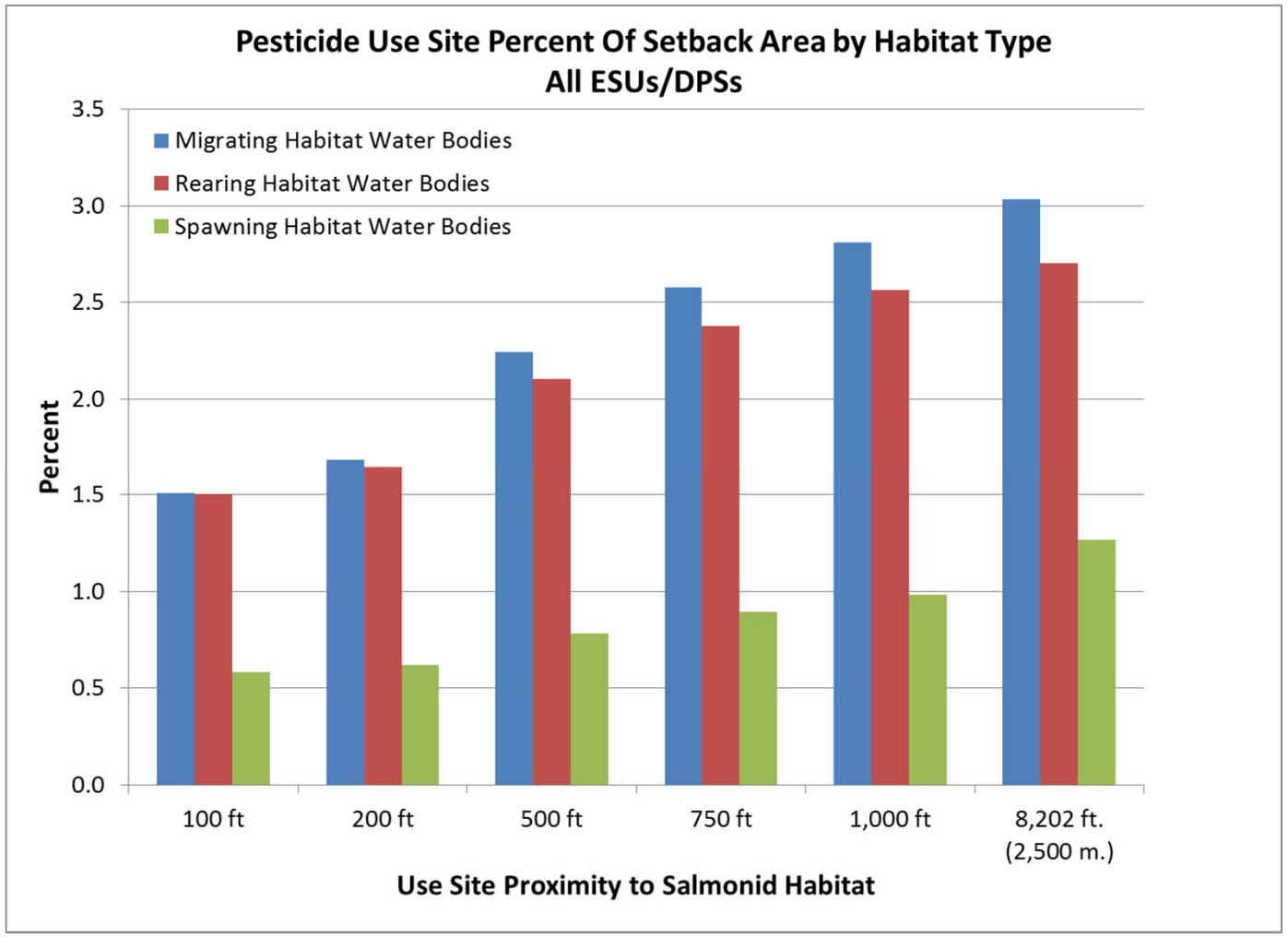
# Results: Potential Use Site Intensity Variability by Habitat Classification

- Pesticide use intensity near spawning habitat is 60% - 65% less than use intensity near migrating habitat.



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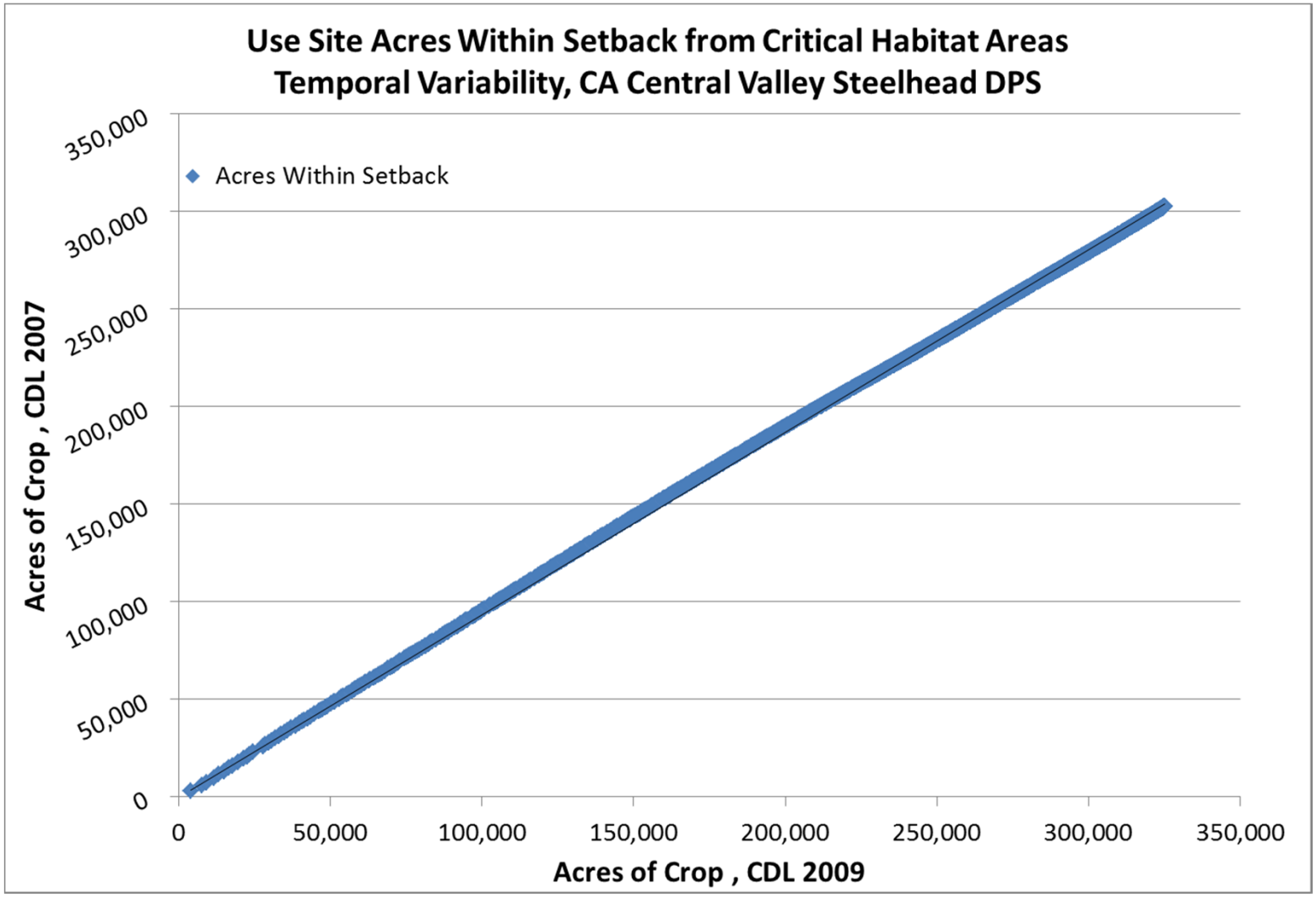
# Assessment Results: Temporal Variability in Potential Use Site Intensity

- Potential pesticide use site acreage for 2007 and 2009 are very similar.



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# Summary and Conclusions

- A GIS-based methodology was developed for evaluating potential pesticide use site proximity to water bodies and was applied to assess salmonid habitat.
- The assessment incorporated crop-specific data and salmonid habitat classifications (in 26 of 28 ESUs/DPSs), allowing for independent analysis of water bodies supporting migrating, spawning, and rearing life stages.
- The majority of ESUs had very low potential use areas within close proximity to salmonid habitat, with only 6 of the 28 ESUs having >1% intensity within 1,000 ft. of these habitats.
- On average, potential use site intensity within 1,000 ft. of spawning habitat was approximately 40% of the area within 1,000 ft. of migrating and rearing habitat.
- The use of crop specific and habitat specific hydrography data results in a more accurate assessment of potential pesticide exposure resulting from proximity to potential use sites.