

LYR M&E Plan Spatial Structure

Geomorphic Observational Data and Analysis

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LYR Geomorphic Observational Suite

- **Flow Regime** (LYR Accord flow schedule.)
 - Gaging stations: LYR@Smartville (#11418000), LYR@Marysville (#11421000), and Deer Creek (#11418500)
 - Dry Creek releases upon request to BVID (no downstream gages)
 - Feather River @ Gridley (GRL) gage for downstream backwater effects.
 - 5 stage-discharge rating locations using water level loggers.
- **Topography**
 - Site-based mapping 1896-present in support of individual projects
 - Comprehensive mapping of mainstem LYR in 1999 by USACE
 - New Years 2006 flood overhauled river, necessitating new map
 - 2006 TBR map, 2007 EDR map. 2008 LIDAR flight, 2008-2009 map the rest
- **Substrate**
 - Site-based mapping 1896-present in support of individual projects
 - 2010 visual substrating mapping of whole river within ~5000 cfs wetted area.
- **Cover (including riparian vegetation)**
 - Site-based mapping in recent years in support of individual projects.
 - 2008 imagery with 1' resolution for cover mapping in GIS

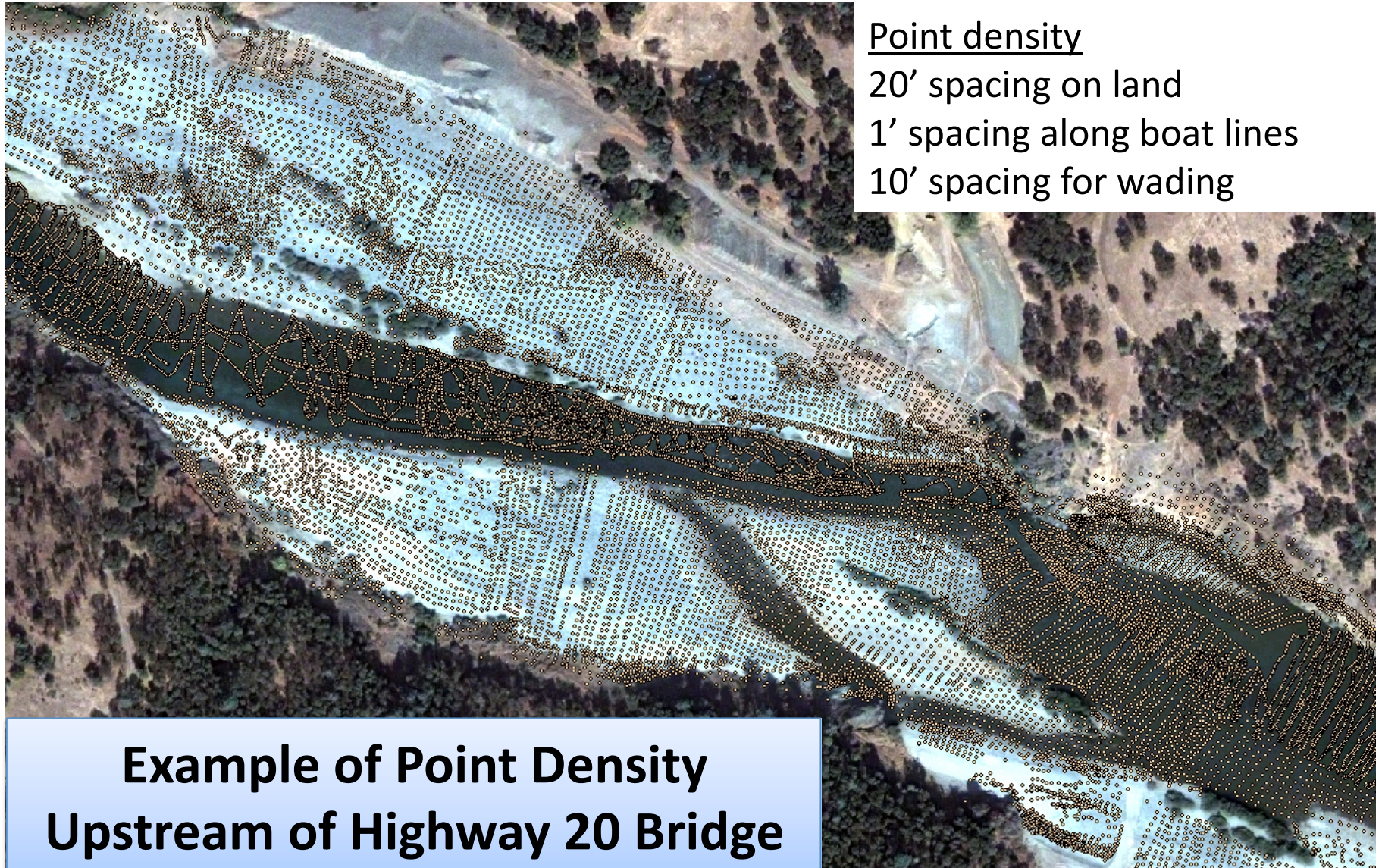
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Surveying Methods Upstream of Highway 20 Bridge

- Benchmarks established using RTK GPS and NOAA OPUS.
- Single-beam echosounder survey by Environmental Data Solutions (EDS).
- Robotic total station surveys of land and unboatable waters by UC Davis LAWR



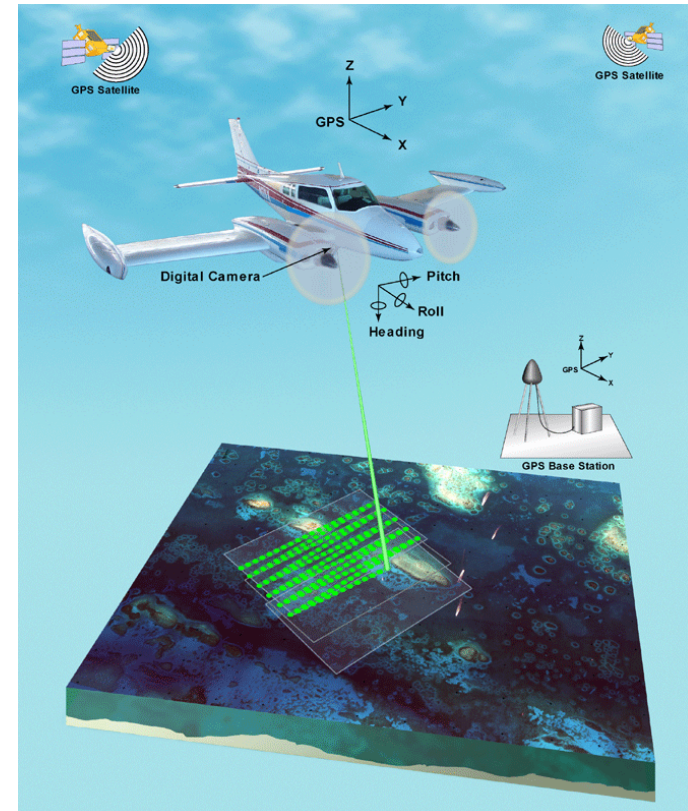
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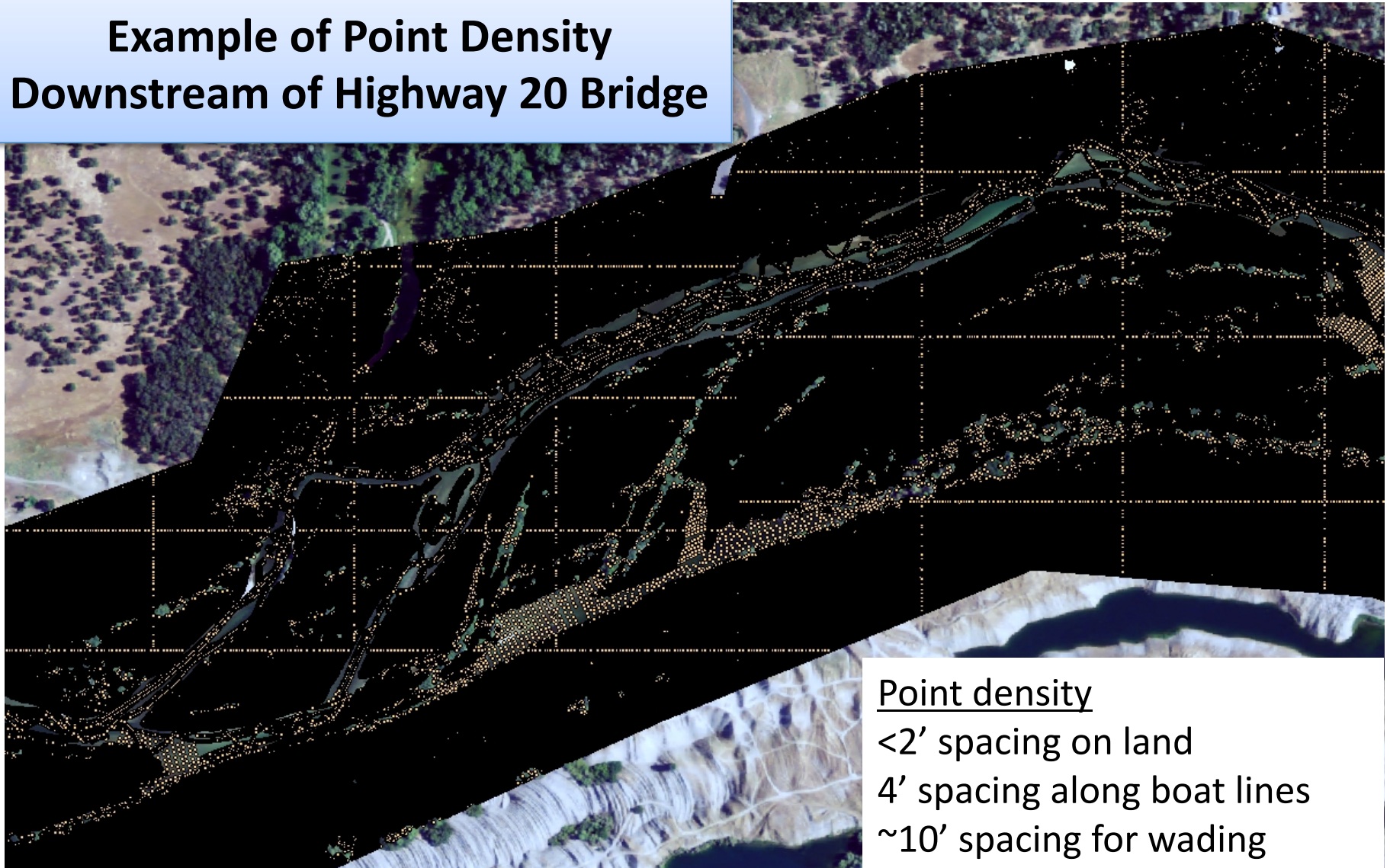
Surveying Methods Downstream of Highway 20 Bridge

- Benchmarks established using RTK GPS and NOAA OPUS.
- 4-beam echosounder survey by EDS.
- Airborne LIDAR survey by Aerometrics, Inc.
- Robotic total station and RTK GPS surveys by RMT, CBEC, and EDS.



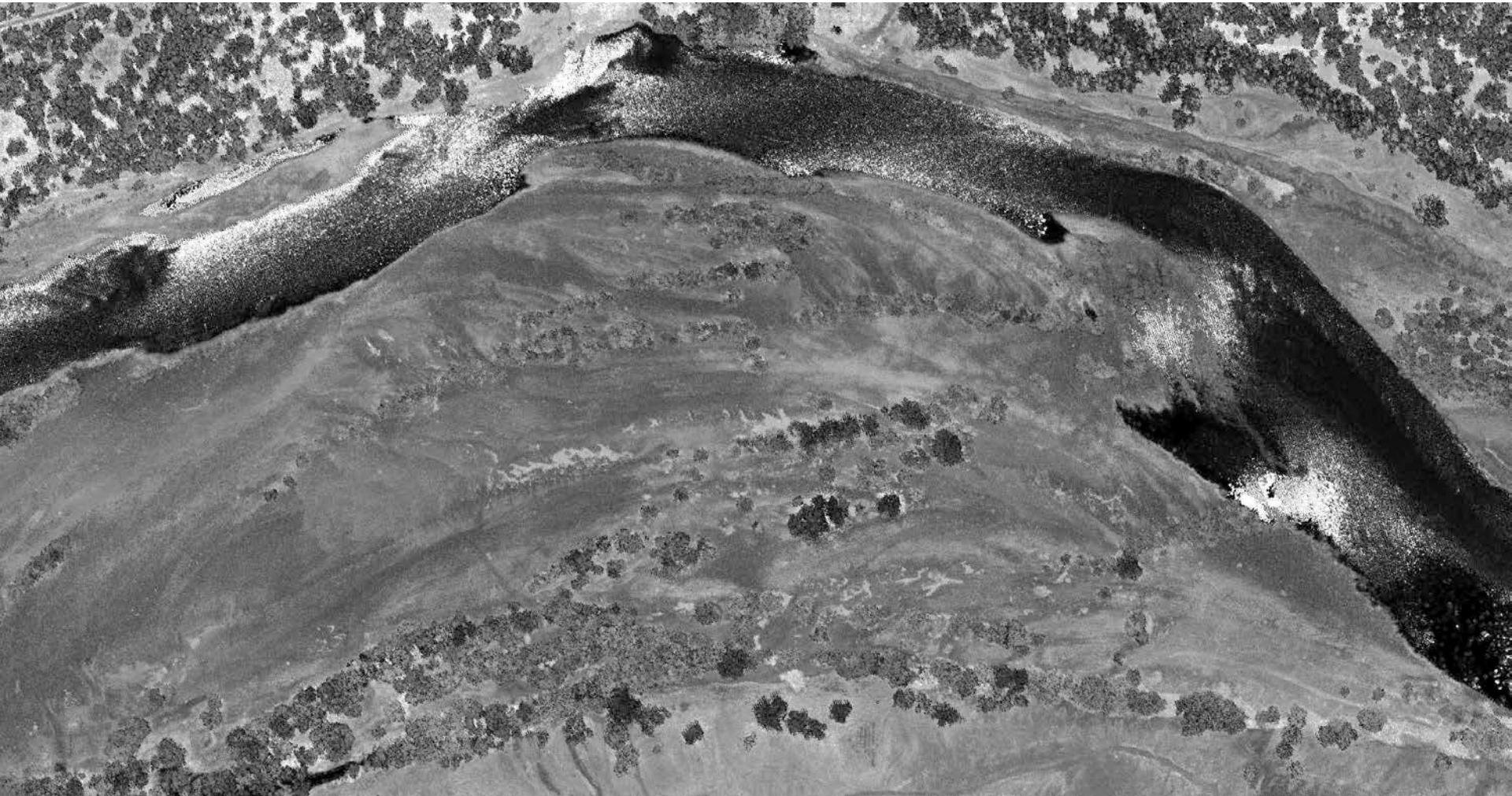
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Example of Point Density Downstream of Highway 20 Bridge



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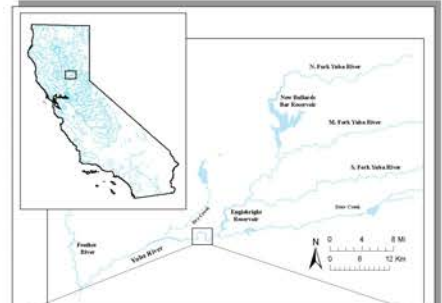
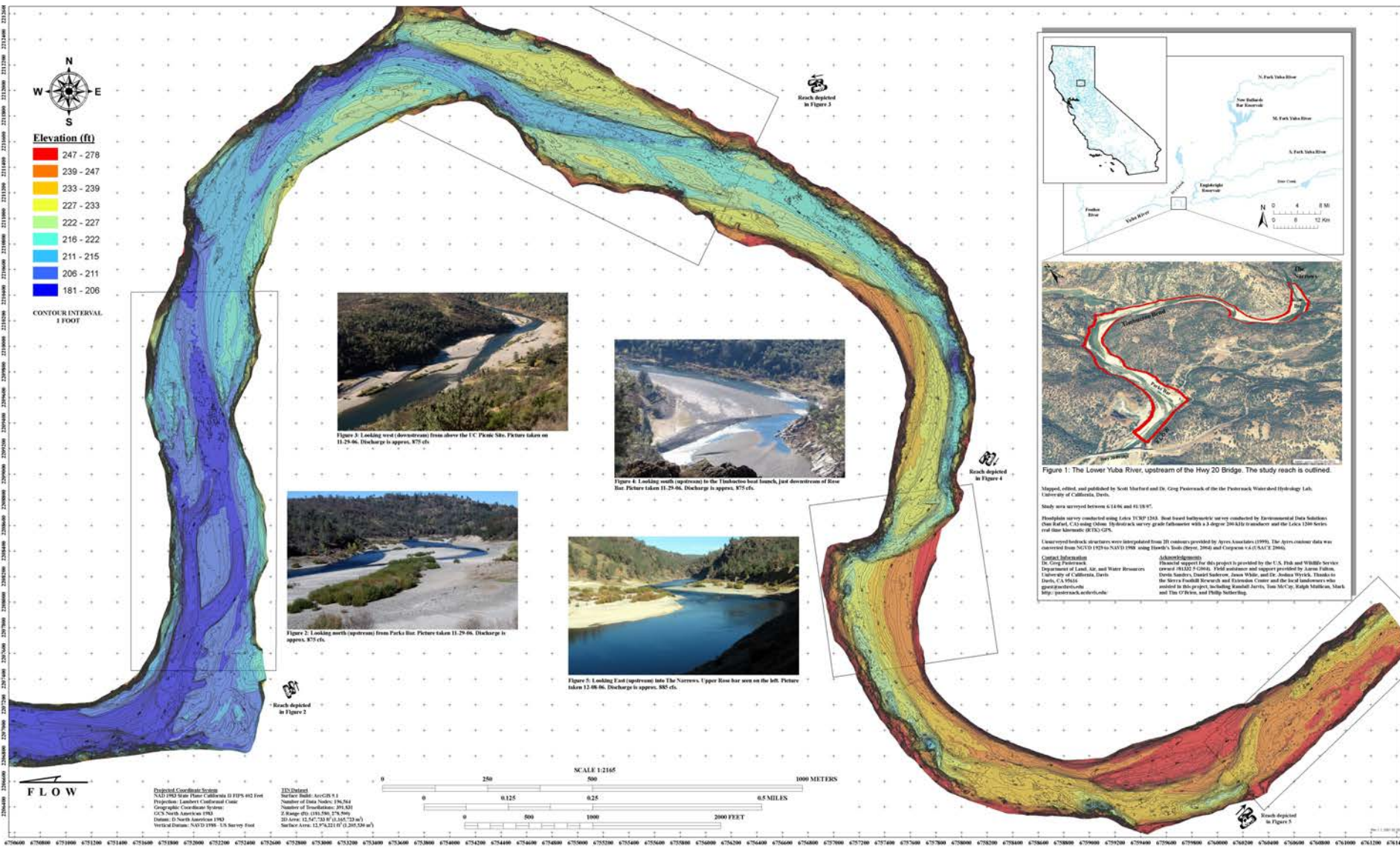
Example of LIDAR Intensity Imagery



Topographic Map Production

- **Create important point and polygon shapefiles**
 - Shoreline, ponds, islands, data-gap areas, map boundary
- **Separate LIDAR points into land and water sets**
- **Intercompare LIDAR, ground, and boat data and do QA/QC**
 - Check geodetic datums and coordinate systems
 - Use spatial join to locate proximal points and calculate deviations
- **Build preliminary terrain in ArcGIS and do more QA/QC**
 - Iteratively remove questionable points and rebuild terrain.
 - Augment terrain with a few artificial points and breaklines as needed.
- **Build final terrain and conduct point density analysis**
 - Density categories are 2x2 ft², 5x5 ft², 10x10 ft², 20x20 ft², and 50x50 ft²

Timbuctoo Bend Topographic Map



Mapped, edited, and published by Scott Thorford and Dr. Greg Pastreich of the Pastreich Watershed Hydrology Lab, University of California, Davis.

Study area surveyed between 6/14/06 and 8/18/07.

Photogrammetry was conducted using Leica 3530 12A3. Best based bathymetry was very conducted by Environmental Data Solutions (now AECOM), CA using a Hobas survey grade echosounder with a 2 degree 200 kHz transducer and the Leica 1200 scanner real time kinematic (RTK-GPS).

LiDAR derived bathymetry was interpolated from 2D contours provided by Aeres Associates (1999). The Aeres contour data was extracted from NAD 83 UTM Zone 18N using ArcView 3.2a and ArcToolbox v. 9.3.1.

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Sample of the LYR Digital Terrain Model

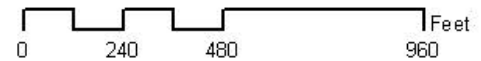
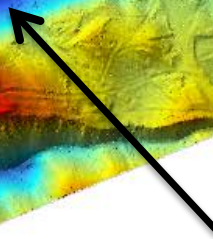
Dry Creek



flow

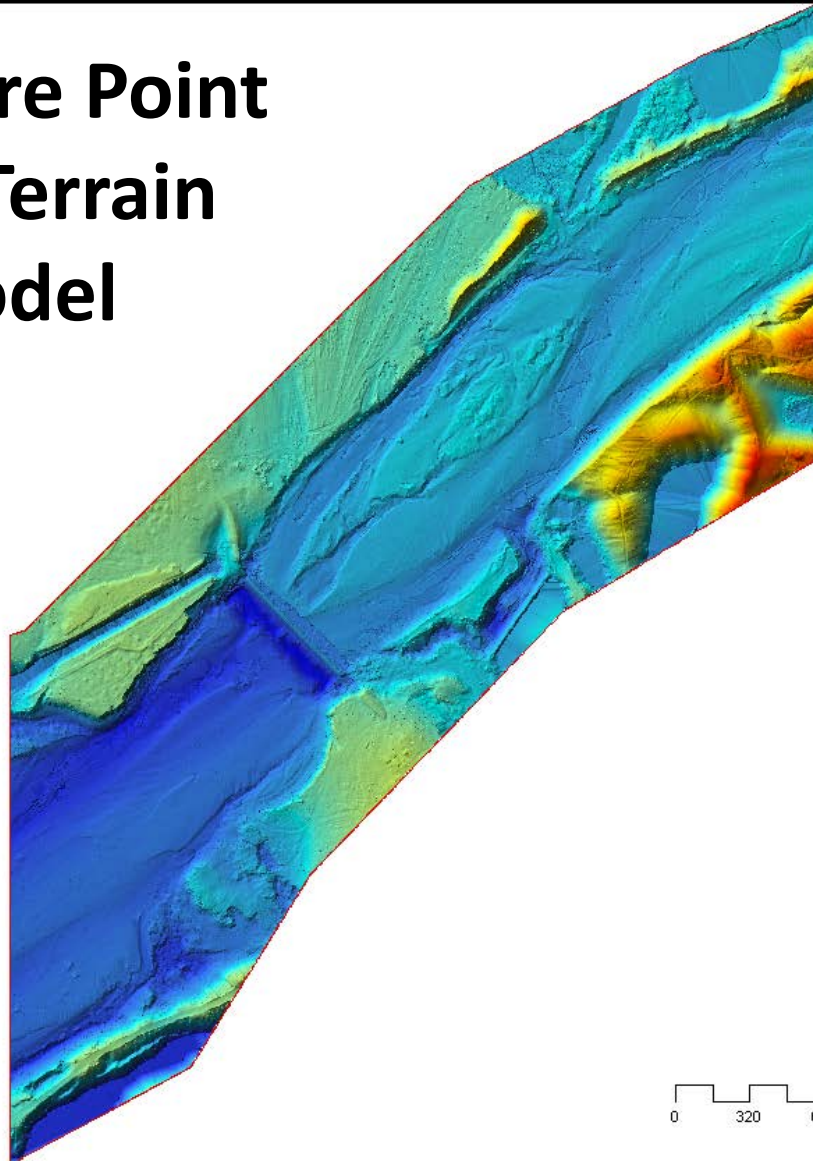


Hammon
Backwater



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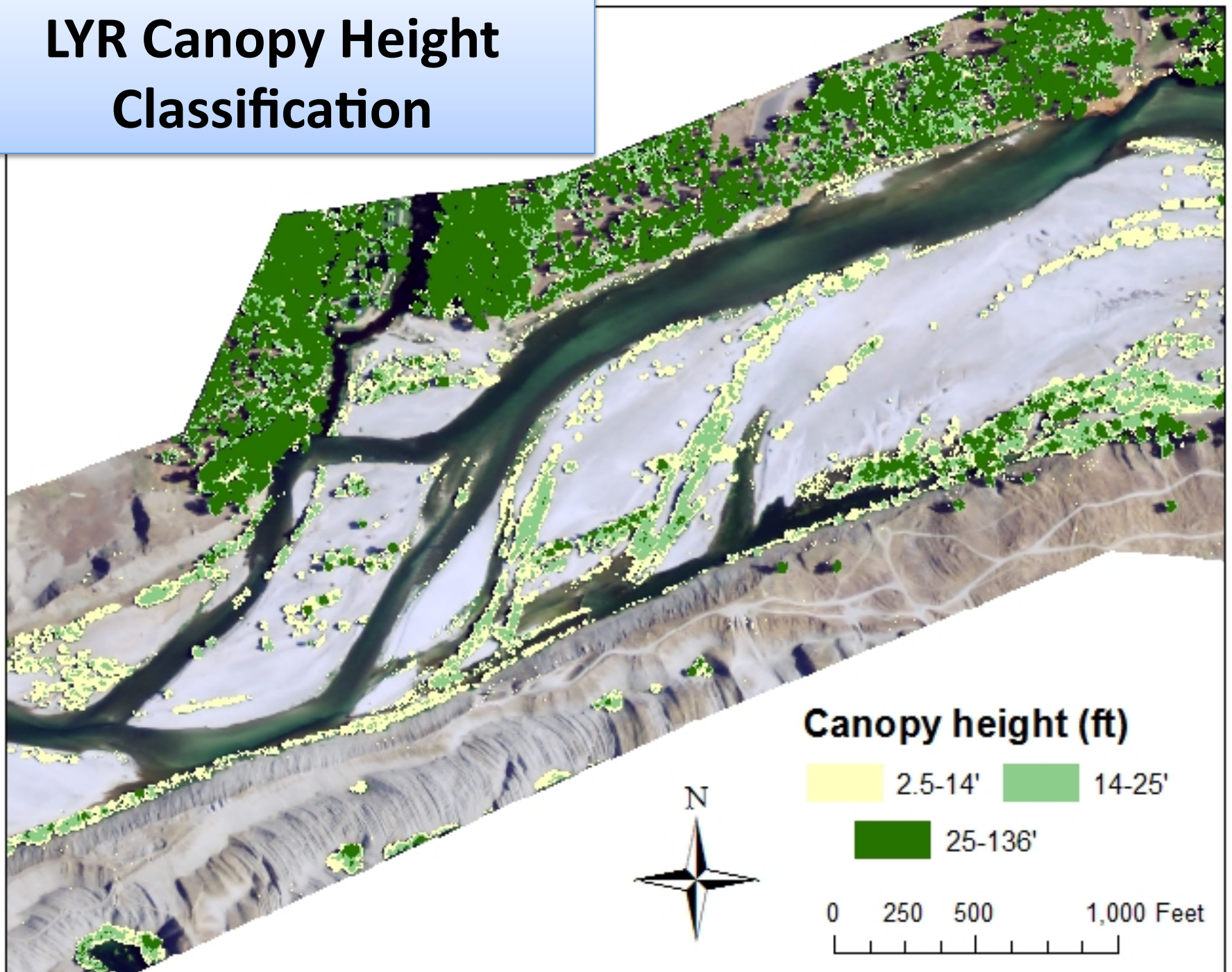
Daguerre Point Dam Terrain Model



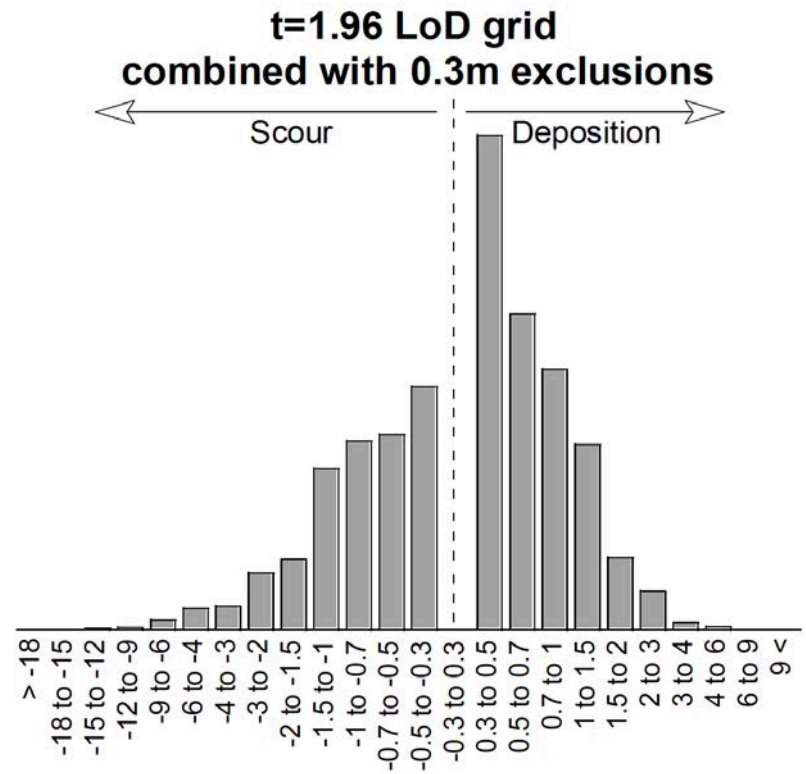
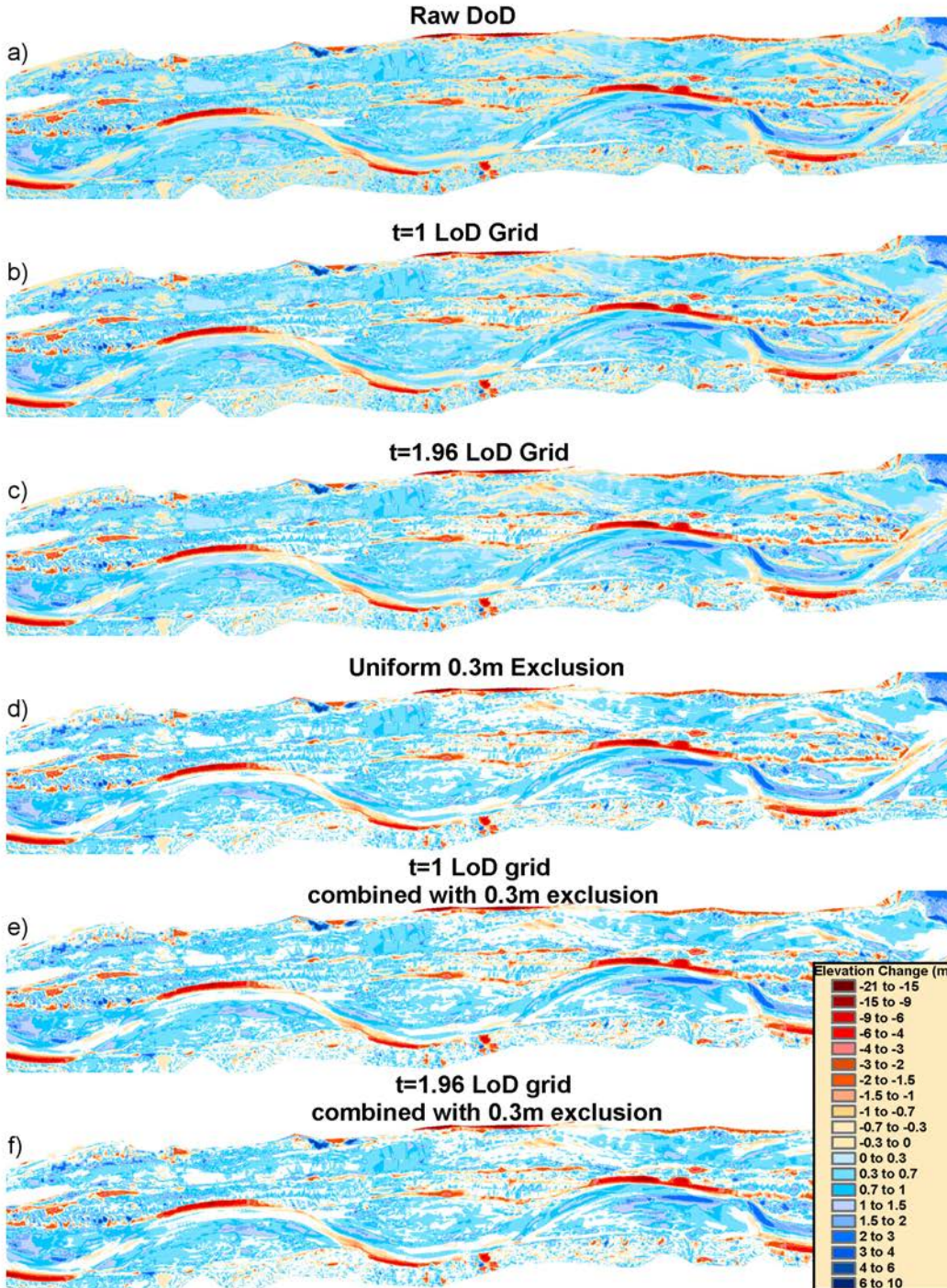
Significant LYR Map Products

- LYR topographic map (gap in Narrows)
 - Longitudinal profile
 - Slope-detrended relief map
- 1-m rasters of vegetation presence/absence and canopy-height (Highway 20 to mouth)
 - Englebright to Highway 20- vegetation presence/absence polygons
- 1999-2009 topographic change map (5-ft raster)
 - comprehensive uncertainty analysis
- Substrate and covers maps (pending)

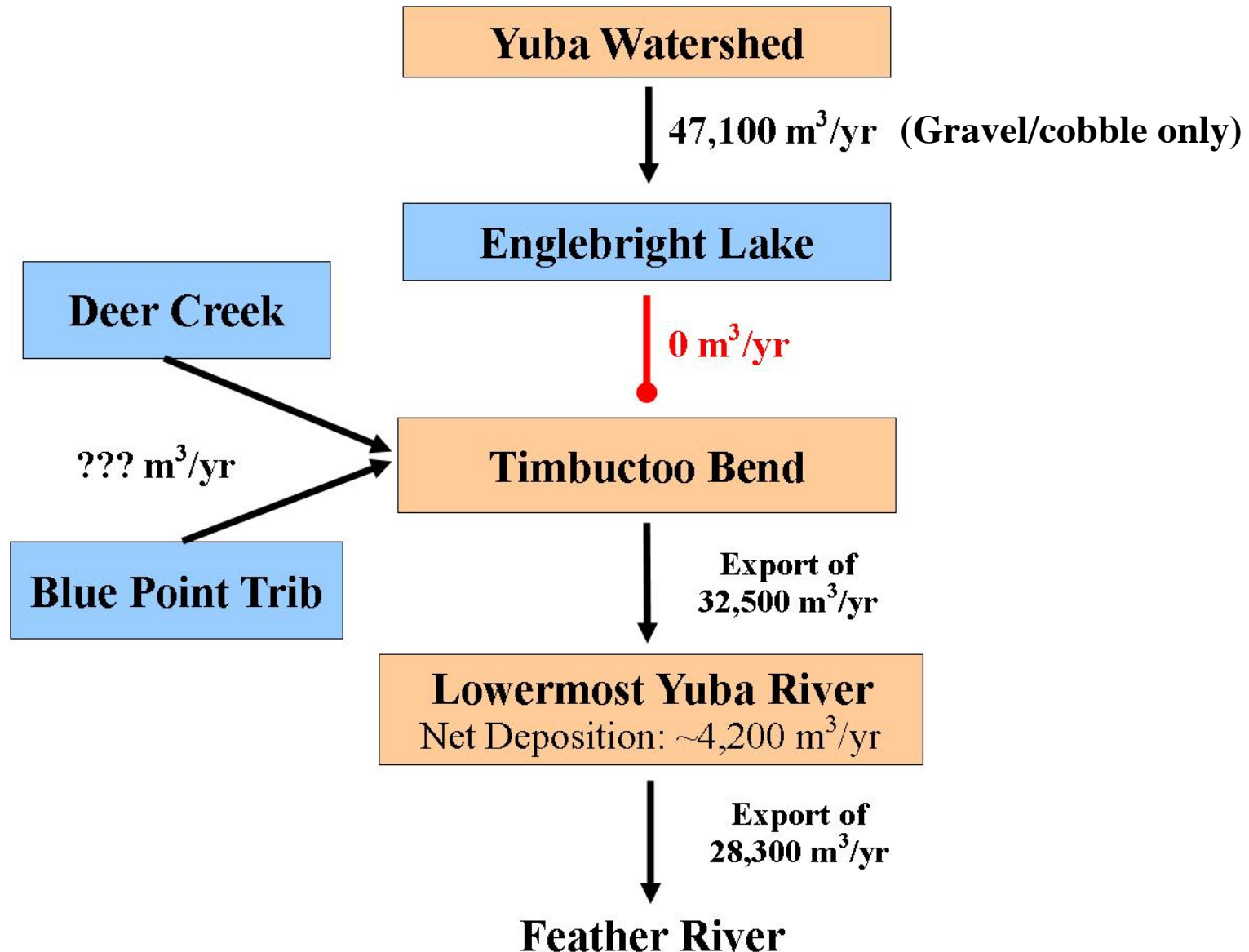
LYR Canopy Height Classification



1999-2009 Topographic Change Detection (TCD)



TCD Volumetric Sediment Budget

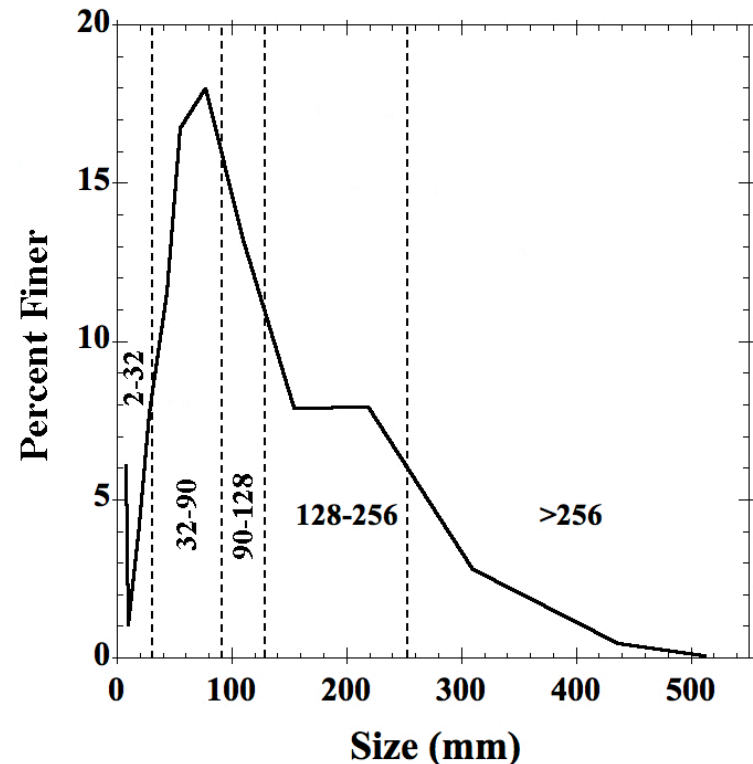


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LYR Substrate Characterization

New substrate classification that links statistical properties of LYR bed material grain size distributions and physical habitat suitability for salmonids.

Class	Particle Size Range (mm)	Habitat suitability
Bedrock	No alluvium	Periphyton only
Boulder Field*	$D > 256$	Chinook salmon and steelhead trout fry, parr, and smolt cover and foraging
Large Cobble	** $128 < D < 256$	Chinook salmon and steelhead trout fry and parr cover and foraging
Cobble	$90 < D < 128$ **	Chinook salmon spawning, embryo incubation, and fry cover
Medium Gravel/Small Cobble	$32 < D < 90$	Chinook salmon and steelhead trout spawning, embryo incubation, and fry cover
Fine Gravel	$2 < D < 32$	Steelhead trout spawning and embryo incubation
Sand	$0.0625 < D < 2$	
Silt/Clay	$D < 0.0625$	SAV



Substrate mapping completed summer/fall 2010 (except for deep pools pending camera)

LYR Cover Characterization

Classification	Key Identifier to Measure Object	GPS object type
Wood Log	≥ 3 m long and ≥ 10 cm diameter	Line along stem
Wood Jam	≥ 3 m long	polygon
Boulder	> 3 m in longest dimension	point
Boulder Cluster	> 3 m in longest dimension	polygon
Undercut Bank	> 3 m in longest dimension	Line along bank
Submerged Aquatic Vegetation	> 3 m in longest dimension	polygon
Woody vegetation in the wetted channel	> 3 m in longest dimension and > 1 m above substrate	* see note below
Riparian (Overhanging) Vegetation	> 3 m in longest dimension and > 1 m above substrate	*see note below
Human Detritus By Name	car, cement block, refrigerator, and other items ≥ 3 -m length and ≥ 10 -	point