Bathymetric Survey and Sediment Hydroacoustic Study of Canyon Lake

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Canyon Lake was constructed in 1928 as the Railroad Canyon Reservoir as a result of the impoundment of the San Jacinto River. The reservoir thus receives runoff from a very large (>1900 km$^2$) watershed. Canyon Lake receives very large total suspended solids loads during strong runoff events. As a result, the lake has a high sedimentation rate (about 2.4 cm/yr based upon a core collected by USGS in 1998).
• Sedimentation in East Bay has also been identified as a significant concern for residents
• The accumulation of sediment lowers the storage capacity of the reservoir
• The distribution of sediments and the properties of those sediments also affects water quality and efforts to improve it
• Sediment properties directly influence rates of:
  – internal recycling of nutrients
  – sediment oxygen demand
Objective

• Overall objective of the study was to better understand Canyon Lake from bottom up

• Specific objectives were to:
  – Develop up-to-date bathymetric map
  – Derive up-to-date storage curve for the reservoir (elevation-area-volume)
  – Estimate volume of sediment deposited and where
  – Characterize distribution of sediment types across basin
  – Develop estimate of fish abundance by size class
Approach

• Hydroacoustic survey was conducted over 2-days on December 16-17, 2014

• Survey conducted using a BioSonics DTX echosounder with multiplexed transducers:
  – 430-kHz single beam with pitch-roll sensor
  – 201-kHz split beam
  – 38-kHz single beam with pitch-roll sensor

• Transducers operated at 5 pps on each frequency, with 0.4 m pulse duration

• Position recorded each second using a JRC 202W realtime DGPS

• Data acquired using BioSonics VisualAcquisition v.6.0 software on a Dell ATG laptop
Results

Depth

• Depths ranged from <1 m at lake margin and 16 m near dam

• Depths increased with distance from inflows

• Original river channel evident
Elevation-Area-Volume

- Bathymetric data used to develop elevation-area-volume curves

![Graphs showing elevation-area-volume relationships](image)

- Full pool = 438.2 acres
- Full Pool = 8960 af
Sediment Thickness

- Echograms at 38-kHz provide information about sediment thickness
• Thickness of sediment ranged from 0 to 8 m

• Thickness varied in complex way across basin

• Sediment deposited in river channel & deeper areas of basin

• Sedimentation has reduced capacity by >4000 af
**Sediment Properties**

- Attributes of bottom echo correlated with properties
- Fractal dimension strongly correlated with organic C %
**Mobile-P**

- Fractal dimension also correlated with mobile-P content of sediments
- Equation used to estimate mobile-P across basin

![Graph showing the relationship between Mobile-P (mg/kg) and Fractal Dimension with the equation Mobile-P (mg/kg) = exp(13.826 * FD) * 0.0003259 and R² = 0.99.](image)
Mobile-P

- Mobile-P content of surficial sediments enriched in original river channel north of Causeway
- Mobile-P also elevated in deeper sediments near closer to dam
- This distribution can help guide alum treatment for sediment inactivation
Conclusions

• Survey provide up to date bathymetry and elevation-area-volume relations for Canyon Lake

• Measurements also provide new insights into the distribution, thickness and properties of sediment within the lake

• Sedimentation projected to have reduced storage capacity by >4000 af

• Sediments enriched in mobile-P and organic matter deposited in deeper regions of lake, and represent regions of greater nutrient flux and oxygen demand
Lake Elsinore & Canyon Lake Nutrient TMDLs
Draft Phase 2 Monitoring Plan

Nancy Gardiner
January 13, 2015
Phase 2 Monitoring: Focus on Two Objectives

• Evaluate status and trends towards achieving response targets and determine how to quantify the amount of influence natural background has on the status and trend (highest priority/easiest)

• Quantify the external pollutant loading originating in the upstream watershed above the lakes
Additional Objectives

• Support stormwater compliance activities by stakeholders in the watershed (MS4 permit)

• Support land use monitoring requirements related to the Conditional Waiver for Agricultural Dischargers (CWAD)
Watershed-Wide Monitoring

• Monitor during storm events (3/year) and monthly during dry weather (when conditions allow):
  • San Jacinto River @ Goetz Road
  • Salt Creek @ Murrieta Road
  • San Jacinto River below Railroad Canyon (Canyon Lake) Dam (when dam is spilling)
  • San Jacinto River @ Ramona Expressway (not expected to flow except under extremely high rainfall conditions)
Watershed-Wide Monitoring

• Sample at one or more additional “contingency” sites that may change from year to year
• Collect data from a new area or to help answer a technical study question

Examples:
• Background station
• Agricultural land use station
• Site impacted by wildfire
• Other examples?
Watershed-Wide Monitoring

- Sample same constituents that historically have been measured

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<tr>
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<td>Nitrate Nitrogen</td>
<td>Total Suspended Solids</td>
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<td>Water Temperature</td>
<td>Ammonia Nitrogen</td>
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<td>Nitrite Nitrogen</td>
<td>Soluble Reactive Phosphorous</td>
<td>Total Hardness</td>
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In-Lake Monitoring Study Questions

• What is the status and trend of each lake towards achieving TMDL response targets?

• Are prior monitoring methods providing sufficiently representative values for TMDL compliance assessment over time?

• What is the extent of influence of in-lake aeration at Lake Elsinore?

• How are plankton communities responding to in-lake management strategies in both Lake Elsinore and Canyon Lake?
In-Lake Core Monitoring

- Sample historical locations to maintain consistency and facilitate assessment of trends

- Lake Elsinore
  - 3 lake monitoring sites, monthly/bi-weekly sample collection (e.g., at historical sampling locations)
  - Depth-integrated sampling and in-situ field monitoring

- Canyon Lake
  - 3 locations, monthly sample collection (two in main body, one in East Bay)
  - Same sampling approach as in Lake Elsinore
Candidate Special Studies

• Two categories of special studies
  • Water quality
  • Biological
• Conduct in near term (~ next 1-2 years)
• Gain a better representation of water quality in Lake Elsinore and Canyon Lake for assessment of TMDL compliance
WQ Special Study 1 – Existing Data Assessment & Enhance Monitoring in LE

• Gather more accurate measurements of DO
• Mine and analyze existing data collected by EVMWD’s two sondes used for monitoring the aeration system
• Install additional sondes at the TMDL monitoring stations to collect data further away from the aeration system and compare results with field collected data
WQ Special Study 2 – Enhanced In Situ Sonde Monitoring in CL

- No existing sondes present in Canyon Lake
- Install sondes at the 3 TMDL monitoring locations and one additional location in the East Bay
WQ Special Study 3 – Comparison of Depth-Integrated and Discrete Sampling in CL

• Collect both depth-integrated and discrete samples at the 2 TMDL stations in the main body
• Further investigate existing historical data from 2007-2012 to explore potential differences related to sampling techniques and calculation methods
WQ Special Study 4 – Satellite Imagery Measurements for Chlorophyll-a

- Conduct monthly satellite mapping of chlorophyll-a in both lakes (summer months only in LE)
- Consider reducing the resolution (pixels per acre) to optimize costs versus resolution
Biological Monitoring Special Study in LE

Zooplankton

- Monthly sampling for zooplankton at one location (TMDL Site 2)
- Conduct using same methods as in 2004 and 2011 (composite from 3 replicate vertical tows using a Wisconsin plankton net)
- Identify and enumerate zooplankton and assess reproductive index
Biological Monitoring Special Study in LE

Phytoplankton

• Conduct using same methods as in 2003 and 2011 (depth-integrated 0-2m samples using polycarbonate tube sampler)

• Quantify major algal groups and assess primary productivity
Biological Monitoring Special Studies in CL

- Limited data on plankton are available for Canyon Lake
- Recommend conducting similar studies described for Lake Elsinore at the 3 TMDL monitoring locations at a minimum of 4 months
Special Studies to Assess Daphnia Species Potential as Phytoplankton Grazers

• Healthy zooplankton population (Daphnia) is important to keep lake in balance

• Threats to populations of Daphnia species:
  • Predation by threadfin shad
  • Lack of vegetation habitat
  • Elevated conductivity/TDS
  • Food quality

• Recommendation: conduct additional special studies to build on past/current efforts by others
Zooplankton Special Study 1: Ion Concentration Evaluation

• Measure natural ion concentrations over 1 year
  • Monthly at central lake location in LE and CL
  • Quarterly in major source waters (reclaimed water and in-lake groundwater wells)
• Composite stormwater samples during 3 storms at the 3 historical monitoring sites
• Evaluate relative change in ion concentrations and ratios throughout the year and compare to published information regarding toxicity to Daphnia
Zooplankton Special Study 2: Daphnia Food Quality and Algae Toxicity Evaluation

- Subsample phytoplankton populations from LE and CL monthly or quarterly and provide as food source to Daphnia under controlled laboratory conditions
- Assess food quality and potential toxic effects
Other Potential Special Studies

• Evaluate Wildfires as a Source of Nutrients
  • Monitor water quality immediately downstream of the burn area and compare results with historical data

• Evaluate Use of Satellite Imagery for Phosphorous and Other Constituents
  • Conduct a pilot study using this new technology
Other Ideas/Suggestions

- Determining the capacity of Mystic Lake
- Sampling at a location above Mystic Lake
- Developing a documentation and reporting dashboard
Discussion/Comments/Next Steps