

Capitol Lake Permitting Analysis
Permitting Recommendations
Report

Appendix C
TerraSond Bathymetric Survey Report

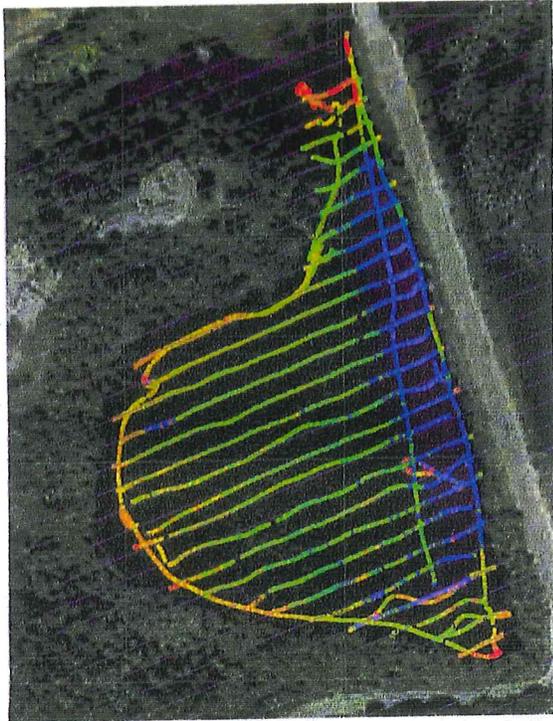
FINAL

Project Summary

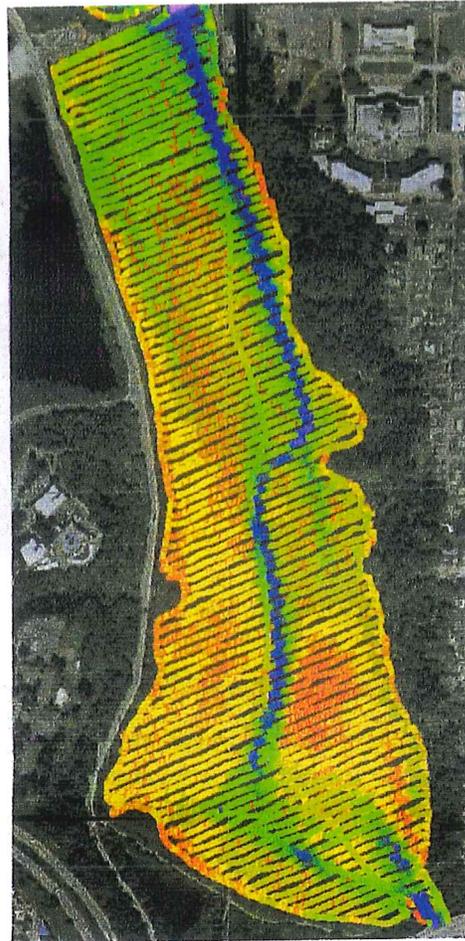
TerraSond, Limited performed a singlebeam hydrographic survey on the Capitol Lakes in Olympia, WA. The field survey took place March 12th – 15th, 2013. The survey was timed for early spring to avoid the majority of vegetation growth. The survey area is shown below.



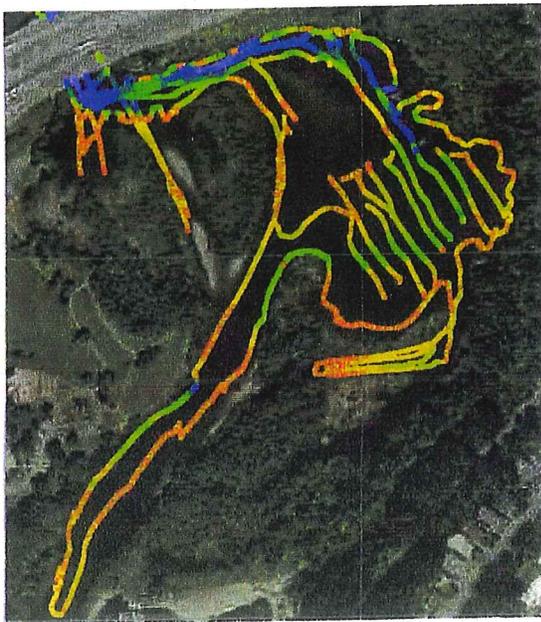
Data coverage for each basin is shown below.



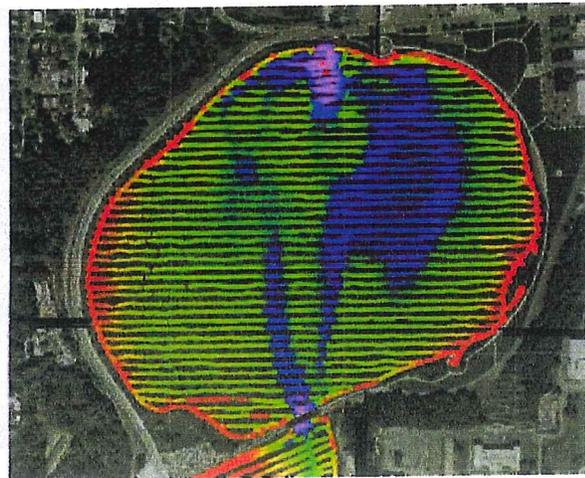
Percival Cove



Middle Capitol Lake



South Capitol Lake & River



North Capitol Lake

Survey Control

Thurston County project control was used for this project.

GPS base point used for the survey was "Capitol Lake" shown right. RTK GPS checks were made to control point "Capitol Lake-1". Coordinates and checks are shown below in Table 1. Coordinates are NAD83 in Washington State Plane South Zone and US Survey Feet. Elevations are NAVD88.

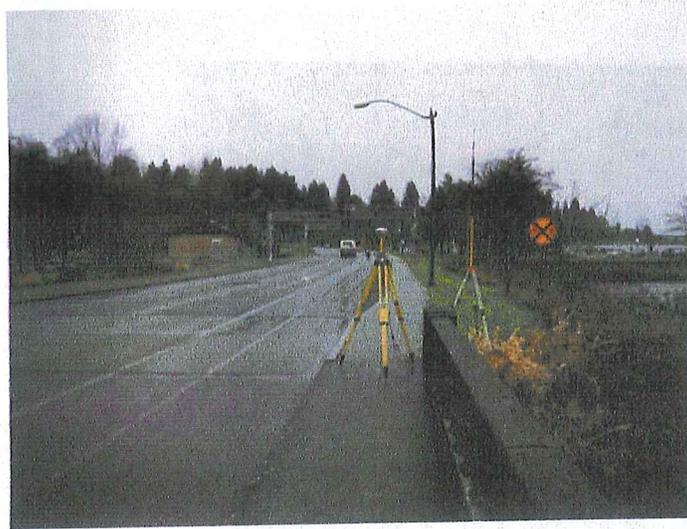
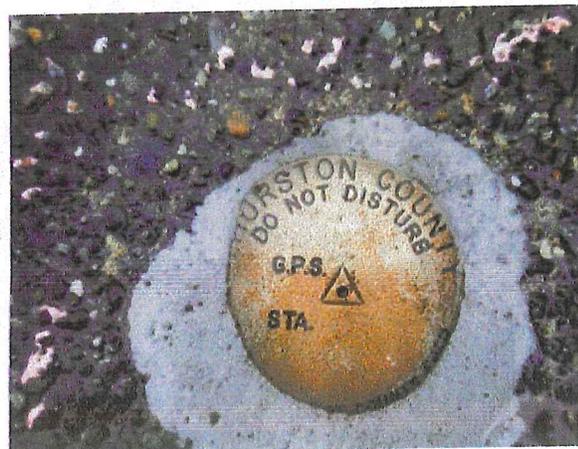


Table 1 – Control Checks

Station	Northing	Easting	Elevation
Capitol Lake	630067.291	1039075.457	18.12
Capitol Lake-1	628559.689	1039535.355	17.52
Check shot CL-1	$\Delta -0.007$	$\Delta -0.005$	$\Delta -0.001$



Survey Equipment

Table 2 - Survey Equipment

Component	Model	Description
Singlebeam Echosounder	Odom CVM	Portable, 200khz single beam, 4 degree beamwidth.
RTK Base Station	Trimble R8	Dual frequency, low-latency base GPS receivers.
Acquisition Software	HYPACK 2012	Hydrographic data acquisition and navigation software.
Processing Software	HYPACK 2012	Hydrographic data cleaning and processing software.

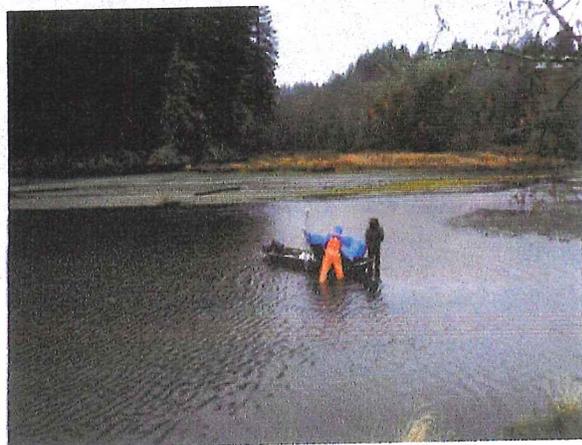
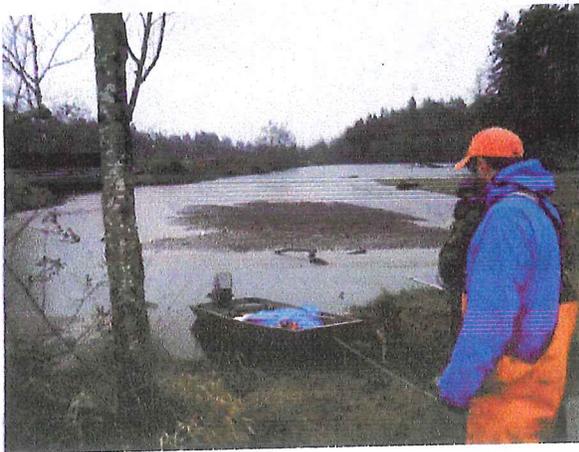


Vessel

Two boats were used to perform the survey. The primary vessel used in the survey was the *R/V It Sea*, TerraSond's 15 foot, jet driven, specially modified SeaDoo survey platform. The transducer is mounted inside the engine compartment on the hull near the rear of the vessel which maintains the smooth bottom thus allowing the *It Sea* to survey extremely shallow water. The GPS antenna is co-located on the tower above the transducer. Real Time Kinematic (RTK) GPS was used for vessel positioning.



Launch access was limited in Percival Cove so a 12 foot John boat was used to collect survey data. The ODOM CVM Echosounder and a laptop running HYPACK 2012 were used. A pole with the transducer and a GPS antenna was mounted to the John boat.



Pre-Survey Checks

Prior to and during data collection, a series of quality assurance checks were conducted to verify the sounding accuracies. The checks that were conducted included:

1. Control Check (Described in Survey Control Section)
2. Bar Check

Bar Check

A bar check was performed at the beginning of each day to ensure accurate readings and calibration of the echosounder.

Latency Check

A latency check was conducted prior to the survey to resolve the timing latency between the echosounder and the GPS. The latency was found to be 0 seconds for the GPS and was held constant throughout the entire project.

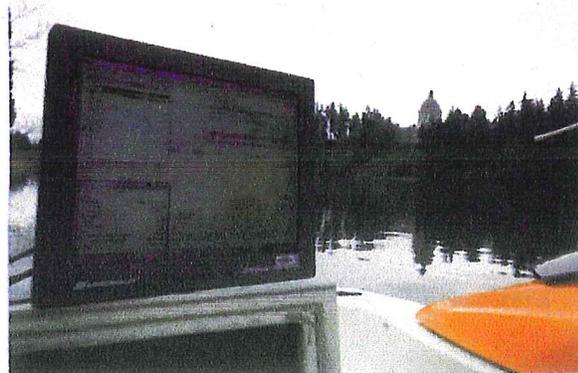
Data Acquisition Procedures

Data acquisition was collected using Hypack 2012. Primary survey lines were run perpendicular to the thread of the old streambed as near as possible. Cross lines were run down through the primary lines at separate timeframes to quality check the survey measurements. Lines were also run around the perimeter of each area.

Percival Cove was surveyed first, followed by South, Middle and North Lakes. Water levels were raised approximately 1 foot to overcome shallow depths near the southern end of the project. The variation in water levels is shown in the table below.

Table 3 – Daily Water Level Observations

Date	Water Level (in feet)
March 12, 2013	8.44
March 13, 2013	8.51
March 14, 2013	9.26
March 15, 2013	9.28

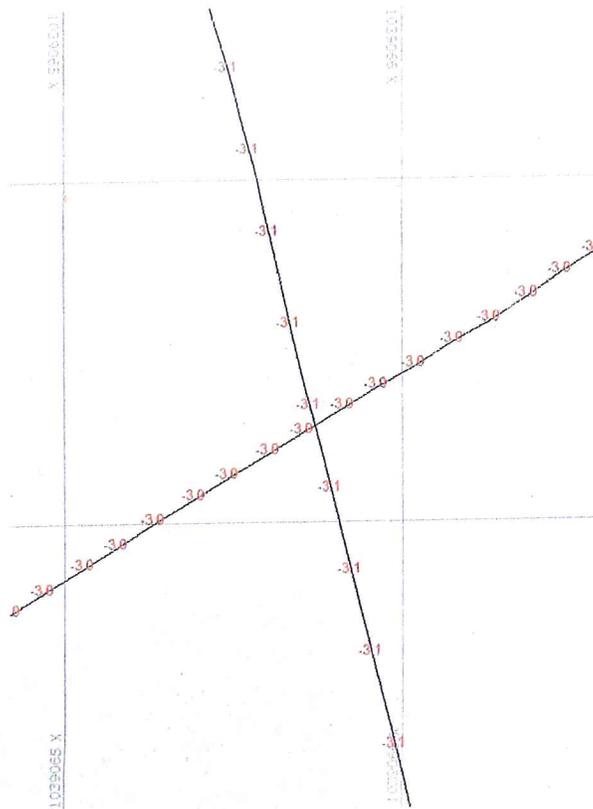


Processing Procedure

Singlebeam sonar data was processed using Hypack 2012, the same software it was collected in. It provides very simple and efficient editing tools as part of processing. The general Hypack workflow is composed of the following steps:

1. Data Import. Raw singlebeam data is imported into the Hypack Singlebeam editor.
2. Sensor editing. Vessel vertical offsets and latency values are input into the vessel configuration.
3. Data editing. Erroneous data was examined and removed or corrected.
4. Sorting. Once all data was reviewed and accepted it was sorted to use soundings at a 1 foot and 10 foot interval to reduce density. The 10 foot sort was used for creating contours in the final drawing.

To ensure the quality of the collected soundings, a visual comparison of depths throughout the survey extents was made between lines that intersected. On average, depths between lines were within a tenth of a foot.

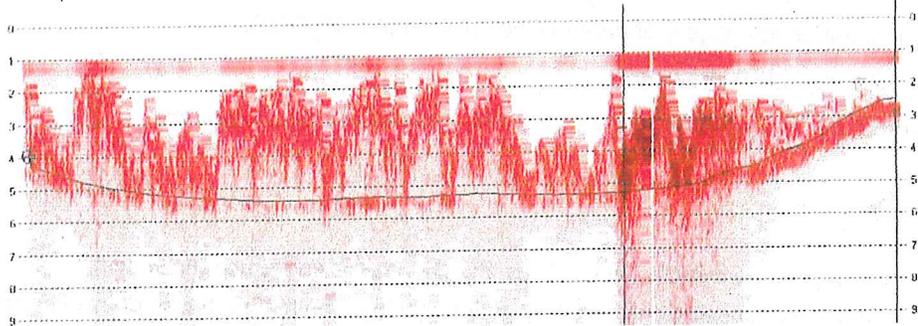


An example of the visual comparison done for intersecting lines to check the quality of depth soundings.

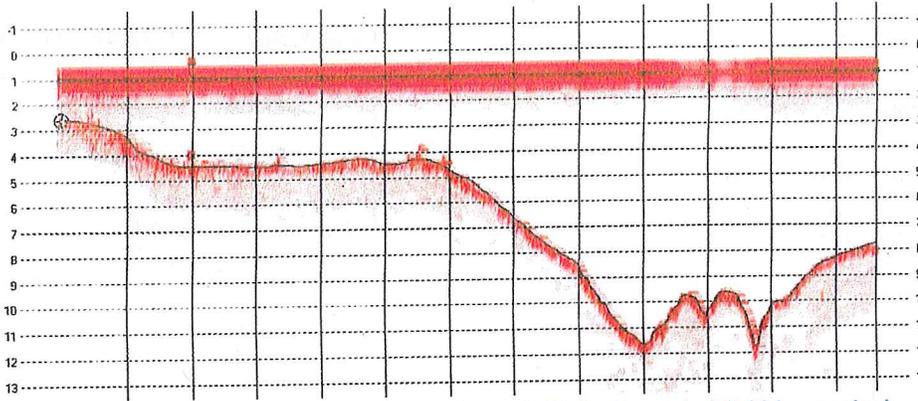
Results

Singlebeam Bathymetry

The singlebeam data quality in areas without vegetation was good. However, in areas of high vegetation, such as Percival Cove, the echosounder had a difficult time tracking the bottom. The image below illustrates a good example of the amount of vegetation encountered. Although the echosounder was tracking the closest return from the tops of the plants, a trace of the actual bottom was apparent below, and the processor was able to manually digitize the bottom and correct the depths.



The vegetation in Percival Cove. The black line is the manually digitized bottom.



A clean trace without vegetation from Middle Capitol Lake. No manual digitizing required.

Decontamination of Equipment

The boat was moored in middle Capitol Lake overnight. Upon completion of the survey of North Capitol Lake the boat was pulled from the water at Marathon Park. It was inspected for invasive species, of which none were found. The keel of the boat was brushed and sprayed with Formula 409 Cleaner.

The boat was then trailered to a carwash and washed down and sprayed again with Formula 409 Cleaner. The boat is currently housed at TerraSond's office in Ballard, if inspection is required.



Deliverables

The deliverables provided for this project include:

- ASCII X,Y,Z point files of bathymetric points.
 - 1 foot point sort data file
 - 10 foot point sort data file (used for creating contours in ACAD)
 - Point file with RTK GPS ground topo of shallow area in Percival Cove.
- Sun-illuminated imagery of data in GEOTIF format (TIF/TFW).
- ACAD Civil 3d PDF drawing
- Project report summarizing data collection and processing procedures.

ASCII X,Y,Z points

The point files are of the singlebeam data. Each survey line was sorted to reduce the spacing of the point data at both a 1 foot point spacing and a 10 foot point spacing. The format for all point files are Easting, Nothing, Elevation and comma delimited.

File Name	Resolution	Number of Points
CapitolLakes_WASP83S_ENZ_1ft.xyz	1 FT spacing	183,406
CapitolLakes_WASP83S_ENZ_10ft.xyz	10 FT spacing	20,909
PercivalCove_GPS_Topo.xyz	Random	94