Hydrographic Survey For Irrigation Pond Evaluation

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Surveying Engineering Capstone Project

Planning

Conceptualization and Site Selection

A common application for hydrographic surveying is in support of pond restoration, as submarine information is required for sedimentation assessment and dredging. In addition to beautifying the landscape and providing storm runoff, ponds are often a source of irrigation and as such must be monitored at regular intervals. Times of drought require a knowledge of water capacity and bottom silt can impact pump performance.

After reviewing the limited water bodies residing on golf course property within the Keweenaw, a pond was discovered at the Portage Lake Golf Course (above). This location was ideal for two reasons: The pond area was deemed small enough to survey the entire bottom, while relying on limited experience, and there were no immediate obstructions that could interfere with GNSS measurements of the surrounding grounds. The course's manager was contacted and the project team was granted full access.

Safety Considerations

Safety was the team's first concern. Motorized cart drivers needing to be aware of the surveyors' presence and stray golf balls were identified as the primary issues. It was determined that safety vests and hardhats were necessary to mitigate these concerns (below left). There was also a small, concrete block, weather shelter adjacent to the primary work area. This shelter served as a safety solution to inclement weather and acted as a shield from opposing tee offs. The course closed for the season on October 16th, nullifying the initial safety precautions and the safety vests and hard hats were discarded for the remaining portion of the project. An additional safety consideration became a factor near the conclusion of the field work: kayaks needed to be taken out on the pond during cold weather. To do this safely, properly rated life jackets were worn (below right), a heated vehicle was kept nearby and a volunteer was stationed on shore for help in the event of an accident.

Fieldwork

Overview

Fieldwork included reconnaissance, static observations to establish GNSS control and RTK enabled topographic/bathymetric data collection. Manual verification of the bathymetric data was also performed.

Reconnaissance and Setting Control

To use RTK for the data collection, a local GNSS control point would need to be set and used for a base station. A visit to the site allowed an acceptable location to be identified and provided insight into how future fieldwork would best be performed.

After the reconnaissance, it was determined that the control point would work best near the corner of a concrete pad. This would help protect the control from being disturbed by activity such as mowing and also minimally impact the cultivated turf. A half-inch rebar was set and immediately occupied for the first of two separate static sessions

RTK Enabled Topographic/Bathymetric Data Collection

The topographic data collection was performed with a Trimble R10 and a TSC3 data collector. All features within fifty feet of the edge of water were collected including trees, structures, and ground shots. The bathymetric data collection was completed with a Hydrone ROV, Sonarmite Echosounder, Trimble R10, and Trimble TSC3 data collector. The ROV was piloted in multiple grids across the pond. After collecting data for a short time, the survey was stopped briefly to ensure everything was working properly. Far more data was collected than necessary in order to guarantee there would be no need for a return trip with the Hydrone. Manual checks were performed with range poles and a selection of the sonar points for stakeout. The checks were found to be consistent with the collected data.

Processing

Microsoft Excel

Excel was used for combining the coordinates of the two static sessions and for adjusting the coordinates of the RTK topographic survey. The adjusted base coordinates (CP1a) were computed by applying a weighted average of the number of observations in each session (top below). The topographic coordinates were adjusted by shifting all of the points by the coordinate differences between the 20-min base coordinates and the adjusted base coordinates (bottom below).

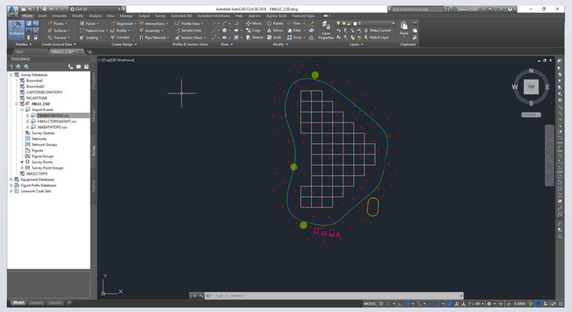
	X	Y	Z	dX	dY	dZ	Obs	Obs %
2 Hour Static	111788.215	-4348666.4160	4649063.8000	0.0040	0.0090	0.0090	738.0000	0.8601
20 Min Static	111788.2180	-4348666.3860	4649063.8000	0.0090	0.0250	0.0160	120.0000	0.1399
Diff, Sum, Coord	0.0030	0.0300	0.0000	0.0130	0.0340	0.0250	858.0000	1.0000

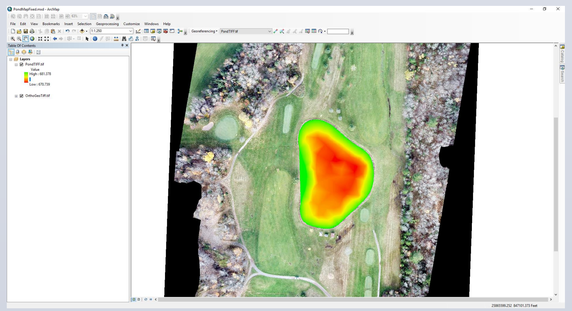
X Adj	Y Adj	Z Adj	Northing (iFt)	Easting (iFt)	Elev. (iFt)	Northing (m)	Easting (m)	Elev. (m)
96153.4996	-3740461.3229	3998845.0867						
15634.7158	-608205.0890	650218.7133						
111788.2154	-4348666.4118	4649063.8000	846521.2270	25866271.9000	683.3045	258019.6700	7884039.6751	208.2712

	Northing	Easting	Elevation	Adjusted N	Adjusted E	Adjusted Z
20 min	846521.2890	25866271.9100	571.1350			
CP1a	846521.2270	25866271.9000	683.3045	846521.2270	25866271.9000	683.3045
Adjustment	-0.0620	-0.0100	112.1695	846538.8280	25866245.8900	681.4805
	-0.0620	-0.0100	112.1695	846529.1900	25866239.4200	682.8665
	-0.0620	-0.0100	112.1695	846554.1010	25866212.3700	681.4785
	-0.0620	-0.0100	112.1695	846573.8720	25866197.6600	681.5355

AutoCAD Civil 3D and ESRI ArcMap

Civil 3D was utilized to create a surface model with which the pond volume could be computed and to generate Exhibit A. The surface created in Civil 3D was exported as a TIN to ArcMap. An elevation gradient was applied and overlaid on aerial imagery, which facilitated the creation of Exhibit B.

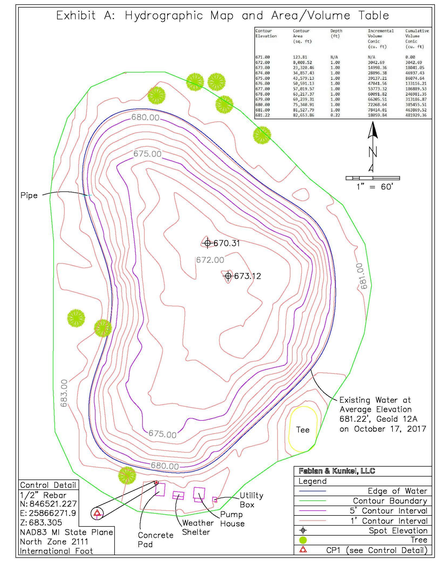


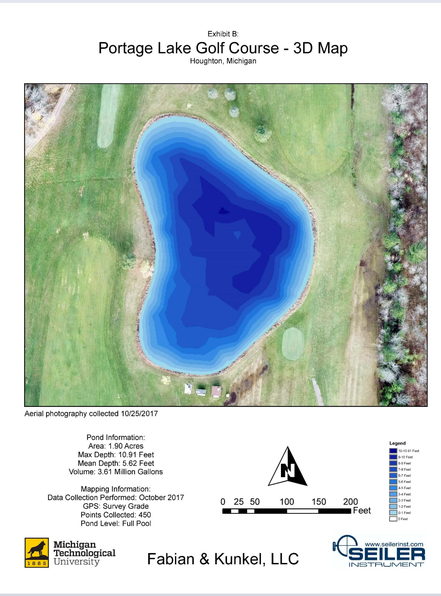


Deliverables

The results of the survey needed to be presented in a professional format. Examples of industry-standard deliverables were reviewed and used as the basis for the project's final results.

Results





Acknowledgments and Contact Information

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