

# Ultra Shallow Water Hydrographic & Siltation Surveys

J.A. Calzada, Jr.  
Principal Marine Scientist  
Unabara Corporation

A.C. Dumestre III  
VP Engineering/Chief Technology Officer  
Unabara Corporation

## Background

Renewed interest in soil conservation, siltation (sedimentation) mapping, and eutrophication have caused researchers to demand better tools for use in ultra shallow water bodies. Sonar/echo sounder equipment must be capable of both high frequency (i.e. 200 Khz.) and low frequency (i.e. 30 Khz. & lower) operation; Both acoustic frequencies must be transmitted in very narrow beam widths; transducer acoustic side-lobes must be eliminated; and a method must be included to mitigate multiple bottom to surface reflections and reverberations.

## Tooling for the Survey

Unlike all conventional hydrographic echo sounders, Unabara's Z Axis-2F™ Dual Frequency Hydrographic Echo Sounder has very narrow beam widths and no side-lobes. Unwanted reflections are eliminated using a real-time processing technique which Unabara terms "Controlled Reflection". The Below Surface Unit (BSU) containing the acoustic transducer is placed at a very shallow depth below the water surface; and tilted 20 degrees from vertical to deflect the main reflection away from the transducer's face and thus using the acoustic back scatter from within the sediments for depth measurement.

While the user may, for the low frequency, select 18, 24, 28, or 30 Khz., 30 Khz. was selected for this survey. This is because 30 Khz. has the shortest acoustic wave length and shortest pulse length, thus allowing for the most optimal minimum depth of operation.

Depth correction for the 20 degree "tilt" is accomplished by entry of a simple, single correction at the time of setup of the Z Axis-2F™ BSU; via the Z Axis-2F™ PC APP. This correction is entered via the sound velocity input on the SETTING screen of the PC APP. The speed of sound in the shallow water body will be measured using a sound velocimeter or predicted using a speed of sound vs. temperature (of freshwater) table. This measured or predicted speed of sound is then multiplied by the sine(90 degrees – Tilt degrees) and the resulting speed of sound entered via the SETTINGS screen. This results in a correct, real-time display and logging of the depths along the survey lines.

A demonstration of this survey technique was given for potential users at a 0.25 acre, land-locked, freshwater, farm pond near Franklinton, Louisiana. Water depths in this pond varied from 0.7 feet to 7.0 feet. Since some of the water depths were too shallow for a manned survey boat, an unmanned canoe was used. The Z Axis-2F™ BSU was mounted on a standard one inch diameter survey pole and attached to the canoe using an optional Unabara over-the-side tilting mount. The canoe was then moved back and forth across the pond via ropes in a "lawn mower" survey pattern. Depths, along with corresponding RTK GPS derived geositions were recorded using an un-manned Windows PC tablet running HydroMagic™ Mapping Software (by Eye4Software of The Netherlands). For larger ponds, a "micro" USV could be used for faster and easier surveying.

## **Survey Results**

Attached is a satellite photograph which shows the location of the pond surveyed and surrounding country side. Following that is a contour map of the SURFICIAL water bottom depths derived from the 200 KHz. acoustic echoes. Then the harder, more consolidated sub-bottom layer depths, derived from the 30 KHz. echoes, denoted CONSOLIDATED bottom. The map presentation denoted SILTATION THICKNESS is the loose small grain size sedimentation which has accumulated in the pond over the years. The pond was reworked about 16 years ago so siltation was moderate, maximizing at about 1.5 feet in some areas of the pond. All measurements on these maps are in feet (and fractions of feet).

HydroMagic™ not only generates contours but can also generate echograms for depths along any of the many survey lines. Attached is an echogram along one random survey line. The red trace represents returns from the surficial bottom while the green trace represents returns from the consolidated bottom. The last photo shows the Z Axis-2F BSU mounted on a survey pole, held in place by a Unabara tilting mount, with RTK GPS at top.

## **Data Portability**

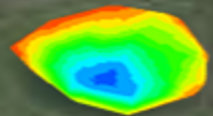
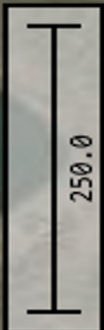
HydroMagic™ also has the capability to generate various format survey files for further use on other platforms and presentation software. Depth contours may be outputted as Autocad DXF, Google Earth, ESRI or KML/KMZ files. Further, regular spaced grids from sounding data can be exported as DXF, KML or ASCII files. A built-in map/satellite image downloading capability allows for an augmented reality presentation of survey data; a utility is included to calibrate your survey's geo-boundaries with the satellite image. Calculation of volumes within the survey areas is also a standard feature.

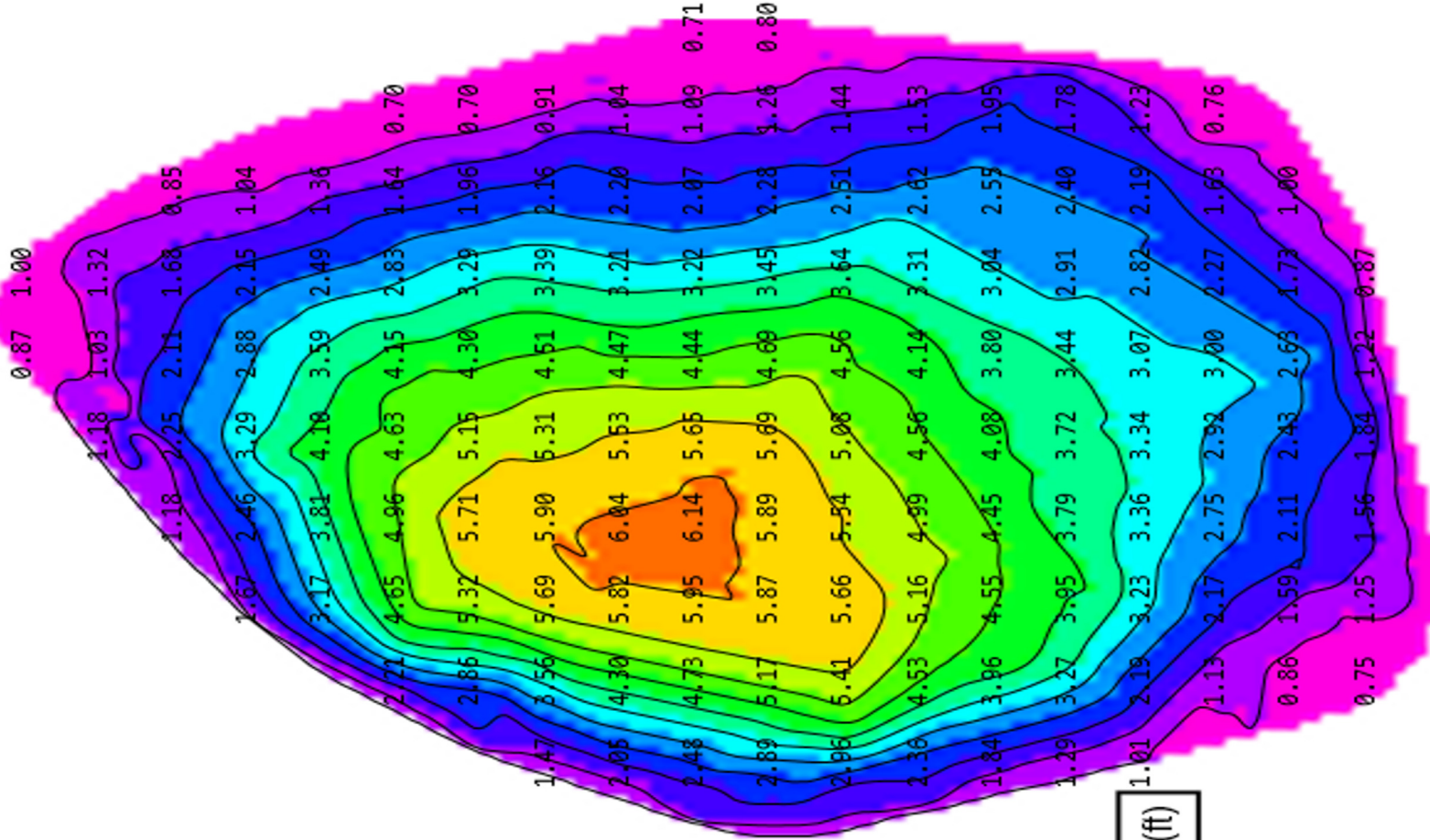


home

18458 Hwy 450, Franklinton LA, 70438

0.25 Acre Farm Pond

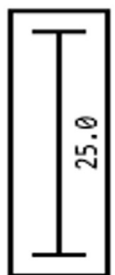




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0.25 Acre Farm Pond

Unabara Z-Axis2F: HF 200KHz Surficial Depth (ft)



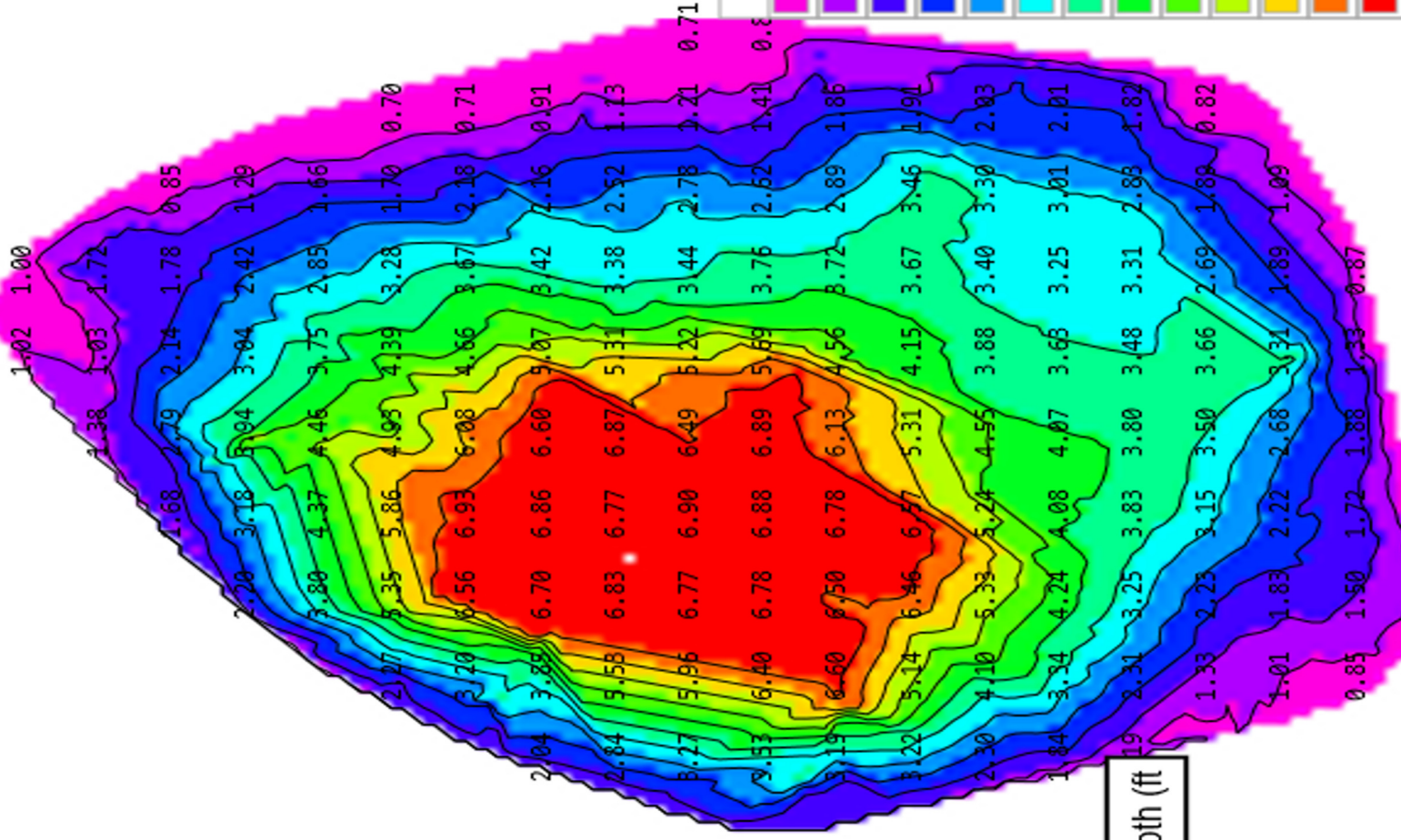


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0.25 Acre Farm Pond

Unabara Z-Axis2F: LF 30KHz Consolidated Bottom Depth (ft)

25.0



LF Depth (ft)

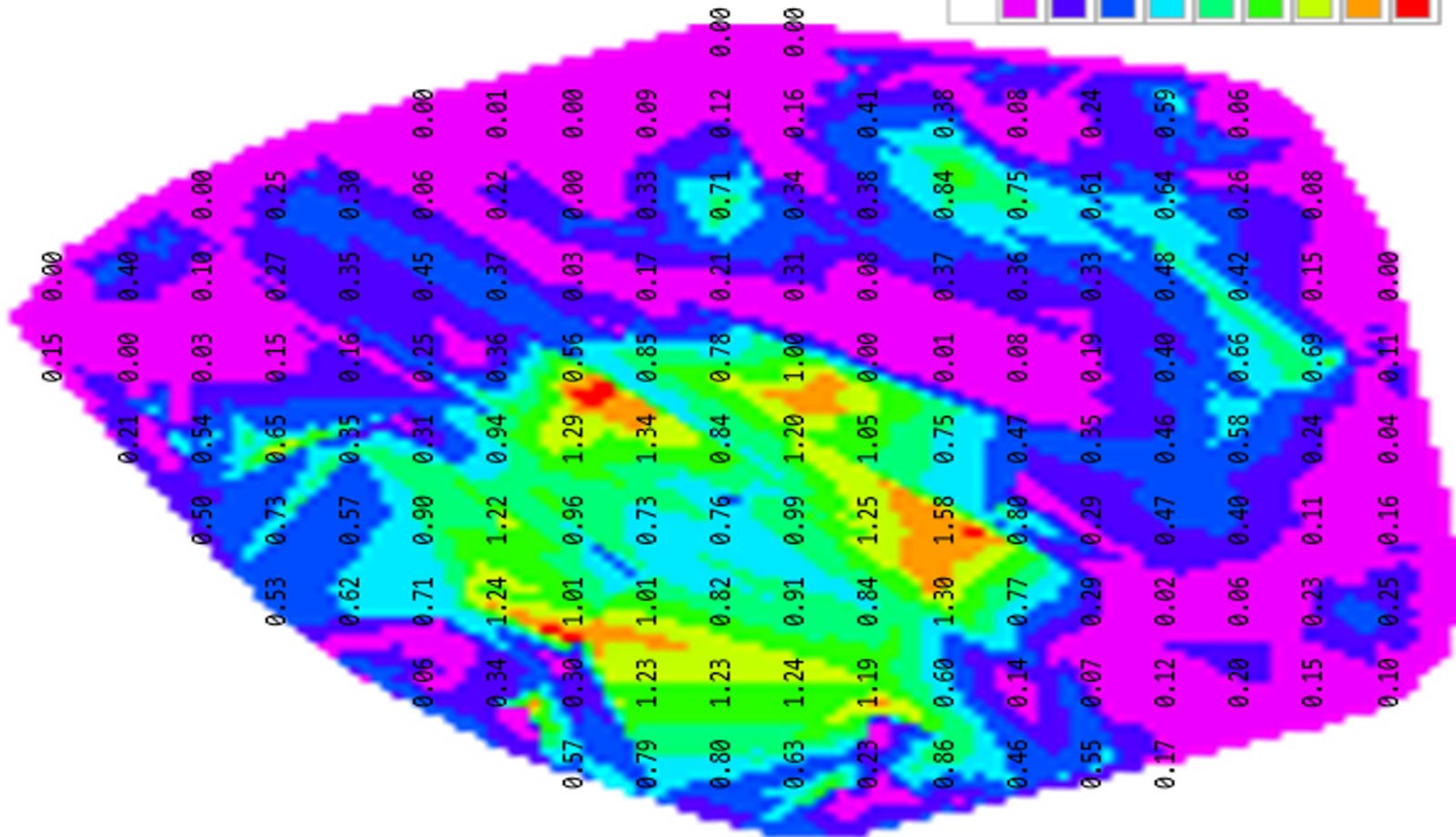
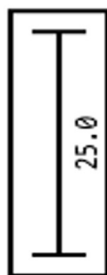
0.50	1.00
1.00	1.50
1.50	2.00
2.00	2.50
2.50	3.00
3.00	3.50
3.50	4.00
4.00	4.50
4.50	5.00
5.00	5.50
5.50	6.00
6.00	6.50
6.50	7.00



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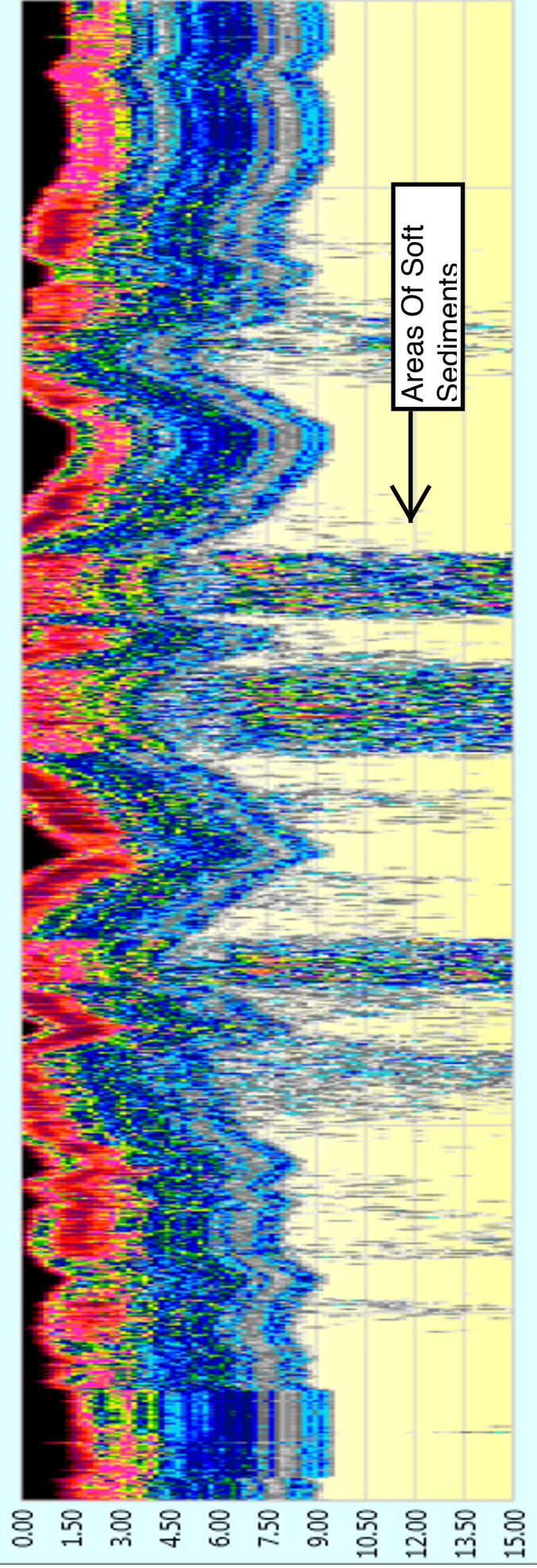
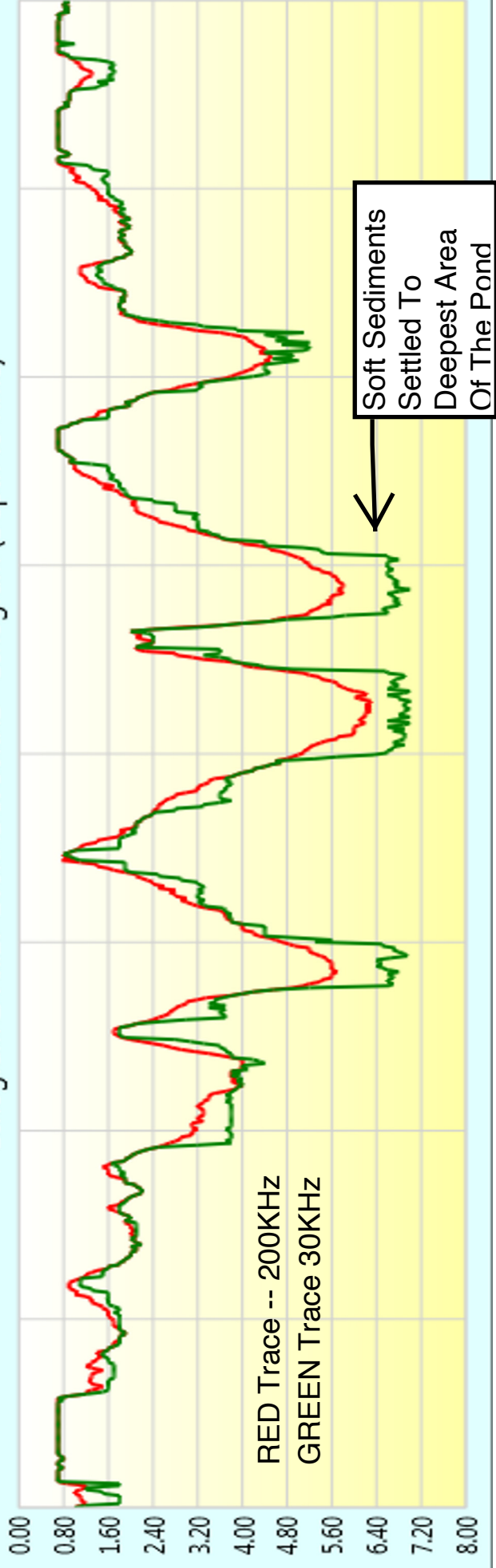
0.25 Acre Farm Pond

Unabara Z-Axis2F: Siltation Thickness (ft)



Siltation Layer (ft)	
0.00	0.20
0.20	0.40
0.40	0.60
0.60	0.80
0.80	1.00
1.00	1.20
1.20	1.40
1.40	1.60
1.60	1.80

Echogram Z-Axis 2f 200KHz & 30KHz - Echogram (Depth vs Time)



Sub-bottom, Water Column Removed. Sub-bottom Echogram Begins At RED Trace

