RESERVOIR ASSESSMENT REPORT FOR MEDARD RESERVOIR IN HILLSBOROUGH COUNTY, FLORIDA

Date Assessed: August 19 & 20, 2009
Assessed by: David Eilers, Cheran Williams, and Brian Rosegger
Reviewed by: Jim Griffin, Ph.D.

INTRODUCTION

This assessment was conducted to update existing physical and ecological data for Medard Reservoir on the Hillsborough County Watershed Atlas (**http://www.hillsborough.wateratlas.usf.edu/**). The project is a collaborative effort between the University of South Florida's Center for Community Design and Research and Hillsborough County Stormwater Management Section. The project is funded by Hillsborough County and the Southwest Florida Water Management District's Northwest Hillsborough, Hillsborough River and Alafia River Basin Boards. The project has, as its primary goal, the rapid assessing of up to 150 lakes in Hillsborough County during a five year period. The product of these investigations will provide the County, lake property owners and the general public a better understanding of the general health of Hillsborough County lakes, in terms of shoreline development, water quality, lake morphology (bottom contour, volume, area etc.) and the plant biomass and species diversity. These data are intended to assist the County and its citizens to better manage lakes and lake centered watersheds. For the purposes of this report a reservoir is considered to have similar characteristics as a natural lake and is assessed as a lake.

Figure 1. Photo of Medard Reservoir, taken August 19, 2009.

The first section of the report provides the results of the overall morphological assessment of the reservoir. Primary data products include: a contour (bathymetric) map of the reservoir, area, volume and depth statistics, and the water level at the time of assessment. These data are useful for evaluating trends and for developing management actions such as plant management where depth and reservoir volume are needed.

The second section provides the results of the vegetation assessment conducted on the reservoir. These results can be used to better understand and manage vegetation in the reservoir. A list is provided with the different plant species found at various sites around the reservoir. Potentially invasive, exotic (non-native) species are identified in a plant list and the percent of exotics is presented in a summary table. Watershed values provide a means of reference.

The third section provides the results of the water quality sampling of the reservoir. Both field data and laboratory data are presented. The trophic state index (TSI)[i] is used to develop a general reservoir health statement, which is calculated for both the water column with vegetation and the water column if vegetation were removed. These data are derived from the water chemistry and vegetative submerged biomass assessments and are useful in understanding the results of certain reservoir vegetation management practices.

The intent of this assessment is to provide a starting point from which to track changes in the reservoir, and where previous comprehensive assessment data is available, to track changes in the reservoir's general health. These data can provide the information needed to determine changes and to monitor trends in physical condition and ecological health of the reservoir.

Section 1: Reservoir Morphology

Bathymetric Map[ii]. Table 1 provides the reservoir's morphologic parameters in various units. The bottom of the lake was mapped using a Lowrance LCX 28C HD Wide Area Augmentation System (WAAS)[iii] enabled Global Positioning System (GPS) with fathometer (bottom sounder) to determine the boat's position, and bottom depth in a single measurement. The result is an estimate of the reservoir's area, mean and maximum depths, and volume and the creation of a bottom contour map (Figure 2). Besides pointing out the deeper fishing holes in the reservoir, the morphologic data derived from this part of the assessment can be valuable to overall management of the reservoir vegetation as well as providing flood storage data for flood models.

Table 1. Reservoir Morphologic Data (Area, Depth and Volume).

Parameter	Feet	Meters	Acres	Acre-ft	Gallons
Surface Area (sq)	26,246,680.37	2,438,396.4	602.55		
Mean Depth	6.36	1.94			
Maximum Depth	21.48	6.55			
Volume (cubic)	197,118,879.59	5,581,785.1		4,525.26	1,474,561,838
Gauge (relative)	58.52	17.84			

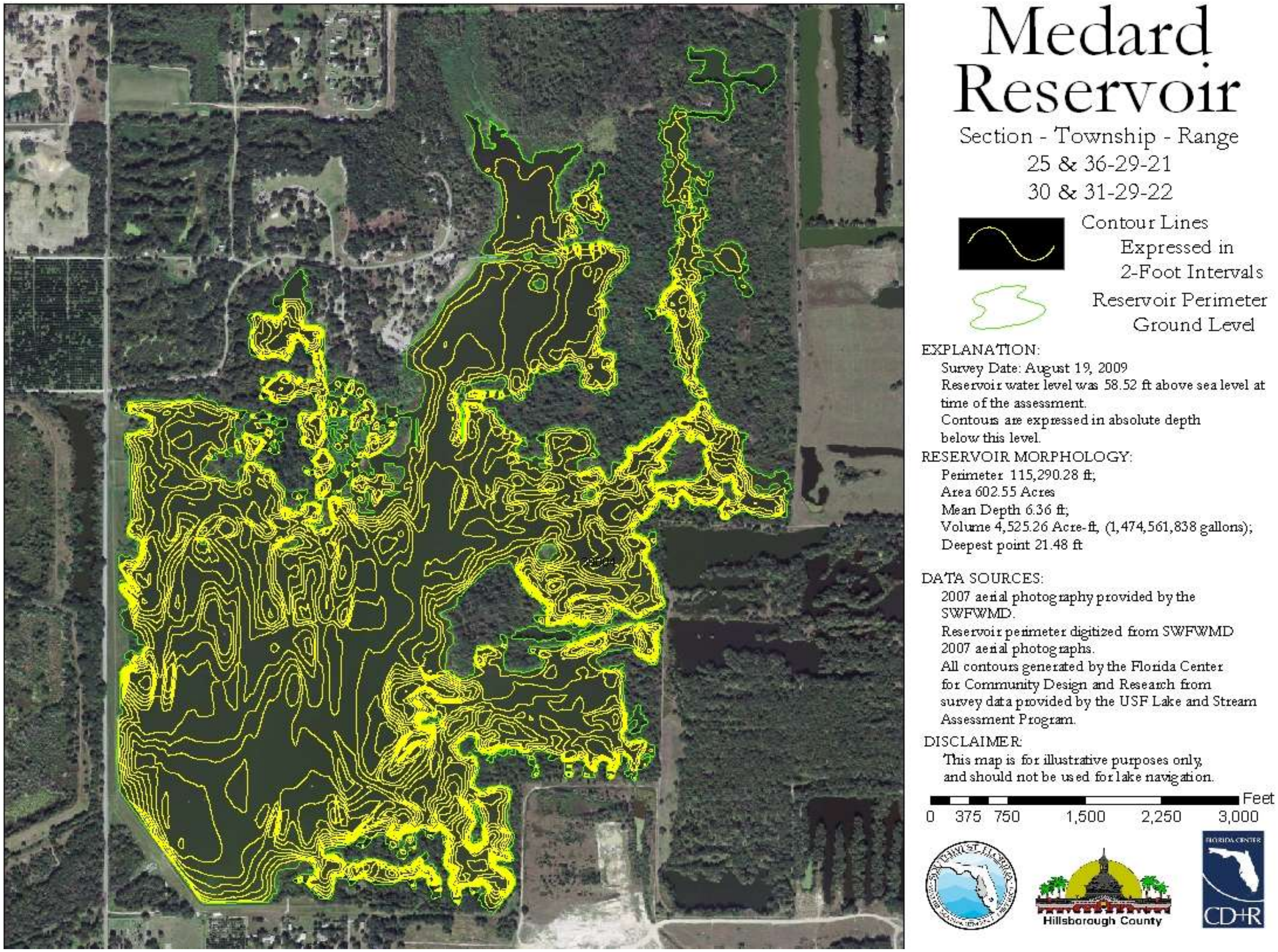


Figure 1. Contour map for Medard Reservoir (overview). The mapping technique used in 2009 employs a standard DGPS for horizontal position and a fathometer for depth.

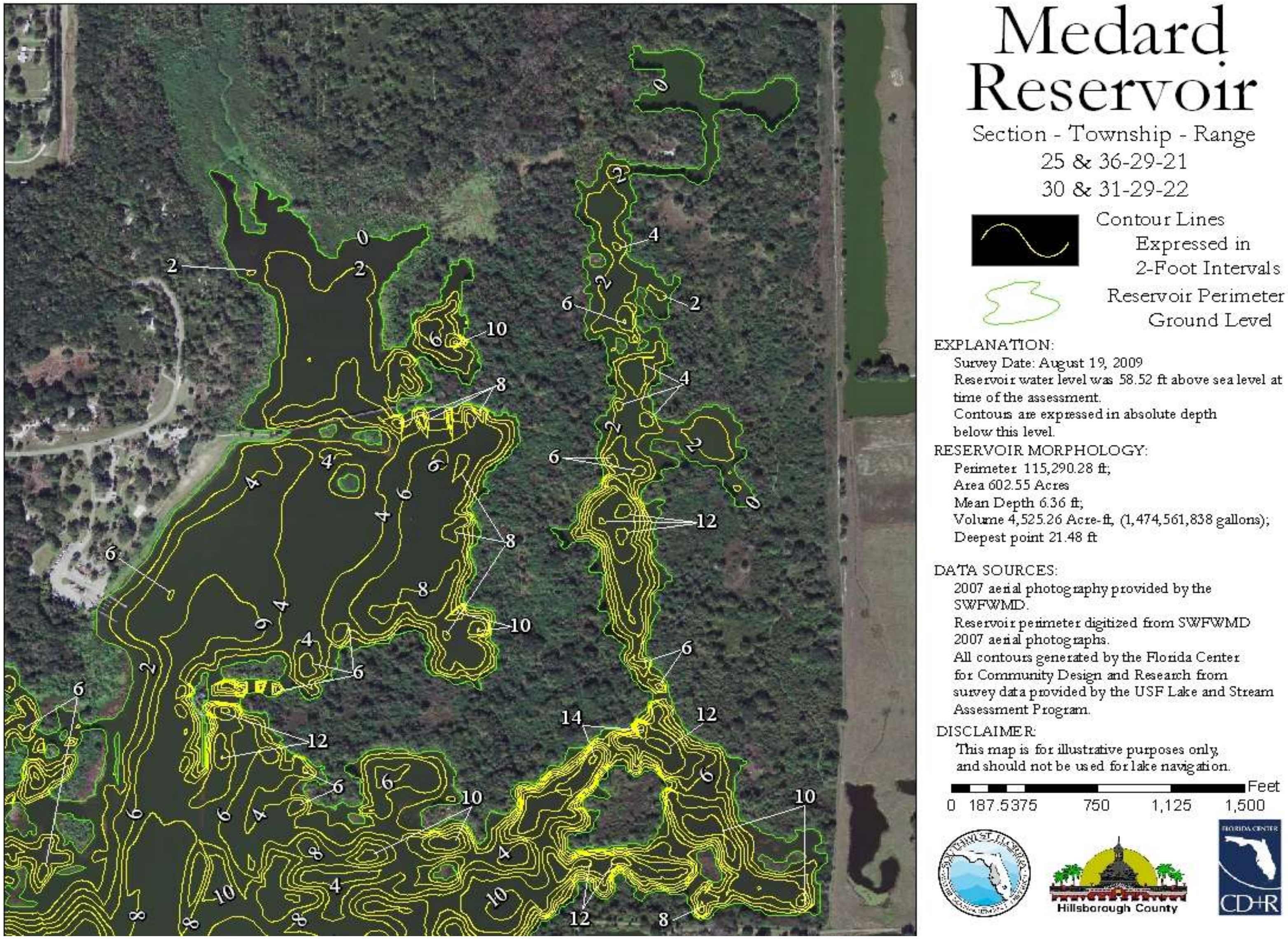


Figure 3. Contour map for Medard Reservoir (northeast). The mapping technique used in 2009 employs a standard DGPS for horizontal position and a fathometer for depth.

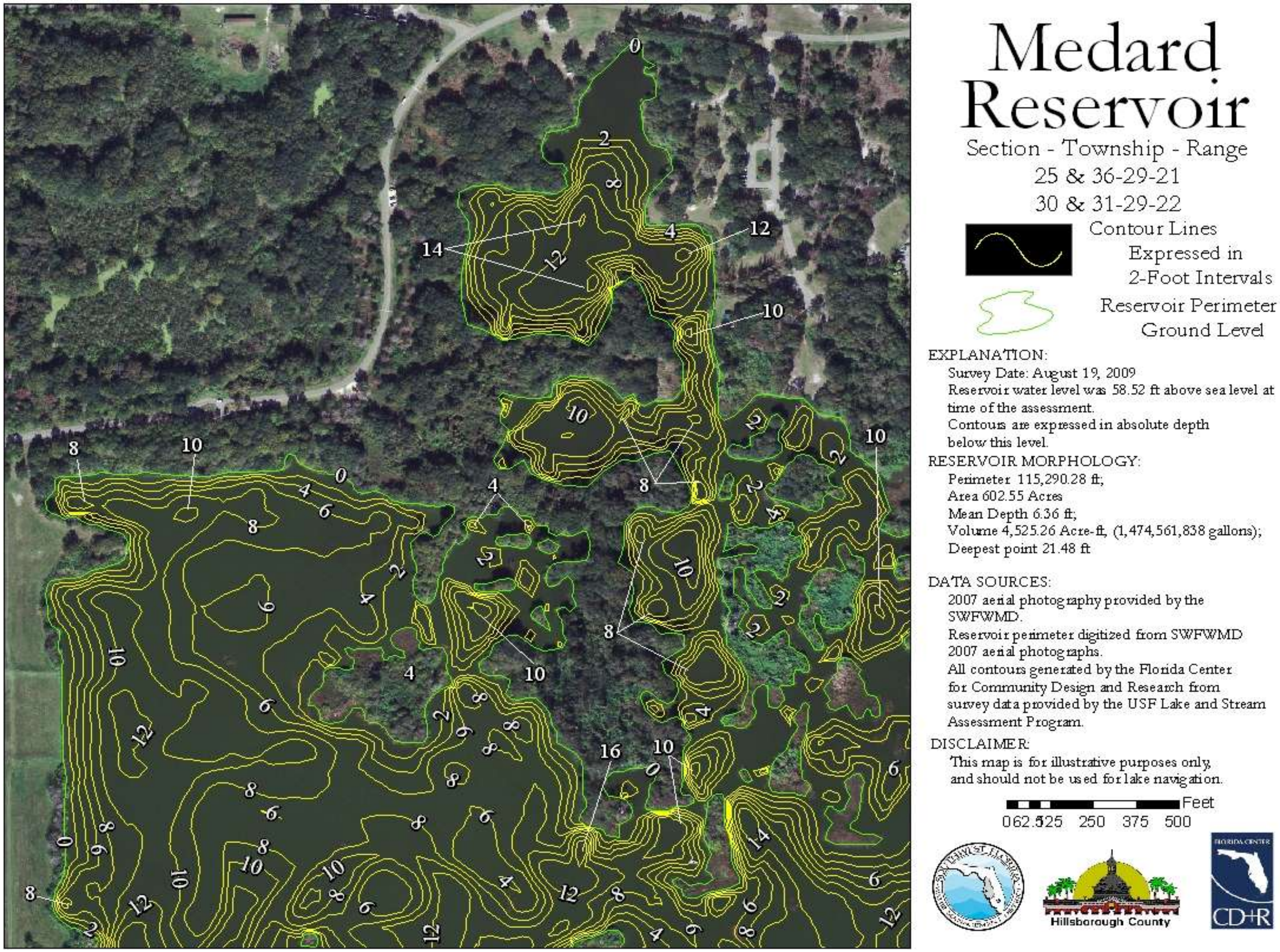


Figure 4. Contour map for Medard Reservoir (northwest). The mapping technique used in 2009 employs a standard DGPS for horizontal position and a fathometer for depth.

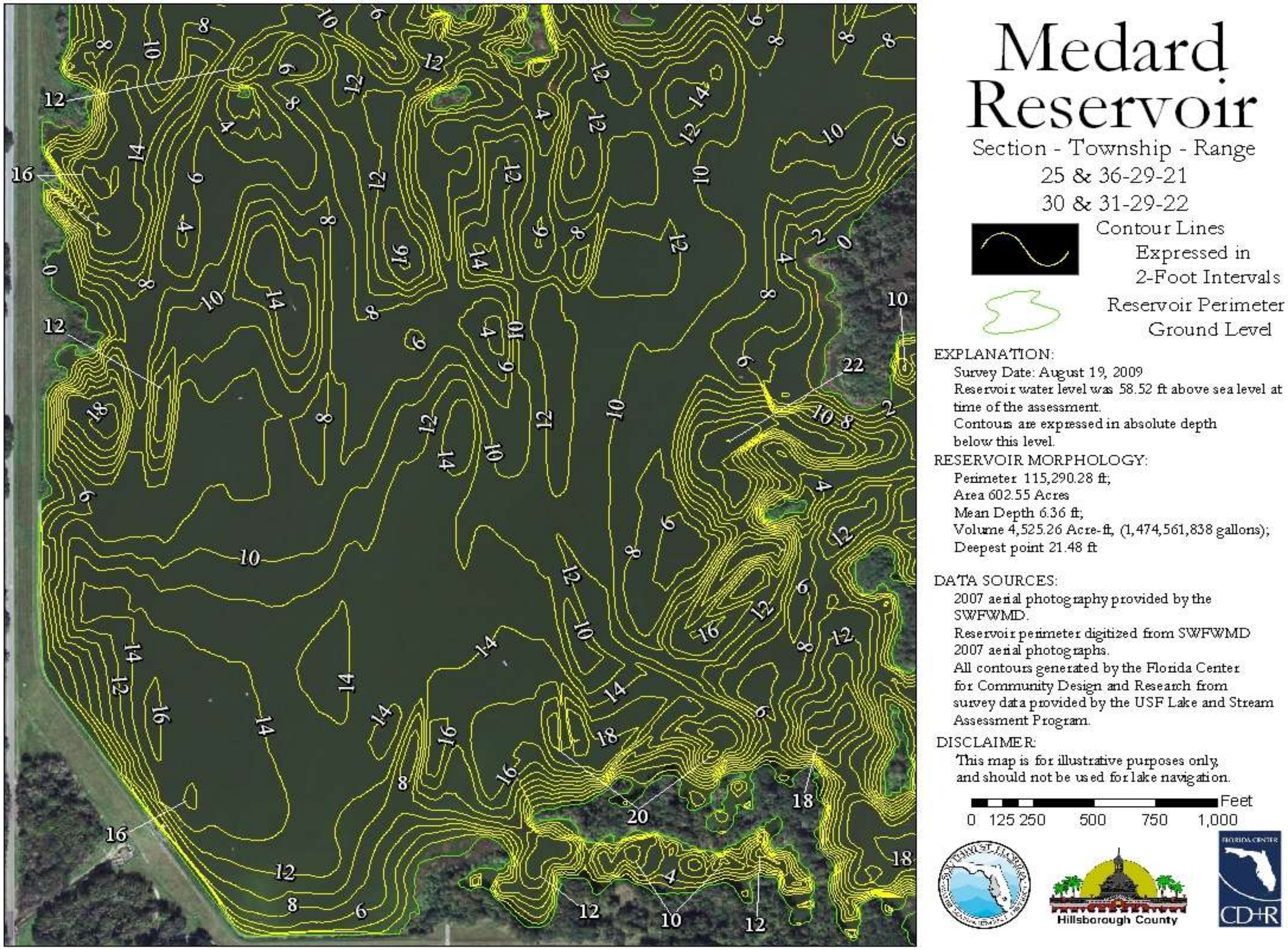


Figure 5. Contour map for Medard Reservoir (southwest). The mapping technique used in 2009 employs a standard DGPS for horizontal position and a fathometer for depth.

Figure 6. Contour map for Medard Reservoir (southeast). The mapping technique used in 2009 employs a standard DGPS for horizontal position and a fathometer for depth.

Section 2: Reservoir Ecology (vegetation)

The lake's apparent vegetative cover and shoreline detail are evaluated using the latest lake aerial photograph as shown in Figure 7 and by use of WAAS enabled GPS. Submerged vegetation is determined from the analysis of bottom returns from the Lowrance 28c HD combined GPS/fathometer described earlier. As depicted in Figure 7, 30 vegetation assessment sites were chosen for intensive sampling based on the *Lake Assessment Protocol* (copy available on request) for a lake of this size. The site positions are set using GPS and then loaded into a GIS mapping program (ArcGIS) for display. Each site is sampled in the three primary vegetative zones (emergent, submerged and floating).[iv] The latest high resolution aerial photos are used to provide shore details (docks, structures, vegetation zones) and to calculate the extent of surface vegetation coverage. The primary indices of submerged vegetation cover and biomass for the reservoir, percent area coverage (PAC) and percent volume infestation (PVI), are determined by transiting the reservoir by boat and employing a fathometer to collect "hard and soft return" data. These data are later analyzed for presence and absence of vegetation and to determine the height of vegetation if present. The PAC is determined from the presence and absence analysis of 100 sites in the reservoir and the PVI is determined by measuring the difference between hard returns (reservoir bottom) and soft returns (top of vegetation) for sites (within the 100 analyzed sites) where plants are determined present (Figure 7).

The data collected during the site vegetation sampling include vegetation type, exotic vegetation, predominant plant species and submerged vegetation biomass. The total number of species from all sites is used to approximate the total diversity of aquatic plants and the percent of invasive-exotic plants on the reservoir (Table 2). The Watershed value in Table 2 only includes lakes sampled during the lake assessment project begun in May of 2006. These data will change as additional lakes are sampled. Tables 3 through 5 detail the results from the 2008 aquatic plant assessment for the reservoir. These data are determined from the 30 sites used for intensive vegetation surveys. The tables are divided into Floating Leaf, Emergent and Submerged plants and contain the plant code, species, common name and presence (indicated by a 1) or absence (indicated by a blank space) of species and the calculated percent occurrence (number sites species is found/number of sites) and type of plant (Native, Non-Native, Invasive, Pest). In the "Type" category, the term invasive indicates the plant is commonly considered invasive in this region of Florida and the term "pest" indicates that the plant has a greater than 55% occurrence in the reservoir and is also considered a problem plant for this region of Florida, or in a non-native invasive that is or has the potential to be a problem plant in the reservoir and has at least 40% occurrence. These two terms are somewhat subjective; however, they are provided to give reservoir property owners some guidance in the management of plants on their property. Please remember that to remove or control plants in a wetland (reservoir shoreline) in Hillsborough County the property owner must secure an Application To Perform Miscellaneous Activities In Wetlands (http://www.epchc.org/forms_documents.htm) permit from the Environmental Protection Commission of Hillsborough County and for management of in-lake vegetation outside the wetland fringe (for lakes with an area greater than ten acres), the property owner must secure a Florida Department of Environmental Protection permit (http://www.dep.state.fl.us/lands/invaspec).

Table 2. Total diversity, percent exotics, and number of Exotic Pests Plants Council pest plants.

Parameter	Reservoir	Watershed
Total Plant Diversity (# of Taxa)	50	50
% Non-Native Plants	30%	30%
Total Pest Plant Species	14%	14%

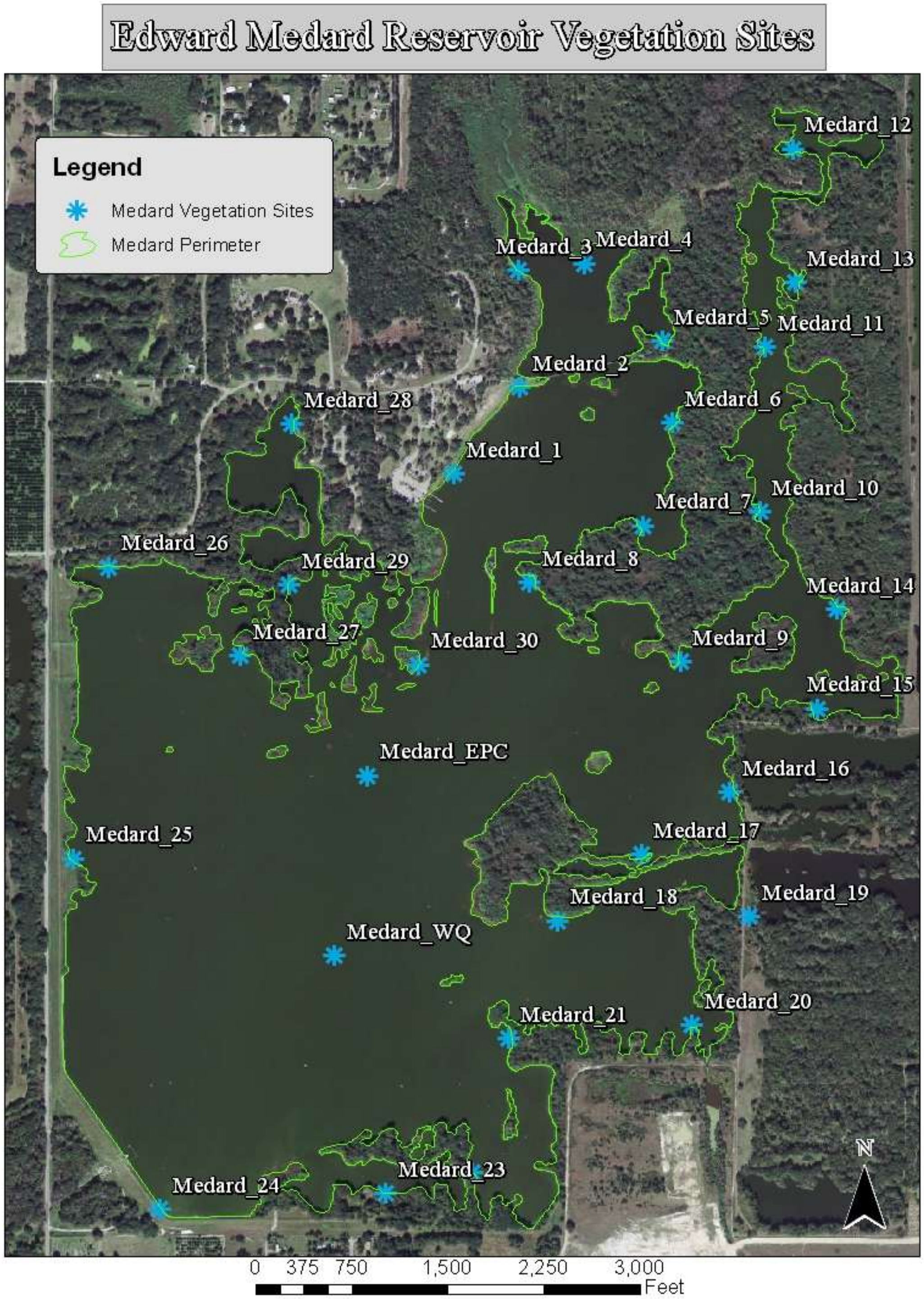


Figure 7. 2007 six-inch resolution aerial photograph showing location of vegetation assessment sites on Medard Reservoir. Major emergent and floating vegetation zones as well as structures are also observable in this aerial.

Table 3. List of Floating Leaf Zone Aquatic Plants Found.

Plant Species Code	Plant Species	Common Name	Sample Site 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
PSS	*Pistia stratoides*	Water Lettuce	1	1	1	1	1	1	1								
HYE	*Hydrocotyl umbellata*	Manyflower Marshpennywort, Water Pennywort	1	1		1	1			1							
SMA	*Salvinia minima*	Water Spangles, Water Fern	1		1	1	1										
LEN	*Lemna spp.*	Common Duckweed			1	1	1										
SPI	*Spirodela polyrhiza*	Giant Duckweed			1	1	1										
ECS	*Eichornia crassipes*	Water Hyacinth		1													

Plant Species Code	Sample Site 16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	Percent Occurrence	(N) Native, (NN) Non-native, (I) Invasive, (P) Pest
PSS															1	70.00%	NN,I,P
HYE	1	1			1		1	1					1		1	50.00%	N
SMA																40.00%	NN,I,P
LEN																30.00%	N
SPI																30.00%	N
ECS																10.00%	NN,I

Figure 8. *Pistia stratoides,* (Watter Lettuce), in the foreground, is a non-native invasive species found on Medard Reservoir. *Hydrocotyl umbellata,* (Water Pennywort), in the middle is a common native species found on Medard Reservoir.

Figure 9. Photograph of *Nelumbo lutea*, (American Lotus) on Medard Reservoir. This native floating vegetation was found on Medard Reservoir although it was not found at a vegetation assessment site.

Table 4. List of Aquatic Zone Emergent Plants Found.

Plant Species Code	Plant Species	Common Name	Sample Site																														Percent Occurrence	(N) Native, (NN) Non-native, (I) Invasive, (P) Pest
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30		
CEA	*Colocasia esculenta*	Wild Taro, Dasheen, Coco Yam					1	1	1	1	1	1	1	1	1	1	1				1	1	1	1	1	1	1	1	1	1	1	1	76.67%	NN,I,P
PGM	*Paspalidium geminatum*	Egyptian Paspalidium	1	1		1		1	1	1	1		1	1			1	1	1	1	1	1	1	1	1		1	1	1		1	1	76.67%	N
QLO	*Quercus laurifolia*	Laurel oak	1	1	1		1			1	1	1	1	1	1		1			1	1	1	1	1	1			1	1	1	1		70.00%	N
VRA	*Vitis rotundifolia*	Muscadine Grape					1	1	1	1	1	1	1	1	1	1	1		1		1	1	1	1			1	1	1	1	1		70.00%	N
LPA	*Ludwigia peruviana*	Peruvian Primrosewillow	1	1		1	1	1	1			1			1		1		1	1	1	1	1	1	1		1	1	1			1	66.67%	N,P
SAL	*Salix spp.*	Willow			1	1		1	1	1	1		1	1			1	1	1	1	1	1	1	1	1		1					1	63.33%	N
WAX	*Myrica cerifera*	Wax Myrtle			1			1		1	1	1	1		1	1			1	1		1	1	1	1			1	1		1		56.67%	N
TYP	*Typha spp.*	Cattails	1	1	1	1		1		1	1	1											1	1	1	1	1	1	1			1	53.33%	N
URL	*Urena lobata*	Caesar's Weed					1			1	1		1				1		1	1	1	1	1	1	1			1	1	1	1		53.33%	NN,I,P
MSS	*Mikania scandens*	Climbing Hempvine	1		1		1	1												1	1	1	1	1		1	1		1	1	1	1	50.00%	N
APS	*Alternanthera philoxeroides*	Alligator Weed	1	1	1	1	1	1	1	1		1		1							1					1		1		1			46.67%	NN,I,P
NSS	*Nephrolepsis spp.*	Sword Fern					1		1		1	1	1	1			1		1			1		1	1			1		1			43.33%	N
STS	*Schinus terebinthifolius*	Brazilian Pepper											1	1		1	1	1	1	1	1		1		1			1	1		1		43.33%	NN,I,P
SSP	*Sabal spp.*	Cabbage Palms, Palmetto						1					1	1	1	1	1	1			1			1	1			1		1			40.00%	N
BMA	*Urochloa mutica*	Para Grass	1	1	1	1	1	1										1		1			1					1					33.33%	NN,I
POL	*Polygonum spp.*	Smartweed, Knotweed	1	1																			1	1			1	1		1	1	1	30.00%	N
PRS	*Panicum repens*	Torpedo Grass																				1		1	1	1		1	1			1	23.33%	NN,I
PNA	*Phyla nodiflora*	Frog-fruit, Carpetweed, Turkey Tangle Fogfruit																			1		1	1	1				1		1		20.00%	N
AAS	*Amelopis arborea*	Peppervine					1							1	1												1	1					16.67%	N
EAA	*Eclipta alba (prostrata)*	False Daisy, Yerba De Tajo																			1	1				1			1		1		16.67%	N
OCA	*Osmunda cinnamomea*	Cinnamon Fern					1	1					1	1						1													16.67%	N
QNA	*Quercus nigra*	Water Oak												1								1			1				1	1			16.67%	N
SSM	*Sapium sebiferum*	Popcorn Tree, Chinese Tallow Tree					1	1	1	1	1																						16.67%	NN,I
CCA	*Cinnamomum camphora*	Camphor-tree						1	1				1					1															13.33%	NN,I
COS	*Cephalanthus occidentalis*	Common Buttonbush			1														1			1		1									13.33%	N
PFA	*Paederia foetida*	Skunk Vine													1									1	1				1				13.33%	NN,I
PLU	*Pluchea spp.*	Marsh Fleabane,Camphorweed															1				1	1						1					13.33%	N
ACE	*Acer rubrum var. trilobum*	Southern Red Maple			1				1									1															10.00%	N
CSS	*Cyperus surinamensis*	Flat Sedge																								1		1	1				10.00%	N
CYP	*Cyperus spp.*	Sedge															1					1				1							10.00%	N
PAR	*Paspalum repens*	Water Paspalum			1	1	1																										10.00%	N
BOC	*Boehmeria cylindrica*	Bog Hemp, False Nettle																				1		1									6.67%	N
CMX	*Cicuta mexicana*	Water Hemlock																									1					1	6.67%	N
DBA	*Dioscorea bulbifera*	Air Potato																			1									1			6.67%	
GAA	*Gleditsia aquatica*	Water Locust																						1						1			6.67%	N
JES	*Juncus effusus var solutus*	Soft Rush																											1			1	6.67%	N
MAH	*Melia azedarach*	Chinaberry																											1	1			6.67%	NN,I
SAM	*Sambucus canadensis*	Elderberry	1			1																											6.67%	N
TDM	*Taxodium distichum*	Bald Cypress	1	1																													6.67%	N
TGA	*Thalia geniculata*	Fireflag, Arrowroot								1																						1	6.67%	N
WTA	*Sphagneticola (Wedelia) trilobata*	Creeping Oxeye		1													1																6.67%	NN,I
LAN	*Lantana spp.*	Lantana															1																3.33%	NN
PSQ	*Parthenocissus quinquefolia*	Woodbine																													1		3.33%	N
TOX	*Toxicoendron radicans*	Poison Ivy																					1										3.33%	N

Figure 10. *Paspalum repens*, (Water Paspalum) is a native emergent grass found on Medard Reservoir shown here in the foreground. *Typha spp.*, (Cattails) are also a native emergent vegetation commonly found on Medard Reservoir shown here just behind the *Paspalum repens*.

Section 3: Reservoir Water Chemistry

A critical element in any reservoir assessment is the long-term water chemistry data set. The primary source of water quality trend data for Florida Lakes and reservoirs is the Florida LAKEWATCH volunteer and the Florida LAKEWATCH water chemistry data. Hillsborough County is fortunate to have a large cadre of volunteers who have collected lake water samples for significant time period. These data are displayed and analyzed on the Water Atlas as shown in Figure 11 for Medard Reservoir. No active volunteer monitoring exists for Medard Reservoir and the last agency sampling was 2005. Figures 12-14 are graphs based on combined sources for the period of available total nitrogen, total phosphorus and chlorophyll a data for Medard from the Data Download graphing feature. This is a dark water system (USGS 1979 measured total color at 240 PCU) and as such it must maintain a TSI of below 60 to not be considered impaired by the State of Florida guidelines. [v.] The lake's long term water quality data indicates enough violations of these criteria to be classified by Florida DEP as impaired. However, there is no water chemistry data available for the resource after 2005. The County should make every effort to add a volunteer monitor to this site of begin monthly monitoring of the site by different means.

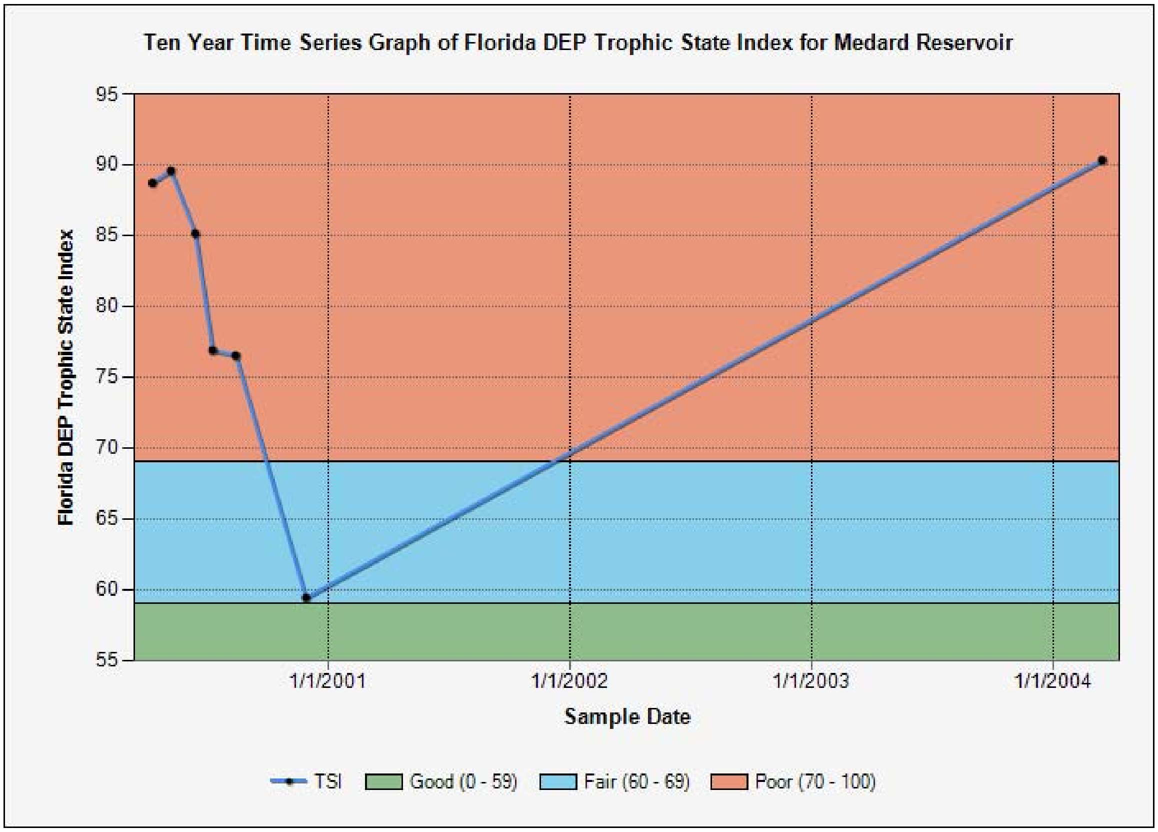


Figure 11. Recent Trophic State Index (TSI) graph from Hillsborough Watershed Atlas. For the latest data go to:
(http://www.hillsborough.wateratlas.usf.edu/lake/waterquality.asp?wbodyid=5464&wbodyatlas=lake **)**
Note: The graph above includes benchmarks for using verbal descriptors of "good", "fair" and "poor". The verbal descriptors for these benchmarks are based on an early determination by stakeholders of the generally acceptable and understood terms for describing the state of lakes. The same benchmarks are used for nutrient graphs (Nitrogen and Phosphorus), chlorophyll graphs and trophic state index (TSI) graphs. The TSI is a calculated index of lake condition based on nutrient and chlorophyll (a) concentrations (please see "Learn more about Trophic State Index"). The benchmarks are established based on the TSI range that relates to a specific descriptor. The source for the TSI concentration relationships is the Florida Water Quality Assessment, 1996, 305(b) (Table 2-8).

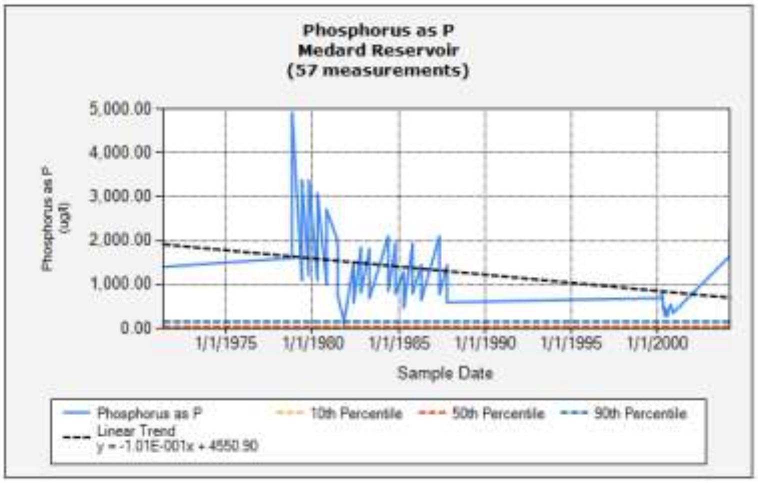


Figure 12. Total Phosphorus in µg/L from multiple sources.

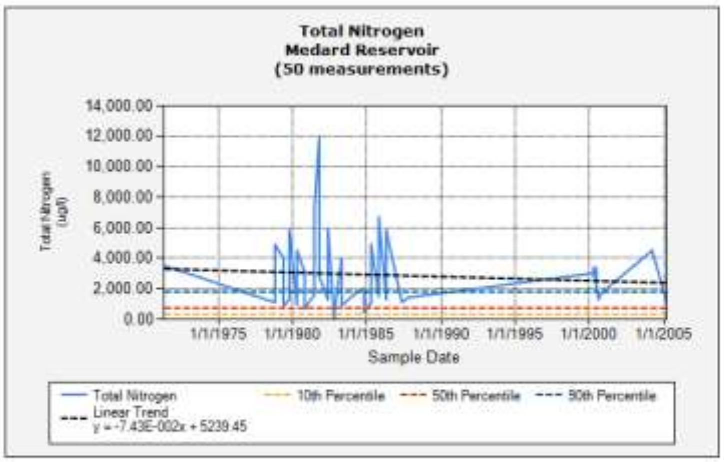


Figure 13. Total Nitrogen in µg/L from multiple sources.

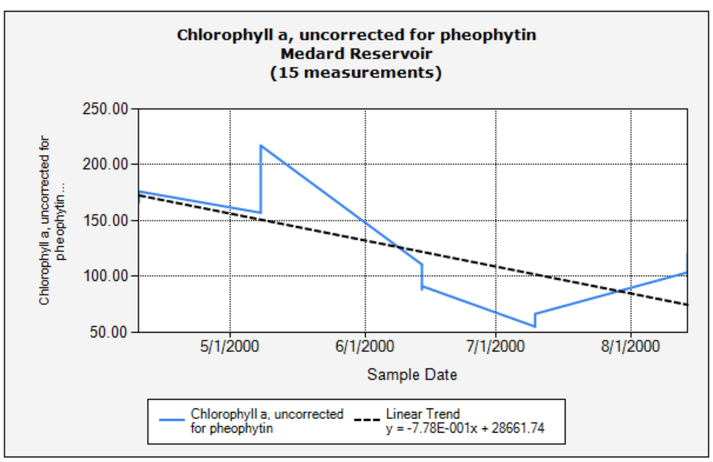


Figure 14. Chlorophyll a µg/L from multiple sources

As part of the reservoir assessment the physical water quality and chemical water chemistry of a reservoir are measured. These data only indicate a snap shot of the reservoir's water quality; however they are useful when compared to the trend data available from LAKEWATCH or other sources. Table 5 contains the summary water quality data and index values and adjusted values calculated from these data. The total phosphorus (TP), total nitrogen (TN) and chlorophyll (a) water chemistry sample data are the results of chemical analysis of samples taken during the assessment and analyzed by the Hillsborough County Environmental Protection Commission laboratory.

Another important lake and reservoir parameter is the "potential trophic state index (pTSI). This parameter is determined by calculating the amount of nutrients (phosphorus and nitrogen) that could be released by existing submerged vegetation if this vegetation were treated with an herbicide or managed by the addition of Triploid Grass Carp (*Ctenopharyngodon idella*). While it would not be expected that all the vegetation would be turned into available nutrients by these management methods, the data is useful when planning various management activities. Medard reservoir has no measureable submerged. Thus the pTSI is the same as the TSI or 59.57 at the time the sample was taken. One approach to managing the reservoir's water quality would be to encourage native submerged vegetation such as tape grass (*Vallisneria americana*). The TSI measured as part of this lake assessment was just below the level required for a TMDL. Additional samples should be drawn to determine if the reservoir's long-term water quality trend.

Table 5. Water Quality Parameters (Laboratory)

Lake	Meddard Reservoir
Date	8/17/2009
TN (mg/L)	1.005
TP (mg/L)	0.243
Chlorophyll a (µg/L)	149.7
Color (PCU)	224
Secchi (Ft)	2.65
TN/TP	4.14
Limiting Nutrient	Nitrogen
TSI	59.73
pTSI	59.73

Table 6 contains the field data taken in the center of the reservoir using a multi-probe (we use either a YSI 6000 or a Eureka Manta) which has the ability to directly measure the temperature, pH, dissolve oxygen (DO), percent DO (calculated from DO, temperature and conductivity) and turbidity. These data are listed for three levels in the reservoir and twice for the surface measurement. The duplicate surface measurement was taken as a quality assurance check on measured data. Three water chemistry profiles were taken for the western, center and eastern sections of the reservoir. As is apparent from Table 6 and Figure 15, the reservoir exhibits the typical properties of a eutrophic system. High DO at the surface and reduced DO with depth. The DO and pH levels indicate a productive system with algal photosynthesis producing high levels of oxygen and high pH (acid condition). The later indicates removal of carbon from the water which shifts the system to a less alkaline system. Please see the discussion of lake alkalinity and pH at: http://lakeaccess.org/russ/pH.htm.

To better understand many of the terms used in this report, we recommend that the visit the Hillsborough Watershed Atlas (http://www.hillsborough.wateratlas.usf.edu) and explore the "Learn More" areas which are found on the resource pages. Additional information can also be found using the Digital Library on the website.

Tables 6. Water Quality Parameters (Field-YSI) Tables reflect data collected from Medard Reservoir.

Date	Time	Temperature °C	Sp.Cond ms/cm	DO mg/L	pH	Depth m	Salinity PSS	DO %	Latitude	Longitude	Annotation
24-Aug-09	10:43:17	30.54	0.289	9.29	8.94	0.51	0.1	121.38	27.91743N	82.16922W	Medard West
24-Aug-09	10:47:51	29.75	0.292	6.17	8.72	2.44	0.1	79.56	27.91743N	82.16926W	Medard West
24-Aug-09	10:49:51	29.61	0.297	2.65	7.98	4.58	0.1	34.07	27.91741N	82.16921W	Medard West
24-Aug-09	10:51:51	30.42	0.289	8.93	9.04	0.84	0.1	116.37	27.91744N	82.16919W	Medard West
24-Aug-09	10:57:49	30.88	0.289	10.33	9.04	0.51	0.1	135.68	27.91553N	82.16642W	Medard Center
24-Aug-09	10:59:49	29.91	0.292	6.28	8.74	2.08	0.1	81.14	27.91551N	82.16646W	Medard Center
24-Aug-09	11:01:49	29.81	0.294	4.13	8.39	2.75	0.1	53.31	27.91553N	82.16646W	Medard Center
24-Aug-09	11:03:49	31.11	0.289	10.66	9.21	0.44	0.1	140.55	27.91556N	82.16646W	Medard Center
24-Aug-09	11:09:30	31.19	0.29	10.86	9.2	0.56	0.1	143.41	27.91410N	82.16229W	Medard East
24-Aug-09	11:11:30	30.31	0.292	5.47	8.65	1.38	0.1	71.19	27.91411N	82.16234W	Medard East
24-Aug-09	11:13:30	30.05	0.296	2.14	7.92	2.8	0.1	27.76	27.91413N	82.16234W	Medard East
24-Aug-09	11:15:30	31.18	0.29	11.31	9.31	0.6	0.1	149.35	27.91411N	82.16232W	Medard East

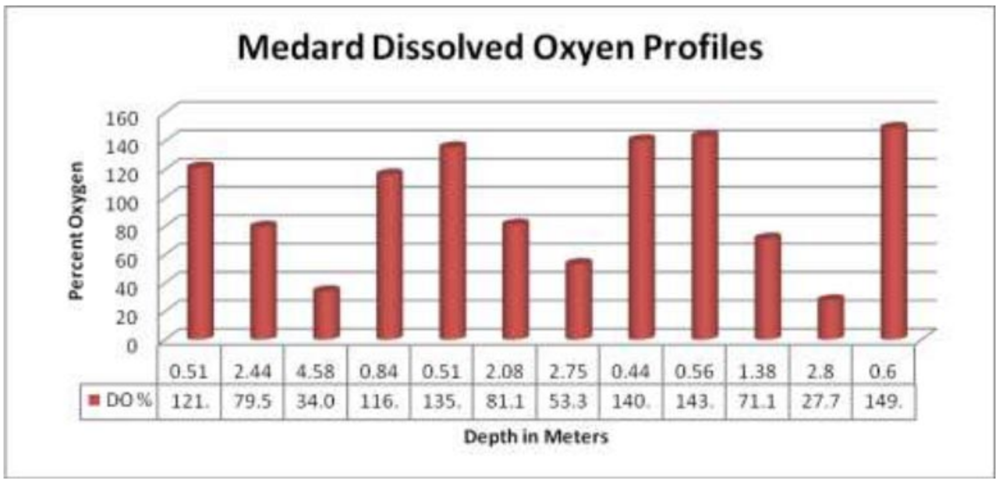


Figure 15. Dissolve Oxygen Profiles for stations: West, Center and East.

Section 4: Conclusion

Medard Reservoir is a large (602.55 acre) lake that would be considered in the eutrophic (fair) to hypereutrophic (poor) category of reservoirs based on water chemistry. It has a lower than normal concentration of aquatic vegetation and no submerged vegetation. Vegetation helps to maintain the nutrient balance in the reservoir as well as provide good fish habitat. The reservoir has many open water areas that support various types of recreation and has a fair diversity of plant species. The primary Pest plants in the reservoir include Peruvian primrose willow (*Ludwigia peruviana*), Cattails (*Typha spp.*), Wild Taro (*Colocasia esculenta*), Caesars Weed (*Urena lobata*), Alligator Weed (*Alternanthera philoxeroides*), Brazilian Pepper (*Schinus terebinthifolius*), Water Lettuce (*Pistia stratoides*) and Water Fern (*Salvinia minima)*. For more information and recent updates please see the Hillsborough Watershed Atlas (water atlas) w*ebsite at: http://www.hillsborough.wateratlas.usf.edu .*

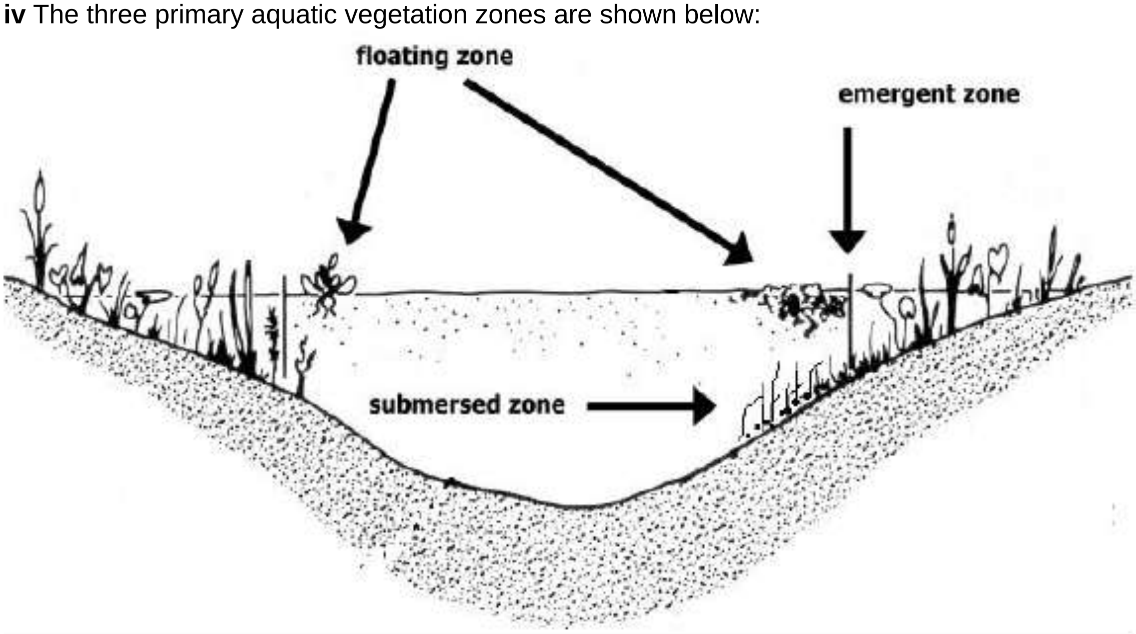
Lake Assessment Footnotes

i "Trophic" means "relating to nutrition." The Trophic State Index (TSI) takes into account chlorophyll, nitrogen, and phosphorus, which are nutrients required by plant life. For more information please see *learn more* at:
http://www.hillsborough.wateratlas.usf.edu/lake/default.asp?wbodyid=5464&wbodyatlas=lake

ii A bathymetric map is a map that accurately depicts all of the various depths of a water body. An accurate bathymetric map is important for effective herbicide application and can be an important tool when deciding which form of management is most appropriate for a water body. Lake volumes, hydraulic retention time and carrying capacity are important parts of lake management that require the use of a bathymetric map**.**

iii WAAS is a form of differential GPS (DGPS) where data from 25 ground reference stations located in the United States receive GPS signals form GPS satellites in view and retransmit these data to a master control site and then to geostationary satellites. The geostationary satellites broadcast the information to all WAAS-capable GPS receivers. The receiver decodes the signal to provide real time correction of raw GPS satellite signals also received by the unit. WAAS enabled GPS is not as accurate as standard DGPS which employs close by ground stations for correction, however; it was shown to be a good substitute when used for this type of mapping application. Data comparisons were conducted with both types of DGPS employed simultaneously and the positional difference was determined to be well within the tolerance established for the project.

iv The three primary aquatic vegetation zones are shown below:



v A lake is impaired if " (2) For lakes with a mean color less than or equal to 40 platinum cobalt units, the annual mean TSI for the lake exceeds 40, unless paleolimnological information indicates the lake was naturally greater than 40, or For any lake, data indicate that annual mean TSIs have increased over the assessment period, as indicated by a positive slope in the means plotted versus time, or the annual mean TSI has increased by more than10 units over historical values. When evaluating the slope of mean TSIs over time, the Department shall use a Mann's one-sided, upper-tail test for trend, as described in Nonparametric Statistical Methods by M. Hollander and D. Wolfe (1999 ed.), pages 376 and 724 (which are incorporated by reference), with a 95% confidence level." Excerpt from Impaired Water Rule (IWR). Please see: http://www.dep.state.fl.us/water/tmdl/docs/AmendedIWR.pdf