Preliminary Engineering Study

Consideration of a Normal Lake Level for Eagle and Crooked Lakes

in accordance with MCL 324.307 et seq. Inland Lake Levels, Part 307, Act 451 of 1994.

Prepared for

The Office of the Kalamazoo County Drain Commissioner

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2200395

Prein&Newhof

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1 INTRODUCTION

The purpose of this study is to collect data and analyze the impact of setting a Normal Lake Level on Eagle Lake and Crooked Lake, located in Texas Township, Kalamazoo County, Michigan. The study has been prepared in accordance with the Michigan Department of Environment, Great Lakes, and Energy procedures under Part 307, Inland Lake Levels, of the Natural Resources and Environmental Protection Act, 1994 PA 451 as amended. All elevations referenced in this study, unless specifically called out separately, are referenced to NAVD88.

Unprecedented flooding due to high groundwater started in Texas Township in October 2017 and peaked in June of 2019. The flooding has not only impacted Eagle, Crooked and Pine Island Lakes, but also the Vineyards Plats, Pine Island Plats, and the surrounding areas. In response to numerous requests for assistance, Texas Township assembled a Task Force Committee to determine a short-term and long-term solution. The committee was comprised of representatives from organizations that would be involved in a decision-making process as well as representatives from those areas impacted by the flooding and downstream flows.

The Township, the Task Force, and the Township's engineers (Prein&Newhof) developed a short-term pumping plan to help alleviate the flooding that was occurring. The short-term pumping plan consists of a pumping system to move water from Eagle Lake to Crooked Lake and then from Crooked Lake to Bass Lake which has a natural outlet to the West Fork of the Portage Creek where it eventually flows into the Kalamazoo River. The Township created a special assessment district to fund the project which includes 630 impacted properties.

After a five-month permitting process, the Michigan Department of Environment, Great Lakes and Energy (EGLE), approved implementation of the short-term pumping project in March 2019, with pumping commencing in May. Unfortunately, this was too late to save sixteen homes that were abandoned, two of which have since been demolished. It is estimated that there have been millions of dollars spent on personal protection measures and damage to the impacted properties; however, the full extent of the damages will not be known until the water level returns to pre-flooding conditions.

The permit and temporary easements for the short-term pumping solution have been extended until June 1, 2021. Based on recent data we may see Crooked Lake meet its target level during this time

but we don't expect Eagle Lake to meet its target level. It is proposed that a permanent gravity system, consisting of constructing outlets for both Eagle and Crooked Lakes as the best solution for continued lowering of the lake levels and preventing future flooding.

Establishing the Normal Lake Levels is the most expedient option to establish a permanent gravity solution. An established Normal Lake Level will allow the Township to work with the office of the Kalamazoo County Drain Commissioner to proceed with this project.

2 RECOMMENDATION

Our recommendation is to set the Normal Lake Levels at elevations in accordance with the levels that both lake associations have been operating their augmentation pumps. They are as follows:

Crooked Lake 895.12 feet (GEOID12B Adjustment of the 1988 North American Vertical Datum (NAVD88) with the units being in international feet)

Eagle Lake 899.26 feet* (GEOID12B Adjustment of the 1988 North American Vertical Datum (NAVD88) with the units being in international feet)

Our findings of this report show that at these levels, there will be no negative impact on the lakes with respect to recreational issues, septic tanks or drain fields, docks, ice damage, environmental issues including endangered species or fisheries habitat, or aquatic weed growth. Additionally, the results of the residents' survey support continuing the levels previously operated by the lake associations.

Further, these Normal Lake Levels are being recommended with the understanding that the lake associations will be able to continue to operate their augmentation pumps when water levels are below the Normal Lake Levels in a manner consistent with past practice. The practice for both lakes is to turn the pumps on 8" below the Normal Lake Level (894.45 for Crooked Lake and 898.59 for Eagle Lake) and off at 4" below the Normal Lake Level (894.78 for Crooked Lake and 898.92 for Eagle Lake). The normal lake levels will be monitored from staff gauges that will be set on both lakes.

*The Ordinary Water Elevation established for a building setback baseline of Eagle Lake as found in the Municipal Code was 899.84 feet. To convert this number to coincide with the modern datum

utilized for this report and identified above, a conversion value of 0.58 feet shall be subtracted. Ex. 899.84 feet minus 0.58 feet = 899.26 feet.

3 FEASIBILITY OF THE PROJECT ESTABLISHING THE NORMAL LAKE LEVEL

As discussed above, the Township developed a short-term pumping project that has been in operation since May 2019. The project has been successful in lowering Eagle Lake by 1.9 ft. and Crooked Lake by 2.3 ft despite the ongoing higher than normal annual precipitation. A total of 1,225 million gallons of water have been pumped out of the Eagle Lake/Crooked Lake area since pumping began. Water levels for Crooked and Eagle Lake, as well as upstream lakes, would otherwise have been flooded for a much longer period with peak levels reaching approximately 0.6 feet higher than the already high flood levels, as shown in Figures 12a and 12b.

During this project development the Township has decided that a permanent gravity solution will be necessary, to ensure that the risk of future flooding is greatly reduced in both scope and duration. A permanent gravity solution at the recommended levels will use the same strategy of the short-term pumping project, by moving water from Eagle Lake to Crooked Lake and on to Bass Lake and eventually the Kalamazoo River.

A long-term pumping solution has been rejected as a feasible option due to the high cost of operation (daily inspection and power costs), maintenance (mechanical equipment, filters, pumps), and the inconvenience to the lake residents (above ground infrastructure, noise).

A permanent gravity solution at the recommended levels is feasible as it will take advantage of the elevation differences between these lakes which will allow for gravity flow of this water. Once installed, the ongoing operation and maintenance of the system will be very low and the inconvenience to the lake residents will be minimized.

The permanent gravity solution in conjunction with maintaining the lake augmentation levels will allow for seasonal water level fluctuations and will act to reduce the incidents of extreme high and low water levels. Regular water level variation maintains wetlands and crucial shoreline vegetated habitat, and establishes lakeshore stability.

The permanent gravity solution will not alter how the lakes have been traditionally managed for decades. It will only provide flooding and property damage relief during prolonged periods of substantially higher than average precipitation,

4 EXPEDIENCY OF THE NORMAL LAKE LEVEL PROJECT

The proposed permanent gravity project at the recommended levels includes construction of positive outlets on Crooked Lake and Eagle Lake to provide flood relief during periods of high groundwater/high lake levels. Figure 1 shows an overview of the project area. Bass Lake and Scouters Pond currently have an outlet which conveys water downstream when levels are high. Crooked Lake and Eagle Lake, along with the entire tributary area to these lakes, is subject to higher groundwater when precipitation is high for prolonged periods because of the lack of outlets from any of the lakes. Figure 2 shows the general route of flow proposed to convey water downstream eventually to the Kalamazoo River.

It is proposed that the lake bottom will be used to provide a natural filter to eliminate the risk of transferring invasive species to a perforated pipe inlet adjacent to the lake (a more detailed discussion of this filtration strategy is discussed in section 16.5). A control structure manhole will be located near the lake with an internal weir structure which will allow water to flow over the top of the weir when lake levels rise above the design level. The water will flow over the weir and into gravity piping to the outlet. The perforated pipe inlet to the wetland outlet can be seen in Figure 3. At the outlet, erosion control will be provided. This design will be applied to both Crooked and Eagle Lake outlets. Figures 4 and 5 show the piping routes that are being considered to convey high waters from Crooked Lake to the wetlands west of Bass Lake and from Eagle Lake to Crooked Lake.

The proposed project is both technically feasible and the most economically prudent option because the hydraulics of gravity piped flow is more effective in controlling high lake levels than reliance on natural groundwater flow, which is very slow. It is thought that during long periods of greater than normal rainfall that the continuous gravity flow would mimic what is occurring downstream at Bass Lake with respect to water quality and temperature. Bass Lake has been fluctuating by approximately 6 inches with high rainfall and the addition of the pumped flow from Crooked Lake over the past 19 months of 1000 gpm to 2000 gpm. Water level fluctuation is crucial for maintaining wetlands and crucial shoreline vegetated habitat, as well as establishing lake shore stability. Once all these lake levels are reduced from the very high levels, Bass Lake level will drop lower and the lake level fluctuation range will return to a more normal range. The long-term solution will cause lake level fluctuations based on long-term weather patterns and a changing flow upstream from 0 to 1800 gpm with the maximum occurring over a day rather than many days.

Following lake level stabilization, the flow into Bass Lake out of Crooked Lake will be reduced in volume from the current flows (during pumping), resulting in lower Bass Lake levels and no adverse impact on this lake nor downstream water bodies. The new outlets would provide outflow from Crooked and Eagle Lake following longer periods of high precipitation more often than during individual events. Figure 9a shows how the new outlet would approximately have been activated from 2015 to present. The proposed Crooked Lake outlet would not be activated during years of average to low rainfall such as Years 2015 and 2016. However, when rainfall increases dramatically such as in 2017 through 2020, as shown in Figure 9b, the new overflows will then be activated.

Figures 9c and 9d show the alternative impacts to the Crooked Lake and Eagle Lake levels with the new outlets constructed. For the annual 100-year rainfall over several years, Eagle Lake and Crooked lake would only increase by a maximum of 1 foot as opposed to what they actually did increase by (see the actual data on figure 9).

With this new outflow, the impacts downstream on Bass Lake were evaluated. Figure 9a showed that the volume of water conveyed directly downstream is much less than the amount from pumping. The new outflow would have provided significant relief for the two lakes, but would not have increased water levels dramatically downstream as a result. Figure 10a shows the actual Bass Lake measurements (with pumping from Crooked Lake) as well as the estimated impact on Bass Lake with the proposed outlets in place and the estimated impact on Bass Lake with neither pumping nor the proposed outlets in place. The proposed overflow would have a maximum of approximately 6 inches and no difference during periods of less than average rainfall. Figure 10b shows that the water surface elevation at Portage Creek is minimal, with a maximum of 0.01 feet.

To the extent practical, the routes of the outlet pipes are located to align with existing sanitary sewer easements, in public road rights-of-way and along existing driveways to accommodate operation and maintenance to minimize the impact to property owners.

All property owners along the proposed permanent gravity route have been contacted about the necessary easements and the Township has received positive feedback from all.

The Township met with representatives from EGLE in February 2020 to discuss the permanent gravity solution and the plan was received well with constructive comments from them regarding the permanent gravity permitting process.

5 FEASIBLE AND PRUDENT ALTERNATIVE METHODS AND DESIGNS FOR CONTROLLING THE NORMAL LEVEL

The solution to address high water levels is to allow for a transfer of water from Eagle Lake to Crooked Lake, then Crooked Lake to Bass Lake, which has a natural outlet. This transfer of water currently takes place through the movement of groundwater; however, at a much slower rate. The only practical alternative to this project would be to continue pumping as is being done under the short-term pumping solution. However, the short-term pumping solution is not feasible in the long-term due to the high operating costs associated with the pumping activity, electricity, daily oversight, filter maintenance, etc.

6 ESTIMATED COSTS OF CONSTRUCTION AND MAINTENANCE OF THE NORMAL LEVEL PROJECT

An estimate of probable cost for the permanent gravity project and ongoing maintenance can be found in Table 1.

7 METHOD OF FINANCING INITIAL COSTS

The cost of the permanent gravity solution is intended to be financed pursuant to Part 307 of NREPA with a revenue bond or loan with the revenues from a second special assessment district to be set by the Circuit Court.

8 NECESSITY OF A SPECIAL ASSESSMENT DISTRICT AND TENTATIVE BOUNDARIES

A second special assessment district is necessary to fund this infrastructure project. The assessment district with boundaries to be set by the Circuit Court will include property owners who will benefit from the project. Figure 6 shows a proposed district that includes both riparian and deeded access lot owners.

9 OTHER INFORMATION

The Township Assessor has reduced the assessed values in the impacted areas for 2018 and 2019, resulting in a significant negative impact on taxable value. The taxable values in the impacted areas for 2019 and 2020 have decreased by $11,262,121, resulting in a tax loss to County Programs of $141,475, loss to schools of $344,252, and loss to Texas Township programs of $22,577.

10 PAST LAKE LEVEL RECORDS

Prein & Newhof has researched government and private sources for water surface elevations; these sources include neighborhood plat records, sanitary and storm sewer construction records, public survey records including USGS and MDNR, and private boundary surveys. The records search also uncovered numerous documents showing fixed lake reference elevations for both Eagle and Crooked Lakes. These fixed reference elevations include ordinary high-water mark and 100-year flood plain elevations. In addition, Appendix A includes data relating to the operation of the augmentation wells on Crooked Lake and Eagle Lake, and available well data for the Crooked Lake augmentation well and the Eagle Lake augmentation well.

Texas Township has been conducting routine lake elevation monitoring since flooding began in 2017. All elevations in this study are referenced to NAVD88 datum.

10.1 Crooked Lake

Longtime residents of Crooked Lake report that the water surface elevation has fluctuated significantly in the past between flooding in 1952, to droughts where the lake "dried up" in 1963. In 1964 the Crooked Lake Texas Association (CLTA) installed the first augmentation well to maintain the lake level, allowing for more consistent use of the lake for recreational purposes. Two replacement augmentation wells were installed in 2002 and 2011. Information from the CLTA president Jim Roberts indicates that the CLTA has operated the augmentation pump for the past 30 or so years using a high-water mark of 895.12 (elevation of the top of Mr. Robert's sea wall). The pump is turned off at an elevation of 4" below the high-water mark and beginning pumping at 8" below the high-water mark. In the fall they have left the augmentation well off at a level of 12" below the high-water mark to allow for spring snowmelt and rains.

Mr. Roberts also believes that this operating procedure helps control aquatic weed growth, allows for navigation of the east end of the lake, has not caused shore erosion or ice damage, and has not negatively affected septic systems.

USGS maps from 1922 and 1967 show Crooked Lake water elevations of 894 and 893, respectively. USGS maps are created off 10-ft contours so these maps should only be used for general reference only. A complete list of sources and elevations are compiled in Table 2 and depicted on Figure 7. Source documents showing elevations can be found in Appendix B.

10.2 Eagle Lake

For the past few decades, Eagle Lake was maintained at a near consistent level by the Eagle Lake Texas Association (ELTA) through use of an augmentation well. ELTA operated the augmentation pump using a high-water mark of 899.84. (measured from a benchmark at the DNR launch site and also the elevation set by the Township as the Ordinary Water Elevation for use in determining building setbacks-see footnote in section 2). The pump is turned off at an elevation of 4" below the high-water mark and pumping at 8" below the high-water mark. The near consistent historical lake level has maintained several natural sandbars used as destinations for swimming and socializing. This consistent lake level also supports a robust fishery habitat and wildlife sanctuary. The DNR boat launch on Eagle Lake has provided public access and boat launch activities given consistent lake levels. Both would be impacted negatively with a significant raising or lowering of the lake level. The ELTA operating procedures for their augmentation pump can be found in Appendix B page 11.

Eagle Lake is prone to ice damage and lake residents normally remove docks in the winter to avoid damage. This lake level affords lake residents standard benchmarks for placement and care of docks and shoreline maintenance.

USGS maps from 1922 and 1967 show lake elevations of 898. A complete list of sources and elevations are compiled in Table 3 and depicted on Figure 8. Record documents can be found in Appendix B.

11 RECREATIONAL USES

11.1 Crooked Lake

Crooked Lake is an all-purpose recreational lake that is used for swimming, boating, fishing, and lake side living enjoyment. There is no public access to Crooked Lake; boat access is achieved by private landings. The recommended Normal Lake Level will not negatively affect the recreational uses of the lake.

11.2 Eagle Lake

Eagle Lake is an all-purpose recreational lake that is used for swimming, boating, fishing, and lake side living enjoyment. There is a MDNR public access and boat launch at the north end of

the lake. The recommended Normal Lake Level will not negatively affect the recreational uses of the lake.

12 LOCATION OF SEPTIC TANKS, DRAIN FIELDS, SEA WALLS, DOCKS, AND OTHER PERTINENT PHYSICAL FEATURES

An analysis was performed of all properties surrounding Eagle Lake and Crooked Lake to determine the location of private septic systems currently in operation and how they might be affected by the setting of a Normal Lake Level. There is currently public sewer around both lakes; however, multiple properties are presently operating on private septic systems according to township records.

A list of these parcels was sent to the Kalamazoo County Health & Community Services Department to obtain septic system records. Kalamazoo County Health Department and Community Services returned septic system drawings for many of the properties in question.

The current sanitary code requires 4 feet of isolation between high groundwater and the bottom of the drain field. Location and elevation investigation of active septic systems was performed to see if any of these systems will be affected by the new Normal Lake Level.

A search of properties around Eagle Lake found 18 active private septic systems. All 18 residents currently have public sanitary sewer available at the street. County records show 7 of these 18 septic systems have ground elevations of 905 feet or lower, within one foot of the adequate depth between high ground level and the septic system. Considering the county sanitary code requirements these systems could become compromised with the setting of a Normal Lake Level of 899.26. These low septic system record drawings can be found starting on Appendix C, page 1.

A search of properties around Crooked Lake found 10 active private septic systems. All 10 residents currently have public sanitary sewer available at the street. One parcel has a septic system ground elevation of 901 feet or lower, within one foot of the adequate depth between high ground level and the septic system. Considering the county sanitary code requirements these systems could become compromised with the setting of a Normal Lake Level of 895.12. This low septic system record drawing can be found in Appendix C, page 7.

Survey questions were sent to all residents on Eagle and Crooked Lakes seeking information on issues with private septic systems. Eagle Lake had one property with known septic issues prior to the 2017 flooding while Crooked Lake had two. Properties where public sanitary sewer is available have

a township mandate to connect to public sewer by 2022. This township sewer ordinance can be found in Appendix C, page 8. We have found that septic tanks and drain fields around both lakes will not be negatively affected by the recommended lake levels.

Elevation records of seawalls and docks where not found available or reliable. Many seawalls on both Eagle Lake and Crooked Lake were completely breached with standing lake water into the front yards and in some cases into the houses/crawlspaces. Docks used on Eagle Lake and Crooked Lake are adjustable and largely removed during the winter therefor are not at risk due to flooding and will not be negatively affected by the recommended lake levels.

13 GOVERNMENT SURVEYS AND REPORTS

No other government survey or reports were found other than referenced in this report.

14 HYDROLOGY OF WATERSHED

Eagle Lake and Crooked Lake are located in the Charter Township of Texas to the west of the City of Kalamazoo, Kalamazoo County, Michigan. An overview of the project area has been included labeled Figure 1.

Eagle Lake and Crooked Lake are part of a watershed that has many lakes and very few county drains and streams. No direct outlets for Eagle Lake or Crooked Lake exist. Eagle Lake is approximately 5,200 feet long and 4,300 feet wide with an area of 249 acres. Crooked Lake has a size of 5,500 feet long by 3,400 feet wide totaling 171 acres. These measurements have been taken from the USGS Quadrangle Map shown in Appendix B, page 2.

The watershed for Eagle Lake and Crooked Lake encompasses Duck Lake, Pine Island Lake, Pretty Lake, and some other smaller lakes, though the runoff is not directly connected (each lake collects local surface runoff). Rainfall from the upstream area is conveyed via groundwater flow to the east and north from the surrounding areas toward both Eagle Lake and Crooked Lake and on to Bass Lake. Without a positive outlet, excessive rainfall can cause flooding of these lakes and upstream areas.

The surrounding topography consists of many hills with numerous low points that collect water. In Texas Township, these low points do not often connect leaving frequent lakes and ponds with very few natural streams. The soils in the area were studied using available soil borings, well logs, well

pumping tests, and anecdotal information as well as the USGS Soil Survey. Most of the surface soils around the lakes are classified as sandy loam or loamy sand. Soil units are approximately evenly divided between the Coloma loamy sand, Oshtemo sandy loam, and the Spinks loamy sand. EGLE studies describe glacial outwash and deposits present from the ground surface to over 300 feet deep. The bedrock in this area is Coldwater Shale.

For locations with a directly-connected tributary area less than 2 square miles, which includes a large portion of the area of concern, the SCS-92 Method (frequently used by EGLE to compute flood flows) was used along with HEC-HMS to produce hydrographs for all design storms. Design rainfall data was based on the National Oceanic and Atmospheric Administration (NOAA) Atlas 14 rainfall data for this area. These are the most current point precipitation frequency estimates.

For tributary areas greater than 2 square miles, the hydrologic computations were provided by EGLE. The hydrogeology was modeled for this area as well.

Data obtained over the past 2 years indicates that excessive rainfall results in an increasing water table. Data collected at various lakes that do not have a positive outlet show similar increases. However, as can been seen with the Bass Lake water level data in Figure 11, the lake levels remain more steady. And the estimates in Figure 10a show that the addition of outlets at Eagle Lake and Crooked Lake will reduce the highest water table levels. Projections indicate high water table levels would occur infrequently when multiple years of substantial rainfall exceed the transmissivity capacity of the groundwater.

15 DOWNSTREAM FLOW REQUIREMENTS AND IMPACTS ON DOWNSTREAM RIPARIANS.

Rainfall, along with groundwater flow and evaporation, provides a critical role in flooding when there is no positive outlet. In fact, the entire Great Lakes region has been impacted by higher than normal rainfall, as lake levels have risen to near historic highs. The lake levels for Lake Michigan, as well as the other Great Lakes, has increased over the past several years because of 3 historically high annual rainfall volumes. As recently as 2013, Lake Michigan was at a record low of 576 feet (IGLD85). But with all the precipitation, the Great Lakes are near record highs in 2020 - more specifically at over 582 feet (IGLD85).

More critical is the effect of local rainfall along with the lack of a positive outlet from Eagle Lake and Crooked Lake on the consistency of groundwater levels. The local rainfall has increased over the past several years similar to other communities in southwestern Michigan.

Elevation-area tables were developed for Bass Lake, Crooked Lake, Duck Lake, and Eagle Lake and input into the HEC-HMS model to simulate level-pool routing. Survey data collected was used to develop the outlet structure geometry, or lack thereof, for each lake.

Various hydraulic scenarios were evaluated for short- and long-term impacts to the system:

15.1 No Transfer of Surface Water from Crooked Lake to Bass Lake (Existing)

A. No transfer of surface water out of Crooked Lake, Duck Lake, Eagle Lake, Pine Island Lake or Pretty Lake. The purpose of this scenario is to establish baseline water surface elevations for downstream receiving waterbodies if Crooked Lake and Eagle Lake were to be positively drained.

15.2 Pumping from Crooked Lake into Bass Lake (Short-Term)

A. Pumping from Crooked Lake into Bass Lake at rates from 0 to 2,000 gpm was permitted by EGLE. The existing outlet configuration for Bass Lake was modified in 2019 to increase the outlet capacity without adverse impact downstream. Pumping at up to 2,000 gpm from Crooked Lake into Bass Lake with concurrent 1, 10, and 100-year storm events was analyzed to identify the impacts downstream and ensure no adverse impact. Measurements as required by the short term permit are taken at various locations to confirm model results and verification of no adverse impacts.

B. Pumping from Eagle Lake to Crooked Lake has had no short-term impacts on Crooked Lake. The Eagle Lake pump has not been operated when the Crooked Lake pump is not operating to ensure that the pumping does not increase the Crooked Lake level.

15.3 Gravity Flow from Crooked Lake to Bass Lake (Long-Term)

Existing and short-term scenarios were modeled assuming each lake started with a water surface elevation equal to the surveyed elevation on September 20, 2018. The long-term simulations assume a drawdown of each lake to its normal lake elevation.

The most reliable and cost-effective long-term approach is to provide a positive outlet for relief of excessively high groundwater levels through a gravity storm water system. This provides a direct route for conveyance of flood waters out of the area and ultimately downstream to Lake Michigan.

Two critical requirements for providing a positive outlet are:

- The water quality is acceptable for the receiving waters. EGLE will not permit a release of flood water unless an environmental review is provided which shows that the flood waters will not have an adverse impact on downstream receiving waters, including to the wetlands, endangered species and the general environment.

- The additional water from the non-contiguous tributary area cannot have an adverse impact to areas downstream – primarily the peak water levels. This includes contributing invasive species, base flows and bankfull flood flows.

As a short-term solution, the pumping of water from the flooded lakes to the nearby wetlands has been occurring since May 2019. This permitted approach has a high capital and operational cost. Pretreatment using screens and filtration system is required to control invasive species, and these must be cleaned periodically along with maintenance associated with the pumps.

As a long-term solution, the positive gravity outlet is estimated to have very low operational costs. However, the capital costs for the lake outlet are significant, specifically with the inclusion of a bed and collection piping to convey higher quality water that has been filtered by the lake bottom. The capital cost estimate is provided in Table 1. The only follow-up costs after the initial investment would be for maintenance purposes of the tile and bedding. A control weir is placed in a structure to maintain the Normal Lake Level and the gravity pipe will convey water that overtops the weir.

With these design constraints for the long-term solution, the Normal Lake Level will not have an adverse impact to the system hydraulics downstream, as accomplished by the short-term solution.

Evaluation of the Proposed Project – Volume Discharged

In 2018 and 2019, southwest Michigan observed the highest rainfall in recorded history over a two-year period. Simulations were performed over that period to show the hypothetical impact on the lakes had the proposed outlets been in place and activated. This could be considered a worst-case condition. Figure 9 shows that the flows are substantially less than pumped discharges that occurred

over the past two years, and so the impacts to the wetlands will be reduced. The figure also shows that the average annual flow from Crooked Lake to the wetland is only 23 gpm, a typical and insignificant volume during periods of average rainfall or less.

Evaluation of Proposed Project on Portage Creek

Further downstream on Portage Creek, the impact of the long-term plan was documented as shown in Figure 10b. This figure shows that the water surface elevation change of less than 0.02 feet (1/4 inch) at very infrequent intervals. This small increase is a worst-case condition that would occur if rainfall in the area exceeded norms for multiple consecutive years. Typically, the long-term control structure and system attenuate peaks from a storm as the lake provides substantial detention. In fact, the impact is negligible (0.00 feet) 99 percent of the time.

Evaluation of Proposed Project on Downstream Wetlands

GEI Consultants was asked to evaluate the long-term downstream effects on wetlands and geomorphology from the anticipated long-term gravity solution flows as discussed above. Their report is included in Appendix D and it indicates that there will be no negative downstream effects from this discharge.

We have performed an evaluation of the stream geomorphology to show the relative minimal impact to downstream channel dimensions. The evaluation compares the natural channel dimensions as estimated using Regional Reference Curves for southwest Michigan. Table 4 shows a comparison of the natural channel depth and width going downstream for pre-pumping conditions and post long-term outlet construction. These show that the depth change downstream of Atwater Pond would be less than .02 feet (1.2%) and the channel width change would be less than 0.63 feet (2.8%). The results for Atwater Pond would approximately represent the flowing channel just downstream of the pond. It is important to note that the proposed outlets are only activated periodically during long periods of high annual rainfall. As a result, the geomorphology in the downstream channel is likely to be ever changing with the long-term weather patterns. And the changing geomorphology will be even less further downstream.

16 FISHERIES AND WILDLIFE HABITAT PROTECTION AND ENHANCEMENT

16.1 Endangered Species Assessment for Eagle Lake and Crooked Lake, Kalamazoo, MI

On February 19, 2020, Prein&Newhof contacted the Michigan Department of Natural Resources (MDNR) for assistance in evaluating the area of Eagle Lake and any surrounding endangered species, regarding our Normal Lake Level study. Jay Wesley with MDNR (269-685-6851 ext. 117) put us in contact with Michael Sanders, a specialist with Michigan State University - Michigan National Features Inventory. Due to the size and scope of the project Prein&Newhof were also referred to U.S. Fish & Wildlife Service. Endangered Species review documents can be found in Appendix E.

16.2 IPaC Review (U.S. Fish & Wildlife Service)

Prein&Newhof conducted an Information, Planning, and Consultation System (IPaC) Review for Endangered Species within the project area. This review lists threatened or endangered species as well as methods for mitigating negative effects to their habitats, migration periods to avoid, and level of concern regarding conservation. The IPaC is funded through the U.S. Fish & Wildlife Service and is intended to obtain information early in the design process.

Mammals: Indiana Bat (endangered), Northern Long-eared Bat (threatened)

Reptiles: Eastern Massasauga (rattlesnake - threatened)

Clams: Snuffbox Mussel (endangered)

Insects: Mitchell's Satyr Butterfly (endangered)

Critical Habitats: No critical habitats have been found at this location

Migratory Birds: Bald Eagle (non-bcc), Lesser Yellowlegs (bcc nationwide), Red-headed Woodpecker (bcc nationwide), Rusty Blackbird (bcc nationwide), Willow Flycatcher (bcc regional), Wood thrush (bcc nationwide)

*bcc – bird of conservation concern

Project activities are "not likely to adversely affect" the above endangered or threatened species. The IPaC review will be used throughout the project to aid in identifying and mitigating potential

impacts to animals and their habitats. There is a special provision with MDOT pertaining to tree removal within areas having both Indiana Bats and Northern Long-eared Bats that states "Due to the existence of federally protected species, complete all tree removals required for the project between October 1 and March 31."

According to the U.S. Fish & Wildlife Service – Midwest Region records (revised Oct. 2018), "No Endangered or Threatened plants are found in Kalamazoo County." The complete IPaC Review can be found in Appendix E, page 1.

16.3 Michigan Natural Features Inventory Review

Prein&Newhof conducted a search of the Michigan Natural Features Inventory (MNFI) database run by Michigan State University. A MNFI review provides a search of all known information on the location of threatened or endangered species throughout Michigan. This review considers the exact location of the project and identifies potential impacts to rare species. While no threatened or endangered species were found the MNFI review did find some "at-risk" species within 1.5 miles of the project which should be monitored over the course of the project. The MNFI response and review can be found in Appendix E, page 15.

MNFI Review response from Matt Diana, MDNR Fisheries Biologist (04/23/2020):

> "There are no known threatened or endangered fish species in Eagle or Crooked Lakes. Creek chubsucker (State Endangered) is showing up in the species observed in Crooked Lake, but we have only surveyed Crooked Lake once since 1970 in 1985 and we only observed Lake Chubsuckers. I will have to reference the paper files once I return to the office to determine if there is any historical occurrence of Creek Chubsuckers here.
>
> The eastern massasauga (federally threatened) and Blanchard's cricket frog (state threatened) have both been identified in wetlands adjacent to lakes in this township, although there are no records specifically citing Eagle or Crooked Lake (however, there is an EO in a wetland adjacent to Crooked Lake and on Bass Lake). I suspect both species may be present in the watersheds of these lakes and BMPs should be utilized for these species.

There are multiple species of rush (Bald-rush-T; Black-fruited spike-rush-SC; Dwarf-bulrush-SC) reported on Eagle Lake. Rush species are often reliant on shoreline fringe wetland habitat that exists because of natural water level fluctuations.

Although there are no records in Eagle or Crooked Lake, lakes in the vicinity have reported Blanding's Turtle (SC); Eastern Box Turtle (SC); Spotted Turtle (T) and it is likely these species are found here.

Eagle Lake also has identified Coastal Plain Marshes along certain shorelines. These are rare wetland habitat that are highly reliant on water level fluctuations.

I do not have any historic water level data other than the information from the Township and EGLEs water budget analysis conducted for the pumping permit your organization was involved in. I know FEMA did an analysis of historic water levels and may have data they can provide (contact was Bettina Crosby, bettina.crosby@associates.fema.dhs.gov).

DNR Fisheries discourages the creation of lake level control structures and does not support the establishment of legal lake levels (see attached policy). Eagle and Crooked Lakes have already been impacted by water control measures including the long-time augmentation of water levels using groundwater wells. At a minimum, any proposed legal lake level should allow for natural water level fluctuations seasonally (and naturally) while allowing for control during extreme high water."

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269-910-0157 (C)
269-204-7008 (W)
dianam@michigan.gov

16.4 Effect on Levels of Aquatic Weed Growth (Jennifer L. Jermalowicz-Jones Ph.D.: Restorative Lake Sciences)

Aquatic vegetation assumes three distinct forms including submersed (below the water), floating-leaved (on the water), and emergent (above the water). The responses of individual aquatic plant species differ both within and among individual sites. Both Crooked and Eagle Lakes

(Kalamazoo County, Michigan) have robust aquatic plant communities of all growth forms. Excess invasive aquatic vegetation and nuisance native aquatic vegetation are treated annually in both lakes to enhance recreational and navigational activities.

Aquatic plants have evolved to adapt to low-light conditions which limits their distribution underwater, especially in turbid lakes. The water clarity of both Eagle and Crooked Lakes is very high and thus continued robust growth could be expected even with a modest increase in lake water levels. A decline in water levels could lead to further growth; however, the nutrients in the lakes would be more limiting for growth than the light given the current transparency depths for each lake. Wilcox and Meeker (1991) cited less structural diversity in aquatic vegetation communities in lakes with regulated water levels. However, the current diversity in both lakes is high and thus is not likely to be reduced without major (> 5 foot) water level changes that would further reduce available light to lower-growing aquatic plant species. Both lakes have low total and non-volatile solids (TSS and NVSS) which have been shown to contribute to light attenuation (Havens, 2003) so a decline in submersed aquatic vegetation is unlikely. Floating-leaved plants such as lily pads are able to adjust growth readily near the water surface during high water periods and emergent aquatic plants common in wetland areas (i.e. such as cattails, bulrushes) are adaptable to rising or falling water levels since they can tolerate significant fluctuations in saturation. Thus, it is unlikely that a modest increase or decline in water level will have notable impacts on the aquatic plant communities of both Crooked and Eagle Lakes.

Literature Cited:

Havens, K.A. 2003. Submersed aquatic vegetation correlations with depth and light attenuating materials in a shallow subtropical lake. Hydrobiologia 493:173-186.

Wilcox, D.A., and J. E. Meeker. 1991. Disturbance effects on aquatic vegetation in regulated and unregulated lakes in northern Minnesota. Canadian Journal of Botany 69(7):1542-1551.

16.5 Protection from Transferring of Invasive Species

The proposed strategy to ensure that invasive species are not transferred downstream is to use the lake bottom and adjacent soils as a natural filter. The soil survey grain size distribution of the Coloma soils gives a general idea of the sand aquifer through which groundwater currently leaves

Crooked Lake. The 50 percent passing size is around 0.4 mm or less, and the 10 percent passing size is around 0.075 mm (75 microns). Four samples from two soil boring samples were sent for grain size analysis and showed an average 50 percent passing size of 0.25 mm and 10 percent passing size of 67 microns. Thus, the actual material sampled is a little finer than the values from the soil survey.

Currently, lake water is continuously flowing through the ground between Eagle Lake and Crooked Lake and from Crooked into the wetland to the east. The proposed solution would reduce the length that groundwater would flow through the soil, but relative to the grain sizes and pore sizes, a 70-micron zebra mussel larvae (veliger) would still need to travel a long distance to reach the infiltration gallery/horizontal wells.

Since packing of the sand grains can vary, there is not a general relationship we can use for determining the exact pore sizes of the material, but based on the significant fraction of grain size less than 67 microns, this soil should provide a filtration that is similar to or better than a 40-micron filter. This is supported by evidence from several infiltration gallery intakes in Lake Michigan. Examples include intakes designed by Prein&Newhof in Grand Haven and in South Haven. These intakes have native beach sand at a thickness of 6 to 10 feet over coarser materials. Sieve analyses of these sands show a 10 percent passing size of approximately 200 microns and a 50 percent passing size of about 250 microns. In other words, the sand on the lake bottom above these existing water intakes is coarser with larger grain sizes and pore sizes than those in the sand in the soil borings at Crooked Lake. There has been no evidence of zebra mussel larvae passing through the sand at these water intake locations as no zebra mussel attachment has occurred in downstream pipes to the raw water pumping stations. In fact, that is one of the major benefits of these intakes as chlorine feed at the intake is not necessary.

It is also recognized that sand filters do not only “strain” materials that are larger than the pore sizes, but also remove materials through sedimentation, absorption and other processes and are therefore capable of removing material much smaller than the pore sizes.

In summary, the data available suggest that the natural soils in this location are more than adequate to prevent migration of zebra mussel veligers.

17 UPSTREAM DRAINAGE

Upstream drainage is limited to the tributary area for each lake and groundwater flow. As discussed in the hydrology section, flow hydrographs for various locations were developed for analysis. The upstream drainage was factored into the flow contribution of individual lakes but currently mostly contributes to the water table level as it flows toward Bass Lake, the first lake with a positive surface outlet.

Groundwater models, and field data, show that rising lake levels at Crooked Lake and Eagle Lake further increase the lake levels at upstream lakes. These lakes do not have their own direct positive outlet, but the levels will closely maintain a historically normal level since both Eagle and Crooked Lake will be at normal levels in the long term. The two new lake outlets relieve the entire groundwater system of waters that would otherwise build up during long term heavy rainfalls such as what has occurred from 2017-2020.

18 RIGHTS OF RIPARIANS

Surveys of property owners on Crooked and Eagle Lake were completed between May 1 and May 10, 2020. The survey included 11 questions related to property as well as personal preference. 110 surveys were completed for Crooked Lake and 128 for Eagle Lake, the survey results for Crooked Lake are provided in Appendix F and Eagle Lake in Appendix G.

Results indicate that property owners on Crooked Lake prefer a lake level of approximately 895.12, which is the same level at which the augmentation pump had operated historically. Eagle Lake property owners prefer a lake level of 899.84 feet which also is the same level the augmentation pump had been operated.

The percentage of respondents who had water at their house and in their yard was 2 and 68, respectively for Crooked Lake. Similarly, 2 percent of Eagle Lake respondents had water in their house and 11 percent in their yards.

19 OTHER PERTINENT FACTS AND CIRCUMSTANCES

As stated in this report, the lake system in this area is connected via groundwater flow toward Bass Lake, and both groundwater flow and surface water flow from Bass Lake to Portage Creek. As such, when Crooked Lake and Eagle Lake rise, other upstream lakes including Pine Island Lake, Duck

Lake and Pretty Lake, will rise due to the increase in hydraulic gradient. As a result, the addition of lake level controls to ensure the Crooked and Eagle Lakes do not rise will also lower upstream lakes due to the lesser hydraulic gradient at Crooked and Eagle Lakes.

20 CONCLUSION

This entire process, beginning in 2017 with the onset of the flooding event thru the recent collection of signatures of the lake residents in support of setting a Normal Lake Level as a first step to establish a permanent gravity solution, has been an exercise in "getting back to normal". There is no known previous effort to establish a Normal Lake Level prior to this event on either lake.

This study shows the proposed Normal Lake Level for both lakes will not cause negative environmental, habitat, aquatic weed growth, septic, shore erosion, or ice damage issues that raise to the level that would lead us to any particular level higher or lower than has previously been operated by the lake associations. Also, as previously indicated, the results of the resident's survey support continuing the levels previously operated by the lake associations.

Tables

Table No. 1

Prein&Newhof
Engineers ▪ Surveyors ▪ Environmental ▪ Laboratory

Estimate of Probable Cost

Owner:
Charter Township of Texas
Project Title:
Lakes WSE control: Phase 2
Date:
July 2, 2019
Project #:
M19058

Item No.	Description	Quantity	Unit	Unit Price	Total Amount
	Eagle to Crooked				
1	Inlet Control Structure	1	LS	$125,000.00	$125,000.00
2	Outlet Control Structure	1	LS	$30,000.00	$30,000.00
3	Tree Removal/Clearing	1	LS	$15,000.00	$15,000.00
4	12" HDPE <10'	1,046	LF	$45.00	$47,070.00
5	12" HDPE 10-16'	959	LF	$60.00	$57,540.00
6	12" HDPE 16-20	285	LF	$75.00	$21,375.00
7	12" HDPE >20'	425	LF	$95.00	$40,375.00
8	Dewatering	2,715	LF	$45.00	$122,175.00
9	Manholes <10 (Inc. RCKC inlets)	12	EA	$3,500.00	$42,000.00
10	Manhole Additional Depth	45	VF	$175.00	$7,875.00
11	Gravel Drive Restoration (Easement area)	850	LF	$10.00	$8,500.00
12	HMA Access Drive Restoration (Eagle Lake Access)	380	LF	$35.00	$13,300.00
13	Driveway Restoration-General	6	EA	$1,000.00	$6,000.00
14	PQ Ave Gravel	2,040	TON	$15.00	$30,600.00
15	PQ Ave HMA	1,380	TON	$85.00	$117,300.00
16	Striping	1	LS	$5,000.00	$5,000.00
17	General Restoration	27	STA	$750.00	$20,362.50
18	SESC	1	LS	$10,000.00	$10,000.00
19	Traffic Control	1	LS	$10,000.00	$10,000.00
	Eagle to Crooked: Construction Subtotal				**$729,472.50**
	Crooked to Wetland				
1	Inlet Control Structure	1	LS	$125,000.00	$125,000.00
2	Outlet Control Structure	1	LS	$30,000.00	$30,000.00
3	Tree Removal/Clearing	1	LS	$25,000.00	$25,000.00
4	12" HDPE <10'	200	LF	$45.00	$9,000.00
5	12" HDPE 10-16'	200	LF	$60.00	$12,000.00
6	12" HDPE 16-20	200	LF	$75.00	$15,000.00
7	12" HDPE >20'	200	LF	$95.00	$19,000.00
8	Dewatering	800	LF	$45.00	$36,000.00
9	Manholes	2	EA	$5,000.00	$10,000.00
10	General Restoration	8	STA	$1,250.00	$10,000.00
11	SESC	1	LS	$5,000.00	$5,000.00
12	Traffic Control	1	LS	$2,500.00	$2,500.00
	Crooked to Wetland: Construction Subtotal				**$298,500.00**
	Subtotal				$1,027,972.50
	Engineering (20%)				$205,594.50
	Permitting				$100,000.00
	Administration & Legal (10%)				$102,797.25
	Contingencies (20%)				$205,594.50
	Project Total				$1,641,958.75

Table 2 - Crooked Lake Recorded Lake Levels

Date	Elevation	Datum	NAVD88 conv.	Source	Appendix A, page#
1/1/1922	894.00	NGVD	893.56	USGS Quad Map - Schoolcraft 7.5 min	1
1/1/1967	893.00	NGVD	892.56	USGS Quad Map - Schoolcraft 7.5 min	2
5/28/1996	893.86	NGVD	893.42	Boundary survey - 198 W. Crooked Lake Drive	12
9/17/2009	895.40	NAVD88		Boundary survey - 57 N. Crooked Lk Dr	13
9/28/2018	897.70	NAVD88		Township Flood Monitoring	
2/4/2019	897.92	NAVD88		Township Flood Monitoring	
4/26/2019	897.84	NAVD88		Township Flood Monitoring	
6/20/2019	898.58	NAVD88		Township Flood Monitoring	
12/17/2019	897.34	NAVD88		Township Flood Monitoring	
3/1/2020	897.41	NAVD88		Township Flood Monitoring	
5/7/2020	897.00	NAVD88		Township Flood Monitoring	

Fixed elevations

10/25/2007	897.00	NAVD88		Approximate 100-Yr Flood Plain Elevation	14
5/29/2008	893.87	NAVD88		Ordinary Water Elevation (Township Zoning Setback)	15
	895.12	NAVD88		Crooked Lake Pump Operating Policy High Level	
	894.78	NAVD88		Crooked Lake Pump Operating Policy - Pumps Off	
	894.45	NAVD88		Crooked Lake Pump Operating Policy - Pumps On	

Table 3 - Eagle Lake Recorded Lake Levels

Date	Elevation	Datum	NAVD88 conv.	Source	Appendix A, page#
1/1/1922	898.00	NGVD	897.56	USGS Quad Map - Schoolcraft 7.5 min	1
1/1/1967	898.00	NGVD	897.56	USGS Quad Map - Schoolcraft 7.5 min	2
4/26/1972	898.58	NGVD	898.14	Reed/Lambert Plat records	3
10/10/1975	900.50	NGVD	900.06	Eagle Lk Terrance Estates Plat records	4
12/3/1982	899.98	NGVD	899.54	Water Level Determination memo	5
3/4/1983	900.00	NGVD	899.56	DNR survey notes	6
6/1/1983	899.93	NGVD	899.49	Pepper Ave storm sewer records	7
9/1/1989	899.90	NGVD	899.46	Eagle Heights Plat record	8
9/28/2018	902.40	NAVD88		Township Flood Monitoring	
2/4/2019	902.41	NAVD88		Township Flood Monitoring	
4/26/2019	902.81	NAVD88		Township Flood Monitoring	
6/20/2019	903.80	NAVD88		Township Flood Monitoring	
6/28/2019	903.72	NAVD88		Township Flood Monitoring	
12/17/2019	902.68	NAVD88		Township Flood Monitoring	
3/1/2020	902.90	NAVD88		Township Flood Monitoring	
5/7/2020	902.81	NAVD88		Township Flood Monitoring	

Fixed elevations

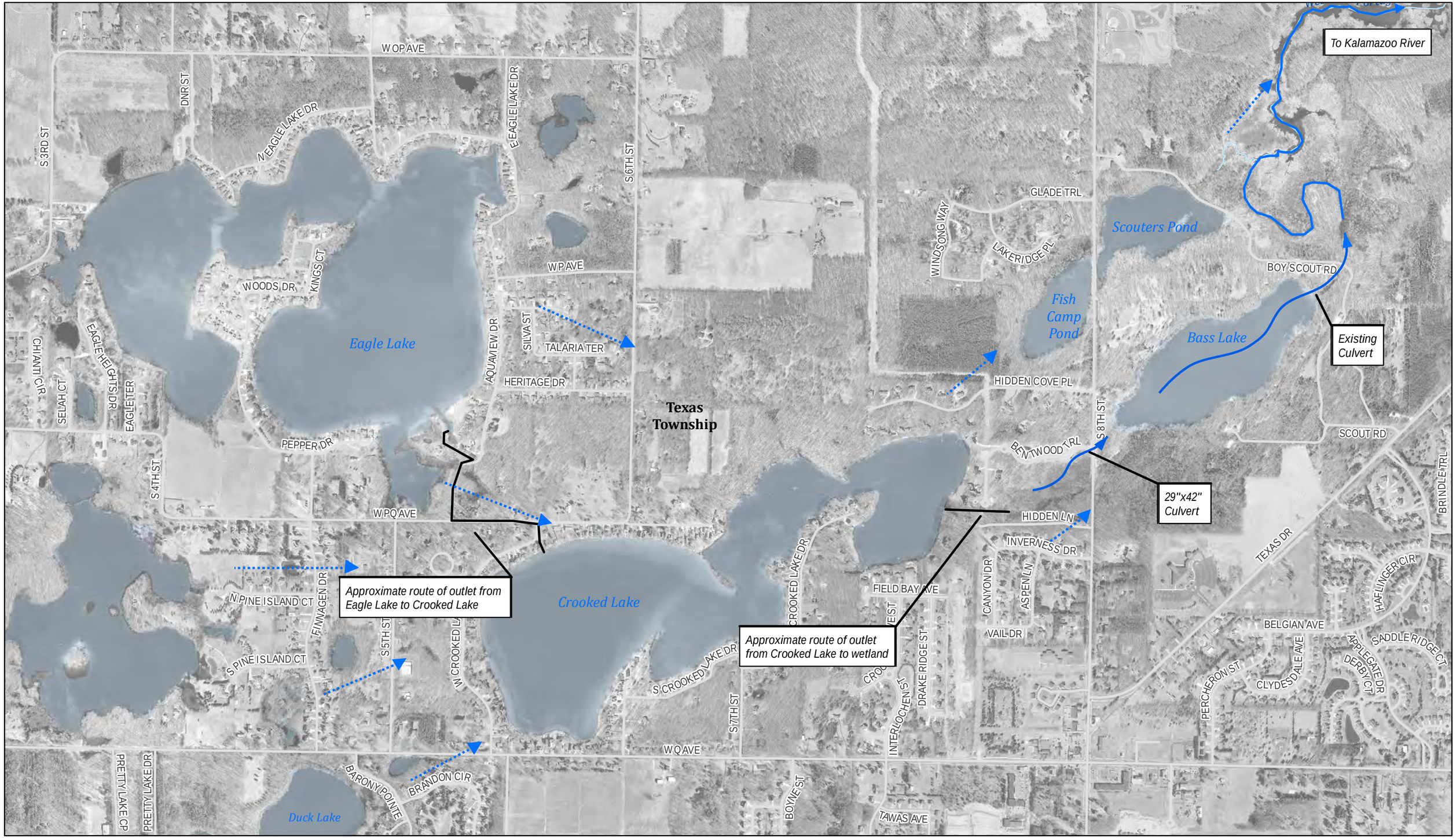
12/5/1949	898.40	NGVD	897.96	"Ordinary High Water Mark" (Supervisor's Plat Turner/Bright #1)	9
1976	902.00	NGVD	901.56	DNR 100-Yr Flood Plain (Eagle Lake Terrace & Eagle Heights)	8 & 10
5/29/2008	899.84	NAVD88		Ordinary Water Elevation (Township Zoning Setback)	15
	899.51	NAVD88		Eagle Lake Pump Operating Policy - Pumps Off	11
	899.17	NAVD88		Eagle Lake Pump Operating Policy - Pumps On	11

CHART TOWNSHIP OF TEXAS
LEGAL LAKE LEVEL STUDY

Table 4 - Natural Channel Dimensions from Regional Reference Curves

Location	Parameter	Prior to Short-Term Pumping	Proposed Long-Term Conditions	Difference
Atwater Pond USGS 04106400	Bankfull Width	25.3 feet	26.0 feet	0.63 feet
	Bankfull Depth	1.70 feet	1.72 feet	0.02 feet
Portage Creek USGS 04106500	Bankfull Width	47.5 feet	48.0 feet	0.48 feet
	Bankfull Depth	2.13 feet	2.14 feet	0.01 feet
Kalamazoo River USGS 04106000	Bankfull Width	201.2 feet	201.4 feet	0.25 feet
	Bankfull Depth	3.598 feet	3.600 feet	0.002 feet

Figures



SCALE: 1 " = 1,000 '

CHARTER TOWNSHIP OF TEXAS

KALAMAZOO COUNTY

FIGURE 1: OVERVIEW OF PROJECT AREA

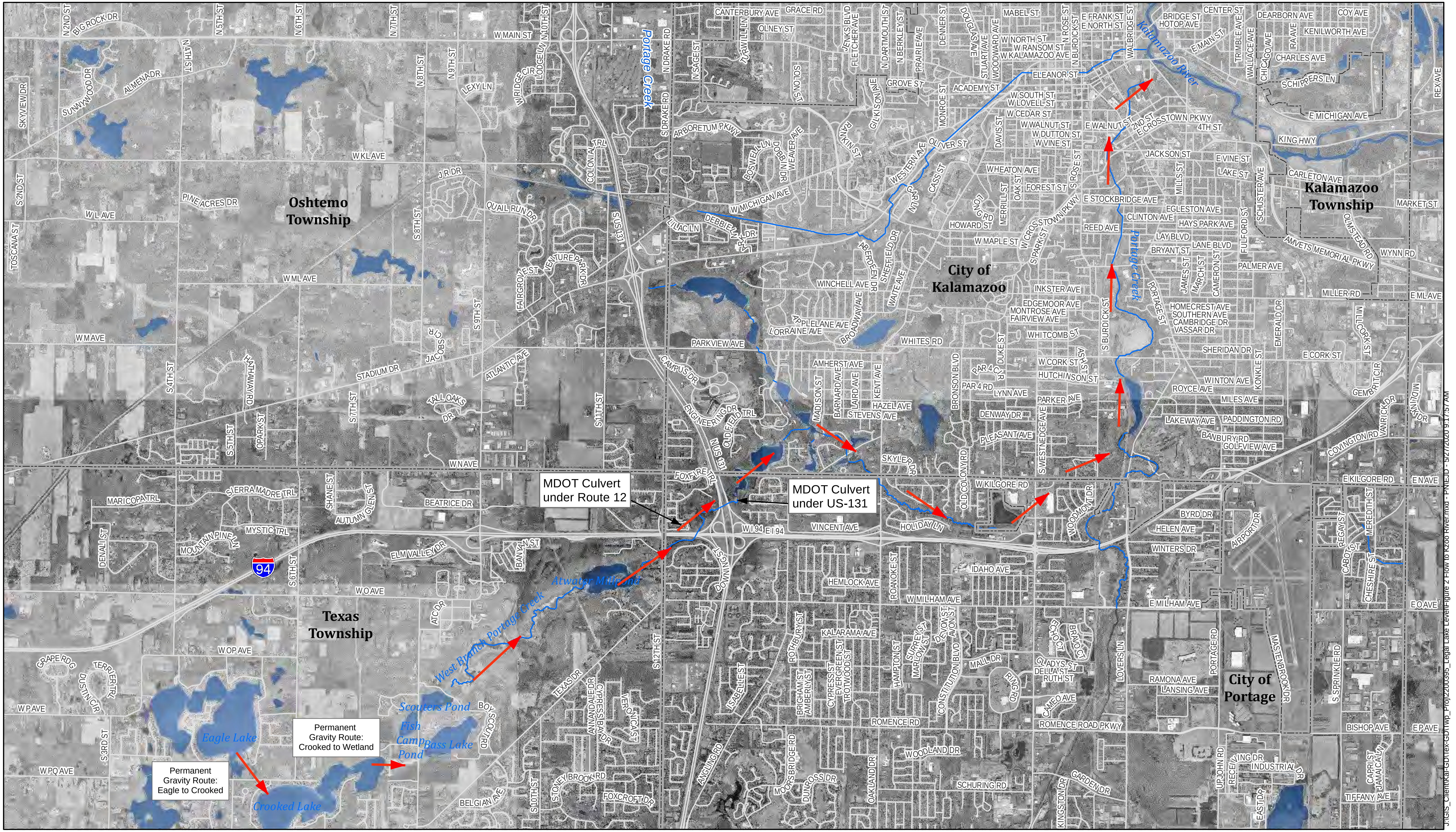
Prein&Newhof

2200395

LEGEND

- Approximate Location of Proposed Routes
- Approximate Groundwater Flow Direction
- Overland Flow

J:\GIS_Client\Kal-GD\Tex-GD\Twp_Proj\2200395_Legal Lake Level\Figure 1 Overview Map.mxd - PNEJD - 5/20/2020 9:15:49 PM



Miles

0 0.25 0.5 1

CHARTER TOWNSHIP OF TEXAS

KALAMAZOO COUNTY

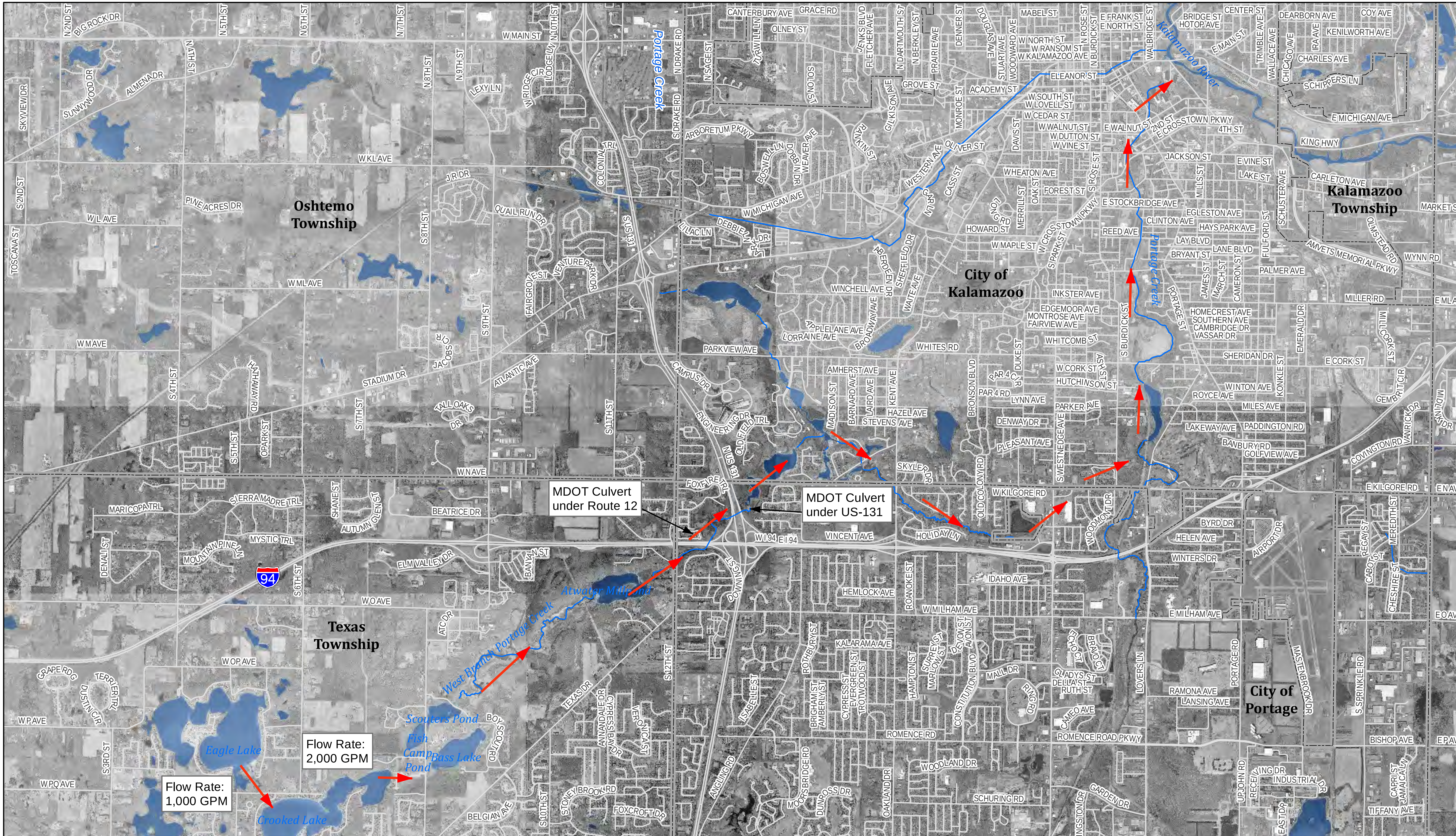
FIGURE 2: GENERAL ROUTE OF PROPOSED PERMANENT GRAVITY FLOW PROJECT TO KALAMAZOO RIVER

Prein&Newhof

2200395

LEGEND

Flow Direction



CHARTER TOWNSHIP OF TEXAS

KALAMAZOO COUNTY

FIGURE 2: GENERAL ROUTE OF PROPOSED PERMANENT GRAVITY FLOW PROJECT TO KALAMAZOO RIVER

Prein&Newhof

2200395

N

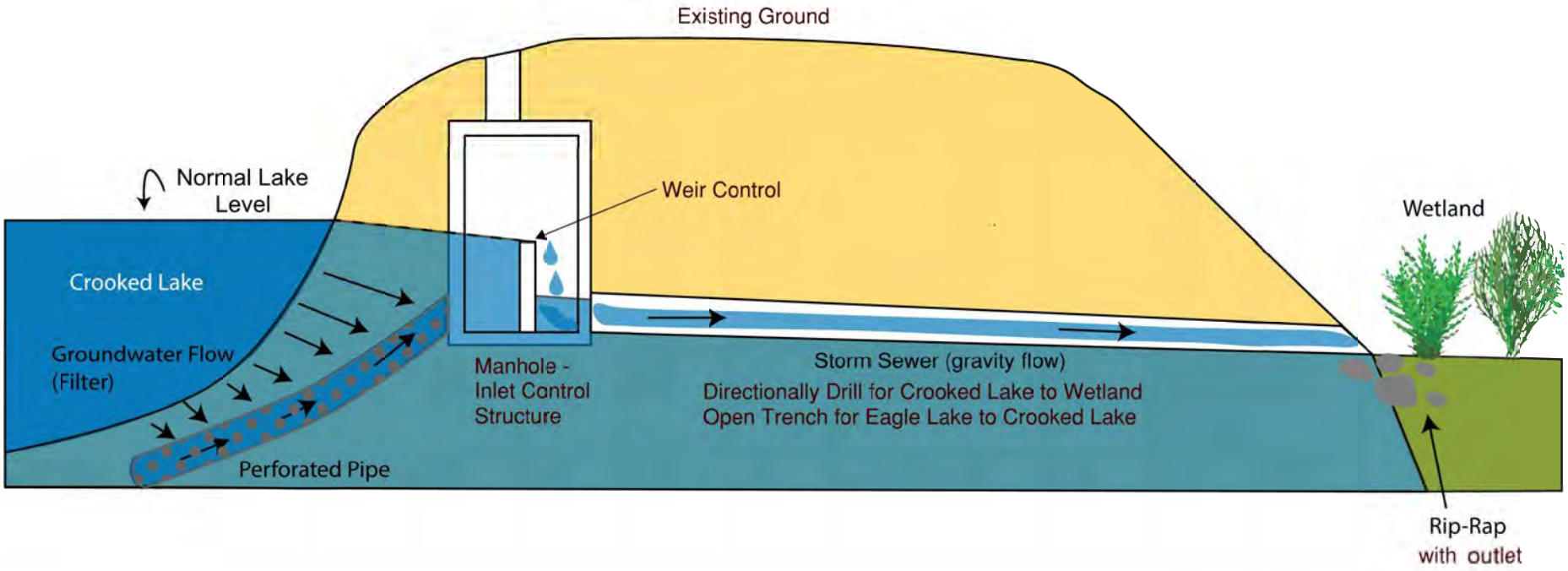
0 0.25 0.5 1 Miles

LEGEND

Flow Direction

J:\GIS_Client\Kal-GD\Tex-GD\Twp_Proj\2200395_Legal Lake Level\Figure 2 Flow to Kzoo River.mxd - PNEJD - 5/27/2020 9:17:57 AM

FIGURE 3 - Normal Lake Level Control Concept for Crooked Lake



Texas Township

Kalamazoo County, Michigan

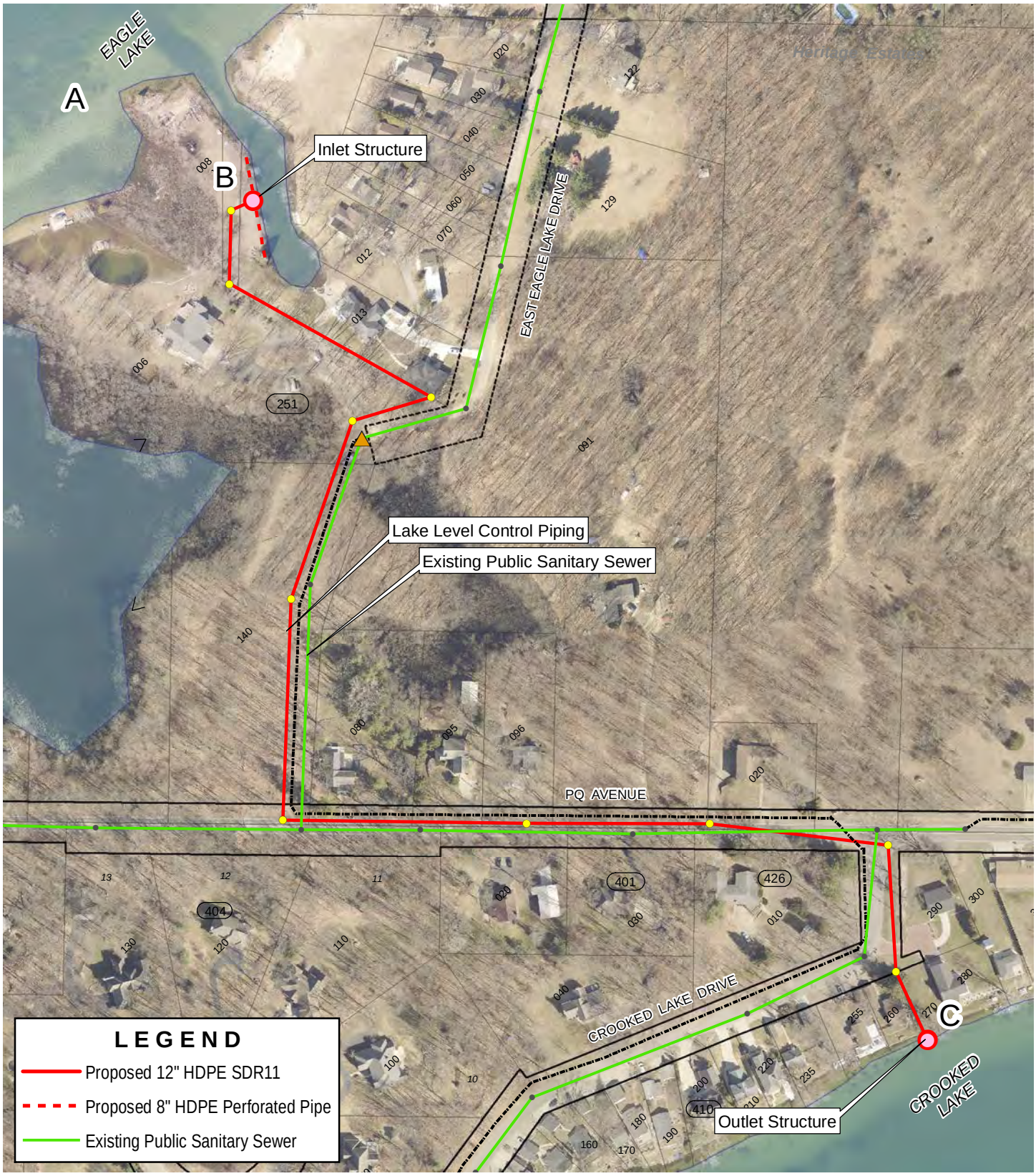
Figure 4: Proposed Mitigation Infrastructure - Crooked Lake to Wetland

Date Printed: 5/22/2020

N
W E
S

0 160 320
Feet

Prein&Newhof



Texas Township

Kalamazoo County, Michigan

Figure 5: Proposed Mitigation Infastructure - Eagle to Crooked

Date Printed: 5/22/2020

N
W E
S

0 180 360
Feet

Prein&Newhof

Charter Township of Texas

Kalamazoo County, Michigan

- FIGURE 6**a** -

Crooked Lake Normal Lake Level Assessment District

June 2020

N
W E
S

800 400 0 800
Feet

Scale: 1" = 800'

LEGEND

- District Boundary
- Parcels Within District

Prein&Newhof

J:\GIS_Client\Kal-GDT\ex-GDT\wp_Proj\22000395_Legal Lake Level\Figure 6 Short Term District Map_Crooked Lake.mxd - pkinsler - 5/26/2020 4:44:50 PM

Charter Township of Texas

Kalamazoo County, Michigan

- FIGURE 6**b** -

Eagle Lake Normal Lake Level **Assessment** District Map

June 2020

N
W E
S

800 400 0 800
Feet

Scale: 1" = 800'

LEGEND

- District Boundary
- Parcels Within District

Prein&Newhof

J:\GIS_Client\Kal-GD\Tex-GD\Twp_Proj\2200395_Legal\Lake Level\Figure 6 Short Term District Map_Eagle Lake.mxd - pknsler - 5/26/2020 4:43:29 PM

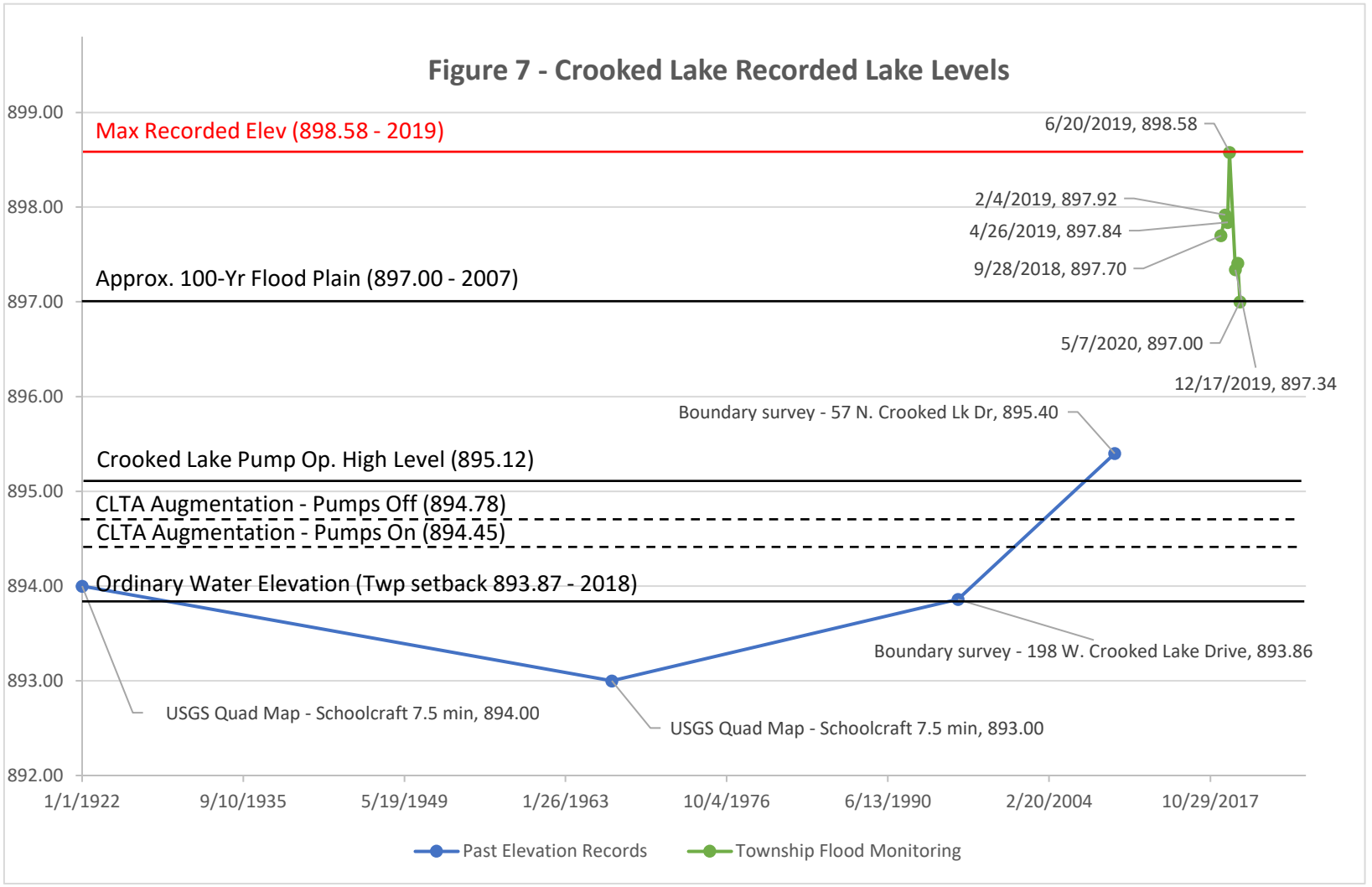


Figure 7 - Crooked Lake Recorded Lake Levels
899.00
898.00
897.00
896.00
895.00
894.00
893.00
892.00
Max Recorded Elev (898.58 - 2019)
Approx. 100-Yr Flood Plain (897.00 - 2007)
Crooked Lake Pump Op. High Level (895.12)
CLTA Augmentation - Pumps Off (894.78)
CLTA Augmentation - Pumps On (894.45)
Ordinary Water Elevation (Twp setback 893.87 - 2018)
6/20/2019, 898.58
2/4/2019, 897.92
4/26/2019, 897.84
9/28/2018, 897.70
5/7/2020, 897.00
12/17/2019, 897.34
Boundary survey - 57 N. Crooked Lk Dr, 895.40
Boundary survey - 198 W. Crooked Lake Drive, 893.86
USGS Quad Map - Schoolcraft 7.5 min, 894.00
USGS Quad Map - Schoolcraft 7.5 min, 893.00
1/1/1922
9/10/1935
5/19/1949
1/26/1963
10/4/1976
6/13/1990
2/20/2004
10/29/2017
Past Elevation Records
Township Flood Monitoring

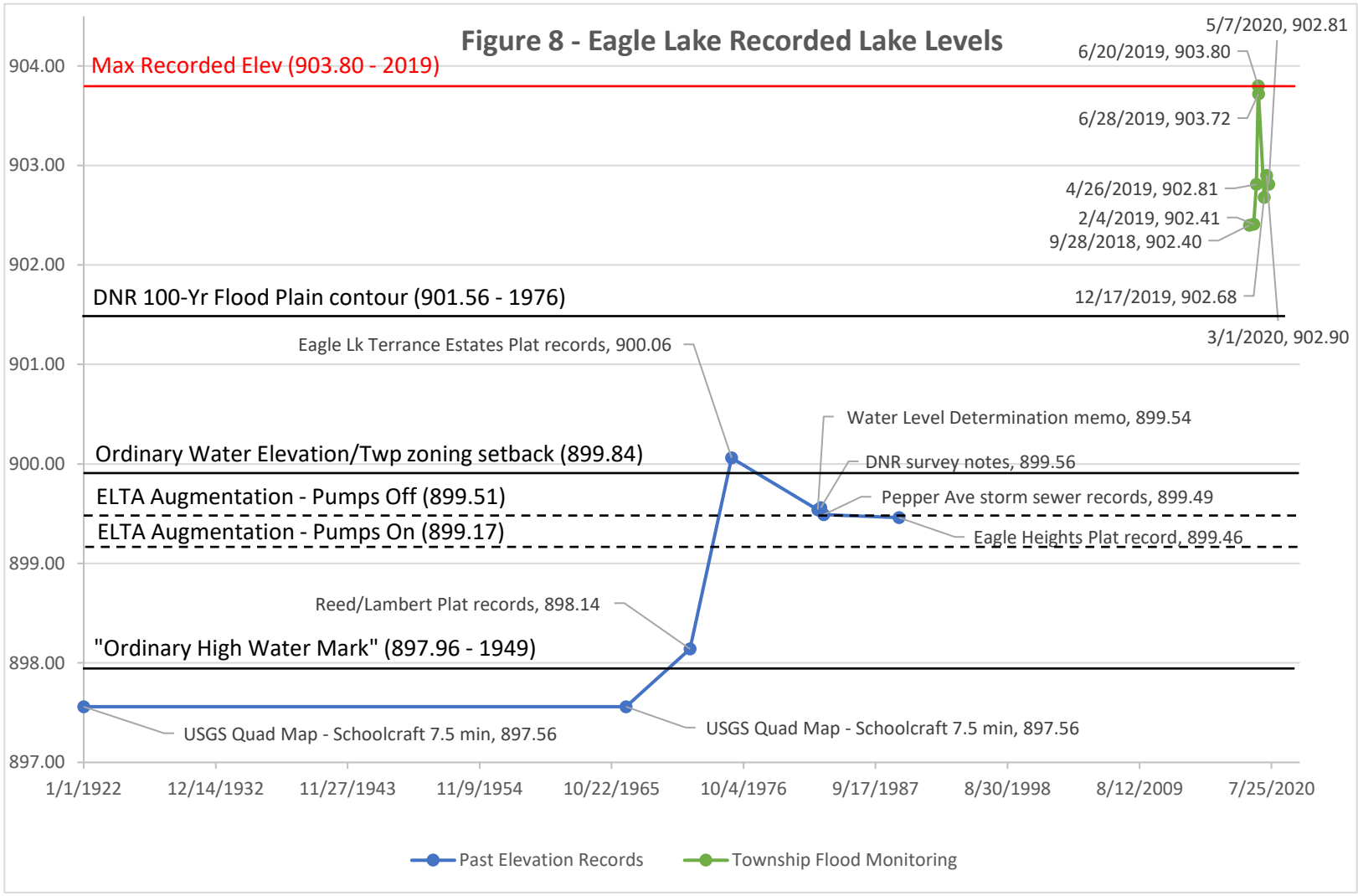


Figure 8 - Eagle Lake Recorded Lake Levels
Max Recorded Elev (903.80 - 2019)
DNR 100-Yr Flood Plain contour (901.56 - 1976)
Ordinary Water Elevation/Twp zoning setback (899.84)
ELTA Augmentation - Pumps Off (899.51)
ELTA Augmentation - Pumps On (899.17)
"Ordinary High Water Mark" (897.96 - 1949)
5/7/2020, 902.81
6/20/2019, 903.80
6/28/2019, 903.72
4/26/2019, 902.81
2/4/2019, 902.41
9/28/2018, 902.40
12/17/2019, 902.68
3/1/2020, 902.90
Eagle Lk Terrance Estates Plat records, 900.06
Water Level Determination memo, 899.54
DNR survey notes, 899.56
Pepper Ave storm sewer records, 899.49
Eagle Heights Plat record, 899.46
Reed/Lambert Plat records, 898.14
USGS Quad Map - Schoolcraft 7.5 min, 897.56
USGS Quad Map - Schoolcraft 7.5 min, 897.56
904.00
903.00
902.00
901.00
900.00
899.00
898.00
897.00
1/1/1922
12/14/1932
11/27/1943
11/9/1954
10/22/1965
10/4/1976
9/17/1987
8/30/1998
8/12/2009
7/25/2020
Past Elevation Records
Township Flood Monitoring

Figure 9a - Hypothetical Crooked Lake Discharge with Long Term Infrastructure in Place

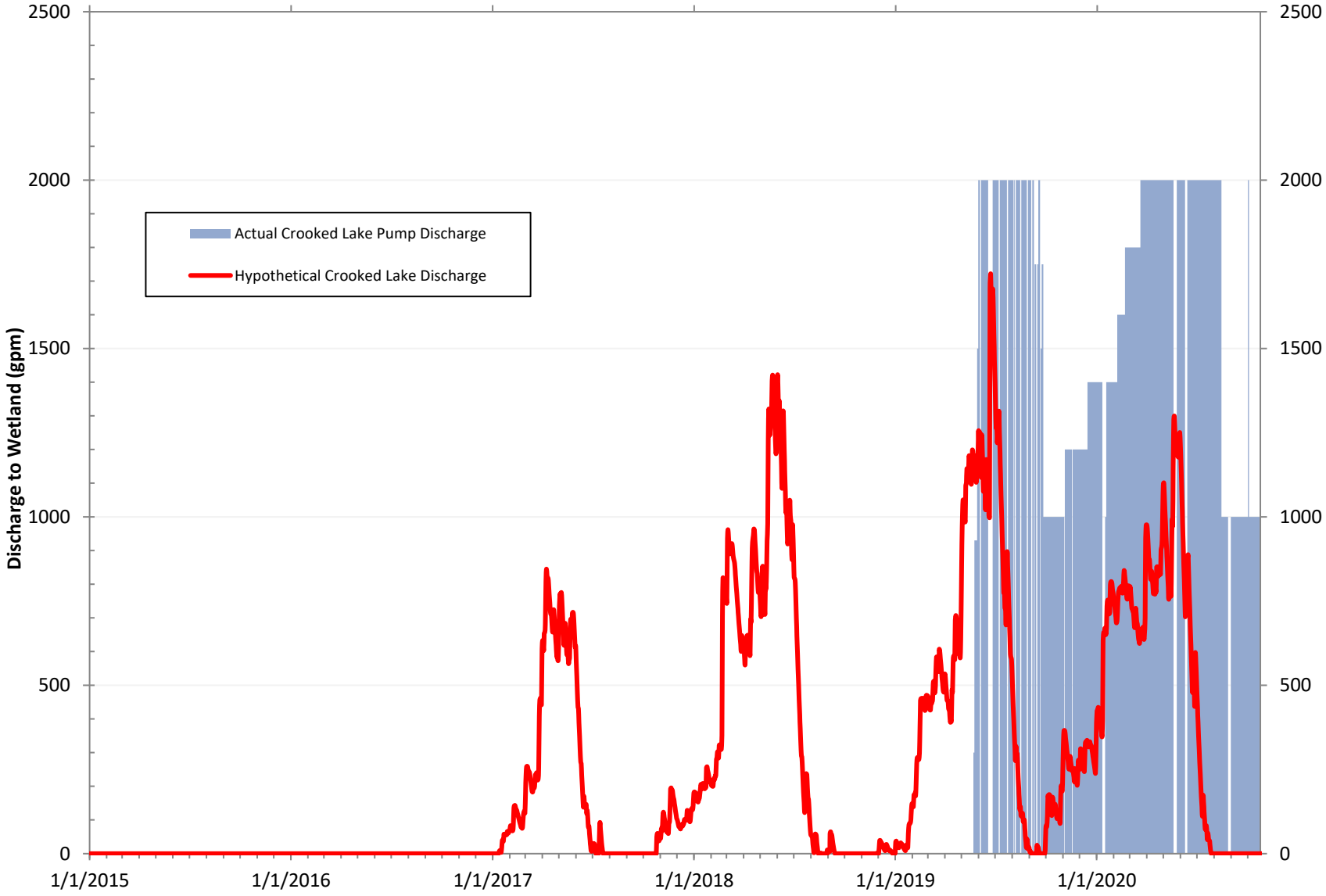
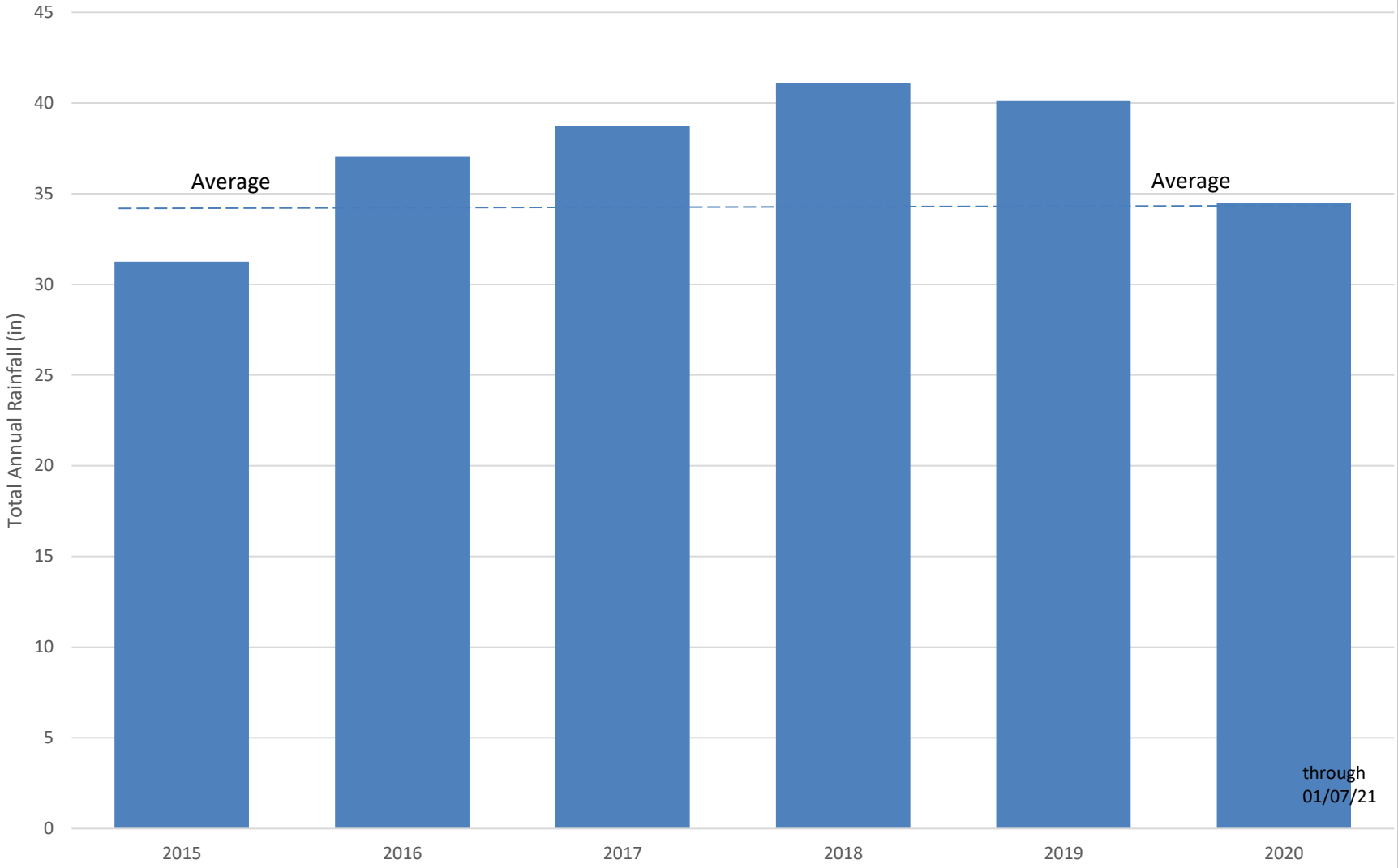


Figure 9b - Historical Annual Rainfall Southwest Michigan



Source: Enviro-weather - Lawton Site

CHART TOWNSHIP OF TEXAS
LEGAL LAKE LEVEL STUDY

Figure 9c - Hypothetical Crooked Lake Levels with Long Term Infrastructure In Place

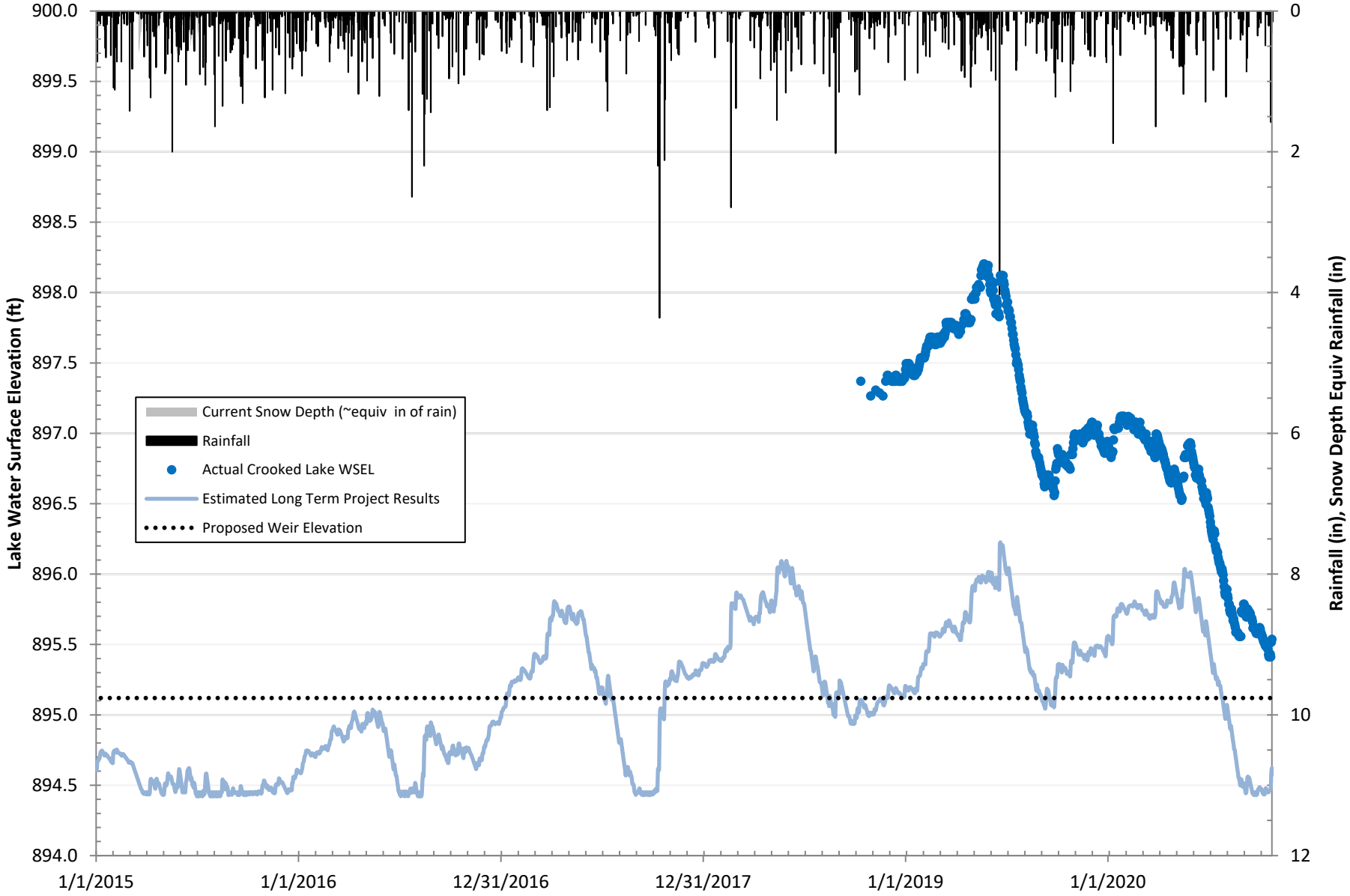


CHART TOWNSHIP OF TEXAS
LEGAL LAKE LEVEL STUDY

Figure 9d - Hypothetical Eagle Levels with Long Term Infrastructure in Place

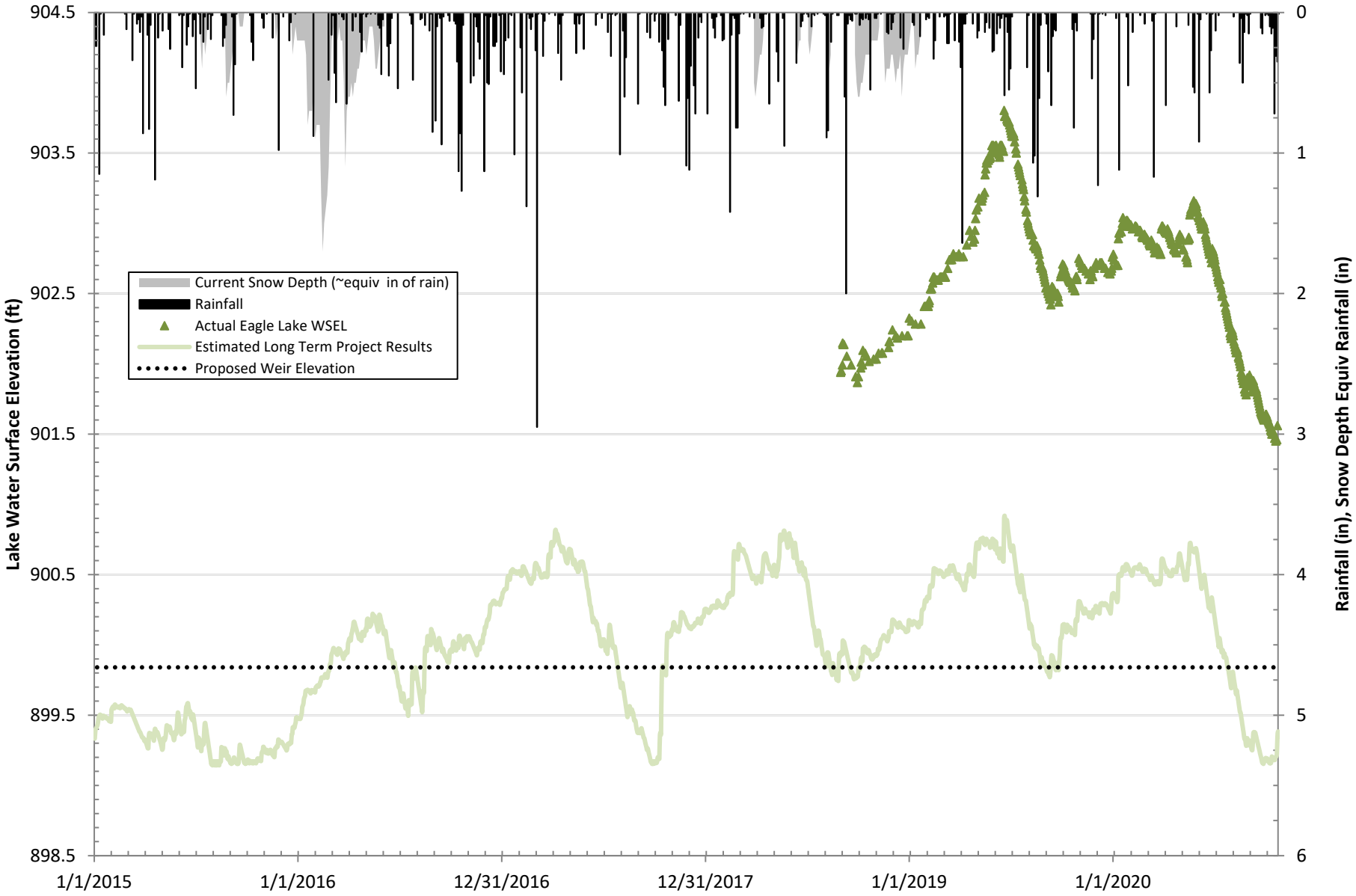


CHART TOWNSHIP OF TEXAS
LEGAL LAKE LEVEL STUDY

Figure 10a - Hypothetical Bass Lake Level Comparison

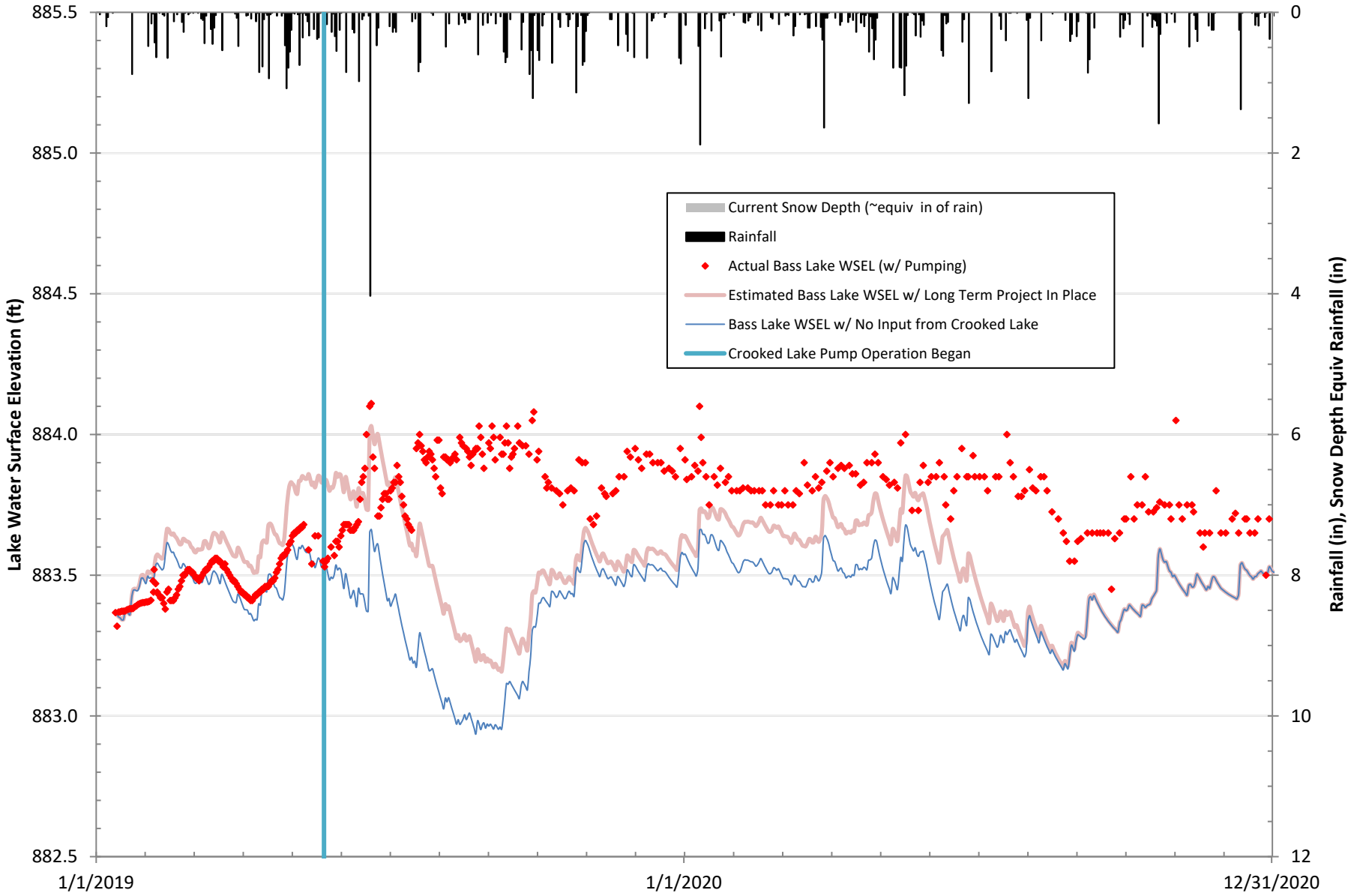


CHART TOWNSHIP OF TEXAS
LEGAL LAKE LEVEL STUDY

Figure 10b - Hypothetical Portage Creek Level Comparison

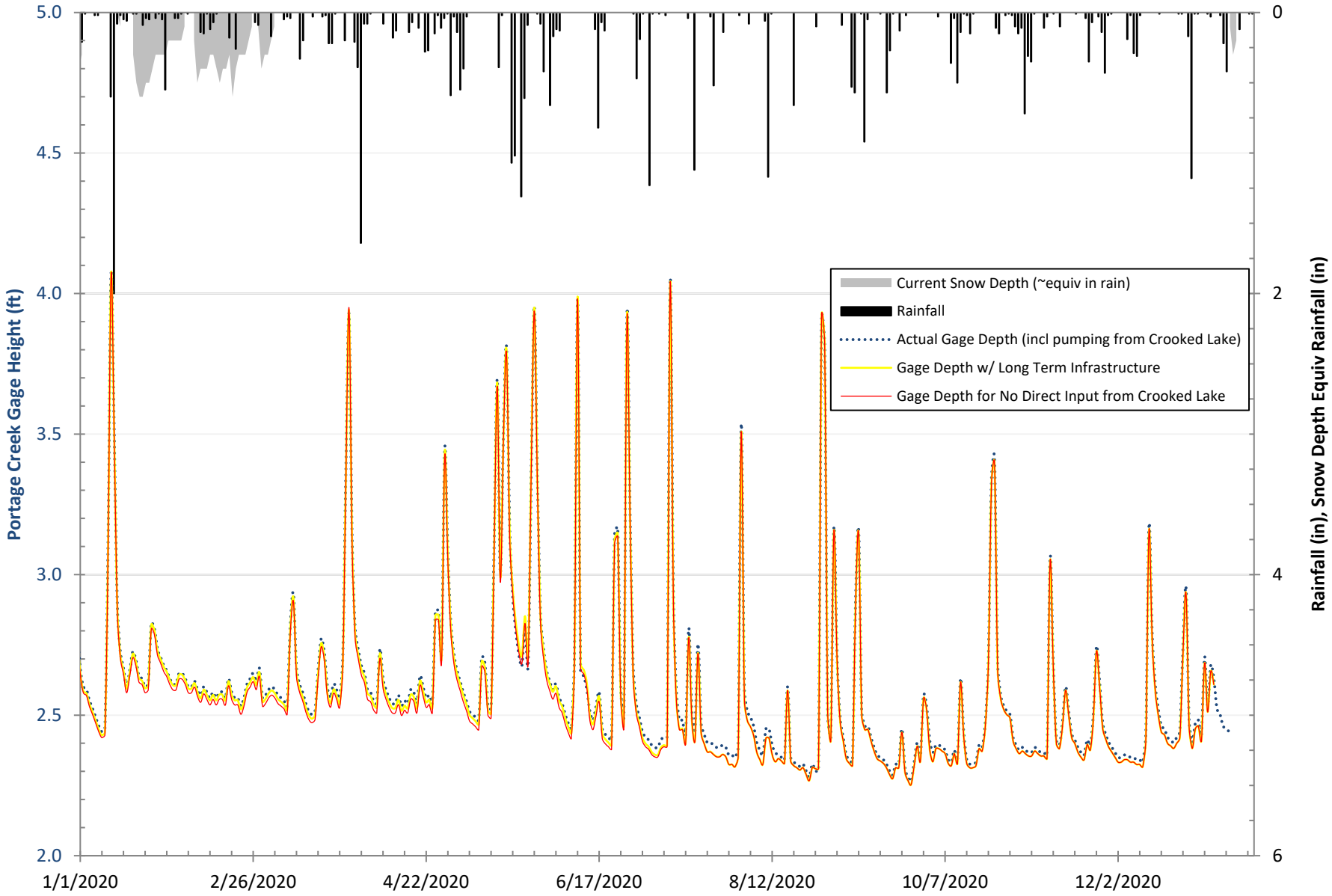
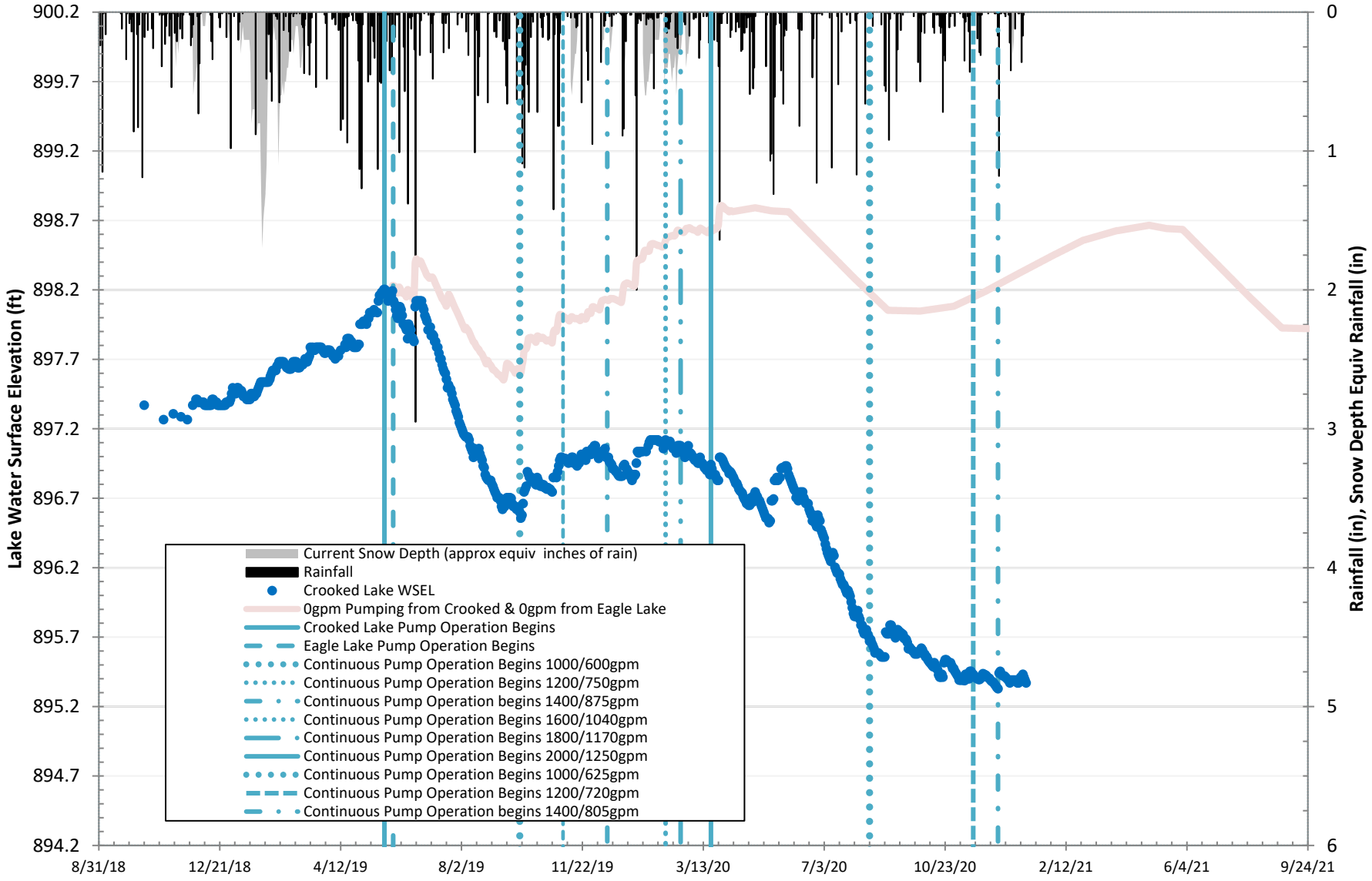


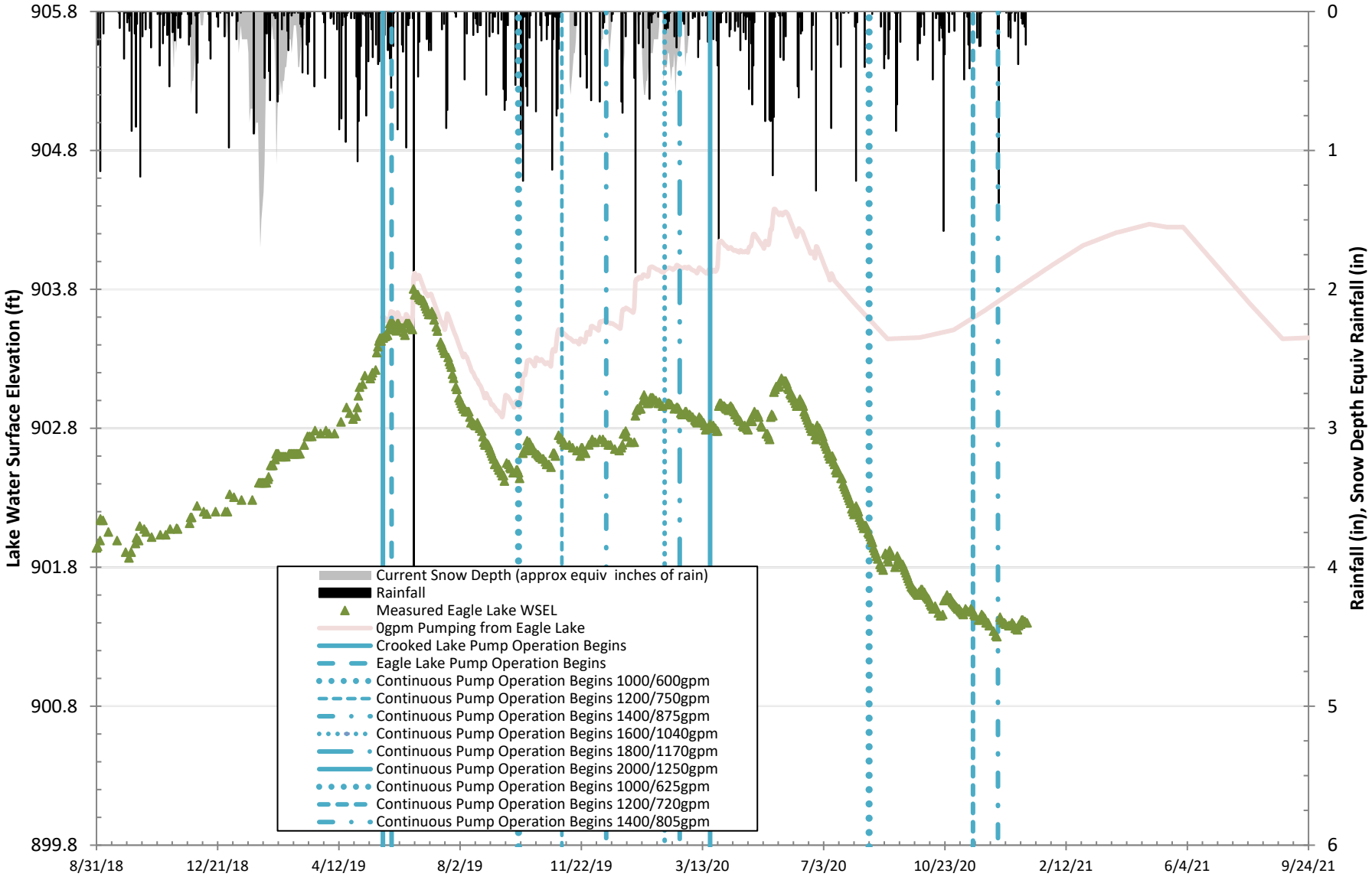
Figure 11 - Crooked, Eagle and Bass Lake Monitoring Results

Figure 12a - Crooked Lake Monitoring Results/Estimated Projections for Average Rainfall



CHARTER TOWNSHIP OF TEXAS
LEGAL LAKE LEVEL STUDY

Figure 12b - Eagle Lake Monitoring Results/Estimated Projections for Average Rainfall



Appendix A

Augmentation Well Data

Water Well And Pump Record

Completion is required under authority of Part 127 Act 368 PA 1978.
Failure to comply is a misdemeanor.

Wellogic

Import ID:

Tax No:	Permit No:	County: Kalamazoo	Township: Texas

Town/Range:	Section:	Well Status:	WSSN:	Source ID/Well No:
03S 12W	5	Active		

Well ID: 39000014293

Elevation:
Latitude: 42.239143
Longitude: -85.733185
Method of Collection: QQQ - Centroid

Distance and Direction from Road Intersection:

Well Owner: CROOKED LAKE TEXAS ASSC

Well Address:	Owner Address:
HIDDEN COVE PLACE KALAMAZOO, MI	7455 HIDDEN COVE PLACE KALAMAZOO, MI 49009

Drilling Method: Cable Tool
Well Depth: 243.00 ft. Well Use: Irrigation
Well Type: New Date Completed: 5/15/2002
Casing Type: Steel - black Height:
Casing Joint: Unknown
Casing Fitting: Drive shoe

Diameter: 12.00 in. to 211.00 ft. depth

Borehole: 12.00 in. to 253.00 ft. depth

Pump Installed: Yes Pump Installation Only: No
Pump Installation Date: HP: 30.00
Manufacturer: Other Pump Type: Submersible
Model Number: 9TL3 Pump Capacity: 1200 GPM
Drop Pipe Length: 120.00 ft. Pump Voltage:
Drop Pipe Diameter: Drilling Record ID:
Draw Down Seal Used: No

Pressure Tank Installed: No
Pressure Relief Valve Installed: No

Static Water Level: 15.00 ft. Below Grade (Not Flowing)
Unrestricted Flow Rate: Yield Test Method: Test pump
Well Yield Test:
Pumping level 55.00 ft. after 8.00 hrs. at 1150 GPM

Formation Description	Thickness	Depth to Bottom
Sand Dry	23.00	23.00
Gray Clay Soft	23.00	46.00
Sand & Gravel Coarse	43.00	89.00
Gray Clay Soft	5.00	94.00
Sand & Clay Coarse Soft	16.00	110.00
Sand Coarse Water Bearing	44.00	154.00
Gray Clay Soft	5.00	159.00
Sand Coarse Wet/Moist	11.00	170.00
Sand Coarse	13.00	183.00
Gray Clay Soft	17.00	200.00
Sand Coarse Wet/Moist	10.00	210.00
Sand Coarse	43.00	253.00

Screen Installed: Yes Filter Packed: No
Screen Diameter: 12.00 in. Blank:
Screen Material Type: PVC-slotted

Slot	Length	Set Between
25.00	42.00 ft.	211.00 ft. and 253.00 ft.

Fittings: Neoprene packer

Well Grouted: Yes Grouting Method: Unknown

Grouting Material	Bags	Additives	Depth
Bentonite dry granular	10.00	None	0.00 ft. to 25.00 ft.

Wellhead Completion: Pitless adapter

Geology Remarks:

Nearest Source of Possible Contamination:

Type	Distance	Direction
Unknown		

Drilling Machine Operator Name: CHARLIE JR
Employment: Employee

Contractor Type: Water Well Drilling Contractor Reg No: 0112
Business Name: SANDERS & SON
Business Address:

Water Well Contractor's Certification

This well was drilled under my supervision and this report is true to the best of my knowledge and belief.

Signature of Registered Contractor Date

General Remarks:
Other Remarks: Pump Manufacturer:ROBBCO

Print Report

Department of Environmental Quality
2019 Water Use Report

Facility

Crooked Lake Texas Association SAD No.1

Contact Information

Jim Roberts
1213 E Crooked Lake Dr
Kalamazoo, MI 49009

Water Use Information

Pump Name: Crooked Lake well 1
Unique Pump ID: 3083
Water Source: Groundwater
Latitude: 42.21110
Longitude: -85.69223
Capacity: 991
Total Annual Use: 0 Gallons

Monthly Use (Gallons)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	0	0	0	0	0	0	0	0	0	0

Discharge Location Information

Name of Discharge Location: Crooked Lake Texas Township
Unique Discharge Location ID: 2161
DCode: Inland Surface Water
Latitude: 42.20493
Longitude: -85.70906
Annual Discharge: Gallons

Print Report

Department of Environmental Quality
2018 Water Use Report

Facility

Crooked Lake Texas Association SAD No.1

Contact Information

Jim Roberts
1213 E Crooked Lake Dr
Kalamazoo, MI 49009

Water Use Information

Pump Name: Crooked Lake well 1
Unique Pump ID: 3083
Water Source: Groundwater
Latitude: 42.21110
Longitude: -85.69223
Capacity: 991
Total Annual Use: 0 Gallons

Monthly Use (Gallons)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	0	0	0	0	0	0	0	0	0	0

Discharge Location Information

Name of Discharge Location: Crooked Lake Texas Township
Unique Discharge Location ID: 2161
DCode: Inland Surface Water
Latitude: 42.20493
Longitude: -85.70906
Annual Discharge: Gallons

WATER USE RE RTING FORM

S of Michigan
Department of Environmental Quality

Required under Part 327 of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended. Failure to follow the provisions of the act may result in a civil fine up to $1,000.

Please PRINT the following information:

I. Facility Information		Contact Person Information	
Facility or Company Name: Crooked Lake Lake Texas Assoc.-Well (Report online! use this form only if no internet access)		Name: Jim Roberts, President, CLTA Crooked Lake Texas Assoc.	Phone: (269) 375-0055
Sub-Facility Name (if applicable): N/A		Mailing address: 1213 East Crooked Lake Drive	
Facility County: Kalamazoo		City / State / Zip: Kalamazoo, MI 49009	
Facility Township(s): Texas Twp.		Email address: jim@jimrobertsconstruction.com	

II. Did this facility withdraw 1,500,000 or more gallons of water in 2016?

☒ YES	Complete the rest of the form, and submit with Water Use Reporting Fee payment and invoice.	☐ NO	Water use information, part III.b. is not required. Water use reporting fee is NOT required. Return unpaid invoice to DEQ if submitting report by mail.

III. Water Withdrawal Information (see instructions)

a. Water Source and Pump Information Pumps approx. 1,427,000 gal. per day

1. Name of Water Source #1	2. Water Source Type (choose one)	3. Pump Capacity	4. Location	5. Static Water Level	6. Installed after 2/28/06 ?
Crooked Lake Texas Assoc. Well	☒ Groundwater ☐ Inland Surface Water ☐ Great Lakes	991 Gallons per minute	Latitude: Longitude:	45' Feet	☒ YES ☐ NO If yes, indicate WWAT registration ID number :

b. Water Use for Source #1 in 2016 — REPORT WATER USE IN GALLONS PER MONTH

January —	February —	March 20th to 31st 17,124,000 gal.	April N/A	May 8th to 23rd 22,832,000	June 12th to 30th 27,113,000
July 1 to 9th 12,843,000	August 4th to 16th 18,551,000	September —	October —	November —	December —

c. Primary Purpose of Use for Source #1 (choose one)

☐ Irrigation	☐ Industrial / Manufacturing	☐ Potable / Sanitary	☐ Quarry / Mining / Dewatering	☐ Electric Power Generation	☒ Lake Augmentation	☐ Fire Protection	☐ Bottled Water

☐ Other :

Facility: ***Crooked Lake Texas Association SAD No.1***

Reporting Year 2017

Map

Pump Information

Select a Withdrawal: Crooked Lake well 1 — Add New Pump

* Name of Water Source: Crooked Lake well 1

* Water Source Type: Groundwater

* Capacity: 991 Gallons Per Minute

Dec. Degrees / Deg. Min.

Lat.: 42.21110

Lon.: -85.69223

Static Water Level: 41 feet

Installed after 2/28/06: Yes

Expand Map | Update Lat/Long

Water Withdrawal Assessment Tool Registration ID: 1431-201112-10 — Delete Pump

Water Use Information

Water Use, in gallons

Jan	0
Feb	0
Mar	0
Apr	0
May	0
Jun	0
Jul	0
Aug	29,400,000
Sep	0
Oct	0
Nov	0
Dec	0

☐ **Withdrew < 1,500,000 gallons in 2017**

* **Primary Purpose of Use**: Other

Save water use report for 2017

Prev Pump | Next Pump

Save Water Use for this Pump

WATER USE RE. RTING FORM

S of Michigan
Department of Environmental Quality

Required under Part 327 of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended. Failure to follow the provisions of the act may result in a civil fine up to $1,000.

Please PRINT the following information:

I. Facility Information	Contact Person Information	
Facility or Company Name Report online! use this form only if no internet access	Name	Phone ( )
Sub-Facility Name (if applicable) 29.4	Mailing address	
Facility County	City / State / Zip	
Facility Township(s)	Email address	

II. Did this facility withdraw 1,500,000 or more gallons of water in 2017?

☐ YES — Complete the rest of the form, and submit with Water Use Reporting Fee payment and invoice.

☐ NO — Water use information, part III.b. is not required. Water use reporting fee is NOT required. Return unpaid invoice to DEQ if submitting report by mail.

III. Water Withdrawal Information (*see instructions) 991 l/min

a. Water Source and Pump Information

1. Name of Water Source #1	2. Water Source Type (choose one)	3. Pump Capacity	4. Location	5. Static Water Level	6. Installed after 2/28/06 ?
	☒ Groundwater ☐ Inland Surface Water ☐ Great Lakes last year	Gallons per minute	Latitude: Longitude:	45' Feet	☐ YES ☐ NO If yes, indicate WWAT registration ID number :

b. Water Use for Source #1 in 2017 — REPORT WATER USE IN GALLONS PER MONTH

January —	February —	March 20th to 31st 17,124,000 gal	April N/A	May 8th to 23rd 22,832,000	June 12th to 30th 27,113,000
July 1 to 9th 12,843,000	August 4th to 16th 18,551,000	September —	October —	November —	December —

c. Primary Purpose of Use for Source #1 (choose one)

Irrigation ☐	Industrial / Manufacturing ☐	Potable / Sanitary ☐	Quarry / Mining / Dewatering ☐	Electric Power Generation ☐	Lake Augmentation ☒	Fire Protection ☐	Bottled Water ☐

☐ Other :

Aug 5th to 26th 29,400,000

Print Report

Department of Environmental Quality
2015 Water Use Report

Facility

Crooked Lake Texas Association SAD No.1

Contact Information

Jim Roberts
1213 E Crooked Lake Dr
Kalamazoo, MI 49009

Water Use Information

Pump Name: Crooked Lake well 1
Unique Pump ID: 3083
Water Source: Groundwater
Latitude: 42.21110
Longitude: -85.69223
Capacity: 555
Total Annual Use: 147,000,000 Gallons

Monthly Use (Gallons)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	0	24,000,000	24,000,000	12,000,000	15,000,000	24,000,000	24,000,000	24,000,000	0	0

Discharge Location Information

Name of Discharge Location: Crooked Lake Texas Township
Unique Discharge Location ID: 2161
DCode: Inland Surface Water
Latitude: 42.20493
Longitude: -85.70906
Annual Discharge: 147,000,000 Gallons

WATER USE REPORTING FORM

Required under Part 327 of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended. Failure to follow the provisions of the act may result in a civil fine up to $1,000.

State of Michigan
Department of Environmental Quality

Please PRINT the following information:

I. Facility Information	Contact Person Information	
Facility or Company Name: Crooked Lake Texas Association SAD No. 1 (report online! use this form only if no internet access)	Name: Jim Roberts	Phone: (269) 217-2923
Sub-Facility Name (if applicable)	Mailing address: 1213 E Crooked Lake Dr	
Facility County: Kalamazoo	City / State / Zip: Kalamazoo, MI, 49009	
Facility Township(s): Texas	Email address: jim@jimrobertsconstruction.com	

II. Did this facility withdraw 1,500,000 or more gallons of water in 2015?

☐ YES — Complete the rest of the form, and submit with Water Use Reporting Fee payment and invoice.

☐ NO — Water use information, part III.b. is not required. Water use reporting fee is NOT required. Return unpaid invoice to DEQ if submitting report by mail.

III. Water Withdrawal Information (new- see instructions)

a. Water Source and Pump Information

1. Name of Water Source #1	2. Water Source Type (choose one)	3. Pump Capacity	4. Location	5. Static Water Level	6. Installed after 2/28/06 ?
Crooked Lake Well	☑ Groundwater ☐ Inland Surface Water ☐ Great Lakes or Connecting Waterways	555 Gallons per minute	Latitude: 42.21110 Longitude: -85.69223	Feet	☑ YES ☐ NO If yes, indicate WWAT registration ID number :

b. Water Use for Source #1 in 2015 — REPORT WATER USE IN GALLONS PER MONTH

January	February	March	April	May	June
July	August	September	October	November	December

c. Primary Purpose of Use for Source #1 (choose one)

Irrigation ☐	Industrial / Manufacturing ☐	Potable / Sanitary ☐	Quarry / Mining / Dewatering ☐	Electric Power Generation ☐	Lake Augmentation ☒	Fire Protection ☐	Bottled Water ☐

☐ Other :

2015 Lake Augmentation Well - #3

2-Apr-15	On
16-Jun-15	Off
3-Jul	On
19-Jul-15	Off
28-Jul-15	on
29-Oct-15	Off for Season

Print Report

Department of Environmental Quality
2014 Water Use Report

Facility

Crooked Lake Texas Association SAD #__1

Contact Information

Jim Roberts
1213 E Crooked Lake Dr
Kalamazoo, MI 49009

Water Use Information

Pump Name: Crooked Lake well
Unique Pump ID: 3083
Water Source: Groundwater
Latitude: 42.21110
Longitude: -85.69223
Capacity: 555
Total Annual Use: 132,000,000 Gallons

Monthly Use (Gallons)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	0	24,000,000	24,000,000	0	24,000,000	24,000,000	0	24,000,000	12,000,000	0

Discharge Location Information

No discharge locations reported

Print Report

Department of Environmental Quality
2013 Water Use Report

Facility

Crooked Lake Texas Association SAD #_1

Contact Information

Jim Roberts
1213 E Crooked Lake Dr
Kalamazoo, MI 49009

Water Use Information

Pump Name: Crooked Lake well
Unique Pump ID: 3083
Water Source: Groundwater
Latitude: 42.21110
Longitude: -85.69223
Capacity: 555
Total Annual Use: 96,000,000 Gallons

Monthly Use (Gallons)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	0	0	0	24,000,000	24,000,000	24,000,000	24,000,000	0	0	0

Discharge Location Information

No discharge locations reported

2014

WATER USE REPORTING FORM

Required under Part 327 of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended. Failure to follow the provisions of the act may result in a civil fine up to $1,000.

Michigan Department of Environmental Quality

Please PRINT the following information:

I. Facility Information	Contact Person Information	
Facility or Company Name: Crooked Lake Texas Association SAD #1	Name: Jim Roberts	Phone: (269) 217-2923
Sub-Facility Name (if applicable): N/A	Mailing address: 1213 East Crooked Lake Drive	
Facility County: Kalamazoo	City / State / Zip: Kalamazoo, MI 49009	
Facility Township(s): Texas Twp.	Email address: jim@jimrobertsconstruction.com	

II. Did this facility withdraw 1,500,000 or more gallons of water in 2013?

☒ YES — Complete the rest of the form, and submit with Water Use Reporting Fee payment and invoice.

☐ NO — Water use information, part III.b. is not required. Water use reporting fee is NOT required. Return unpaid invoice to DEQ if submitting report by mail.

III. Water Withdrawal Information (new- see instructions)

a. Water Source and Pump Information

1. Name of Water Source #1	2. Water Source Type (choose one)	3. Pump Capacity	4. Location	5. Static Water Level	6. Installed after 2/28/06 ?
Crooked Lake well	☒ Groundwater ☐ Inland Surface Water ☐ Great Lakes or Connecting Waterways	555 gal currently Gallons per minute	Latitude: 42.211101 Longitude: 85.692226	201 Feet	☒ YES ☐ NO If yes, indicate WWAT registration ID number: 1431-201112-10

b. Water Use for Source #1 in 2013 — REPORT WATER USE IN GALLONS PER MONTH

January: OFF	February: OFF	March: OFF	April: 24,000,000 gal	May: 24 mil. gal.	June: OFF
July: 24, mil. gal.	August: 24 mil. gal.	September: OFF	October: 24, Mil gal	November: 12 mil. gal.	December: OFF

c. Primary Purpose of Use for Source #1 (choose one)

Irrigation ☐	Industrial / Manufacturing ☐	Potable / Sanitary ☐	Quarry / Mining / Dewatering ☐	Electric Power Generation ☐	Lake Augmentation ☒	Fire Protection ☐	Bottled Water ☐

☐ Other :

2013

WATER USE REPORTING FORM

Required under Part 327 of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended. Failure to follow the provisions of the act may result in a civil fine up to $1,000.

Michigan Department of Environmental Quality

Please PRINT the following information:

I. Facility Information		Contact Person Information	
Facility or Company Name: Crooked Lake Texas Association SAD #1		Name: Jim Roberts	Phone: (269) 217-2923
Sub-Facility Name (if applicable): N/A		Mailing address: 1213 East Crooked Lake Drive	
Facility County: Kalamazoo		City / State / Zip: Kalamazoo, MI 49009	
Facility Township(s): Texas Twp.		Email address: jim@jimroberts construction.com	

II. Did this facility withdraw 1,500,000 or more gallons of water in 2013?

☒ YES — Complete the rest of the form, and submit with Water Use Reporting Fee payment and invoice.

☐ NO — Water use information, part III.b. is not required. Water use reporting fee is NOT required. Return unpaid invoice to DEQ if submitting report by mail.

III. Water Withdrawal Information (new- see instructions)

a. Water Source and Pump Information

1. Name of Water Source #1	2. Water Source Type (choose one)	3. Pump Capacity	4. Location	5. Static Water Level	6. Installed after 2/28/06 ?
Crooked Lake well	☒ Groundwater ☐ Inland Surface Water ☐ Great Lakes or Connecting Waterways	555 gal currently Gallons per minute	Latitude: 42.211101 Longitude: 85.692226	201 Feet	☒ YES ☐ NO If yes, indicate WWAT registration ID number : 1431-20112-10

b. Water Use for Source #1 in 2013 — REPORT WATER USE IN GALLONS PER MONTH

January	February	March	April	May	June
⊖	⊖	⊖	⊖	⊖	24,000,000 gal
July	**August**	**September**	**October**	**November**	**December**
24 mil. gal	24 mil. gal.	24 mil. gal.	Turned off	Turned off	⊖

c. Primary Purpose of Use for Source #1 (choose one)

☐ Irrigation	☐ Industrial / Manufacturing	☐ Potable / Sanitary	☐ Quarry / Mining / Dewatering	☐ Electric Power Generation	☒ Lake Augmentation	☐ Fire Protection	☐ Bottled Water

☐ Other :

WATER USE REPORTING FORM

2012

Michigan Department of Environmental Quality

Required under Part 327 of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended. Failure to follow the provisions of the act may result in a civil fine up to $1,000.

Please PRINT the following information:

I. Facility Information		Contact Person Information	
Facility or Company Name		Name	Phone
Crooked Lake Special Assessment District		Jim Roberts	(269) 217-2923
Sub-Facility Name (if applicable)		Mailing address	
		1213 E. Crooked Lake Dr.	
Facility County		City / State / Zip	
Kalamazoo		Kalamazoo, MI 49009	
Facility Township(s)		Email address	
Texas Township		jim@jimrobertsconstruction.com	

II. Did this facility withdraw 1,500,000 or more gallons of water in 2012?

☒ YES	Complete the rest of the form, and submit with Water Use Reporting Fee payment and invoice.	☐ NO	Water use information, part III.b. is not required. Water use reporting fee is NOT required. Return unpaid invoice to DEQ if submitting report by mail.

III. Water Withdrawal Information (new- see instructions)

a. Water Source and Pump Information

1. Name of Water Source #1	2. Water Source Type (choose one)	3. Pump Capacity	4. Location	5. Static Water Level	6. Installed after 2/28/06 ? ☒ YES ☐ NO
Crooked Lake SAD pump #1	☒ Groundwater ☐ Inland Surface Water ☐ Great Lakes or Connecting Waterways	1,100 Gallons per minute	Latitude: 42.211101 Longitude: -85.692226	201 Feet	If yes, indicate WWAT registration ID number : 1431-20112-10

b. Water Use for Source #1 in 2012 — REPORT WATER USE IN GALLONS PER MONTH

January	February	March	April	May	June
July	August	September	October	November	December

c. Primary Purpose of Use for Source #1 (choose one)

☐ Irrigation	☐ Industrial / Manufacturing	☐ Potable / Sanitary	☐ Quarry / Mining / Dewatering	☐ Electric Power Generation	☒ Lake Augmentation	☐ Fire Protection	☐ Bottled Water

☐ Other :

Mark Van Kuik

From: Len Bosma <lfbosma@gmail.com>
Sent: Friday, August 21, 2020 1:55 PM
To: Tom Wheat
Subject: Re: Augmentation Well Logs

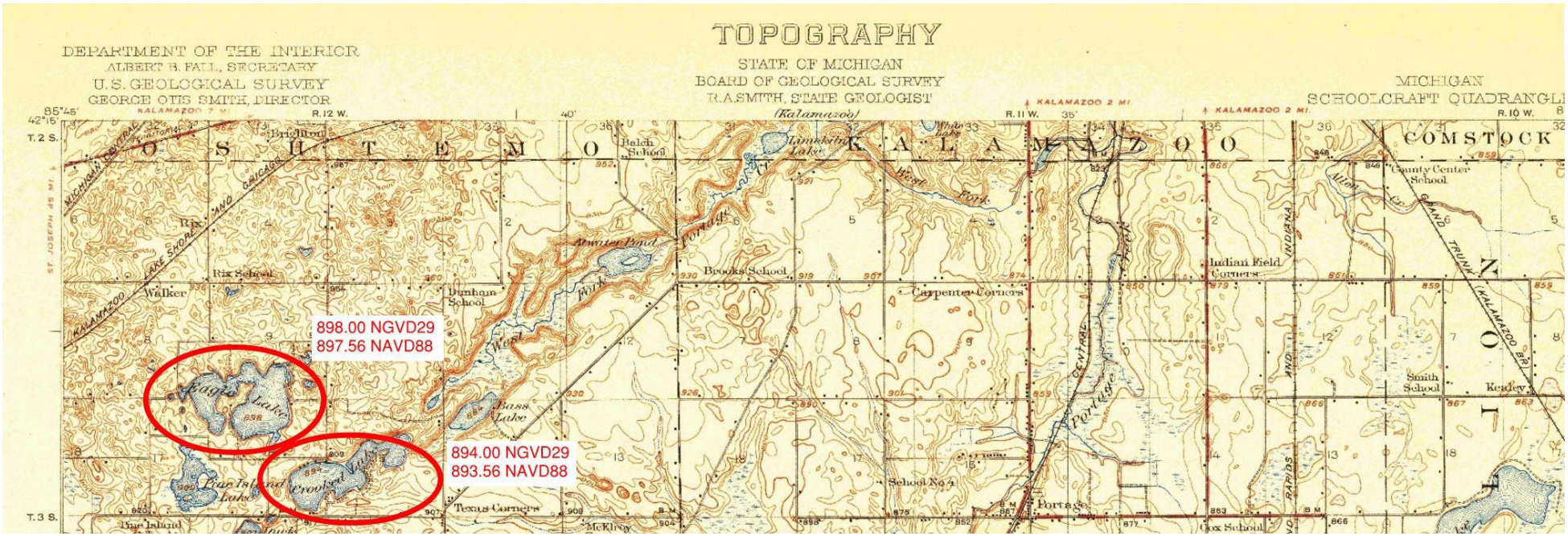
Tom
Our well is 166 feet deep with a 2 million per day pump rate according to our resident expert. Our log for the pumping on/off cycles was destroyed in the Recent flooding. Evidently, the water tight pouch was not water tight.
Len

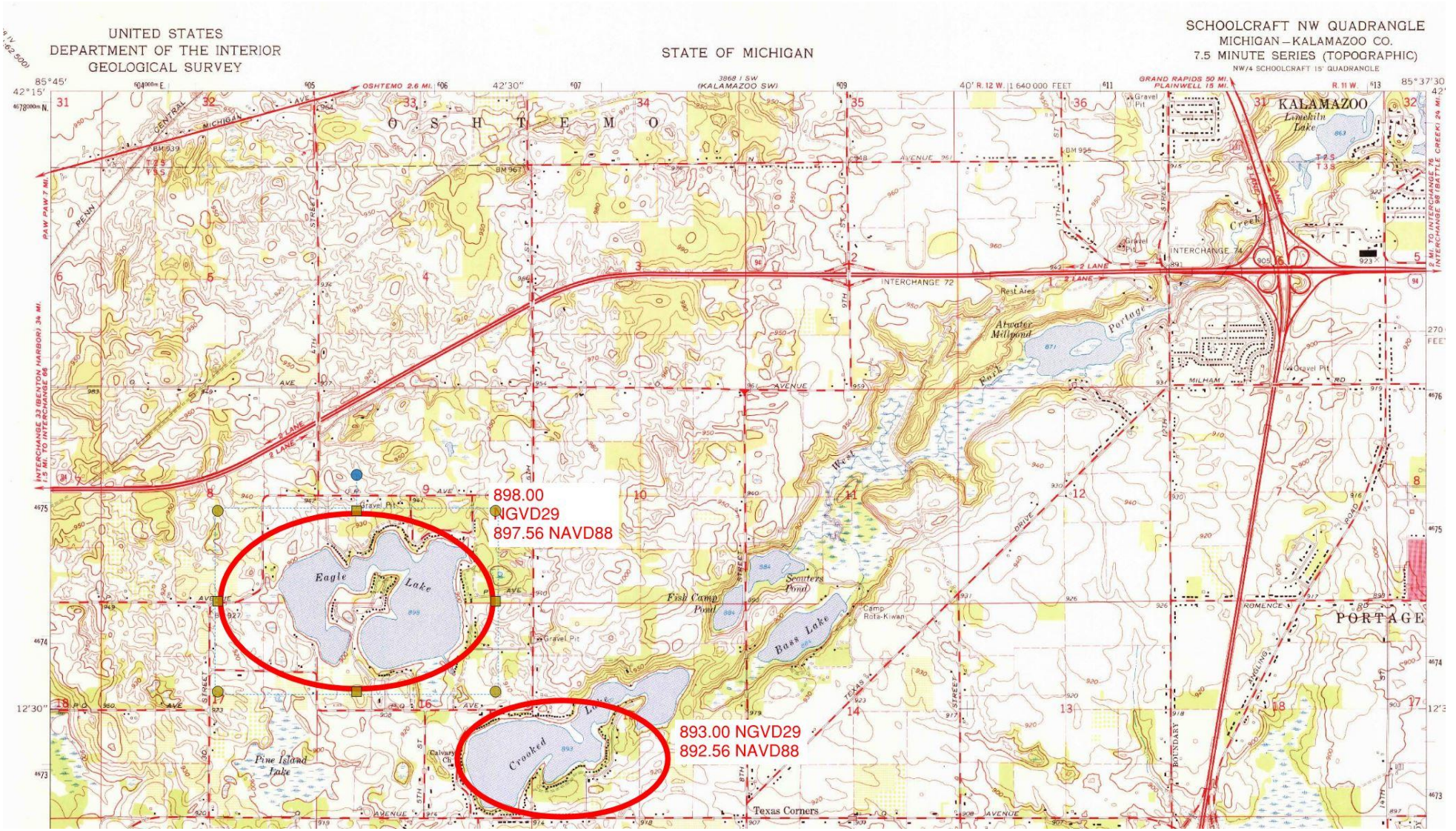
Sent from my iPhone

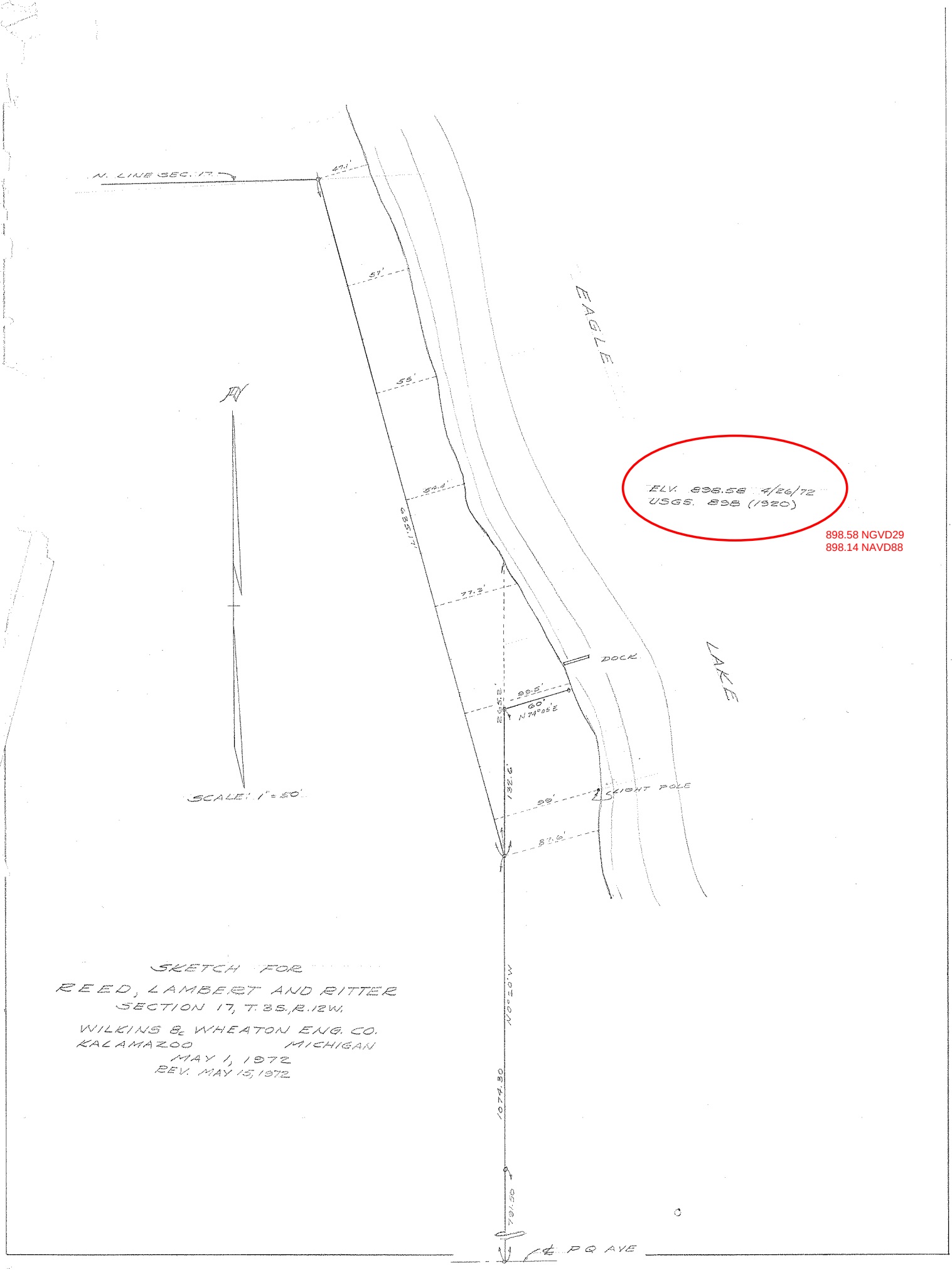
> On Aug 20, 2020, at 10:28 AM, Tom Wheat <twheat@preinnewhof.com> wrote:
>
> Len, Jim
> As part of the legal lake level EGLE is interested in the augmentation well logs, depths, capacities, pump rates…
>
> Please send me whatever you may have.
>
> **Thomas C. Wheat, P.E.**
> **Prein&Newhof**
> t. 269-372-1158
> f. 616-364-6955
> Website | Blog | LinkedIn

Appendix B

Water Elevation Records


TOPOGRAPHY
DEPARTMENT OF THE INTERIOR
ALBERT B. FALL, SECRETARY
U.S. GEOLOGICAL SURVEY
GEORGE OTIS SMITH, DIRECTOR
STATE OF MICHIGAN
BOARD OF GEOLOGICAL SURVEY
R.A.SMITH, STATE GEOLOGIST
MICHIGAN
SCHOOLCRAFT QUADRANGLE
898.00 NGVD29
897.56 NAVD88
894.00 NGVD29
893.56 NAVD88
Eagle Lake
Crooked Lake
Bass Lake
Portage
Texas Corners
Carpenter Corners
Brooks School
Dunham School
Rix School
Walker
Indian Field Corners
School No 4
Smith School
Gox School
County Center School
COMSTOCK
KALAMAZOO


UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
STATE OF MICHIGAN
SCHOOLCRAFT NW QUADRANGLE
MICHIGAN—KALAMAZOO CO.
7.5 MINUTE SERIES (TOPOGRAPHIC)
NW/4 SCHOOLCRAFT 15' QUADRANGLE
OSHTEMO
KALAMAZOO
PORTAGE
Eagle Lake
Crooked Lake
Pine Island Lake
Bass Lake
Fish Camp Pond
Scotters Pond
Atwater Millpond
Portage Creek
Texas Corners
898.00
NGVD29
897.56 NAVD88
893.00 NGVD29
892.56 NAVD88


N. LINE SEC. 17
49.1'
57'
55'
54.1'
S 25° 51' W
77.3'
EAGLE
LAKE
DOCK
99.5'
60'
N 74° 05' E
132.6'
99'
87.6'
LIGHT POLE
N 0° 20' W
1077.30'
66.18'
℄ P Q AVE
ELV. 898.58 4/26/72
USGS. 898 (1920)
898.58 NGVD29
898.14 NAVD88
SCALE: 1" = 50'
N
SKETCH FOR
REED, LAMBERT AND RITTER
SECTION 17, T. 3S., R. 12W.
WILKINS & WHEATON ENG. CO.
KALAMAZOO MICHIGAN
MAY 1, 1972
REV. MAY 15, 1972

SOMERS ASSOCIATES 230 5-75 60939-

900.50 NGVD29
900.06 NAVD88

EAGLE LAKE
WATER SURFACE = 900.5
(10-10-75)

E. LINE, SEC. 17, T 3 S, R 12 W.

N.0° 20'-00" W., 949.85'

E. ¼ POST, SEC. 17, T 3 S., R. 12 W.

E. & W. ¼ LINE, SEC. 17, T 3 S., R 12 W.

ELEV. 902.0

S.0° 20'-00" E., 800'±

PHYSICAL ℄ PQ AVE.

N.89° 00'-00" W., 142.30'

N.89° 00'-00" W., 195.54'

℄ PQ AVENUE

B.M.
NAIL IN N. SIDE
36" OAK
U.S.G.S. EL. = 909.77

40'-SET-BACK LINE

STORM WATER RECHARGE AREA

EAGLE TERRACE

STORM WATER FLOW

HIGH POINT

TRAVERS LINE

POPLAR GROVE

"EXCEPT"

N.0° 20'-00" W., 281.03'

N.89° 00'-00" W., 165.00'

N.89° 00'-00" W., 195.00'

N.0° 20'-00" W., 510.47'

131.00'±

FLOOD PLAIN LIMIT
ELEV. 902.0 (USGS)

281.03'

SCALE: 1" = 40'

LEGEND

- 908 — EXISTING CONTOUR LINE (U.S.G.S.)
- △ TOPO STATION
- ○ IRON ROD
- (1) SOIL BORING
- 902.0 PROP. FINISH. & ELEV.

GENERAL NOTES

1. WATER WILL BE SUPPLIED BY INDIVIDUAL WELLS.
2. SANITARY SEWER SERVICE WILL BE BY SEPTIC TANKS AND TILE FIELDS OR DRY WELLS.
3. CURB AND GUTTER WILL BE INSTALLED.
4. TELEPHONE SERVICE WILL BE SUPPLIED BY MICH. BELL TELEPHONE CO.
5. ELECTRIC SERVICE WILL BE SUPPLIED BY FRUIT BELT ELECTRIC CO.
6. STORM WATER WILL BE COLLECTED IN CATCH BASINS AND PIPED TO A RECHARGE BASIN.
7. 10 LOTS PROPOSED
8. 40' BUILDING SET-BACK.
9. 16,500 SQ. FT. MIN. LOT AREA. W/ 110' MIN. WIDTH @ BUILDING SET-BACK LINE.
10. 6± TOTAL ACRES

BORING LOG

#1 0.0: 905.5 TOP SOIL 1.0 — SAND (MED.) — 4.5 WET SAND & WATER

#2 0.0: 917.3 0.2 TOP SOIL — SAND (MED.) — 10.0

#3 0.0: 922.8 0.2 TOP SOIL — SAND (MED.) — 10.0

#4 0.0: 917.6 0.2 TOP SOIL — SAND (MED.) — 10.0

#5 0.0: 911.4 — SAND (MED.) — 10.0

#6 0.0: 913.2 0.2 TOP SOIL — SAND (MED.) — 10.0

#7 0.0: 917.5 0.5 TOP SOIL — SAND (MED.) — 10.0

APPROVED
WITH CONDITIONS SPECIFIED

In June 18, 1976 Letter to Robert L. Sauers, RLS

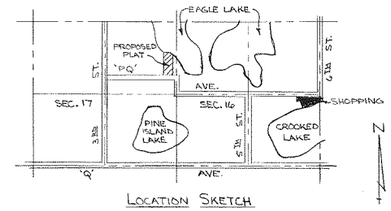
DEPARTMENT OF NATURAL RESOURCES

By Blake W. Ranger

CHIEF, HYDROLOGICAL SURVEY DIVISION, BUREAU OF WATER MANAGEMENT

DATE 6/18/76 FILE NO. 2321-17

IT IS FURTHER MADE A REQUIREMENT OF THIS ~~DEDICATION~~ APPROVAL THAT THE APPLICANT GIVE NOTICE TO PUBLIC UTILITIES IN ACCORDANCE WITH ACT 53 OF THE PUBLIC ACTS OF 1974, COMPILED LAWS 460.701 TO 460.718, AND COMPLY WITH EACH OF THE REQUIREMENTS OF THAT ACT.



LOCATION SKETCH
NO SCALE

PROPRIETOR:
MORREN CONST. CO.
104 E. KILGORE RD.
KALAMAZOO, MICHIGAN 49

RECEIVED
JUN 17 1976
Hydrological Surv.

SURVEYOR:
ROBERT L. SAUERS
REGISTERED LAND SURVEYOR
R.L.S. NO. 10069

ACRO ENGINEERING & SURVEYING, INC.
120 E. KILGORE RD. KALAMAZOO, MICHIGAN

PROPOSED PLAT OF
"EAGLE LAKE TERRACE ESTATES"
FOR: MORREN CONST. CO.
LOCATED IN THE N.E. FRACTIONAL ¼, SECTION 17, T. 3S., R.12 W., TWP. OF TEXAS, CO. OF KALAMAZOO, MICHIGAN

REVISIONS	JOB NO.	DATE	SHEET
NO. OF LOTS, RDWY. GRADES 12-3-75			
REMARK TE SURVEY 1-30-76	1541-75	11/10/75	1
LAKE LOTS, ENG 6/11/76			

1541-75

✓		ASSISTANT
		ADMINISTRA
✓		SECRETA
		LOCAL GOV
		FISCAL
		CONTRACT ADM.
		ARCHITECTURE
	✓	ENGINEERING
		MECH./ELEC.
		CONSTRUCTION
		CARTOGRAPHIC DRAFT.
		SURVEY

PREPARE
- ☐ PLANS
- ☐ CONTRACT DOC.
- ☐ WORK ORDER
- ☐ PROG. DIRECTIVE
- ☐ SET-UP PROJECT
- ☐ REPLY
- ☐ REPORT
- ☑ FILE
- ☐

December 16, 1982

TO: Albert Massey, Inland Lakes Management Unit
Land Resource Programs Division

FROM: Gary C. Bilow, L.S., Survey and Mapping Section – Engineering Division

SUBJECT: Eagle Lake, Kalamazoo County, Ordinary High Water Mark Determination
Engineering Division Project No. 18-95279

This letter will confirm my opinion that a new Ordinary High Water Mark elevation on Eagle Lake is not required.

Eagle Lake has had a history of large fluctuations in its level. Records indicate it has been as much as 7 feet below its present level and our investigation showed an old shoreline 1.2 feet above the present water surface elevation. Vince McCann examined the Lake in 1968, after a long period of low water, and found the ordinary high to be 898.4. Don Bissell inspected the shoreline in 1976, during a period when the water level was 2.5 feet above McCann's elevation, and re-affirmed that elevation for the Ordinary High Water Mark. During our shoreline inspection on December 3, 1982, we found no positive indicators of a different Ordinary High Water Mark. We did find healthy, woody vegetation (button bush) growing 1.3 feet to 2. feet below the water elevation of 899.98.

898.40 NGVD29
897.96 NAVD88
1949 - ref on pg. 6

900.46 NGVD29
900.02 NAVD88
1976

899.98 NGVD29
899.54 NAVD88
Dec. 3, 1982

I believe the high water elevations of the past several years are a part of the natur of Eagle Lake. This high water is certainly masking the indicators of the Ordin Water Mark but has not created a new mark. We would not revise the ordin downward during extended periods of extremely low water and we should not revise it upward based on a few years of extreme high water.

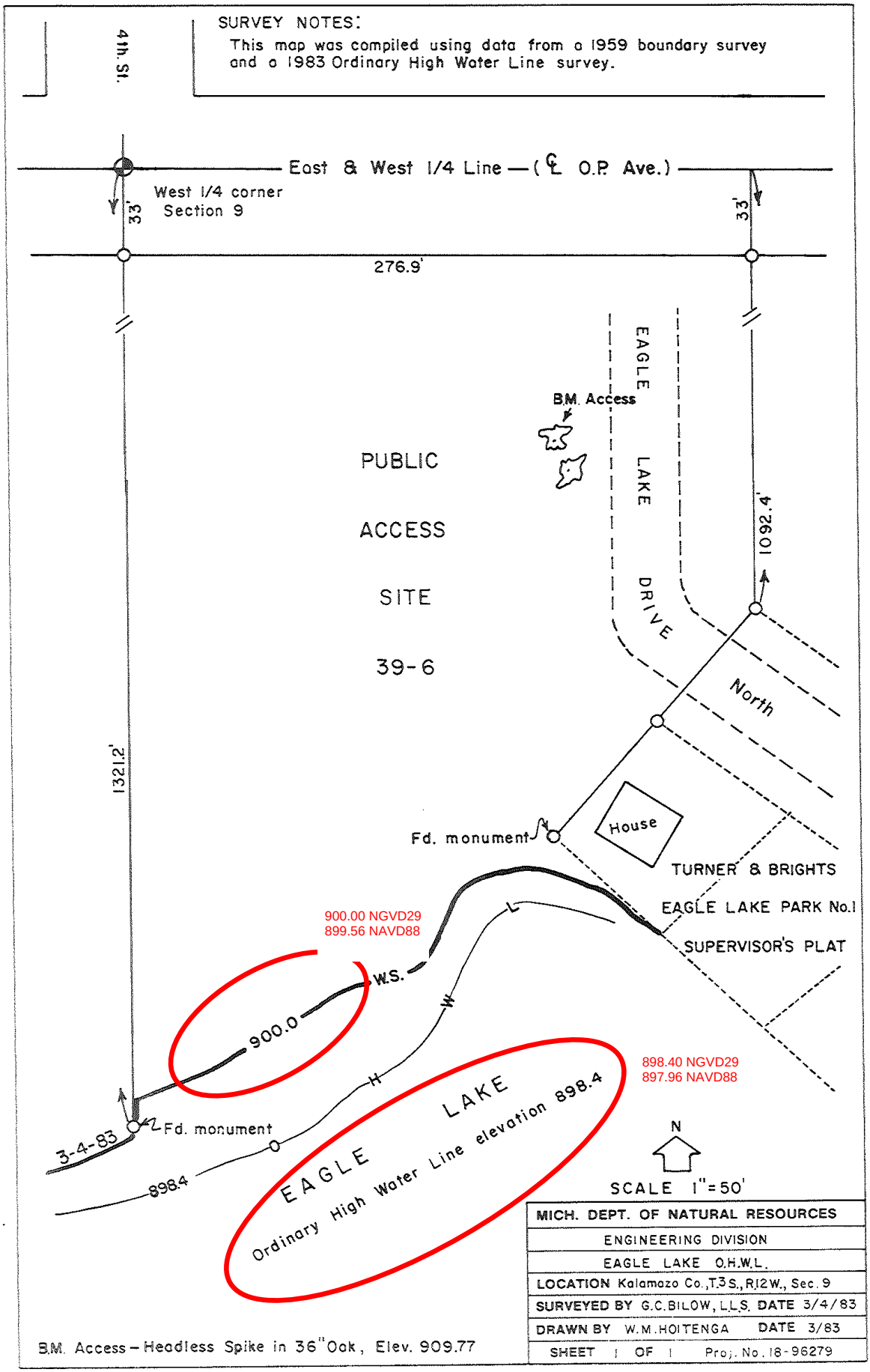
I believe that the water level fluctuations of Eagle Lake make it a special and difficult resource to manage. The Department can adequately protect this resource during periods of extreme high water without changing the Ordinary High Water Mark elevation. By requiring permits under Section 3(d) or 3(e) of the Inland Lakes and Streams Act or, as is being done currently, by applying the Wetlands Act to contiguous wetlands, the public's interest in the waters of Eagle Lake can be asserted.

The request from which this project was established requires a map be made of a site designated by Mr. Milbeck. That site will be the Public Access Site on the northwest shore. I will send you a copy of that map when it is complete.

I have enclosed the list of Ordinary High Water Marks established by Engineering Division to date. Please share this list with your staff and field people who might be interested.

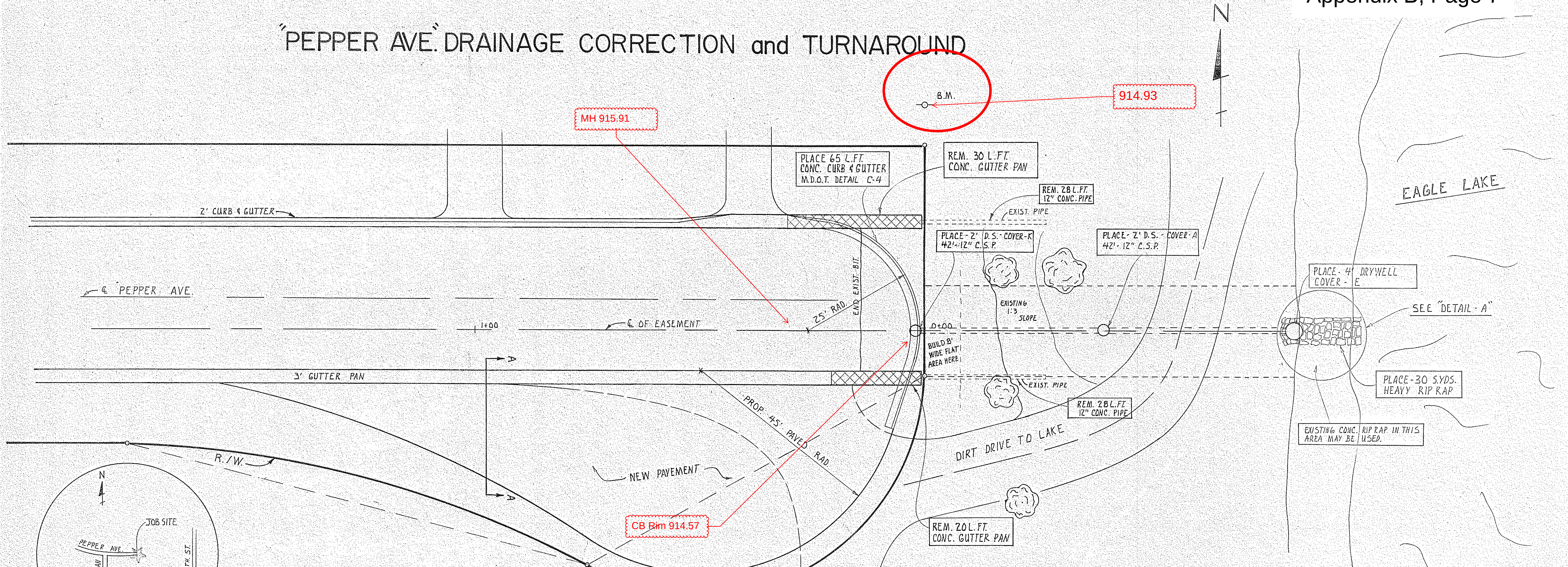
GCB:cjr
Enclosure

Waterways Div.

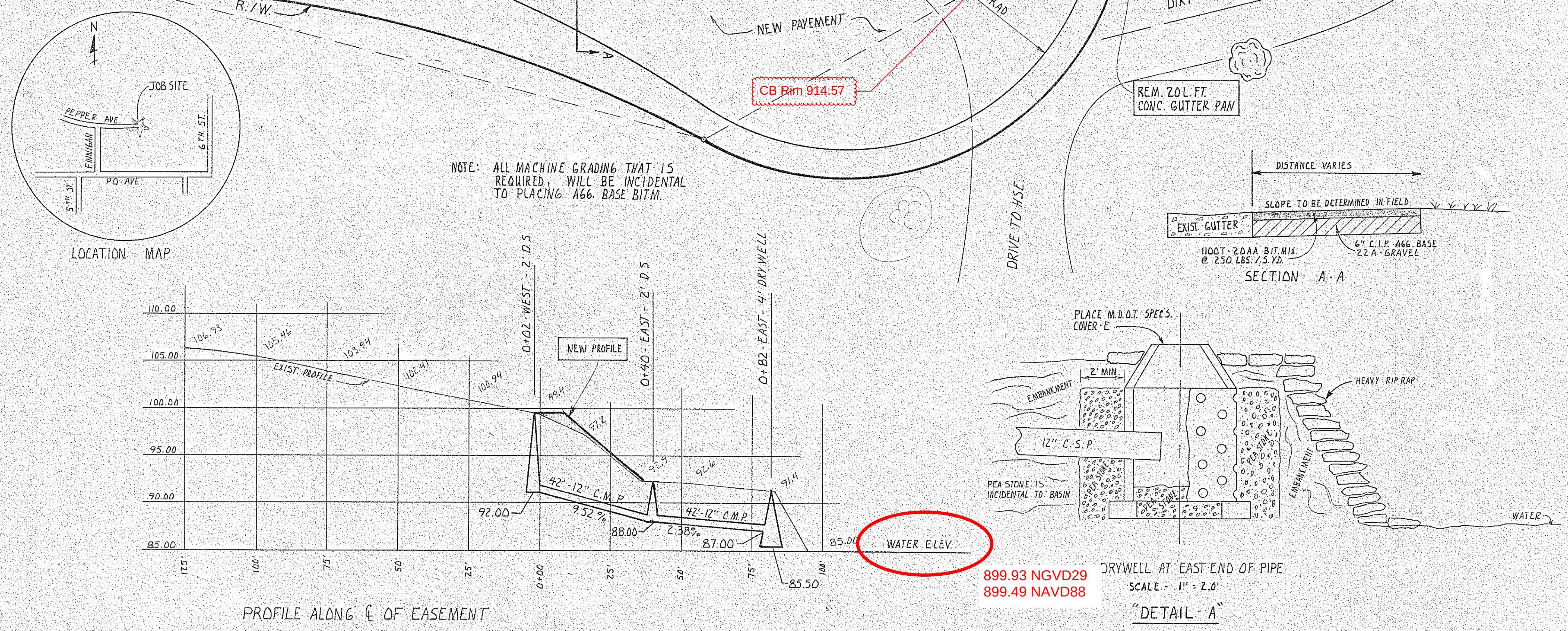


PLAN No. Y39F

"PEPPER AVE." DRAINAGE CORRECTION and TURNAROUND



N
B.M.
914.93
MH 915.91
PLACE 65 L.FT. CONC. CURB & GUTTER M.D.O.T. DETAIL C-4
REM. 30 L.FT. CONC. GUTTER PAN
REM. 28 L.FT. 12" CONC. PIPE
EXIST. PIPE
PLACE - 2' D.S. - COVER - K 42' - 12" C.S.P.
PLACE - 2' D.S. - COVER - A 42' - 12" C.S.P.
2' CURB & GUTTER
℄ PEPPER AVE.
1+00
℄ OF EASEMENT
25' RAD.
END EXIST. BIT.
0+00
BUILD 8' WIDE FLAT AREA HERE
EXISTING 1:3 SLOPE
3' GUTTER PAN
A
A
EXIST. PIPE
REM. 28 L.FT. 12" CONC. PIPE
PROP. 45' PAVED RAD.
DIRT DRIVE TO LAKE
R./W.
NEW PAVEMENT
CB Rim 914.57
REM. 20 L.FT. CONC. GUTTER PAN
EAGLE LAKE
PLACE - 4' DRYWELL COVER - E
SEE "DETAIL - A"
PLACE - 30 S.YDS. HEAVY RIP RAP
EXISTING CONC. RIP RAP IN THIS AREA MAY BE USED.



N
JOB SITE
PEPPER AVE.
FINNIGAN
6TH. ST.
PQ AVE.
5TH. ST.
LOCATION MAP
NOTE: ALL MACHINE GRADING THAT IS REQUIRED, WILL BE INCIDENTAL TO PLACING A66. BASE BITM.
DRIVE TO HSE.
DISTANCE VARIES
SLOPE TO BE DETERMINED IN FIELD
EXIST. GUTTER
1100T - 20AA BIT. MIX. @ 250 LBS. / S.YD.
6" C.I.P. A66. BASE 22A - GRAVEL
SECTION A - A
0+02 - WEST - 2' D.S.
0+40 - EAST - 2' D.S.
0+82 - EAST - 4' DRYWELL
NEW PROFILE
110.00
105.00
100.00
95.00
90.00
85.00
106.93
105.46
103.94
102.41
100.94
99.4
97.2
92.9
92.6
91.4
EXIST. PROFILE
42' - 12" C.M.P.
9.52 %
42' - 12" C.M.P.
2.38%
92.00
88.00
87.00
85.50
85.00
WATER ELEV.
899.93 NGVD29
899.49 NAVD88
125'
100'
75'
50'
25'
0+00
25'
50'
75'
100'
PROFILE ALONG ℄ OF EASEMENT
PLACE M.D.O.T. SPEC'S. COVER - E
2' MIN.
EMBANKMENT
12" C.S.P.
PEA STONE IS INCIDENTAL TO BASIN
PEA STONE
HEAVY RIP RAP
EMBANKMENT
WATER
DRYWELL AT EAST END OF PIPE
SCALE - 1" = 2.0'
"DETAIL - A"

SUMMARY OF QUANTITIES

ITEM OF WORK	QUANTITY	UNIT
REMOVING 3' WIDE GUTTER PAN	50	L.FT.
REMOVING 12" CONC. PIPE	56	L.FT.
CONC. CURB & GUTTER - C-4	65	L.FT.
2' D.S.	2	EACH
4' D.S.	1	EACH
12" C.S.P.	84	L.FT.
D.S. COVER - DET. K	1	EACH
D.S. COVER - DET. A	1	EACH
D.S. COVER - DET. E	1	EACH
HEAVY RIP RAP	30	S.YD.
A66. BASE BITM.-L.M. (22A GRAV)	80	C.YD.
EMBANKMENT (C.I.P.)	80	C.YD.
TOPSOIL 3"	250	S.YD.
CLASS A SEEDING	5	LBS.
STRAW BALES (FOR MULCH)	10	EACH
1100T - 20AA - BIT. MIX.	50	TON

KALAMAZOO COUNTY ROAD COMMISSION
ENGINEERING DEPARTMENT
3801 EAST KILGORE ROAD KALAMAZOO, MICHIGAN

PROJECT: PEPPER AVE. - TEXAS TWP.		
FROM	TO	
SURVEYED BY K.C.R.C.	DESIGNED BY	PROJECT No. 2442-380
DRAWN BY P.E.C.	DATE JUNE - 1983	
CHECKED BY	SCALE 1" = 10'	SHEET 1 OF 1

EAGLE HEIGHTS

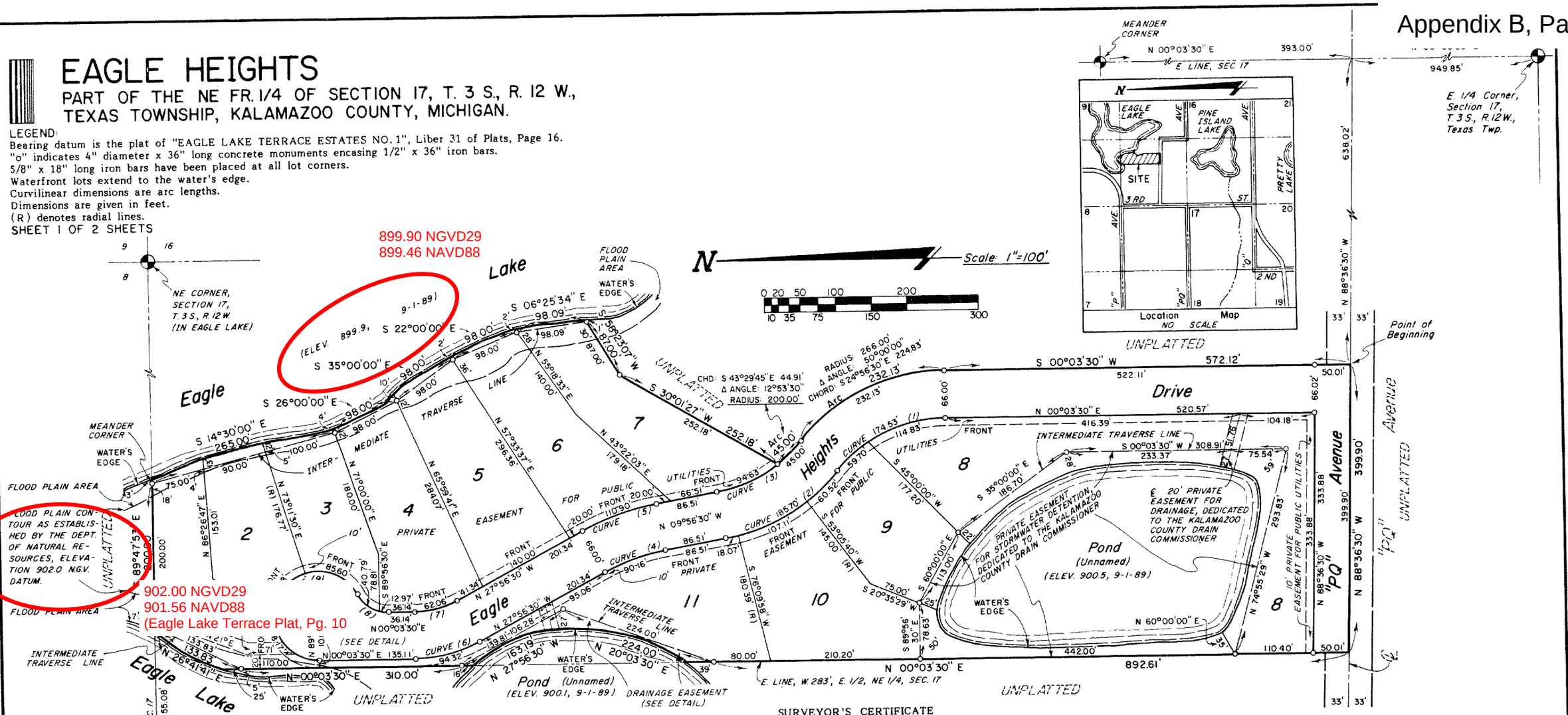
PART OF THE NE FR. 1/4 OF SECTION 17, T. 3 S., R. 12 W., TEXAS TOWNSHIP, KALAMAZOO COUNTY, MICHIGAN.

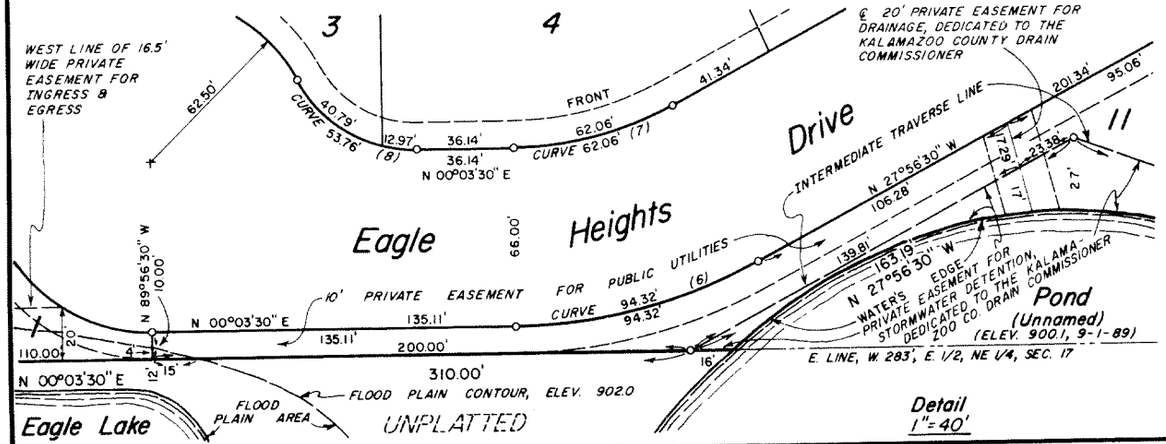
LEGEND:
Bearing datum is the plat of "EAGLE LAKE TERRACE ESTATES NO. 1", Liber 31 of Plats, Page 16.
"o" indicates 4" diameter x 36" long concrete monuments encasing 1/2" x 36" iron bars.
5/8" x 18" long iron bars have been placed at all lot corners.
Waterfront lots extend to the water's edge.
Curvilinear dimensions are arc lengths.
Dimensions are given in feet.
(R) denotes radial lines.

SHEET 1 OF 2 SHEETS

899.90 NGVD29
899.46 NAVD88

902.00 NGVD29
901.56 NAVD88
(Eagle Lake Terrace Plat, Pg. 10





RECORDING CERTIFICATE

State of Michigan)
Kalamazoo County)

This plat was received for record on the 16th day of May, 1990 at 9:05 AM and recorded in Liber 35 of Plats on Pages 18.

James O. Youngs, Register of Deeds

RESTRICTIONS CERTIFICATE

This plat is subject to restrictions, as required by Act 288 of 1967 as amended, on certain lots with respect to the requirements of the Michigan Department of Natural Resources and the Michigan Department of Public Health, which are recorded in Liber 1456 on Pages 1491 of records of Kalamazoo County.

SURVEYOR'S CERTIFICATE

I, Thomas W. Chettleburgh, Surveyor, certify:

That I have surveyed, divided and mapped the land shown on this plat, described as follows:

EAGLE HEIGHTS, part of the Northeast fractional 1/4 of Section 17, Town 3 South, Range 12 West, Texas Township, Kalamazoo County, Michigan, commencing at the East 1/4 corner of said Section 17; thence N 00°03'30"E along the East line of said Section 949.85 feet to the centerline of "PQ" Avenue (66 feet wide); thence N 88°36'30"W along said centerline 638.02 feet to the Point of Beginning of this description; thence N 88°36'30"W along said centerline 399.90 feet; thence N 00°03'30"E, along the East line of the West 283 feet of the East 1/2 of said Northeast 1/4, 892.61 feet; thence N 20°03'30"E along an intermediate traverse line of an unnamed pond 224.00 feet; thence N 27°56'30"W along said traverse line 163.19 feet; thence N 00°03'30"E, along said East line of said West 283 feet, 310.00 feet; thence N 26°41'41"E along an intermediate traverse line of Eagle Lake 133.83 feet; thence S 89°47'53"E along the North line of said Section 200.00 feet; thence the following five courses along an intermediate traverse line of said Eagle Lake: S 14°30'00"E 265.00 feet; S 26°00'00"E 98.00 feet; S 35°00'00"E 98.00 feet; S 22°00'00"E 98.00 feet; S 06°25'34"E 98.09 feet; thence S 58°23'07"W 87.00 feet; thence S 30°01'27"W 252.18 feet; thence Southeasterly 45.00 feet on the arc of a 200.00 feet radius curve to the left with a central angle of 12°53'30" and a chord bearing S 43°29'45"E 44.91 feet; thence Southeasterly 232.13 feet on the arc of a 266.00 feet radius curve to the right with a central angle of 50°00'00" and a chord bearing S 24°56'30"E 224.83 feet; thence S 00°03'30"W 572.12 feet to the point of beginning, including all land to the water's edge of Eagle Lake and said unnamed pond, and containing 11 lots.

That I have made such survey, land division and plat by the direction of the owners of such land.

That such plat is a correct representation of all the exterior boundaries of the land surveyed and the subdivision of it.

That the required monuments and lot markers have been located in the ground or that surety has been deposited with the municipality as required by Section 125 of the Act.

That the accuracy of survey is within the limits required by Section 126 of the Act.

That the bearings shown on the plat are expressed as required by Section 126 (3) of the Act and as explained in the legend.

Date: FEBRUARY 6, 1990

Curve Data

Curve	Radius	Tangent	Central Angle	Chord Bearing	Chord	Arc
1	200.00'	93.26'	50°00'00"	N 24°56'30" W	169.05'	174.53'
2	266.00'	96.82'	40°00'00"	N 29°56'30" W	181.95'	185.70'
3	200.00'	48.22'	27°06'30"	N 23°29'45" W	93.75'	94.63'
4	287.00'	45.46'	18°00'00"	N 18°56'30" W	89.79'	90.16'
5	353.00'	55.91'	18°00'00"	N 18°56'30" W	110.44'	110.90'
6	193.00'	48.12'	28°00'00"	N 13°56'30" W	93.38'	94.32'
7	127.00'	31.66'	28°00'00"	N 13°56'30" W	61.45'	62.06'
8	50.00'	29.81'	61°36'16"	N 30°51'38" E	51.21'	53.76'
9	62.50'	104.84'	241°36'16"	N 59°08'22" W	107.37'	263.55'

STATE OF MICHIGAN
THOMAS W. CHETTLEBURGH
LAND SURVEYOR NO. 16036
REGISTERED LAND SURVEYOR

CHETTLEBURGH & ASSOCIATES
5858 Hall Street, SE
Grand Rapids
Michigan 49546

Thomas W. Chettleburgh, L.S.
Sole Proprietor
Registration Number 16036

60832

Prein&Newhof
Engineers ▪ Surveyors ▪ Environmental ▪ Laboratory

2040052K

TO: Board Members, Charter Township of Texas

FROM: Thomas C. Wheat, P.E., Township Engineer

DATE: April 19, 2004

SUBJECT: Eagle Lake – Water Levels

Per your request, we have investigated the Water Levels for Eagle Lake. We found that Eagle Lake does not have a "Normal (Legal) Lake Level". A "Normal (Legal) Lake Level" is a level that is determined by an engineering study which takes into consideration many factors including shoreline erosion and ice damage, control of some aquatic weeds, fisheries, wildlife and aesthetic issues. The level is then set by Circuit Court action and maintained by the County Board or their authorized authority (usually the Drain Commissioner). The costs of this level control are contemplated to be paid through a special assessment by the benefited properties. A "Normal (Legal) Lake Level" is most appropriate for lakes with an outlet, so that an outlet control structure (dam) may be utilized for the level control.

We did speak with Scott Sylvester of the Eagle Lake Association and he confirmed that no legal lake level was ever established. However, we found that Eagle Lake does have two other established lake levels. They are as follows:

100 year Flood Plain (Elevation 902.0)

902.00 NGVD29
901.56 NAVD88
(Eagle Heights, Pg. 8 and Eagle Lake Terrace Plat, Pg. 10)

This elevation was determined by the Michigan Department of Natural Resources during the platting of "Eagle Heights" in 1990.

Ordinary High Water Mark (Elevation 898.4)

898.40 NGVD29
897.96 NAVD88
(Turner/Bright No1,1949)

This elevation was set by the Michigan Department of Natural Resources during the platting of "Supervisor's Plat of Turner & Bright's Eagle Lake Park No. 1". An Ordinary High Water Mark (OHWM) is defined by the Michigan Department of Environmental Quality and the U.S. Army Corps of Engineers as:

"The line on the shore established by the fluctuations of water and indicated by physical characteristics such as clear, natural line impressed on the bank, shelving, changes in the character of soil, destruction of terrestrial vegetation, the presence of litter and debris, or other appropriate means that consider the characteristics of the surrounding areas."

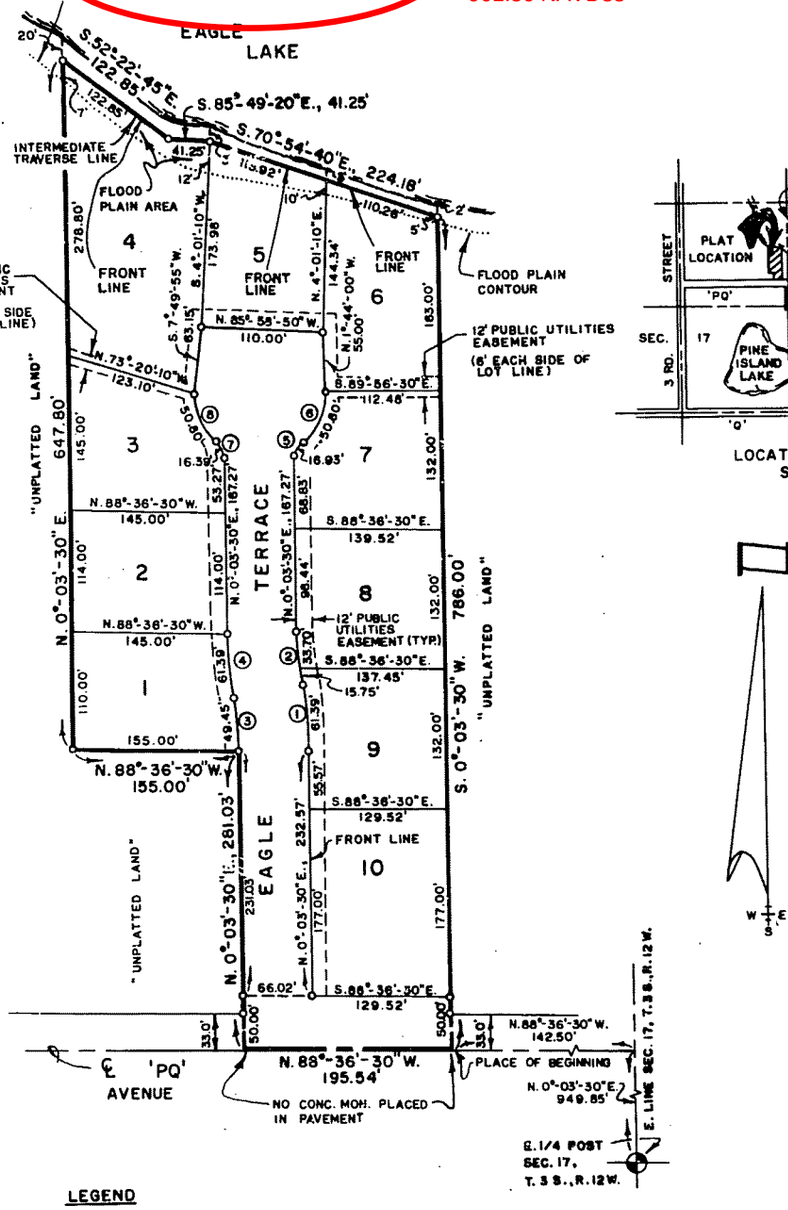
7123 Stadium Drive Kalamazoo, MI 49009 t. 269-372-1158 f. 269-372-3411 www.preinnewhof.com

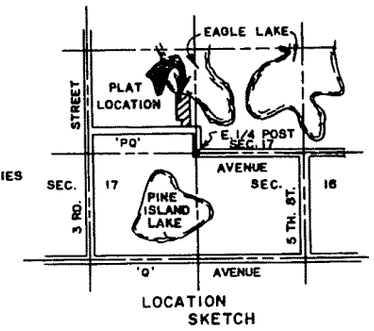
"EAGLE LAKE TERRACE ESTATES NO. 1"

N.E. FRACTIONAL 1/4, SEC. 17, T. 3 S., R. 12 W., TEXAS TOWNSHIP, KALAMAZOO COUNTY, MICHIGAN

0' 100' 200' 300'

SCALE : 1" = 100'





LOCATION SKETCH

Certified true copy of Recorded plat

ALLISON GREEN
STATE TREASURER

By Richard E. Lomax
Richard E. Lomax - Plat Examiner

Date October 18, 1976

PLAT RESTRICTIONS

This plat is subject to restrictions as required by Act 288 of 1967, as amended on certain lots with respect to the requirements of the Michigan Department of Natural Resources and/or the Michigan Department of Public Health, which are recorded in Liber 992, Page 436 of records of this county.

SURVEYOR'S CERTIFICATE

I, Robert L. Sauers, Surveyor, certify: That I have surveyed, divided and mapped the land shown on this Plat, described as follows: The Plat of "Eagle Lake Terrace Estates No. 1", located in part of the Northeast (N.E.) fractional ¼, Section 17, T. 3 S., R. 12 W., Texas Township, Kalamazoo County, Michigan.

Commencing at the East quarter (E.¼) post of Section 17, T. 3 S., R. 12 W., Texas Township, Kalamazoo County, Michigan; thence N. 0°-03'-30"E. along the East line of said Section 17, 949.85 feet to the center-line of 'PQ' Avenue; thence N. 88°-36'-30" W. along the center-line of said 'PQ' Avenue, 142.50 feet for the Place of Beginning; thence continuing N. 88°-36'-30" W. along the center-line of said 'PQ' Avenue, 195.54 feet; thence N. 0°-03'-30" E., 281.03 feet; thence N. 88°-36'-30" W. parallel with the center-line of said 'PQ' Avenue, 155.00 feet; thence N. 0°-03'-30" E., 647.80 feet; thence S. 52°-22'-45" E. along an intermediate traverse line, 122.85 feet; thence S. 85°-49'-20" E. continuing along the said intermediate traverse line, 41.25 feet; thence S. 70°-54'-40" E. continuing along the said intermediate traverse line, 224.18 feet; thence S. 0°-03'-30" W., 786.00 feet to the Place of Beginning.

This Plat contains 10 lots numbered 1 through 10, 5.85 acres (±).

That I have made such survey, land-division and Plat by the direction of the owners of such land.

That such plat is a correct representation of all the exterior bounderies of the land surveyed and the subdivision of it.

That the required monuments and lot markers have been located in the ground or that surety has been deposited with the municipality, as required by Section 125 of the Act.

That the accuracy of the survey is within the limits required by Section 126 of the Act.

That the bearings shown on the Plat are expressed as required by Section 126 (3) of the Act and as explained in the Legend.

Date July 14, 1976

Acro Engineering & Surveying Inc.
120 East Kilgore Road
Kalamazoo, Michigan 49001

Robert L. Sauers
Registered Land Surveyor
#10069

STATE OF MICHIGAN — ROBERT L SAUERS — LAND SURVEYOR No. 10069 — REGISTERED LAND SURVEYOR

PROPRIETOR'S CERTIFICATE - CORPORATION

MORREN CONST. CO., a Michigan Corporation, a corporation duly organized and existing under the laws of the State of Michigan by Willis Morren, Jr., President and James R. Morren, Secretary, as proprietor, have caused the land to be surveyed, divided, mapped, and dedicated as represented on the plat; that the Avenue and Terrace are for the use of the public and that the public utility easements are private easements and that the lots adjacent to Eagle Lake extend to the waters edge.

MORREN CONST. CO.
a Michigan Corporation
106 East Kilgore Road
Kalamazoo, Michigan 49001

Witness:
Robert Jaecke Jr.
ROBERT JAECKE JR.

Willis Morren Jr. Pres.
Willis Morren, Jr., President

Thomas A. Hamming
THOMAS A. HAMMING

James R. Morren Sec
James R. Morren, Secretary

ACKNOWLEDGEMENT
CORPORATION

State of Michigan)
Kalamazoo County) SS

Personally came before me this 20TH day of July, 1976, Willis Morren, Jr., President and James R. Morren, Secretary of the above named Corporation, to me known to be the persons who executed the foregoing instrument, and to me known to be such President and Secretary of said corporation and acknowledged that they executed the foregoing instrument as such officers as the free act and deed of said corporation, by its authority.

Notary Public, Robert L. Sauers
ROBERT L. SAUERS
KALAMAZOO County, Michigan.
My Commission expires MAY 17TH, 1977

LEGEND

1. ALL DIMENSIONS ARE IN FEET.
2. CURVILINEAR MEASUREMENTS SHOWN ARE ARC DISTANCES.
3. 4" DIAMETER CONCRETE MONUMENTS PLACED AT ALL POINTS MARKED THUS 'o'
4. ALL LOT CORNERS MARKED WITH 1/2" DIAMETER X 1'-6" LONG STEEL RODS
5. BEARING ORIENTATION ESTABLISHED BY A POLARIS OBSERVATION

CURVE DATA

NO.	CENTRAL ANGLE	RADIUS	CHORD	CHORD BEARING	TANGENT	ARC
1	10°-22'-00"	339.28'	61.31'	N. 5°-07'-30" W.	30.78'	61.39'
2	10°-22'-00"	273.28'	49.38'	N. 5°-07'-30" W.	24.79'	49.45'
3	10°-22'-00"	273.28'	49.38'	N. 5°-07'-30" W.	24.79'	49.45'
4	10°-22'-00"	339.28'	61.31'	N. 5°-07'-30" W.	30.78'	61.39'
5	48°-30'-35"	20.00'	16.43'	N. 24°-18'-45" E.	9.01'	16.93'
6	48°-30'-35"	60.00'	49.30'	N. 24°-18'-45" E.	27.03'	50.80'
7	48°-30'-35"	20.00'	16.43'	S. 24°-11'-45" E.	9.01'	16.93'
8	48°-30'-35"	60.00'	49.30'	S. 24°-11'-45" E.	27.03'	50.80'

55338

EAGLE LAKE TEXAS WATER LEVEL POLICY

The "Eagle Lake Texas Association" Board authorized a survey of the water level of Eagle Lake. This survey was conducted by Prein&Newhof, Engineers & Surveyors on May 29, 2008. The purpose of the survey was to establish an "Ordinary High Water Mark" (OHWM) for Eagle Lake which will be used to govern the operation of the pump in the boards attempt to maintain an appropriate and healthy lake level.

The following elevation measurements were provided on May 29, 2008:

- "Ordinary High Water Mark" (OHWM) 899.84 Elevation

899.84 NAVD88

EAGLE LAKE PUMP OPERATION POLICY

The following policy shall determine yearly lake pump operation at Eagle Lake:

- During the months of October, November, December, January, February and March; the pump will be disconnected from power and not operational.

- During the months of April, May, June, July, August and September; the pump will only run as necessary to assist in keeping the lake level between a range of 8 to 4 inches below the Official High Water Mark.

- Whenever the water level reaches 4 inches or higher, below the Official High Water Mark, the pump will be off and not operational.

ELTA Board Approval: 2012

BOUNDARY SURVEY
FOR
JOHN & SANDY SCHOELL

SECTION 16, T 3 S, R 12 W
KALAMAZOO CO., MICHIGAN

BY

WILKINS & WHEATON ENGINEERING CO., INC.

169 PORTAGE STREET
KALAMAZOO, MICHIGAN 49007
PHONE: (616) 345-1158

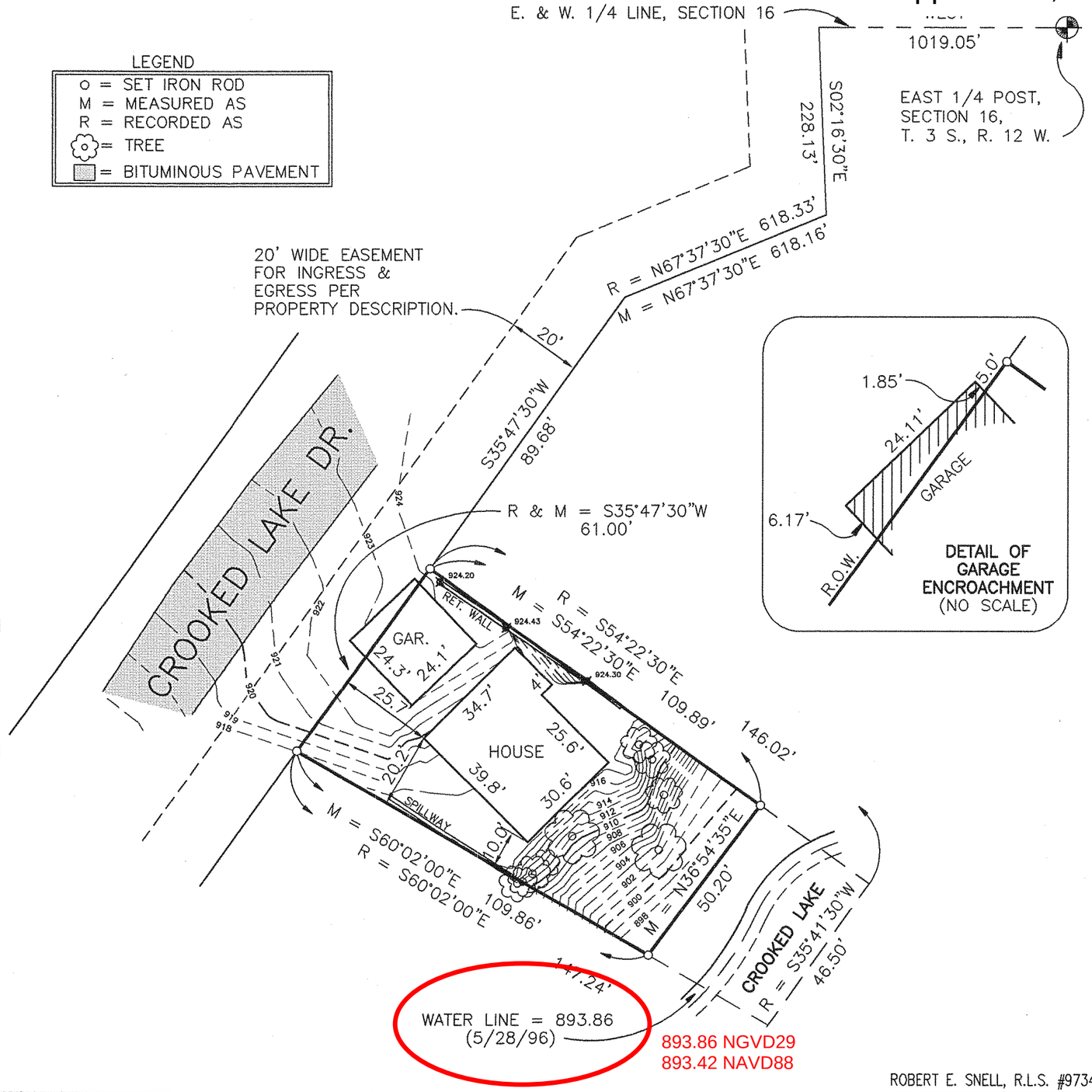
MAY 29, 1996

SCALE 1" = 30'

0 15 30 60

PARCEL DESCRIPTION:
A parcel of land located in the North 1/2 of the Southeast 1/4 of Section 16, T. 3 S., R. 12 W., and more particularly described as follows: Commencing at a point on the East and West 1/4 line of Section 16, 1,019.05 feet West of East 1/4 post of Section 16; thence South 2°-16'-30" East, 228.13 feet; thence South 67°-37'-30" West, 618.33 feet; thence South 35°-47'-30" West, 89.68 feet for the place of beginning of this description; thence South 54°-22'-30" East, 146.02 feet to a point on the shore of Crooked Lake; thence South 35°-41'-30" West along the shore of said Lake, 46.5 feet; thence North 60°-2' West, 147.24 feet; thence North 35°-47'-30" East, 61 feet to the place of beginning.
Intending to describe Lot 14 of Mendocha Plat (unrecorded).
Together with the right of ingress and egress over the following described 20 foot roadway. Commencing at a point on the East and West 1/4 line, 1,019.05 feet West of the East 1/4 post of Section 16; thence South 2°-16'-30" East, 33 feet for the place of beginning; continuing thence South 2°-16'-30" East, 173.88 feet; thence North 67°-37'-30" East, 130.58 feet; thence South 24°-15'-30" West, 20 feet; thence South 67°-37'-30" West, 765.23 feet; thence South 35°-47'-30" West, 228.28 feet; thence South 21°-52'-30" West, 277.5 feet; thence South 3°-38'-30" West, 365.71 feet; thence North 89°-13'-30" West, 20.06 feet; thence North 3°-38'-30" East, 370.46 feet; thence North 21°-53'-30" East, 283.15 feet; thence North 35°-47'-30" East, 236.17 feet; thence North 67°-37'-30" East, 604.4 feet; thence North 2°-16'-30" West, 181.20 feet; thence West 20 feet to the place of beginning.

LEGEND
o = SET IRON ROD
M = MEASURED AS
R = RECORDED AS
= TREE
= BITUMINOUS PAVEMENT



ROBERT E. SNELL, R.L.S. #9734

BLUE-E:\DRAWINGS\15927

C230-407

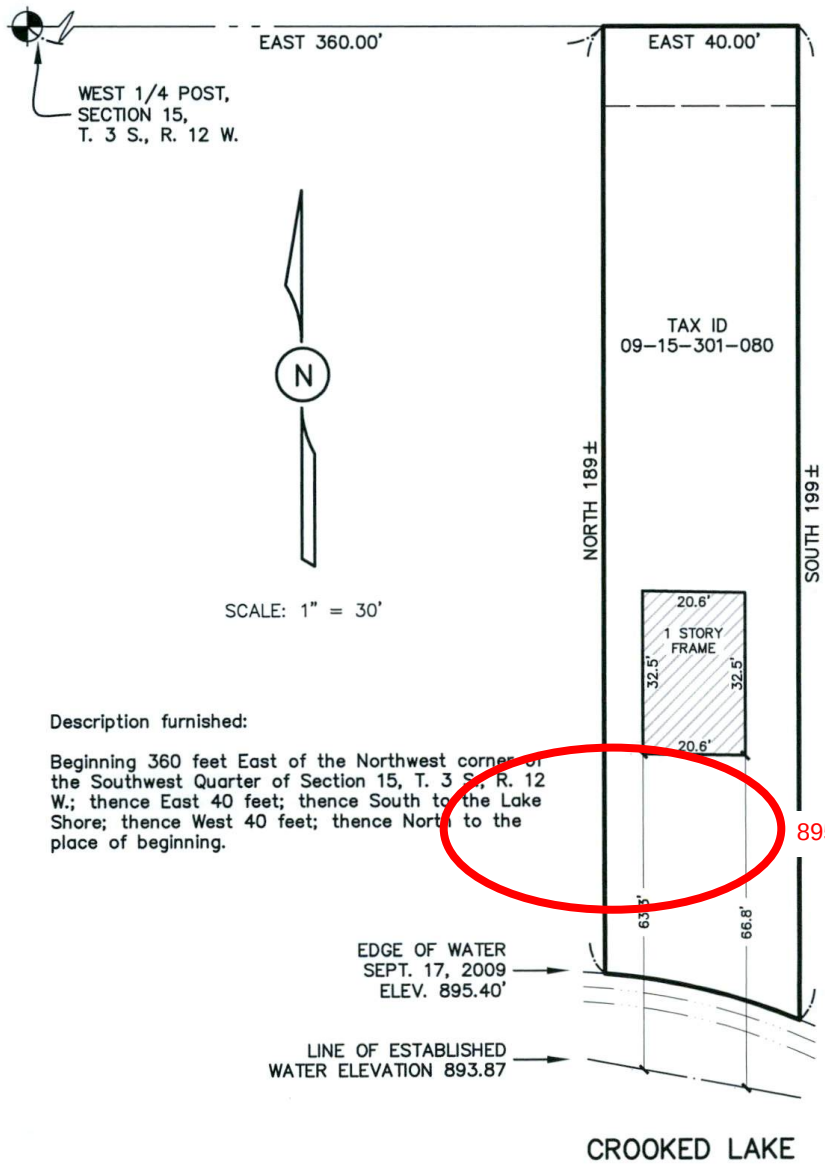
D 270-20

PARCEL SKETCH
FOR
THOMAS & YVONNE PATTEN

LOCATED IN SECTION 15, T. 3 S., R. 12 W.
TEXAS TOWNSHIP, KALAMAZOO COUNTY, MICHIGAN
BY

Prein&Newhof
Engineers ▪ Surveyors ▪ Environmental & Soils Laboratory
7123 STADIUM DRIVE
KALAMAZOO, MICHIGAN 49009
PHONE: (269) 372-1158

SEPTEMBER 28, 2009

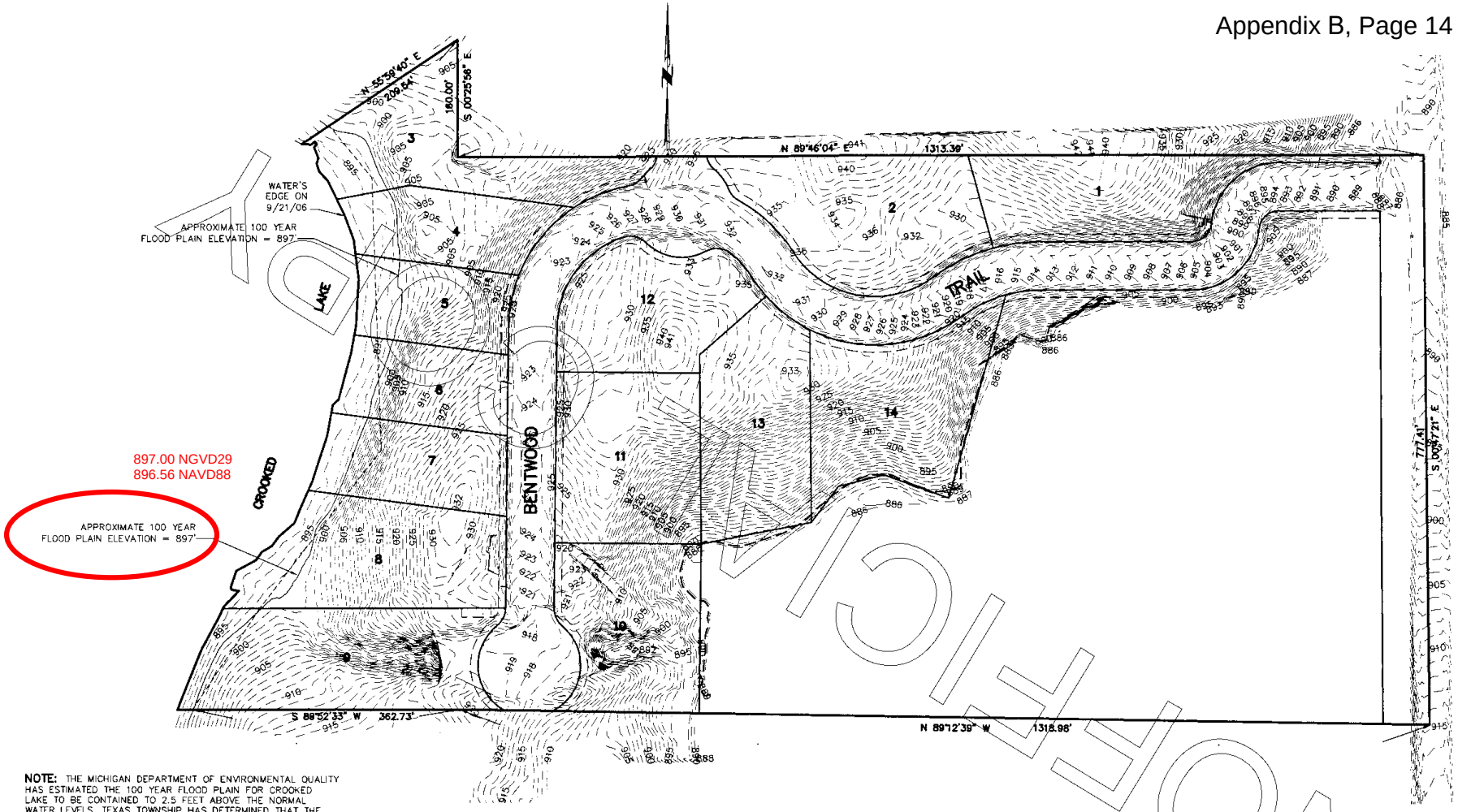


Description furnished:

Beginning 360 feet East of the Northwest corner of the Southwest Quarter of Section 15, T. 3 S., R. 12 W.; thence East 40 feet; thence South to the Lake Shore; thence West 40 feet; thence North to the place of beginning.

T:\CIVIL3D PROJECTS\2009\2090455 THOMAS PATTEN\DWG\2090455.DWG - DLJ - Sep. 25 2009

D 270-20



NOTE: THE MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY HAS ESTIMATED THE 100 YEAR FLOOD PLAIN FOR CROOKED LAKE TO BE CONTAINED TO 2.5 FEET ABOVE THE NORMAL WATER LEVELS. TEXAS TOWNSHIP HAS DETERMINED THAT THE ORDINARY WATER ELEVATION OF CROOKED LAKE IS 893.87 FEET. PER THE MDEQ THE MICHIGAN RESIDENTIAL BUILDING CODE REQUIRES THAT THE LOWEST FLOOR OF A RESIDENTIAL STRUCTURE BE ELEVATED AT LEAST ONE FOOT ABOVE THE DESIGN FLOOD LEVEL. BASEMENT FLOORS THAT ARE BELOW GRADE ON ALL FOUR SIDES SHALL BE ELEVATED TO OR ABOVE THE DESIGN FLOOD LEVEL.

THE CONTOURS SHOWN HEREON SHOULD NOT BE UTILIZED FOR SITE DESIGN PURPOSES

GRAPHIC SCALE
60 0 60 120 180
SCALE: 1" = 60'

BENTWOOD SHORES ON CROOKED LAKE CONDOMINIUM

FLOOD PLAIN PLAN

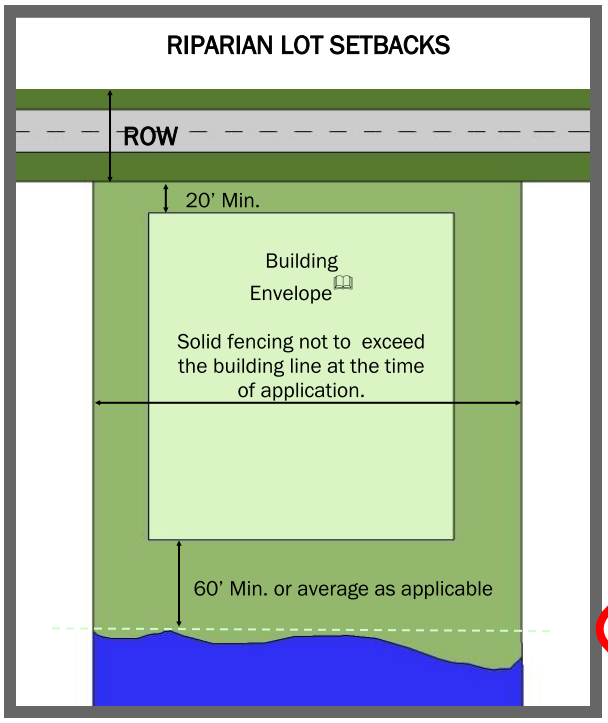
WIGHTMAN WARD, INC.
9835 PORTAGE RD.
PORTAGE, MI 49002

PROPOSED: 10/25/2007
SHEET NO.: 5
DWG. NO.: D-2836

STATE OF MICHIGAN GARY D. HAHN LAND SURVEYOR No. 38116 REGISTERED LAND SURVEYOR

BY GARY D. HAHN
PROFESSIONAL SURVEYOR NO. 38116

2. The required setback shall be measured from the "ordinary water elevation" set out below for each of the listed lakes and ponds. The "benchmark" is a metal cap placed at the elevation listed, and it can be used as a reference point to determine the "ordinary water elevation." For any lake, pond, stream or river not listed below, in the event of a controversy concerning the location of the benchmark from which the required setback shall be measured, the determination of the board of appeals established under this Ordinance shall be conclusive.
3. On the street side of every lot abutting a lake, river or stream, every principal building, and every fence 50% or more solid and every berm shall be set back from the street at least 20'. On the riparian side of the lot, no solid fencing shall be permitted nor any fence greater than 4' in height shall be installed beyond the established building line. Any solid fencing or any fencing greater than 4' in height shall only be permitted between the building line on the riparian side and the 20' setback line on the road side, unless attached to a detached accessory building at the setback line that is 20' from the right of way line, or 18' from the edge of pavement (whichever is less), but never less than 3' from the property line. Solid fencing on side property lines may be measured from the building line for either abutting property. In no instance shall a solid fence be in front of the principal building in the riparian yard or the street-side yard.



36-5.4.2 Elevation Table—DATUM: (NAVID '88)	
Paw Paw Lake:	
Benchmark (Brass Cap): Located on South property line of House #10437, tan frame walkout. 2.65' ENE from flagpole. 10.5'± E of edge of water. 4' NE of NE corner of wood headwall N--245711.8521 ; E--12747534.4031	
Ordinary water elevation--871.59 feet.	Elevation of benchmark--873.06 feet
Pretty Lake:	
Benchmark (Brass Cap): Located at 178 Pretty Lake Drive. 2' S; 2' E of the NW corner of steel sea wall N--256374.4197 ; E--12755284.8662	
Ordinary water elevation--901.51 feet.	Elevation of benchmark--903.76 feet
Crooked Lake:	
Benchmark (Brass Cap): Located at 184 W. Crooked Lake Drive. 2'± N of sea wall; 6'± E of property line. N--None ; E--None	
Ordinary water elevation--893.87 feet	Elevation of benchmark--897.15 feet
Bass Lake: 893.87 NAVD88	
Benchmark (Brass Cap): Located in sandy beach at the foot of the hill of the Cub Camp Administration Building. Go down steps to the N of building to Klepper's Water Front Building. Then from the bottom of the steps to the beach at the N corner of the last concrete step, head W 91'± to monument. Monument is N of face of 12-inch poplar, 14.2', and ENE of face of 12-inch red oak 42'±. N--262380.8431 ; E--12767200.1560	
Ordinary water elevation--883.13 feet	Elevation of benchmark--883.13 feet
Scouter's Pond:	
Ordinary water elevation--879.86 feet (Elevation recorded at outlet control structure invert on NE side of Scouter's Pond.)	
Eagle Lake	
Benchmark (Brass Cap): Located approximately 8 ft east of west property fence, approximately 30 ft south of gravel parking area, approximately 35 ft west of boat ramp, and approximately 69 ft from the south end of the fence. N--265122.70 ; E--12755266.69	
Ordinary water elevation—899.84 feet	Elevation of benchmark—900.92 ft
899.84 NAVD88	

Appendix C

Septic Records

KALAMAZOO COUNTY HEALTH DEPARTMENT

Lk.

pproval is given Modern
n the construction of a Sewage Disposal System

t: 500 East Eagle Lk. Dr.

eptic Tank: Capacity 1500 gal Length _____
Width _____ Depth _____

-y Well: _____ Depth _____ Diam. _____

rench: Block ____ Length ____ Width ____ Depth ____
rench: Tile ____

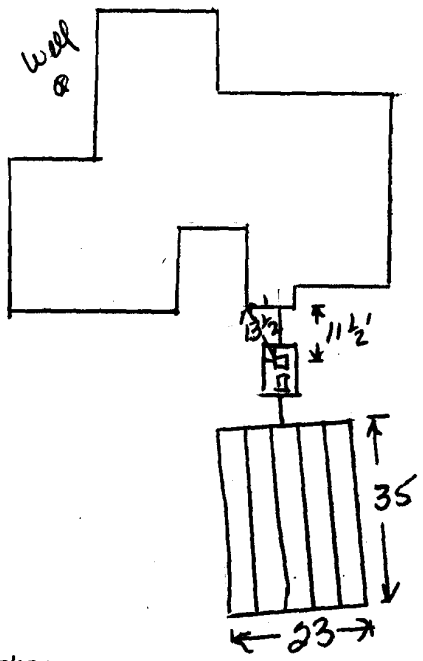
ile Field: V Area 805 Ft.² of Tile Bed

ater Supply: Public _____ Private X

Approved for 4 Bedrooms

Approved for Garbage Grinder - YES ___ NO X

ate: 5-5-86 R. Watkins
Sanitarian



Remarks: Tile Bed 30" above 1st Mottling
#10317
Inspector

FINAL INSPECTION REPORT FOR SEWAGE TREATMENT SYSTEM (S

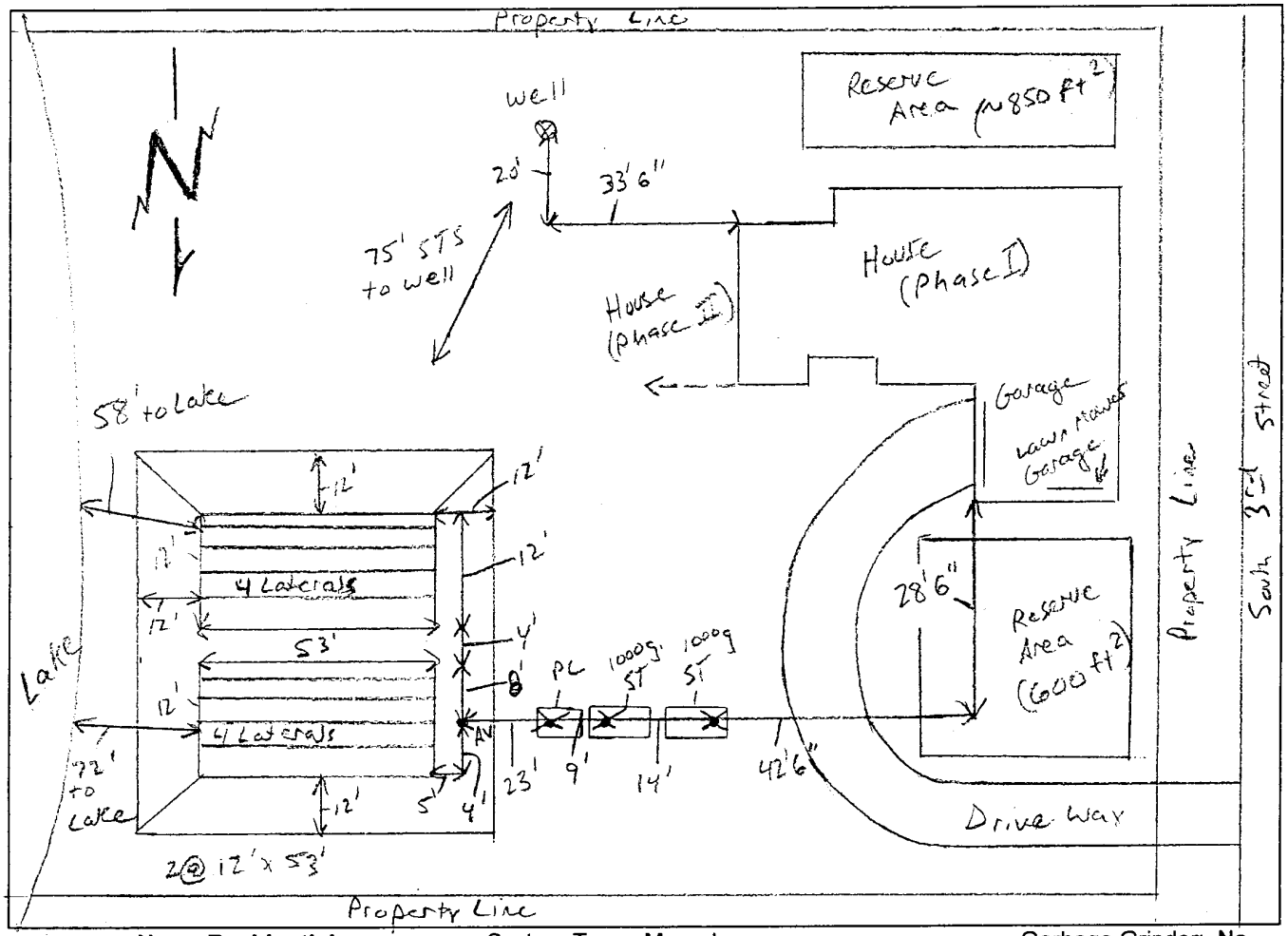
Site Address: 6813 SOUTH 3RD STREET
Texas Township, Section #: 08
Licensed Installer: Suburban Tank Co.
Inspected and Approved By: Lucus Pols JP

Parcel ID: 09-08-476-026
Permit Number: S-12-1277
STS approved for: 5 bedrooms
Final Approval ~~Date~~: November 7, 2013

Comments
In order to meet space requirements for reserve area, this area will need to be split between two areas of property as indicated on drawing. Approximately 3-4' of heavy soils cut out (to loamy sand) and 5.5' of 2NS sand filled to ensure bottom of system is 4' above signs of water (bottom of system 1.5' above grade).

X Existing water well location noted ___ Water well not ~~installed~~ ___ Connected to Municipal Water

Note: Property boundries are based on applicant / owner information; the Environmental Health Division does not confirm property line locations. Drawing of installed STS is a top view with dimensions and isolation distances noted; dimensions are approximations and should ~~not~~ be relied upon as being exact measurements (not to scale).



New - Residential

System Type: Mound		Garbage Grinder: No
# of Septic tanks: 2	Field Size (square feet): 1250	Pump Chamber (gallons): 500
Capacity (gallons): 2000	Final Cover (inches): 6	Effluent filter: Yes
Alternator Valve: Yes	Depth of Stone (inches): 6	Identified Reserve Area: Yes

This system abandoned

KALAMAZOO COUNTY HEALTH DEPARTMENT

ɔval is given A+B
ıe construction of a Sewage Disposal System

6885 S. 3rd

Texas

ic Tank: Capacity 2-1000 Length ____

Width ____ Depth ____

Well: 4 Depth 3' Diam. 8'

ch: Block ____ Length ____ Width ____ Depth ____
ch: Tile ____

Field: ____ Area ____ Ft. of Tile ____

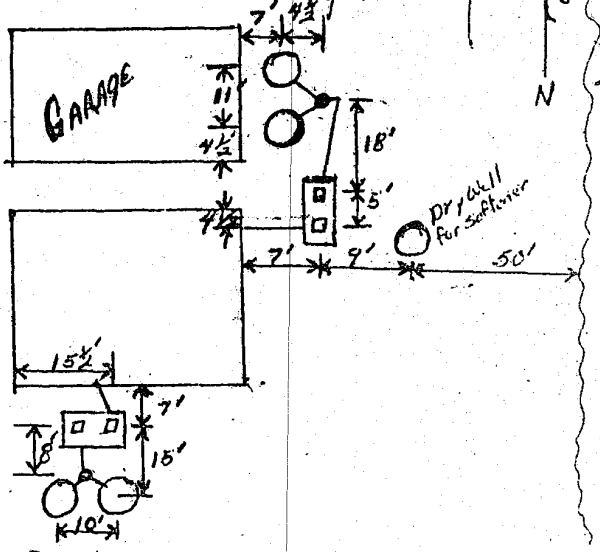
r Supply: Public ____ Private ✓

Approved for 3 Bedrooms

pproved for Garbage Grinder - YES ___ NO ✓

: 8/15/80 James E. Eckert
Sanitarian

A. - V.A. #6032



Remarks:

Equipped with alternator valves

FINAL INSPECTION REPORT

Date Inspection Request Received 9/5/96- 8:15

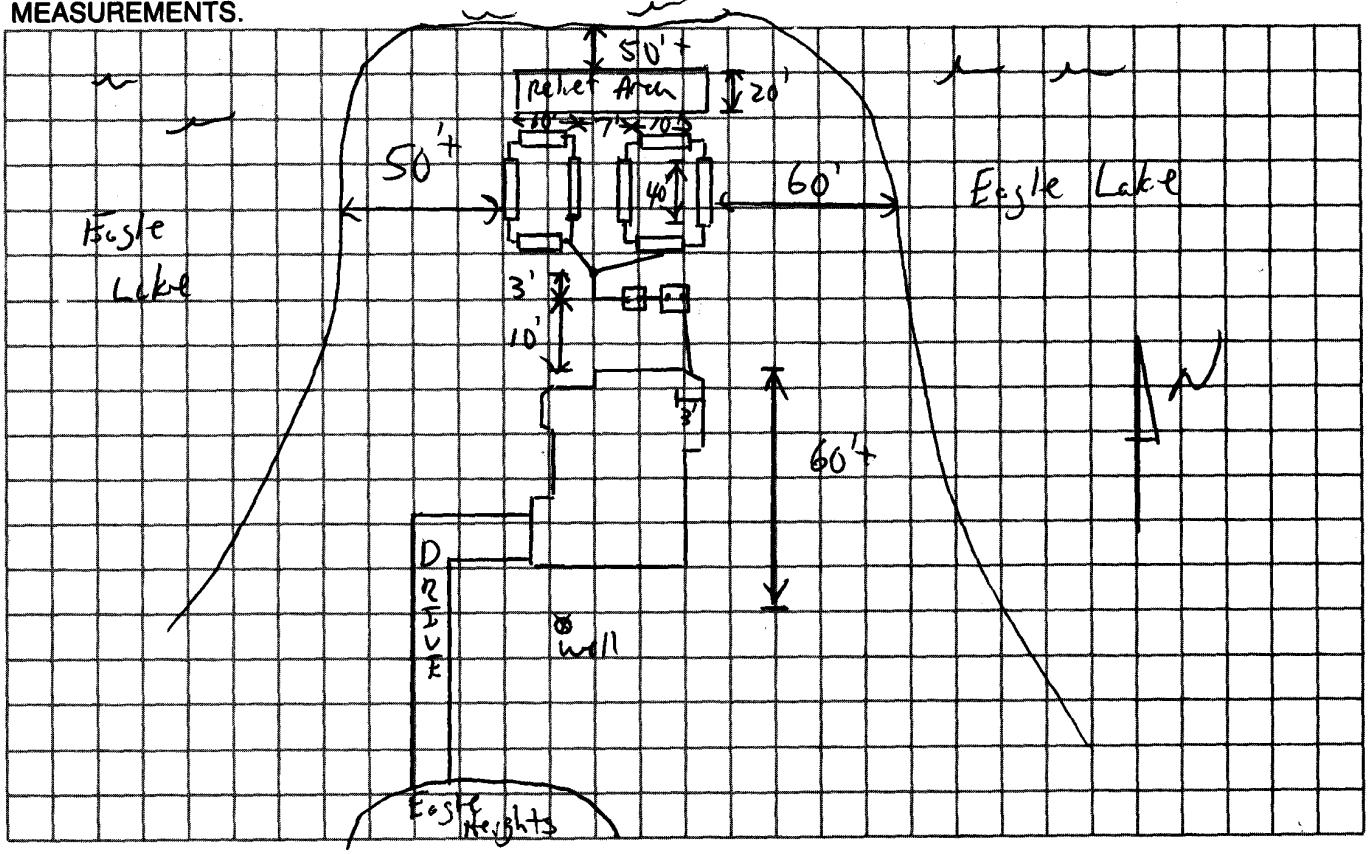
Date (Time) Inspection Requested 9/5/96- 1:00

Name of Installer David

DATE INSPECTED	EHS	FINDINGS
9-4-96	V. Johnson	1-Alternator Valve
		Bottom of SBZ Isolated 4' from
		Seasonal high ground water signs. (Auger)
9-5-96	V. Johnson	200' of SBZ Installed

Drawing of Installed Sewage Disposal System (top view with dimensions and isolation distances noted):

NOTE: BELOW DIMENSIONS ARE APPROXIMATIONS AND SHOULD NOT BE RELIED UPON AS BEING EXACT MEASUREMENTS.



Address: Township:

Specifications of Installed Sewage Disposal System

Septic Tanks: No. 2 and capacity of each 1000 gallons and 500 gallons

☐ TRENCHES	☐ DRAIN BED	☒ OTHER
Area _____ Sq. Ft.	TOTAL _____ Sq. Ft.	Specify 200' of SBZ
Trench Depth _____ Ft.	_____ Ft. X _____ Ft.	
Trench Width _____ Ft.		
Total Linear Ft. of Trench _____ Ft.	No. of Laterals _____	

FINAL INSPECTION REPORT

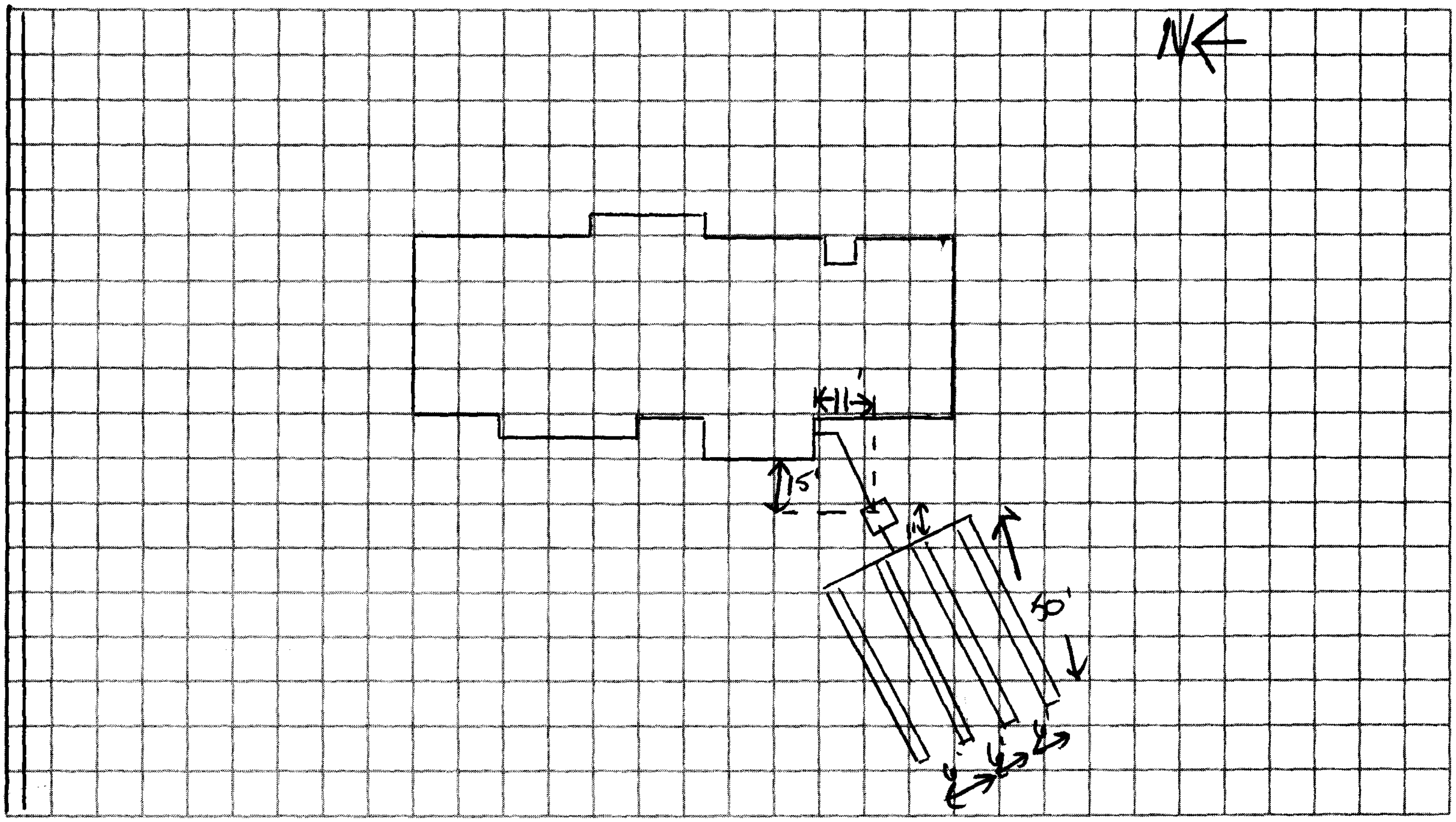
Date Inspection Request Received 12-18-90 3:50

Date (Time) Inspection Requested 12-19-90 Ready when called Anytime

Name of Installer Jim Chapman

DATE INSPECTED	SANITARIAN	FINDINGS
12-19-90	Werner	1-1000 gallon septic tank
		4-50' trenches
		1'd x 3'w

Drawing of Installed Sewage Disposal System (top view with dimensions and isolation distances noted):



Specifications of Installed Sewage Disposal System

Septic Tanks: No. 1 and capacity of each 1000 gallons and ______ gallons

☑ TRENCHES		☐ DRAIN BED	☐ OTHER
Area 600 Sq. Ft.		TOTAL ______ Sq. Ft.	Specify ______
Trench Depth 1 Ft.			
Trench Width 3 Ft.			
Total Linear Ft. of Trench 200 Ft.		______ Ft. X ______ Ft.	
		No. of Laterals ______	

FINAL INSPECTION REPORT

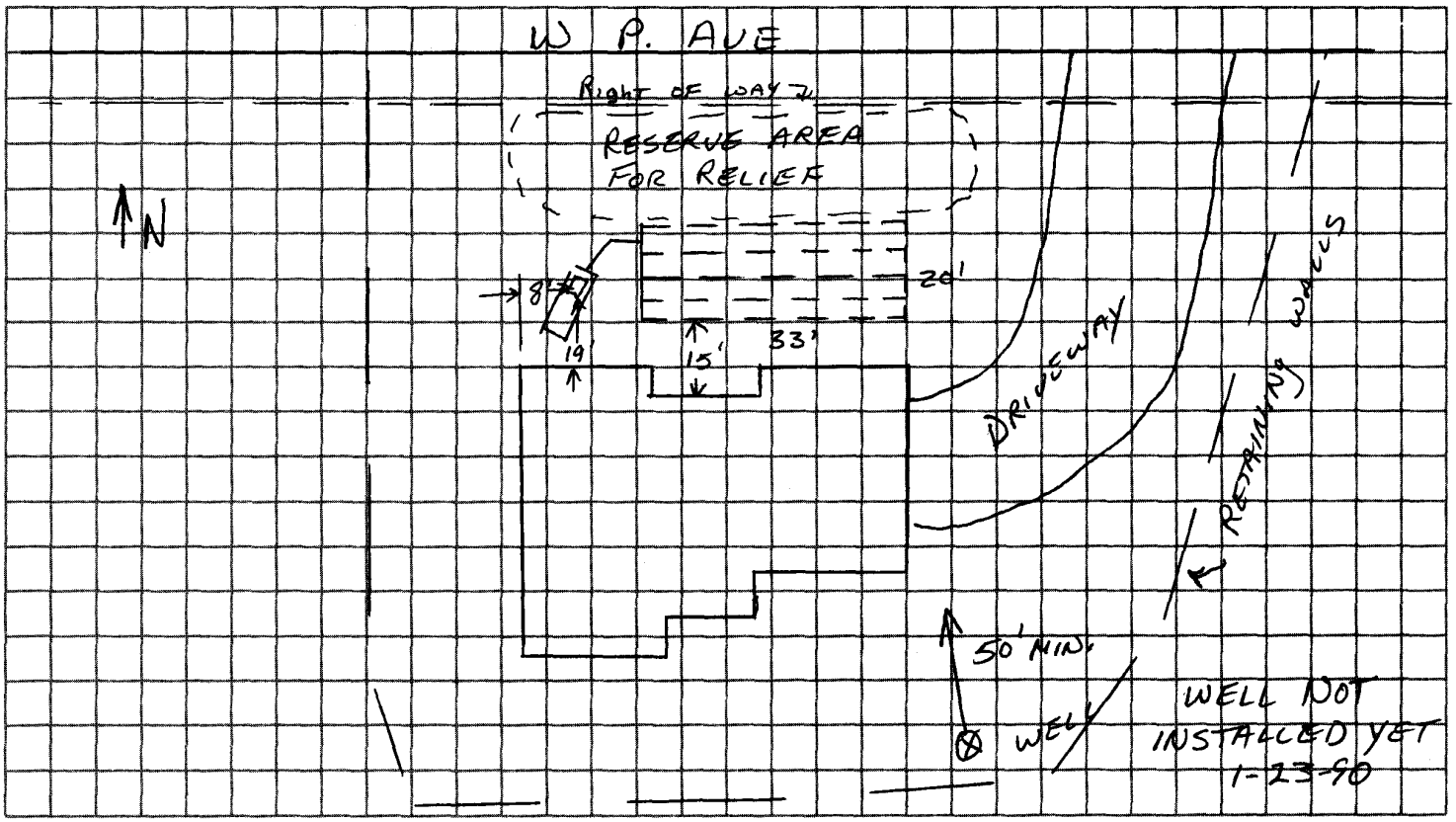
Date Inspection Request Received 1-23-90

Date (Time) Inspection Requested 1-23-90 11:00AM

Name of Installer RICHARDS

DATE INSPECTED	SANITARIAN	FINDINGS
1-23-90	L. Duholt	SYSTEM APPROVED, CONCERN @ WELL LOCATION AND ACCESSABILITY.

Drawing of Installed Sewage Disposal System (top view with dimensions and isolation distances noted):



9303 W P

Specifications of Installed Sewage Disposal System

Septic Tanks: No. 1 and capacity of each 1000 gallons and _____ gallons

☐ TRENCHES	☒ DRAIN BED	☐ OTHER
Area _____ Sq. Ft.	TOTAL 660 Sq. Ft.	Specify _____
Trench Depth _____ Ft.		
Trench Width _____ Ft.		
Total Linear Ft. of Trench _____ Ft.	33' Ft. X 20' Ft.	
	No. of Laterals 5	

8064 west Q Ave?

KALAMAZOO COUNTY HEALTH DEPARTMENT

Approval is given Bill Gibson
on the construction of a Sewage Disposal System

At: W/s "Q" Ave; 3rd lot
West Crooked Lake DR. South
on "Q" Ave

Septic Tank: Capacity 1000 gal Length ____
Width ____ Depth ____

Dry Well: ✓ Depth 7.5 Diam. 7

Trench: Block ____ Length ____ Width ____ Depth ____
Trench: Tile ____

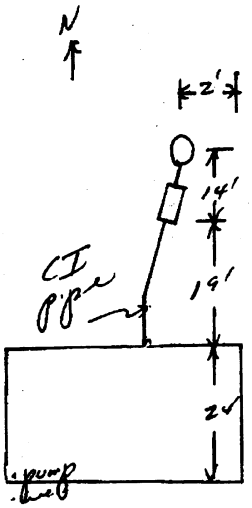
Tile Field: ____ Area ____ Ft. of Tile ____

Water Supply: Public ____ Private ✓

Approved for 3 Bedrooms
Approved for Garbage Grinder - YES ____ NO ✓

Date: 5/22/64 M G Hosmith
Sanitarian

F.H.A. - V.A. ____
H-77



Remarks: ____

CHARTER TOWNSHIP OF TEXAS

ORDINANCE TO AMEND SEWER ORDINANCE

ORDINANCE NO. 328

THE CHARTER TOWNSHIP OF TEXAS ORDAINS:

Section 1. Amendment of Section 32-121 of Article III, "Sewers"

Section 32-121 of the Township Code is hereby amended as follows, with added text indicated by bold-faced text and deleted text stricken:

Sec. 32-121. - Connection charges.

Owners or occupants ~~desiring to connect~~ **connecting** any premises with any sanitary sewer shall pay for such ~~connecting sewer~~ **connection** at a rate to be determined by the township board from time to time.

Section 2. Amendment of Section 32-122 of Article III, "Sewers"

Section 32-122 of the Township Code is hereby amended as follows, with added text indicated by bold-faced text and deleted text stricken:

Sec. 32-122. - Permit to connect generally**; mandatory connections**

(a) Permits for connections with sanitary sewers shall be issued by such person as shall be designated by the township director. Such a permit shall not be issued until **(i) all charges for a sewer connection have been paid in full or, if the township agrees to specially assess for the public improvement, including connection charges, then only after the special assessment roll is confirmed by the township board; and (ii)** ~~all assessments due and the charge for sewer connections have been paid and until~~ the director has determined that there is capacity available for the wastewater to be discharged in all downstream sewers, lift stations, force mains, and compatible wastes.

(b) The director may require from any proposed user or from any existing user who is altering the composition of the wastewater a compatibility study to demonstrate to the satisfaction of the director that the wastewater to be discharged is compatible with the existing wastewater system, and will not adversely affect the wastewater system. Such study shall be at the expense of the user.

(c) Structures in which sanitary sewage originates for which there is an available public sanitary sewer system shall not be used or occupied unless said structures are connected to the public sanitary sewer system; provided, however, that structures in which sanitary sewage is originating on the effective date of this Ordinance shall be connected to said system within five (5) years

Appendix D

GEI Downstream Effects Report

Memo

To: Tom Wheat, Prein and Newhof (P&N)

From: Steve Rice, CWB, GEI Consultants of Michigan, P.C. (GEI)

Date: October 15, 2020

Re: Pumping Versus Proposed Water Control Structure: A Qualitative Comparison of Potential Impacts to Wetland Vegetation and Geomorphology of Receiving Waters, Texas Township, Kalamazoo County, Michigan.

INTRODUCTION

Over the last several years, Texas Township has experienced a significant increase in groundwater elevation in the vicinity of Eagle and Crooked Lakes. There are no natural outlets to these lakes, and the residents in these areas have been experiencing ongoing flooding. The Michigan Department of Environment, Great Lakes, and Energy (EGLE – formerly the Michigan Department of Environmental Quality) issued a permit in 2019 allowing Texas Township to pump water from Eagle Lake to Crooked Lake and from Crooked Lake to Bass Lake, which has a natural outlet, in an attempt to lower the local groundwater and provide relief to flooded residents.

The 2019 EGLE permit allows Texas Township to pump water at a rate not to exceed 2,000 gallons per minute (gpm), but requires the Township to monitor wetland vegetation downstream of the pumping outlet to evaluate changes in vegetation condition and health that may be associated with pumping activities. In May 2019, GEI Consultants of Michigan, P.C. (GEI) was contracted to conduct weekly monitoring, and data from these monitoring events are reviewed by EGLE to evaluate potential impacts and modify pumping rates.

Based on our understanding at this time, there is a proposal to eliminate the pumping system and replace it with a permanent water control structure. GEI has been requested to complete a qualitative comparison of potential impacts to wetland vegetation and geomorphology of receiving waters downstream from pumping versus a proposed water control structure. This memo is intended to provide a summary of our qualitative comparison.

METHODS

To evaluate the potential impacts associated with pumping versus the proposed water control structure, GEI obtained/reviewed the following data to complete a comparison. First, GEI completed a site visit on September 15, 2020, to qualitatively assess wetland vegetation and bank stability along the downstream water course. GEI qualitatively assessed the current vegetation (type and health) and, where appropriate, visually inspected the seven EGLE selected representative sites for signs of erosion, sedimentation, and bank instability. The following locations were assessed:

1. Crooked Lake existing pump outfall structure
2. South 8th Street culvert (near weekly monitoring Site 7)

GEI Consultants, Inc.
5225 Edgewater Drive, Allendale, MI 49401
616.384.2710
www.geiconsultants.com

3. Bass Lake outlet
4. Boy Scout Road culvert
5. El Sabo Land Preserve culvert
6. South 12th Street culvert
7. Angling Road (Sunvalley Drive) culvert

GEI then reviewed results of a hydrological evaluation completed by Prein and Newhof (P&N). This evaluation compared discharge rates from the actual Crooked Lake pump discharge to the proposed Crooked Lake water control structure. Review of this data focused on how proposed discharge from the water control structure compared to actual discharge from pumping.

Finally, GEI reviewed data from the weekly vegetative and hydrologic monitoring events. As noted above, the purpose of these weekly assessments has been to document changes in vegetative condition and health following the initiation of pumping. Review of this data focused on a qualitative assessment as to how discharge from the proposed water control structure compares to actual discharge rates from the pump and how this difference may affect vegetation health.

RESULTS

September 15, 2020 Site Visit

The Crooked Lake existing pump outfall structure consists of a rip-rap pad immediately below the pump outlet pipe, surrounded by an area of dense giant reed (*Phragmites australis*) (Appendix A). There were no signs of erosion. However, it is important to note that this discharge point is located within the same wetland system as weekly vegetation monitoring Sites 6 and 7, and the weekly wetland vegetation monitoring noted signs of stress in both 2019 and 2020.

The South 8th Street culvert is immediately adjacent to weekly vegetation monitoring Site 7 and consists of a grated culvert under South 8th Street (Appendix A). At the time of this site visit (and as noted in the weekly monitoring reports), there was a consistent flow of water through this culvert, but there were no signs of erosion. However, as noted above, the weekly vegetation monitoring noted signs of stress in both 2019 and 2020.

The Bass Lake outlet consists of a culvert and short stream segment between the outlet and Boy Scout Road (Appendix A). There were no signs of erosion or vegetation stress at this location. In addition, review of pre-pumping and current photographs of this area show no apparent signs of geomorphological changes (erosion, increased bank instability, or sediment accretion or deposition).

Like the Bass Lake outlet, the Boy Scout Road culvert consists of a culvert and short stream segment from the culvert to a large wetland complex downstream (Appendix A). There were no signs of erosion or vegetation stress at this location. In addition, review of pre-pumping and current photographs of this area show no apparent signs of geomorphological changes (erosion, increased bank instability, or sediment accretion or deposition).

The El Sabo Land Preserve culvert is located under a service road that is approximately 10 feet above the wetland (Appendix A). The wetland upstream of the outlet consists of an emergent wetland with a fringe of scrub-shrub. Downstream of the culvert, there is a more defined channel (stream/creek) that flows through a wetland complex that includes emergent, scrub-shrub, and forested wetlands. The vegetation within the upstream emergent wetland appears to be dominated by cattails (*Typha* spp.) and swamp loosestrife (*Decodon verticillatus*) while the surrounding scrub-shrub wetland contains red maple (*Acer rubrum*), sassafras (*Sassafras albidum*), box-elder (*Acer negundo*), and reed canary grass (*Phalaris arundinacea*). There were no signs of erosion or vegetation stress at this location.

Both the South 12th Street and Angling Road (Sunvalley Drive) culverts are located in residential areas (Appendix A). The South 12th Street culvert site has been landscaped as part of the adjacent yard and it appears that work has been completed in the area within the last year. The vegetation in this area included cattails, swamp loosestrife, box-elder, purple loosestrife (*Lythrum salicaria*), touch-me-not (*Impatiens capensis*), glossy buckthorn (*Frangula alnus*), and cottonwood (*Populus deltoides*). There were no signs of erosion or vegetation stress at this location.

The Angling Road culvert is associated with a channelized creek with a fringe of aquatic wetland plants including arrow-arum (*Peltandra virginica*) and waterlilies (*Nymphaea* spp.) (Appendix A). The area immediately adjacent to the culvert is dominated by oriental bittersweet (*Celastrus orbiculatus*) and Virginia creeper (*Parthenocissus quinquefolia*). There were no signs of erosion or vegetation stress at this location.

P&N Hydrological Evaluation

The hydrological evaluation completed by P&N indicates that the proposed Crooked Lake outfall structure discharge will be consistently less than the discharge from current pumping activities (Figure 1). The evaluation also indicates that the proposed discharge will more closely mimic a natural system with increased discharge after rain events, seasonal fluctuations, and an inconsistent peak discharge.

GEI Weekly Monitoring

Review of the weekly monitoring data appears to be inconclusive as to the source of impact (pumping vs. regional increase in ground water elevations) to wetland vegetation at the monitoring sites. The 2019 data noted vegetation stress, but with no comparison wetlands, the source of stress was inconclusive and although 2020 monitoring included two "control" sites, in GEI's opinion, the source of impact remained inconclusive. During the 2020 monitoring, vegetation stress was noted at the seven original monitoring sites approximately one week prior to similar stress being observed at the "control" sites.

CONCLUSIONS

Upon review of the information identified above, it is GEI's opinion that the proposed water control structure will not increase the potential for impacts to wetland vegetation and/or the geomorphic stability of the downstream receiving waters. Instead, the P&N hydrological evaluation indicates that peak discharge from the proposed outfall structure will be less than

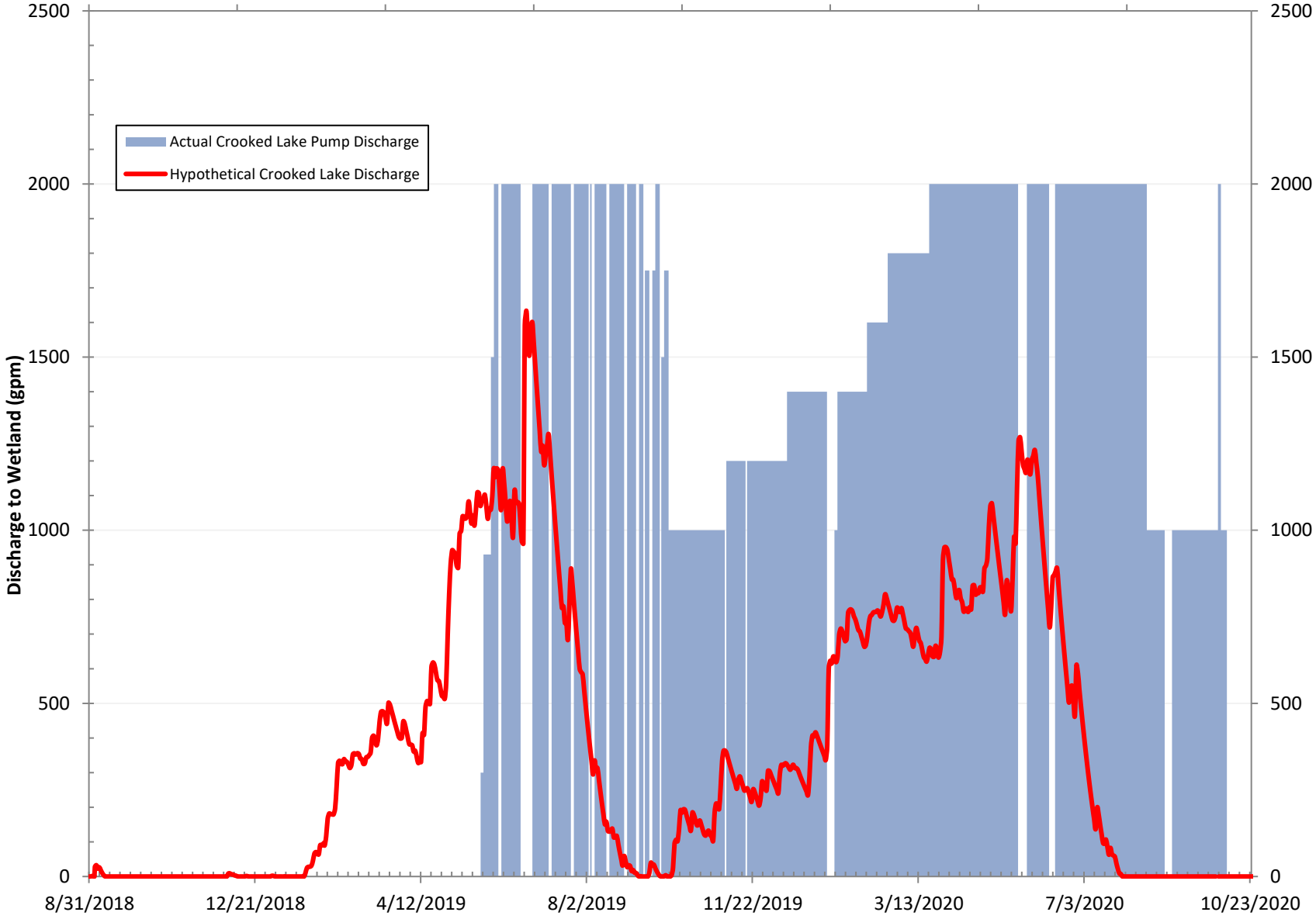
that of pumping, will promote seasonal and weather dependent variability, and will more closely mimic a natural system.

Attachments
Figure 1: P&N Hydrological Evaluation
Appendix A: Site Photographs

Charter Township of Texas Flood Study

Figure

Hypothetical Crooked Lake Discharge with Long Term Infrastructure in Place



Appendix A: Site Photographs

Photo 1. Crooked Lake Outfall Structure: 9/15/2020

Photo 2. Crooked Lake Outfall Structure: 9/15/2020

Photo 3. East side of S. 8th Street Culvert: 9/15/2020

Photo 4. East side of S. 8th Street Culvert: 9/15/2020

Photo 5. Bass Lake Outlet: 9/15/2020

Photo 6. Bass Lake Outlet: 9/15/2020

Photo 7. Bass Lake Outlet: 5/2019

Photo 8. Bass Lake Outlet: 6/2019

Photo 9. Boy Scout Road Culvert: 9/15/2020

Photo 10. Boy Scout Road Culvert: 9/15/2020

Photo 11. Boy Scout Road Culvert: 6/2019

Photo 12. El Sabo Land Preserve Culvert: 9/15/2020

Photo 13. El Sabo Land Preserve Culvert: 9/15/2020

Photo 14. S. 12th Street Culvert: 9/15/2020

Photo 15. S. 12th Street Culvert: 9/15/2020

Photo 16. S. 12th Street Culvert: 9/15/2020

Photo 17. Angling Road Culvert: 9/15/2020

Photo 18. Angling Road Culvert: 9/15/2020

Photo 19. Angling Road Culvert: 9/15/2020

Photo 20. Angling Road Culvert: 9/15/2020

Photo 21. Angling Road Culvert: 9/15/2020

Appendix E

Endangered Species Review

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Michigan Ecological Services Field Office
2651 Coolidge Road Suite 101
East Lansing, MI 48823-6360
Phone: (517) 351-2555 Fax: (517) 351-1443
http://www.fws.gov/midwest/endangered/section7/s7process/step1.html

In Reply Refer To: March 28, 2020
Consultation Code: 03E16000-2020-SLI-0760
Event Code: 03E16000-2020-E-02239
Project Name: Crooked Lake and Eagle Lake Permanent Gravity Outlets

Subject: List of threatened and endangered species that may occur in your proposed project location, and/or may be affected by your proposed project

To Whom It May Concern:

The attached species list identifies any federally threatened, endangered, proposed and candidate species that may occur within the boundary of your proposed project or may be affected by your proposed project. The list also includes designated critical habitat if present within your proposed project area or affected by your project. This list is provided to you as the initial step of the consultation process required under section 7(c) of the Endangered Species Act, also referred to as Section 7 Consultation.

Section 7 of the Endangered Species Act of 1973 requires that actions authorized, funded, or carried out by Federal agencies not jeopardize federally threatened or endangered species or adversely modify designated critical habitat. To fulfill this mandate, Federal agencies (or their designated non-federal representative) must consult with the Fish and Wildlife Service if they determine their project may affect listed species or critical habitat.

There are several important steps in evaluating the effects of a project on listed species. Please use the species list provided and visit the U.S. Fish and Wildlife Service's Region 3 Section 7 Technical Assistance website at http://www.fws.gov/midwest/endangered/section7/s7process/index.html. This website contains step-by-step instructions to help you determine if your project may affect listed species and lead you through the section 7 consultation process.

Under 50 CFR 402.12(e) (the regulations that implement section 7 of the Endangered Species Act), the accuracy of this species list should be verified after 90 days. You may verify the list by visiting the ECOS-IPaC website (http://ecos.fws.gov/ipac/) at regular intervals during project planning and implementation and completing the same process you used to receive the attached list.

For all **wind energy projects** and **projects that include installing towers that use guy wires or are over 200 feet in height**, please contact this field office directly for assistance, even if no federally listed plants, animals or critical habitat are present within your proposed project area or may be affected by your proposed project.

Please see the "Migratory Birds" section below for important information regarding incorporating migratory birds into your project planning. Our Migratory Bird Program has developed recommendations, best practices, and other tools to help project proponents voluntarily reduce impacts to birds and their habitats. The Bald and Golden Eagle Protection Act prohibitions include the take and disturbance of eagles. If your project is near an eagle nest or winter roost area, see our Eagle Permits website at https://www.fws.gov/midwest/eagle/permits/index.html to help you avoid impacting eagles or determine if a permit may be necessary.

Executive Order 13186: *Responsibilities of Federal Agencies to Protect Migratory Birds*, obligates all Federal agencies that engage in or authorize activities that might affect migratory birds, to minimize those effects and encourage conservation measures that will improve bird populations. Executive Order 13186 provides for the protection of both migratory birds and migratory bird habitat. For information regarding the implementation of Executive Order 13186, please visit https://www.fws.gov/birds/policies-and-regulations/administrative-orders/executive-orders.php.

We appreciate your concern for threatened and endangered species. Please include the Consultation Tracking Number in the header of this letter with any request for consultation or correspondence about your project that you submit to our office.

Attachment(s):

- Official Species List
- USFWS National Wildlife Refuges and Fish Hatcheries
- Migratory Birds
- Wetlands

Official Species List

This list is provided pursuant to Section 7 of the Endangered Species Act, and fulfills the requirement for Federal agencies to "request of the Secretary of the Interior information whether any species which is listed or proposed to be listed may be present in the area of a proposed action".

This species list is provided by:

Michigan Ecological Services Field Office
2651 Coolidge Road Suite 101
East Lansing, MI 48823-6360
(517) 351-2555

Project Summary

Consultation Code: 03E16000-2020-SLI-0760

Event Code: 03E16000-2020-E-02239

Project Name: Crooked Lake and Eagle Lake Permanent Gravity Outlets

Project Type: LAND - FLOODING

Project Description: The project includes the construction of a positive outlet on Crooked Lake and Eagle Lake to provide flood relief during periods of high groundwater/high lake levels. The lake bottom provides a natural filter and perforated pipe is proposed adjacent to the lake to collect water. A control structure is located near the lake with a weir structure, which allows water to flow over the top when the lake levels rise above the design level. Once over the weir, the water flows by gravity to the outlet. This concept would be applied for each of Crooked and Eagle Lake.

Project Location: Texas Township, Kalamazoo County, Michigan
Project Timing: Permitting - construction estimated 2020-2021
Project Scope: Install storm sewer (500' of 8" pipe open trench x 10' wide x 8' deep), (800' of 12" pipe directional bore x 6' wide x 8'-38' deep) and (2,700' of 12" pipe open trench x 10' wide x 8'-30' deep)

Project Location:

Approximate location of the project can be viewed in Google Maps: https://www.google.com/maps/place/42.20985997334812N85.71325343043421W

Counties: Kalamazoo, MI

Endangered Species Act Species

There is a total of 5 threatened, endangered, or candidate species on this species list.

Species on this list should be considered in an effects analysis for your project and could include species that exist in another geographic area. For example, certain fish may appear on the species list because a project could affect downstream species. Note that 1 of these species should be considered only under certain conditions.

IPaC does not display listed species or critical habitats under the sole jurisdiction of NOAA Fisheries[1], as USFWS does not have the authority to speak on behalf of NOAA and the Department of Commerce.

See the "Critical habitats" section below for those critical habitats that lie wholly or partially within your project area under this office's jurisdiction. Please contact the designated FWS office if you have questions.

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1. NOAA Fisheries, also known as the National Marine Fisheries Service (NMFS), is an office of the National Oceanic and Atmospheric Administration within the Department of Commerce.

Mammals

NAME	STATUS
Indiana Bat *Myotis sodalis* There is **final** critical habitat for this species. Your location is outside the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/5949 General project design guidelines: https://ecos.fws.gov/ipac/guideline/design/population/1/office/31410.pdf	Endangered
Northern Long-eared Bat *Myotis septentrionalis* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/9045 General project design guidelines: https://ecos.fws.gov/ipac/guideline/design/population/10043/office/31410.pdf	Threatened

Reptiles

NAME	STATUS
Eastern Massasauga (=rattlesnake) *Sistrurus catenatus*	Threatened

No critical habitat has been designated for this species.

This species only needs to be considered under the following conditions:

- All Projects: Tier 2 EMR Habitat Present
- All Projects: Project is Within EMR Range

Species profile: https://ecos.fws.gov/ecp/species/2202

General project design guidelines:
https://ecos.fws.gov/ipac/guideline/design/population/7800/office/31410.pdf

Clams

NAME	STATUS
Snuffbox Mussel *Epioblasma triquetra*	Endangered

No critical habitat has been designated for this species.

Species profile: https://ecos.fws.gov/ecp/species/4135

Species survey guidelines:
https://ecos.fws.gov/ipac/guideline/survey/population/5281/office/31410.pdf

Insects

NAME	STATUS
Mitchell's Satyr Butterfly *Neonympha mitchellii mitchellii*	Endangered

No critical habitat has been designated for this species.

Species profile: https://ecos.fws.gov/ecp/species/8062

Critical habitats

THERE ARE NO CRITICAL HABITATS WITHIN YOUR PROJECT AREA UNDER THIS OFFICE'S JURISDICTION.

USFWS National Wildlife Refuge Lands And Fish Hatcheries

Any activity proposed on lands managed by the National Wildlife Refuge system must undergo a 'Compatibility Determination' conducted by the Refuge. Please contact the individual Refuges to discuss any questions or concerns.

THERE ARE NO REFUGE LANDS OR FISH HATCHERIES WITHIN YOUR PROJECT AREA.

Migratory Birds

Certain birds are protected under the Migratory Bird Treaty Act[1] and the Bald and Golden Eagle Protection Act[2].

Any person or organization who plans or conducts activities that may result in impacts to migratory birds, eagles, and their habitats should follow appropriate regulations and consider implementing appropriate conservation measures, as described below.

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1. The Migratory Birds Treaty Act of 1918.
2. The Bald and Golden Eagle Protection Act of 1940.
3. 50 C.F.R. Sec. 10.12 and 16 U.S.C. Sec. 668(a)

The birds listed below are birds of particular concern either because they occur on the USFWS Birds of Conservation Concern (BCC) list or warrant special attention in your project location. To learn more about the levels of concern for birds on your list and how this list is generated, see the FAQ below. This is not a list of every bird you may find in this location, nor a guarantee that every bird on this list will be found in your project area. To see exact locations of where birders and the general public have sighted birds in and around your project area, visit the E-bird data mapping tool (Tip: enter your location, desired date range and a species on your list). For projects that occur off the Atlantic Coast, additional maps and models detailing the relative occurrence and abundance of bird species on your list are available. Links to additional information about Atlantic Coast birds, and other important information about your migratory bird list, including how to properly interpret and use your migratory bird report, can be found below.

For guidance on when to schedule activities or implement avoidance and minimization measures to reduce impacts to migratory birds on your list, click on the PROBABILITY OF PRESENCE SUMMARY at the top of your list to see when these birds are most likely to be present and breeding in your project area.

NAME	BREEDING SEASON
Bald Eagle *Haliaeetus leucocephalus* This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities. https://ecos.fws.gov/ecp/species/1626	Breeds Dec 1 to Aug 31
Red-headed Woodpecker *Melanerpes erythrocephalus* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.	Breeds May 10 to Sep 10

NAME	BREEDING SEASON
Willow Flycatcher *Empidonax traillii* This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA https://ecos.fws.gov/ecp/species/3482	Breeds May 20 to Aug 31
Wood Thrush *Hylocichla mustelina* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.	Breeds May 10 to Aug 31

Probability Of Presence Summary

The graphs below provide our best understanding of when birds of concern are most likely to be present in your project area. This information can be used to tailor and schedule your project activities to avoid or minimize impacts to birds. Please make sure you read and understand the FAQ “Proper Interpretation and Use of Your Migratory Bird Report” before using or attempting to interpret this report.

Probability of Presence (■)

Each green bar represents the bird's relative probability of presence in the 10km grid cell(s) your project overlaps during a particular week of the year. (A year is represented as 12 4-week months.) A taller bar indicates a higher probability of species presence. The survey effort (see below) can be used to establish a level of confidence in the presence score. One can have higher confidence in the presence score if the corresponding survey effort is also high.

How is the probability of presence score calculated? The calculation is done in three steps:

1. The probability of presence for each week is calculated as the number of survey events in the week where the species was detected divided by the total number of survey events for that week. For example, if in week 12 there were 20 survey events and the Spotted Towhee was found in 5 of them, the probability of presence of the Spotted Towhee in week 12 is 0.25.
2. To properly present the pattern of presence across the year, the relative probability of presence is calculated. This is the probability of presence divided by the maximum probability of presence across all weeks. For example, imagine the probability of presence in week 20 for the Spotted Towhee is 0.05, and that the probability of presence at week 12 (0.25) is the maximum of any week of the year. The relative probability of presence on week 12 is 0.25/0.25 = 1; at week 20 it is 0.05/0.25 = 0.2.
3. The relative probability of presence calculated in the previous step undergoes a statistical conversion so that all possible values fall between 0 and 10, inclusive. This is the probability of presence score.

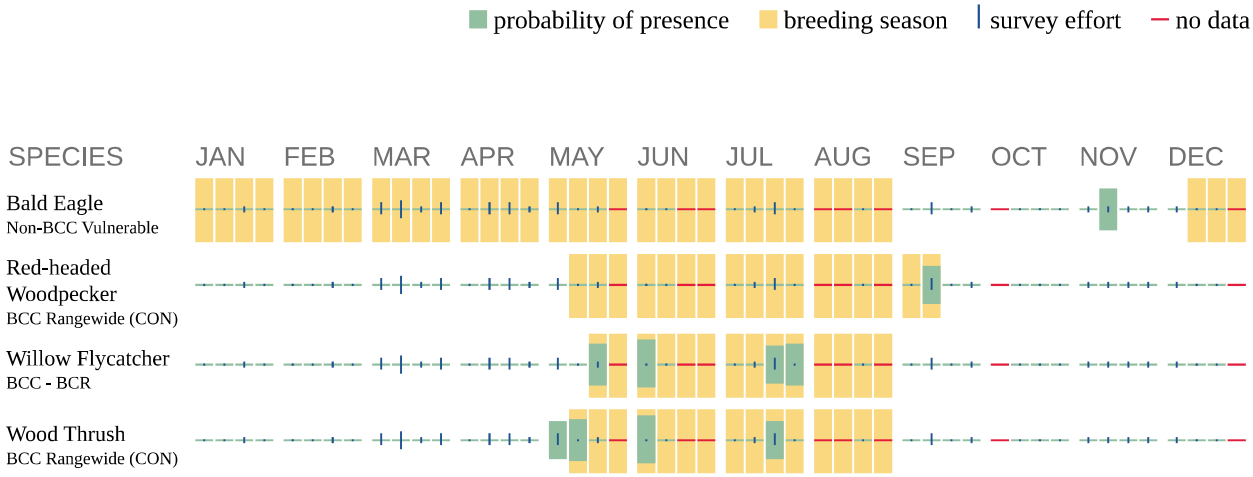
Breeding Season (■)

Yellow bars denote a very liberal estimate of the time-frame inside which the bird breeds across its entire range. If there are no yellow bars shown for a bird, it does not breed in your project area.

Survey Effort (|)
Vertical black lines superimposed on probability of presence bars indicate the number of surveys performed for that species in the 10km grid cell(s) your project area overlaps. The number of surveys is expressed as a range, for example, 33 to 64 surveys.

No Data (–)
A week is marked as having no data if there were no survey events for that week.

Survey Timeframe
Surveys from only the last 10 years are used in order to ensure delivery of currently relevant information. The exception to this is areas off the Atlantic coast, where bird returns are based on all years of available data, since data in these areas is currently much more sparse.



Additional information can be found using the following links:

- Birds of Conservation Concern http://www.fws.gov/birds/management/managed-species/birds-of-conservation-concern.php
- Measures for avoiding and minimizing impacts to birds http://www.fws.gov/birds/management/project-assessment-tools-and-guidance/conservation-measures.php
- Nationwide conservation measures for birds http://www.fws.gov/migratorybirds/pdf/management/nationwidestandardconservationmeasures.pdf

Migratory Birds FAQ

Tell me more about conservation measures I can implement to avoid or minimize impacts to migratory birds.
Nationwide Conservation Measures describes measures that can help avoid and minimize impacts to all birds at any location year round. Implementation of these measures is particularly important when birds are most likely to occur in the project area. When birds may be breeding in the area, identifying the locations of any active nests and avoiding their destruction is a very helpful impact minimization measure. To see when birds are most likely to occur and be breeding in your project area, view the Probability of Presence Summary. Additional measures and/or permits may be advisable depending on the type of activity you are conducting and the type of infrastructure or bird species present on your project site.

What does IPaC use to generate the migratory birds potentially occurring in my specified location?
The Migratory Bird Resource List is comprised of USFWS Birds of Conservation Concern (BCC) and other species that may warrant special attention in your project location.

The migratory bird list generated for your project is derived from data provided by the Avian Knowledge Network (AKN). The AKN data is based on a growing collection of survey, banding, and citizen science datasets and is queried and filtered to return a list of those birds reported as occurring in the 10km grid cell(s) which your project intersects, and that have been identified as warranting special attention because they are a BCC species in that area, an eagle (Eagle Act requirements may apply), or a species that has a particular vulnerability to offshore activities or development.

Again, the Migratory Bird Resource list includes only a subset of birds that may occur in your project area. It is not representative of all birds that may occur in your project area. To get a list of all birds potentially present in your project area, please visit the AKN Phenology Tool.

What does IPaC use to generate the probability of presence graphs for the migratory birds potentially occurring in my specified location?
The probability of presence graphs associated with your migratory bird list are based on data provided by the Avian Knowledge Network (AKN). This data is derived from a growing collection of survey, banding, and citizen science datasets .

Probability of presence data is continuously being updated as new and better information becomes available. To learn more about how the probability of presence graphs are produced and how to interpret them, go the Probability of Presence Summary and then click on the "Tell me about these graphs" link.

How do I know if a bird is breeding, wintering, migrating or present year-round in my project area?
To see what part of a particular bird's range your project area falls within (i.e. breeding, wintering, migrating or year-round), you may refer to the following resources: The Cornell Lab of Ornithology All About Birds Bird Guide, or (if you are unsuccessful in locating the bird of

interest there), the Cornell Lab of Ornithology Neotropical Birds guide. If a bird on your migratory bird species list has a breeding season associated with it, if that bird does occur in your project area, there may be nests present at some point within the timeframe specified. If "Breeds elsewhere" is indicated, then the bird likely does not breed in your project area.

What are the levels of concern for migratory birds?
Migratory birds delivered through IPaC fall into the following distinct categories of concern:

1. "BCC Rangewide" birds are Birds of Conservation Concern (BCC) that are of concern throughout their range anywhere within the USA (including Hawaii, the Pacific Islands, Puerto Rico, and the Virgin Islands);
2. "BCC - BCR" birds are BCCs that are of concern only in particular Bird Conservation Regions (BCRs) in the continental USA; and
3. "Non-BCC - Vulnerable" birds are not BCC species in your project area, but appear on your list either because of the Eagle Act requirements (for eagles) or (for non-eagles) potential susceptibilities in offshore areas from certain types of development or activities (e.g. offshore energy development or longline fishing).

Although it is important to try to avoid and minimize impacts to all birds, efforts should be made, in particular, to avoid and minimize impacts to the birds on this list, especially eagles and BCC species of rangewide concern. For more information on conservation measures you can implement to help avoid and minimize migratory bird impacts and requirements for eagles, please see the FAQs for these topics.

Details about birds that are potentially affected by offshore projects
For additional details about the relative occurrence and abundance of both individual bird species and groups of bird species within your project area off the Atlantic Coast, please visit the Northeast Ocean Data Portal. The Portal also offers data and information about other taxa besides birds that may be helpful to you in your project review. Alternately, you may download the bird model results files underlying the portal maps through the NOAA NCCOS Integrative Statistical Modeling and Predictive Mapping of Marine Bird Distributions and Abundance on the Atlantic Outer Continental Shelf project webpage.

Bird tracking data can also provide additional details about occurrence and habitat use throughout the year, including migration. Models relying on survey data may not include this information. For additional information on marine bird tracking data, see the Diving Bird Study and the nanotag studies or contact Caleb Spiegel or Pam Loring.

What if I have eagles on my list?
If your project has the potential to disturb or kill eagles, you may need to obtain a permit to avoid violating the Eagle Act should such impacts occur.

Proper Interpretation and Use of Your Migratory Bird Report
The migratory bird list generated is not a list of all birds in your project area, only a subset of birds of priority concern. To learn more about how your list is generated, and see options for identifying what other birds may be in your project area, please see the FAQ “What does IPaC

use to generate the migratory birds potentially occurring in my specified location". Please be aware this report provides the "probability of presence" of birds within the 10 km grid cell(s) that overlap your project; not your exact project footprint. On the graphs provided, please also look carefully at the survey effort (indicated by the black vertical bar) and for the existence of the "no data" indicator (a red horizontal bar). A high survey effort is the key component. If the survey effort is high, then the probability of presence score can be viewed as more dependable. In contrast, a low survey effort bar or no data bar means a lack of data and, therefore, a lack of certainty about presence of the species. This list is not perfect; it is simply a starting point for identifying what birds of concern have the potential to be in your project area, when they might be there, and if they might be breeding (which means nests might be present). The list helps you know what to look for to confirm presence, and helps guide you in knowing when to implement conservation measures to avoid or minimize potential impacts from your project activities, should presence be confirmed. To learn more about conservation measures, visit the FAQ "Tell me about conservation measures I can implement to avoid or minimize impacts to migratory birds" at the bottom of your migratory bird trust resources page.

Wetlands

Impacts to NWI wetlands and other aquatic habitats may be subject to regulation under Section 404 of the Clean Water Act, or other State/Federal statutes.

For more information please contact the Regulatory Program of the local U.S. Army Corps of Engineers District.

Please note that the NWI data being shown may be out of date. We are currently working to update our NWI data set. We recommend you verify these results with a site visit to determine the actual extent of wetlands on site.

FRESHWATER EMERGENT WETLAND

- Palustrine

LAKE

- Lacustrine

MICHIGAN STATE UNIVERSITY | Extension

Mr. Zac Culbert
Prein & Newhof
4910 Stariha Drive
Muskegon, MI 49441
269-372-1158

April 27, 2020

Re: Rare Species Review #2594 – Lake Levelling Project, Eagle Lake & Crooked Lake, Texas Township, Kalamazo0 County, MI (T3S R12W several sections).

Mr. Culbert:

The location for the proposed project was checked against known localities for rare species and unique natural features, which are recorded in the Michigan Natural Features Inventory (MNFI) natural heritage database. This continuously updated database is a comprehensive source of existing data on Michigan's endangered, threatened, or otherwise significant plant and animal species, natural plant communities, and other natural features. Records in the database indicate that a qualified observer has documented the presence of special natural features. The absence of records in the database for a particular site may mean that the site has not been surveyed. The only way to obtain a definitive statement on the status of natural features is to have a competent biologist perform a complete field survey.

Under Act 451 of 1994, the Natural Resources and Environmental Protection Act, Part 365, Endangered Species Protection, "a person shall not take, possess, transport, …fish, plants, and wildlife indigenous to the state and determined to be endangered or threatened," unless first receiving an Endangered Species Permit from the Michigan Department of Natural Resources (MDNR), Wildlife Division. Responsibility to protect endangered and threatened species is not limited to the lists below. Other species may be present that have not been recorded in the database.

Several at-risk species have been documented within 1.5 miles of the project site and **it is possible** that negative impacts will occur. This response reflects a desktop review of the database and MNFI cannot fully evaluate this project without visiting the area. MNFI offers several levels of Rare Species Reviews, including field surveys which I would be happy to discuss with you.

Sincerely,

Michael A. Sanders

Michael A. Sanders
Environmental Review Specialist/Zoologist
Michigan Natural Features Inventory

MSU EXTENSION

Michigan Natural Features Inventory

PO Box 13036
Lansing MI 48901

(517) 284-6200
Fax (517) 373-9566

mnfi.anr.msu.edu

Comments for Rare Species Review #2594: It is important to note that it is the applicant's responsibility to comply with both state and federal threatened and endangered species legislation. Therefore, if a state listed species occurs at a project site, and you think you need an endangered species permit please contact: Casey Reitz, Wildlife Division, Michigan Department of Natural Resources, 517-284-6210, or ReitzC@michigan.gov. If a federally listed species is involved and, you think a permit is needed, please contact Carrie Tansy, Endangered Species Program, U.S. Fish and Wildlife Service, East Lansing office, 517-351-8375, or Carrie_Tansy@fws.gov.

Please consult MNFI's Rare Species Explorer for additional information regarding the listed species.

Special concern species and natural communities are not protected under endangered species legislation, but efforts should be taken to minimize any or all impacts. Species classified as special concern are species whose numbers are getting smaller in the state. If these species continue to decline they would be recommended for reclassification to threatened or endangered status.

Table 1: Occurrences of threatened & endangered species within 1.5 miles of #2594

ELCAT	SNAME	SCOMNAME	USESA	SPROT	G_RANK	S_RANK	FIRSTOBS	LASTOBS
Animal	*Clemmys guttata*	Spotted turtle		T	G5	S2	1977	1977
Animal	*Acris blanchardi*	Blanchard's cricket frog		T	G5	S2S3	2007-07-04	2007-07-04
Plant	*Sabatia angularis*	Rosepink		T	G5	S2	1935	1979-08-23
Plant	*Fuirena pumila*	Umbrella-grass		T	G4	S2	1990	1990-10-24
Plant	*Fuirena pumila*	Umbrella-grass		T	G4	S2	1931	1997
Plant	*Berula erecta*	Cut-leaved water parsnip		T	G4G5	S2	1947	1947
Plant	*Eryngium yuccifolium*	Rattlesnake-master or button snakeroot		T	G5	S2	1947	1981-07-31
Plant	*Rhynchospora scirpoides*	Bald-rush		T	G4	S2	1934	1935-08-26
Plant	*Sabatia angularis*	Rosepink		T	G5	S2		1980-08-11
Plant	*Juncus scirpoides*	Scirpus-like rush		T	G5	S2	1930	1930-09-20
Plant	*Fuirena pumila*	Umbrella-grass		T	G4	S2	1979	2005-10-02
Plant	*Besseya bullii*	Kitten-tails		E	G3	S1	1947	1947
Plant	*Coreopsis palmata*	Prairie coreopsis		T	G5	S2	1947	1947
Plant	*Triphora trianthophora*	Nodding pogonia or three birds orchid		T	G4?	S1	1937	1948-08-18
Plant	*Rhynchospora scirpoides*	Bald-rush		T	G4	S2	1935	1935-08-26
Plant	*Platanthera ciliaris*	Orange- or yellow-fringed orchid		E	G5	S1S2	1947	2018-08-03
Plant	*Sabatia angularis*	Rosepink		T	G5	S2	1937	1997

Comments for Table 1:

Blanchard's cricket frog - the state threatened Blanchard's cricket frog (*Acris crepitans blanchardi*) has been known to occur near the project area. It is a tiny, non-climbing member of the treefrog family. They are usually tan, brown, gray, or olive green in color, and sometimes have blotches or a stripe down the back. Most individuals have a dark triangular mark on the back of the head. Best survey time for this species is during the breeding season, which is typically from mid-May to mid-July. Blanchard's cricket frogs inhabit the open edges of bogs, seeps, slow-moving streams & rivers, and ponds.

Management and Conservation: Blanchard's cricket frogs have been in a steep decline in abundance. The loss and degradation of wetlands is likely a major contributing factor in this decline. Avoid eliminating mud flats and vegetated shallow water areas required by this frog.
Another threat may be the stocking of game fish, which consume both tadpoles and adult frogs, into wetlands and marginal ponds.

Rosepink – the state threatened rosepink *(Sabatia angularis)* has been known to occur in the area. Rose-pink is found along moist sandy shores, in depressions in dunes, in marshy ground, and on the edges of lakes. Flowering typically occurs in August but may extend from mid-July through early September.

Management and Conservation: this species requires conservation of habitat and protection of the hydrology, including maintenance of cyclical drawdown regime and water table. Maintain moist, open habitat. It is also vulnerable to ORV impacts and dredging and filling activities.

Umbrella-grass - the state threatened umbrella-grass *(Fuirena squarrosa)* has been known to occur in the area. Umbrella-grass inhabits sandy to peaty shores of seepage lakes with fluctuating water levels. It is usually found with other plants of Atlantic coastal plain marsh affinity, and usually occupies a zone of moderately to highly organic sand. Flowering occurs from July to October. This species requires specific spring hydrologic conditions. When hydrologic conditions are not appropriate, it remains dormant in the soil and will not be detected in surveys.

Management and Conservation: primarily requires conservation and protection of hydrology of intermittent wetlands; vulnerable to ORV impacts and dredging and filling of sites.

Eastern massasauga rattlesnake - the federally threatened and state special concern eastern massasauga rattlesnake *(Sistrurus catenatus)* has been known to occur in the area. This is Michigan's only venomous snake and it is found in a variety of wetland habitats including bogs, fens, shrub swamps, wet meadows, marshes, moist grasslands, wet prairies, and floodplain forests. Eastern massasaugas occur throughout the Lower Peninsula but are not found in the Upper Peninsula. Populations in southern Michigan are typically associated with open wetlands, particularly prairie fens, while those in northern Michigan are better known from lowland coniferous forests, such as cedar swamps. These snakes normally overwinter in crayfish or small mammal burrows often close to the groundwater level and emerge in spring as water levels rise. During late spring, these snakes move into adjacent uplands they spend the warmer months foraging in shrubby fields and grasslands in search of mice and voles, their favorite food.

Often described as "shy and sluggish", these snakes avoid human confrontation and are not prone to strike, preferring to leave the area when they are threatened. However, like any wild animal, they will protect themselves from anything they see as a potential predator. Their short fangs can easily puncture skin and they do possess potent venom. Like many snakes, the first human reaction may be to kill the snake, but it is important to remember that all snakes play vital roles in the ecosystem. Some may eat harmful insects. Others like the massasauga consider rodents a delicacy and help control their population. Snakes are also a part of a larger food web and can provide food to eagles, herons, and several mammals.

Management and Conservation: any sightings of these snakes should be reported to the Michigan Department of Natural Resources, Wildlife Division. If possible, a photo of the live snake is also recommended.

Table 2: Occurrences of special concern species & other natural features within 1.5 miles of #2594

ELCAT	SNAME	SCOMNAME	USESA	SPROT	G_RANK	S_RANK	FIRSTOBS	LASTOBS
Animal	*Sistrurus catenatus*	Eastern massasauga	LT	SC	G3	S3	1981-08	2003-07-03
Animal	*Pantherophis spiloides*	Gray ratsnake		SC	G4G5	S2S3	1977	1977
Animal	*Sistrurus catenatus*	Eastern massasauga	LT	SC	G3	S3	1991-07	1991-07
Animal	*Catocala dulciola*	Quiet underwing		SC	G3	S2S3	1985	1985
Animal	*Papaipema cerina*	Golden borer		SC	G2G4	S2	1992	1992
Animal	*Terrapene carolina carolina*	Eastern box turtle		SC	G5T5	S2S3	2001-04-23	2001-04-23
Animal	*Lasmigona compressa*	Creek heelsplitter		SC	G5	S3		1960pre
Animal	*Lasmigona costata*	Flutedshell		SC	G5	SNR		
Animal	*Setophaga citrina*	Hooded warbler		SC	G5	S3	1999-06-09	1999-07-11
Community	Coastal Plain Marsh	Infertile Pond/marsh, Great Lakes Type			G2	S2	1935	2010-08-24
Community	Coastal Plain Marsh	Infertile Pond/marsh, Great Lakes Type			G2	S2	1935	2010-09-23
Community	Coastal Plain Marsh	Infertile Pond/marsh, Great Lakes Type			G2	S2	1990-10-24	2009-08-04
Plant	*Lipocarpha micrantha*	Dwarf-bulrush		SC	G5	S3	1947	1997
Plant	*Brickellia eupatorioides*	False boneset		SC	G5	S2	1947-PRE	1947-PRE
Plant	*Eleocharis melanocarpa*	Black-fruited spike-rush		SC	G4	S3	1944	2005-10-19
Plant	*Lycopodiella subappressa*	Northern appressed clubmoss		SC	G2	S2	1940	1940-09-14
Plant	*Amorpha canescens*	Leadplant		SC	G5	S3	1980 - PRE	1988-08-21
Plant	*Rhexia virginica*	Meadow beauty		SC	G5	S3	1935	1981-09-07
Plant	*Lechea minor*	Least pinweed		X	G5	S1	1938	1941-08-06
Plant	*Eleocharis melanocarpa*	Black-fruited spike-rush		SC	G4	S3	1932	1997
Plant	*Amorpha canescens*	Leadplant		SC	G5	S3	1981	1987
Plant	*Amorpha canescens*	Leadplant		SC	G5	S3	1980-PRE	2013-08-20
Plant	*Viburnum prunifolium*	Black haw		SC	G5	S3	1935	1935-05-31
Plant	*Lipocarpha micrantha*	Dwarf-bulrush		SC	G5	S3	1935	1954-08-10
Plant	*Eleocharis melanocarpa*	Black-fruited spike-rush		SC	G4	S3	1983-09-10	1983-09-10
Plant	*Lipocarpha micrantha*	Dwarf-bulrush		SC	G5	S3		1947
Plant	*Lipocarpha micrantha*	Dwarf-bulrush		SC	G5	S3	1947-PRE	2005-10-19
Plant	*Amorpha canescens*	Leadplant		SC	G5	S3	1980-PRE	2013-08-19

Plant	*Rhexia virginica*	Meadow beauty		SC	G5	S3		1981-08
Plant	*Rhynchospora macrostachya*	Tall beakrush		SC	G4	S3S4	1947	1997
Plant	*Amorpha canescens*	Leadplant		SC	G5	S3	1980-PRE	2013-08-20
Plant	*Arnoglossum plantagineum*	Prairie indian-plantain		SC	G4G5	S3	1980-08-11	1996
Plant	*Brickellia eupatorioides*	False boneset		SC	G5	S2	1947-pre	1997
Plant	*Amorpha canescens*	Leadplant		SC	G5	S3	1900s	1900s
Plant	*Lycopodiella subappressa*	Northern appressed clubmoss		SC	G2	S2	1940	1941-09-20
Plant	*Polygala cruciata*	Cross-leaved milkwort		SC	G5	S3	1938	1938-09-06
Plant	*Lechea minor*	Least pinweed		X	G5	S1	1946	1946-08-03
Plant	*Rhexia virginica*	Meadow beauty		SC	G5	S3	1935	1983-09-10
Plant	*Amorpha canescens*	Leadplant		SC	G5	S3	2015-06-25	2015-06-25
Plant	*Lipocarpha micrantha*	Dwarf-bulrush		SC	G5	S3	1980	1997

Comments for Table 2:

Special concern species and natural communities are not protected under endangered species legislation, but efforts should be taken to minimize any or all impacts. Species classified as special concern are species whose numbers are getting smaller in the state. If these species continue to decline they would be recommended for reclassification to threatened or endangered status.

Eastern box turtle - the special concern eastern box turtle *(Terrapene carolina carolina)* has been known to occur in the area. The eastern box turtle is Michigan's only truly terrestrial turtle. This species typically prefers deciduous or mixed woodlands, especially those with sandy soils. They also utilize adjacent thickets, old fields, pastures, vegetated dunes, marshes, and bog edges. Access to water (e.g. small ponds, seepages, springs, bogs, or slow streams) is important, as is the availability of unshaded nesting sites.

As a species of special concern, the eastern box turtle is not protected under state or federal endangered species legislation, but it is becoming rare throughout its range and it is protected under the authority of the **Department of Natural Resources Director's Order, Regulations on the Take of Reptiles and Amphibians, dated October 12, 2001 (section 324 of PA 451).**

Eastern box turtles are active from late April to late October and breeding typically occurs from late May to mid-October. Home ranges can be as large as 40 acres. Many box turtles are killed on roads and collected as pets each year. These turtles are diurnal and most active in spring and fall. During the summer they may have brief activity in the morning or falling rain, but otherwise spend much time buried in leaf litter, shallow burrows, under brush piles or rotting logs. Hibernation occurs most frequently in burrows or under leaf litter, less often submerged in a pond or stream.

Box turtles consume a wide variety of plant and animal foods with a taste for raspberries or blackberries. Most box turtles remain in a rather small home range (often less than 5 acres) for most of their lives. Nesting takes place in June and early July, with eggs being buried in an open, often elevated location. Hatchlings emerge in September and October.

Management and Conservation: management recommendations include protection of forests. Loss of wooded habitat to various human uses is the most serious threat to the species. Conservation efforts should concentrate on protecting large tracts of habitat especially on public land to provide the box turtle additional protection from the effects of development. Wetland hydrology and quality should be maintained by preventing improper off-road vehicle use, implementing minimum development set-back distances, leaving buffer zones during timber harvest, grazing and agricultural operations, minimizing use of herbicides and pesticides in or near wetlands, and/or controlling invasive plants. Upland nesting areas should be identified, protected and in some cases created. Construction of new roads should be minimized or routed to avoid separating foraging and/or overwintering habitat from nesting areas. Finally, the public should be educated about the laws protecting reptiles and amphibians and encouraged to leave wild turtles in their natural habitats rather than collecting them for pets.

Dwarf-bulrush – the state special concern dwarf-bulrush *(Lipocarpha micrantha)* has been known to occur in the area. Dwarf-bulrush is found on the sandy-peaty shore of soft water lakes associated with intermittent wetlands and coastal plain marshes, especially in lake plain landscapes in western Lower Michigan. Dwarf-bulrush can be easily overlooked because of its small size; its rather curly culms (stems) can be inconspicuous when growing in a dense stand with other vegetation. Flowering occurs from August to October.

Management and Conservation: this species requires conservation of habitat and protection of the hydrology, including maintenance of cyclical drawdown regime and water table. Maintain moist, open habitat. It is also vulnerable to ORV impacts and dredging and filling activities. Species of special concern are not protected under state endangered species legislation, but they are considered to be rare in Michigan and should be protected to prevent future listing.

Black-fruited spike-rush – the state special concern black-fruited spike-rush *(Eleocharis melanocarpa)* has been known to occur in the area. Black-fruited spike-rush inhabits the moist sandy, mucky, or boggy shores of receding lakes. Found in areas with a fluctuating water table such as coastal plain marshes, sandy lake edges, dune swales, seepages, sandy marshes, sandy and peaty edges of wetlands, and intermittent wetlands. This species flowers late June to October.

Management and Conservation: this species requires conservation of habitat and protection of the hydrology, including maintenance of cyclical drawdown regime and water table. Maintain moist, open habitat. It is also vulnerable to ORV impacts and dredging and filling activities.

Leadplant - the state special concern leadplant (*Amorpha canescens*) has been known to occur in the area. Leadplant inhabits prairies, dry bluffs and hills, sandy roadsides and clearings. Flowering occurs in June and July.

Management and Conservation: the habitat of this species has been severely degraded and diminished. This species likely requires natural disturbances associated with prairie habitat such as prescribed fire and brush removal. Prevent invasive species from entering the site. As a species of special concern, the leadplant is not protected under endangered species legislation, but it is becoming rare throughout its range and should be protected to prevent future listing.

Codes to accompany Tables:

State Protection Status Code Definitions (SPROT)
E: Endangered
T: Threatened
SC: Special concern

Federal Protection Status Code Definitions (USESA)
LE = listed endangered
LT = listed threatened
LELT = partly listed endangered and partly listed threatened
PDL = proposed delist
E(S/A) = endangered based on similarities/appearance
PS = partial status (federally listed in only part of its range)
C = species being considered for federal status

Global Heritage Status Rank Definitions (GRANK)
The priority assigned by NatureServe's national office for data collection and protection based upon the element's status throughout its entire world-wide range. Criteria not based only on number of occurrences; other critical factors also apply. Note that ranks are frequently combined.
G1 = critically imperiled globally because of extreme rarity (5 or fewer occurrences range-wide or very few remaining individuals or acres) or because of some factor(s) making it especially vulnerable to extinction.
G2 = imperiled globally because of rarity (6 to 20 occurrences or few remaining individuals or acres) or because of some factor(s) making it very vulnerable to extinction throughout its range.
G3: Either very rare and local throughout its range or found locally (even abundantly at some of its locations) in a restricted range (e.g. a single western state, a physiographic region in the East) or because of other factor(s) making it vulnerable to extinction throughout its range; in terms of occurrences, in the range of 21 to 100.
G4: Apparently secure globally, though it may be quite rare in parts of its range, especially at the periphery.
G5: Demonstrably secure globally, though it may be quite rare in parts of its range, especially at the periphery.
Q: Taxonomy uncertain

State Heritage Status Rank Definitions (SRANK)
The priority assigned by the Michigan Natural Features Inventory for data collection and protection based upon the element's status within the state. Criteria not based only on number of occurrences; other critical factors also apply. Note that ranks are frequently combined.
S1: Critically imperiled in the state because of extreme rarity (5 or fewer occurrences or very few remaining individuals or acres) or because of some factor(s) making it especially vulnerable to extirpation in the state.
S2: Imperiled in state because of rarity (6 to 20 occurrences or few remaining individuals or acres) or because of some factor(s) making it very vulnerable to extirpation from the state.
S3: Rare or uncommon in state (on the order of 21 to 100 occurrences).
S4 = apparently secure in state, with many occurrences.
S5 = demonstrably secure in state and essentially ineradicable under present conditions.
SX = apparently extirpated from state.

Section 7 Comments
Rare Species Review #2594
Prein&Newhof
Lake Levelling Project
Texas Township
Kalamazoo County, MI
April 27, 2020

For projects involving Federal funding or a Federal agency authorization

The following information is provided to assist you with Section 7 compliance of the Federal Endangered Species Act (ESA). The ESA directs all Federal agencies "to work to conserve endangered and threatened species. Section 7 of the ESA, called "Interagency Cooperation, is the means by which Federal agencies ensure their actions, including those they authorize or fund, do not jeopardize the existence of any listed species."

This activity falls within the range of five (5) federally listed/proposed species which have been identified by the U.S. Fish and Wildlife Service (USFWS) to occur in Kalamazoo County, Michigan:

Federally Endangered

Indiana bat - there appears to be suitable habitat within the 1.5-mile search buffer. The state and federally endangered Indiana bats (*Myotis sodalis*) are found only in the eastern United States and are typically confined to the southern three tiers of counties in Michigan. Indiana bats that summer in Michigan winter in caves in Indiana and Kentucky. This species forms colonies and forages in riparian and mature floodplain habitats. Nursery roost sites are usually located under loose bark or in hollows of trees near riparian habitat. Indiana bats typically avoid houses or other artificial structures and typically roost underneath loose bark of dead elm, maple and ash trees. Other dead trees used include oak, hickory and cottonwood.

Foraging typically occurs over slow-moving, wooded streams and rivers as well as in the canopy of mature trees. Movements may also extend into the outer edge of the floodplain and to nearby solitary trees. A summer colony's foraging area usually encompasses a stretch of stream over a half-mile in length. Upland areas isolated from floodplains and non-wooded streams are generally avoided.

Management and Conservation: the suggested seasonal tree cutting range for Indiana bat is between October 1 and March 31 (i.e., no cutting April 1-September 30). This applies throughout the Indiana bat range in Michigan.

Mitchell's satyr butterfly – there does not appear to be suitable habitat within the 1.5-mile search buffer. The federally endangered and state endangered Mitchell's satyr butterfly *(Neonympha mitchellii mitchellii)* is restricted to calcareous wetlands known as prairie fens. In Michigan, this habitat is characterized by scattered tamaracks, poison sumac, and dogwood with a ground cover of sedges, shrubby cinquefoil, and a variety of herbaceous species with prairie affinities. Adult Mitchell's satyr butterflies are active two to three weeks each summer, with males emerging before females. Adult flight dates are from mid-June to mid-July. Larvae hibernate near the bottom of a sedge. The larval food plant is thought to be several species of sedge. The caterpillar is green with white stripes.

Management and Conservation: the primary threat to the continued survival of this species is habitat loss and modification. Many of the wetland complexes occupied currently have been altered or drained for agriculture or development. Wetland alteration is responsible for extirpating the single known satyr population in Ohio. Wetland alteration also can lead to invasion by exotic plant species such as glossy buckthorn (*Rhamnus frangula*), purple loosestrife (*Lythrum salicaria*), common buckthorn (*Rhamnus cathartica*), and the common reed (*Phragmites australis*). In addition, landscape-scale processes that may be important for maintaining suitable satyr habitat and/or creating new habitat, such as wildfires, fluctuations in hydrologic regimes, and flooding from beaver (*Castor canadensis*) activity, have been virtually eliminated or altered throughout the species' range.

Snuffbox – there does not appear to be suitable habitat within 1.5-miles of the project site. The state and federally endangered snuffbox mussel (*Epioblasma triquetra*) inhabits rivers and streams with cobble, gravel, or sand bottoms in swift currents and usually is deeply buried in the substrate. Glochidia, the parasitic larval stage of the mussel, are released from May to mid-July. In Michigan, the only host fish known for snuffbox is the log perch (*Percina caprodes*). In other parts of their range the banded sculpin (*Cottus carolinae*) is also a known host. After completing the parasitic stage and reaching adulthood, snuffbox remain relatively sessile on the river bottom, living between 8-10 years. The best time to survey for snuffbox is April through September.

Conservation and Management: the snuffbox mussel is sensitive to river impoundment, siltation and disturbance, due to its requirement for clean, swift current and relative immobility as an adult. To maintain the current populations in Michigan, rivers need to be protected to reduce silt loading and run-off. Maintaining or establishing vegetated riparian buffers can aid in controlling many of the threats to mussels. Control of zebra mussels is critical to preserving native mussels. And as with all mussels, protection of their hosts habitat is also crucial. Because the life cycle of the snuffbox is inherently linked with that of the logperch in Michigan, conservation and management of this fish species is needed to ensure that of the snuffbox.

Federally Threatened

Northern long-eared bat - Northern long-eared bat (*M. septentrionalis*) numbers in the northeast US have declined up to 99 percent. Loss or degradation of summer habitat, wind turbines, disturbance to hibernacula, predation, and pesticides have contributed to declines in Northern long-eared bat populations. However, no other threat has been as severe to the decline as White-nose Syndrome (WNS). WNS is a fungus that thrives in the cold, damp conditions in caves and mines where bats hibernate. The disease is believed to disrupt the hibernation cycle by causing bats to repeatedly awake thereby depleting vital energy reserves. This species was federally listed in May 2015 primarily due to the threat from WNS.

Although no known hibernacula or roost trees have been documented within 1.5 miles of the project area, this activity occurs within the designated WNS zone (i.e., within 150 miles of positive counties/districts impacted by WNS. In addition, there appears to be suitable habitat within the buffer. The USFWS has prepared a dichotomous key to help determine if this action may cause prohibited take of this bat. Please consult the USFWS Endangered Species Page for more information.

Also called northern bat or northern myotis, this bat is distinguished from other *Myotis* species by its long ears. In Michigan, northern long-eared bats hibernate in abandoned mines and caves in the Upper Peninsula; they also commonly hibernate in the Tippy Dam spillway in Manistee County. This species is a regional migrant with migratory distance largely determined by locations of suitable hibernacula sites.

Northern long-eared bats typically roost and forage in forested areas. During the summer, these bats roost singly or in colonies underneath bark, in cavities or in crevices of both living and dead trees. Roost trees are selected based on the suitability to retain bark or provide cavities or crevices. Common roost trees in southern Lower Michigan include species of ash, elm and maple. Foraging occurs primarily in areas along woodland edges, woodland clearings and over small woodland ponds. Moths, beetles and small flies are common food items. Like all temperate bats this species typically produces only 1-2 young per year.

Management and Conservation: when there are no known roost trees or hibernacula in the project area, we encourage you to conduct tree-cutting activities and prescribed burns in forested areas during October 1 through March 31 when possible, but you are not required by the ESA to do so. When that is not possible, we encourage you to remove trees prior to June 1 or after July 31, as that will help to protect young bats that may be in forested areas but are not yet able to fly.

Eastern massasauga rattlesnake – there is a known occurrence in the area. The federally threatened and state special concern eastern massasauga rattlesnake *(Sistrurus catenatus)* is Michigan's only venomous snake occurring in a variety of wetland habitats including bogs, fens, shrub swamps, wet meadows, marshes, moist grasslands, wet prairies, and

floodplain forests. Eastern massasaugas occur throughout the Lower Peninsula but are not found in the Upper Peninsula. Populations in southern Michigan are typically associated with open wetlands, particularly prairie fens, while those in northern Michigan are better known from lowland coniferous forests, such as cedar swamps. These snakes normally overwinter in crayfish or small mammal burrows often close to the groundwater level and emerge in spring as water levels rise. During late spring, these snakes move into adjacent uplands they spend the warmer months foraging in shrubby fields and grasslands in search of mice and voles, their favorite food.

Often described as “shy and sluggish”, these snakes avoid human confrontation and are not prone to strike, preferring to leave the area when they are threatened. However, like any wild animal, they will protect themselves from anything they see as a potential predator. Their short fangs can easily puncture skin and they do possess potent venom. Like many snakes, the first human reaction may be to kill the snake, but it is important to remember that all snakes play vital roles in the ecosystem. Some may eat harmful insects. Others like the massasauga consider rodents a delicacy and help control their population. Snakes are also a part of a larger food web and can provide food to eagles, herons, and several mammals.

Management and Conservation: any sightings of these snakes should be reported to the Michigan Department of Natural Resources, Wildlife Division. If possible, a photo of the live snake is also recommended.

USFWS Section 7 Consultation Technical Assistance can be found at:

https://www.fws.gov/midwest/endangered/section7/s7process/index.html

The website offers step-by-step instructions to guide you through the Section 7 consultation process with prepared templates for documenting “no effect.” as well as requesting concurrence on "may affect, but not likely to adversely affect" determinations.

Please let us know if you have questions.

Mike Sanders
Environmental Review Specialist/Zoologist
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517-284-6215

Appendix F

Survey Results and Maps – Crooked Lake

CROOKED LAKE - LAKE LEVEL STUDY
OFFICE OF THE KALAMAZOO COUNTY DRAIN COMMISSIONER
SURVEY TABULATION

Your response to this questionnaire will help in the investigation of establishing a legal lake level on Crooked Lake.

1. Please provide your name and address details below:

   Name: _____ Telephone:_____

   Home address:_____

   _____

   Crooked Lake address (if different):_____

   _____

2. How long have you been at the Crooked Lake address? 17 Years (Average)
3. What is your status with regard to this property? (Check one)

   95 Owner residing or conducting business at property

   1 Tenant

   8 Owner not residing or conducting business at property

   5 Other (please specify) Summer Home, Part Time Resident, Mother Life Lease, Building & Used as Cottage

4. Are you in favor of an established lake level on Crooked Lake?

   94 Yes (87% of respondents)

   14 No (13% of respondents)

5. At what elevation would you like the lake level to be established relative to the elevation which the Lake Association had previously operated the augmentation pump (prior to the 2017 flooding).

   13 Higher, (14% of respondents)

   25 Lower, (28% of respondents)

   51 Same (57% of respondents)

6. Did the lake level prior to the 2017 flooding affect your septic tank/field?

   2 Yes

   108 No

   47 Not Applicable

7. At your Crooked Lake address have you ever experienced flooding prior to the 2017 flooding? (Please check all that apply.)

   7 Flooding in your yard area

   2 Flooding above habitable floor (house)

   101 I have never experienced flooding

8. If you experienced flooding prior to 2017, during what time of year did it occur?

   0 Winter

   4 Spring

   1 Summer

   1 Fall

   *Provide number of occurrences infrequent and dates of flooding, if known Respondents indicated 1950 and 2008-2009

9. Did you consider aquatic weed growth a problem in the lake at lake levels prior to the 2017 flooding?

   54 Yes

   54 No

10. Did you have shoreline ice damage to your property prior to the 2017 flooding? (Does not include structures such as docks.)

    7 Yes

    102 No

11. Did you have erosion damage to your property during periods of high water in the fall and spring prior to the 2017 flooding?

    15 Yes

    94 No

Comments and opinions to this Questionnaire and return to:

- It's important to make sure that while the levels are raised artificially beyond what nature provides, there needs to be a way to lower it, quicklyAnd permanently. There needs to be a long term plan to keep this flooding from happening again. The cost of damage to our property, the necessity to add a new sea wall to try to reduce damage and still having water issues in our home, including an ongoing mold problem, have caused enormous stress for us. We're still have to repair our home and lakefront when the water goes down enough. So if the association is going beyond what nature provides for the lake level, there has to be a way to reduce the levels quickly and permanently. We know many others have been affected too, and there needs to be a level that works for everyone.

- I have lived on this lake on and off for 40 years, in 5 different locations on the lake. After approx. 2005 when the asssoc. upgraded the lake pump as the old one trickled, someone decided to fill the lake as high as he could to get the back end of the lake to not be a weed/muck bed along with adding an aeriation system. We should only use the pump as absolutely necessary, and let mother nature do its job. This is a very deep lake that can handle evaporation. Such a shame we are here. Had the pump not been pumping in so much water to make an artificial water table line, mother natures changes (80 yr flood) would not have impacted us. Other lakes just let it be, if it's low it's low. No one individual should be in charge of our lake level. We all enjoy it lower than higher. Many of the homes on this lake don't have a sea wall. Fortunately, we do but it has been damaged. Thank you.
- We've had minimal erosion damage with our seawall.
- I would like the lake level to set where the lake community is comfortable and accepting of wake board and surf wakes.
- If I had a choice, I would like the lake to go down 20+ feet, so I could once again have some yard/beach.
- We would like the lake level to be such that the sump pumps would not need to run.
- My electrical outlet is in the water now. It was on the beach, dry, prior to 2017. The lake level should be down at least 10 more inches from what it is today. That would or should be the minimum level going forward.
- When we moved here in 2913, we had no weeds in our frontage, but now it is all weeds. Is this due to the flood, or is the aerating and spraying not working?
- We have only lived here for nine months. So, we are only going off what we have been told. The weed growth is an issue across the lake it seems.
- Natural shorelines and lake levels VARY, please stop building so close to shorelines, stop phosphate fertilizing , INSPECT septic systems, stop dumping chemicals into our waterways, stop killing and polluting our natural water wonderland.
- my rock wall that was 12-14 feet away from water is now all crumbly
- I lost my beautiful sandy beach when the "keeper of the Pump" decided arbitrarily to raise the lake level to the point where we lost our beaches. That was before 2017. And here we are.
- We do not have a motor boat. In the fall of 2017 I thought the lake level was higher then it had ever been and I was not happy. At that time we had a small bank at the shoreline, and the water level was 3 or 4 inches up my bank. When boats went by our bank was eroding. I had hoped to put in an eco friendly retaining wall of some sort the next spring but the water level never went down. Now my bank is under water and I have no idea what it will look like if the water level goes down. Our shoreline will need major renovation but I am glad our house is away from the water and suffered no damage.
- We bought on this lake to utilize it as a motor sports lake, because it was deep (important to wakeboarding and surfing) and private. We want to be able to use the lake for the reasons why we purchased our house 6.5 years ago.

- This pump issue seems like a joke. At 2000 gpm, we were told 3000 gpm, plus the approx. 1.2 million gal. evaporation per day, we haven't seen much for our money spent and taxes paid.
- It's hard to discuss lake level numbers when numbers are not being offered. What is the lake level in feet that the association kept the lake at? What was the normal highest level in the spring? What was the lake level number in 2017 that this survey continually references? It's impossible to give a valid opinion without scientific data. We had erosion issues all summer in 2017. In Oct 2017 was when we stopped having erosion issues, and the lake was at the level we want it at, and we got our beach back. I have pictures to show that. But what the lake level was at in feet at that time? That is unknown to me.
- Ground water flooded our basement last summer. At the high water mark we lost almost 30 feet of yard to the lake. Had to install two new sump pumps and cost a total of around $6000 (some of which was paid by insurance).
- Never had a problem until after they passed the special assessment to raise the lake level and started pumping water into our lake! I was totally against the pumping water into the lake!!!
- Yard underwater. Had to install 100 sandbags when water reached patio. Lost several gardens and more than half of lawn. Fire pit completely underwater. Some damage to drywall on one side of house.
- Our home suffered significant damage with the flooding and we have ongoing issues with our yard even at the current lake level. We strongly support developing a lower legal lake level and were satisfied with the level prior to the 2017 flooding.
- I would support the water level that the association was achieving prior to 2017
- Following the 2017 flooding our sandy lakefront bottom has transitioned to abundant weed cover.
- We would like to see 19 inches lower with a maximum of 24 inches, related to the level today. May 7, 2020. Taking the water to your suggested level that you gave in the newsletter, would possibly be too low resulting in the need to pump water in....Let's try to take a breather and not keep everyone on the edge of their chair.
- There have always been fluctuations in the lake level, but never to this degree. I've had to shorten and raise my dock twice. Lost my beautiful beach, and my newly professionally landscaped rock wall is destroyed and falling into the water.
- The problem with the previously determined augmentation lake level was docks and boat lifts were set in the spring when the water level was usually high and the summer evaporation took the lake level toward the augmentation level the docks and lifts often had to be repositioned based on the lower water level. We need the new legal level to be slightly higher than the augmentation level so we are not having to reset all this stuff in August. Thank you for all of your efforts with this process.
- I have already provided a letter to the Deputy Drain Commissioner of Kalamazoo and Prein & Newhof about my lost beach front. Photos of the beach I used to have were provided. I also have attended Crooked Lake Association meetings and spoke with a member on the Crooked Lake Association about the high lake level that started in 2009, and the lake level has not receded since then. I hope the new lake level will take into account climate change and the heavier rain fall that has occurred over the recent years in this area.

- Since taking on Eagle Lakes water, our lake has seen a huge influx of invasive weeds and vegetation not previously seen. The water levels should be set higher, if this goes through, due to this new vegetation. We had a huge problem getting our boat in and out of our dock due to all the weeds BEFORE this temporary "solution", now with the weeds being extremely worse, we worry the lower set water level will dry dock us back in the cove.
- We don't need the lake level near as high as the Lake Association set the lake level.
- I strongly recommend we utilize the CLT Association Guidelines in Setting the Legal lake Level
- I am tired of the board president having all the say because he wants to profit from building homes. The lake was fine before pumping and it was low with lots of beach. The board does not want to ever listen to owners against what they want. Especially the people who have lived on this lake and know about the lakes history. I have never in all my 47 years seen the lake this high and all the problems that we have had. Lower the lake and leave it low and leave it alone and stop listening to people who only care about making a profit by selling lots!!!
- We have a growing weed problem on the lake which is getting worse ever year and it is starting to effect lake health. Lowering the lake to much I think would not help. But peoples homes are the most important to protect. I support the association and will on this issue. I do feel that we are caring the financial load of this for the whole surrounding area beyond Crooked and Eagle Lakes.
- I would be comfortable with the current high water mark of 895.50 being the LLL as long as there are very clear and well-publicized levels for starting and stopping the augmentation well during the summer and prior to winter. I believe it is very important that both Eagle and Crooked lakes use the same off level for their augmentation well relative to the LLL (preferably 4 to 5 inches below LLL).
- Obviously the lake being too high is a much larger problem than it being too low. If you promise not turn the pump back on to add water to the lake , maybe ever. Then I think the legal lake level can be higher, in other words, let it go below the level, just not above . If you are going to add water to the lake to keep it at a certain level, then it needs to be quite low. When I moved in 2013 the lake was in great shape, it had fantastic fishing , I had sand beach I invested in , and the boating was very navigable .
- if a legal lake level is set, what exceptions will be made for a low lake level? will additional pumps be needed or required to keep legal lake level?
- The best source to determine our legal lake level is our lake association board.
- My concern with setting the legal lake level is the solution which has not been testing or used in other lake leveling. There is no way that a siphon system will pump anywhere near the 2000 gallon per minute the physical pumps will. In addition, we are draining the entire areas water table which will take extensive flow to be effective. What guarantees at a certain GPM of the new solution will we have when everyone will be paying for an untested solution?
- Established level should be lower than current but high enough to keep east end of lake usable
- We need to consider that the lake water is not always smooth and placid. If the water level is one foot below the height of adjacent seawalls and a wake-boarder is on the lake, the wave

created by his boat will splash OVER THE SEAWALLS causing erosion. Property owners should not have to incur cost of a seawall to deal with this specific situation and many properties do not even have a seawall. There are about a dozen such boats on Crooked Lake.

- We feel the association set lake level was working very well in the years we have been here. were are hoping that is the level that will be set and maintained.
- I am happy with the progress the Lake Association has made. Thank you.
- Please do everything you can to get this done quickly so that we can safely enjoy our lake and water sports again. Thank you!
- I feel the lower levels will occur with nature and that evaporation will be the main component.
- It would be better if the level didn't vary so much. With the flooding it came 40 feet into my yard

Charter Township of Texas

Kalamazoo County, Michigan

Crooked Lake
Lake Level
Flooding Issues

June 2020

N
W E
S

800 400 0 800
Feet

Scale: 1" = 800'

LEGEND

- Flooding in your yard area (7)
- House had Flooding (2)
- Flooding Affected Septic Tank/Field (1)

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Charter Township of Texas

Kalamazoo County, Michigan

Crooked Lake
Lake Level
Ice Damage/Erosion Issues

June 2020

N
W E
S

800 400 0 800
Feet

Scale: 1" = 800'

LEGEND

- Ice Damage (7)
- Erosion Damage (16)

Charter Township of Texas

Kalamazoo County, Michigan

Crooked Lake
Lake Level
Flood Level Survey Results

June 2020

N
W E
S

800 400 0 800
Feet

Scale: 1" = 800'

LEGEND

Lake Level Survey Results

- Same (51)
- Lower (25)
- Higher (13)

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Charter Township of Texas

Kalamazoo County, Michigan

Crooked Lake
Lake Level
Weed Growth

June 2020

N
W E
S

800 400 0 800
Feet

Scale: 1" = 800'

LEGEND

Weed Growth

- Yes (55)
- No (55)

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Appendix G

Survey Results and Maps – Eagle Lake

EAGLE LAKE - LAKE LEVEL STUDY
OFFICE OF THE KALAMAZOO COUNTY DRAIN COMMISSIONER
SURVEY TABULATION

Your response to this questionnaire will help in the investigation of establishing a legal lake level on Eagle Lake.

1. Please provide your name and address details below:

   Name: _____ Telephone:_____

   Home address:_____

   _____

   Eagle Lake address (if different): _____

   _____

2. How long have you been at the Eagle Lake address? 15 Years (Average)
3. What is your status with regard to this property? (Check one)

   126 Owner residing or conducting business at property

   _____ Tenant

   2 Owner not residing or conducting business at property

   _____ Other (please specify) _____

4. Are you in favor of an established lake level on Eagle Lake?

   125 Yes (98% of respondents)

   3 No (2% of respondents)

5. At what elevation would you like the lake level to be established relative to the elevation which the Lake Association had previously operated the augmentation pump (prior to the 2017 flooding).

   15 Higher (14% of respondents)

   8 Lower (7% of respondents)

   84 Same (86% of respondents)

6. Did the lake level prior to the 2017 flooding affect your septic tank/field?

   1 Yes

   80 No

   44 Not Applicable

7. At your Eagle Lake address have you ever experienced flooding prior to the 2017 flooding? (Please check all that apply.)

   14 Flooding in your yard area

   2 Flooding above habitable floor (house)

   108 I have never experienced flooding

8. If you experienced flooding prior to 2017, during what time of year did it occur?

   2 Winter

   9 Spring

   4 Summer

   1 Fall

   *Provide number of occurrences Respondents indicated 1951, late 1980's, early 1990' and 2008 and dates of flooding, if known _____

9. Did you consider aquatic weed growth a problem in the lake at lake levels prior to the 2017 flooding?

   110 Yes

   12 No

10. Did you have shoreline ice damage to your property prior to the 2017 flooding? (Does not include structures such as docks.)

    6 Yes

    115 No

11. Did you have erosion damage to your property during periods of high water in the fall and spring prior to the 2017 flooding?

    13 Yes

    110 No

Comments:

- Because we keep building without infrastructure - roadside flooding is terrible. Lake has to go a little higher to accommodate and I hope we get some benefit in that it will help Weed's if we reuse lake a little . We deserve a good lake after all if this.
- No body can get this water out of here in the last 3 years....what makes you think you will get it out of here in 1 year?? Someone should of stepped in to help us before it got to this level, they knew it kept getting higher and apparently nobody cared!
- I think the township needs to add considerable focus and infrastructure to drains around the township. We keep adding buildings, raising taxes and it is causing more surrounding drainage to Eagle Lake. We don't need more parks we need more drains.

- We feel the legal lake level should be at the historic level that was established prior to the addition of the augmentation pump. Lake level: 898.4
- I am strongly in favor of the legal lake level and am excited for the long term solution to our flooding
- Regarding question 8 I am saying the level should be 899.45 ft When the water level gets much above this height we start to have water in the well pit.
- I have two homes on the lake.
- Let's get going Appreciate hard work and cooperation done by many
- All damage to my yard and property is a result of the flooding since 2017. I just received this survey from my neighbor. Why was it not sent to me? Thanks so much.
- Do not want lake as low as it was in 2015-2016
- Flooding above habitable floor (house) - basement continuous problems and we use basement.
- At present this property is not usable. We cannot wait until the levels get back below our metal sea wall so we can begin the cleanup on this lot.
- Don't know why a legal lake level is necessary.
- We moved in late 2018 so have no idea about what was going on with this property in 2017 and before. However, if the lake were down 3 ft from where it is today, we would have less inland water retention and issue with our basement now. Weeds are a huge problem on the lake
- Help needed
- Please keep the Legal Lake Level same as target elevation used by ELTA for pump augmentation.
- Please keep LLL same as target elevation used by ELTA for pump operation
- Our basement has been flooded since Feb of 2018. Our backyard fully flooded and over $100,000 in damage. We are surprised it has taken this long to fix this problem.
- I am more than happy to help in any way to establish this
- We would like to see our lakefront picnic lot restored to the level it was prior to the 2017 lake level, with the lawn area containing our fire pit and a sandy beach. We don’t know what level the lake needs to be maintained at to restore our lot since the sea walls and berms installed to protect homes have made our unprotected property a floodplain.
- As one of the first homes that was impacted by the Eagle Lake flood, we trust that the severity of the situation is understood. The financial and emotional toll that this flood has taken on so many of our neighbors, friends, and family is monumental! Texas Township has been very supportive of getting this issue corrected and putting us in a position to never have to worry about this again. We appreciate the support of Texas Township! Moreover, the real estate values of the homes not only on Eagle and Crooked Lake but the surrounding neighborhoods will continue to negatively be impacted if no permanent fix/solution is in place. To echo the comments at last year's KVCC meeting, "this is not a lake problem, this is a Kalamazoo County problem" this statement couldn't be more true as the flooding on Eagle

and Crooked Lake is impacting approximately 800 homes. Our family looks forward to being able to enjoy the full use of Eagle Lake. On behalf of my friends, family, and neighbors we are fully trusting in the individuals and agencies that will be involved in this lake level legalization process that you will do what is right for all of us. Thank you!

- Flooding has caused damage to property and significant investment to keep my home secure from water damage.
- Keep level same
- Please consider the loss of native growth and all the trees that have and will die due to the excessive water for the past 2 years.
- Thank you.
- Lost part of the rock wall, since then we have lost the compete wall.
- As the past ELTA President I am excited to establish a legal lake level. In the past we were always trying to maintain a lake level by running our pump. To be able to control our lake level would be great. Thank for all your work.
- Thank you for working on solutions to this horrendous flooding problem! We miss being able to enjoy our lake!!
- Never dream we would lose our family cottage, so many great memories. We hope to rebuild some day, Lord willing! Thank you for doing all you can, I might not like the message, but the honest information is greatly appreciated. We don't feel alone!
- No comment
- The questions not answered are due to us not living here and not having a knowledge to those answers.
- Really need this fixed...
- To preclude damage from ice or water erosion prior to 2017, I installed a Block Sea Wall which has now been damaged due to the flooding since 2017.
- Please get this done! Every tree on our property, including mature unreplacable trees have died while waiting for a resolution.
- I favor legal lake level if the lake residents maintain a voting majority on any established lake board. Otherwise, I don't trust that the best interests of lake residents would be guaranteed.
- Have boat house that has been flooded and damaged since flooding
- We appreciate the association and community efforts
- I trust that the history that has been kept on the lake level over the years will help to establish the ideal level for the lake. I can't tell you what that elevation in feet above sea level should be. The ideal level for my property is for the lake to just be a couple of inches up my sea wall which then allows me to have some beach area.
- The Eagle Lake residents were not given the opportunity to vote on the temporary solutions before the township got involved and decided our direction. At an ELTA special meeting in Aug 2018, members, by a show of hands, were overwhelmingly in favor of establishing a legal lake level. Yet, somehow, the voices were not heard and our desire for early action towards a legal lake level has not occurred even as of today - almost two years later. We

understand the process for establishing a legal lake level is timely, including about a year to establish the legal lake level and another year to get action on the legal lake level, but we feel that we should be further ahead by now. The original Prein & Newhof plan that was presented to residents with an assurance that our lake level would go down in 1.5 years has not come to fruition. This is frustrating, personally, because we have more water in our basement today than when the temporary solution of pumping began. I understand that we are not the only ones in this situation. There is a great deal of flooding in our area and we believe that there are other success stories and experiences that we could learn from to help our situation. In addition, it would be beneficial to consult with other organizations that have colleagues with extensive environmental regulatory and hydrology experience (VanBuren drain commission office, GEI, Keiser & Associates, for example). Finally, we have doubts that a legal lake level, as proposed, will be approved by the legal system when the locations downstream that would be recipients of our water, are also flooded (downtown Kalamazoo and eventually South Haven/Lake Michigan). As we know, Kalamazoo County has already pushed back on our efforts to reduce our lake level because it is perceived that their water levels will increase. Again, just as above for the technical experts, we are encouraging legal experts to be consulted in this process (maybe this has already occurred). Thanks for the opportunity to comment.

- Please try to expedite the construction of the permanent solution. Thank you for all you have done.
- I purchased this property from the prior owner who had lived in one of the three cottages on the property for 41 years. Due to the water level flooding his home, he was forced to vacate in the Fall of 2018.
- The Drain Commissioner, in 2013, gave a recommended lake pump operation policy as follows: During the months of April thru September, the pump will run only as necessary to assist in keeping the lake level between a range of 10 inches (898.84 NAVD88) to 14 inches (899.14 NAVD88) above the MDNR Official High Water Mark of 897.97 (NAVD88) elevation. See Patricia Crowley for detailed report. Further, the MDNR, MDEQ Official Ordinary High Water Mark was established in 1968 and was reaffirmed in documents in 1976, 1982, and 1988. 898.4 (NGVD29) and 897.97 (NAVD88), is the same elevation. The 897.97 (NAVD88) is used today and should be used as the starting point for any legal lake level setting. It has not been changed since since 1968 to the present day. Also Patricia Crowley spent 2 months researching her final lake level proposal in 2013. It should have considerable weight in your final proposal. Most lake residents do not have sufficient knowledge of causes of lake level flucations over time. That is in part why we are at the flooding stage we are at now. Thank you.
- common sense lake level, not like now, about 2-3 feet lower, so boating okay but no one flooded
- Minimal wash out of my beach only. No lawn or house damage. Lucky...
- please make sure the current permit is extended to allow for pumping until we implement a permanent solution.
- I have no comments expect to speed the process and get the water under control.

- Thank you to the Eagle Lake Texas board and to theTexas Township commissioners for their diligence and consideration for attending to solutions to the high water levels, and for assisting township residents in many ways.
- In about 1993 lake levels rose high onto our sea wall and that winter we had ice damage to the wall. There after we had receding levels with normal beach of around 4-5 feet. Now since 2017 flooding the water is over our sea wall and into our lawn and landscaping. Our entire wall will need to be replaced when water is at least 3.5 feet lower as will our lawn and landscaping. We also had to pump out our crawl space under the house last spring and summer. In all our years here we had never had water in the crawl space.
- None
- We have lost property, irrigation, sea wall, beach, etc in the flooding and are would like to return as close to previous levels as possible. We hope the process will continue.
- We are going into the 3rd summer with not full use of our waterfront property; increasing damage to property & declining property values with no decline in property tax.
- The long term solution to this human created problem needs to be fast tracked. Many residents have/are been struggling keeping their homes dry. The natural flow of the water was disrupted by the hidden cove installation of the road and homes. The marshy area east of the hidden cove road was always wet. It has almost dried up prior to the new pumping. It is now wet again because of the forces main pumping. Get this fixed.
- Establishing a normal lake level is vital to protect homes, in ground utilities, roads and infrastructure, etc.
- None
- The level as maintained with the augmentation well prior to the 2017 flooding has worked very well. Levels lower than that will cause navigation problems in the sand-bar areas, as well as the bay area to the west of the western basin of the lake.
- I've had to tear this house down due to flooding
- I am not sure how to answer question #8. All I know is that it would be nice to have the level what it was in 2016 prior to the flooding. Thank you

Charter Township of Texas

Kalamazoo County, Michigan

Eagle Lake
Lake Level
Flooding Issues

June 2020

N
W E
S

800 400 0 800
Feet

Scale: 1" = 800'

LEGEND

- Flooding in your Yard Area (14)
- Flooding in your House (2)
- Flooding Affected Septic Tank/Field (1)

Prein&Newhof

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Charter Township of Texas

Kalamazoo County, Michigan

Eagle Lake
Lake Level
Ice Damage/Erosion Damage

June 2020

N
W E
S

800 400 0 800
Feet

Scale: 1" = 800'

LEGEND

- Ice Damage (6)
- Erosion Damage (12)

Prein&Newhof

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Charter Township of Texas

Kalamazoo County, Michigan

Eagle Lake
Lake Level
Survey Results

June 2020

N
W E
S

800 400 0 800
Feet

Scale: 1" = 800'

LEGEND

Lake Level Survey Results

- Same (84)
- Lower (8)
- Higher (15)

WEST OP AVE.
SOUTH 3RD ST.
DNR DRIVE
EAGLE LAKE DRIVE NORTH
SOUTH 5TH ST.
EAGLE LAKE DR. NORTH
EAGLE LAKE DR. EAST
SOUTH 6TH ST.
WEST P AVE.
CONTINGO TERRACE
AQUA VIEW DR.
SILVA ST.
TALARIA TERRACE
HERITAGE DR
KLEPPER ST.
EAGLE LAKE DR. EAST
EAGLE LAKE
CHIANTI
HEIGHTS DR.
EAGLE CIRCLE
RIESLING ST.
SELAH CT.
EAGLE TERRACE
WEST PQ AVE.
S. 4TH ST.
TREASURE ISLAND DR.
PEPPER AVENUE STREET
WEST PQ AVE.
N. CROOKED DRIVE
FINNAGEN
CRESTWAY DR.
PINE ISLAND COURT N.
PINE ISLAND COURT S.
SOUTH 5RD ST.
FIELDWOOD CIR.
FIELDWOOD PT.
WEST CROOKED LAKE DR.
PINE
CROOKED

Prein&Newhof

Charter Township of Texas

Kalamazoo County, Michigan

Eagle Lake
Lake Level
Weed Growth

June 2020

N
W E
S

800 400 0 800
Feet

Scale: 1" = 800'

LEGEND

- Affected by Weed Growth (110)
- Not Affected by Weed Growth (12)

Prein&Newhof

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