PRELIMINARY

DUCK LAKE
LAKE LEVEL CONTROL STUDY

Section 22, T.26N. – R.12W.
Green Lake Township, Grand Traverse County, Michigan
Tributary to Betsie River

Prepared for:

Grand Traverse County Drain Commissioner
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Project I.D. Number 122289SG2015C

August 19, 2015

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EXECUTIVE SUMMARY

Kevin P. McElyea, L.L.A., Grand Traverse County Drain Commissioner retained Spicer Group, Inc. to complete a Preliminary Lake Level Control Study to review and update the 1959 Lake Level Report and to complete a Part 307 Dam Inspection Report for Duck Lake, located in Section 22, T.2N. – R.12W., Green Lake Township, Grand Traverse County.

Recommendations include leaving the established legal summer lake level as was established in 1959 at elevation 837.3 NVGD29 and establishing a target Lake Level 0.5 feet lower during winter months. Minor maintenance recommended for the Lake Level Control Structure (Dam) consist of clearing selected trees in the narrows and placing riprap on both the left and right abutments below the Dam. Explore opportunities to purchase and install electronic remote sensing equipment to monitor lake levels. Remote sensing equipment would improve the Drain Commissioner's Lake Level Control operations. Also, detailed land surveys are recommended for the Dam and Narrows to determine ownership. In addition, detailed Hydrology and Hydraulics Analysis to update lake level information is recommended.

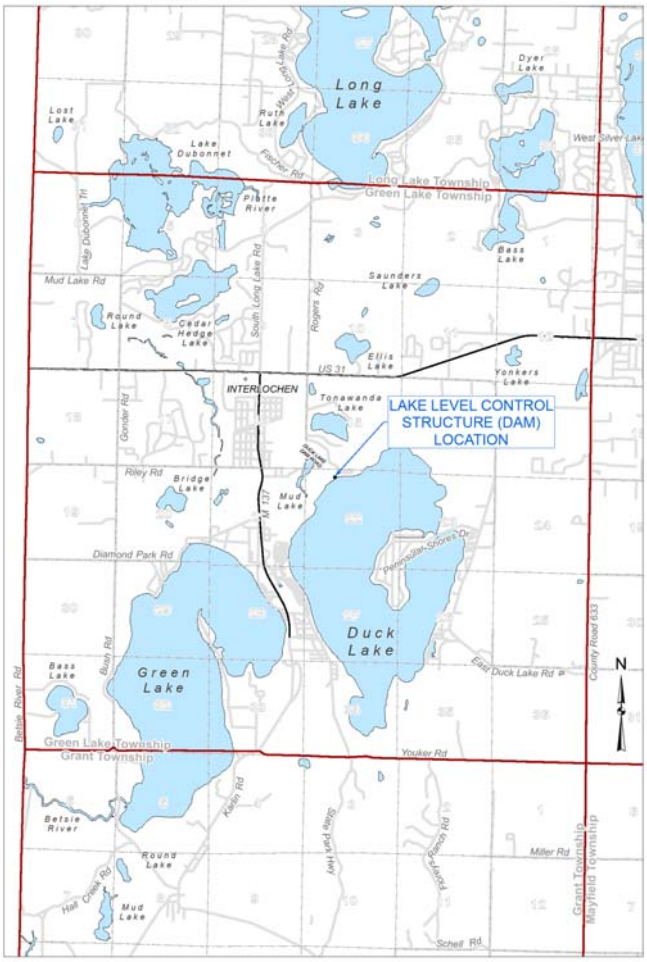
The Dam and areas around the lake were surveyed in NAVD88 vertical datum and survey information with photographs are located in Appendix A of the Duck Lake Preliminary Lake Level Study. The expediency of the normal lake level project was discussed in the 1959 Duck Lake Level Report of Special Investigation located in Appendix B, and the Investigation indicated the project was appropriate, proper, and benefited the community. Also, the 1959 Feasibility Study with current land use were evaluated. A 1960 Special Assessment District Base Map with 2015 boundaries are shown in Appendix C. Appendix D includes the 2015 Special Assessment District Base Maps and the 2015 Assessment Roll is shown in Appendix E. Cost of the preliminary Duck Lake Level Control Study, additional studies, maintenance and improvements will be paid by the Special Assessment District. A 2015 Recommended Special Assessment District and Assessment Roll has been prepared. The Part 307 Dam Inspection was completed in June 2015 and is located in Appendix F.

INTRODUCTION

Duck Lake (Exhibit 1) is located approximately 15 miles southwest of Traverse City, near the Village of Interlochen in Grand Traverse County, Michigan. The Lake's drainage area is 35 Sq. Mi. and the surface area is approximately 1930 acres in size. The lake outlets into the Betsie River that flows to the southwest and outlets into Green Lake, then continues to flow out of Green Lake to the west. Substrates in Duck Lake consist mostly of sand, marl and organic matter. The surrounding area is hilly and mostly forested, although some subdivisions are present as well. There are some large wetland complexes nearby. The shoreline is fairly developed with homes and cottages. Most of the developed areas around Duck Lake have septic systems.

Interlochen State Park is located on the western shore between Duck and Green Lakes. Interlochen State Park was the first state park in Michigan, dedicated in 1917. The only other publicly owned land on Duck Lake is some state-owned forest near the southern tip of the lake. Public access to Duck Lake is available at Interlochen State Park, which hosts two boat launches.

EXHIBIT 1 - LOCATION MAP



Reference: Michigan Department of Natural Resources and Environment status of the Fishery Resource Report 2012-128

NATURAL RESOURCES AND ENVIRONMENTAL PROTECTION ACT 451 OF 1994 (EXCERPT) 324.30703 PRELIMINARY STUDY; COSTS; CONTENTS OF STUDY

A. Feasibility of a Project to Establish and Maintain a Normal Level of the Inland Lake.

The lake level was established in 1959 and the Dam was constructed in 1960. Therefore, the feasibility to establish and maintain the lake level has been proven and has been functional since 1960.

A normal or summer lake level elevation of 837.3 NVGD29 was established in 1959 in accordance with the Inland Lake levels Act 194, P.A. 1939 and the existing Lake Level Control Structure (Dam) was installed in 1960. The existing dam is in fairly good condition; however, Spicer Group is recommending minor maintenance in accordance with the June 2015 Dam Inspection Report. Recommendations include leaving the established legal summer lake level as is and establishing the lake level six (6) inches lower during the winter months.

B. Expediency of the Normal Level Project

In this case there are not any functional changes proposed to the existing control structure which makes the expediency of the project already established. The expediency of the normal lake level project was examined at length in the 1959 Duck Lake Level Report of Special Investigation (Appendix B) and a review of the 1959 Investigation indicated the project was appropriate and proper. The project has benefited Duck Lake residents, the township and county.

C. Feasible and Prudent Alternative Methods and Designs to Control the Normal Level

Alternative methods and designs to control the normal lake level considered include:

1. Do nothing or maintain the existing Lake Level Control Structure and legal Lake Level elevation of 837.3 NVGD29.
2. Maintain System as is with minor maintenance and incorporating a winter lake level.
3. Reconstruct the existing Lake Level Control Structure and maintain the legal lake level elevation of 837.3 NVGD29.
4. Reconstruct the Lake Level Control Structure and establish new Lake Levels in accordance with the Natural Resources and Environmental Protection Act 51 of 1994, Part 307 commonly known as the Inland Lake Level Act.

Alternative No. 2 is the recommended feasible and prudent alternative. Maintain the System as is with minor maintenance and incorporate a target winter lake level 0.5 feet below the summer lake elevation of 837.3 NVGD29. Alternative No. 1 was determined to be a less prudent alternative since it did not contain a seasonal adjustment. The seasonal

adjustment of a target winter lake level of 0.5 feet below the summer lake level was determined to prevent erosion, be more protective of natural features of the lake and existing shoreline, and to be more consistent with actual historical operation of the existing dam structure. It was further determined that Alternatives 3 and 4 were not feasible and prudent. Reconstructing the control structure would result in significant expense and would not provide any additional benefit given that the existing structure is functioning effectively. These alternatives are cost prohibitive in light of their minimal benefit.

D. Estimated Costs of Construction and Maintenance of the Normal Level Project

Since the project was constructed in 1960, there will be no costs for construction and the cost of maintenance for 2015 is located in the June 2015 Dam Inspection Report located in Appendix F.

E. Method of Financing Initial Costs

It is recommended that future project cost, initial study, and future maintenance costs be financed by the proposed 2015 Duck Lake Special Assessment District. Maps of the proposed district are located in Appendix D and the Assessment District is shown in Appendix E.

F. Necessity of a Special Assessment District and the Tentative Boundaries

It is necessary to establish a Special Assessment District to pay for the re-establishment and maintenance of a Legal Lake Level. The proposed assessment district includes the landowners who have lake-frontage property, those that have deeded and/or open access to the lake.

To establish the recommended 2015 Special Assessment District a review of property records, aerial photographs, subdivision plats, along with the 1960 and draft 2012 Special Assessment District Base Maps provided by the county were completed. Also, additional field reviews and surveys were completed. The maps provided in Appendix D show the properties and the recommended limits of the Special Assessment District.

G. Other Information that the County Board resolves is Necessary.

A current survey of the elevations at the Dam and around the lake was requested, and the current survey information be converted from the NGVD29 elevations to NAVD88 elevations and that the dam and areas around the lake be surveyed in NAVD88. This information is shown in Appendix A and Exhibit 4, shown on page 8. A current road system map and parcel base map was also requested this map shown in Exhibit 5 on page 10.

1959 FEASIBLITY STUDY REVIEW

The expediency of the normal lake level project was discussed at length in the 1959 Duck Lake Level Report of Special Investigation (Appendix B). A review of the 1959 Investigation indicated the project was advantageous, appropriate, practical and proper. The project benefits Duck Lake's residents and the township. The Inland Lake Levels Act of 194, P.A. 1939 was used to implement the action of setting the Lake Level at elevation 837.3 NVGD29, and we recommend this established lake level remain as is. The Parks and Recreation Division of the Department of Conservation (currently known as MDNR) concurred with the 837.3 summer lake level. In addition, available riparian owners agreed with the 837.3 elevation in 1959. Occasional field checks on Duck Lake Levels from 1938 to 1959 indicated the lake ranged from elevation 836.6 and 837.78.

Engineering calculations at the time indicated the maximum level expected to result from a 25-year storm run-off is elevation 838.2 and would not cause serious damage to existing structures. According to MDEQ the 1% chance of occurrence or 100-year peak discharge into the lake is 240 cfs. See Exhibit 2 for MDEQ's Hydrology and Flood Discharge Information. This information was based on a 1985 gauge regression. Spicer Group recommends a detailed hydrology and hydraulics analysis be completed for at least the 100-year and 500-year floods. A detailed HEC-RAS and TR-20 analysis would determine more accurate water surface elevation in Duck Lake and the downstream channel.

EXISTING DAM

The Lake Level Control Structure (Dam) was built in 1960 based on the Dam Inspection Report completed by Jeremy L. Wade of Gourdie-Fraser in December 2012. The Dam was installed on the northwest shore of Duck Lake. The narrows is located southwest of the Dam and is approximately 300 feet in length and varies in width from 18 feet to 100 feet. (See Exhibit 2 for Aerial View of Dam and Narrows) It does not appear that the narrows were constructed but rather a natural area formed at the Lake's outlet. This area serves as the southwest embankment of the dam (See Exhibit 4 for Dam Profile and Cross Sections Downstream). Spicer Group recommends ownership of this area and the Dam be verified by a licensed surveyor since both the Assessment District and MDEQ Inventory indicate the Dam is located on Property ID 07-021-001-00, a private landowner.

The existing Dam is in fairly good condition; however, Spicer Group recommends selective tree removal from the narrows southwest of the Dam. In addition, we recommend considerations should be given to repairing the concrete surface of the Dam epoxy, and additional riprap be placed on the right and left abutments downstream of the Dam. See Appendix E, June 2015 Dam Inspection Report for additional details.

EXHIBIT 2 - LAKE LEVEL CONTROL STRUCTURE (DAM)

DUCK LAKE DRAIN

GRAND TRAVERSE COUNTY, MICHIGAN

GRAND TRAVERSE COUNTY DRAIN COMMISSIONER – KEVIN P. Mc ELYEA, L.L.A.

N

0 75 150 300 600

SECTION 14–15, 21–23,
26–28, & 34–35
T.26N.–R.12W
GREEN LAKE TOWNSHIP
GRAND TRAVERSE COUNTY,
MICHIGAN

BY	MARK	REVISIONS	DATE

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DUCK LAKE DRAIN
GRAND TRAVERSE COUNTY, MICHIGAN

EXHIBIT 2
LAKE LEVEL CONTROL
STRUCTURE (DAM)

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DE. BY: TAM DR. BY: TAM	CH. BY: TDB APP. BY: LJP	PROJECT NO. 122289SG2015
STDS.	SHEET 1 OF 1	
DATE JULY, 2015 SCALE 1" = 300'	FILE NO. EXHIBIT 2	2

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EXHIBIT 3

Department of Environmental Quality

Michigan.gov

Flood Discharge Request Record 20000061

7/14/2015

Discharge Information

Watercourse:	BETSIE RIVER		
Location:	Duck Lake Dam # 1952	Drainage Area:	34.63 mi^2
Basin Name:	04 - Betsie	Contributing Area:	33.65 mi^2
County:	Grand Traverse	Tn/Rng/Sec:	26N12W/22
Township:	Green Lake	Latitude:	44.642831
Quad Name:	Lake Ann	Longitude:	-85.751162
Quad ID:	L19NE		
Requested By:	Equity Resource Environmental	Received Date:	2/22/2000
Request Type:	Floodplain	Issued Date:	2/25/2000
File Number:	20000061	Reference Number:	

Discharge Frequencies:	Volume Frequencies:
10%: 150 cfs	
2%: 200 cfs	
1%: 220 cfs	1%:
0.5%: 240 cfs	0.5%:
0.2%: 270 cfs	

Access to the Flood Flow Database is provided as a service to allow you to check the status of your flood flow requests or to view discharges from previous requests for preliminary design purposes. The discharges values are only valid for the original requestor and for one year after the original request date. To obtain discharge information from the Hydrologic Studies Program, a flood flow discharge request form may be submitted electronically to the DEQ. A written or email response to your request will be returned to you and must accompany your permit application.

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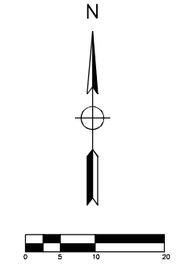
EXHIBIT 4 - LAKE LEVEL CONTROL STRUCTURE (DAM) DETAIL

DUCK LAKE DRAIN

GRAND TRAVERSE COUNTY, MICHIGAN

GRAND TRAVERSE COUNTY DRAIN COMMISSIONER – KEVIN P. Mc ELYEA, L.L.A.



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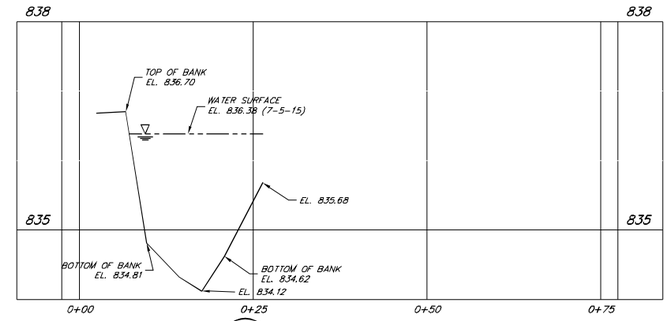
T.26N.–R.12W
GREEN LAKE TOWNSHIP
GRAND TRAVERSE COUNTY, MICHIGAN



B / 4 SECTION
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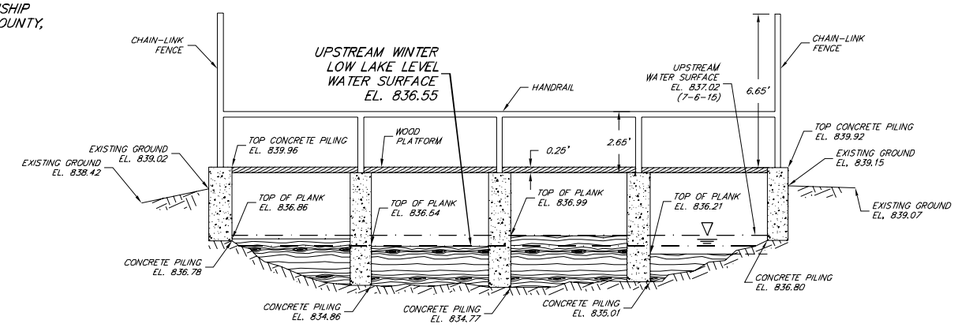

C / 4 SECTION – UPSTREAM ELEVATION VIEW
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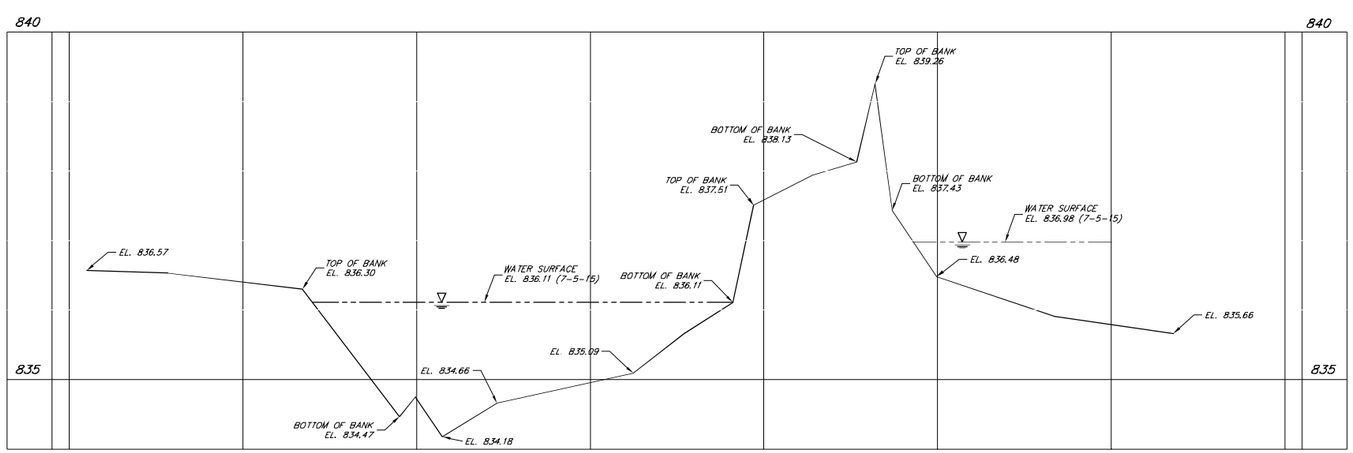

A / 4 SECTION
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BY	MARK	REVISIONS	DATE

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DUCK LAKE DRAIN
GRAND TRAVERSE COUNTY, MICHIGAN

EXHIBIT 4
LAKE LEVEL CONTROL STRUCTURE (DAM) PROFILE & DOWNSTREAM CROSS SECTIONS

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DATE JULY, 2015
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1959 FEASIBILITY STUDY WITH CURRENT LAND USE

There has been a considerable amount of development around the lake over the last 56 years from 1959 to the present. See 1960 and 2015 Special Assessment District Base Maps in Appendices C and D.

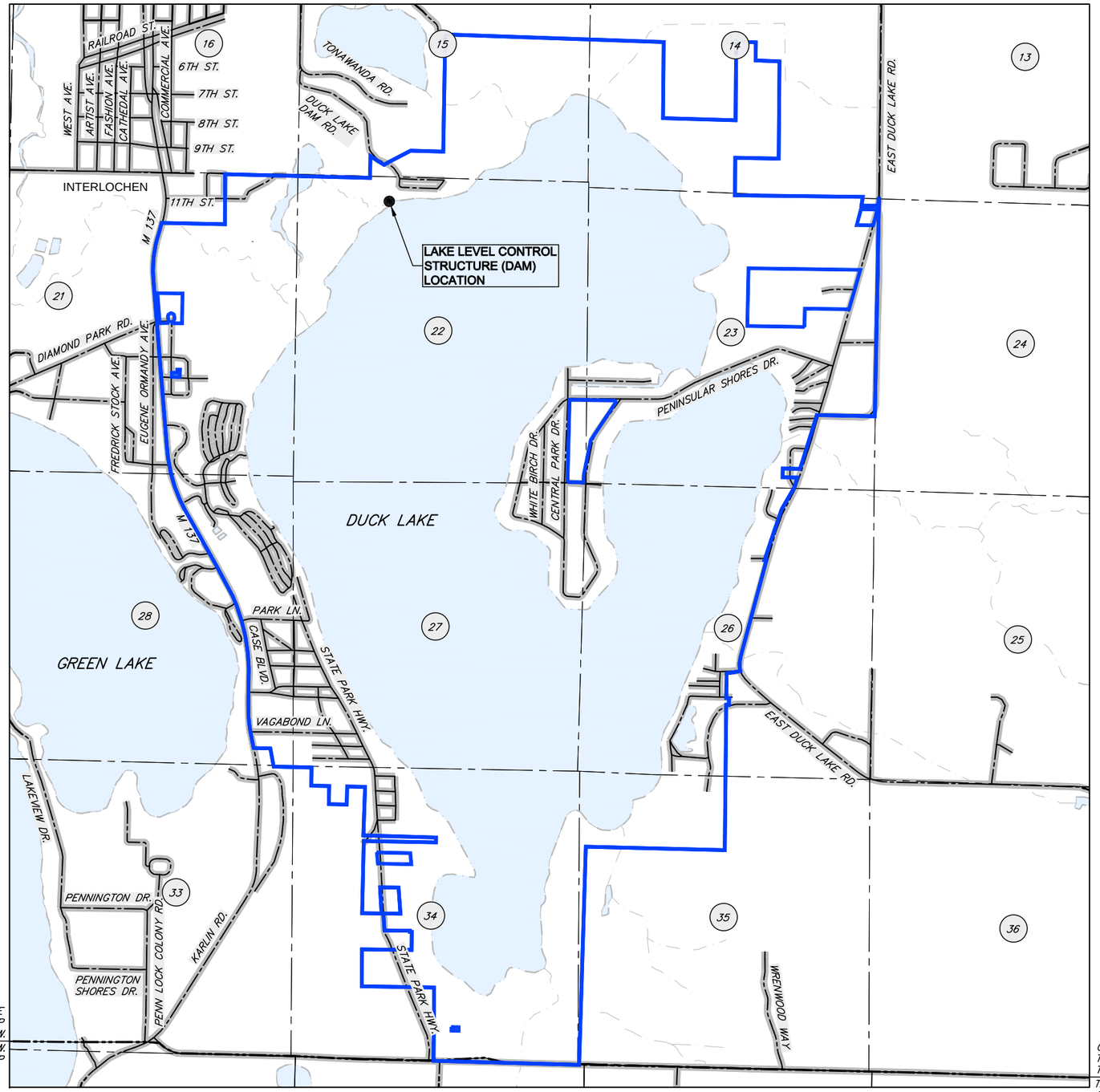
The total drainage area is 35 Sq. Miles and development around the lake would probably not have much of an effect on hydrology and hydraulic calculations; however, Spicer Group recommends detailed hydrology and hydraulic calculations with a minimum of 100 and 500-year rainfall events. This may require additional surveys of the outlet channel, Green Lake and the Betsie River and would provide more accurate lake level information.

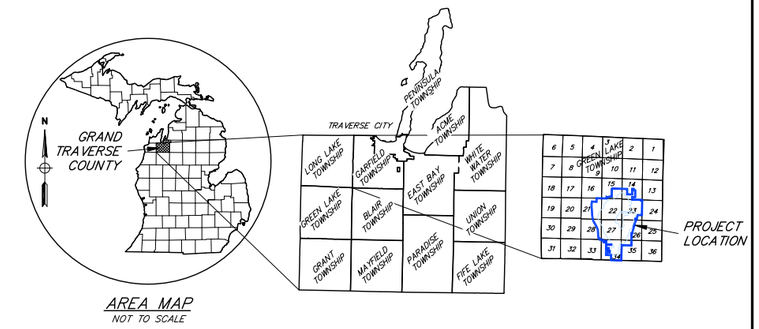
The development from 1959 to present has resulted in a considerable amount of additional septic systems being installed around the lake. These additional septic systems may eventually affect lake water quality and consideration should be given for additional sanitary studies. A central sewerage system located west of Duck Lake south of Interlochen provides services for some of the residents on Duck Lake; however, an additional central sewerage plant or plants would improve water quality if needed.

EXHIBIT 5 - CURRENT ROAD SYSTEM

GRAND TRAVERSE COUNTY, MICHIGAN

GRAND TRAVERSE COUNTY DRAIN COMMISSIONER – KEVIN P. Mc ELYEA, L.L.A.





AREA MAP
NOT TO SCALE

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0 50 100 200 400

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GREEN LAKE TOWNSHIP
GRAND TRAVERSE COUNTY, MICHIGAN

LEGEND

- DISTRICT LINE – DUCK LAKE 2012 DRAINAGE DISTRICT BOUNDARY
- ROAD
- PROJECT DRAIN
- OTHER WATERCOURSES
- MUNICIPAL BOUNDARY
- SECTION

* HORIZONTAL CONTROL:
SPC–MI S–ZONE 2113 WGS 84 GEOID '03

PROJECT DATUM	
HORIZONTAL:	STATE PLANE CENTRAL MI '83 2113
VERTICAL:	NORTH AMERICAN VERTICAL DATUM '88
GIS DATA SOURCE:	PARCELS: GRAND TRAVERSE COUNTY, 3–4–2015

BY	MARK	REVISIONS	DATE

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DUCK LAKE DRAIN
GRAND TRAVERSE COUNTY, MICHIGAN

EXHIBIT 5
CURRENT
ROAD SYSTEM

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STDS.	SHEET 1 OF 1	
DATE JUNE, 2015 SCALE 1" = 1,000'	FILE NO. FIGURE 5	1

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FEASIBILITY OF LOWER LAKE LEVEL IN WINTER MONTHS

According to MDEQ the "Dam is not regulated under Part 315." The Lake Level Control Structure is a low hazard dam regulated under Part 307, Act 451 of 1994.

Since lake levels can be set by raising or lowering the wooden planks in the Lake Level Control Structure (Dam) it is possible to set a winter lake level 0.50 foot lower than the legal summer level elevation of 837.05, NAVD88. Setting a winter low lake level elevation of 836.55 is feasible. Lake level elevations vary throughout the year depending on rainfall, runoff, evaporation, evapotranspiration, soil infiltration air, soil, and water temperature. From April 1 through October 31 the current operational maintenance level is 837.05, NAVD88. The proposed winter low lake elevation will be achieved by removing boards in the Lake Level Control Structure to achieve an operational maintenance low lake level of 836.55, NAVD88 from November 1 through March 31.

The current summer level of 837.3 appears to be adequate and acceptable; however, setting a lower winter low lake level would have some of the more common advantages and/or disadvantages of having summer and winter lake levels as follows:

Advantages

I. Provide for stabilized water levels to protect property values and the lake environment.
II. Maximize recreational benefits.
III. Provide for a winter drawdown level to
   A. Minimize shoreline ice damage.
   B. Minimize erosion damage during periods of high water in the fall and spring.
   C. Minimize flooding by providing a cushion against high water, particularly in the spring.
   D. Control of some aquatic weeds.
IV. Maximize fisheries, wildlife and aesthetic values.
V. Place responsibility of maintaining the desired lake level(s) in the hands of the County Drain Commissioner, or other authority designated by the County Board.
VI. Provide a means whereby all benefited property owners and political subdivisions share in the cost of maintaining the necessary lake level control facilities.
VII. Liabilities for accidents at the control structure may be insured by the County at a lower cost.
VIII. The cost of repairs and maintenance at the control structure may be spread over a period of years and is tax deductible for Federal returns, if the tax payer itemizes.

Disadvantages

I. Costs are incurred in establishing normal (legal) levels; i.e. costs of studies and surveys, court costs, cost of preparing assessment roll and noticing, cost of acquiring, constructing, operating and maintaining the control structures necessary for maintaining the legally established level(s). These costs are normally passed along to the benefited property owners by special assessment.
II. Length of time to get a legal level(s) established can be long, (one year or more).
III. Stabilizing lake levels can have an adverse impact on pike spawning, if flooding of marshes on the lake fringe is reduced or eliminated during pike spawning periods.

PROPOSED SUMMER AND WINTER LAKE LEVELS

Spicer Group recommends the current summer elevation of 837.05, NAVD88 remain as is from April 1 through October 31. We recommend the winter lake level be set at a low lake level elevation of 836.55 NAVD88 from November 1 through March 31.

CONCLUSION AND RECOMMENDATIONS

Spicer Group recommends the following:

1. Leave legal summer lake level as is at 837.3 NGVD29 = 837.05 NAVD88.
2. Set winter low lake level 0.50 feet lower at 836.8 NGVD29 = 836.55 NAVD88. Consideration should be given to mailing out a questionnaire regarding proposed lake levels to landowners for input and conduct a public meeting.
3. Perform minor maintenance, clearing and additional riprap, on the Lake Level Control Structure.
4. Consideration should be given to repairing minor cracks in concrete dam with epoxy.
5. Perform detailed Hydrology and Hydraulics calculations on the Duck Lake and downstream channel to upgrade the Hydrology and Hydraulics data.
6. Conduct detailed land survey of Dam and Narrows to determine ownership.
7. Explore grant opportunities to install electronic remote sensing equipment that monitor the lake level.