AGENDA

CHARTER TOWNSHIP OF
MERIDIAN
TOWNSHIP BOARD
SPECIAL MEETING
September 29, 2015
6:00 P.M.

1. CALL MEETING TO ORDER
2. PLEDGE OF ALLEGIANCE
3. PUBLIC REMARKS*
4. DISCUSSION OF POTENTIAL IMPROVEMENTS TO THE DANIELS DRAIN
5. PUBLIC REMARKS*
6. ADJOURNMENT

***PUBLIC REMARKS (Any topic - 3 minutes per person)**
****PUBLIC COMMENT (Agenda item specific - 3 minutes per person)**

Individuals with disabilities requiring auxiliary aids or services should contact the Meridian Township Board by writing or calling the following: Township Manager Frank L. Walsh, 5151 Marsh Road, Okemos, MI 48864-1198. (517-853-4258) — Ten days notice required.

Meridian Township exists to create a sustainable community through the most effective use of available resources that achieve the highest quality of life.

MEMORANDUM

TO: Township Board

FROM: Derek N. Perry, Assistant Township Manager
Director of Public Works & Engineering

DATE: September 25, 2015

RE: **Daniels Drain Neighborhood Meeting**

As requested by the Township Board, a notice (attached) was sent to residents of the Daniels Drain drainage district inviting them to the neighborhood meeting being held on September 29, 2015 at 6 pm in the Township Hall. The purpose of the meeting is to inform the property owners of the requested project to improve the pond and the associated drainage infrastructure.

To accomplish this goal, representatives of The Ponds Condominium Association will be present to provide an overview of their request to the Township Board and the residents. In addition, the Ingham County Drain Commission (ICDC) will also be present to provide information to the attendees on how a drain project would proceed and be funded if the Township Board were to petition the ICDC.

We have also requested that the Michigan Department of Transportation (MDOT) also be in attendance to provide information on how they may participate in the project if it's approved. They have an interest because a portion of Grand River Avenue and its associated drainage structures are in the proposed project district.

Ms. Stacy Hissong, from our Township Attorney firm, will also be available to answer questions from the Township Board regarding drain projects and all their complexities including process and funding mechanisms.

For your reference we have also included project information previously provided to the Township Board that was given to us by representatives of The Ponds Condominiums.

CHARTER TOWNSHIP OF MERIDIAN

09/21/15

RE: INVITE TO SPECIAL MEETING TO DISCUSS POTENTIAL DRAIN PROJECT

Dear Resident:

You are cordially invited to attend a special meeting of the Meridian Charter Township Board on **TUESDAY, SEPTEMBER, 29, 2015 AT 6 PM** at the Meridian Township Hall to discuss a potential project to improve the Daniels Drain and its pond. You are being invited because you own property in the drainage district and your property contributes to the drain. As a contributor, you may be assessed to pay for a portion of the improvements if the Township Board approves a project, and proceeds to petition the Ingham County Drain Commissioner.

These drain improvements have been requested by members of The Ponds Cooperative Homes, Inc. ("The Ponds"); and the Township Board and administrative staff would like to solicit your opinion on the project and your willingness to fund these improvements before considering moving forward. The Ponds and their technical advisors, GEI Consultants, are requesting that several improvements to the drain be implemented. A few of those improvements include: removal of sediments, chlorides and other potential pollutants from the pond, installation of pre-treatment basins and nutrient filtering features and the replacement of failed pipes.

On Tuesday evening, members of The Ponds and their technical advisors, GEI Consultants, will be providing a presentation to you and the Township Board to provide additional details and a more comprehensive overview of the project that they would like to see occur. In addition, representatives of the Ingham County Drain Commission will also be in attendance to describe the drainage improvement and assessment process and how a potential project would move forward and be implemented if they are petitioned by the Meridian Township Board.

We look forward to your attendance and your comments. If you have any questions regarding this project or the special meeting, please feel free to contact the Meridian Township Department of Public Works & Engineering at 517-853-4440.

Respectfully,

Derek N. Perry
Assistant Township Manager
Director of Public Works & Engineering

July 30, 2015

NECESSITY OF DANIELS DRAIN IMPROVEMENTS
EXECUTIVE SUMMARY

1. **HISTORY**: The Daniels Drain is a Chapter 20 drain created in the 1970s to provide drainage of certain lands largely located south of Grand River Avenue (M-43) in Okemos between Marsh and Cornell Roads. The constituent public entities of this Chapter 20 drain are Meridian Township, Ingham County Road Department and the Michigan Department of Transportation ("MDOT"). The drainage district includes a detention pond which was designed with an inlet of 48 inches from the south and one outlet of 18 inches to the north where it discharges to a pipe located under Grand River Avenue. In the late 1980s, a 144 unit condominium complex was built around the approximate 2.5 acre pond; that complex is owned by The Ponds Cooperative Homes, Inc. ("The Ponds"), which was formed as nonprofit corporation. Other than general maintenance, the drain has received no other attention, although the Drain Commissioner with funds provided by Meridian Township and The Ponds paid for a study in early 2015 to reassess the surface water drainage for possible future reapportionment of Drain District costs.

2. **PHYSICAL CONDITION OF THE DRAIN**: The pond, as initially enjoyed by The Ponds, was encircled by desirable wetland and wood vegetation, as well as improved asphalt trails and outdoor lighting. The pond supported normal aquatic vegetation and a healthy fish population. The pond benefited not only the condominium unit owners and residents but also other nearby residents and visitors who can gain access from the north and south of the condominium complex. Conditions have deteriorated over time due to the evolved drainage. The 2.5 acre pond actually drains additional water from the south as another 40 inch plus drain inlet was added to the south. In addition, sheet and other drainage from the north has increased due to the expansion of Grand River Avenue from two lanes to five lanes. The 2015 study for the Drain Commissioner has confirmed the increase in drainage area. The pond has received sediments that have accumulated in the pond; pond water levels have increased; drain pipes have deteriorated to the point that sinkholes have developed, and the connecting pipe from the pond to the north side of Grand River Avenue has collapsed.

3. **ENVIRONMENTAL STATUS OF DRAIN**: As largely supported by the attached draft report of GEI Consultants, the Daniels Drain has caused serious environmental damage to the pond and likely damage underneath the pond and in downstream waters from the pond. Testing of sediments in the pond show elevated chlorides and phosphorus. Chlorides are largely the result of nearby road salt application by both MDOT and the Ingham County Road Department. Phosphorus is largely the result of fertilizer application, particularly from neighborhoods west, south and east of The Ponds complex. The Ponds has not used chloride and phosphorus fertilizers. The turbid condition of the pond and chlorides found in the pond have destroyed healthy aquatic vegetation. In addition, the phosphorus in certain areas close to the bank has created algal blooms. Very likely, groundwater is contaminated as the pond does not appear to have an impermeable bottom or liner. Those conditions, along with the sediment addition, have resulted in a substantial loss of the previous fish population.

Furthermore, the sedimentation, along with drain pipe collapse at the outlet and the added water from two inlets, has caused pond water levels to rise, inundating wetland vegetation and trees which have died. In fact, over 75 trees have died. The pollution and impairment of natural resources is severe and substantial.

4. **IMPACT ON THE PONDS FROM DANIELS DRAIN**. The Ponds faces a significant crisis as the condition of the pond is vital for maintaining and attracting condominium unit owners. The recent recession in particular has caused The Ponds to take over 40 units which should be brought back on the market and sold to insure the nonprofit entity's survival. The continued uncertainty and delay affects the retention of existing unit owners, possible resale of repossessed units and normal sale and purchase of existing units. The Ponds also cannot make vital long term improvements to parking areas or add features such as a community center for its residents, when those areas could be torn up and required for the drain in the future. The Ponds is finally saddled with significant safety issues posed by sinkholes, flooding that occurs with heavy rains and poor drainage, and inadequate trail lighting caused by electrical shorting resulting from elevated water around the pond.

5. **NEEDED COUNTERMEASURES AND IMPROVEMENTS**. The Daniels Drain requires prompt and significant improvements. Based on discussions with the Drain Commissioner and GEI Consultants, which has considerable experience in drain matters, The Ponds submits that sediments from the existing pond and drains must be removed, the existing pond must be lined and enlarged, existing pipes (which may not have reinforced concrete or other suitable structure) must be replaced, and forebays and rain gardens must be added to properly manage storm water and prevent or minimize future pollution. The Ponds, in addition to accepting the process for a reasonable and fair apportionment of its share to future project costs, stands ready to assist a project through possible contribution of property for forebays and rain gardens, temporary storage of excavated material and possible acceptance and deposit of sediments on its property, as long as they are not severely contaminated. This project appropriately should be timed to take advantage of MDOT's current commitment to provide resources and in anticipation of possible future needs for this transportation corridor. The Drain Commissioner is prepared for this project as soon as a drain petition is filed.

THE PONDS URGENTLY ASKS THE TOWNSHIP TO APPROVE A DRAIN PETITION.

Submitted on behalf of The Ponds

Charles E. Barbieri
Foster Swift Collins & Smith, PC
313 S. Washington Square
Lansing, MI 48933
Email: cbarbieri@fosterswift.com
Telephone: 517-371-8155

GEI Consultants

Client-Attorney Privileged Technical Memo (In Draft)

To: Charles (Chuck) Barbieri, Foster Swift

From: Stu Kogge, PWS and Scott B. Dierks, PE, GEI Consultants

Date: July 30, 2015 (Update to June 30, 2015 Draft Version)

Re: The Ponds – Daniels Drain – Field & Hydrologic Modeling Assessments

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This Technical Memorandum summarizes our on-site, desktop and hydrologic modeling assessments of the water feature (pond) and its surrounding lands located within The Ponds Cooperative Homes, Inc. (The Ponds).These represent the authorized Tasks 1 through 3 of our contract agreement dated May 21, 2015. The pond is part of the Daniels Drain, an Ingham County designated drain, pursuant to Michigan's Drain Code (Public Act 40 of 1956). The assessment area includes an approximate 2.8 acre pond and its surrounding lands, located within The Ponds which is south of Grand River Avenue, east of Dobie Road, in Meridian Township, Ingham County, Michigan.

GEI's scope of services was to review all available documents and correspondence pertaining to the pond and its associated wetlands; to conduct field assessments and create a hydrologic model of the pond and its drainage area to substantiate and/or provide additional pertinent information relative to the eventual petition for maintenance work on the Daniels Drain and the associated pond.

The history of the pond that we could reconstruct from available drawings, appears to indicate that the pond was constructed sometime in the early 1970s. The pond pre-dates The Ponds development. The original drainage area shown in the drawings indicates that it would take drainage from areas to be developed to the southwest and southeast of the pond. Also, it appears likely that the drainage area the pond was originally designed for has been expanded several times since the pond's original construction.

The following is a bulleted summary of GEI's review of the existing and recently collected data as well information already provided to assist with meetings attended by MDOT, MDEQ, Meridian Township, and Ingham County Drain Commissioner staff:

Desktop Review (includes some literature reviews):

- Chlorides may get into surface water from several sources including:
  1) rocks containing chlorides;
  2) agricultural runoff;
  3) wastewater from industries;
  4) oil well wastes;
  5) effluent wastewater from wastewater treatment plants, and;
  6) road salting.

     GEI suspects road salts may be the main contributor to elevated chlorides in the pond. Sources of road salt runoff can be from the parking lots associated with The Ponds, the upstream developments and from Grand River Avenue

- Long term exposure to chloride levels above 400 mg/liter can be toxic to small minnows (fathead minnows) and macroinvertebrates (snails). Long term exposure to chloride levels above 800 mg/liter can be toxic to fish (channel catfish and carp)
- National Aquatic Life Criteria for Chloride lists the current EPA national criteria for chloride for aquatic life protection (EPA 1988).

  National Criteria
  Acute 860 mg/l
  Chronic 230 mg/l
- Chloride toxicity is linked to hardness/alkalinity – as alkalinity increases so does toxicity (Soucek et. al 2011).
- Chloride concentrations are typically higher in the sediment than they are in the overlying water (Harriss 1967)

Field Assessments:

- Based on aerial photography and field assessments the size of the open water feature (pond) and its associated wetlands were determined to be approximately 2.70 and 0.38 acres in size, respectively.

- The size of the open water feature exceeds 1.0 acres of permanent open water and therefore is defined as a "pond" pursuant to Part 303, Wetland Protection, and Part 301, Inland Lakes and Streams, of the Natural Resources and Environmental Protection Act (NREPA). The wetlands that surround this pond are immediately adjacent to, or also termed contiguous, to this pond are defined as regulated wetlands pursuant to Part 303 of NREPA.

- The general wetland and water quality of the pond was:
  - Very turbid water – there was a high amount of suspended material in the water column
  - The pond likely has high phosphorus concentrations as a result of collecting runoff.
  - Outer margins of the wetlands that surround the pond were mostly comprised of reed canary grass (*Phalaris arundinacea*, an invasive non- native plant species) and narrowleaf cattail (*Typha angustifolia,* another invasive plant but a good one).
  - The shallower and vegetated areas of the pond were comprised mostly of curly leaf pondweed (*Potamogeton crispus*, a non-native invasive species; however, it does provide cover and habitat for fish) and starry stonewort (*Nitellopsis obtusa*, a non-native invasive plant species). There were also a couple native plant species, although they were not dominant.
  - Central/deeper potions of the pond were absent of vegetation – likely due to the high turbidity (blocking sunlight penetration)
  - Deepest portion of the pond was 9 feet (in the central region of the pond); other deep areas of the pond also in the central region of the pond ranged from 6-8 feet.
  - Vegetation seemed to go sparse and then absent once we went over 4 feet in water depth.

- Bottom of pond is "soft bottom" likely covered with detrital, silts and organic matter. Part of the accretion of organic material is likely accelerated by phosphorus fertilizers washing into the pond.
- Interestingly, found peat at western end by inlet pipe from storm drain – however silty clay and and organic material over top of that peat material
- Material near the southeastern inlet pipe from storm drain was mostly sands and small gravel (likely area of initial deposition of heavier material from point source)
- Outlet end heavily covered with detrital matter, and silty clay soils (typical of depositional areas)
- The outlet of the pond/Daniels Drain, at the northeast corner of the pond, bottom substrates were comprised of silts, clays and much more detrital and organic matter, as compared to other areas of the pond. No visual signs of "panfish beds" or other fish in the shallows – not saying they are not there, but it does not appear to be a very productive pond
- According to Mr. Bob Hearitt, manager of The Ponds, there was a significant "fish winter kill" in winter 2014-2015.

- We looked at the inlets and catch basins along Grand River, the inlets, pipes and catch basins on the grounds of The Ponds and did some "windshield surveys" of the other areas contributing runoff to Walden Pond. Figure 1 shows the location of stormwater features observed and photographs taken. Our preliminary observations include the following:
  - Most drainage within The Ponds is via swale or sheet flow. The parking lots mostly drain to swale features that drain to the pond (Photographs 1,7 & 8). Most of the swales end up draining over turf grass, with little evidence of erosion at the downstream end of these features.
  - All rooftop downspouts appear to release water on the ground, just off the building walls. Several downspouts actually release water at or near the top of the rise that the buildings sit on above the pond (Photograph 3). In some of these areas, these downspout outlets are causing hillside erosion, with some of that erosion making its way into the pond.
  - Grand River Avenue runoff is contained via curb and gutter. There are several low points with inlets that collect roughly 1,500 linear feet of road runoff and direct it to the pond. There is also a roadside swale along the south side of the road that has two inlets (Photo 4) that appear to take swale drainage to the pond.
  - By far and away the largest drainage area that may contribute the greatest runoff volume is from the developed areas south of the Ponds. The drainage from these areas dumps into the storm sewer (Photograph 6) that empties into the pond. As noted, the majority of the sediment, salt and fertilizers (among other products) may originate from these areas.
  - Most of the drainage area is well-established lawn. Well-kept lawn, while potentially a source of fertilizer in runoff, is not usually a big contributor of sediment. In our experience, we have found that many small, suburban ponds experienced their most intensive sediment loading during and immediately following construction, when the surrounding area was more prone to erosion. The perceived change in pond depth is either a drop in water level or the accumulation of

organic detritus or some combination of the two.
    - There seemed to be some kind of "leakage" or drainage out of the pond beyond the outlet pipe. It is not clear if this was by design or not. Further investigation is required to verify the current situation.
- Collected six (6) sediment samples (five (5) from around the pond and one (1) adjacent to the pond) as shown in Figure 2. These samples were analyzed for chlorides at Fibertec (lab in Holt, MI). The following are descriptions and discussions of their locations, soil characteristics and chloride levels:
    - Sample #1 – within two (2) feet of the Grand River Avenue storm sewer discharge pipe located at the north end of the pond. Bottom soils are loam (mixture of sand and clay) with detrital and organic material on top.
        - Lab analysis: 220,000 ug/l (220 mg/l)
    - Sample #2 – depressed land area (not within the pond) receiving overland runoff from Grand River Avenue right-of-way and lawn area of The Ponds (parallel to Grand River Avenue). A coarse sand and gravel mixture with minimal to no organic material.
        - Lab analysis: non-detectable (less than 100,000 ug/l (<100 mg/l))
    - Sample #3 – northeast outlet end of the pond within 15 feet of riser pipe. Very silty clay texture with high amount of detrital and organic material.
        - Lab analysis: 620,000 ug/l (620 mg/l)
    - Sample #4 – eastern end of the pond in the same location as Meridian Township's water sample for chlorides was taken. Soils are mixture of sand, silt and clay with a moderate amount of detrital and organic material.
        - Lab analysis: 450,000 ug/l (450 mg/l)
    - Sample #5 – southeastern end of the pond within 25 feet of a storm water discharge pipe to the pond. Soils are mostly coarse to fine grained sands with a minimal amount of detrital and organic material.
        - Lab analysis: 130,000 ug/l (130 mg/l)
    - Sample #6 – western end of the pond within 15 feet of a storm water discharge pipe to the pond. Soils are mostly silty clay with minimal detrital and organic material overtop of fibrous peat.
        - Lab analysis: 550,000 ug/l (550 mg/l)

Preliminary Analysis of Field Data:

- The highest concentrations of chlorides were found at the storm water discharge pipe at the western end of the pond (550 mg/l) and the outlet at the eastern end of the pond (620 mg/l). The eastern end of the pond also had a high level of chlorides (450 mg/l) in the sediments. The high level of chlorides at these locations appears to be associated with high level inputs from the western storm sewer and accumulation of chlorides in the eastern end/outlet of the pond.
- Chloride levels within the surface water samples taken by Meridian Township showed similar concentrations to those of the bottom sediments in the eastern end of the pond (445 mg/l in the surface water sample taken 5/7/2015 and 450 mgl/ in the sediments).
- Chloride levels within the surface water samples taken by Meridian Township showed higher concentrations to those of the bottom sediments in the northern end of the pond (448 mg/l in the surface water sample taken 5/7/2015 and only

220 mgl/ in the sediments). This could represent a recent flush of water high in chlorides from this outfall.

- Chloride levels within the surface water samples taken by Meridian Township showed lower concentrations to those of the bottom sediments in the western end of the pond (448 mg/l in the surface water sample taken 5/7/2015 and 550 mg/l in the sediments). This could represent an accumulation over time of chlorides in the bottom substrates.
- There has been sediment loading to the pond from all of the storm sewers; however, the southern storm sewer appears to show a greater amount of coarse-grain sediment discharge as observed by the large plume of coarse sand within the small channel that leads into the pond. This channel collects much of the stormwater from offsite and to the south. This appears to be where the majority of runoff and associated pollutants come into the pond.
- Collectively, the water and sediment samples obtained by Meridian Township and GEI show elevated chloride levels within the pond.

Hydrologic Asssessment

For the hydrologic assessment, we created a model of Walden Pond and its contributing watershed. The goal of the hydrologic assessment was to determine the relative contributions of flow to the pond, infldow and outflow rates and change in pond depths for the 1-year, 10-year and 100-year rainfall events.

Following review, the Ingham County Drain Commissioner's watershed delineation for the pond was used as the contributing watershed in the hydrologic model. We also used the original design drawings for the pond layout. We measured the pond outlet structure characteristics in the field. It is not clear from the drawings if that outlet structure was original or added on at some point following pond construction. We did not perform an as-built survey on the pond and its surrounding area. This was not part of our scope, and we assumed that we could get a relative idea of pond performance, at least against the original pond design using existing data. An as-built survey would have to be performed to determine more accurately the relationship of pond water level changes due to various rain events.

We used the USEPA Stormwater Management Model (SWMM) version 5.1 to simulate the watershed and pond. SWMM is an industry standard for urban hydrologic and hydraulic modeling. It is capable of dynamically simulating rainfall, evapotranspiration, infiltration and runoff and then tracking runoff as it moves overland and flows into and through pipes, swales, streams, pump stations and ponds. We have several decades of experience applying SWMM and have also calibrated several dozen models to continuously measured water depth, flow and velocity data. This experience becomes particularly useful when we develop un-calibrated models like this one.

We have found that refining a storm water model so that it best emulates reality is like tuning an instrument with coarse and fine tuning knobs. Estimating the right amount of runoff is like turning with the coarse knob and defining the correct hydraulics of flow in pipes and ponds is like turning the fine knob. Typically, these models are most sensitive to the amount of impervious area in the watershed. Certainly for the pond, the Directly Connected Impervious Area (DICA) is the most important parameter for estimating flows into the pond.

In SWMM applications, DCIA is any impervious area such as roads, parking lots and rooftops that drain directly to storm sewer. Any impervious area that drains via curb cuts or downspouts onto lawns or other vegetated areas is not considered DCIA. This is because this water has a chance to infiltrate before making its way to stormwater infrastructure. For this model we

assumed the developed areas around the pond averaged 25% DCIA. This number comes from several studies in suburban areas where we had calibration data. It is a reasonable first cut estimate of the vaiue of this parameter.

We assumed loamy soils. The soil samples indicate a range of soils from silty clay to sand. Loam is roughly the average, particularly in its infiltration capacity, of the range of soil types found on site. We delineated subwatersheds based on 1) our presumption of The Ponds property boundary and 2) the major development areas outside of The Ponds. The subwatershed areas are shown in Figure 3 attached.

We simulated just the major inlet channel and inlet and outlet pipes. Conveyance of stormwater from the point of runoff generation to the pond is relatively short. Conveyance can delay the arrival of peak flows from distant areas. In this case, we do not believe that simulating a lot of storm sewer conveyance would substantively change our results. It might change the time it takes peak flows to arrive at the pond, but not so much that the peaks would decrease significantly below our results.

We simulated three 24-hour design rainfall events. These design rainfall events are based on long-term statistical analysis of rainfall data for this area (Huff and Angel, 1993). They are statistical creations; e.g., a one year event has approximately a 90% chance of occurring in any given year. It could not occur for two years or happen multiple times in a year. It is a long-term statistical average value. We distribute the rainfall in the model using the Soil Conservation Service Type II distribution. This is a fairly conservative distribution because more than half the rain falls in the middle two hours of the event. These rainfall distributions create high runoff peaks. For engineering analyses, it is a conservative approach.

The results of our model runs are summarized in Tables 1 and 2 below. A couple findings stand out:

1. The Ponds watershed and maximum runoff rates are the smallest of all the pond subwatersheds.

2. Maximum design water level is 862. The simulated 100-year event is very close to the maximum design water level. Given the assumptions in our analysis, maximum water surface elevation could be somewhat higher or lower. One suspects, if deposition in the pond is substantial or the pond was undersized during construction, or the outlet has less capacity than portrayed on the design, that maximum water levels would be higher. Our conclusion is this pond is at or just above or below maximum capacity. It is not clear from the drawings that the pond and its outlet were ever sized for complete build-out. If it is meeting capacity now, it appears to be at least partly out of good fortune.

3. The outlet pipe for the pond, running under Grand River Avenue, appears to have a maximum flow capacity of 25 cfs. Under the conditions of this analysis, this pipe is creating pressure flow in the pipe. It is undersized to convey peak flows from the pond outlet structure. During large rain events then part of the rise in the water surface elevation is due this pipe's under-capacity.

Table 1. Subwatershed Maximum Runoff Rates for Selected Design Rainfall Events

Subwatershed	Area (ac)	Peak Runoff Rates (cfs)		
		1-year (2.03-in)	10-year (3.43-in)	100-year (5.02-in)
1	26	14.3	30.5	53
2	45	23.5	49	84
3	68	32.5	65	109
4	28	18.4	40.8	69.5
5 (The Ponds)	16	12.5	28	47

Table 2. Pond Maximum Inflow and Outflow Rates and Maximum Water Surface Elevation for Selected Design Rainfall Events

Pond Feature	1-year (2.03-in)	10-year (3.43-in)	100-year (5.02-in)
Pond Inflow	104	217	364
Pond Outflow	16	21.9*	25*
Pond Max Water Surface Elevation (in ft above MSL)	856.8	859.3	861.4

**At these elevations, the manhole just downstream of the pond outlet would flood onto the ground. It would not be catastrophic, but it would be an indication that water in the pipe is flowing under pressure.*

Recommendations:

- Removal of sediment containing chlorides, and other pollutants not assessed to date, would improve upon the water quality of the pond and decrease chloride toxicity which is likely contributing to the apparent impact on the existing low numbers and diversity of macroinvertebrates within the pond.

- Utilization of forebays (pretreatment basins), rain gardens, bioswales, and other similar storm water management and nutrient uptake/filtering features into the current site plan may not only address chlorides but also more generally address sediment and phosphorus which carries these and other pollutants and would improve the water quality and ecology (e.g. biota) of the pond and its associated wetlands. These BMPs would also provide some additional storage capacity that would relieve potential capacity issues in the pond. Primary areas of concern include the western, northern and southern storm sewer outfalls to the pond.

- Ultimately, to most effectively improve the pond water quality, the unconsolidated and organic sediments in the pond likely need to be dredged or deactivated with a treatment like alum. Testing of sediment phosphorus levels

would verify if this is required. In our experience ponds that have been receiving runoff from suburban areas for three to four decades, likely have a significant source of phosphorus in the sediment. Even if all the runoff-associated phosphorus were now controlled, if the pond sediment has sufficient phosphorus, algae blooms and other associated issues would likely still occur..

- If The Ponds could permit a groundwater well to use to help supplement pond levels, it would help with pond temperature and water quality. The more the pond water "turns over", that is the more stagnant water is replaced with fresh water, the healthier the pond will become. The pump could be turned on and off automatically if it is tied to a float switch that has set water levels to turn the pump on and off.

- Deicing activities should be evaluated to determine if there are ways to better limit salt and/or sand accumulation in the pond. Ultimately, rain gardens and forebays may be needed to capture chloride-laden runoff.

- It is our understanding The Ponds is using phosphorus-free fertilizer. Residents in the other drainage areas should be encouraged to also use phosphorus-free fertilizer.

- While we have noted that outlet pipe is under-sized, replacing that pipe wil be very costly. Upsizing that pipe would require boring and jacking under Grand River Avenue. Depending on pipe size, that could cost several hundred dollars per linear foot of pipe. Upsizing the pipe would also mean more water is sent downstream. This could have implications for downstream properties. It may be useful to also consider steops to try and reduce peak flow volumes coming into the pond.

- The recent issues with soil failure around the outlet pipe suggest that piping, and/or pipe failure is washing away fines and creating cavities around and under the pipe. Hopefully, the cause of the failure will be diagnosed, and comprehensive measures taken to fix it. Clay cutoff walls, a concrete end structure, etc. may be measures required to fix the problem. Without doing an assessment ourselves, we cannot provide more assistance with this issue, but given that pipe travels under Grand River Avenue, whatever the fix, it should provide confidence that in the long-term the issue has been comprehensively addressed.

Literature Citations:

- Environmental Protection Agency (EPA). 1988. Ambient Water Quality Criteria for Chloride. EPA 440/5-001.
- Harriss Robert C. , *(*1967*),* SILICA AND CHLORIDE IN INTERSTITIAL WATERS OF RIVER AND LAKE SEDIMENTS, Limnology and Oceanography, 12, *doi: 10.4319/lo.1967.12.1.0008*
- Soucek DJ1, Linton TK, Tarr CD, Dickinson A, Wickramanayake N, Delos CG, Cruz LA. 2011. Influence of water hardness and sulfate on the acute toxicity of chloride to sensitive freshwater invertebrates. Environ Toxicol Chem. 2011 Apr;30(4):930-8. doi: 10.1002/etc.454. Epub 2011 Feb 11.

We look forward to discussing our report with you.
Sincerely,

GEI Consultants, Inc.

Scott B. Dierks, PE
Senior Water Resources Engineer

Stu Kogge, PWS
Project Manager/Senior Wetland/Aquatic Biologist

Attachments:

Figure 1- Location of Stormwater Features and Representative Photographs
Figure 2 – Location of Sediment Samples
Representative Photographs
Figure 3 – Walden Pond Subwatershed Map

Figure 1- Location of Stormwater Features and Representative Photographs

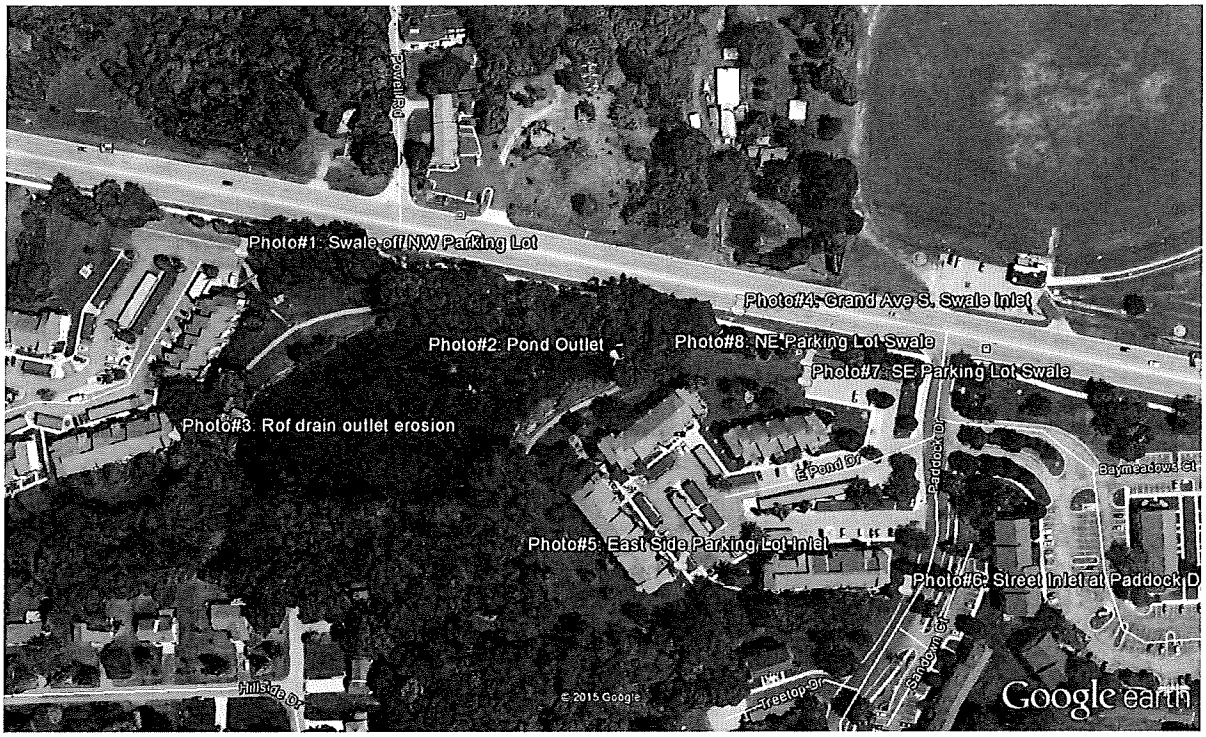
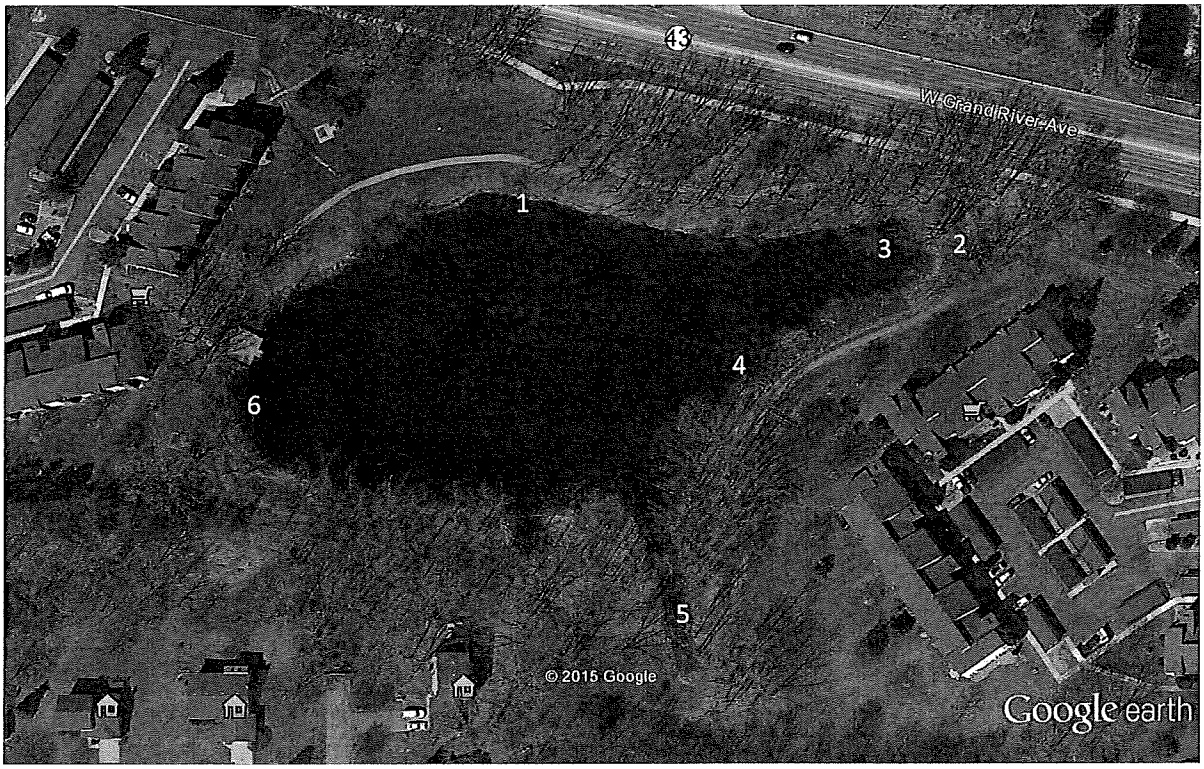


Figure 2 – Location of Sediment Samples



The Ponds – Example Photographs
GEI Consultants, Inc.

Figure 1. Swale from north corner of west parking lot of The Ponds

Figure 2. Walden Pond Outlet (note stain line at lower holes)

The Ponds – Example Photographs
GEI Consultants, Inc.

Figure 3. Erosion at roof drain outlet

Figure 4. Grand Avenue southside swale inlet

The Ponds – Example Photographs
GEI Consultants, Inc.

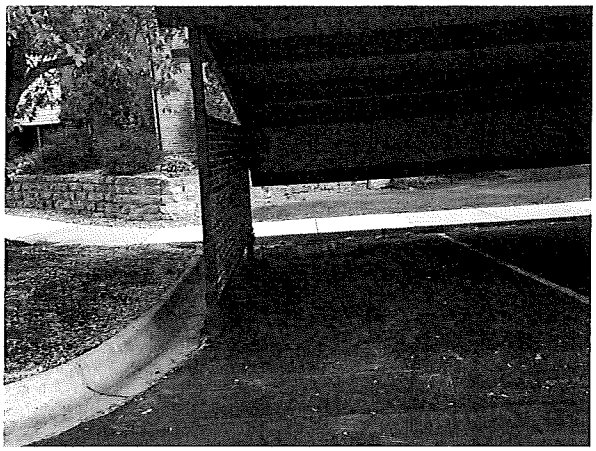


Figure 5. East side Parking Lot Inlet (to pond)

Figure 6. Street inlet on Paddock Drive

The Ponds – Example Photographs
GEI Consultants, Inc.

Figure 7. Grass swale off south corner of east side parking lot

Figure 8. Grass swale off north corner of east side parking lot

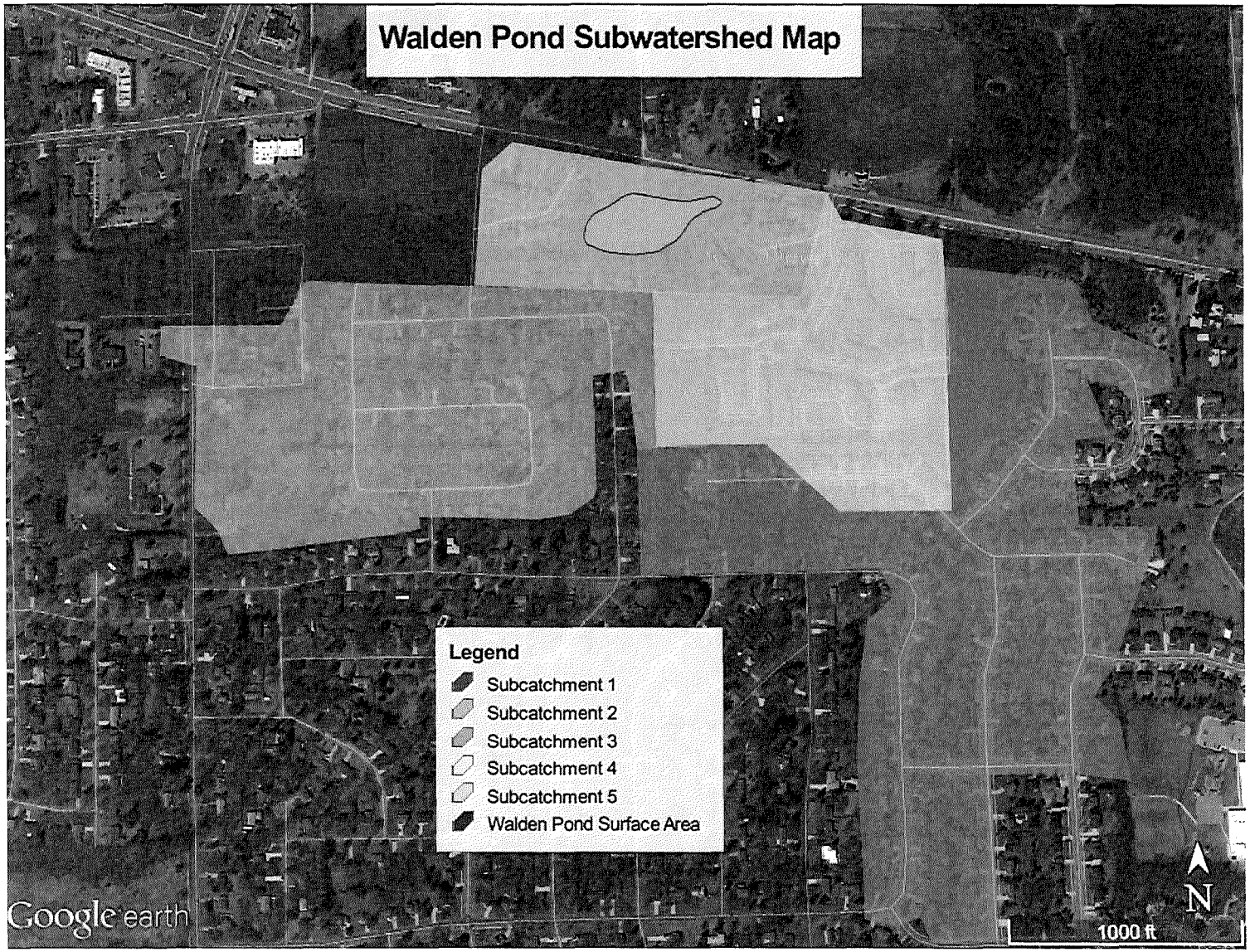


Figure 3. Walden Pond Subwatershed Map