

Cuddy Intercounty Drain

Engineering Report



Prepared for:

Cuddy Intercounty Drain Drainage Board

February 5, 2014

LAND & RESOURCE
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Common Sense • Lasting Solutions



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INTRODUCTION

Background Information

Watershed: The Cuddy Intercounty Drain (Cuddy) Watershed encompasses approximately 6.3 square miles throughout Wayland Township, Allegan County and Yankee Springs Township, Barry County as shown in the enclosed [Drainage District Map](#). Land use consists primarily of agricultural, wooded and low density residential developments. Soils are composed of fairly well draining sands and loamy sand material. A few pockets of forested wetland border the Cuddy.

Drainage: The Cuddy is a tributary to Gun Lake. The total length of established drain is approximately 3.2 miles. The headwaters of the Cuddy are located west of Fourth Street in the northeast quarter of Section 22, Wayland Township, Allegan County. The Cuddy flows southeasterly before discharging into Gun Lake, approximately one quarter mile east of Patterson Road in Section 30 of Yankee Springs Township, Barry County. Established county drain tributaries to the Cuddy, located in Allegan County, include the Vida Drain, Boot Lake Drain, Gardner Drain, Boyles Drain, Tawsley Drain and Holbrook Drain, and the Holbrook Drain Branch.

Recent Events

Patterson Road: Chronic flooding problems at the Patterson Road crossing of the Cuddy prompted the Cuddy Intercounty Drain Drainage Board (Board) in conjunction with the Allegan County Road Commission to retain an engineering consultant in 2011 to complete a study and design for a proposed crossing replacement. Construction drawings and specifications were developed for a 16-ft x 4-ft concrete box culvert. A Michigan Department of Environmental Quality (MDEQ) permit, pursuant to Parts 301 and 31 of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended (NREPA), and a Michigan Department of Transportation (MDOT) Right-of-Way (R.O.W.) permit for a proposed detour were obtained. Unfortunately, funding issues put the project on hold as the Board was denied a resolution from Yankee Springs Township to exceed the statutory spending limit.

2013 Petition: A series of severe rainfall events in April 2013 caused a failure of the crossing at First Street in Wayland Township. The failure of the First Street crossing, in conjunction with ongoing concerns over the condition of the Patterson Road culvert, prompted Wayland Township to petition the Board for improvements to the Cuddy. In addition, the petition sought to consider consolidating the Gardner Drain. The petition was filed by Wayland Township on June 3, 2013.

Hearing of Practicability: The Board held a Hearing of Practicability on September 25, 2013, at which time the petition was found practicable. Land and Resource Engineering, Inc. (LRE) was retained by the Board to complete an engineering study of the Cuddy in preparation for the Hearing of Necessity. The results and recommendations of our study are presented in this report.

PROJECT GOALS

The Board was asked to set the following goals for the project based on testimony from the Hearing of Practicability:

1. Prevent flooding on developed property (specifically the home at 2814 Patterson Road).
2. Limit debris from flowing through the Cuddy and into the navigable channel and Gun Lake, downstream of Patterson Road (Barry County).
3. Limit sediment transport from Allegan County to the navigable channel and Gun Lake, downstream of Patterson Road (Barry County).
4. Prevent or minimize *Escherichia coli* (*E.Coli*) contamination, which has been reportedly detected in the Cuddy from entering Gun Lake.
5. Ensure that the project is “fair and equitable” to all parties who will be paying assessments for drainage improvements and provide significant opportunity for public input throughout the design process.

DRAIN HISTORY

General History

Drain Establishment and Easement: The Cuddy Intercounty Drain was established in 1915. A 60-foot drainage easement is provided, 30-feet each side of the Cuddy centerline, within Allegan County. A drainage easement is established over the approximately 80-foot wide navigable channel located downstream (east) of Patterson Road in Barry County. In addition, a 30-foot wide drainage easement is provided over the Valley Park Shores subdivision lots located adjacent to the Cuddy, downstream (east) of Patterson Road.

1951 Drain Relocation: In 1951, a petitioned project was undertaken to dredge the Cuddy as well as relocate the channel east of Patterson Road, in Barry County. The outlet of the Cuddy was relocated north approximately 600-feet to its current terminus in Gun Lake. The entire channel was dredged to the historic grade shown on the enclosed [Survey Drawing \(Sheet C1\)](#). Drain bottom widths within Allegan County varied from 2-feet, upstream (west) of Fourth Street to 8-feet near Patterson Road.



1985 Dredging

1957 Valley Park Shores: In 1957, the channel downstream (east) of Patterson Road was widened to approximately 80-feet to provide a navigable channel to Gun Lake and spur the waterfront development known as Valley Park Shores subdivision. The channel bottom was dredged approximately 4-feet below the legal lake level of Gun Lake.

1985 Dredge Project: By the mid 1980's, accumulated sediment was impairing navigability along the channel, downstream (east) of Patterson Road in Barry County. A 300-foot-long sandbar had developed immediately downstream (east) of Patterson Road. The depth of sediment protruded as much as one-foot above the legal lake level of Gun Lake. The petitioned project included dredging approximately 12,000 cubic yards of sediment from the navigable channel in Barry County between Patterson Road and Gun Lake. The channel bottom was dredged to an elevation of approximately 740.3-feet (NGVD 29), approximately 4-feet below the legal lake level of Gun Lake. Dredge spoils were deposited, north of Valley Drive.



1985 Dredge Disposal

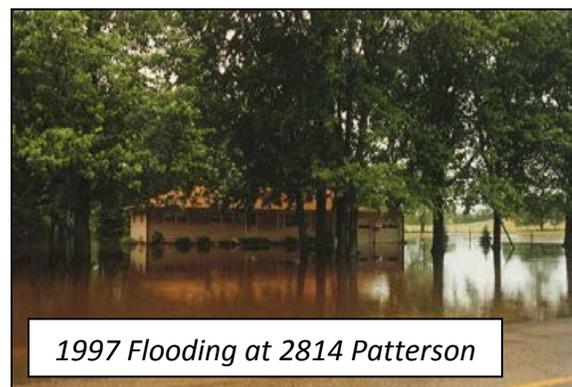
1991 Sediment Basin: Increasing sediment buildup in the navigable channel, downstream (east) of Patterson Road, prompted the Board to construct an in-line sediment basin between First Street and Patterson Road in Allegan County. The intent of the basin was to capture sediment, thereby, reducing the rate of sediment build-up in the navigable channel and frequency of required dredging. The basin was designed to capture predominately coarser grain material, such as sand, with finer suspended sediment (silt and clay) transported downstream. The sediment basin extended approximately 430 linear feet with a 2-foot deep usable sump, 8-foot wide bottom width and 3:1 (H:V) side slopes that provided up to 450 cubic yards of sediment storage. The easement agreement limits the height of spoil to 2-feet and the disposal area has been exhausted; therefore, any additional dredge material must be removed from the site.

According to Stephen Shine's (Michigan Department of Agriculture) testimony from the meeting minutes of the Cuddy Intercounty Drain Drainage Board on June 19, 1997 *"the sediment trap has done a fairly good job of keeping the drain clean"*. Tom Doyle (Barry County Drain Commissioner) commented at the Cuddy Intercounty Drain Drainage Board meeting on February 10, 2005 that *"The sediment basin was last cleaned in 2002 ... and that due to soil types, it is his opinion that cleaning the sediment basin every five years is sufficient."* The Allegan County Drain Commissioner's office indicated that the last clean-out of the sediment basin was performed in 2008. Subsequent maintenance attempts have been hindered due to the inability to locate a suitable disposal area for spoil material.

1996 Failed Petition: A petition dated August 29, 1996 was received to add the Island Drive channel located east of Patterson Road in Barry County to the Cuddy Intercounty Drain Drainage District. The petition was driven by excessive sediment build-up within the Island Drive channel. A Hearing of Practicability was held on June 19, 1997, at which time the Board found the petition project to not be practicable. The decision to vote down the petition was due to the fact that the primary purpose for establishing the proposed branch was for boat access as opposed to drainage.



1997 Patterson Road Washout: On June 20, 1997, approximately 10-inches of rain fell within a 2-hour period. The resulting flood event caused a partial washout along Patterson Road, damage to downstream (east) properties and flooding of properties west of Patterson Road, including 2814 Patterson Road. An emergency project was undertaken to repair Patterson Road and stabilize the Patterson Road crossing.



Route and Course Review

Cuddy Intercounty Drain: The original 1915 route and course description of the Cuddy extended from Gun Lake in the northeast quarter of Section 30 in Yankee Springs Township, Barry County, to approximately the center of the northeast quarter of Section 22 in Wayland Township, Allegan County. The total length of established drain was 1056 rods (3.3 miles). In 1951, the outlet of the Cuddy, east of Patterson Road in Barry County, was relocated approximately 600-feet north as part of a petitioned project, previously described.

LRE surveyed section corners within the drainage district and plotted both the original route and course description, as documented in the December 2, 1915 Final Order of Determination, and description of the relocated channel in Barry County, as documented in the July 17, 1985 Final Order of Determination. The historic route and course description closely follows the current alignment of the Cuddy, as determined by topographic survey of drain crossings and rectified aerial images of the drain provided by the Allegan County and Barry County Land Information Services (LIS) departments. Although there are a few minor discrepancies, the current alignment of the Cuddy is within the historic 60-foot drainage easement.



The current drain alignment as well as historic route and course description are shown in the enclosed [Drainage District Map](#). An updated route and course description based on survey data collected by LRE and other firms, as well as rectified aerial imagery is provided in [Appendix 1](#).

Gardner Drain: The Gardner Drain (Gardner) is an Allegan County Drain established in 1882. The route and course of the Gardner begins at the County Line (Patterson Road) and overlaps (shares the same watercourse with) the Cuddy to just east of Timber Creek Drive. The upstream terminus of the Gardner is located just west of Fourth Street in the northwest quarter of Section 26, Wayland Township, Allegan County. There are numerous discrepancies between the route and course description and actual watercourse. A “sufficient width” easement is provided over the parcels that border the Gardner.

Boot Lake Drain: The Boot Lake Drain (Boot) is an Allegan County Drain established in 1896. The Boot extends from just north of Fourth Street in the northwest quarter of Section 26, Wayland Township, Allegan County, to the southeast corner of Boot Lake in Section 27 of Wayland Township, Allegan County. There are numerous discrepancies between the route and courses description and actual water course. A “sufficient width” easement is provided over the parcels that border the Boot.

Drainage District Delineation

Historic Drainage District: A drainage district map of the Cuddy was provided for the most recent petitioned project in 1985; however, the corresponding Final Order did not provide a description of the lands to be assessed (drainage district description). The 1985 drainage district area encompassed 4,147.1 acres.

The most recent drainage district description on file is from the Final Order of the 1951 petition project. The 1951 drainage district area encompasses 3,411.3 acres as shown in the enclosed [Drainage District Map](#). Lands to be added or removed from the drainage district are based on the 1951 drainage district description.

Proposed Drainage District: Proposed drainage district boundaries developed by the LIS departments for Allegan and Barry Counties were reviewed and refined, as necessary, to accurately reflect the contributing drainage area based on available topographic contours, record drawings and field verification. Micro-topography and depression storage areas that may provide for some infiltration within the larger boundary were included in the drainage district. A description of the proposed drainage district boundary is provided in [Appendix 2](#).

The proposed Cuddy drainage district encompasses 4,037.4 acres as shown in the enclosed [Drainage District Map](#). Approximately 3,984.6 acres of land are within Allegan County and 52.8 acres of land are within Barry County. The land split between Allegan and Barry Counties is approximately 98.7% to 1.3%. A total of 759.1 acres are recommended to be removed from the 1951 drainage district and 133 acres are recommended to be added to the 1951 drainage district as shown in the enclosed [Lands Added/Removed](#) drawing.

Historic Apportionment

Minutes from the February 10, 2005 Cuddy Drainage Board meeting state:

*“When originally constructed in 1916, percentages were set with Allegan County having 92.5% and Barry County 7.5%. When the channel was dredged in 1985, thus providing Barry County residents greater benefit, the percentages were set with Barry County having 78% of the project and Allegan County having the remaining 22%. Doyle (Barry County Drain Commissioner) stated that he does not have an objection to current percentages when maintenance is done on the channel and sediment trap, but he would rather the original percentage prevail when general maintenance, such as what the Allegan maintenance crew will be doing. As Rininger (Allegan County Drain Commissioner) was in agreement, she moved that the **percentages between counties for normal maintenance be Allegan County – 78% and Barry County – 22% but when maintenance on the channel or sediment traps is done, percentages will reverse with Barry County assuming 78% and Allegan County the remaining 22%.** Motion seconded by Doyle and carried.”*

FIELD RECONNAISSANCE

Field Investigation

A field investigation of the Cuddy and Gardner was conducted on October 3, 2013 with representatives from LRE, Streamside Ecological Services, Inc. (SES) and the Michigan Department of Agriculture and Rural Development (MDARD). “Friends of the Cuddy” members, Deb Masselink and Greg Purcell, accompanied the group on the inspection of the Cuddy downstream of First Street.

The purpose of the field investigation was to assess the condition and morphological character of the Cuddy and Gardner, identify areas of channel instability and excessive sediment supply, review the condition of existing crossings, locate potential *E. coli* sources and develop a woody debris management plan. Below is a summary of our field reconnaissance by channel reach.



Cuddy at 4th St.

Cuddy – Upstream (North) of 129th Avenue (M-179):

The Cuddy is stable with fairly well connected floodplain and densely wooded riparian corridor upstream of 129th Avenue (M-179). Base flow was minimal and the upstream portion of the Cuddy was essentially dry during our inspection. Aside from some minor deadfall, the channel is relatively open and clean.



Typical Channel

The 36-inch diameter polyethylene (PE) culvert at Fourth Street is in good condition. The 24-inch diameter corrugated metal pipe (CMP) private crossing near Sta. 133+00 is in fair condition, with some rusting along the flow line and some downstream scouring of the channel bottom and banks. The 48-inch reinforced concrete pipe (RCP) culvert at 129th Avenue (M-179) is in relatively good condition.



Outfall Pipe

Three 4-inch diameter outfall pipes of suspicious origin were encountered along this reach of the Cuddy as shown in the [Survey Drawing \(Sheet C1\)](#). The outfall pipes appeared to lead toward residential septic drain fields, but additional investigation would be required to confirm this speculation.

Cuddy – 129th Avenue (M-179) to Timber Creek Drive:

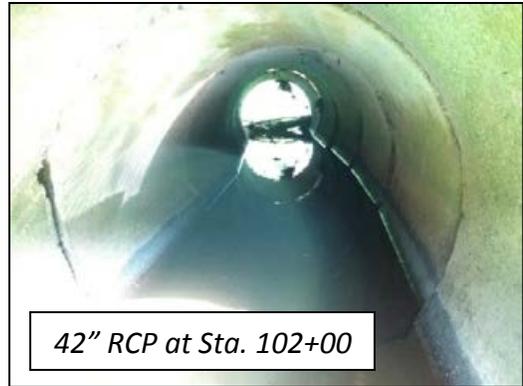
A “two-stage”, meandering low flow channel has developed within the larger dredged channel cross section downstream of 129th Avenue. Some minor scour along the toe of bank was noted near Timber Creek Drive, but in general, the channel is well vegetated and very stable. At least some level of riparian buffer exists between the Cuddy and agricultural fields. Direct surface runoff inlets are limited to only a few concentrated locations as shown in the [Survey Drawing \(Sheet C1\)](#). Subsurface agricultural tiling appears to be very limited.

The 42-inch diameter RCP/CMP private crossing near Sta. 102+00 and the 30-inch diameter RCP private crossing near Sta. 101+00 are in poor condition. The upstream CMP portion of the culvert near Sta. 102+00 has separated from the CMP culvert and the grouting used to seal the joints of the RCP has severely deteriorated. Woody debris is also partially blocking flow near the culvert inlet. The culvert near Sta. 101+00 is too short and the timber headwalls are severely deteriorated. Riprap consisting of broken concrete and brick and other measures have been installed in an attempt to shore up the crossing.

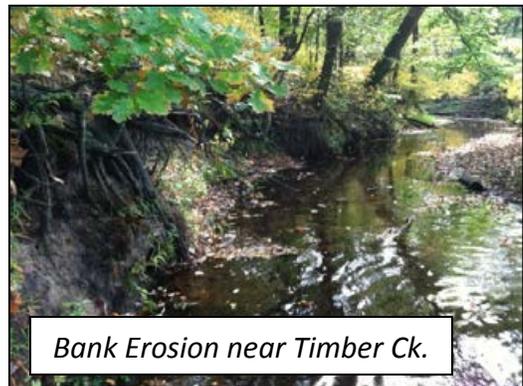
Cuddy – Timber Creek Drive to First Street: The highest degree of instability within the Cuddy is downstream of Timber Creek Drive. A significant head-cut has developed along this reach and the Timber Creek Drive culvert is now perched almost 2-feet above the normal channel bottom. Channel banks within 300-feet downstream of Timber Creek Drive are actively eroding. The channel is deeply incised with bank heights between 5 and 7 feet. Scour along the toe of bank is common with some more significant localized areas of bank erosion along channel bends. The riparian corridor is heavily wooded and although woody debris is not extensive, some fallen trees and log jams were noted. Several sediment point bars have developed along this reach as well as a large mid-channel bar in the over-widened section of channel immediately upstream of the twin culverts at First Street.



Typical 2-Stage Channel



42" RCP at Sta. 102+00



Bank Erosion near Timber Ck.

The 48-inch CMP culvert at Timber Creek Drive is in poor condition. The downstream end is undermined and the end-section has broken off and is obstructing flow through the channel. The culvert is perched almost 2-feet above the normal channel bottom and a large scour hole has developed immediately downstream of the culvert, causing channel banks to actively erode.



The twin 48-inch CMP culverts at First Street are in extremely poor condition. As noted in the introduction, a series of severe rainfall events in April 2013 caused a failure of the crossing. The culverts are damaged, undersized, severely rusted and perched more than one-foot above the normal channel bottom.



Cuddy – First Street to Patterson Road: The stability of the Cuddy improves downstream of First Street. Channel incision decreases toward Patterson Road and floodplain connection improves. In general, the channel appears to be able to transport the supplied sediment load. No significant signs of sedimentation were noted and sections of gravel substrate with more natural riffle-pool sequences was observed along this reach. The riparian corridor is heavily forested, however, woody debris within the channel is minimal.



The existing sediment basin located near Sta. 60+00 is completely full of sediment and virtually indistinguishable from the normal channel.

The twin 64-inch by 43-inch CMP arch culverts at Patterson Road are in poor condition and in need of replacement. The culverts are undersized, rusted, and perched approximately one-foot above the legal lake level of Gun Lake. The trash rack at the upstream end is bent and in poor condition.



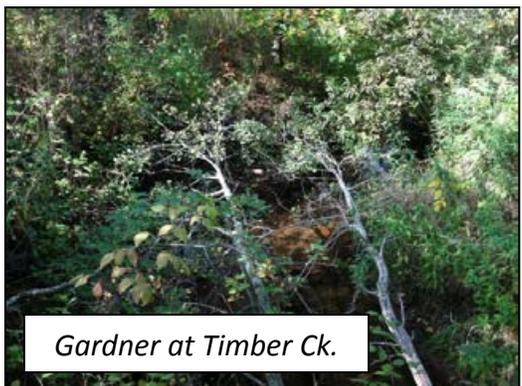
Cuddy – Patterson Road to Gun Lake: Sediment build-up continues to plague the navigable channel downstream of Patterson Road. A large sand sediment bar has developed within 300-feet downstream (east) of Patterson Road. In some areas, water depths are less than one-foot. According to local residents, approximately 1,700 cubic yards of material was dredged from this location approximately 3-years ago, most of which has filled back in with sediment. No written documents were obtained to confirm the dredge volume.



Gardner Drain: In general, the Gardner Drain is very stable and in good condition upstream of Timber Creek Drive. However, the approximately 200-foot stretch of channel between Timber Creek Drive and the Cuddy is severely impaired and unstable. Similar to the Cuddy, a significant head-cut has developed downstream of the Timber Creek Drive culvert, which is now perched almost 3-feet above the normal channel bottom. Channel banks downstream of Timber Creek Drive are actively eroding. The channel is deeply incised with bank heights of approximately 7 feet.



The 60-inch RCP culvert at Fourth Street is in good condition. The 48-inch CMP culvert at Timber Creek Drive is structurally in fair condition. However, the downstream end is perched almost 3-feet above the normal channel bottom and a large scour hole has developed immediately downstream of the culvert causing channel banks to actively erode. Therefore, the culvert is susceptible to undermining and potential failure.



Topographic Survey

LRE conducted a topographic survey of select areas along the Cuddy and Gardner, including all road and driveway crossings, on October 24, 2013. A plan and profile of the topographic survey is provided in the enclosed [Survey Drawings \(Sheets C1 and C2\)](#).

The average gradient of the Cuddy upstream of Timber Creek Drive is approximately 0.17%. The culverts at Timber Creek Drive, First Street and Patterson Avenue are perched and act as grade control structures. The average gradient of the Cuddy between Timber Creek Drive and First Street is 0.1% and between First Street and Patterson Road is 0.12%. The slope of the Gardner from Fourth Street to Timber Creek Drive is approximately 0.17%.

The channel bottom width varies from 6 to 12-feet, generally increasing in a downstream direction. The bottom width is slightly less than 6-feet in areas that have developed a low flow channel, upstream of Timber Creek Drive.

Comparison to Historic Drawings: The historic profile of the Cuddy from the 1951 petition project is shown relative to the existing channel bottom in the enclosed [Survey Drawing \(Sheets C1\)](#). The historic channel was constructed at a relatively steep gradient that was as high as 0.22% between First Street and 129th Avenue (M-179). Given the predominately sandy soils and substrate, this section would have been prone to head-cutting. The evidence of perched culverts and flatter slopes closer to 0.1%, confirm the field observations that a channel head-cut has propagated upstream to Timber Creek Drive. Rough estimates indicate that over 7,000 cubic yards of sediment has been delivered to the Cuddy from in-stream channel erosion.



Cuddy downstream 129th Ave.



Cuddy upstream 1st St



Cuddy upstream Patterson Rd.



Gardner at 4th St.

HYDROLOGIC AND HYDRAULIC ANALYSIS

A hydrologic and hydraulic analysis was performed to evaluate the hydraulic capacity of various road and driveway crossings along the Cuddy and Gardner.

Hydrologic Analysis

A discharge request was submitted to the MDEQ at each major road crossing along the Cuddy and Gardner with contributing drainage area greater than 2 square miles. For locations with contributing drainage areas less than 2 square miles, peak discharges were calculated by LRE using the methods prescribed by the MDEQ report *Computing Flood Discharges for Small Ungaged Watersheds* (Sorrell, 2010). A summary of peak discharges at each design location is provided in [Table 1](#). A copy of the MDEQ discharge request is included in [Appendix 3](#).



Table 1 – Peak Discharges

Location	Drainage Area (sq. miles)	Peak Discharge Rate (cfs)				
		Return Period and 24-Hour Precipitation Depth				
		2-Year 2.37- Inches	5-Year 3.00- Inches	10-Year 3.52- Inches	25-Year 4.45- Inches	100-Year 6.15- Inches
Cuddy at 4 th St.	0.44	11	22	33	59	121
Cuddy at 129 th Ave.	0.97	18	35	54	139	196
Cuddy at Timber Ck.	1.17	18	35	54	139	196
Cuddy at 1 st St.	5.9	40	100	160	280	600
Cuddy at Patterson	6.3	45	110	180	320	650
Gardner at 4 th St.	1.5	20	40	61	108	229
Gardner at Timber Ck.	2.1	25	45	70	120	260

cfs – cubic feet per second

Hydraulic Analysis

A hydraulic analysis of key crossings along the Cuddy and Gardner was performed using hydrologic peak discharge data and the Federal Highway Administration (FHWA) HY-8 computer program. In general, county road crossings along the Cuddy and Gardner have between a 10-year and 100-year hydraulic capacity (point at which water surface overtops the roadway). Private driveway crossings have between a 5-year and 10-year hydraulic capacity. A summary of the existing hydraulic capacity (defined as the point at which water overtops the roadway) and physical condition of each road crossing is summarized in [Table 2](#).



1st St. Culverts - Perched

Table 2 – Hydraulic Analysis of Key Road Crossings

Location	Crossing Description	Crossing Condition	Hydraulic Capacity*
Cuddy at 4 th St.	36" PE	Good	25-year
Cuddy at Sta. 133+00 (PVT)	24" CMP	Fair	10-year
Cuddy at 129 th Ave.	48" RCP	Good	50-year
Cuddy at Sta. 102+00 (PVT)	42" RCP / CMP	Poor	10-year
Cuddy at Sta. 101+00 (PVT)	30" RCP	Poor	5-year
Cuddy at Timber Ck. (PVT)	48" CMP	Poor	10-year
Cuddy at 1 st St.	Twin 48" CMP	Poor	10-year
Cuddy at Patterson	Twin 64"x43" CMPA	Poor	10-year+
Gardner at 4 th St.	60" RCP	Good	100-year
Gardner at Timber Ck. (PVT)	48" CMP	Poor	5-year

*Hydraulic Capacity – elevation at which water overtops roadway

WATER QUALITY CONCERNS

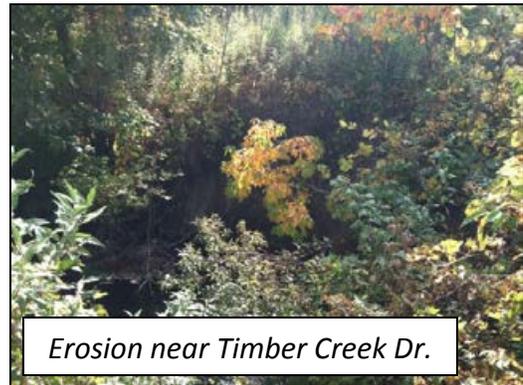
Water quality concerns related to sediment, debris and Escherichia coli (*E. coli*) have been an ongoing concern along the Cuddy. A letter from the 1985 project engineer, William B. Ruddell, PE. stated *“The major problem to be addressed is the excessive sedimentation build up in the boat channel East of Patterson Road”*. Minutes from the June 19, 1997 Cuddy Intercounty Drainage Board meeting indicate that elevated *E. Coli* levels in the navigable channel were a concern.

“The Association (Gun Lake Protective Association) is concerned about what pollutants are going into the channel from upstream farms. Tom Krueger from AAT Labs explained ... the tests are clean at the creek’s headwaters, but samples at Patterson Road reflect very high E-Coli concentrations on May 2, June 3, and June 16, 1997.”

The following is a summary of LRE and SES’ analysis of identified water quality concerns pertaining to sediment, debris and *E. Coli*.

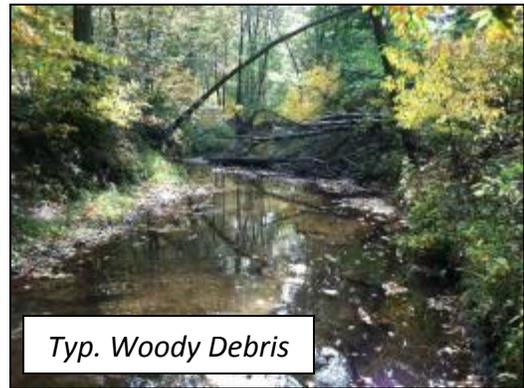
Sediment and Debris

Sediment Transport: Sediment transport is a natural phenomenon within stream systems. The presence of gravel riffle beds and minimal point bars suggests that the Cuddy is efficiently transporting the supplied sediment load. No upland sources (gully washouts, side inlets, etc.) of excessive sediment input were noted and some level of vegetative buffer is provided along nearly the entire length of the Cuddy. In general, the Cuddy and Gardner are relatively stable and the channel bottom head-cut has halted. Areas of channel instability and bank erosion are primarily limited to downstream of Timber Creek Drive and are delivering several hundred cubic yards of excess sediment to the stream system on an annual basis.



Annual Sediment Load: Due to the higher sediment transport capacity of the Cuddy, relative to the dredged (widened and deepened) navigable channel east of Patterson Road, routine dredging and maintenance of the navigable channel is unavoidable. History indicates that dredging of the navigable channel is required approximately every 30-years (original dredging in the late 1950’s, maintenance dredging in 1985 and current need for dredging). The amount of material removed during dredging operations suggests that the annual sediment load (bed load and suspended sediment load) delivered by the Cuddy is approximately 400 cubic yards. This figure was produced by dividing the roughly 12,000 cubic yards of sediment removed in 1985 over the 30-year period since the original dredging of the navigable channel, east of Patterson Road. This figure appears to be confirmed by the fact that the purported 1,700 cubic yards of material dredged immediately downstream (east) of Patterson Road over 3 years ago has been replaced by new sediment.

Debris: Woody debris (logs, leaves, etc.) is a natural and critical part of a healthy stream system, however, these items can pose a nuisance in county drain systems by obstructing flow or causing localized bank erosion. In general, the Cuddy is free of obstructions and the respective counties have done well managing woody debris. The highest concentration of woody debris along the Cuddy was noted between Timber Creek Drive and First Street, which is also the section experiencing the most instability. The densely forested riparian corridor produces a significant



Typ. Woody Debris

amount of leaf litter that can be transported downstream, where it eventually settles out in the navigable channel east of Patterson Road or Gun Lake. The proportion of stream-transported organic debris to that which builds up from the lake and surrounding properties is unknown.

E-Coli

Background Information: The following information has been copied from the State of Michigan website (http://www.michigan.gov/deq/0,1607,7-135-3313_3686_3730-11005--,00.html) to provide a summary of background information relative to Escherichia coli (*E.coli*):

“Escherichia coli (E.coli) bacteria live in the digestive systems of humans and other warm-blooded animals. Most strains of the E. coli bacteria are not dangerous, but they can indicate the presence of other disease-causing bacteria. There are a variety of sources that contribute bacteria and other pathogens to the surface water. These sources include illicit waste connections to storm sewers or roadside ditches, septic systems, combined and sanitary sewer overflows, storm (rain) runoff, wild and domestic animal waste, and agriculture runoff.

E. coli bacteria do not survive long in water. Factors such as wind and wave action, as well as ultraviolet light from the sun help to reduce the level of bacteria. The amount of time needed to reduce bacteria levels can be unpredictable, however it usually takes less than 48 hours.

It is a popular misconception that if one area of the lake is contaminated, then the whole lake is contaminated. Bacteria contamination originates from conditions or factors present on or near the shore. Two beaches on opposite ends of a lake that have different on-shore conditions will not have the same bacteria levels. This is why it is important for private homeowners who swim near their house to periodically take samples from where they swim and not rely on results from a beach located on a different part of the lake. Since contamination originates near the shore, it is generally considered safer to swim in deeper water away from the shoreline.

Water quality standards for surface waters in Michigan

Epidemiological studies of fresh water bathing beaches have established a direct relationship between the density of Escherichia coli (E. coli) in water and the occurrence of swimming-associated gastroenteritis. Recognition of this relationship has led to the development of criteria that can be used to establish recreational water quality standards. The basis for these criteria can be found in the United States Environmental Protection Agency (EPA) documents entitled, "Ambient Water Quality Criteria for Bacteria - 1986" and "Implementation Guidance for Ambient Water Quality Criteria for Bacteria -1986."

The Michigan Department of Community Health and the Michigan Department of Environmental Quality used guidance provided by the EPA to develop ambient standards for E. coli. E. coli standards for water used for total body contact recreation are provided in the Michigan Public Health Code and Rule 323.1062(1) of the Part 4. Water Quality Standards (Promulgated pursuant to Part 31 of the Natural Resources and Environmental Protection Act, 1997 PA 451, as amended). R 323.1062(1) states, "All waters of the state protected for total body contact recreation shall not contain more than 130 Escherichia coli (E. coli) per 100 milliliters (ml), as a 30-day geometric mean. Compliance shall be based on the geometric mean of all individual samples taken during five or more sampling events representatively spread over a 30-day period. Each sampling event shall consist of three or more samples taken at representative locations within a defined sampling area. At no time shall the water of the state protected for total body contact recreation contain more than a maximum of 300 E. coli per 100 ml. Compliance shall be based on the geometric mean of three or more samples taken during the same sampling event at representative locations within a defined sampling area."

Review of Resource Information: A review of existing information suggests that *E. coli* contamination may be a problem in the Cuddy. In 1997, *E. coli* was detected at seven locations within the Cuddy and Gardner (Gun River Watershed Management Plan). However, no numerical results could be found for this report.

Local resident, Ms. Deb Masselink, has been collecting and analyzing water samples along the Cuddy, Gardner and Boot Lake Drain since May 2013. Data from Ms. Masselink *E. coli* sampling are available online at <http://friendsofthecuddydrain.wordpress.com/category/water-test-data/>. Ms. Masselink's results indicate that *E. coli* pollution does exist, has often exceeded the aforementioned State of Michigan's Water Quality Standards, and is relatively widespread. However, methods for sample collection and analysis are not clear and may not have followed approved protocol.

The MDEQ Draft 2014 Integrated Report, summarizing waters of the state that are not meeting protected Designated Uses, does not include the Cuddy. The Main Beach on Gun Lake is the most proximate listing in this report, where the lake water is not meeting the designated use of Total Body Contact Recreation due to *E. coli* contamination (AUID 040500030701-06). A Total Maximum Daily Load (TMDL) for this area is scheduled for completion by 2026.

Field Investigation: SES and LRE conducted a preliminary field investigation to identify potential sources of *E. coli* contamination in the Cuddy. During this assessment, several outfall pipes were found to be entering the drain from unknown origins. None of these pipes were flowing on the date of inspection, but observation from the drain right-of-way and from aerial photography indicated that these pipes are located proximate to residential housing and septic fields. In addition to these pipes, cattle were observed within the watershed and much of the land use



adjacent the drain is row-crop agriculture. Records obtained from the MDEQ indicate that a nearby Concentrated Animal Feeding Operation (CAFO) does spread cow manure on several of these fields. Finally, widespread evidence of heavy wildlife use was observed over the entire length of the drain. Deer and raccoon tracks and feces were readily apparent in, and adjacent to, the flowing water within the drain. All of these three sources should be considered as potentially contributing to purportedly high *E. coli* levels measured in the Cuddy.

RECOMMENDATIONS

Based on our evaluation of existing conditions in respect to the project goals established at the Hearing of Practicability, the following additional study and improvements are recommended along the Cuddy as described below and as illustrated in [Figure 1](#):

1. Prevent Flooding

Replace Culverts near Sta. 101+00 and Sta. 102+00 (Private): The existing private crossings at Sta. 101+00 (Totten Property, Parcel No. 24-023-011-70) and Sta. 102+00 (Jackson Property, Parcel No. 24-023-009-10) are in poor condition and in need of replacement. We recommend increasing the culvert diameter of each crossing to 48-inches in order to convey the 10-year peak discharge without overtopping the driveway or causing erosive outlet velocities. Due to the close proximity of the two private crossings, the Board may consider approaching the landowners for their consideration of providing a single replacement culvert centered along the property line of the subject parcels.

Replace Timber Creek Drive Culverts (Private): Both the Cuddy and Gardner private crossings along Timber Creek Drive are in poor condition, perched above the channel bottom and in need of replacement. We recommend increasing the culvert diameter of each crossing to 60-inches in order to convey the 10-year peak discharge without overtopping the driveway or causing erosive outlet velocities. Appropriate grade control structures should be provided to prevent the channel head-cut from propagating upstream.

Replace First Street Culvert: The Allegan County Road Commission has completed a preliminary design for a replacement 16-ft x 5-ft concrete box culvert (with 1-foot of gravel bury). The proposed culvert will increase the level of flood protection (point at which flood waters overtop the roadway) for First Street from a 10-year (3.52-inches in 24-hours) to a 50-year (5.27-inches in 24-hours) rainfall event and reduce erosive outlet velocities. Appropriate grade control structures should be provided to prevent the channel head-cut from propagating upstream. In addition, the Tawsley and Holbrook Drain may need to be relocated, west (away from First Street), in order to accommodate the proposed culvert extension.



Due to the low traffic volume along First Street, the Board may consider installing a smaller diameter culvert that is capable of conveying a peak discharge somewhere between the 10-year and 25-year recurrence interval. This alternative will require coordination with the Allegan County Road Commission but could result in a significant cost savings of up to \$100,000.

Replace Patterson Road Culvert: The proposed 16-ft x 4-ft concrete box culvert replacement will increase the level of flood protection (point at which flood waters breach the crawl space window) for the home at 2814 Patterson Road from an existing 10-year level of flood protection to just under a 100-year level of flood protection. In addition, the proposed culvert will increase the level of flood protection (point at which flood waters overtop the roadway) for Patterson Road from a 10-year (3.52-inches in 24-hours) to a 100-year (6.15-inches in 24-hours) rainfall event and reduce erosive outlet velocities.



2. Limit Debris

Woody debris is a natural and critical part of a healthy stream system, however, it can also pose a nuisance in county drain systems by obstructing flow or causing localized bank erosion. In addition, property owners along the navigable channel east of Patterson Road are concerned that logs and other transported debris and organic matter may damage boats or hamper navigability.

Channel instability and bank erosion are the major causes of excessive woody debris within the Cuddy and are primarily limited to the reach between Timber Creek Drive and First Street. Therefore, we recommend developing a restoration/stabilization plan designed to limit bank erosion and associated woody debris as outlined below in Item 3. In addition, woody debris management, including the removal of log jams and dead or leaning trees within the drain right-of-way, should be conducted along both the Cuddy and Gardner.

Due to the potential for obstruction and associated flooding, we do not recommend that trash racks be installed immediately upstream of hydraulically critical structures such as culverts. Opportunities for debris catchers within open portions of the drain system, such as the sediment basin, may be possible. However, regular maintenance is generally the best approach to managing woody debris and minimizing the potential for adverse impacts downstream.

3. Reduce Sediment Load

Sediment transport is a natural phenomenon within stream systems. Due to the higher sediment transport capacity of the Cuddy, relative to the dredged (widened and deepened) navigable channel east of Patterson Road, routine dredging and maintenance of the navigable channel is unavoidable. The estimated average annual sediment load delivered to the navigable channel, east of Patterson Road is approximately 400 cubic yards per year. We recommend a two-phased approach to reducing the sediment load delivered to the navigable channel (Barry County) by eliminating sources of excessive sediment input from in-stream erosion and re-establishing a sediment basin between First Street and Patterson Road.

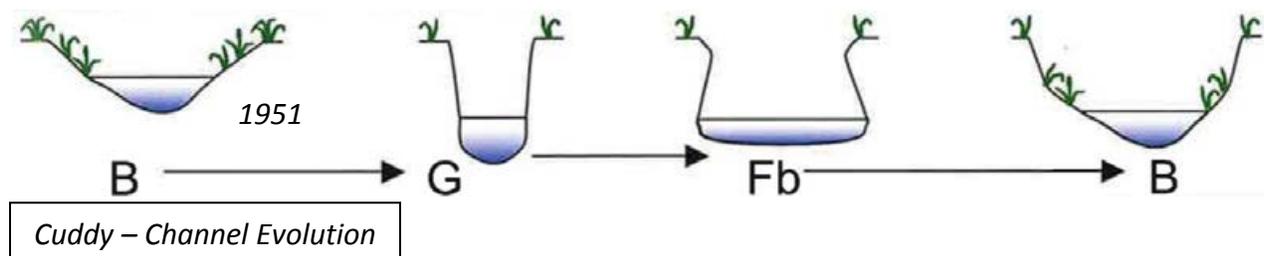
Dredge Navigable Channel: History and present conditions suggest that the navigable channel, east of Patterson Road, is due for maintenance dredging. We recommend that the navigable channel be dredged to the historic elevation of approximately 740.3-feet (NGVD 29).

Approximately 3,500 cubic yards of primarily sand sediment material has been transported by the Cuddy and deposited within 300 to 400 feet downstream (east) of Patterson Road. Up to 3-feet of sediment has accumulated in this area, decreasing channel depths to less than one-foot in areas and making navigation impossible.

Sediment buildup along the remaining approximately 2,100 feet of navigable channel appears to be composed of primarily finer (silt / organic) material, more typical of natural decay processes within dredged channels. Navigation is still possible through this reach, although residents complain that it is somewhat hindered. An estimated 6,500 cubic yards of material has accumulated through this section of the Cuddy, assuming an average sediment depth of one-foot.

The former dredge disposal area, north of Valley Drive, has been developed. Therefore, a new site will have to be secured for disposing spoil material. Potential disposal site locations are limited within Barry County and may need to be secured, west of Patterson Road, in Allegan County.

Channel Stabilization: Over the past 50+ years, the Cuddy has undergone an evolutionary process of channel degradation (deepening) and lateral expansion (widening) from Patterson Road to Timber Creek Drive, as shown in the diagram below. The channel slope appears to have stabilized relative to the established culvert invert at Patterson Road, First Street and Timber Creek Drive, which serve as grade control structures. The most critical areas of instability that are actively eroding are located within 300-feet downstream of Timber Creek Drive.



We recommend working with natural evolutionary processes of the channel to develop a comprehensive channel restoration/stabilization plan, including modifications to the channel geometry, for the Cuddy and Gardner within 300-feet downstream of Timber Creek Drive. In addition, we recommend selective stabilization measures, such as channel bank pull-back, limited channel reconfiguration and bank protection be conducted along the remainder of the Cuddy between Timber Creek Drive and First Street.

Sediment Basin: Ideally, a new sediment basin (sediment trap) should be constructed immediately upstream (west) of Patterson Road to capture sediment prior to entering the navigable channel. However, easement and/or property acquisition may make this endeavor difficult, if not impossible. Assuming a dredge disposal site is secured west of Patterson Road, the area could also serve as a location for the sediment basin.

Historical records suggest that the existing sediment basin, when actively maintained, did help to reduce the transported sediment load to the navigable channel east of Patterson Road. Therefore, if a new site cannot be secured immediately upstream (west) of Patterson Road, we recommend re-establishing the existing sediment basin. Minor structural and geometric modifications may be necessary to improve the effectiveness of the sediment basin. Annual or bi-annual maintenance dredging will likely be required, assuming the historic 450 cubic yard storage volume is maintained. Due to easement constraints, dredge material will likely need to be hauled and disposed of off-site.

4. Prevent or Minimize *E-Coli*

Based upon review of existing information and brief field investigation, it appears that the Cuddy Drain may be contaminated with *E. coli*. However, information necessary to confirm the problem appears to be lacking. It is, therefore, suggested that the following data and information is collected and submitted to the MDEQ and/or the county health departments.

Concentration Sampling: Intended to determine the number of colonies of *E. coli* bacteria in a known volume of water, concentration sampling has been conducted at several locations over the past several years. It is not known, however, if the protocols used for sample collection and analysis followed approved methods. Thus, it is recommended that additional concentration sampling is conducted following a Quality Assurance Project Plan (QAPP) to ensure standardized sampling and acceptable results. This QAPP should be reviewed and approved by the MDEQ and/or county health department.

Loading Calculations: Once concentration of bacteria in a known volume of water is determined, it is suggested that discharge is measured at each of the sampling stations to calculate the overall bacterial loading at each site and from the Cuddy into Gun Lake. For example, if *E. coli* concentrations are extremely high at a particular site, but there is little to no flow at that site, the overall load contributed from that site may be insignificant. Conversely, if the concentration is low to moderate, but discharge is high, the overall load could still be significant.

Source Tracking: Commonly cited sources of *E. coli* include humans, cattle (bovine), horses (equine) and wildlife (deer, raccoons, waterfowl, etc). At least three of these possible sources were noted during field inspections conducted as part of the current study. Human sources of bacteria are efficiently tracked using scent-trained canines. Based on results of the dog work, DNA source-tracking can be conducted by a lab capable of identifying markers unique to specific animal types. Source tracking is recommended to ensure that any funds potentially spent to address *E. coli* are targeted to the specific cause and location of the source.

E-Coli Action Plan: There is no evidence to suggest that the Cuddy is the source of *E. coli* contamination. Like any other stable natural or maintained drainage system, the channel simply serves as a conduit for transport of the water, sediment and associated particles supplied by its watershed. As such, it is the professional opinion of LRE and SES that most of these recommendations fall outside of the normal duties of county drain commissioners.

We recommend that a study be commissioned to determine if the unknown outfall pipes entering the Cuddy, identified during field inspection and shown in the enclosed [Survey Drawings \(Sheets C1\)](#), are introducing human waste into the drain. Scent-trained canines are the most efficient and economical means of obtaining the information necessary for this determination. If results of the study identify a specific problem, it is the duty of the Board to report the problem to the county health department. In lieu of conducting an independent study, the Board may wish to contact the county health department directly and have them investigate the unknown outfall pipes.

Regarding *E. coli* concentration sampling and load calculations, it is recommended that this work is conducted outside of the petitioned project. The Friends of the Cuddy Drain and/or other local partners, such as the county conservation district, could pursue this work using outside sources of funds. Once a sufficient *E. coli* study is complete, appropriate Best Management Practices (BMPs) can be selected.

5. Fiscal Responsibility

The recommendations presented in this report were established to ensure the project goals are met in a fiscally prudent manner.

Project Cost Estimate: The preliminary estimate of probable construction cost, including 10% contingency, for the recommended scope of work is approximately \$1,000,000. This figure includes costs to be paid for by the Allegan County Road Commission for replacement of the Patterson Road and First Street culverts, which have a combined total cost of approximately \$500,000. A detailed construction cost breakdown is provided in [Appendix 4](#).

The preliminary estimate of probable project cost, including construction, engineering, and easement and/or land acquisition is approximately \$1.25M. A detailed project cost breakdown with recommended apportionment by county is provided in [Appendix 5](#).

Apportionment: The historic apportionment for the Cuddy as agreed to at the February 10, 2005 Board meeting calls for a 78 percent to 22 percent split between Allegan County and Barry County when conducting work west of Patterson Road; and a 22 percent to 78 percent split between Allegan County and Barry County when conducting work east of Patterson Road or along the sediment basin. Based on the recommended scope of work, a cost share which adheres strictly to the current apportionment agreement would result in a roughly 50/50 split between counties.

LRE was tasked with reevaluating the apportionment between counties to ensure a “fair and equitable split”. Due to the unique nature and complexity of the system, which involves the transport of not only water but also sediment and includes both a traditional agricultural drain as well as a navigable channel, a standard apportionment by land area or runoff volume was not employed. Instead, each element of proposed work was broken down and evaluated equally in terms of the county responsible for the cause/source of sediment and the county receiving benefit from the proposed element of work. For example, the source of sediment captured by the sediment basin is from Allegan County, however, the beneficiaries are the residents in Barry County; therefore, a 50/50 split between counties was employed. Stabilization work in Allegan County was charged solely to Allegan County since Allegan County is not only the source of sediment but also receiving the benefit by reducing erosion and land loss along properties. Using the above methodology, we recommend that the project apportionment be set based on the recommended cost share between counties for individual areas of work as provided in [Appendix 5](#). The apportionment between counties would be split 62 percent to 38 percent between Allegan County and Barry County based on recommended scope of work and estimated cost presented in [Appendix 5](#). This percentage split may be revised as necessary based on the final scope of work and associated actual costs.

The Board should coordinate efforts with the Allegan County Road Commission for replacement of both the Patterson Road and First Street crossings. The Board agreed to work with Allegan County Road Commission on the culvert replacement at Patterson Road. The proposed cost share was split 50/50 between the Board and Allegan County Road Commission. The Board’s proposed apportionment was further broken down based on a 50/50 split between Allegan County and Barry County.

IMPLEMENTATION

The following steps will need to be considered for implementation of the recommended improvements presented in this report, assuming the petition is determined necessary for public health, convenience and welfare.

Consolidation: The proposed scope of work along the Gardner (downstream of Timber Creek Drive) can be conducted as part of the petitioned project; however, there does not appear to be any long term necessity to consolidate the two drains. Therefore, consolidation of the Cuddy and Gardner should be limited to the portions that overlap between Patterson Road and just east of Timber Creek Drive.

Add/Remove Lands: Add and remove lands from the Cuddy Intercounty Drain Drainage District in accordance with Chapter 8, Section 197 of The Drain Code (Act 40 of 1956) at the Hearing of Necessity. The Allegan County Drain Commissioner may also consider adjusting tributary sub-districts to match the Cuddy Drainage District boundary in accordance with the recent revisions to Section 197 of The Drain Code.

Right of Way: The existing drainage easement along the Cuddy appears to be adequate. The established easement for the existing sediment basin (Sweeney property, parcel no. 24-024-010-10) should be sufficient for construction; however, additional easement may need to be secured for sediment disposal or if a new sediment basin location is secured. Up to two easements (Amante property [parcel no. 24-023-011-00], and Timber Creek Drive [private]) may also be required along the Gardner for the proposed work at / downstream of Timber Creek Drive. Easement or land acquisition may also be required for the disposal site from dredging operations along the navigable channel, east of Patterson Road.

Permitting: An MDEQ permit (File No. 12-03-0008-P) and MDOT Right-of-Way permit have already been secured by the Allegan County Road Commission for the work associated with the proposed Patterson Road crossing replacement. If the culvert replacement at First Street is performed by the Allegan County Road Commission, then MDEQ Permits pursuant to Part 301, Inland Lakes and Streams, and Part 31, Water Resources Protection, of the Natural Resources and Environmental Protection Act, PA 451 of 1994 (NREPA), will be required.

The MDEQ is in the process of making statutory changes to exemptions for established county drains relative to Part 301, Inland Lakes and Streams and Part 303, Wetland Protection of the NREPA. Based on our understanding of the proposed statutory changes, proposed items such as dredging to original contours, re-shaping channel banks, bank stabilization to prevent erosion and culvert replacement/extensions of up to 24 additional feet should be exempt from permitting pursuant to the NREPA. Other proposed items of work, such as the installation of grade control structures, should fall under the General Permit category.

Investigate Grant Opportunities: The Board and/or partnering groups may consider investigating potential grant opportunities, such as the MDEQ’s Clean Michigan Initiative, to fund *E. coli* studies and/or implementation projects.

Final Design and Construction: Complete the project design and prepare construction documents for bidding and construction.

Project Timeline: A preliminary project timeline is provided in **Table 3**. The critical path includes easement acquisition, permitting and coordination with the Allegan County Road Commission, therefore, the actual project timeline may vary.

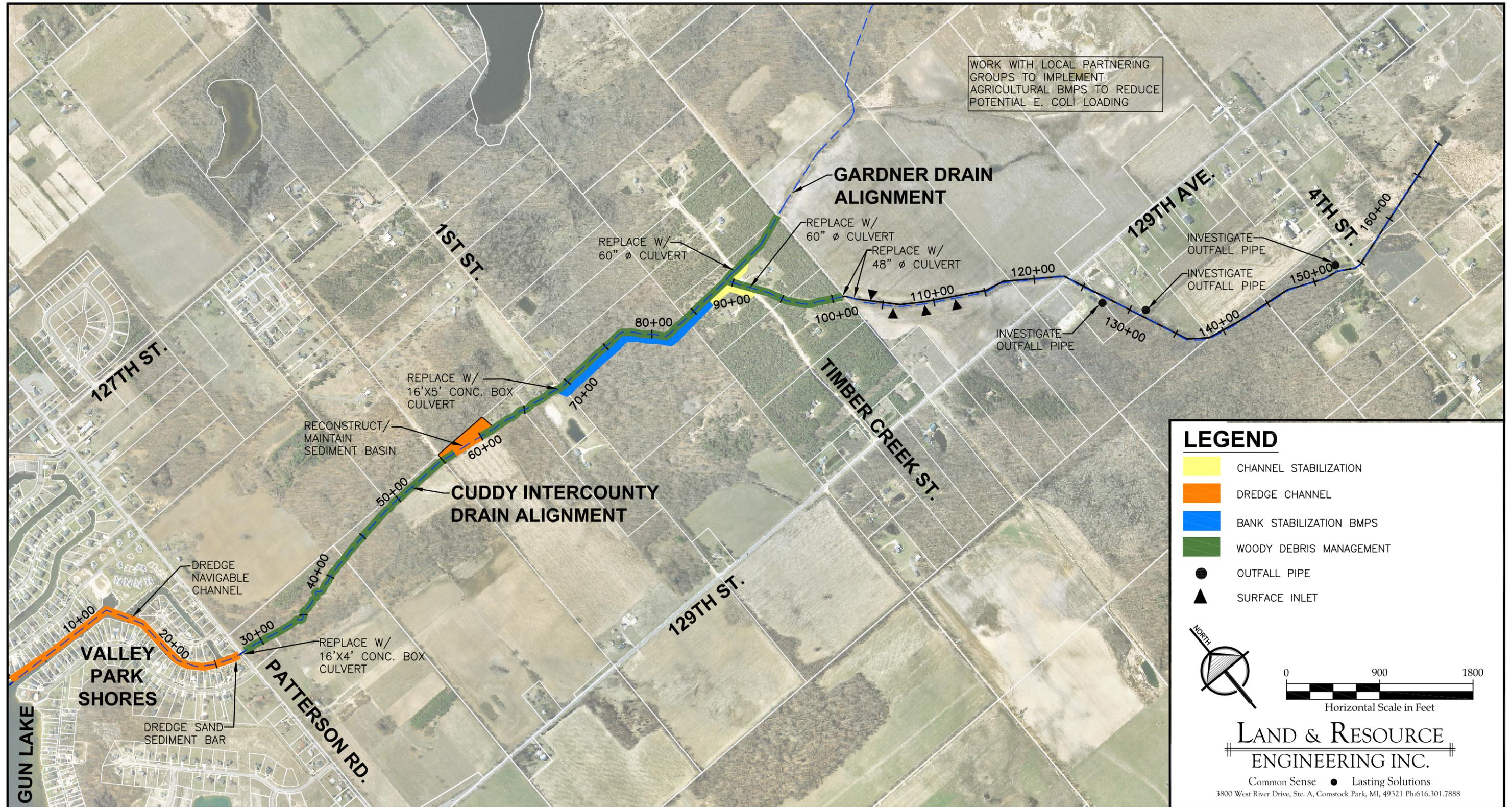
Table 3 – Project Timeline

Task	2014				2015			
	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter
Topographic Survey								
Engineering Design								
Easement Acquisition								
Permitting								
Bidding								
Construction								

**Note – dark blue represents target schedule.*

CUDDY INTERCOUNTY DRAIN

FIGURE 1- RECOMMENDATIONS



APPENDIX 1 – ROUTE AND COURSE DESCRIPTION

CUDDY INTERCOUNTY DRAIN:

COMMENCING AT THE NORTHWEST CORNER OF SECTION 30, TOWNSHIP 3 NORTH, RANGE 10 WEST, YANKEE SPRINGS TOWNSHIP, BARRY COUNTY, MICHIGAN; THENCE EAST ALONG THE NORTH LINE OF SAID SECTION SOUTH 89°44'56" WEST A DISTANCE OF 1950.50 FEET; THENCE SOUTH 00°25'33" WEST A DISTANCE OF 909.69 FEET TO A POINT IN GUN LAKE AND ALSO THE POINT OF BEGINNING; THENCE NORTH 87°30'00" WEST A DISTANCE OF 1210.00 FEET; THENCE NORTH 29°32'30" WEST A DISTANCE OF 370.38 FEET; THENCE NORTH 03°15'00" WEST A DISTANCE OF 470.83 FEET; THENCE NORTH 22°54'45" WEST A DISTANCE OF 63.17 FEET TO A POINT LYING NORTH 89°44'52" EAST A DISTANCE OF 504.23 FEET FROM THE NORTHWEST CORNER SECTION 30, TOWNSHIP 3 NORTH, RANGE 10 WEST; CONTINUING NORTH 22°54'45" WEST A DISTANCE OF 61.39 FEET; THENCE NORTH 44°19'45" WEST A DISTANCE OF 167.45 FEET; THENCE NORTH 63°51'15" WEST A DISTANCE OF 203.03 FEET; THENCE NORTH 76°16'30" WEST A DISTANCE OF 157.08 FEET; THENCE NORTH 84°00'51" WEST A DISTANCE OF 28.24 FEET TO A POINT LYING NORTH 00°04'22" EAST A DISTANCE OF 308.23 FEET FROM THE SOUTHWEST CORNER SECTION 19, TOWNSHIP 3 NORTH, RANGE 10 WEST; CONTINUING NORTH 84°00'51" WEST A DISTANCE OF 138.23 FEET; THENCE NORTH 78°54'27" WEST A DISTANCE OF 420.67 FEET; THENCE SOUTH 85°28'16" WEST A DISTANCE OF 201.70 FEET; THENCE SOUTH 75°54'33" WEST A DISTANCE OF 473.43 FEET; THENCE SOUTH 80°38'45" WEST A DISTANCE OF 744.32 FEET; THENCE SOUTH 88°33'15" WEST A DISTANCE OF 736.36 FEET; THENCE NORTH 81°24'56" WEST A DISTANCE OF 1302.91 FEET; THENCE NORTH 85°02'45" WEST A DISTANCE OF 71.06 FEET; THENCE SOUTH 87°30'19" WEST A DISTANCE OF 745.94 FEET; THENCE NORTH 44°42'14" WEST A DISTANCE OF 426.00 FEET; THENCE SOUTH 87°15'18" WEST A DISTANCE OF 264.37 TO A POINT LYING NORTH 00°04'27" EAST A DISTANCE OF 560.57 FEET FROM THE SOUTHWEST CORNER SECTION 24, TOWNSHIP 3 NORTH , RANGE 11 WEST; CONTINUING SOUTH 87°15'18" WEST A DISTANCE OF 529.37 FEET; THENCE NORTH 33°57'24" WEST A DISTANCE OF 419.81 FEET; THENCE NORTH 26°16'25" WEST A DISTANCE OF 195.43 FEET; THENCE NORTH 40°43'41" WEST A DISTANCE OF 208.89 FEET; THENCE NORTH 62°01'21" WEST A DISTANCE OF 368.14 FEET; THENCE NORTH 34°52'51" WEST A DISTANCE OF 98.89 FEET; THENCE NORTH 42°57'07" WEST A DISTANCE OF 439.50 FEET; THENCE NORTH 56°13'16" WEST A DISTANCE OF 237.51 FEET; THENCE NORTH 60°36'35" WEST A DISTANCE OF 605.11 FEET; THENCE NORTH 78°03'28" WEST A DISTANCE OF 182.80 FEET; THENCE NORTH 54°45'50" WEST A DISTANCE OF 586.63 FEET; THENCE NORTH 23°04'52" WEST A DISTANCE OF 1329.99 FEET; THENCE NORTH 52°45'28" WEST A DISTANCE OF 213.28 FEET; THENCE NORTH 78°35'52" WEST A DISTANCE OF 326.20 FEET; THENCE NORTH 82°57'23" WEST A DISTANCE OF 562.00 FEET; THENCE NORTH 66°30'59" WEST A DISTANCE OF 364.23 FEET; THENCE NORTH 79°56'34" WEST A DISTANCE OF 151.86 FEET; THENCE NORTH 59°14'35" WEST A DISTANCE OF 169.97 FEET; THENCE NORTH 83°50'11" WEST A DISTANCE OF 33.85 FEET TO A POINT LYING SOUTH 00°04'32" WEST A DISTANCE OF 924.15 FEET FROM THE NORTHWEST CORNER SECTION 23, TOWNSHIP 3 NORTH, RANGE 11 WEST; CONTINUING NORTH 83°50'11" WEST A DISTANCE OF 26.04 FEET; THENCE SOUTH 73°03'11" WEST A DISTANCE OF 1389.70 FEET TO THE POINT OF ENDING LYING SOUTH 00°04'32" WEST A DISTANCE OF 1351.20 FEET AND NORTH 89°10'58" WEST A DISTANCE OF 1353.93 FEET FROM THE NORTHEAST CORNER SECTION 22, TOWNSHIP 3 NORTH, RANGE 11 WEST;

TOTAL LENGTH OF THE CUDDY DRAIN IS 16,700 FEET, MORE OF LESS.

APPENDIX 2 – DRAINAGE DISTRICT DESCRIPTION

CUDDY INTERCOUNTY DRAIN:

ALL OF THAT LAND LOCATED IN SECTIONS 13, 14, 15, 22, 23, 24, 25, 26, 27, 28, 34, 35 AND 36 OF T3N, R11W, WAYLAND TOWNSHIP, ALLEGAN COUNTY, MICHIGAN AND ALSO SECTIONS 19 AND 30 OF T3N, R10W, YANKEE SPRINGS TOWNSHIP, BARRY COUNTY, MICHIGAN BOUNDED BY A LINE DESCRIBED AS FOLLOWS: COMMENCING AT THE WEST QUARTER CORNER OF SECTION 14, TOWNSHIP 3 NORTH, RANGE 11 WEST, WAYLAND TOWNSHIP, ALLEGAN COUNTY, MICHIGAN WHICH IS ALSO THE POINT OF BEGINNING; THENCE NORTH 89°20'37" EAST A DISTANCE OF 3257.05 FEET; THENCE NORTH 01°14'57" WEST A DISTANCE OF 106.53 FEET; THENCE NORTH 10°47'03" EAST A DISTANCE OF 49.65 FEET; THENCE NORTH 35°18'40" EAST A DISTANCE OF 68.31 FEET; THENCE NORTH 63°26'06" EAST A DISTANCE OF 60.84 FEET; THENCE NORTH 19°04'01" EAST A DISTANCE OF 209.23 FEET; THENCE NORTH 16°30'16" EAST A DISTANCE OF 65.40 FEET; THENCE NORTH 59°15'25" WEST A DISTANCE OF 59.07 FEET; THENCE NORTH 08°20'24" WEST A DISTANCE OF 192.15 FEET; THENCE NORTH 05°31'39" EAST A DISTANCE OF 72.34 FEET; THENCE NORTH 42°18'58" WEST A DISTANCE OF 210.45 FEET; THENCE NORTH 37°34'56" EAST A DISTANCE OF 341.65 FEET; THENCE NORTH 30°28'45" EAST A DISTANCE OF 282.59 FEET; THENCE NORTH 78°26'24" EAST A DISTANCE OF 163.92 FEET; THENCE NORTH 39°04'32" EAST A DISTANCE OF 100.01 FEET; THENCE NORTH 30°59'32" EAST A DISTANCE OF 228.75 FEET; THENCE NORTH 86°16'55" EAST A DISTANCE OF 184.20 FEET; THENCE SOUTH 73°52'07" EAST A DISTANCE OF 224.51 FEET; THENCE NORTH 88°10'04" EAST A DISTANCE OF 238.68 FEET; THENCE SOUTH 62°04'52" EAST A DISTANCE OF 182.12 FEET; THENCE SOUTH 78°06'14" EAST A DISTANCE OF 133.60 FEET; THENCE SOUTH 09°26'23" EAST A DISTANCE OF 137.57 FEET; THENCE SOUTH 41°56'01" EAST A DISTANCE OF 131.57 FEET; THENCE NORTH 79°48'07" EAST A DISTANCE OF 127.43 FEET; THENCE NORTH 58°21'19" EAST A DISTANCE OF 100.55 FEET; THENCE NORTH 31°04'31" EAST A DISTANCE OF 58.50 FEET; THENCE NORTH 81°20'22" EAST A DISTANCE OF 50.68 FEET; THENCE SOUTH 68°24'02" EAST A DISTANCE OF 74.13 FEET TO A POINT LYING SOUTH 00°10'10" WEST A DISTANCE OF 1186.38 FEET FROM THE NORTHEAST CORNER OF SECTION 14, TOWNSHIP 3 NORTH, RANGE 11 WEST; CONTINUING SOUTH 68°24'02" EAST A DISTANCE OF 13.30 FEET; THENCE NORTH 41°33'59" EAST A DISTANCE OF 305.55 FEET; THENCE NORTH 08°47'37" EAST A DISTANCE OF 60.77 FEET; THENCE NORTH 90°00'00" EAST A DISTANCE OF 46.45 FEET; THENCE NORTH 46°07'24" EAST A DISTANCE OF 83.77 FEET; THENCE NORTH 09°16'21" EAST A DISTANCE OF 115.31 FEET; THENCE NORTH 21°48'05" EAST A DISTANCE OF 62.54 FEET; THENCE NORTH 56°12'31" EAST A DISTANCE OF 312.61 FEET; THENCE NORTH 73°18'03" EAST A DISTANCE OF 96.99 FEET; THENCE NORTH 53°18'01" EAST A DISTANCE OF 89.39 FEET; THENCE NORTH 41°27'38" EAST A DISTANCE OF 182.41 FEET; THENCE NORTH 19°34'38" EAST A DISTANCE OF 100.01 FEET; THENCE NORTH 29°23'03" EAST A DISTANCE OF 78.44 FEET; THENCE NORTH 64°05'37" EAST A DISTANCE OF 90.37 FEET; THENCE SOUTH 76°05'18" EAST A DISTANCE OF 222.19 FEET; THENCE SOUTH 58°59'28" EAST A DISTANCE OF 216.40 FEET; THENCE NORTH 88°38'10" EAST A DISTANCE OF 97.58 FEET; THENCE SOUTH 71°33'54" EAST A DISTANCE OF 110.17 FEET; THENCE SOUTH 49°31'51" EAST A DISTANCE OF 124.74 FEET; THENCE SOUTH 13°14'26" EAST A DISTANCE OF 40.56 FEET; THENCE SOUTH 75°57'50" EAST A DISTANCE OF 38.31 FEET; THENCE SOUTH 51°19'06" EAST A DISTANCE OF 136.44 FEET; THENCE NORTH 79°47'14" EAST A DISTANCE OF 129.12 FEET; THENCE NORTH 57°48'15" EAST A DISTANCE OF 158.80 FEET; THENCE SOUTH 71°46'58" EAST A DISTANCE OF 137.98 FEET; THENCE SOUTH 35°17'12" EAST A DISTANCE OF 184.95 FEET; THENCE SOUTH 18°46'05" WEST A DISTANCE OF 144.38 FEET; THENCE SOUTH 83°39'05" EAST A DISTANCE OF 252.05 FEET; THENCE SOUTH 65°29'20" EAST A DISTANCE OF 70.38 FEET; THENCE SOUTH 07°36'16" WEST A DISTANCE OF 127.87 FEET; THENCE SOUTH 08°01'21" EAST A DISTANCE OF 49.93 FEET; THENCE SOUTH 00°00'00" EAST A DISTANCE OF 151.30 FEET; THENCE SOUTH 35°01'20" EAST A DISTANCE OF 51.46 FEET; THENCE NORTH 87°46'23" EAST A DISTANCE OF 59.77 FEET; THENCE SOUTH 57°20'03" EAST A DISTANCE OF 82.37 FEET; THENCE SOUTH 06°00'32" EAST A DISTANCE OF 69.73 FEET; THENCE SOUTH 18°57'54" WEST A DISTANCE OF 102.10 FEET; THENCE SOUTH 53°12'01" WEST A DISTANCE OF 54.28 FEET; THENCE SOUTH 20°19'53" WEST A DISTANCE OF 79.26 FEET; THENCE SOUTH 04°28'15" EAST A DISTANCE OF 161.75 FEET; THENCE SOUTH 59°08'58" EAST A DISTANCE OF 57.59 FEET; THENCE SOUTH 35°25'15" EAST A DISTANCE OF 94.46 FEET; THENCE SOUTH 85°53'42" EAST A DISTANCE OF 69.52 FEET; THENCE SOUTH 27°18'10" EAST A DISTANCE OF 172.88 FEET; THENCE SOUTH 01°32'01" EAST A DISTANCE OF 458.71 FEET; THENCE SOUTH 08°56'17" WEST A DISTANCE OF 143.08 FEET; THENCE SOUTH 01°27'46" EAST A DISTANCE OF 480.93 FEET; THENCE SOUTH 09°15'31" WEST A DISTANCE OF 276.34 FEET; THENCE SOUTH 88°37'50" WEST A DISTANCE OF 416.53 FEET; THENCE SOUTH 06°54'57" WEST A DISTANCE OF 372.00 FEET; THENCE SOUTH 00°54'34" WEST A DISTANCE OF 146.34 FEET; THENCE SOUTH 32°14'56" EAST A DISTANCE OF 190.27 FEET; THENCE NORTH 90°00'00" EAST A DISTANCE OF 72.00 FEET; THENCE SOUTH 03°33'35" WEST A DISTANCE OF 283.24 FEET; THENCE SOUTH 11°48'01" EAST A DISTANCE OF 121.69 FEET; THENCE SOUTH 04°11'30" WEST A DISTANCE OF 472.08 FEET; THENCE SOUTH 21°43'20" EAST A DISTANCE OF 133.58 FEET; THENCE SOUTH 41°52'51" EAST A DISTANCE OF 159.54 FEET; THENCE SOUTH 58°16'46" EAST A DISTANCE OF 198.15 FEET; THENCE SOUTH 43°31'34" EAST A DISTANCE OF 136.83 FEET; THENCE SOUTH 00°00'00" EAST A DISTANCE OF 23.53 FEET TO A POINT LYING NORTH 89°26'26" EAST A DISTANCE OF 421.42 FEET FROM THE SOUTH QUARTER CORNER OF SECTION 13, TOWNSHIP 3 NORTH, RANGE 11 WEST; CONTINUING EAST ALONG THE SOUTH LINE OF SAID SECTION A DISTANCE OF 136.37 FEET; THENCE SOUTH 02°04'58" EAST A DISTANCE OF 200.85 FEET; THENCE SOUTH 75°30'37" WEST A DISTANCE OF 30.50 FEET; THENCE SOUTH 03°35'29" WEST A DISTANCE OF 79.46 FEET; THENCE SOUTH 07°37'41" WEST A DISTANCE OF 149.97 FEET; THENCE SOUTH 11°59'11" EAST A DISTANCE OF 440.95 FEET; THENCE SOUTH 01°02'35" WEST A DISTANCE OF 255.19 FEET; THENCE SOUTH 14°47'38" EAST A DISTANCE OF 115.65 FEET; THENCE SOUTH 05°44'55" EAST A DISTANCE OF 99.38 FEET; THENCE SOUTH 56°27'34" EAST A DISTANCE OF 246.81 FEET; THENCE SOUTH 88°15'04" EAST A DISTANCE OF 86.97 FEET; THENCE NORTH 68°35'13" EAST A DISTANCE OF 109.06 FEET; THENCE NORTH 87°07'41" EAST A DISTANCE OF 99.33 FEET; THENCE SOUTH 78°29'56" EAST A DISTANCE OF 136.45 FEET; THENCE SOUTH 86°39'49" EAST A DISTANCE OF 558.70 FEET; THENCE SOUTH 63°39'53" EAST A DISTANCE OF 296.18 FEET; THENCE SOUTH 75°57'50" EAST A DISTANCE OF 91.66 FEET; THENCE SOUTH 51°09'33" EAST A DISTANCE OF 328.01 FEET; THENCE NORTH 56°53'19" EAST A DISTANCE OF 63.78 FEET; THENCE SOUTH 71°42'38" EAST A DISTANCE OF 182.52 FEET TO A POINT LYING NORTH 00°25'55" WEST A DISTANCE OF 755.66 FEET FROM THE EAST QUARTER CORNER OF SECTION 13, TOWNSHIP 3 NORTH, RANGE 11 WEST; CONTINUING SOUTH ALONG THE EAST LINE OF SAID SECTION A DISTANCE OF 442.25 FEET; THENCE SOUTH 28°08'41" EAST A DISTANCE OF 471.58 FEET; THENCE SOUTH 00°07'13" WEST A DISTANCE OF 1713.82 FEET; THENCE NORTH 89°00'44" EAST A DISTANCE OF 96.24 FEET; THENCE SOUTH 00°10'40" WEST A DISTANCE OF 497.48 FEET; THENCE SOUTH 62°49'56" EAST A DISTANCE OF 136.37 FEET; THENCE SOUTH 49°51'02" EAST A DISTANCE

OF 141.51 FEET; THENCE SOUTH 38°25'32" EAST A DISTANCE OF 139.34 FEET; THENCE SOUTH 26°08'25" EAST A DISTANCE OF 140.08 FEET; THENCE SOUTH 13°46'18" EAST A DISTANCE OF 43.20 FEET TO A POINT LYING NORTH 00°00'00" EAST A DISTANCE OF 703.22 FEET FROM THE SOUTHWEST CORNER OF SECTION 19, TOWNSHIP 3 NORTH, RANGE 10 WEST; CONTINUING SOUTH 13°46'18" EAST A DISTANCE OF 96.18 FEET; THENCE SOUTH 02°21'26" EAST A DISTANCE OF 137.15 FEET; THENCE SOUTH 03°50'17" EAST A DISTANCE OF 158.62 FEET; THENCE SOUTH 18°11'39" EAST A DISTANCE OF 49.94 FEET; THENCE SOUTH 28°14'15" EAST A DISTANCE OF 81.35 FEET; THENCE SOUTH 41°19'10" EAST A DISTANCE OF 40.20 FEET; THENCE SOUTH 49°55'06" EAST A DISTANCE OF 79.36 FEET; THENCE SOUTH 67°43'52" EAST A DISTANCE OF 120.83 FEET; THENCE SOUTH 85°01'49" EAST A DISTANCE OF 99.58 FEET; THENCE SOUTH 89°32'09" EAST A DISTANCE OF 614.18 FEET; THENCE SOUTH 39°59'53" EAST A DISTANCE OF 295.49 FEET; THENCE SOUTH 36°12'59" WEST A DISTANCE OF 414.16 FEET; THENCE SOUTH 89°28'46" WEST A DISTANCE OF 564.39 FEET; THENCE SOUTH 82°27'12" WEST A DISTANCE OF 155.14 FEET; THENCE NORTH 89°42'45" WEST A DISTANCE OF 935.99' TO A POINT LYING NORTH 00°25'40" EAST A DISTANCE OF 1416.68 FEET FROM THE WEST QUARTER CORNER OF SECTION 30, TOWNSHIP 3 NORTH, RANGE 10 WEST; CONTINUING SOUTH ALONG THE WEST LINE OF SAID SECTION A DISTANCE OF 493.05 FEET; THENCE SOUTH 72°24'24" WEST A DISTANCE OF 515.93 FEET; THENCE SOUTH 81°45'37" WEST A DISTANCE OF 122.70 FEET; THENCE SOUTH 89°02'22" WEST A DISTANCE OF 277.09 FEET; THENCE NORTH 56°46'41" WEST A DISTANCE OF 56.32 FEET; THENCE SOUTH 51°09'29" WEST A DISTANCE OF 391.49 FEET; THENCE SOUTH 34°03'03" WEST A DISTANCE OF 263.10 FEET; THENCE SOUTH 84°01'40" WEST A DISTANCE OF 108.42 FEET; THENCE NORTH 82°18'14" WEST A DISTANCE OF 111.49 FEET; THENCE SOUTH 64°39'14" WEST A DISTANCE OF 83.71 FEET; THENCE SOUTH 54°35'49" WEST A DISTANCE OF 98.51 FEET; THENCE SOUTH 11°39'43" WEST A DISTANCE OF 116.54 FEET; THENCE SOUTH 01°42'05" EAST A DISTANCE OF 33.53 FEET; THENCE SOUTH 89°30'17" WEST A DISTANCE OF 2149.14 FEET; THENCE SOUTH 06°52'45" EAST A DISTANCE OF 124.66 FEET; THENCE SOUTH 60°34'44" WEST A DISTANCE OF 131.04 FEET; THENCE SOUTH 01°36'10" EAST A DISTANCE OF 272.84 FEET; THENCE SOUTH 16°09'21" EAST A DISTANCE OF 124.01 FEET; THENCE SOUTH 78°42'09" WEST A DISTANCE OF 303.17 FEET; THENCE SOUTH 01°46'04" EAST A DISTANCE OF 161.33 FEET; THENCE SOUTH 24°27'54" WEST A DISTANCE OF 149.82 FEET; THENCE NORTH 85°34'43" WEST A DISTANCE OF 64.56 FEET; THENCE NORTH 53°31'10" WEST A DISTANCE OF 58.60 FEET; THENCE NORTH 71°06'22" WEST A DISTANCE OF 183.41 FEET; THENCE SOUTH 82°56'45" WEST A DISTANCE OF 99.96 FEET; THENCE SOUTH 56°18'36" WEST A DISTANCE OF 116.04 FEET; THENCE SOUTH 82°15'08" WEST A DISTANCE OF 147.67 FEET; THENCE NORTH 82°05'15" WEST A DISTANCE OF 197.64 FEET; THENCE SOUTH 13°27'49" WEST A DISTANCE OF 458.88 FEET; THENCE SOUTH 10°34'15" EAST A DISTANCE OF 95.86 FEET; THENCE SOUTH 01°15'03" EAST A DISTANCE OF 532.00 FEET; THENCE SOUTH 12°18'41" EAST A DISTANCE OF 208.52 FEET; THENCE SOUTH 04°41'00" EAST A DISTANCE OF 117.85 FEET; THENCE SOUTH 28°59'40" EAST A DISTANCE OF 245.05 FEET; THENCE SOUTH 04°06'23" WEST A DISTANCE OF 64.87 FEET; THENCE SOUTH 00°55'27" EAST A DISTANCE OF 65.88 FEET TO A POINT LYING NORTH 89°25'42" EAST A DISTANCE OF 272.27 FEET FROM THE SOUTHEAST CORNER OF SECTION 25, TOWNSHIP 3 NORTH, RANGE 11 WEST; CONTINUING SOUTH 00°55'27" EAST A DISTANCE OF 222.16 FEET; THENCE SOUTH 14°38'42" WEST A DISTANCE OF 166.67 FEET; THENCE NORTH 90°00'00" WEST A DISTANCE OF 168.55 FEET; THENCE SOUTH 43°59'42" WEST A DISTANCE OF 93.92 FEET TO A POINT LYING SOUTH 00°00'38" WEST A DISTANCE OF 448.23 FEET FROM THE NORTHWEST CORNER OF SECTION 36, TOWNSHIP 3 NORTH, RANGE 11 WEST; CONTINUING THENCE SOUTH 43°59'42" WEST A DISTANCE OF 13.08 FEET; THENCE SOUTH 70°35'52" WEST A DISTANCE OF 111.86 FEET; THENCE SOUTH 54°53'57" WEST A DISTANCE OF 85.98 FEET; THENCE NORTH 30°13'23" WEST A DISTANCE OF 123.26 FEET; THENCE NORTH 61°49'17" WEST A DISTANCE OF 84.32 FEET; THENCE NORTH 31°44'21" WEST A DISTANCE OF 37.84 FEET; THENCE NORTH 72°05'07" WEST A DISTANCE OF 80.90 FEET; THENCE NORTH 51°32'17" WEST A DISTANCE OF 105.09 FEET; THENCE SOUTH 79°50'23" WEST A DISTANCE OF 188.09 FEET; THENCE NORTH 68°33'34" WEST A DISTANCE OF 88.05 FEET; THENCE NORTH 85°45'11" WEST A DISTANCE OF 67.21 FEET; THENCE SOUTH 74°36'42" WEST A DISTANCE OF 75.02 FEET; THENCE NORTH 65°53'23" WEST A DISTANCE OF 169.76 FEET; THENCE NORTH 25°17'44" WEST A DISTANCE OF 53.58 FEET; THENCE NORTH 58°34'14" WEST A DISTANCE OF 48.99 FEET;

THENCE NORTH 74°49'20" WEST A DISTANCE OF 193.90 FEET; THENCE NORTH 60°13'47" WEST A DISTANCE OF 92.89 FEET; THENCE NORTH 78°02'36" WEST A DISTANCE OF 57.66 FEET; THENCE NORTH 89°46'56" WEST A DISTANCE OF 174.53 FEET; THENCE NORTH 00°34'20" WEST A DISTANCE OF 33.22 FEET TO A POINT LYING NORTH 89°50'07" EAST A DISTANCE OF 1015.57 FEET FROM THE NORTH QUARTER CORNER OF SECTION 35, TOWNSHIP 3 NORTH, RANGE 11 WEST; CONTINUING ALONG THE NORTH LINE OF SAID SECTION A DISTANCE 1271.12 FEET; THENCE NORTH 01°11'53" EAST A DISTANCE OF 111.08 FEET; THENCE NORTH 23°10'05" WEST A DISTANCE OF 245.41 FEET; THENCE NORTH 37°48'36" WEST A DISTANCE OF 153.71 FEET; THENCE SOUTH 81°14'21" WEST A DISTANCE OF 98.03 FEET; THENCE NORTH 45°00'00" WEST A DISTANCE OF 55.84 FEET; THENCE SOUTH 28°45'26" WEST A DISTANCE OF 62.07 FEET;

THENCE SOUTH 58°37'51" WEST A DISTANCE OF 104.53 FEET; THENCE SOUTH 73°53'49" WEST A DISTANCE OF 116.04 FEET; THENCE NORTH 81°11'36" WEST A DISTANCE OF 47.68 FEET; THENCE SOUTH 34°28'30" WEST A DISTANCE OF 87.34 FEET; THENCE SOUTH 75°27'26" WEST A DISTANCE OF 245.77 FEET; THENCE SOUTH 86°36'31" WEST A DISTANCE OF 44.87 FEET; THENCE SOUTH 03°33'54" WEST A DISTANCE OF 213.43' TO A POINT LYING SOUTH 89°58'43" WEST A DISTANCE OF 1204.06 FEET FROM THE SOUTHWEST CORNER OF SECTION 26, TOWNSHIP 3 NORTH, RANGE 11 WEST; CONTINUING ALONG THE SOUTH LINE OF SAID SECTION A DISTANCE 1751.75 FEET TO THE SOUTHWEST CORNER OF SECTION 26, TOWNSHIP 3 NORTH, RANGE 11 WEST; THENCE NORTH 89°11'16" WEST A DISTANCE OF 1266.75 FEET ALONG THE SOUTH LINE OF SECTION 27, TOWNSHIP 3 NORTH, RANGE 11 WEST; THENCE NORTH 01°31'27" WEST A DISTANCE OF 62.38 FEET; THENCE NORTH 88°05'56" WEST A DISTANCE OF 80.01 FEET; THENCE NORTH 43°02'40" WEST A DISTANCE OF 96.25 FEET; THENCE NORTH 60°36'40" WEST A DISTANCE OF 66.26 FEET; THENCE NORTH 04°36'56" WEST A DISTANCE OF 127.82 FEET; THENCE NORTH 70°46'10" WEST A DISTANCE OF 60.44 FEET; THENCE NORTH 54°56'51" WEST A DISTANCE OF 77.41 FEET; THENCE NORTH 80°13'18" WEST A DISTANCE OF 158.24 FEET; THENCE SOUTH 83°16'17" WEST A DISTANCE OF 59.47 FEET; THENCE SOUTH 54°07'04" WEST A DISTANCE OF 192.47 FEET; THENCE SOUTH 02°53'22" WEST A DISTANCE OF 256.70' TO A POINT LYING NORTH 89°10'58" WEST A DISTANCE OF 349.99 FEET FROM THE SOUTH QUARTER CORNER OF SECTION 27, TOWNSHIP 3 NORTH, RANGE 11 WEST; CONTINUING EAST ALONG THE SOUTH LINE OF SAID SECTION 160.94 FEET; THENCE SOUTH 00°55'47" WEST A DISTANCE OF 245.36 FEET; THENCE SOUTH 12°21'59" WEST A DISTANCE OF 63.52 FEET; THENCE SOUTH 25°57'02" WEST A DISTANCE OF 55.35 FEET; THENCE SOUTH 32°23'25" WEST A DISTANCE OF 486.84 FEET; THENCE NORTH 17°39'32" WEST A DISTANCE OF 185.94 FEET; THENCE SOUTH 77°43'00" WEST A DISTANCE OF 302.56 FEET; THENCE

SOUTH 09°36'03" EAST A DISTANCE OF 67.64 FEET; THENCE SOUTH 24°11'36" EAST A DISTANCE OF 100.39 FEET; THENCE SOUTH 06°22'31" EAST A DISTANCE OF 59.76 FEET; THENCE SOUTH 06°29'21" WEST A DISTANCE OF 70.46 FEET; THENCE SOUTH 58°05'59" WEST A DISTANCE OF 38.30 FEET; THENCE NORTH 87°10'22" WEST A DISTANCE OF 80.73 FEET; THENCE SOUTH 77°34'27" WEST A DISTANCE OF 180.41 FEET; THENCE NORTH 85°39'24" WEST A DISTANCE OF 52.58 FEET; THENCE NORTH 25°03'36" WEST A DISTANCE OF 293.75 FEET; THENCE NORTH 42°02'21" WEST A DISTANCE OF 163.51 FEET; THENCE NORTH 54°10'15" WEST A DISTANCE OF 303.25 FEET; THENCE NORTH 63°44'39" WEST A DISTANCE OF 247.51 FEET; THENCE NORTH 25°16'49" WEST A DISTANCE OF 382.77 FEET TO A POINT LYING SOUTH 89°09'22" EAST A DISTANCE OF 1345.83 FEET FROM THE SOUTHWEST CORNER OF SECTION 27, TOWNSHIP 3 NORTH, RANGE 11 WEST; CONTINUING NORTH 25°16'49" WEST A DISTANCE OF 1.05 FEET; THENCE NORTH 03°06'48" EAST A DISTANCE OF 79.42 FEET; THENCE SOUTH 66°59'07" EAST A DISTANCE OF 40.74 FEET; THENCE NORTH 85°08'08" EAST A DISTANCE OF 78.25 FEET; THENCE NORTH 01°54'44" EAST A DISTANCE OF 198.86 FEET; THENCE NORTH 20°08'50" WEST A DISTANCE OF 108.85 FEET; THENCE NORTH 40°33'05" WEST A DISTANCE OF 124.02 FEET; THENCE NORTH 10°26'15" EAST A DISTANCE OF 102.56 FEET; THENCE NORTH 02°17'11" WEST A DISTANCE OF 365.93 FEET; THENCE NORTH 77°00'19" WEST A DISTANCE OF 53.12 FEET; THENCE NORTH 34°59'31" WEST A DISTANCE OF 32.40 FEET; THENCE NORTH 15°49'26" WEST A DISTANCE OF 64.49 FEET; THENCE NORTH 42°24'16" WEST A DISTANCE OF 88.07 FEET; THENCE NORTH 69°44'37" WEST A DISTANCE OF 178.25 FEET; THENCE NORTH 02°51'45" EAST A DISTANCE OF 33.22 FEET; THENCE NORTH 07°20'19" WEST A DISTANCE OF 88.32 FEET; THENCE NORTH 28°18'03" WEST A DISTANCE OF 73.48 FEET; THENCE NORTH 01°21'50" EAST A DISTANCE OF 69.70 FEET; THENCE NORTH 19°58'59" EAST A DISTANCE OF 38.84 FEET; THENCE NORTH 09°59'35" WEST A DISTANCE OF 147.23 FEET; THENCE NORTH 28°08'51" WEST A DISTANCE OF 134.34 FEET; THENCE NORTH 41°42'53" WEST A DISTANCE OF 77.79 FEET; THENCE NORTH 21°45'52" WEST A DISTANCE OF 95.75 FEET; THENCE NORTH 08°23'35" EAST A DISTANCE OF 122.75 FEET; THENCE NORTH 29°23'46" EAST A DISTANCE OF 54.08 FEET; THENCE NORTH 55°49'39" EAST A DISTANCE OF 43.71 FEET; THENCE NORTH 00°26'18" WEST A DISTANCE OF 173.54 FEET; THENCE NORTH 23°04'13" WEST A DISTANCE OF 58.42 FEET; THENCE NORTH 45°00'00" EAST A DISTANCE OF 47.39 FEET; THENCE NORTH 12°04'08" EAST A DISTANCE OF 103.15 FEET; THENCE NORTH 72°43'47" WEST A DISTANCE OF 108.41 FEET; THENCE NORTH 88°30'44" WEST A DISTANCE OF 102.23 FEET; THENCE NORTH 17°43'12" WEST A DISTANCE OF 176.60 FEET; THENCE NORTH 54°10'16" WEST A DISTANCE OF 197.25 FEET; THENCE NORTH 34°53'14" WEST A DISTANCE OF 118.92 FEET; THENCE NORTH 58°05'16" EAST A DISTANCE OF 151.27 FEET; THENCE NORTH 21°38'55" EAST A DISTANCE OF 69.25 FEET; THENCE NORTH 03°50'07" EAST A DISTANCE OF 178.58 FEET; THENCE NORTH 18°50'42" WEST A DISTANCE OF 161.27 FEET; THENCE SOUTH 84°36'08" WEST A DISTANCE OF 126.98 FEET; THENCE NORTH 34°05'42" WEST A DISTANCE OF 130.22 FEET; THENCE NORTH 56°15'48" WEST A DISTANCE OF 112.91 FEET; THENCE NORTH 90°00'00" WEST A DISTANCE OF 46.78 FEET; THENCE SOUTH 78°15'29" WEST A DISTANCE OF 146.74 FEET; THENCE NORTH 19°09'06" EAST A DISTANCE OF 142.60 FEET; THENCE NORTH 01°30'51" WEST A DISTANCE OF 150.69 FEET; THENCE NORTH 22°21'43" WEST A DISTANCE OF 56.69 FEET; THENCE NORTH 50°01'17" WEST A DISTANCE OF 56.29 FEET; THENCE NORTH 85°08'17" WEST A DISTANCE OF 68.97 FEET TO A POINT LYING SOUTH 00°00'41" WEST A DISTANCE OF 1470.53 FEET FROM THE NORTHWEST CORNER OF SECTION 27, TOWNSHIP 3 NORTH, RANGE 11 WEST; CONTINUING NORTH 85°08'17" WEST A DISTANCE OF 91.53 FEET; THENCE NORTH 62°45'18" WEST A DISTANCE OF 50.01 FEET; THENCE NORTH 41°47'26" WEST A DISTANCE OF 50.29 FEET; THENCE NORTH 87°35'07" WEST A DISTANCE OF 110.25 FEET; THENCE NORTH 02°44'53" WEST A DISTANCE OF 124.57 FEET; THENCE NORTH 31°57'00" EAST A DISTANCE OF 36.37 FEET; THENCE NORTH 53°06'24" EAST A DISTANCE OF 161.39 FEET; THENCE NORTH 82°31'42" EAST A DISTANCE OF 20.41 FEET; THENCE NORTH 57°38'11" EAST A DISTANCE OF 138.32 FEET TO A POINT LYING SOUTH 00°00'41" WEST A DISTANCE OF 1470.53 FEET FROM THE NORTHEAST CORNER OF SECTION 28, TOWNSHIP 3 NORTH, RANGE 11 WEST; CONTINUING NORTH 57°38'11" EAST A DISTANCE OF 159.83 FEET; THENCE NORTH 32°50'59" EAST A DISTANCE OF 169.43 FEET; THENCE NORTH 16°30'51" EAST A DISTANCE OF 275.47 FEET; THENCE NORTH 54°58'40" EAST A DISTANCE OF 154.37 FEET; THENCE NORTH 74°53'26" EAST A DISTANCE OF 103.10 FEET; THENCE NORTH 16°42'49" EAST A DISTANCE OF 125.76 FEET; THENCE NORTH 90°00'00" EAST A DISTANCE OF 71.00 FEET; THENCE NORTH 00°00'00" EAST A DISTANCE OF 97.55 FEET; THENCE NORTH 52°13'49" EAST A DISTANCE OF 63.38 FEET; THENCE NORTH 13°36'55" EAST A DISTANCE OF 142.36 FEET; THENCE NORTH 16°10'20" WEST A DISTANCE OF 34.55 FEET; THENCE NORTH 24°16'18" EAST A DISTANCE OF 24.87 FEET TO A POINT LYING SOUTH 89°10'36" EAST A DISTANCE OF 722.41 FEET FROM THE NORTHWEST CORNER OF SECTION 27, TOWNSHIP 3 NORTH, RANGE 11 WEST; CONTINUING THENCE NORTH 24°16'18" EAST A DISTANCE OF 93.78 FEET; THENCE NORTH 52°03'08" EAST A DISTANCE OF 45.86 FEET; THENCE SOUTH 72°26'32" EAST A DISTANCE OF 89.09 FEET; THENCE NORTH 88°37'04" EAST A DISTANCE OF 247.59 FEET; THENCE NORTH 02°03'16" EAST A DISTANCE OF 74.04 FEET; THENCE NORTH 44°02'34" EAST A DISTANCE OF 98.32 FEET; THENCE NORTH 15°21'35" EAST A DISTANCE OF 111.48 FEET; THENCE SOUTH 89°19'05" EAST A DISTANCE OF 111.49 FEET; THENCE NORTH 02°10'54" EAST A DISTANCE OF 34.86 FEET; THENCE NORTH 67°45'36" EAST A DISTANCE OF 88.54 FEET; THENCE SOUTH 83°56'37" EAST A DISTANCE OF 125.79 FEET; THENCE SOUTH 60°51'42" EAST A DISTANCE OF 66.10 FEET; THENCE SOUTH 89°08'32" EAST A DISTANCE OF 110.83 FEET; THENCE NORTH 52°52'26" EAST A DISTANCE OF 44.53 FEET; THENCE NORTH 18°53'24" WEST A DISTANCE OF 118.88 FEET; THENCE NORTH 49°03'39" WEST A DISTANCE OF 115.96 FEET; THENCE NORTH 09°03'15" EAST A DISTANCE OF 145.48 FEET; THENCE NORTH 47°42'07" WEST A DISTANCE OF 104.52 FEET; THENCE NORTH 83°01'15" WEST A DISTANCE OF 193.88 FEET; THENCE NORTH 00°52'15" WEST A DISTANCE OF 305.62 FEET; THENCE NORTH 15°45'28" EAST A DISTANCE OF 69.64 FEET; THENCE NORTH 52°08'59" EAST A DISTANCE OF 135.73 FEET; THENCE NORTH 26°33'54" EAST A DISTANCE OF 145.42 FEET; THENCE NORTH 10°06'07" EAST A DISTANCE OF 117.28 FEET; THENCE NORTH 45°00'00" EAST A DISTANCE OF 167.52 FEET; THENCE NORTH 69°16'28" EAST A DISTANCE OF 91.88 FEET; THENCE NORTH 17°00'39" EAST A DISTANCE OF 75.99 FEET; THENCE NORTH 05°20'52" EAST A DISTANCE OF 145.96 FEET; THENCE NORTH 16°55'19" WEST A DISTANCE OF 139.07 FEET; THENCE NORTH 00°00'00" EAST A DISTANCE OF 204.39 FEET; THENCE NORTH 90°00'00" WEST A DISTANCE OF 266.10 FEET; THENCE NORTH 81°15'14" WEST A DISTANCE OF 43.64 FEET; THENCE NORTH 69°08'01" WEST A DISTANCE OF 71.73 FEET; THENCE NORTH 38°42'55" WEST A DISTANCE OF 53.58 FEET; THENCE NORTH 89°06'17" WEST A DISTANCE OF 84.95 FEET; THENCE NORTH 65°25'48" WEST A DISTANCE OF 362.28 FEET; THENCE NORTH 81°57'35" WEST A DISTANCE OF 149.45 FEET; THENCE NORTH 01°35'28" WEST A DISTANCE OF 179.24 FEET; THENCE NORTH 90°00'00" WEST A DISTANCE OF 208.70 FEET; THENCE NORTH 85°12'06" WEST A DISTANCE OF 91.23 FEET; THENCE NORTH 00°21'54" EAST A DISTANCE OF 104.19 FEET; THENCE NORTH 28°20'28" EAST A DISTANCE OF 95.75 FEET; THENCE NORTH 07°11'03" EAST A DISTANCE OF 119.39 FEET; THENCE NORTH 42°16'25" EAST A DISTANCE OF 39.46 FEET; THENCE NORTH 51°17'44" EAST A

DISTANCE OF 66.33 FEET; THENCE SOUTH 85°35'09" EAST A DISTANCE OF 94.84 FEET; THENCE NORTH 76°37'12" EAST A DISTANCE OF 70.26 FEET; THENCE NORTH 43°13'54" EAST A DISTANCE OF 174.87 FEET; THENCE NORTH 48°23'33" WEST A DISTANCE OF 182.38 FEET; THENCE NORTH 01°08'04" WEST A DISTANCE OF 67.04 FEET; THENCE NORTH 85°14'11" WEST A DISTANCE OF 75.91 FEET; THENCE NORTH 05°30'41" EAST A DISTANCE OF 38.00 FEET; THENCE NORTH 14°16'52" EAST A DISTANCE OF 56.49 FEET; THENCE NORTH 24°09'12" EAST A DISTANCE OF 151.63 FEET; THENCE NORTH 06°41'34" EAST A DISTANCE OF 65.48 FEET; THENCE NORTH 10°15'55" WEST A DISTANCE OF 85.65 FEET; THENCE NORTH 14°47'19" EAST A DISTANCE OF 42.90 FEET; THENCE NORTH 41°05'58" EAST A DISTANCE OF 41.39 FEET; THENCE NORTH 67°37'45" EAST A DISTANCE OF 223.17 FEET; THENCE NORTH 82°23'17" EAST A DISTANCE OF 72.64 FEET; THENCE NORTH 51°46'32" EAST A DISTANCE OF 47.73 FEET; THENCE NORTH 05°46'41" EAST A DISTANCE OF 56.03 FEET; THENCE NORTH 11°11'42" EAST A DISTANCE OF 97.41 FEET; THENCE NORTH 25°01'01" EAST A DISTANCE OF 54.92 FEET; THENCE NORTH 58°40'17" EAST A DISTANCE OF 44.67 FEET; THENCE NORTH 90°00'00" EAST A DISTANCE OF 30.53 FEET; THENCE SOUTH 64°25'20" EAST A DISTANCE OF 292.81 FEET; THENCE SOUTH 12°57'10" EAST A DISTANCE OF 102.14 FEET; THENCE SOUTH 88°06'13" EAST A DISTANCE OF 50.13 FEET; THENCE SOUTH 65°49'15" EAST A DISTANCE OF 35.64 FEET; THENCE SOUTH 09°37'11" EAST A DISTANCE OF 39.71 FEET; THENCE SOUTH 47°00'09" EAST A DISTANCE OF 33.57 FEET; THENCE SOUTH 83°43'44" EAST A DISTANCE OF 60.75 FEET; THENCE NORTH 65°54'11" EAST A DISTANCE OF 86.14 FEET; THENCE NORTH 85°05'20" EAST A DISTANCE OF 182.16 FEET; THENCE NORTH 45°24'44" EAST A DISTANCE OF 32.61 FEET; THENCE NORTH 12°05'41" WEST A DISTANCE OF 71.26 FEET; THENCE NORTH 12°33'32" EAST A DISTANCE OF 68.67 FEET; THENCE NORTH 54°30'20" EAST A DISTANCE OF 102.29 FEET; THENCE NORTH 60°55'52" EAST A DISTANCE OF 129.07 FEET; THENCE NORTH 49°01'14" EAST A DISTANCE OF 147.23 FEET; THENCE NORTH 37°13'31" EAST A DISTANCE OF 128.34 FEET; THENCE NORTH 19°08'01" EAST A DISTANCE OF 68.84 FEET; THENCE NORTH 05°11'40" EAST A DISTANCE OF 62.30 FEET; THENCE NORTH 11°06'47" WEST A DISTANCE OF 37.87 FEET; THENCE NORTH 46°14'29" EAST A DISTANCE OF 75.80 FEET; THENCE NORTH 16°29'25" EAST A DISTANCE OF 95.85 FEET; THENCE NORTH 32°30'04" EAST A DISTANCE OF 97.57 FEET; THENCE NORTH 12°53'56" EAST A DISTANCE OF 89.18 FEET; THENCE NORTH 38°47'32" EAST A DISTANCE OF 67.26 FEET; THENCE NORTH 50°19'12" EAST A DISTANCE OF 58.20 FEET; THENCE SOUTH 55°39'14" EAST A DISTANCE OF 48.22 FEET; THENCE NORTH 67°42'43" EAST A DISTANCE OF 224.84 FEET; THENCE NORTH 82°01'07" EAST A DISTANCE OF 126.65 FEET; THENCE NORTH 24°21'45" EAST A DISTANCE OF 115.83 FEET; THENCE NORTH 07°36'46" EAST A DISTANCE OF 89.71 FEET TO A POINT LYING SOUTH 89°38'29" EAST A DISTANCE OF 410.91 FEET FROM THE NORTH QUARTER CORNER OF SECTION 22, TOWNSHIP 3 NORTH, RANGE 11 WEST; CONTINUING NORTH 07°36'46" EAST A DISTANCE OF 118.17 FEET; THENCE NORTH 20°44'07" EAST A DISTANCE OF 99.34 FEET; THENCE NORTH 40°33'21" EAST A DISTANCE OF 181.67 FEET; THENCE NORTH 24°38'30" EAST A DISTANCE OF 198.95 FEET; THENCE NORTH 54°21'37" EAST A DISTANCE OF 108.19 FEET; THENCE NORTH 81°20'26" EAST A DISTANCE OF 116.80 FEET; THENCE NORTH 53°43'39" EAST A DISTANCE OF 165.44 FEET; THENCE NORTH 24°01'31" EAST A DISTANCE OF 154.03 FEET; THENCE NORTH 10°12'14" EAST A DISTANCE OF 84.28 FEET; THENCE NORTH 45°15'09" EAST A DISTANCE OF 53.26 FEET; THENCE NORTH 49°41'06" EAST A DISTANCE OF 540.01 FEET; THENCE NORTH 62°06'25" EAST A DISTANCE OF 230.50 FEET; THENCE NORTH 20°08'28" EAST A DISTANCE OF 123.34 FEET; THENCE NORTH 64°15'55" EAST A DISTANCE OF 51.20 FEET; THENCE SOUTH 82°54'15" EAST A DISTANCE OF 161.16 FEET; THENCE SOUTH 47°07'47" EAST A DISTANCE OF 113.63 FEET; THENCE SOUTH 01°10'26" EAST A DISTANCE OF 161.95 FEET; THENCE SOUTH 71°33'54" EAST A DISTANCE OF 73.45 FEET; THENCE NORTH 77°15'29" EAST A DISTANCE OF 135.39 FEET; THENCE NORTH 90°00'00" EAST A DISTANCE OF 72.66 FEET; THENCE SOUTH 65°46'20" EAST A DISTANCE OF 72.77 FEET; THENCE NORTH 62°20'46" EAST A DISTANCE OF 101.51 FEET; THENCE NORTH 03°16'14" WEST A DISTANCE OF 58.16 FEET; THENCE NORTH 46°16'41" WEST A DISTANCE OF 115.69 FEET; THENCE NORTH 09°35'43" WEST A DISTANCE OF 117.44 FEET; THENCE NORTH 20°55'08" EAST A DISTANCE OF 92.00 FEET; THENCE NORTH 48°41'58" EAST A DISTANCE OF 109.09 FEET; THENCE NORTH 86°15'08" EAST A DISTANCE OF 126.91 FEET TO A POINT LYING SOUTH 00°03'27" WEST A DISTANCE OF 860.87 FEET FROM THE EAST QUARTER CORNER OF SECTION 15, TOWNSHIP 3 NORTH, RANGE 11 WEST; CONTINUING NORTH ALONG THE EAST LINE OF SAID SECTION A DISTANCE OF 860.87 FEET MORE OR LESS TO THE WEST QUARTER CORNER OF SECTION 14, TOWNSHIP 3 NORTH, RANGE 11 WEST TO THE POINT OF BEGINNING.

TOTAL AREA OF THE DRAINAGE DISTRICT IS 4037.4 ACRES, MORE OR LESS

APPENDIX 3 – MDEQ DISCHARGE REQUEST

From: deq-wrd-qreq@michigan.gov

To: jam.esc@live.com

Subject: RE: flood or low flow discharge request (ContentID - 168812)

Date: Wed, 23 Oct 2013 17:05:22 +0000

This reply is being sent via email only.

We have estimated the flood frequency discharges requested in your email of October 18, 2013 (Process No. 20130488), as follows:

Cuddy Drain at M-179 (129th Avenue), Section 23, T3N, R11W, Wayland Township, Allegan County, has a drainage area of 0.97 square miles. (Watershed Basin No. 17 Kalamazoo). Since the drainage area is less than two square miles, a permit is not required under the provisions of the Floodplain Regulatory Authority found in Part 31, Water Resources Protection, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended (NREPA). A permit may be required under Part 301, Inland Lakes and Streams, of the NREPA.

Cuddy Drain at Mouth, Section 23, T3N, R11W, Wayland Township, Allegan County, has a drainage area of 1.17 square miles. (Watershed Basin No. 17 Kalamazoo). Since the drainage area is less than two square miles, a permit is not required under the provisions of the Floodplain Regulatory Authority found in Part 31, Water Resources Protection, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended (NREPA). A permit may be required under Part 301, Inland Lakes and Streams, of the NREPA.

Gardiner Drain at 1st Street, Section 24, T3N, R11W, Wayland Township, Allegan County, has a total drainage area of 5.9 square miles and a contributing drainage area of 5.9 square miles. The 50%, 20%, 10%, 4%, 2%, and 1% chance peak flows are estimated to be 40 cubic feet per second (cfs), 100 cfs, 160 cfs, 280 cfs, 410 cfs, and 600 cfs, respectively. (Watershed Basin No. 17 Kalamazoo).

Gardiner Drain at Patterson Road, Section 25, T3N, R11W, Wayland Township, Allegan County, has a total drainage area of 6.9 square miles and a contributing drainage area of 6.8 square miles. The 50%, 20%, 10%, 4%, 2%, and 1% chance peak flows are estimated to be 45 cubic feet per second (cfs), 110 cfs, 180 cfs, 320 cfs, 470 cfs, and 650 cfs, respectively. (Watershed Basin No. 17 Kalamazoo).

Gardiner Drain at Upstream of Cuddy Drain, Section 23, T3N, R11W, Wayland Township, Allegan County, has a drainage area of 2.1 square miles. The 50%, 20%, 10%, 4%, 2%, and 1% chance peak flows are estimated to be 25 cubic feet per second (cfs), 45 cfs, 70 cfs, 120 cfs, 180 cfs, and 260 cfs, respectively. (Watershed Basin No. 17 Kalamazoo).

Boot Lake Drain at 4th Street, Section 26, T3N, R11W, Wayland Township, Allegan County, has a drainage area of 1.53 square miles. (Watershed Basin No. 17 Kalamazoo). Since the drainage area is less than two square miles, a permit is not required under the provisions of the Floodplain Regulatory Authority found in Part 31, Water Resources Protection, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended (NREPA). A permit may be required under Part 301, Inland Lakes and Streams, of the NREPA.

APPENDIX 4 - PRELIMINARY ESTIMATE OF CONSTRUCTION COST

Date: January 20, 2014

Cuddy Intercounty Drain Improvements - West of Patterson Road

No.	Item Description	Quantity	Unit Cost	Total Cost
1	Woody Debris Management	7500 LF	\$ 1.50	\$ 11,250.00
2	Open Channel Stabilization	300 LF	\$ 50.00	\$ 15,000.00
3	Selective Bank Stabilization BMPs	2000 LF	\$ 10.00	\$ 20,000.00
4	Replace Sta. 101+00 (Totten) w/ 48" CMP Culv. (or Equal)	50 LF	\$ 75.00	\$ 3,750.00
5	Replace Sta. 102+00 (Jackson) w/ 48" CMP Culv. (or Equal)	50 LF	\$ 75.00	\$ 3,750.00
6	Replace Timber Creek Dr. w/ 60" CMP Culv. (or Equal)	64 LF	\$ 100.00	\$ 6,400.00
7	Riprap End Treatment & Miscellaneous Stabilization	250 SY	\$ 60.00	\$ 15,000.00
8	Grade Control Structure (Rock Riffle)	4 EA	\$ 2,500.00	\$ 10,000.00
9	Open Channel Seeding	7500 LF	\$ 0.50	\$ 3,750.00

***Estimated Construction Sub-Total \$ 88,900.00**

Cuddy Intercounty Drain Improvements - Sediment Basin

No.	Item Description	Quantity	Unit Cost	Total Cost
1	Open Channel Excavation	2500 CY	\$ 3.00	\$ 7,500.00
2	Haul and Dispose of Spoil Material	2500 CY	\$ 7.00	\$ 17,500.00
3	Grade Control Structure (Upstream and Downstream)	1 LS	\$ 10,000.00	\$ 10,000.00
4	Site Restoration	1 LS	\$ 7,500.00	\$ 7,500.00

***Estimated Construction Sub-Total \$ 42,500.00**

Cuddy Intercounty Drain Improvements - East of Patterson Road (Sand Bar w/in 400' Downstream)

No.	Item Description	Quantity	Unit Cost	Total Cost
1	Open Channel Excavation (Dredging)	3500 CY	\$ 15.00	\$ 52,500.00
2	Haul and Dispose of Spoil Material	3500 CY	\$ 15.00	\$ 52,500.00
3	Site Restoration	1 LS	\$ 10,000.00	\$ 10,000.00

***Estimated Construction Sub-Total \$ 115,000.00**

Cuddy Intercounty Drain Improvements - East of Patterson Road (Navigable Channel)

No.	Item Description	Quantity	Unit Cost	Total Cost
1	Open Channel Excavation (Dredging)	6500 CY	\$ 15.00	\$ 97,500.00
2	Haul and Dispose of Spoil Material	6500 CY	\$ 15.00	\$ 97,500.00
3	Site Restoration	1 LS	\$ 10,000.00	\$ 10,000.00

***Estimated Construction Sub-Total \$ 205,000.00**

APPENDIX 4 - PRELIMINARY ESTIMATE OF CONSTRUCTION COST

Date: January 20, 2014

Gardner Drain Improvements (Allegan County)

No.	Item Description	Quantity	Unit Cost	Total Cost
1	Woody Debris Management	1000 LF	\$ 1.50	\$ 1,500.00
2	Open Channel Stabilization	200 LF	\$ 50.00	\$ 10,000.00
3	Replace Timber Creek Dr. w/ 60" CMPO Culv. (or Equal)	64 LF	\$ 100.00	\$ 6,400.00
4	Riprap End Treatment & Miscellaneous Stabilization	100 SY	\$ 60.00	\$ 6,000.00
5	Grade Control Structure (Rock Riffle)	4 EA	\$ 2,500.00	\$ 10,000.00
6	Open Channel Seeding	1000 LF	\$ 0.50	\$ 500.00

***Estimated Construction Sub-Total \$ 34,400.00**

First Street - Culvert Replacement

(Based on Preliminary Design by Wightman & Associates, Inc., dated August 2013)

No.	Item Description	Quantity	Unit Cost	Total Cost
1	Clearing	1 LS	\$ 3,000.00	\$ 3,000.00
2	Grading	1 LS	\$ 5,000.00	\$ 5,000.00
3	Tawsley and Holdbrook Drain Realignment	300 LF	\$ 10.00	\$ 3,000.00
4	Structure, Rem	1 LS	\$ 2,000.00	\$ 2,000.00
5	Subgrade Undercutting, Type II	100 CY	\$ 10.00	\$ 1,000.00
6	Site Dewatering	1 LS	\$ 5,000.00	\$ 5,000.00
7	Culv, CL F, 12 inch	40 LF	\$ 25.00	\$ 1,000.00
8	Culvert Fill	43 CY	\$ 10.00	\$ 430.00
9	Culv, Precast 16'x5' Conc. Box	72 LF	\$ 1,800.00	\$ 129,600.00
10	Approach, CL II	40 TN	\$ 20.00	\$ 800.00
11	Subbase, CIP	245 CY	\$ 10.00	\$ 2,450.00
12	Aggregate Surface Course, 6"	490 SY	\$ 6.00	\$ 2,940.00
13	Restoration	1 LS	\$ 2,500.00	\$ 2,500.00
14	Mulch Blanket	750 SY	\$ 2.50	\$ 1,875.00
15	Traffic Control	1 LS	\$ 5,000.00	\$ 5,000.00
16	Riprap, Heavy	140 SY	\$ 60.00	\$ 8,400.00
17	Rock Grade Control Structure	60 LF	\$ 100.00	\$ 6,000.00
18	Erosion Control, Silt Fence	300 LF	\$ 2.50	\$ 750.00
19	Project Cleanup	1 LS	\$ 2,500.00	\$ 2,500.00

***Estimated Construction Sub-Total \$ 183,245.00**

APPENDIX 4 - PRELIMINARY ESTIMATE OF CONSTRUCTION COST

Date: January 20, 2014

Patterson Road - Culvert Replacement

(Based on Preliminary Design by Fishbeck, Thompson, Carr and Huber, Inc., dated February 11, 2013)

No.	Item Description	Quantity	Unit Cost	Total Cost
1	Clearing	1 LS	\$ 3,000.00	\$ 3,000.00
2	Grading	1 LS	\$ 7,000.00	\$ 7,000.00
3	Structure, Rem	1 LS	\$ 2,000.00	\$ 2,000.00
4	Topsoil Surface, Salv, 3 inch	60 CY	\$ 10.00	\$ 600.00
5	Excavation, Channel, Modified	1 LS	\$ 2,000.00	\$ 2,000.00
6	Site Dewatering	1 LS	\$ 25,000.00	\$ 25,000.00
7	Aggregate, 6A, Modified	125 TN	\$ 20.00	\$ 2,500.00
8	Culv, Precast 16'x4' Conc. Box, Modified	70 LF	\$ 1,550.00	\$ 108,500.00
9	Steel Sheet Piling Headwall	1300 SF	\$ 30.00	\$ 39,000.00
10	Guardrail Approach Terminal, Type B	1 EA	\$ 1,000.00	\$ 1,000.00
11	Guardrail Departing Terminal, Type B, Curved	1 EA	\$ 2,000.00	\$ 2,000.00
12	Guardrail, Type B	150 LF	\$ 25.00	\$ 3,750.00
13	Guardrail, Type B Over Low Fill Box Culv.	53 LF	\$ 50.00	\$ 2,650.00
14	Subbase, CIP	350 CY	\$ 10.00	\$ 3,500.00
15	Aggregate Base	250 TN	\$ 20.00	\$ 5,000.00
16	HMA, 3C	160 TN	\$ 100.00	\$ 16,000.00
17	HMA, 4C	60 TN	\$ 100.00	\$ 6,000.00
18	Restoration	1 LS	\$ 2,500.00	\$ 2,500.00
19	Mulch Blanket	700 SY	\$ 2.50	\$ 1,750.00
20	Traffic Control	1 LS	\$ 10,000.00	\$ 10,000.00
21	Riprap, Heavy	150 SY	\$ 60.00	\$ 9,000.00
22	Rock Cross Vane	2 EA	\$ 2,500.00	\$ 5,000.00
23	Erosion Control, Silt Fence	300 LF	\$ 2.50	\$ 750.00
24	Project Cleanup, Modified	1 LS	\$ 2,500.00	\$ 2,500.00

***Estimated Construction Sub-Total \$ 261,000.00**

***Estimated Total Construction Cost \$ 930,045.00**

Contingency (10%) \$ 93,004.50

*** Preliminary Estimate of Probable Construction Cost \$ 1,023,049.50**

* Does not include Engineering, Survey, Legal, Administrative, Environmental Permitting, Wetland Mitigation, Floodplain Mitigation, Environmental Remediation, Land Acquisition, Easement Acquisition, or Financing Costs.

APPENDIX 5 - ENGINEER'S RECOMMENDATION OF APPORTIONMENT

Date: January 23, 2014

Preliminary Engineering Study

(Apportionment based on Length of Drain within each County)

No.	Item Description	Estimated Total Cost	Apportionment		Cost Share	
			Allegan	Barry	Allegan	Barry
1	Engineering (Study)	\$ 7,900.00	84%	16%	\$ 6,636.00	\$ 1,264.00
*Estimated Sub-Total		\$ 7,900.00			\$ 6,636.00	\$ 1,264.00

Cuddy Intercounty Drain Improvements - West of Patterson Road

No.	Item Description	Estimated Total Cost	Apportionment		Cost Share	
			Allegan	Barry	Allegan	Barry
1	Construction	\$ 88,900.00	100%	0%	\$ 88,900.00	\$ -
2	Engineering (Design, Construct)	\$ 17,800.00	100%	0%	\$ 17,800.00	\$ -
3	Easement Acquisition	\$ -	100%	0%	\$ -	\$ -
*Estimated Sub-Total		\$ 106,700.00			\$ 106,700.00	\$ -

Cuddy Intercounty Drain Improvements - Sediment Basin

No.	Item Description	Estimated Total Cost	Apportionment		Cost Share	
			Allegan	Barry	Allegan	Barry
1	Construction	\$ 42,500.00	50%	50%	\$ 21,250.00	\$ 21,250.00
2	Engineering (Design, Construct)	\$ 8,500.00	50%	50%	\$ 4,250.00	\$ 4,250.00
3	Land or Easement Acquisition (2 AC.)	\$ 10,000.00	50%	50%	\$ 5,000.00	\$ 5,000.00
*Estimated Sub-Total		\$ 61,000.00			\$ 30,500.00	\$ 30,500.00

Cuddy Intercounty Drain Improvements - East of Patterson Road (Sand Bar w/in 400' Downstream)

No.	Item Description	Estimated Total Cost	Apportionment		Cost Share	
			Allegan	Barry	Allegan	Barry
1	Construction	\$ 115,000.00	100%	0%	\$ 115,000.00	\$ -
2	Engineering (Design, Construct)	\$ 23,000.00	100%	0%	\$ 23,000.00	\$ -
3	Land or Easement Acquisition (5 AC.)	\$ 25,000.00	100%	0%	\$ 25,000.00	\$ -
*Estimated Sub-Total		\$ 163,000.00			\$ 163,000.00	\$ -

Cuddy Intercounty Drain Improvements - East of Patterson Road (Navigable Channel)

No.	Item Description	Estimated Total Cost	Apportionment		Cost Share	
			Allegan	Barry	Allegan	Barry
1	Construction	\$ 205,000.00	0%	100%	\$ -	\$ 205,000.00
2	Engineering (Design, Construct)	\$ 20,500.00	0%	100%	\$ -	\$ 20,500.00
3	Land or Easement Acquisition (5 AC.)	\$ 25,000.00	0%	100%	\$ -	\$ 25,000.00
*Estimated Sub-Total		\$ 250,500.00			\$ -	\$ 250,500.00

APPENDIX 5 - ENGINEER'S RECOMMENDATION OF APPORTIONMENT

Date: January 23, 2014

Gardner Drain Improvements (Allegan County)

No.	Item Description	Estimated Total Cost	Apportionment		Cost Share	
			Allegan	Barry	Allegan	Barry
1	Construction	\$ 34,400.00	100%	0%	\$ 34,400.00	\$ -
2	Engineering (Design, Construct)	\$ 8,600.00	100%	0%	\$ 8,600.00	\$ -
3	Easement Acquisition (2 Easements)	\$ 5,000.00	100%	0%	\$ 5,000.00	\$ -
*Estimated Sub-Total		\$ 48,000.00			\$ 48,000.00	\$ -

First Street - Culvert Replacement

(Based on Preliminary Design by Wightman & Associates, Inc., dated August 2013)

No.	Item Description	Estimated Total Cost	Apportionment		Cost Share	
			Allegan	Barry	Allegan	Barry
1	Construction	\$ 183,245.00	100%	0%	\$ 183,245.00	\$ -
2	Engineering (Design, Construct)	\$ 27,500.00	100%	0%	\$ 27,500.00	\$ -
3	Easement Acquisition	\$ -	100%	0%	\$ -	\$ -
*Estimated Sub-Total		\$ 210,745.00			\$ 210,745.00	\$ -

Patterson Road - Culvert Replacement

(Based on Preliminary Design by Fishbeck, Thompson, Carr and Huber, Inc., dated February 11, 2013)

No.	Item Description	Estimated Total Cost	Apportionment		Cost Share	
			Allegan	Barry	Allegan	Barry
1	Construction	\$ 261,000.00	50%	50%	\$ 130,500.00	\$ 130,500.00
2	Engineering (Design, Construct)	\$ 39,500.00	50%	50%	\$ 19,750.00	\$ 19,750.00
3	Easement Acquisition	\$ -	50%	50%	\$ -	\$ -
*Estimated Sub-Total		\$ 300,500.00			\$ 150,250.00	\$ 150,250.00

E-Coli Study

No.	Item Description	Estimated Total Cost	Apportionment		Cost Share	
			Allegan	Barry	Allegan	Barry
1	Engineering (Investigate Outfall Pipes Only)	\$ 2,000.00	50%	50%	\$ 1,000.00	\$ 1,000.00
*Estimated Sub-Total		\$ 2,000.00			\$ 1,000.00	\$ 1,000.00

*Estimated Total Project Cost	\$ 1,150,345.00	\$ 716,831.00	\$ 433,514.00
Contingency (10%)	\$ 115,034.50	\$ 71,683.10	\$ 43,351.40
*Preliminary Estimate of Probable Project Cost	\$ 1,265,379.50	\$ 788,514.10	\$ 476,865.40

*Recommended Apportionment between Counties	Allegan	Barry
	62%	38%

* All costs (construction, engineering and easement / land acquisition) are estimated, actual costs may vary.

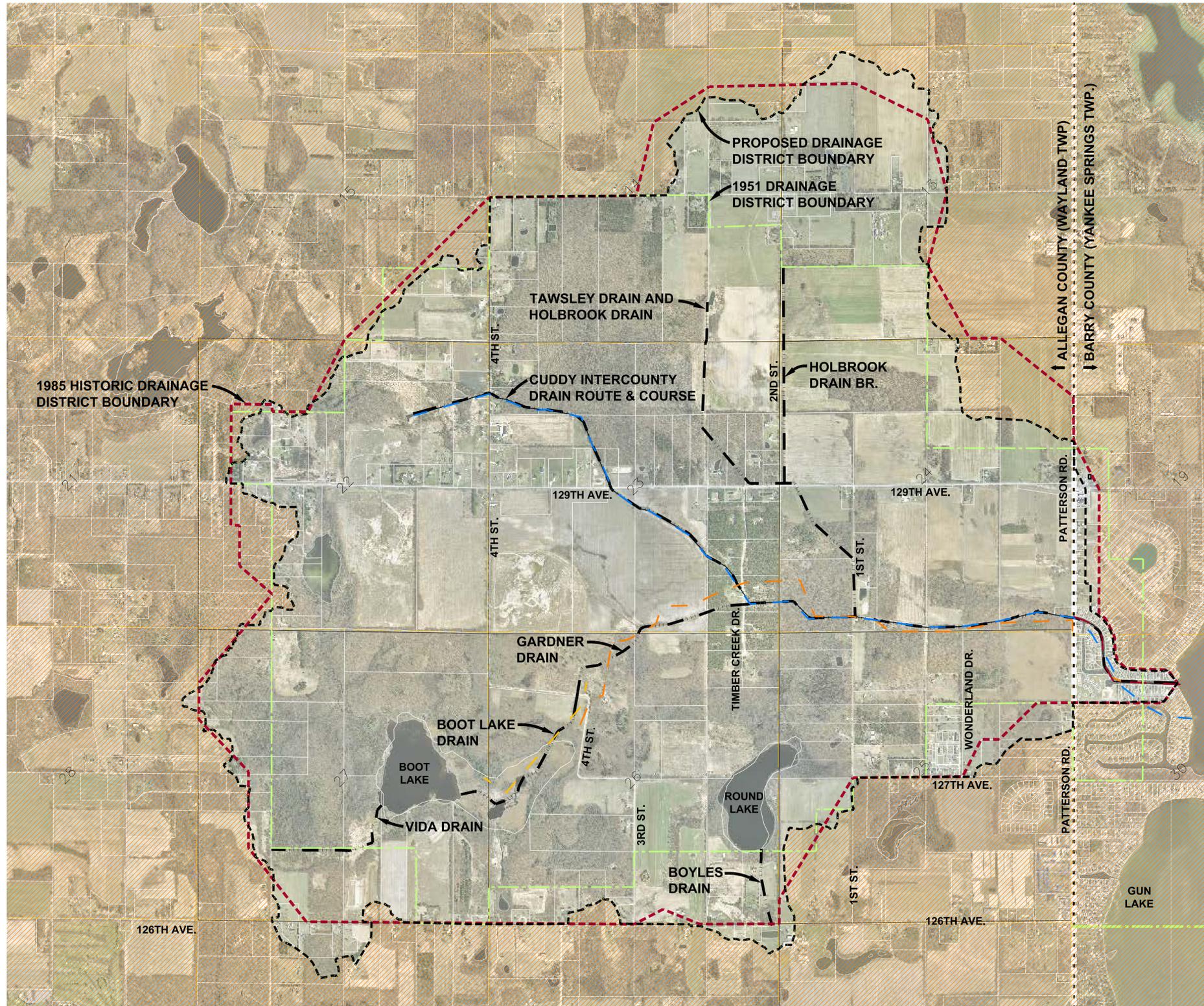
Estimate does not include Legal, Administrative, Environmental Permitting, Wetland Mitigation, Floodplain Mitigation, Environmental Remediation, or Financing Costs.



CUDDY INTERCOUNTY DRAIN



WAYLAND TOWNSHIP, ALLEGAN COUNTY
&
YANKEE SPRINGS TOWNSHIP, BARRY COUNTY



DRAINAGE DISTRICT MAP

DRAIN TOTALS:

PROPOSED ROUTE AND COURSE: 16,700 L.F. (3.16 MILES)
1915 HISTORIC ROUTE AND COURSE: 1,056 RODS (3.3 MILES)

PROPOSED DRAINAGE DISTRICT: 4,037.4 ACRES
1985 HISTORIC DRAINAGE DISTRICT: 4,147.1 ACRES
1951 HISTORIC DRAINAGE DISTRICT: 3,411.3 ACRES

LEGEND

- — — — — DRAIN ALIGNMENT
- — — — — 1915 CUDDY DRAIN ROUTE & COURSE
- — — — — 1951 CUDDY DRAIN RELOCATION
- — — — — 1882 GARDNER DRAIN ROUTE & COURSE
- — — — — 1896 BOOT LAKE DRAIN ROUTE & COURSE
- — — — — PROPOSED DRAINAGE DISTRICT
- — — — — 1985 HISTORIC DRAINAGE DISTRICT
- — — — — 1951 HISTORIC DRAINAGE DISTRICT



0 1000 2000
Horizontal Scale in Feet

LAND & RESOURCE
ENGINEERING INC.

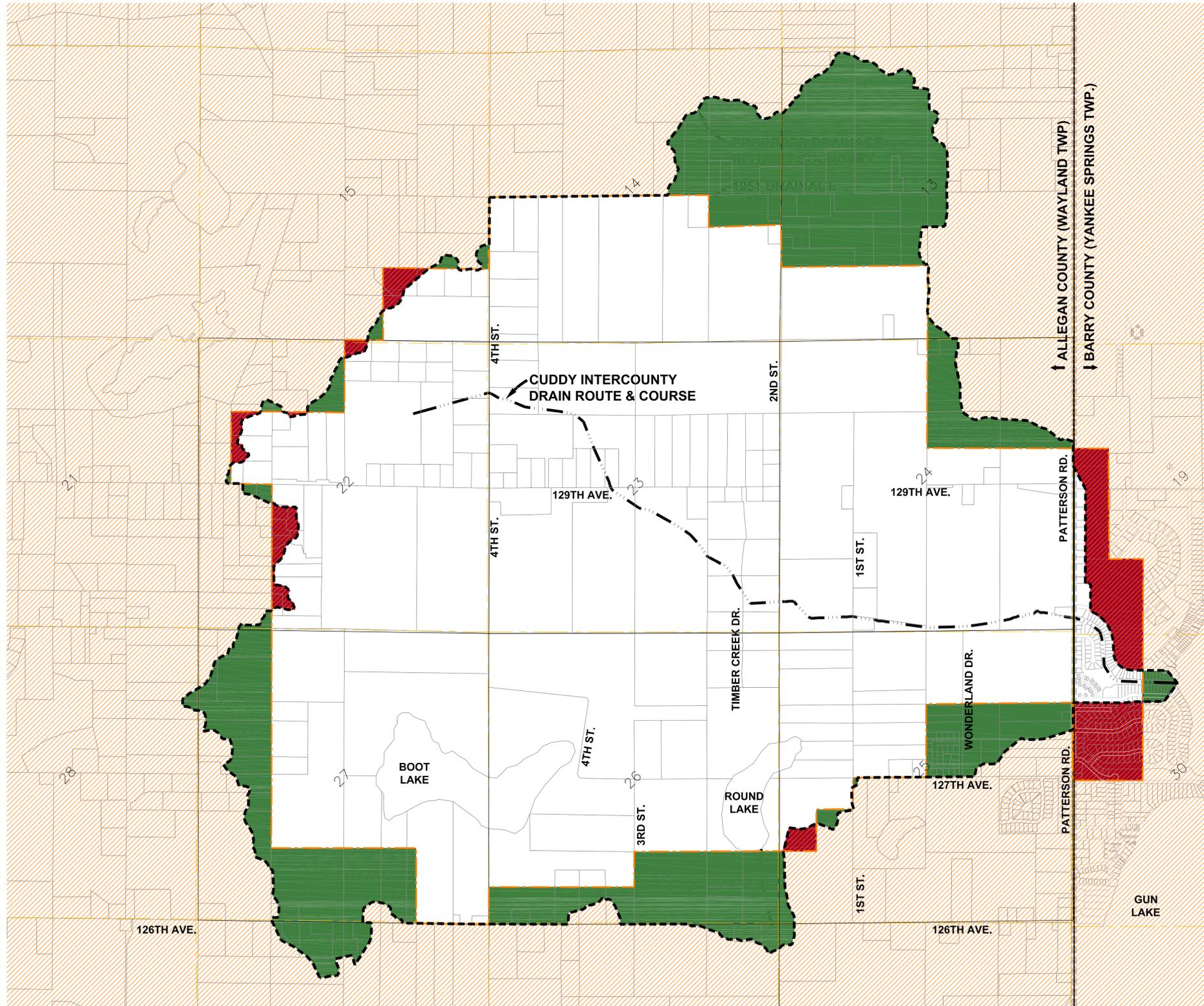
Common Sense • Lasting Solutions
3800 West River Drive, Ste. A, Comstock Park, MI 49321 Ph: 616.301.7888



CUDDY INTERCOUNTY DRAIN



WAYLAND TOWNSHIP, ALLEGAN COUNTY
&
YANKEE SPRINGS TOWNSHIP, BARRY COUNTY



LANDS ADDED/REMOVED

PROPOSED DRAINAGE DISTRICT: 4,037.4 ACRES
1951 HISTORIC DRAINAGE DISTRICT: 3,411.3 ACRES

LANDS ADDED (BASED ON 1951 DISTRICT)
= 759.1 ACRES
LANDS REMOVED (BASED ON 1951 DISTRICT)
= 133.0 ACRES
TOTAL CHANGE = 626.1 ACRES ADDED

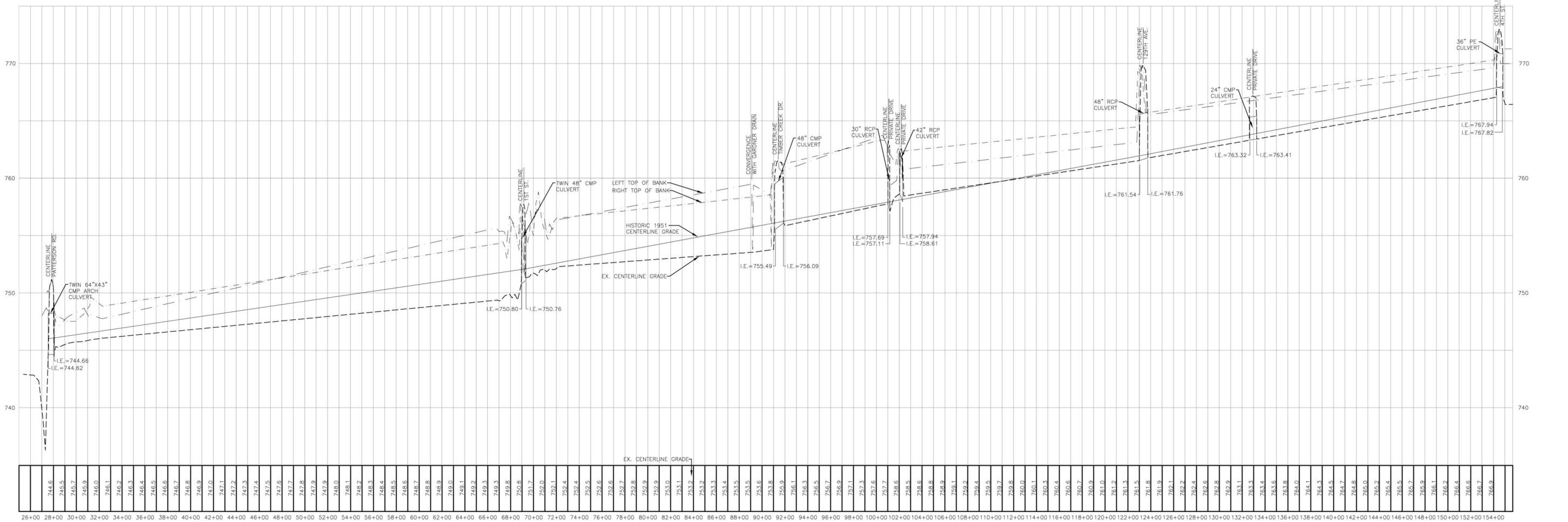
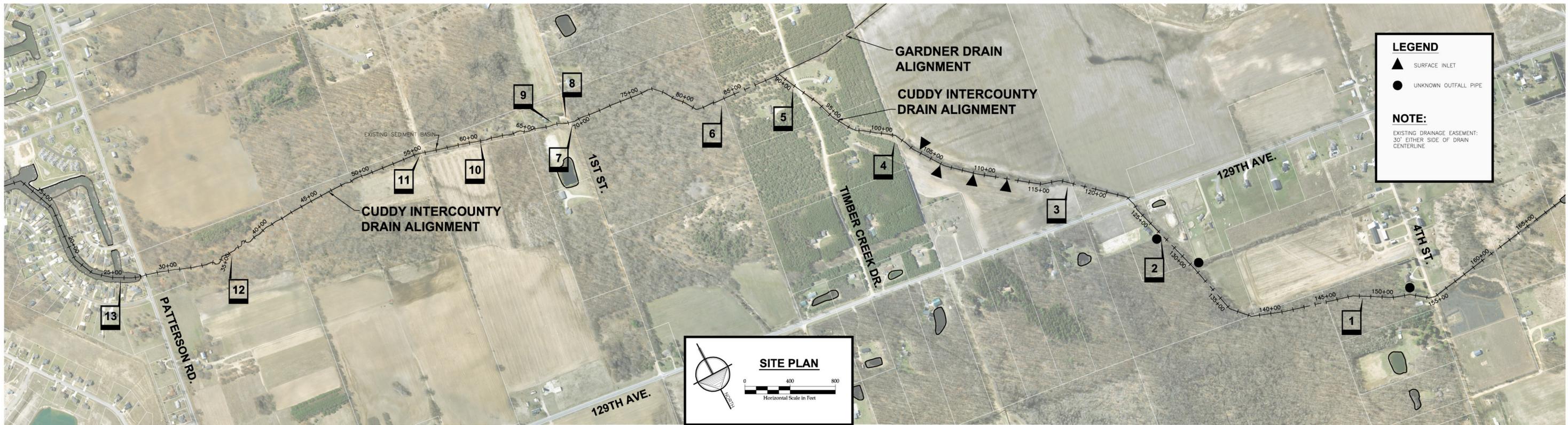
LEGEND

- DRAIN ALIGNMENT
- PROPOSED DRAINAGE DISTRICT
- 1951 HISTORIC DRAINAGE DISTRICT
- LANDS REMOVED
- LANDS ADDED



0 1000 2000
Horizontal Scale in Feet

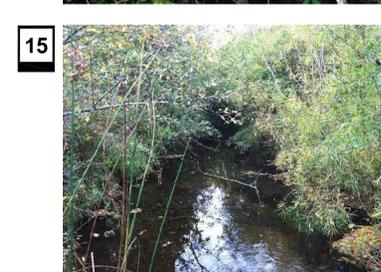
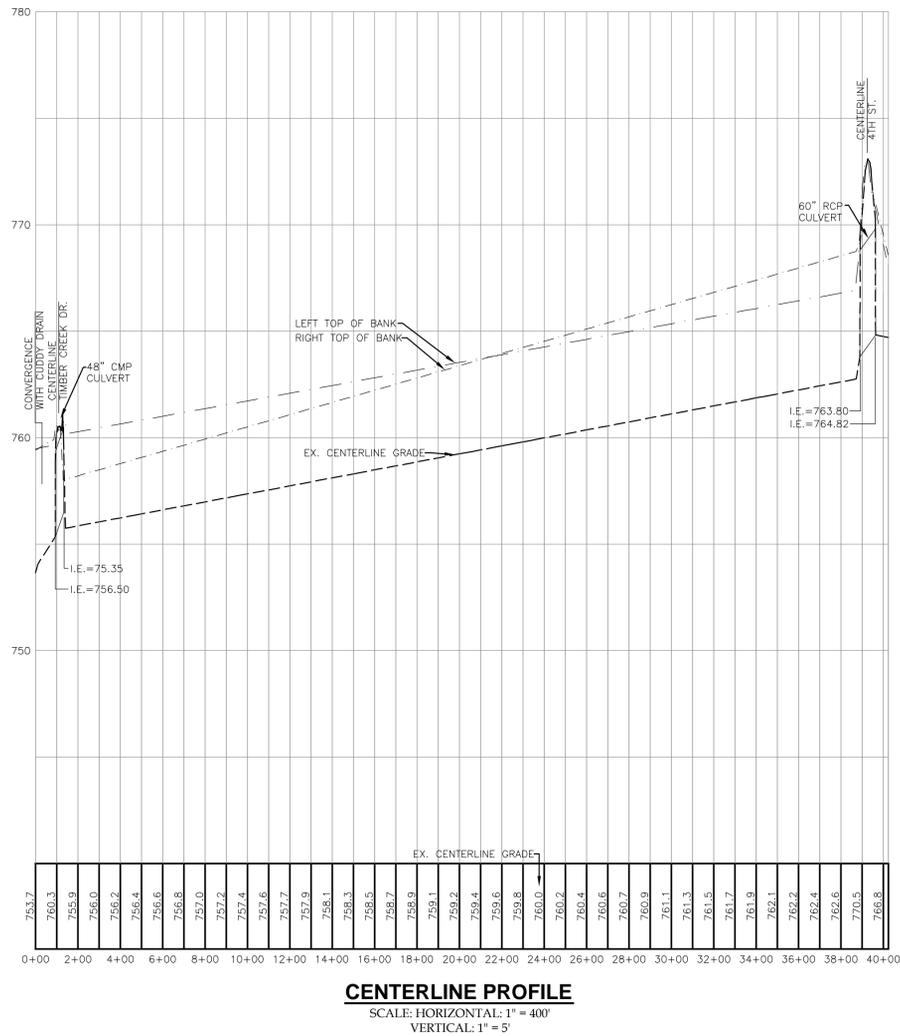
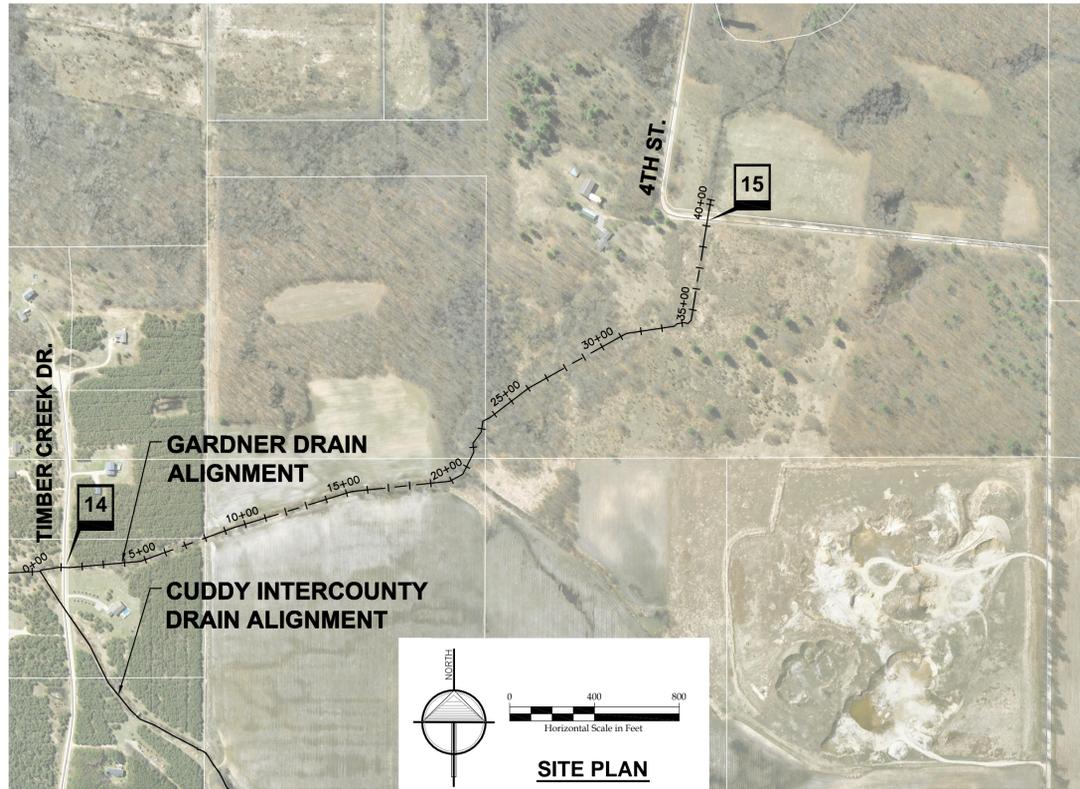
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CENTERLINE PROFILE
 SCALE: HORIZONTAL: 1" = 400'
 VERTICAL: 1" = 4'

SHEET: C1

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SHEET: C2