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ENVIRONMENTAL SCIENCE & ENGINEERING

TECHNICAL MEMORANDUM

To: Russ Anton, AICLA

Date: February 5, 2008

From: Brian Boyer, K&A
Mark Kieser, K&A

cc: Ron Young, Alcona Rd. Comm.

Re: Preliminary Evaluation of Timberlakes Drainage System Improvements
Cedar Lake – Timberlakes Subdivision

OVERVIEW

This Technical Memorandum is provided to the Alcona-Iosco Cedar Lake Association, Inc. (AICLA) by Kieser & Associates, LLC (K&A) to present initial findings related to potential groundwater impacts on the limited stormwater and subsurface drainage improvements being proposed by the Alcona County Road Commission (ACRC) office. This limited analysis consisted of:

- Meeting with ACRC and AICLA representatives
- Review of available information related to the existing Timberlakes drainage system
- Review of proposed "cleanout" or "upgrade plans" provided by ACRC
- Examine invert elevations of the existing drainage system
- Examine invert elevations of the proposed upgrades in relation to the lake outlet structure
- Assess the potential for exacerbated lake level impacts related to proposed upgrades
- Provide a brief summary report of findings, preliminary conclusions and potential impacts on lake levels

BACKGROUND ON HYDROLOGIC CONDITIONS

In July of 2005, K&A completed a Phase I Study (K&A, 2005) for the AICLA to provide an initial assessment of the hydrologic conditions influencing Cedar Lake water levels. As a follow-up to the preliminary Phase I efforts, K&A was authorized by the AICLA to further characterize manageable factors influencing lake levels and more formally identify management and/or structural solutions to help maintain lake levels during summer months. In September of 2006, K&A provided more detailed findings and conclusions within a Phase II Cedar Lake Report (K&A, 2006). Since low lake levels occur during the dry weather months when surface water inflows have ceased, understanding the relationship between the surrounding groundwater aquifer and lake levels is very important. Key findings from the Phase I and Phase II studies revealed all shoreline areas of the lake, except for the areas adjacent to the cedar swamp (northwest of the lake), drain water from the lake year-round. Areas that have historically been storm sewered, specifically Lakewood Shores to the southeast, drain water more rapidly than areas that have not been storm sewered. Based on this latter observation, the Timberlakes subdivision storm sewer conditions and proposed cleanout drew the attention of the AICLA.

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DATA REVIEW AND EVALUATION

On January 3, 2008, Brian Boyer of K&A met with Russ Anton of AICLA and Ron Young of the ACRC to review available information related to the existing Timberlakes subdivision drainage system and the proposed cleanout/upgrade plans. Existing as-built plans (plan and profile) related to the drainage system were not available for review at that time. Mr. Young was able to provide topographic elevation data and limited subsurface invert elevation data that were obtained by the ACRC. Copies of the proposed ACRC improvements were provided to K&A and the AICLA for further review (see Attachment A). Figure 1 illustrates a schematic layout of the Timberlakes subsurface drainage structures with respect to nearby surface water features and major roadways.

Based on their knowledge of the area, both Mr. Young and Mr. Anton estimated that the Timberlakes subdivision was originally developed during the 1960s. Though as-built plans of the stormsewer drainage system were not available for review, information shared by the ACRC suggested that this drainage system is likely very similar to the Lakewood Shores drainage system. The intent appears to be two-fold: 1) to provide a subsurface network of storm sewer structures to collect and route surface drainage during wet weather; and, 2) to maintain a partially depressed groundwater elevation via open-bottom manhole and catch basin structures (functioning like a drain tile system) to limit subsurface moisture impacts on residential basements and crawl spaces.

Mr. Young further explained that notable surface flooding has been observed near the intersection of North Timberlakes Boulevard and Pinetree Drive following spring thaws in recent years (Young, personal communication, 2008). Limited ACRC mapping of the Timberlakes storm sewers reveals that all subsurface drainage is intended to pass through a primary manhole structure near this intersection and is subsequently routed east toward Lake Huron. ACRC staff have observed that many of the existing drains connecting to this primary manhole structure are functioning at decreased capacity. The ACRC suspects that excess surface drainage in this area is the result of partially clogged subsurface drains.

K&A staff conducted a preliminary review of information provided by the ACRC and examined limited invert elevation data of the existing system (and proposed improvement) in relation to the lake outlet structure elevations (and previously modeled groundwater contours from the Phase II study) to assess the potential for exacerbated lake level impacts based on proximity of the Timberlakes drainage system. Our preliminary assessment focused upon the critical summer months and related conditions as reported in the Phase II study.

All previous K&A reporting (2005, 2006) was conducted absent any information related to subsurface drainage and/or storm sewers in the Timberlakes area. Therefore, previous estimates for losses to groundwater flow on the east side of Cedar Lake were provided for an assumed "natural" easterly groundwater gradient toward Lake Huron. These estimates serve as a baseline condition upon which to base potential impact to the easterly groundwater gradient from the presence of a fully functioning Timberlakes subsurface drainage system. A "natural" groundwater gradient (ranging from approximately 0.0067 ft/ft to 0.0075 ft/ft) in the Timberlakes area results in an estimated loss of approximately 183,100 gal/day to 202,500 gal/day in easterly groundwater flows toward Lake Huron. These estimates reflect approximately 1,600 feet of Cedar Lake shoreline west of the Timberlakes development. Figure 2 provides an illustration of estimated groundwater contours that represent the Timberlakes area absent of any subsurface drainage structures.

Based upon January 3, 2008 discussions and K&A's preliminary review, ACRC is only proposing to improve the existing drainage system infrastructure along North Timberlakes Boulevard between Birchcrest and Pinetree Drives (approximately 380 feet of storm sewer pipe). It is K&A's understanding that these planned improvements will serve to prevent surface flooding within this immediate area, and still maintain any subsurface flows (likely intercepting groundwater) toward this location that drains from other north-south structures along Birchcrest and Pinetree Drives. Stated more simply, the proposed improvements will serve to ensure that all flows routed toward North Timberlakes Boulevard will freely discharge toward Lake Huron without restrictions.

Taking into consideration the presence of an existing subsurface storm/groundwater drainage system in the Timberlakes development, K&A staff revised estimates for the easterly groundwater gradients to evaluate potential impacts on groundwater levels and flow. The data reveal a slightly increased easterly groundwater gradient ranging from approximately (0.0075 ft/ft to 0.0082 ft/ft). This increased gradient amounts to an estimated additional loss of approximately 19,900 gal/d to 39,300 gal/d to easterly groundwater flows toward Lake Huron. (Refer to Figure 3 for an illustration of estimated groundwater contours that reflect the presence of the existing subsurface drainage structures within the Timberlakes area). The range of these estimates reflects existing subsurface infrastructure not flowing at full capacity (as ACRC staff have observed) to the extreme of a fully functioning system (i.e., the invert elevations of the existing system shown in Attachment A, are fully unobstructed). The summer seasonal losses (120 days from June through September) are therefore estimated to range from approximately 2.4 million gallons to 4.7 million gallons of groundwater flowing from within the Timberlakes area northeast of Cedar Lake.

Since the actual improvements proposed by the ACRC do not involve replacement or modification of significant portions of the existing Timberlakes infrastructure, K&A does not expect noticeable or exacerbated groundwater losses to occur within much of this area. It is our understanding that the proposed ACRC improvements will only serve to ensure that flows reaching this primary outlet piping (at N. Timberlakes Blvd and Pinetree Dr.) will freely flow without obstruction.

SUMMARY AND CONCLUSIONS

Since the previous Phase I and Phase II Cedar Lake studies did not account for the presence of a subsurface drainage system within the Timberlakes subdivision, K&A was requested by the AICLA to conduct an evaluation necessary to assess the potential for exacerbated lake level impacts based on the proximity of the Timberlakes drainage system and improvements being proposed by the ACRC. Preliminary calculations suggest that the presence of a fully functioning drainage system results in a net increase of previous estimates associated with Cedar Lake losses to easterly groundwater flows toward Lake Huron. The Timberlakes summer seasonal losses (120 days from June through September) are estimated to range from approximately 2.4 million gallons to 4.7 million gallons of groundwater flowing away from Cedar Lake toward Lake Huron. This loss was inherently included in the previous studies based on actual lake level losses. However, the presence of this drainage system would suggest that a portion of the observed losses could be slightly skewed to this Timberlakes area.

During the summer months of 2004 (June through September), Cedar Lake water levels dropped approximately 2.2 feet reflecting approximately 805 million gallons of water losses from the lake. During the following summer of 2005, Cedar Lake water levels dropped approximately 1.1 feet reflecting approximately 402 million gallons of water losses from the lake. The

estimated 2.4 million gallons to 4.7 million gallons of groundwater flow is associated with the presence of the Timberlakes drainage system amounts to approximately 0.6% to 1.2% of the total observed summer 2005 water level loss from Cedar Lake. These volumes (2.4 to 4.7 million gallons) are equivalent to approximately 0.08 to 0.15 inches of observed water level losses.

The improvements to the Timberlakes drainage system proposed by the ACRC are not expected to affect the hydraulic capacity of the entire storm sewer network in this area. Instead, these improvements will only serve to prevent future occurrences of surface flooding (i.e., improved wet weather drainage) near North Timberlakes Boulevard and ensure that groundwater levels do not rise above the existing and/or proposed invert elevations within these structures.

At first glance, the estimated quantities associated with the presence of the Timberlakes drainage system do not appear to suggest significant overall negative impacts on Cedar Lake water levels. However, they do serve to identify the need for a comprehensive approach for future planning and development discussions at the local level. Collective incremental changes that result in detrimental impacts to the water levels in Cedar Lake, have produced the current need to examine local interest in protecting and restoring both surface and groundwater contributions to the lake.

RECOMMENDATIONS

Priority should be placed on protecting existing recharge areas and avoiding future diversions of both surface water and groundwater. Since the Cedar Lake Swamp located along the northwest region of the lakeshore has been identified as the only year-round groundwater recharge area for the lake, it becomes the most significant source targeted for protection. Furthermore, this is the only area that has any significant surface water contribution to the lake (early April to late May). New development in these areas, (and, thus, further dewatering), may divert precious groundwater resources from the lake. Protection can be accomplished through general public awareness of the value that these contributing areas have on Cedar Lake as water sources. These recommendations are consistent with those expressed previously by K&A (2005, 2006).

Approximately 70% of the Cedar Lake shoreline areas are observed to direct lake water and groundwater away from the lake itself. As a result, new or expanded drainage ditches or subsurface drainage systems should be carefully assessed prior to approval for construction. Public awareness regarding the overall gains/losses influencing Cedar Lake water levels is the starting point. This knowledge in the hands of private property owners, community leaders and county officials from both Alcona and Iosco Counties are all considered of vital importance.

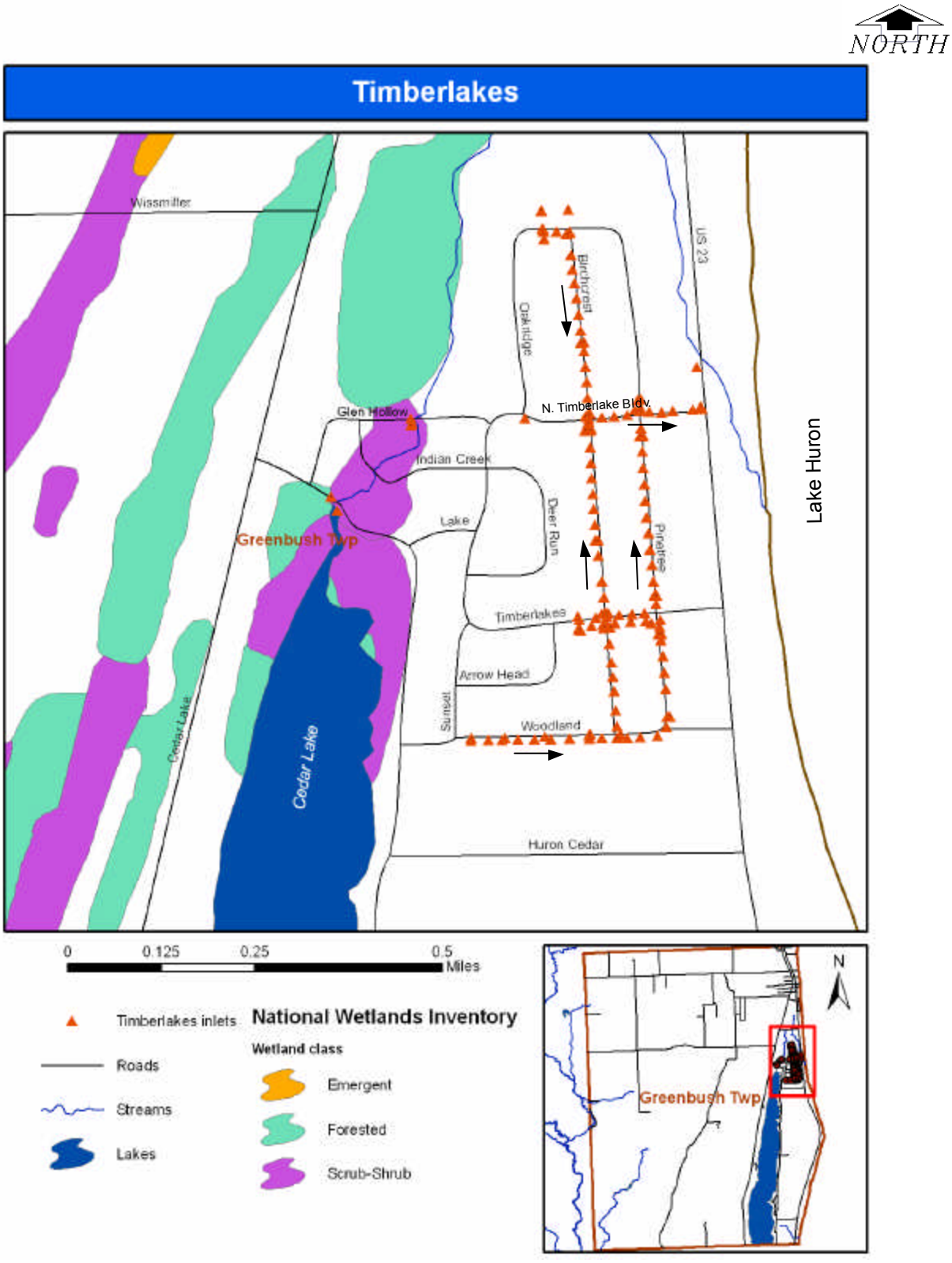
REFERENCES

Anton, Russ. Alcona-Iosco Cedar Lake Association, Inc., Greenbush, Michigan. Personal Communication. January 3, 2008.

KIESER & ASSOCIATES, LLC (K&A). *Phase I Final Report for the Preliminary Hydrologic Evaluation of Cedar Lake with Reference to Lake Levels.* Prepared for Alcona-Iosco Cedar Lake Association, Inc., July 15, 2005.

KIESER & ASSOCIATES, LLC (K&A). *Phase II Final Report For Additional Hydrologic Evaluation of Cedar Lake with Reference to Lake Levels (Alcona & Iosco Counties, MI)*. Prepared for Alcona-Iosco Cedar Lake Association, Inc., September 18, 2006.

Young, Ron. Alcona County Road Commission, Lincoln, Michigan. Personal communication. January 3, 2008.



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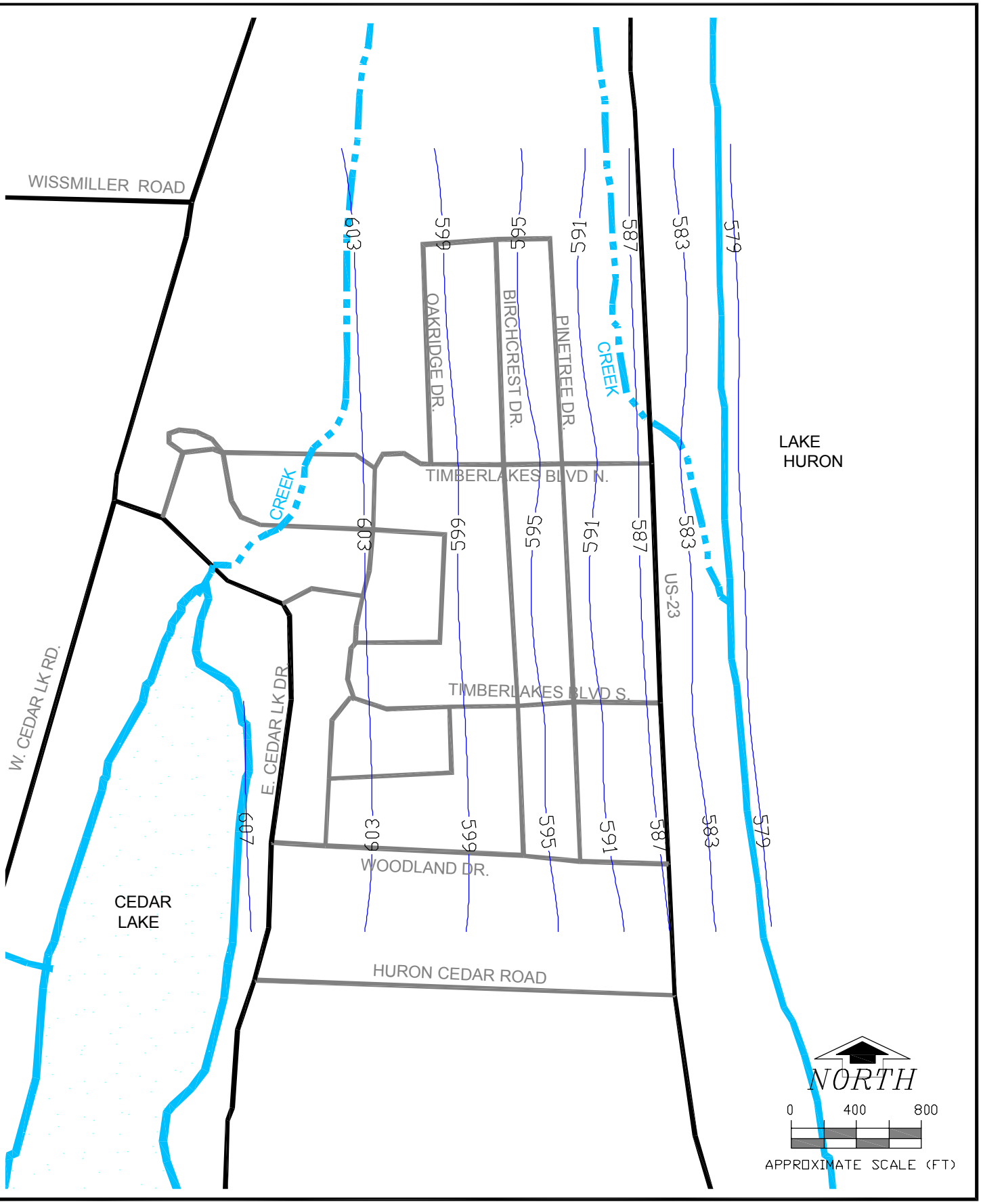
Sitemap of the Timberlakes subdivision storm sewer locations, Greenbush, Michigan with respect to surrounding features and roadways. (Groundwater flow is due east).

FIGURE 1

DRAWN BY: KBB CHECKED BY: MSK REVISED:



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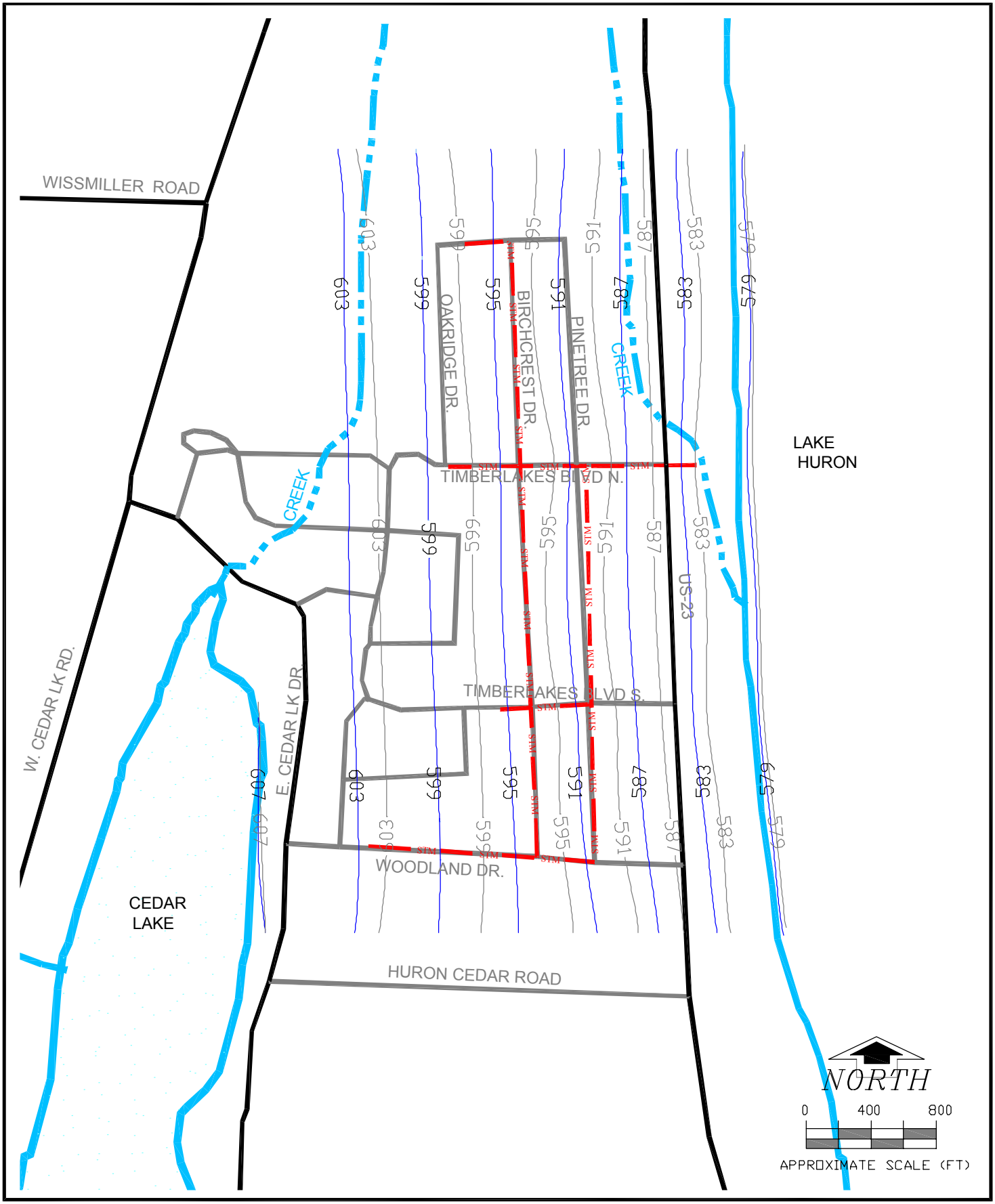
Sketch of estimated groundwater contours depicting natural storm sewer drainage conditions within the Timberlakes subdivision located northeast of Cedar Lake.
(Absent a storm sewer drainage system.)

FIGURE
2

DRAWN BY: KBB CHECKED BY: MSK REVISED:



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Sketch of estimated groundwater contours depicting improved storm sewer drainage conditions within the Timberlakes subdivision located northeast of Cedar Lake. ("Natural" contours are shown in grey.)

FIGURE
3

ATTACHMENT A

Summary of Proposed Alcona County Road Commission Improvements to Timberlakes Drainage System
(Provided to K&A by Mr. Ron Young, P.E. of the Alcona County Road Commission)

Timberlakes - August 6, 2007 - revised

Virtually all subsurface drainage is intended to go through an existing manhole at North Timberlakes Blvd and Pinetree. Many of the existing drains connecting to this manhole are plugged and barely functioning, but do work at a very slow rate.

1) Construct a new catch basin offset 40' from the existing manhole to allow construction of new drains to supplement largely failed existing drains.

2) Re-grade circle area to drain excess surface water to this basin.

3) Construct a new 15" drain using perforated pipe with sock from new catch basin west to existing north-south drain running along the west side of Birchcrest (has potential to aid subsurface drainage to the south, west, and north).

4) Place a series of catch basins along this drain and lower center of North Timberlakes Blvd. below road grade to direct excess surface runoff to these basins.

5) Place an additional 15" drain using perforated pipe with sock from new basin (1) to existing basin at Stackable residence. Connect this above existing outlet at Stackables to avoid disrupting current minimal drainage (has potential to aid subsurface drainage south and west).

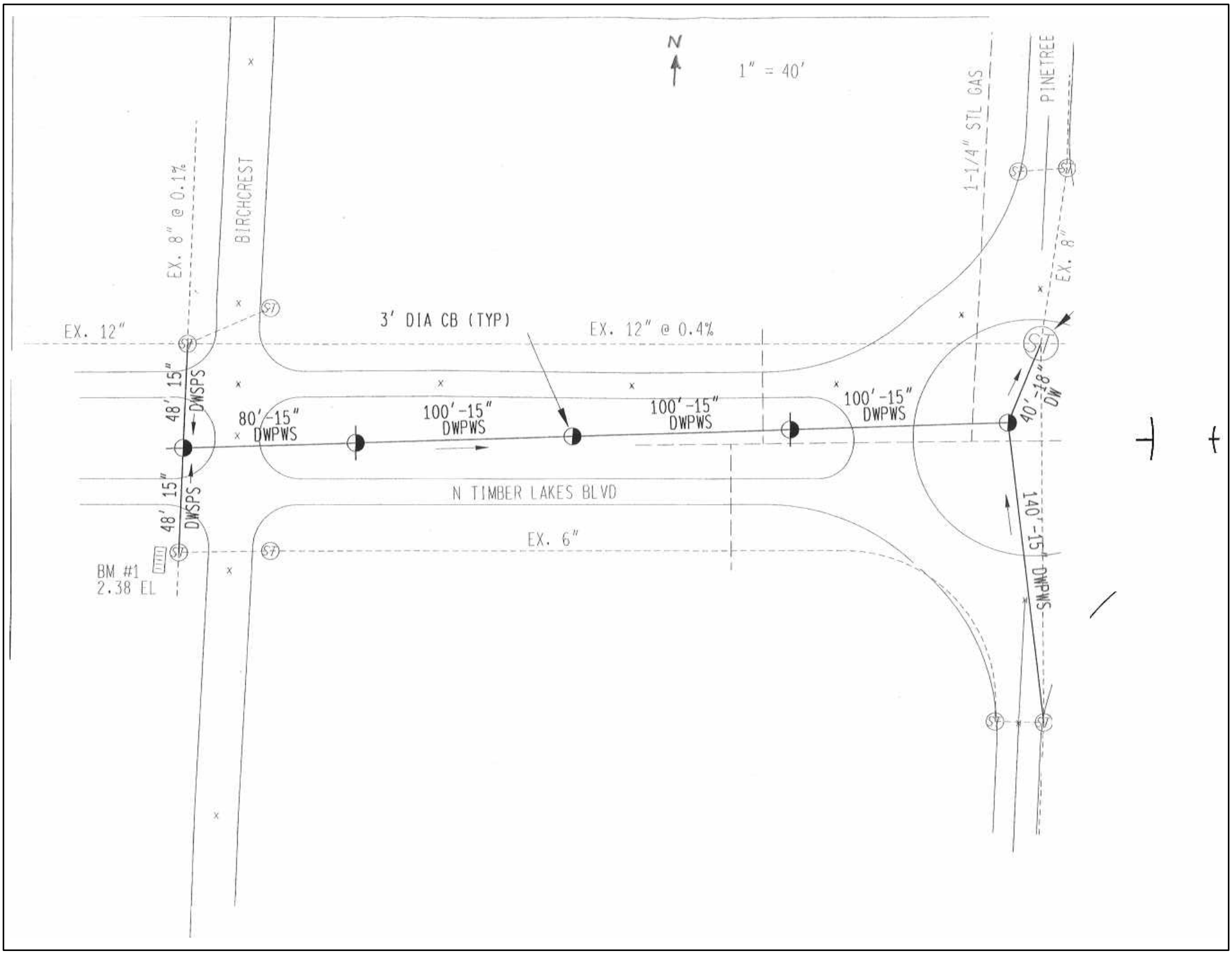
Concerns

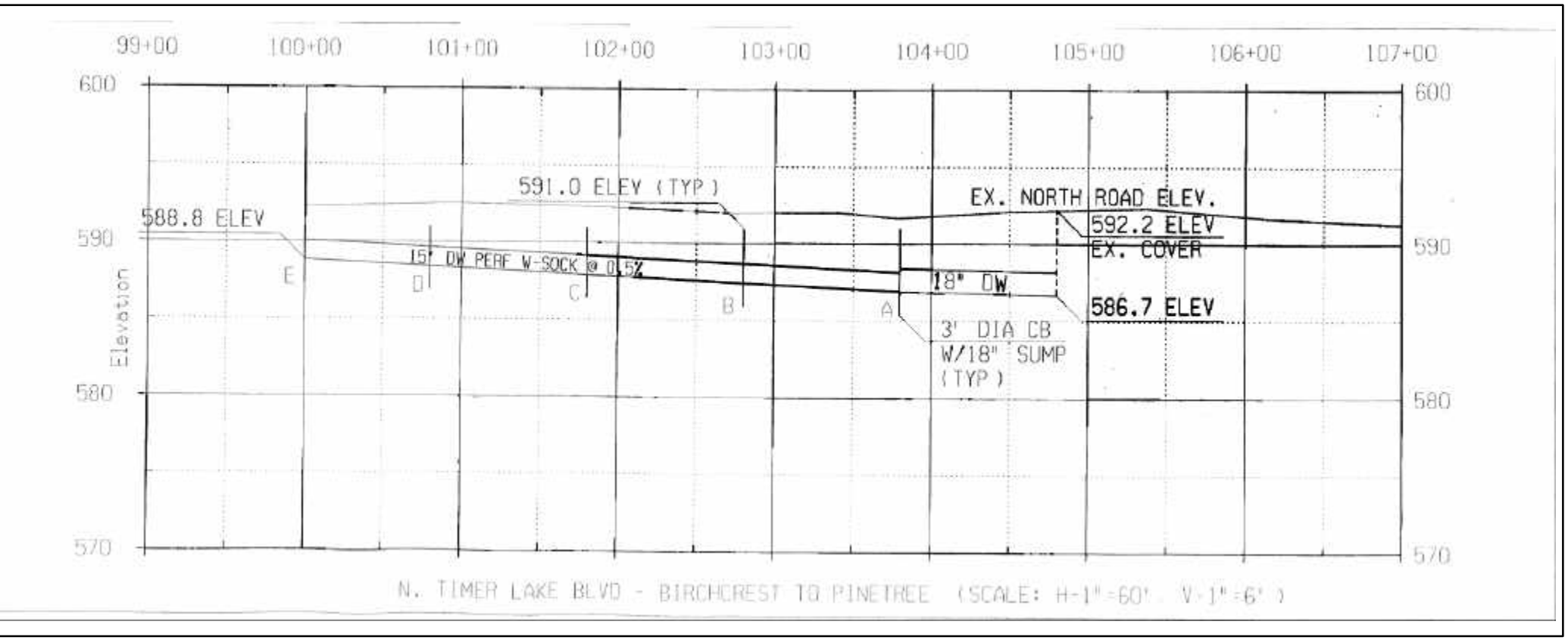
- Ground water level is unknown but likely will adversely impact normal excavation.
- Gas mains are known to exist within the project area and may need to be moved to accommodate new drain lines and catch basins

Cost

- Difficult to determine due to uncertain groundwater conditions
- Best guesstimate pending resolution of unknowns - $30,000

Note: excess surface drainage is believed to be a result of the failed subsurface drainage system.


N
1" = 40'
BIRCHCREST
EX. 8" @ 0.1%
1-1/4" STL GAS
PINETREE
EX. 8"
EX. 12"
3' DIA CB (TYP)
EX. 12" @ 0.4%
48' 15" DWSPS
80'-15" DWPWS
100'-15" DWPWS
100'-15" DWPWS
100'-15" DWPWS
40'-18" DW
48' 15" DWSPS
N TIMBER LAKES BLVD
140'-15" DWPWS
EX. 6"
BM #1
2.38 EL


99+00
100+00
101+00
102+00
103+00
104+00
105+00
106+00
107+00
600
590
580
570
Elevation
591.0 ELEV (TYP)
588.8 ELEV
EX. NORTH ROAD ELEV.
592.2 ELEV
EX. COVER
15" DW PERF W-SOCK @ 0.5%
18" DW
586.7 ELEV
3' DIA CB
W/18" SUMP
(TYP)
E
D
C
B
A
N. TIMER LAKE BLVD - BIRCHCREST TO PINETREE (SCALE: H-1"=60' V-1"=6')