TORREY ROAD EXTENSION
OF THE BIGELOW DRAIN

PART OF SECTION 23, T6N-R6E,
MUNDY TOWNSHIP,
GENESEE COUNTY, MICHIGAN

PRELIMINARY ENGINEERING REPORT (PHASE I)

FEBRUARY 2007

-PREPARED FOR-

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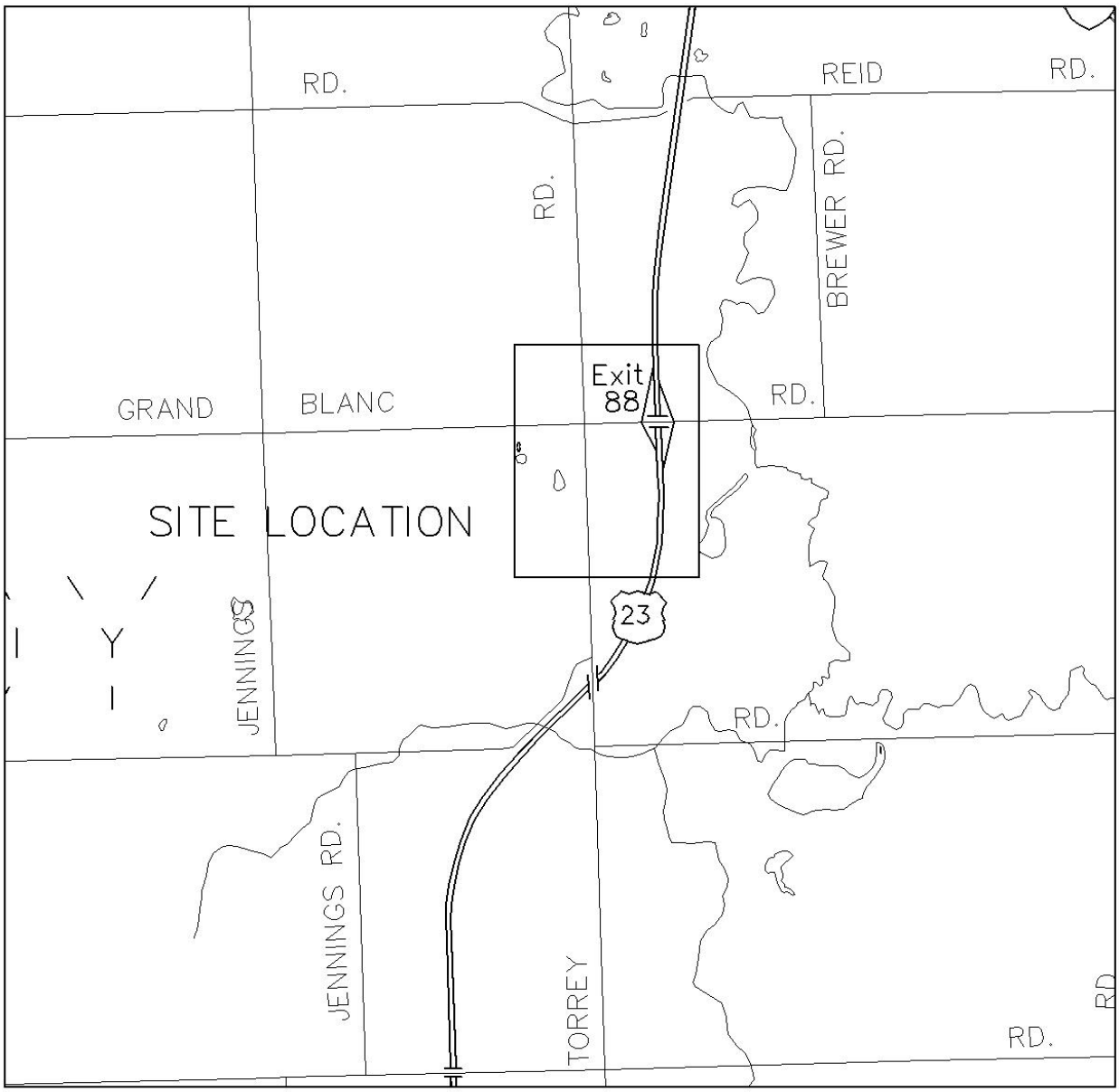
SITE LOCATION MAP



LOCATION MAP

Figure 1, Location of Site

SUMMARY

The purpose of this report is to develop a solution to drainage problems presently occurring within the BIGELOW Drain #0242 Drainage District. Flooding has occurred in the problem area which lies on the South side of Grand Blanc Road, and on the East side of Torrey Road in the Northwest ¼ of Section 23, T6N-R6E, Mundy township, Genesee County, Michigan.

The study area of 35 acres is part of the Bigelow Drain Drainage District #0242, and may be designated as the proposed "Torrey Road Branch of the Bigelow Drain."[1]

A petition, June 18, 2006 signed by residents of Torrey Road called for improvements such as deepening, widening and enclosing of the drain.

A public meeting was held on May 17, 2006 at Mundy Township Hall, where residents complained of flooding on their properties, and that an existing 8" drain was plugged and/or insufficient to drain the affected area. A remark was also made about runoff from a Speedway Super America (gas station/car wash.) The public meeting minutes are not wholly clear regarding areas of concern, however it is clear that flooding has occurred.

The drainage problem appears to be an excess accumulation of surface runoff in a low area on the properties of house no. 8033 Torrey Road, and house no. 8045 Torrey Road. Excess sheet flow runoff, and lack of an adequate drainage outlet causes an unwanted pond to form, making back-yard areas unusable, and creating a public health hazard.

Historically, the low area has been drained by a 6" or 8" farm tile which, by reports of the residents, has become plugged. The existing drain runs Southeast across the private lot of house #8045 Torrey Road. then to the East and South across tax parcel no. 15-23-100-014, to the Bigelow Drain. Following our hydrologic analysis of the drainage area, we determined that an 8" tile drain is not adequately sized for current drainage needs. No easements have been secured for this drain across private lands. Recent satellite imagery shows a large stockpile of sand/or other material in-line with the drainage route.

Since remarks made during the public meeting focused on ponding, what caused it, and how to eliminate it, this study will consider that as its primary goal. There has been an increase in impervious surface over the years due to development along Grand Blanc Road, leading to greater surface water runoff, and resultant ponding. A detention basin has been constructed behind one of the busineses, but there is still an increase in total runoff volume due to hard surfaces.

One complaint at the public meeting cited runoff from the Super Speedway America gas station on the North side of Grand Blanc Road. We observed from erosion patterns that runoff from the gas station normally flows West along the North shoulder of the Road to a catch basin on the Northeast Quad of Grand Blanc and Torrey Roads, and does not normally contribute runoff to the ponding location. Weeds and soil were partially covering the catchbasin grate, so it is possible that water can build up on the North shoulder (away from

[1] See fig. 1 – "Site Location Map"

the subject area.) In an extreme rainfall event, some but not all of the runoff could spill over the roadway into the problem area, but since the centerline of the roadway is one-half foot higher that the edge of pavement, most of the flow would simply travel along the edge of pavement, and then follow the curbline to the North, away from the problem area. Moreover, the ponding in the lowland area occurs with even minor rainfall events, so direct runoff from the gas station cannot be the cause of the the current flooding problem. Investigation of the drainage capacity of those roadside drains, and any needed maintenance may be referred to the Genesee Co. Road Commission.

AREA OF STUDY:

A Drainage Area Map was prepared showing the overall tributary area and alternative drainage routes.[2] The Map is based upon 2-foot contour maps of Genesee County, circa 1970, current tax parcel maps and zoning information from Genesee County Equalization, overlaid on satellite imagery from the USGS National Map. Road names, addresses, and potential drainage alternatives are shown.

On the map, the drainage basin was carefully delineated to enable a drainage analysis. It was determined that an area of 17.2 acres was tributary to the lowland area, and that a total of 35.0 acres would be served by the proposed drainage system, depending upon the drainage route selected.

LAND USAGE:

Most of the study area is occupied by rural residential parcels with areas from 0.75 acres to 8 acres. Commercial parcels make up 6.2 acres of the 17.2 acre drainage basin. On the majority of areas, slopes ranged from 5% to 10%, and grass was generally trimmed, so runoff would be fairly rapid.

[2] See Fig. 2 – Drainage Area Map with Proposed Drainage Alternatives Shown

DRAINAGE AREA MAP:

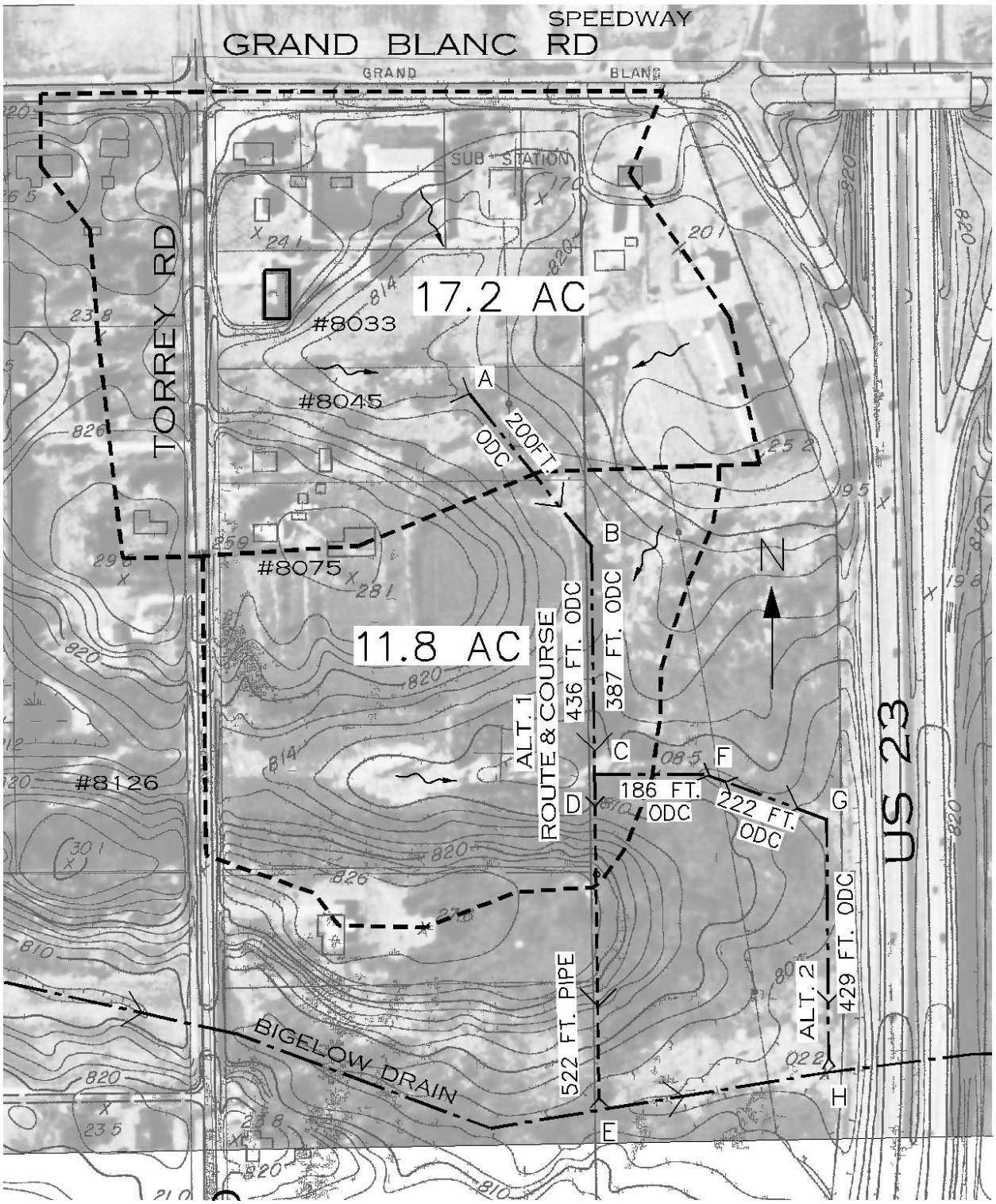


Figure 2- Drainage Area Map
With proposed Drainage Alternatives shown.

SOIL TYPES

Soil types have been determined from the "Soil Survey of Genesee County, Michigan", map sheet #42, April 1972, USDA. The predominant soil classification in the drainage basin is Loam, w/ silt-loam, sand-loam & clay-loam present.

The hydrologic soil groups for the above soils, as defined by the Soil Conservation services are as follows:

SOIL	HYDROLOGIC SOIL GROUP*	Area Percent
Sebewa Loam	C/D	6
Morley Silt-Loam	C	65
Linwood Muck	D	4
Miami Loam	B	8
Miami-Metea complex	B	9
Del Rey Silt-Loam	C	8

* A(Low runoff potential) Soils having a high infiltration rate even when thoroughly wetted and consisting chiefly of deep, well to excessively drained sands or gravels.

* B Soils having a moderate infiltration rate when thoroughly wetted and consisting chiefly of moderately deep to deep, moderately well to well drained soils with moderately fine to moderately course texture.

* C Soils having a slow infiltration rate when thoroughly wetted and consisting chiefly of soils with a layer that impedes downward movement of water or soils with moderately fine to fine texture.

* D (High runoff potential) Soils having a very slow infiltration rate when thoroughly wetted and consisting chiefly of clay soils with a high swelling potential, soils with a permanent high water table, soils with a clay pan or clay layer at or near the surface, and shallow soils over nearly impervious material.

HYDROLOGY:

We analyzed the drainage basin (and sub-basins), using available map information, to determine the average runoff coefficient, and expected runoff for the study area. Using a 2' contour map, the drainage basin and sub-basins were delineated and sized. The total drainage area contributing to the low area was 17.2 Acres. The area of Commercial properties and right-of-way were determined from tax map images, the total right-of-way area was 1.78 acres, and commercial property was 6.18 acres. The USGS National Map (satellite imagery) was used to estimate the runoff coefficient for each area, and an average runoff coefficient of 0.46 was calculated using the standard weighted averaging formula,

Cavg= [6.18 ac.*0.70 (commercial)+ 1.78 ac.* 0.55 (r/w) + 9.24 * 0.30 (resid.)]/17.2 Ac. =

Cavg= 0.47

Slightly inflated runoff coefficients were applied to compensate for well covered commercial areas, and for the relatively steep slopes throughout. The computed runoff coefficient was comparable to those found for similar areas.

ESTIMATED PEAK FLOWS

Runoff was determined using the Rational Method, in accordance with the standards of the Genesee County Drain Commission. Peak runoff was determined for Point 'A' which is the low area where ponding occurs, and also for accumulation points downstream along the outflow route(s).

For point 'A' the area of accumulation was 17.2 acres. The average basin slope was 2 percent. Length of basin was 700 feet.

Using the Genesee Co. approved shallow water flow equation, the initial Time of Concentration was calculated to be 15 minutes, which is the minimum typical time. However, since ponding occurs at the point of concentration (as well as at a small detention basin to the North), we calculated that it would take approximately five minutes for water to accumulate until peak outflow would occur. Therefore, the initial Time of Concentration for peak outflow at point 'A' was increased to 20 minutes. Then, the rainfall intensity was found to be 3.84 in/hr. from the Genesee Co. standard calculation, and the peak discharge rate for a 10-year return period storm was estimated using the rational formula,

Qp= CiA = 0.47* 3.84* 17.2 = 31.0 cfs. |where i=3.84 is the 10-year rainfall intensity for an initial Time of Concentration of 20 minutes, determined by the formula:

$$i = 166.37/(t+23.305)$$

For both Alternative no. 1, and Alternative no. 2, spreadsheets were used to calculate the design flow at locations along each reach of the drainage routes, taking into account the various surface areas and flow times. Lower runoff coefficients resulted from increased drainage area. (See Exhibit nos. 3 & 4 at end of report)

HYDRAULICS

To estimate both pipe, and channel sizes for this report, Genesee County Drain Commission standard calculations have been used. For both open channel, and enclosed pipe flow, "Manning's Equation", with standard Manning's friction coefficients specified by the Genesee County Drain Commission have been applied.[3]

The standard form of Manning's Equation is:

V = 1.486 * R^(2/3) * S0^(1/2) / n | where 'V' is average velocity, 1.486 is a conversion factor to English Customary units, 'R' is the hydraulic radius of the conveyance, 'S0' is the slope, 'n' is the Manning's friction coefficient. The hydraulic radius is characteristic of the cross-section, and, determined from its geometry using the equation:

R = A / P | where 'A' is the cross-sectional area of flow, and 'P' is the wetted perimeter.

By substitution of V (average velocity) = Q (discharge) / A (area of cross-section), the equation may be solved for discharge, 'Q', and placed in its common form (U.S. customary units) as:

Q = 1.486 * A * R^(2/3) * S0^(1/2) / n

Values for 'n' were chosen from the GCDC-SWMD's tabulated values according to the surface Boundary Material of the pipe or channel.

The above formulation is incorporated into Storm Sewer Design spreadsheets at the end of this report.

DESCRIPTION OF ALTERNATIVES:

Two alternatives drainage plans have been identified involving open ditches and enclosed pipes. Alternative No. 1 uses 522 feet of enclosed piping, and Alternative No. 2 uses mostly open ditching.

Referring to the Drainage Area Map, each alternative requires the construction of an open drainage course extending from point 'A' in the lowland area between houses 8033 and 8045 to the Southeast, across the back corner of lot no. 8045, then crossing the property line to point 'B' on parcel no. 15-23-100-014. The drain would then run South, to point 'C' a distance of 387 feet along the West property line of that parcel. From that point, alternative routes are shown across tax parcel no. 15-23-100-014 to the existing Bigelow Drain on the South portion of that parcel.

Briefly, Alternative No. 1 continues South through an enclosed storm sewer pipe; and Alternative No. 2 runs to the East, and then South across the parcel, mostly within an open drain. A more detailed description follows.

[3] See Exhibits 3 & 4, Storm Sewer System Design (spreadsheets)

Alternative No. 1.

Alternative No. 1 requires an Open Drainage Course from point 'A', at the ponding area behind house #8033, across the Northeast corner of lot no. 8045 to point 'B' on tax parcel no. 15-23-100-014 The drain would then run South, to point 'C' a distance of 387 feet along the West property line of that parcel, and then continue another 49 feet to a drainage inlet/catch basin at point 'D', (436 feet.) From that point, enclosed piping is necessary because the higher ground would make ditching impractical.

To transmit the 10-year flow of 35.7 cfs. from point 'D' to point 'E' the enclosed pipeline would have to be 30" dia. concrete at 0.65% grade (min.) The length for the enclosed drain would be around 520 feet. A catch basin at 125 feet from the inlet would reduce the final run to 400 feet (length limited for maintenance purposes), and trap sediment and debris before it reached the Bigelow drain. Pipe Flow would then be let out onto the ground surface at point 'E', at the edge of the existing Bigelow drain. A hydraulic transition with rip-rap would need to be constructed at the outlet for erosion control.

The total cost of Alternative No. 1 not including the cost of land or right-of-way is as follows.[4]

1.	Estimated Net Construction Cost	=	$67,807.00
2.	Estimated Total Engineering Cost	=	$24,027.00
	Estimated Total Project Cost	=	$91,834.00

Alternative No. 2:

Flow could be routed by Open Drainage Course from point 'A', at the ponding area behind house #8033, across the Northeast corner of lot no. 8045 to point 'B' on tax parcel no. 15-23-100-014 The drain would then run South, to point 'C' a distance of 387 feet along the West property line of that parcel. A 50 foot shallow ditch from point 'D' would receive runoff from that low area. From point 'C' the drain would run East, 186 feet to point 'F', where a culvert would be placed to permit vehicle crossings, thence continuing East, 222 feet to point 'G' near the US-23 Right-of-Way, then South, 429 feet along the Right-of-Way to point 'H' on the existing Bigelow drain. The ditchline would transition to the existing drain.

Alternative No. 2 would result in eliminating the expense of a long, enclosed pipe, and would require less excavation. To meet the 32.5 cfs capacity requirement, a 4 foot wide flat-bottom Open Drainage Course with 1 on 2 side-slopes, and a depth of 3 feet from top of bank would convey the flow.

The total cost of Alternative No. 2 not including the cost of land or right-of-way is as follows:*[5]

1.	Estimated Net Construction Cost	=	$59,578.00
2.	Estimated Total Engineering Cost	=	$21,785.00
	Estimated Total Project Cost	=	$81,363.00

[4] Refer to Exhibit no. 1 for tabulated estimate.
[5] Refer to Exhibit no. 2 for tabulated estimate.

RECOMMENDATION:

We recommend the less expensive Alternative No. 2 be constructed. There is an estimated cost savings of $10,471. The proposed route follows the existing natural drainage route, overland, across parcel no. 15-23-100-014. By following the existing drainage route, excavation would be minimized.

If Alternative No. 1 is chosen, a 20' deep cut will be required to install the pipeline. It is likely that contractor bid prices would exceed the estimate because of the depth of cut. There is also a possibility that extra cost would be incurred because of excess groundwater (along the existing quarry,) and possible boulders to be removed. Because of the proximity of the water filled quarry to the pipeline route, it is possible that an unwanted release of stored water could occur due to excavation in the permeable soils nearby.

A further concern is that there is no adequate enclosed drainage or well defined drainage-way at that location to receive the pipeline, so the concentrated stormwater flow would have to be let out onto the ground at the outlet. Additional improvements and soil erosion controls are necessary within the existing drainage easement if Alternative no. 1 is chosen. Finally, the maintenance cost of the enclosed drain and catch basins would be avoided.

Regardless of the Alternative chosen, the Drainage District should obtain public drainage easements across all of the affected parcels extending across lot 8033 to Torrey Road (on the West), and extending to the South property lines of parcels along Grand Blanc Road (on the North).

FURTHER CONCERNS:

The drainage district should request that the Genesee Co. Road Commission investigate the condition of the ditchline culverts and catchbasins along the North Side of Grand Blanc Road between Torrey Road and US-23 to determine whether adequate conveyance is provided for the existing (Super Speedway America) development.

A study of the existing Bigelow Drain to determine its capacity was not a part of this engineering study.

ESTIMATED COSTS Alternative No. 1:

ITEM	AMOUNT	UNIT	UNIT COST	TOTAL
Clearing & Grubbing	672	FT	$ 13.00	$ 8,736
Machine Grading	672	FT	$ 2.00	$ 1,344
Restricted Open Drain Excavation, 4 ft. Bottom,	200	ft	$ 22.00	$ 4,400
Open Drain Excavation, 4 ft. Bottom	436	ft	$ 18.00	$ 7,848
30” Sewer, C-76-3 CONC. TD1	522	FT	$ 55.00	$ 28,710
Furnish & Install 4’ dia. drainage structure, Catch Basin	1	EA	$ 1,500.00	$ 1,500
Furnish & Install 5’ dia. drainage structure, Catch Basin	1	EA	$ 2,000.00	$ 2,000
Drainage Structure Castings	650	LBS	$ 1.50	$ 975
Furnish & Install Steel End Section with				
Bar Grate for 30" Conc. Pipe	2	EA	$ 525.00	$ 1,050
Topsoil Surface, 4"	1200	SYD	$ 2.50	$ 3,000
Chemical Fertilizer Nutrient (240 LBS/ACRE)	50	LBS	$ 4.00	$ 200
Class-A Seeding (200 LBS/ACRE)	40	LBS	$ 3.00	$ 120
Class B Seeding (125 LBS/ACRE)	60	LBS	$ 2.25	$ 135
Mulch (2 TONS/ACRE)	0.5	TON	$ 250.00	$ 125
Soil Erosion & Sedimentation Control Measures	1	LSUM	$ 1,500.00	$ 1,500
Subtotal Cost				$ 61,643
Contingency @ 10 percent				$ 6,164
Estimated Net Construction Costs				$ 67,807
Engineering Design	1	LSUM		$ 13,856
Engineering Construction	1	LSUM		$ 10,171
Engineering Subtotal				$ 24,027
TOTAL ESTIMATED COST				$ 91,834
Cost does not include land or right-of-way acquisition				

Exhibit no. 1

ESTIMATED COSTS: Alternative No. 2

ITEM	AMOUNT	UNIT	UNIT COST	TOTAL
Clearing & Grubbing	1424	FT	$ 13.00	$ 18,512
Machine Grading	1424	FT	$ 2.00	$ 2,848
Restricted Open Drain Excavation, 4 ft. Bottom,	200	FT	$ 22.00	$ 4,400
Open Drain Excavation, 4 ft. Bottom	1224	FT	$ 18.00	$ 22,032
27" Storm Sewer, C-76-3 CONC. TD1	32	FT	$ 50.00	$ 1,600
Furnish & Install Steel End Section for 27" Conc. Pipe	1	EA	$ 425.00	$ 425
Soil Erosion & Sedimentation Control Measures	1	LSUM	$ 1,500.00	$ 1,500
Chemical Fertilizer Nutrient (240 LBS/ACRE)	150	LBS	$ 4.00	$ 600
Class-A Seeding (200 LBS/ACRE)	40	LBS	$ 3.00	$ 120
Class B Seeding (125 LBS/ACRE)	100	LBS	$ 2.25	$ 225
Mulch (2 TONS/ACRE)	1.6	TON	$ 250.00	$ 400
Soil Erosion & Sedimentation Control Measures	1	LSUM	$ 1,500.00	$ 1,500
Subtotal Cost				$ 54,162
Contingency @ 10 percent				$ 5,416
Estimated Net Construction Costs				$ 59,578
Engineering Design	1	LSUM		$ 12,848
Engineering Construction	1	LSUM		$ 8,937
Engineering Subtotal				$ 21,785
TOTAL ESTIMATED COST				$ 81,363
Cost does not include land or right-of-way acquisition				

Exhibit no. 2

DRAINAGE AREA MAP:

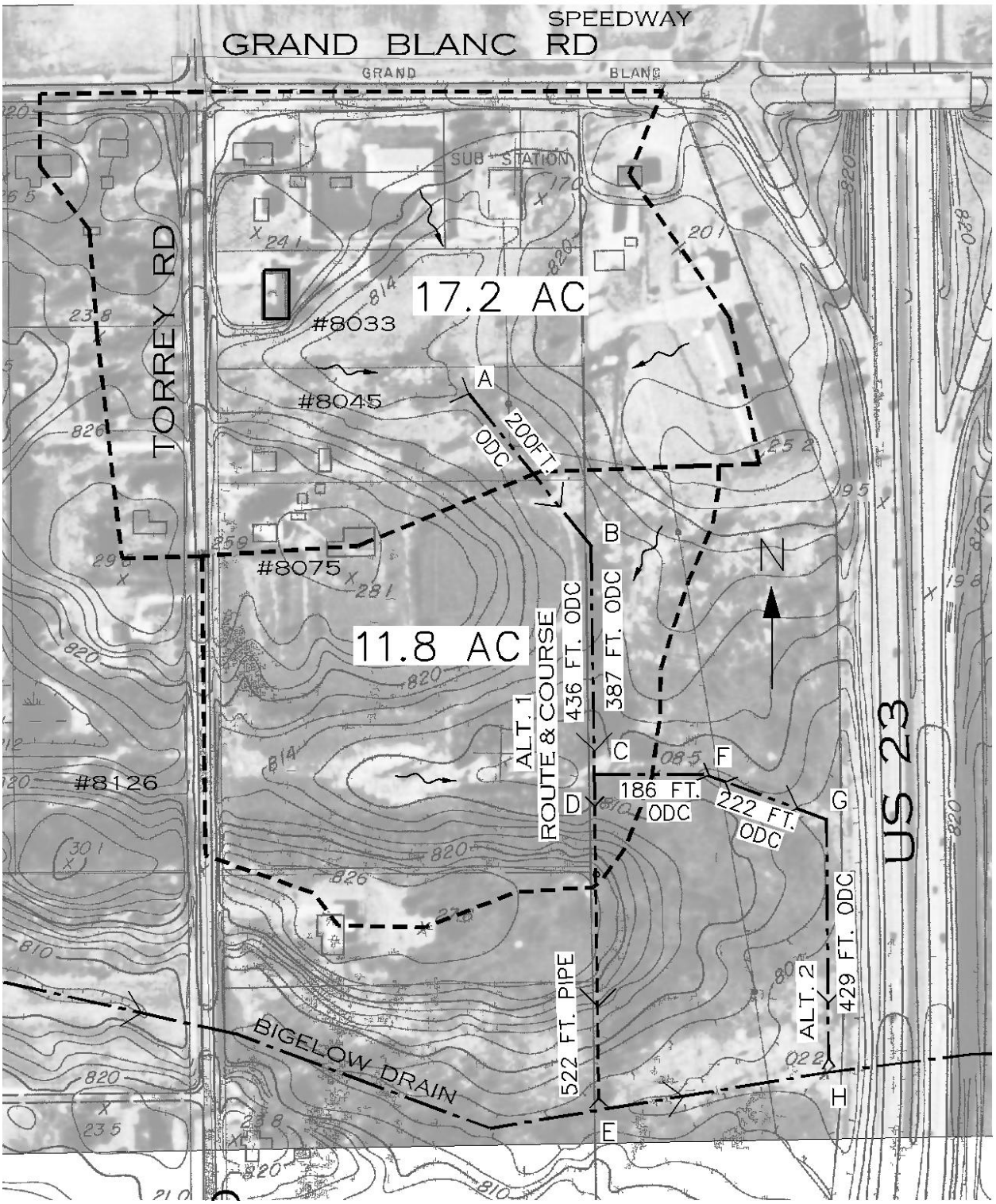


Figure 2- Drainage Area Map
With proposed Drainage Alternatives shown.