

PRELIMINARY ENGINEERING REPORT

FOR

BALDWIN ROAD BRANCH

OF THE

ATHERTON AND EXTENSION DRAIN NO. 1681

**SECTIONS 29, 31 & 32
GAINES TOWNSHIP
GENESEE COUNTY, MICHIGAN**

PREPARED FOR:

**GENESEE COUNTY DRAIN COMMISSIONER
G-4608 BEECHER ROAD
FLINT, MICHIGAN 48532**

PREPARED BY:

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1.0 INTRODUCTION

This Preliminary Engineering report was prepared at the direction of the Genesee County Drain Commissioner. A Meeting of the Board of Determination for the Baldwin Road Branch of the Atherton and Extension Drain No. 1681 was held on June 12, 2007. The Board of Determination approved the necessity of a drain project. A copy of the "Order of Necessity" is included in this Report.

Flint Surveying and Engineering Company (FSE) personnel met with Genesee County Drain Commissioner Surface Water Management (GCDC) personnel to discuss the preparation of a preliminary engineering report for the subject drain. GCDC personnel stated that the major area of concern is in the front yard of a residential property at 11431 Baldwin Road, which is located on the south side of Baldwin Road approximately 0.2 miles east of Duffield Road in Gaines Township. A letter and pictures from the 11431 Baldwin Road property owners indicate ponding occurs in the front yard and driveway of their property. The property owners also stated that water completely covers parts of Baldwin Road at times.

GCDC furnished FSE with copies of an aerial photograph, a soils map and a drainage district map that encompass the area of concern. The route of an existing drain tile that runs across a farm field from the Atherton and Extension Drain, north of Baldwin Road, to Baldwin Road is indicated on the drainage district map. GCDC personnel stated that the owner of the farm field property the tile crosses has made repairs to the tile where breaks in the tile caused washouts. GCDC suggested that it might be possible to locate the existing tile at spot locations in the farm field by identifying washouts where the tile is broken.

GCDC² directed FSE to prepare a preliminary engineering report to:

1. Investigate the existing conditions from the Atherton and Extension Drain north of Baldwin Road and east of Duffield Road, to Baldwin Road.
2. Investigate the existing conditions along Baldwin Road east of Duffield Road.
3. Determine if the existing drain tile can be re-used.
4. Determine if any parts of the existing drain tile can be turned into an open ditch drain.
5. Determine if there are any feasible alternate routes for the drain.

The approximate route of the Baldwin Road Branch of the Atherton & Extension Drain tile is shown on the attached "Existing Drain Plan". The sizes and elevations of existing culverts found by FSE personnel along the route of the existing drain tile and along Baldwin Road are also shown on the "Existing Drain Plan".

2.0 DISTRICT VERIFICATION

FSE plotted the GCDC drainage district boundary on the GCDC Composite Maps for Sections 29, 31 and 32 of Gaines Township. FSE used this overall drainage district boundary and the composite maps to determine sub-drainage areas for use in the preliminary engineering report calculations.

The overall drainage district encompasses approximately 179 acres. The majority of the drainage district is rural farmland. The westerly boundary of the drainage district runs along the centerline of Duffield Road. Single-family residential parcels are located along the east side of Duffield Road in the southwesterly corner of the drainage district. This residential usage area covers approximately 24 acres. All of the residential usage area is located in subcatchment Area 1. The drainage district boundary and subcatchment areas are shown on the "Drainage District and Drainage Areas Map" that is included in the Exhibits.

The land located within the drainage district includes land located in: the South ½ of Section 29, the North ½ of Section 32, and the Northeast ¼ of Section 31 of Gaines Township, Genesee County. Part of the area located in Section 31 is located in the Village of Gaines. The drainage areas established for use in this Preliminary Report are:

<u>SUBCATCHMENT DESIGNATION</u>	<u>AREA (ACRES)</u>
AREA 1	56.9
AREA 2	64.0
AREA 3	12.7
AREA 4	20.7
<u>AREA 5</u>	<u>25.1</u>
TOTAL AREA	179.4 Acres

<u>LAND USAGE</u>	<u>AREA (ACRES)</u>
FARMLAND	155.5
<u>RESIDENTIAL</u>	<u>23.9</u>
TOTAL AREA	179.4 Acres

3.0 ROUTE AND COURSE

3.1 DESCRIBED ROUTE AND COURSE

The route of the Baldwin Road Branch of the Atherton & Extension Drain as described in the Drain Petition is:

Being in Sections 29 & 32 of T6N-R5E, Gaines Township, Genesee County, Michigan. Beginning at a point on the existing Atherton & Extension Drain, which is approximately 1095 feet North of the South ¼ post of Section 29 of T6N-R5E, Gaines Township, running thence South 350 feet along the N-S line of Section 29, thence West 655 feet, thence S 32° W 620 feet, thence S 23° E 215 feet, thence South 20 feet to South Section Line of said Section 29; thence crossing North Section line of Section 32 of T6N-R5E, Gaines Township, at a point approximately 915 feet West of North ¼ Post of said Section 32, running South 20 feet, thence West 515 feet paralleling the Baldwin Road Right-of-Way to the point of ending; and any branch(s) deemed necessary by the Engineer.

The described route and course of the Baldwin Road Branch of the Atherton & Extension Drain is shown on the "Existing Drain Plan".

3.2 SURVEYED ROUTE AND COURSE

The point of beginning for the Baldwin Road Branch of the Atherton & Extension Drain, as surveyed by FSE personnel, is located at the outlet end (North end) of an existing 12" drain tile where it discharges into the Atherton & Extension Drain at a Point 1, shown on the "Existing Drain Plan", that is 2,543 feet East along the centerline of Baldwin Road and 1,085 feet North of Baldwin Road from the Southwest Corner of Section 29, Gaines Township at the intersection of Baldwin Road and Duffield Road.

The existing drain tile traverses from Point 1 to the south and west across a farm field north of Baldwin Road to a Catch Basin 1 at Point 5 that is located in the north roadside ditch of Baldwin Road, 1,622 feet east of Duffield Road. The exact route of the existing drain tile where it traverses across the farm field is unknown. The natural drainage route as surveyed by our personnel is also shown on the "Existing Drain Plan".

A 12" drain tile exiting Catch Basin 1 to the south appears to connect to Catch Basin 2 at Point 6 as shown on the "Existing Drain Plan". Catch Basin 2 is located in the south roadside ditch of Baldwin Road.

The natural drainage route, the existing culverts and the existing catch basins as surveyed by FSE are shown on the "Existing Drain Plan".

4.0 SITE OBSERVATIONS

Flint Surveying and Engineering Company completed a field survey and site inspection of the proposed route and course for the Baldwin Road Branch of the Atherton & Extension Drain. During the survey and site inspection, our personnel attempted to locate the route of the existing drain tile that traverses from the Atherton and Extension Drain across a farm field to Baldwin Road. As described in Section 3.0, our personnel were only able to locate a 12" drain tile that discharges into the Atherton and Extension Drain and two catch basins in the Baldwin Road roadside ditches.

The only other evidence of an existing drain tile FSE observed in the farm field is a suspected washout at Point X shown on the "Existing Drain Plan". However, FSE did not observe any evidence of a tile in the suspected washout and none of the drain tiles exiting Catch Basin 1 appear to be heading toward Point X. 12" drain tiles exit Catch Basin 1 to the northwest, southwest and south. FSE did not observe any evidence of the drain tiles to the northwest and southwest. We suspect that the drain tile to the northwest is the south end of the drain tile traversing across the farm field from Point 1. The drain tile to the southwest may run to the south side of Baldwin Road and pick up roadside drainage there. It may also connect to Catch Basin 2, but we could not verify that.

A 12" drain tile continues to the south from Catch Basin 2. It is not apparent where this drain tile runs to, but the GCDC Composite Map shows a natural low area located 650 feet south of Baldwin Road at Point Y. It is possible that the 12" drain tile extends to the low area at Point Y and drains that area.

The problem area discussed during the Board of Determination is a low area in the front yard of 11431 Baldwin Road. FSE personnel were able to locate the low area. It is shown as Point Z on the "Existing Drain Plan".

Our personnel also completed a limited survey of the south roadside ditch of Baldwin Road from 11431 Baldwin Road to Catch Basin 2 which is shown on the "Existing Drain Plan". This is the route that surface water traverses along on the south side of Baldwin Road until it enters the enclosed drain system at Catch Basin 2. The existing roadside ditch is a shallow ditch overgrown with grass and weeds. Three 12" CMP driveway culverts are located between 11431 Baldwin Road and Catch Basin 2. They are also shown on the "Existing Drain Plan".

5.0 HYDROLOGY REVIEW

The drainage district for the Baldwin Road Branch of the Atherton and Extension Drain contains approximately 179 acres. 46 acres are located north of Baldwin Road and 133 acres are located south of Baldwin Road. A review of an aerial photograph that encompasses the drainage district shows that the majority of the land within the drainage district is farmland or undeveloped land. As described in Section 2.0, there are also approximately 24 acres of residential parcels located within the drainage district along the east side of Duffield Road. There are no retail, commercial or industrial developments, or residential subdivisions located in the drainage district.

The United States Department of Agriculture soil survey maps for Genesee County show the majority of the soils located within the drainage district are approximate equal areas of Del Rey silt loam, 0 to 2% slope and Del Rey silt loam, 2 to 6% slope. The Genesee County Soil Survey describes the Del Rey soils as somewhat poorly drained nearly level to gently sloping soils on lake plains and till plains located in Gaines Township.

The GCDC Composite Maps show the topography of the drainage district varies widely from level and nearly level south of Baldwin Road and on the westerly part of the drainage district located north of Baldwin Road, to rolling and steeply sloping on the easterly part of the drainage district located north of Baldwin Road. The GCDC Composite Maps show the ground surface elevations within the drainage district vary from a low point elevation of approximately 805 near the culvert out-letting at Point 1 to a high point elevation of approximately 850 at the southwest corner of the drainage district at the intersection of Duffield Road and McConnell Street in the Village of Gaines. The GCDC Composite Maps show a low area located north of Baldwin Road near Point X. Low areas are also located south of Baldwin Road with two larger areas being located approximately 650 feet south of Catch Basin 2 at Point Y. A review of the aerial photographs encompassing the drainage district does not indicate any ponding or standing water in these low areas, but the low areas shown on the GCDC Composite Maps are consistent with the Genesee County Soil Survey description for the Del Rey silt loam.

The GCDC Composite Maps show a natural drainage route north of Baldwin Road that traverses from Point X to the existing culvert out-letting at Point 1. The "Natural Drainage Route (Per Survey)" follows the natural drainage route as indicated on the GCDC Composite Maps. Both are shown on the "Existing Drain Plan". The "Described Drain Route" deviates somewhat from the natural drainage route, but follows a more direct route typical of a tile or pipe drain.

The topography shown on the GCDC Composite Maps was used to compute the overland flow travel time for runoff from the farthest point in the drainage district south of Baldwin Road at Point A to existing Catch Basin 2 where runoff discharges to the existing enclosed drain system. Several overland travel routes were considered, but the route from Point A to Point G (Catch Basin 2) was selected for use in this Preliminary Report as being most representative.

The elevations of the existing culverts and ditches obtained during our field survey were used to estimate proposed elevations, distances and grades for use in the preliminary design of the proposed drain improvements described in this preliminary report. The elevations, sizes and materials of the existing culverts and drain pipes observed by our personnel are shown on the "Existing Drain Plan".

6.0 DRAINAGE CALCULATIONS

6.1 GENERAL

The route of the proposed drain was established by the Genesee County Drain Commissioner and is described in the Drain Petition and also in Section 3.0 of this report. The described route is shown on the "Existing Drain Plan".

6.2 DESIGN PARAMETERS

The Genesee County Drain Commissioner "Storm Sewer Design Parameters for Genesee County, Revised November 1, 2006" were used to compute the storm water discharge from the drainage district. Because the overall drainage district is small, less than 300 acres, the Rational Formula was used to compute the volume of storm water runoff from the drainage district. The "10 Year Rainfall Intensity Duration Frequency Curve for Flint, Michigan" was used to establish the Rainfall Intensity (I).

The "Storm Sewer Design Parameters for Genesee County" establish the following Runoff Coefficients (C) for land uses found within the drainage district:

Flat Undeveloped Land, Farmland and Non-Wooded Land	0.25
Woodland and Sloped Undeveloped Land	0.30
Residential Parcels	0.40
Paved Areas	0.95

Since the majority of the drainage district is gently sloping farmland or undeveloped land and rural residential parcels, the following Runoff Coefficients were used:

Sloped Farmland and Undeveloped Areas	0.30
Rural Residential Parcels	0.40

An initial time of concentration of 30 minutes was used as the time for the design storm to develop and peak at the farthest point in the drainage district, and for storm water to begin running off from this point. The overland flow time from Point A to Point G (Catch Basin 2) was computed using the "Time of Concentration of Small Drainage Basins" nomograph.

The following Coefficients of Roughness (n) were used to size the various drain segments:

Open Channel Flow	0.035
Concrete Pipe	0.013
Corrugated Metal Pipe	0.024

A minimum velocity of 2.5 FPS was used as a self-cleansing velocity for proposed drain pipes. Calculations for the overland travel time, runoff discharge, and pipe drain sizing are included in the Exhibits.

The HydroCalc Hydraulics culvert and channel analysis computer program was used for the preliminary sizing of the culverts and open ditch drain sections. The information obtained from the HydroCalc analyses is included in the Exhibits.

6.3 DRAINAGE RUNOFF CALCULATIONS

The storm water runoff first enters the enclosed drainage system at Point G (Catch Basin 2) in the south roadside ditch of Baldwin Road. The volume of runoff entering the system there was computed as the area of the drainage district located south of Baldwin Road (Areas I, II and III) shown on the "Drainage District & Drainage Areas Map". The Time of Concentration was computed as the time it takes for the design storm to develop and begin running off, plus the time for the storm water to travel from the farthest point in the drainage district at Point A to Point G. Therefore, the volume of runoff entering the drainage system at Point G for a 10-year storm is estimated as:

Total Area South of Baldwin Road, A_S =	133.6 Acres
Residential Coefficient of Runoff, C_R =	0.40 (23.9 Acres)
Undeveloped Coefficient of Runoff, C_U =	0.30 (109.7 Acres)
Average Coefficient of Runoff, C_A =	0.32 (133.6 Acres)
Initial Time for Storm to Develop, T_I =	30.0 minutes
Overland Travel Time, T_T =	88.0 minutes (From Nomograph)
Initial Time of Concentration, $T_C = T_I + T_T$ =	30.0 + 88.0 = 118.0 Minutes (Use 2.0 Hours)
I_{10} @ 2.0 Hours (From GCDC-SWM Rainfall Intensity Curve) =	1.17

The Volume of Runoff (Q) entering the system at Point G is estimated as:

$$Q = C_A \times I_{10} \times A$$
$$Q = 0.32 \times 1.17 \times 133.6$$
$$Q = 50.02 \text{ CFS}$$

6.4 AVAILABLE GRADE CALCULATIONS

For purposes of the preliminary design calculations, the existing pipe drain and roadside ditch grades will be used to size the proposed pipes and ditches. The existing grades were calculated from the information obtained from our field survey as follows.

Point 1 to Point 5 (Catch Basin 1)

The invert of the existing 12" culvert out-letting at Point 1 is 805.59. It is approximately 2.5 feet above the flow line of the existing Atherton & Extension Drain, which is at approximate elevation 803.1 at Point 1. The invert of the existing 12" pipe in Catch Basin 1 at Point 5 is 817.16. To maximize the available grade, the available grade will be calculated as the grade from the centerline of the Atherton & Extension Drain to the invert of the outlet pipe in Catch Basin 1. Therefore, there is 14.06 feet of fall from Point 5 to the outlet at Point 1. The distance from Point 1 to Point 5 is 1,824 feet for Alternates 1 and 2 and 2,046 feet for Alternates 3 and 4. Therefore the available grades from Point 1 to Point 5 are computed as:

Alternates 1, 2 and 4

Invert @ Point 5 (Catch Basin 1) =	817.16
Centerline of Drain @ Point 1 =	803.10
Elevation Difference =	14.06'
Distance from Point 1 to Point 5 =	1,824'

% Grade from Point 1 to Point 5 = $14.06' / 1,824' = 0.77\%$

Therefore, use 0.77% as the available grade from Point 1 to Point 5 (Catch Basin 1) for Alternates 1, 2 and 4.

Alternate 3

Invert @ Point 5 (Catch Basin 1) =	817.16
<u>Centerline of Drain @ Point 1 =</u>	<u>803.10</u>
Elevation Difference =	14.06'

Distance from Point 1 to Point 5 = 2,046'

% Grade from Point 1 to Point 5 = $14.06' / 2,046' = 0.68\%$

Therefore, use 0.68% as the available grade from Point 1 to Point 5 (Catch Basin 1) for Alternate 3.

Point 5 to Point 6 (Catch Basin 1 to Catch Basin 2)

The existing grade from Catch Basin 1 to Catch Basin 2 is computed as:

Invert @ Point 6 (Catch Basin 2) =	817.63
<u>Invert @ Point 5 (Catch Basin 1) =</u>	<u>817.16</u>
Elevation Difference =	0.47'

Distance from Point 5 to Point 6 = 44'

% Grade from Point 5 to Point 6 = $0.47' / 44' = 1.07\%$

Therefore, use 1.00% as the available grade from Point 5 to Point 6 (Catch Basin 1 to Catch Basin 2) for all alternates.

Baldwin Road Ditch Grades

Invert of Ex. Culvert @ Point 7 =	823.48
<u>Rim of Catch Basin 2 (Point 6) =</u>	<u>820.90</u>
Elevation Difference =	2.58'

Distance from Point 7 to Point 6 = 270'

% Grade from Point 7 to Point 6 = $2.58' / 270' = 0.95\%$

Invert of Culvert @ Point 9 =	826.15
<u>Invert of Culvert @ Point 7 =</u>	<u>823.48</u>
Elevation Difference =	2.67'

Distance from Point 9 to Point 7 = 440'

% Grade from Point 9 to Point 7 = $2.67' / 440' = 0.60\%$

Therefore, use 0.90% as the available grade from Point 6 to Point 7 and 0.60% as the available grade from Point 7 to Point 9 for all alternates.

6.5 CAPACITY OF EXISTING 12" TILE DRAIN

The existing tile drain is a 12" pipe of unknown material. Information obtained from owner of the property the tile drain crosses indicates it is probably clay pipe that has failed at several locations over the years. The property owner has made repairs to the pipe at various times.

Using the available grade from Point 1 to Catch Basin 1, a 12" pipe at 0.63% has a capacity of 2.83 CFS. This capacity will be used to reduce the design discharge in the calculations for Alternate 2.

Based on information from the owner of the farmland the existing 12" tile drain crosses describing it's poor condition and the small capacity of the existing 12" tile drain, re-use of the existing 12" tile drain does not appear to be a

7.0 PROPOSED DRAIN IMPROVEMENTS

The following alternates were considered for this Preliminary Report.

1. Alternate 1 proposes to replace the existing tile drain at the same location with a new pipe drain sized to carry the computed flows. The roadside ditch along the south side of Baldwin Road will be cleaned out and re-graded to provide adequate capacity to carry the computed flows. This will also include replacing existing driveway culverts in the south roadside ditch of Baldwin Road with culverts sized to carry the computed flows.
2. Alternate 2 is similar to Alternate 1 except that the existing tile drain will be utilized and a new pipe drain will be constructed adjacent to the existing tile drain as a relief drain. The Baldwin Road ditching and culvert replacement will be the same as for Alternate 1.
3. Alternate 3 proposes to abandon the existing tile drain and construct a new pipe drain sized to carry the computed flows along a new route where it won't impact the farm field like the existing tile drain does. The roadside ditch along the South side of Baldwin Road will be cleaned out and re-graded to provide adequate capacity to carry the computed flows. This will also include replacing existing driveway culverts in the South roadside ditch with culverts sized to carry the computed flows.
4. Alternate 4 proposes to replace the existing tile drain between Points 1 and 5 with an open ditch drain that follows the existing natural drainage route across the farmland. The open ditch drain will be sized to carry the computed flows. A farm crossing culvert will be installed to provide the property owner with access to the farm field on both sides of the open ditch drain. The existing tile drain crossing Baldwin Road from Point 5 to Point 6 will be replaced with a culvert sized to carry the computed flow. The roadside ditch along the south side of Baldwin Road will be cleaned out and re-graded to provide adequate capacity to carry the computed flows. This will also include replacing existing driveway culverts in the south roadside ditch with culverts sized to carry the computed flows.

7.1 ALTERNATE 1

Alternate 1 is proposed as a complete replacement of the existing tile drain and drainage structures from the Atherton & Extension Drain to the south side of Baldwin Road. It will include constructing a new pipe drain sized to carry the computed discharge, replacing the existing catch basins at Baldwin Road and any other existing drainage structures located along the route of the existing tile drain, and cleaning out and re-grading the existing South roadside ditch of Baldwin Road from Point 6 to the west past 11431 Baldwin Road (Point Z). It will follow the existing route and course, as described in Section 3.1, with modifications as needed to meet existing conditions.

It will consist of an enclosed pipe drain beginning at Point 1 at the Atherton & Extension Drain and traverse southwesterly to Point 5 (location of existing Catch Basin 1) on the north side of Baldwin Road. It will continue as an enclosed pipe drain to the south side of Baldwin Road to Point 6 (location of existing Catch Basin 2). From there it will traverse to the west along the south side of Baldwin Road as a shallow roadside ditch with driveway culverts to Point 10 west of 11431 Baldwin Road.

For purposes of this preliminary engineering report, it is assumed that all of the runoff from the drainage district located south of Baldwin Road enters the enclosed pipe drain at Point 6 and the runoff from the drainage district located north of Baldwin Road enters the enclosed pipe drain at Points 5, 4, 3 or 2.

It is proposed to use reinforced concrete pipe for the enclosed pipe drain portions of this drain. Existing Catch Basins 1 and 2 will be replaced with new structures and additional structures will be added at the angle points at Points 2, 3 and 4 along the route of the proposed pipe drain.

Alternate 1 is shown on the "Alternate 1 Preliminary Plan", and the Alternate 1 calculations are shown on the "Drainage Calculations" sheet. The Alternate 1 calculations show the following:

<u>LOCATION</u>	<u>FLOW</u>	<u>TRIAL 1A</u>	<u>TRIAL 1B</u>	<u>AVAILABLE GRADE</u>
Point 6 to Point 5	50.02 CFS	30" @ 1.49%	36" @ 0.56%	1.00%
Point 5 to Point 4	52.87 CFS	30" @ 1.66%	36" @ 0.63%	0.77%
Point 4 to Point 3	60.46 CFS	36" @ 0.82%	42" @ 0.36%	0.77%
Point 3 to Point 2	62.17 CFS	36" @ 0.87%	42" @ 0.38%	0.77%
Point 2 to Point 1	64.39 CFS	36" @ 0.93%	42" @ 0.41%	0.77%

The grades required for the Trial 1A pipe sizes are greater than the computed available grades. Therefore, the next larger size pipes were selected for Trial 1B to reduce the grades required so that the proposed grades are less than the available grades. It is noted that the some of the Trial 1A grades only exceed the available grade by small amounts and final construction plan grades may differ from the computed available grades enough to allow for the use of the Trial 1A pipe sizes for those segments. For purposes of this preliminary report, the Trial 1B pipe sizes will be used.

7.2 ALTERNATE 2

Alternate 2 is similar to Alternate 1 except that the existing tile drain from Point 5 to Point 1 will be re-used, if it is determined to be in satisfactory condition, and a relief pipe drain will be

constructed adjacent to the existing tile drain from Point 5 to Point 1. This will allow for the reduction of the flow in the proposed pipe drain calculations by the capacity of the existing tile drain, which is computed as 2.83 CFS in Section 6.5.

Alternate 2 will require prior investigations of the condition of the existing tile drain to determine if it is in satisfactory condition for continued use. These investigations should include internal televising of the pipe to determine its condition, if there are any intermediate structures, and its actual location. It is assumed that some repairs will need to be made to this tile, and that they are economical and practical.

In addition to re-using the existing tile drain and constructing a relief pipe drain, Alternate 2 will include replacing the existing tile drain from Point 6 to Point 5 with a new pipe drain sized to carry the calculated flow, and cleaning out and re-grading the existing South roadside ditch of Baldwin Road from Point 6 to the west past 11431 Baldwin Road (Point Z).

The design assumptions used for Alternate 1 will be used for Alternate 2. Alternate 2 is shown on the "Alternate 2 Preliminary Plan", and the Alternate 2 calculations are shown on the "Drainage Calculations" sheet. The Alternate 2 calculations show the following:

<u>LOCATION</u>	<u>FLOW</u>	<u>TRIAL 2A</u>	<u>TRIAL 2B</u>	<u>AVAILABLE GRADE</u>
Point 6 to Point 5	50.02 CFS	30" @ 1.49%	36" @ 0.56%	1.00%
Point 5 to Point 4	50.04 CFS	30" @ 1.49%	36" @ 0.56%	0.77%
Point 4 to Point 3	57.63 CFS	30" @ 1.97%	36" @ 0.75%	0.77%
Point 3 to Point 2	59.34 CFS	30" @ 2.13%	36" @ 0.79%	0.77%
Point 2 to Point 1	61.56 CFS	30" @ 2.29%	36" @ 0.85%	0.77%

The grades required for the Trial 2A pipe sizes are greater than the computed available grades by considerable amounts. Therefore, the next larger size pipes were selected for Trial 2B so the proposed grades are less than or approximately equal to the available grades. For purposes of this preliminary report, the Trial 2B pipe sizes will be used.

It is noted that the capacity of the existing 12" tile drain does reduce the flow in parts of the proposed relief pipes from the flows computed for Alternate 1 enough to allow for a reduction in some of the relief pipe sizes to the next smaller pipe sizes than those computed for Alternate 1.

7.3 ALTERNATE 3

Alternate 3 is proposed as a complete replacement for the existing tile drain from the Atherton & Extension Drain to the existing catch basins at Baldwin Road, except that it will be constructed at a new location as shown on the "Alternate 3 Preliminary Plan". The existing tile drain will be abandoned. Alternate 3 is proposed as a combination enclosed pipe drain and roadside open ditch drain. A new route will be established to meet existing conditions and where easements can be obtained. For purposes of this Preliminary Report, the route shown on the "Alternate 3 Preliminary Plan" was chosen as a direct route that will minimize the impact on the affected properties.

It will consist of an enclosed pipe drain that begins at Point 1 at the Atherton & Extension Drain, and then it will traverse southerly to Baldwin Road to Point 4. It will then traverse to the west as an enclosed pipe drain along the north side of Baldwin Road to Point 5, and then it will traverse

to the south side of Baldwin Road to Point 6. From there it will continue to the west along the south side of Baldwin Road as a shallow roadside ditch with driveway culverts to Point 10 west of 11431 Baldwin Road, the same as for Alternate 1.

For purposes of this preliminary engineering report, it is assumed that all of the runoff from the drainage district located south of Baldwin Road enters the enclosed pipe drain at Point 6. The runoff from the drainage district located north of Baldwin Road enters the enclosed pipe drain intermittently from Point 5 to Point 2.

It is proposed to use reinforced concrete pipe for the enclosed pipe drain portions of this drain. Existing Catch Basins 1 and 2 will be replaced with new structures and additional drainage structures will be constructed along the proposed route at locations shown on the "Alternate 3 Preliminary Plan".

Alternate 3 is shown on the "Alternate 3 Preliminary Plan", and the Alternate 3 calculations are shown on the "Drainage Calculations" sheet.

<u>LOCATION</u>	<u>FLOW</u>	<u>TRIAL 3A</u>	<u>TRIAL 3B</u>	<u>AVAILABLE GRADE</u>
Point 6 to Point 5	50.02 CFS	30" @ 1.49%	36" @ 0.56%	1.00%
Point 5 to Point 4	59.62 CFS	36" @ 0.80%	42" @ 0.35%	0.68%
Point 4 to Point 3	59.94 CFS	36" @ 0.81%	42" @ 0.35%	0.68%
Point 3 to Point 2	60.67 CFS	36" @ 0.83%	42" @ 0.36%	0.68%
Point 2 to Point 1	64.39 CFS	36" @ 0.93%	42" @ 0.40%	0.68%

The grades required for the Trail 3A pipes are greater than the computed available grades. Therefore, the next larger size pipes were selected for Trial 3B to reduce the grades required so that the proposed grades are less than the available grades. It is noted that some of the Trial 3A grades only exceed the available grades by small amounts and final construction plan grades may differ from the computed available grades enough to allow for the use of the Trial 3A pipe sizes for those segments. For purposes of this preliminary report, the Trial 3B pipe sizes will be used.

Another possibility for Alternate 3 would be to construct an open ditch along part of or the entire Alternate 3 route from Point 5 to Point 1. Using an invert elevation of 817 at Point 5 and ground elevations along Baldwin Road between Point 5 and Point 4 varying from 824 to 830, an open ditch drain would be excessively deep and wide along Baldwin Road. Likewise, a deep open ditch drain located near the existing house and farm buildings from Point 4 to Point 3 would not be desirable. Therefore, open ditches were not considered for Alternate 3.

7.4 ALTERNATE 4

Alternate 4 is proposed as a complete replacement of the existing tile drain from the Atherton & Extension Drain to the south side of Baldwin Road. It will consist of constructing an open ditch drain to replace the existing tile drain from Point 1 to Point 5 and replacing the existing tile drain crossing Baldwin Road from Point 5 to Point 6 with a new culvert. The open ditch drain will follow the existing natural drainage route as shown on the "Alternate 4 Preliminary Plan". A culvert will be installed along the route of the drain in the farm field north of Baldwin Road to provide a crossing for farm equipment. Alternate 4 will also include cleaning out and re-grading

the existing south roadside ditch of Baldwin Road from Point 6 to the west past 11431 Baldwin Road (Point Z).

It is proposed to construct the open ditch drain with 1 on 2 side slopes and a bottom width designed to carry the design flow while maintaining a desirable depth of flow in the ditch. The pipe drain from Point 5 to Point 6 will be designed similar to that in Alternate 1.

Alternate 4 is shown on the "Alternate 4 Preliminary Plan", and the Alternate 4 calculations are shown on the "Drainage Calculations" sheet. The Alternate 4 calculations show that a 42" CMP culvert installed from Point 6 to Point 5 will have a headwater depth of 3.5' at a flow of 50.02 CFS. A 36" CMP Culvert would result in a headwater depth of 4.4'. The 42" CMP culvert was selected to keep the headwater depth approximately equal to the height of the proposed culvert. Using a proposed trapezoidal open ditch drain with 1 on 2 side slopes, a 2' bottom width and a grade of 0.60%, the depth of flow in the proposed ditch varies from 2.22' to 2.41' along the route of the ditch, which is acceptable. Using a 42" CMP culvert for the farm crossing culvert between Points 2 and 3 where the flow is 62.17 CFS, the headwater depth will be approximately 4.2', which is acceptable.

8.0 CONCLUSIONS

The alternates considered in this Preliminary Report were selected based on discussions with Genesee County Drain Commissioner personnel, the existing drain route and a review of the existing land use and conditions. While there are other possible routes and combinations of pipe drain and open ditch drain that could be considered, the alternates selected were chosen to provide a basis for comparison of different routes, types of drain construction and costs.

Alternate 1 is the construction of a new pipe drain sized to carry all of the design flow. It generally follows low land along the natural overland flow route crossing the farm field between Baldwin Road and the Atherton and Extension Drain. This minimizes the depth of the pipe and has a limited impact on the farm field.

Alternate 2 is the construction of a relief pipe drain and would re-use the existing 12" tile drain. The relief pipe drain would provide added capacity to the drain system by being sized to carry the flow over what the existing 12" tile drain can carry. However, the condition and location of the existing tile drain are unknown. Other than the outlet at the Atherton & Extension Drain and the existing catch basins described in this report, our personnel were not able to locate any evidence of the existing tile drain. Before a determination can be made if the existing tile drain can be re-used, additional investigations should be made to determine its condition and route. This would result in additional expenses that might be lost if it is determined that the existing 12" tile drain is not re-usable.

Alternate 3 is the construction of a new pipe drain along a new route that avoids the farm field by traversing along Baldwin Road, but the ground along this route rises by approximately nine feet at Point 4 from the low ground at Points 5 and 6. This would cause excessive depth for a new pipe drain along this route and makes this route not economical or practical.

Alternate 4 is the construction of an open ditch drain from Baldwin Road to the Atherton and Extension Drain. It will follow the low land along the natural overland flow route crossing the farm field between Baldwin Road and the Atherton and Extension Drain. A farm crossing

culvert would be constructed along the route of the open ditch drain to provide access for the property owner to move farm equipment to the farm fields on either side of the open ditch drain.

We also considered using the north roadside ditch of Baldwin Road for the open ditch portion of the drain improvements west of the existing crossing at Points 6 and 5. This would require constructing a new pipe across Baldwin Road near Point 8 and re-ditching the north roadside ditch. Since the north roadside ditch runs along farmland where maintenance of the ditch would be questionable compared to the south roadside ditch where there are residential properties where a ditch might be maintained by the property owners, and there are only three driveway culverts that would need to be replaced on the south side, we determined that the south roadside ditch is the better option.

9.0 RECOMMENDATIONS

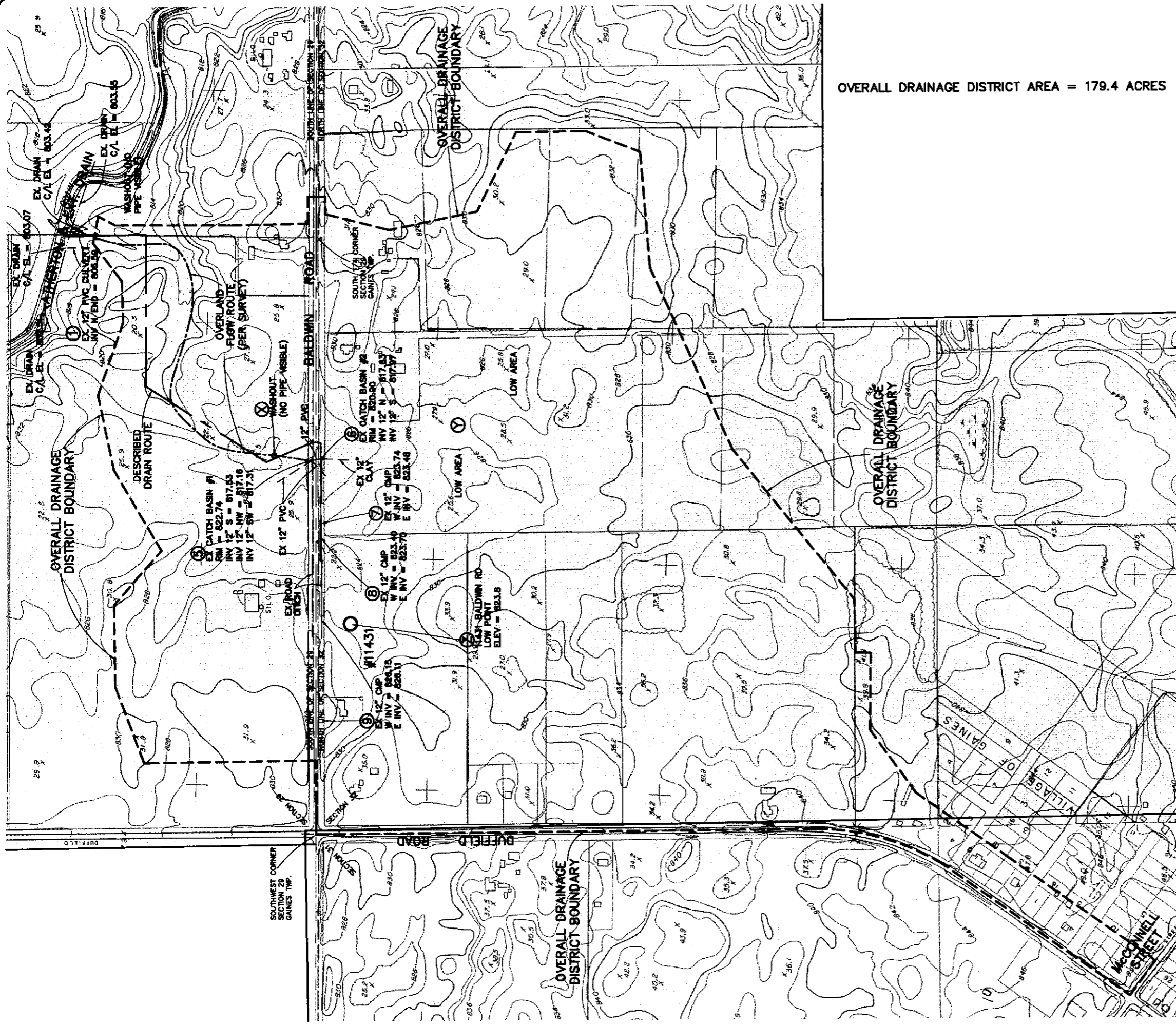
Based on cost, it is our recommendation that Alternate 4 be selected. It follows the natural low land, is the shortest route, and is the most economical of the alternates considered. It also appears that Alternate 4 would be the most economical of any other route or type of drain construction. While Alternate 4 would cost the least to construct, an open ditch drain would have a negative impact on the farming of the land it crosses by dividing the farm field and reducing the tillable area by the width of the open ditch drain.

Alternate 1 appears to provide for the best continued use of the farmland while being the most direct of the pipe drain routes and therefore the most economical of any pipe drain route.

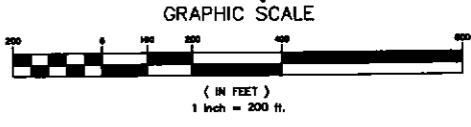
If it is determined that additional information for the existing 12" tile drain is necessary, we recommend that it be televised internally to obtain a visual record of the tile's condition, and to determine if there are any intermediate structures along its route. Locating and exposing additional structures would help identify its route. It is noted that the capacity of the existing 12" tile drain is small. As shown in the drainage calculations, the existing 12" tile drain does allow for a reduction in one pipe size from Alternate 1, but the costs involved to investigate its condition and make repairs would probably offset the difference in cost between the Alternate 1 and Alternate 2 pipe sizes, and re-using the existing tile drain would leave that pipe susceptible to future deterioration and failure faster than a new pipe. Therefore, attempting to re-use the existing tile drain does not appear to be economical or practical.

10.0 ENGINEER'S PRELIMINARY OPINION OF COST

The Engineer's Preliminary Opinion of Costs are included on the following sheets. The quantities contained therein reflect the major items of work but are only a preliminary estimate for this report. Actual quantities would be determined as part of the final construction plan preparation and actual costs would be based on contractors' bids.



OVERALL DRAINAGE DISTRICT AREA = 179.4 ACRES



LEGEND

- ⊙ REFERENCE POINT
- ⊙ DRAINAGE DESIGN POINT
- DRAINAGE DISTRICT BOUNDARY
- DESCRIBED DRAIN ROUTE
- - - SURVEYED OVERLAND FLOW ROUTE

REVISION	REVISIONS

**BALDWIN ROAD BRANCH OF
ATHERTON AND EXTENSION
DRAIN NO. 1681**
SECTIONS 29 & 32
GAINES TOWNSHIP, GENESEE CO.

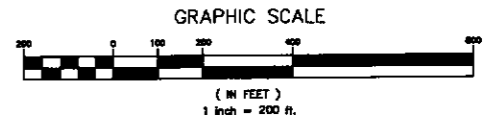
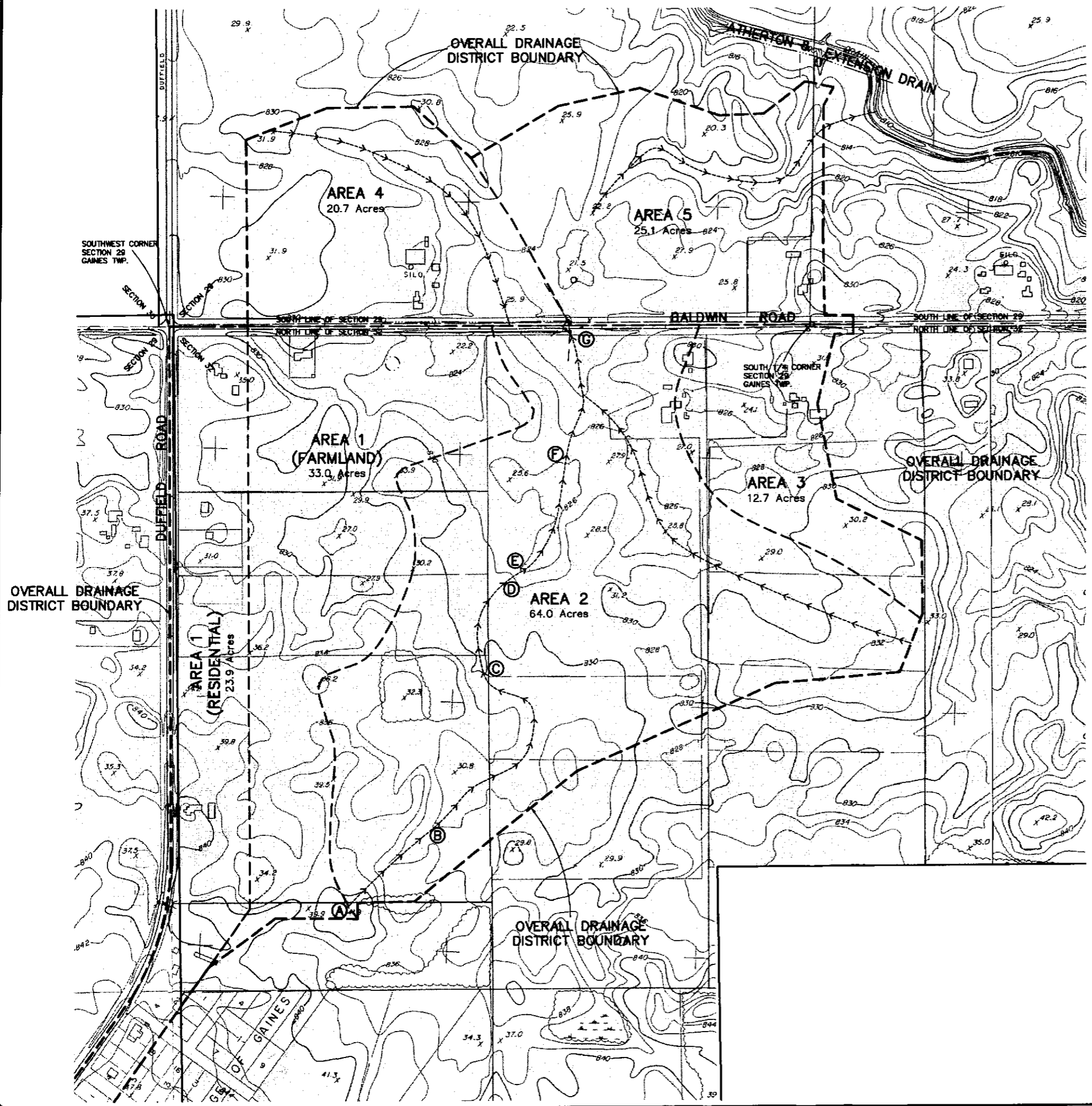
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Designed by:	WJA
Sheet No.:	1 OF 1
Job No.:	24072

EXISTING DRAIN PLAN



LEGEND

- (A) OVERLAND FLOW POINT
- DRAINAGE DISTRICT BOUNDARY
- - - SUB-CATCHMENT AREA BOUNDARY
- ←←← OVERLAND FLOW ROUTE

AREAS SUMMARY

AREA 1 =	56.9 ACRES
AREA 2 =	64.0 ACRES
AREA 3 =	12.7 ACRES
AREA 4 =	20.7 ACRES
AREA 5 =	25.1 ACRES
TOTAL AREA =	179.4 ACRES
RESIDENTIAL =	23.9 ACRES
FARM & UNDEVEL. (SOUTH) =	109.7 ACRES
FARM & UNDEVEL. (NORTH) =	45.8 ACRES
TOTAL AREA =	179.4 ACRES

REVISION	

**BALDWIN ROAD BRANCH OF
ATHERTON AND EXTENSION
DRAIN NO. 1681**
SECTIONS 29 & 32
GAINES TOWNSHIP, GENESSEE CO.

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**DRAINAGE DISTRICT &
DRAINAGE AREAS MAP**

LEGEND

- (A) REFERENCE POINT
- (B) DRAINAGE DESIGN POINT
- DRAINAGE DISTRICT BOUNDARY
- - - PROPOSED PIPE DRAIN ROUTE
- PROPOSED CATCH BASIN
- · - · - PROPOSED OPEN DITCH DRAIN ROUTE
- - - PROPOSED CULVERT



GRAPHIC SCALE

(IN FEET)
1 inch = 200 ft.

DUFFIELD ROAD

DUFFIELD ROAD

OVERALL DRAINAGE DISTRICT BOUNDARY

ATHERTON & EXTENSION DRAIN

EXISTING WASHOUT

PR. 42" PIPE DRAIN

PR. 42" PIPE DRAIN

PR. 36" PIPE DRAIN

PR. OPEN DITCH DRAIN WITH DRIVEWAY CULVERTS

BALDWIN ROAD

SOUTH LINE OF SECTION 29

NORTH LINE OF SECTION 32

SOUTHWEST CORNER SECTION 29 GAINES TWP.

(10) P.O.E.

11431 BALDWIN RD LOW POINT EXISTING PONDING

SOUTH 1/4 CORNER SECTION 29 GAINES TWP.

ALTERNATE 1 PRELIMINARY PLAN

REVISION	DATE

BALDWIN ROAD BRANCH OF
ATHERTON AND EXTENSION
DRAIN NO. 1681
SECTIONS 29 & 32
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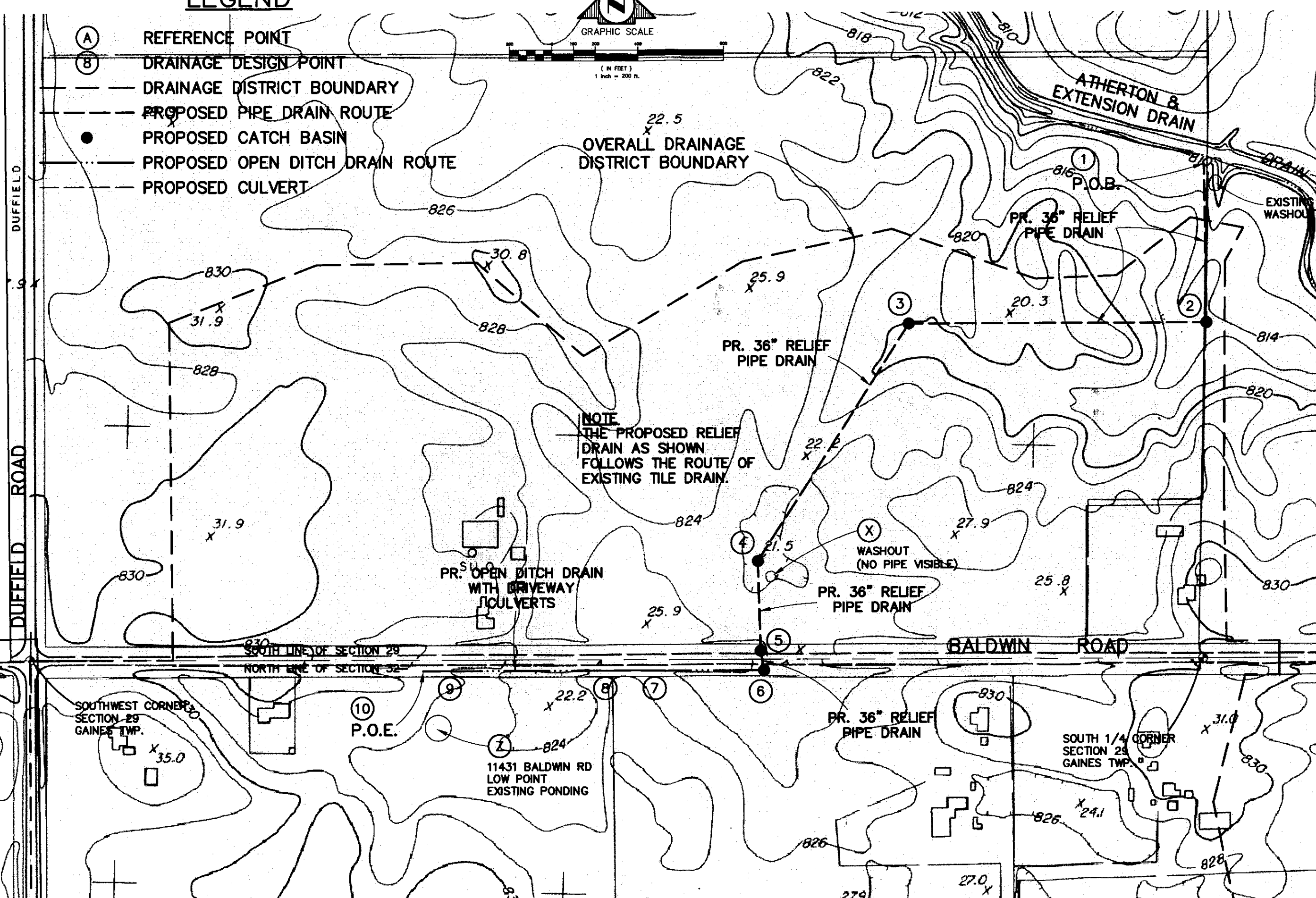
Date:	8-14-09
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Designed by:	WJA
Sheet No.	1 OF 1
Job No.	24072

LEGEND

- (A) REFERENCE POINT
- (B) DRAINAGE DESIGN POINT
- DRAINAGE DISTRICT BOUNDARY
- - - PROPOSED PIPE DRAIN ROUTE
- PROPOSED CATCH BASIN
- PROPOSED OPEN DITCH DRAIN ROUTE
- - - PROPOSED CULVERT



GRAPHIC SCALE
(IN FEET)
1 inch = 200 ft.



NOTE
THE PROPOSED RELIEF DRAIN AS SHOWN FOLLOWS THE ROUTE OF EXISTING TILE DRAIN.

PR. OPEN DITCH DRAIN WITH DRIVEWAY CULVERTS

WASHOUT (NO PIPE VISIBLE)

SOUTHWEST CORNER SECTION 29 GAINES TWP.

(10) P.O.E.

11431 BALDWIN RD LOW POINT EXISTING PONDING

SOUTH 1/4 CORNER SECTION 29 GAINES TWP.

ALTERNATE 2 PRELIMINARY PLAN

Revisions
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SECTIONS 29 & 32
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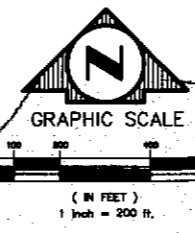
Designed by: WJA

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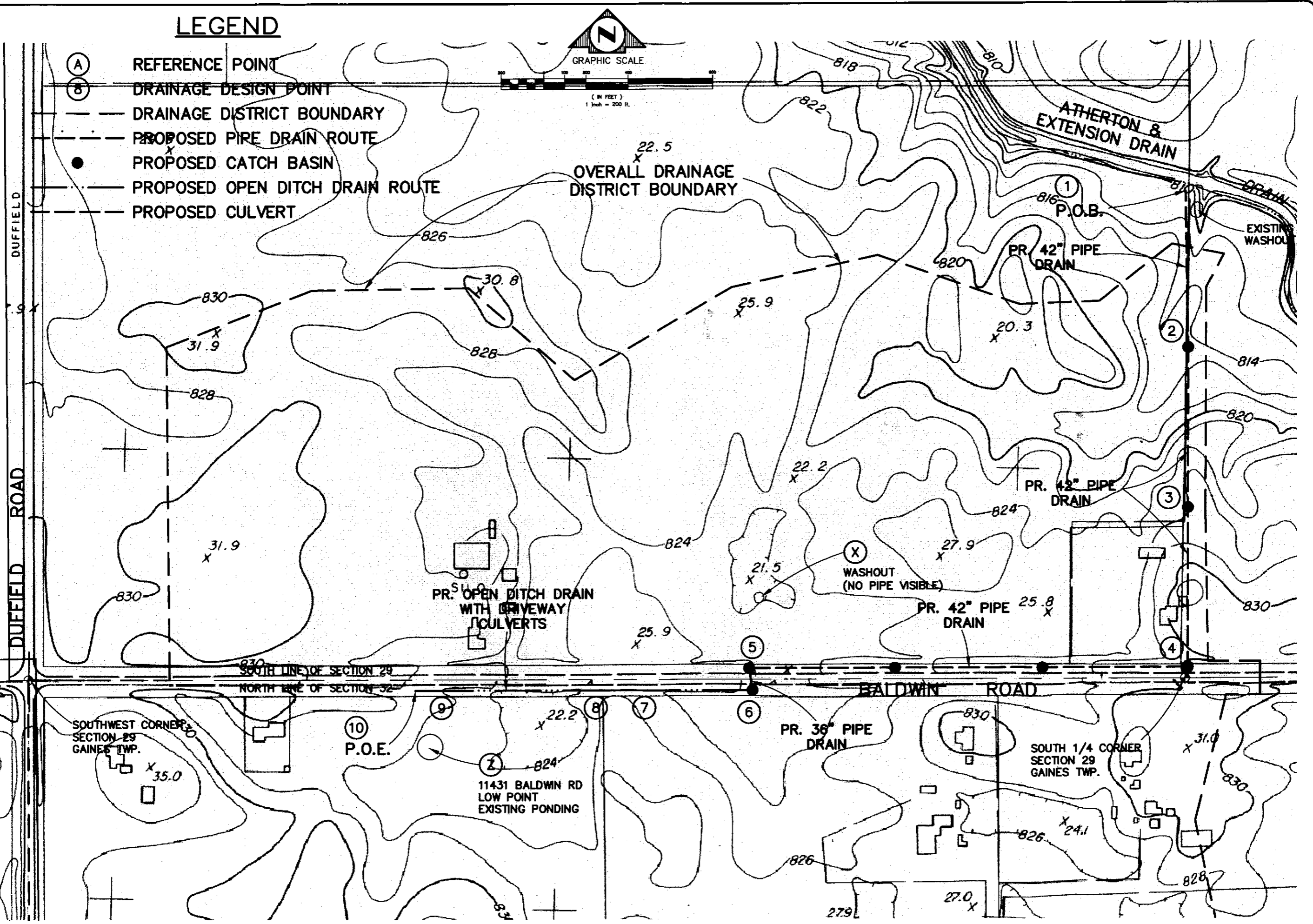
Job No. 24072

LEGEND

- (A) REFERENCE POINT
- (B) DRAINAGE DESIGN POINT
- DRAINAGE DISTRICT BOUNDARY
- - - PROPOSED PIPE DRAIN ROUTE
- PROPOSED CATCH BASIN
- - - PROPOSED OPEN DITCH DRAIN ROUTE
- - - PROPOSED CULVERT



OVERALL DRAINAGE DISTRICT BOUNDARY



REVISION	DATE

BALDWIN ROAD BRANCH OF
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 DRAIN NO. 1681
SECTIONS 29 & 32
 GAINES TOWNSHIP, GENESEE CO.

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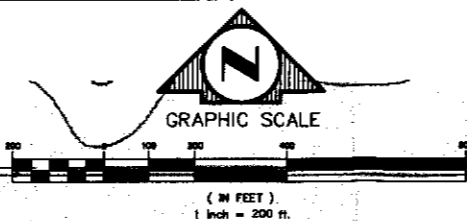
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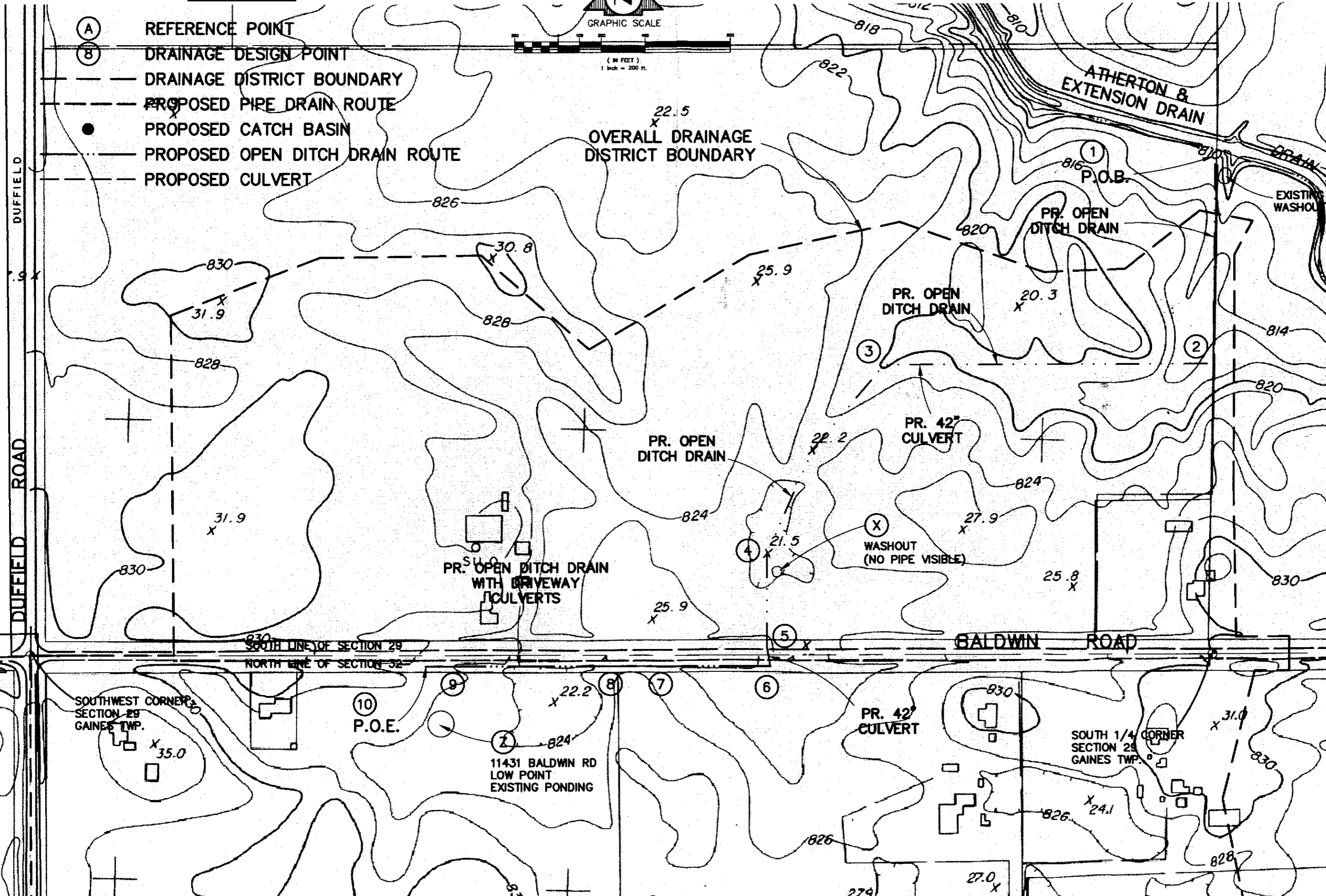
ALTERNATE 3 PRELIMINARY PLAN

LEGEND

- (A) REFERENCE POINT
- (B) DRAINAGE DESIGN POINT
- DRAINAGE DISTRICT BOUNDARY
- - - PROPOSED PIPE DRAIN ROUTE
- PROPOSED CATCH BASIN
- - - PROPOSED OPEN DITCH DRAIN ROUTE
- - - PROPOSED CULVERT



22.5
X
OVERALL DRAINAGE DISTRICT BOUNDARY



ALTERNATE 4 PRELIMINARY PLAN

REVISION	REVISIONS

BALDWIN ROAD BRANCH OF
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DRAIN NO. 1681
SECTIONS 29 & 32
GAINES TOWNSHIP, GENESEE CO.

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**BALDWIN ROAD BRANCH
OF THE
ATHERTON AND EXTENSION DRAIN NO. 1681
GAINES TOWNSHIP, GENESEE COUNTY**

ENGINEER'S OPINION OF COST

ALTERNATE 1

December 23, 2009

<u>ITEM</u>						
<u>NO.</u>	<u>DESCRIPTION</u>	<u>QUANTITY</u>	<u>UNIT</u>	<u>UNIT PRICE</u>		<u>AMOUNT</u>
1	36" RCP Storm Sewer	243	L.F.	\$ 85.00	\$	20,655.00
2	42" RCP Storm Sewer	1,625	L.F.	\$ 100.00	\$	162,500.00
3	5' Dia. Drainage Structure	2	Each	\$ 1,500.00	\$	3,000.00
4	6' Dia. Drainage Structure	3	Each	\$ 2,000.00	\$	6,000.00
5	24" CMP Culvert	90	L.F.	\$ 50.00	\$	4,500.00
6	24" Metal End Section	6	L.F.	\$ 250.00	\$	1,500.00
7	Regrade Roadside Ditch	750	L.F.	\$ 10.00	\$	7,500.00
8	Seeding, Fertilizing & Mulch	1	L.S.	\$ 2,500.00	\$	2,500.00
	SUBTOTAL				\$	208,155.00
	Miscellaneous and Contingencies (15%)				\$	<u>31,223.25</u>
	TOTAL ALTERNATE 1				\$	239,378.25

FLINT SURVEYING AND ENGINEERING COMPANY
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**BALDWIN ROAD BRANCH
OF THE
ATHERTON AND EXTENSION DRAIN NO. 1681
GAINES TOWNSHIP, GENESEE COUNTY**

ENGINEER'S OPINION OF COST

ALTERNATE 2

December 23, 2009

<u>ITEM</u> <u>NO.</u>	<u>DESCRIPTION</u>	<u>QUANTITY</u>	<u>UNIT</u>	<u>UNIT PRICE</u>	<u>AMOUNT</u>
1	36" RCP Storm Sewer	1,868	L.F.	\$ 100.00	\$ 186,800.00
2	5' Dia. Drainage Structure	5	Each	\$ 1,500.00	\$ 7,500.00
3	24" CMP Culvert	90	L.F.	\$ 50.00	\$ 4,500.00
4	24" Metal End Section	6	L.F.	\$ 250.00	\$ 1,500.00
5	Regrade Roadside Ditch	750	L.F.	\$ 10.00	\$ 7,500.00
6	Seeding, Fertilizing & Mulch	1	L.S.	\$ 2,500.00	\$ 2,500.00
7	Televiser Exist. 12" Tile Drain	1,824	L.F.	\$ 2.00	\$ 3,648.00
8	Reconstruct Exist. 12" Tile Drain	100	L.F.	\$ 50.00	\$ 5,000.00
9	Reconstruct Exist. Drainage Structures	4	Each	\$ 400.00	\$ 1,600.00
SUBTOTAL					\$ 220,548.00
Miscellaneous and Contingencies (15%)					<u>\$ 33,082.20</u>
TOTAL ALTERNATE 2					\$ 253,630.20

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**BALDWIN ROAD BRANCH
OF THE
ATHERTON AND EXTENSION DRAIN NO. 1681
GAINES TOWNSHIP, GENESEE COUNTY**

ENGINEER'S OPINION OF COST

ALTERNATE 3

December 23, 2009

<u>ITEM</u>					
<u>NO.</u>	<u>DESCRIPTION</u>	<u>QUANTITY</u>	<u>UNIT</u>	<u>UNIT PRICE</u>	<u>AMOUNT</u>
1	36" RCP Storm Sewer	44	L.F.	\$ 85.00	\$ 3,740.00
2	42" RCP Storm Sewer	2,046	L.F.	\$ 120.00	\$ 245,520.00
3	5' Dia. Drainage Structure	1	Each	\$ 1,500.00	\$ 1,500.00
4	6' Dia. Drainage Structure	6	Each	\$ 2,000.00	\$ 12,000.00
5	24" CMP Culvert	90	L.F.	\$ 50.00	\$ 4,500.00
6	24" Metal End Section	6	L.F.	\$ 250.00	\$ 1,500.00
7	Regrade Roadside Ditch	750	L.F.	\$ 10.00	\$ 7,500.00
8	Seeding, Fertilizing & Mulch	1	L.S.	\$ 4,000.00	\$ 4,000.00
	SUBTOTAL				\$ 280,260.00
	Miscellaneous and Contingencies (15%)				\$ 42,039.00
	TOTAL ALTERNATE 3				\$ 322,299.00

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**BALDWIN ROAD BRANCH
OF THE
ATHERTON AND EXTENSION DRAIN NO. 1681
GAINES TOWNSHIP, GENESEE COUNTY**

ENGINEER'S OPINION OF COST

ALTERNATE 4

December 23, 2009

<u>ITEM</u> <u>NO.</u>	<u>DESCRIPTION</u>	<u>QUANTITY</u>	<u>UNIT</u>	<u>UNIT PRICE</u>	<u>AMOUNT</u>
1	Open Drain Excavation, 2 Ft Bottom	1,853	L.F.	\$ 25.00	\$ 46,325.00
2	42" CMP Culvert	74	L.F.	\$ 100.00	\$ 7,400.00
3	42" Metal End Section	4	L.F.	\$ 500.00	\$ 2,000.00
4	24" CMP Culvert	90	L.F.	\$ 50.00	\$ 4,500.00
5	24" Metal End Section	6	L.F.	\$ 250.00	\$ 1,500.00
6	Regrade Roadside Ditch	750	L.F.	\$ 10.00	\$ 7,500.00
7	Seeding, Fertilizing & Mulch	1	L.S.	\$ 10,000.00	\$ 10,000.00
	SUBTOTAL				\$ 79,225.00
	Miscellaneous and Contingencies (15%)				<u>\$ 11,883.75</u>
	TOTAL ALTERNATE 4				\$ 91,108.75