PRELIMINARY DESIGN REPORT

AND

COST ESTIMATE

BERKSHIRE BRANCH #1684

OF PINE RUN CREEK

Submitted To:

Genesee County Drain Commissioner's Office
Jeffrey Wright, Drain Commissioner
G-4608 Beecher Road
Flint, Michigan 48532

Submitted By:

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I. Summary

The proposed project consists of the creation of the Berkshire Branch #1684 of Pine Run Creek located in Section 19 of Thetford Township and Section 24 of Vienna Township beginning from a high point southeasterly of Hawthorne Heights Subdivision near Tobias Road approximately 1,500 feet west of Lewis Road, traversing west between lots 23-24 and 39-40 of Hawthorne Heights Subdivision, then continuing westerly approximately 3,000 feet, and discharging to the Pine Run Creek.

The proposed drain includes enclosing approximately 650 lineal feet of drain with reinforced concrete pipe and constructing approximately 2,750 lineal feet of open ditch east and west of Hawthorne Heights Subdivision at an estimated cost of $118,000.

Other options evaluated included directing the stormwater north toward Vienna Road or south toward Tobias Road. Directing the water north would exit the current drainage district which is not acceptable per Genesee County Drain Commission standards. Directing the water south toward Tobias Road was too costly. As a third option, enclosing approximately 400 feet of storm sewer behind Lots 39 and 40 (House #11343 and #11357) of Hawthorne Estates was evaluated. This option would be an additional cost of approximately $49,500.

All costs are estimated in year 2008 dollars and actual costs may be higher or lower depending upon final design, contractor's bid prices, and the year of construction.

II. Basin Characteristics

A. General

The Berkshire Branch #1684 drainage basin has an area of approximately 82 acres. The ground surface elevations range from 774' - 740'.

Berkshire Drive and the associated residential lots divide the 82-acre drainage area in the north-south direction. There is approximately 24 acres of land east of the subdivision. With the exception of the 20 single-family houses (1/2-acre lots), the land is undeveloped and generally open.

The Berkshire Branch drainage district was surveyed from the high point near Tobias Road northwesterly along the natural drainage course to the outfall into Brent Run Creek. The existing 36" x 18" storm sewer system beneath Berkshire Drive was located and the rim and invert elevations measured.

Also, a 30-inch diameter R.C.P. storm sewer was located near the outlot into the existing Pine Run drain. The upper invert elevation was measured at 731.31 located in a small depression.

Findings from this field survey indicates that any drain tiles that may have existed in the past along the rear lot lines of Hawthorne Heights Subdivision but could not be located.

B. Existing Conditions

The following problem exists in the basin:

Based on testimony provided in the Board of Determinations minutes, some lots along Berkshire Drive (Hawthorne Heights Subdivision) have experienced street flooding, rear yard flooding, and basement flooding in past years.

III. Basis of Design

A. Hydrology

1. Drainage Area

The drainage area of the district is approximately 82 acres.

2. Future Land Use

It has been assumed for the purposes of this study that land use for the year 2020 in the basin will remain essentially as it exists today.

3. Soils

The following soil types are found in the district. (See Figure A)

Map Symbol	Soil Series Name	Hydrologic Soil Group
CvA	Conover Loam, 0 to 2% Slopes	C
CvB	Conover Loam, 2% to 6% Slopes	C

The hydrologic parameter, A, B, C or D, is an indicator of the minimum rate of infiltration obtained for a bare soil after prolonged wetting.

The hydrologic soil groups, as defined by SCS Soil Scientists, are:

A. (Lowest 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. (Moderately Low Runoff Potential). 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 coarse texture.

C. (Moderately High Runoff Potential). 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 textures.

D. (Highest 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 sinks over nearly impervious materials.

Some soils area classified as belonging to two hydrologic groups by a symbol such as D/B. The first letter indicates the soil's hydrologic characteristics in the drained condition, the second describes its characteristics in the undrained condition.

The majority of the soil in the district is Conover loam.

This soil has somewhat poor drainage; seasonal high water table; moderately slow permeability; and wet depressions in some areas.

4. Land Use

Most of the land is farmed or idle agricultural land with some residential areas along Maple Avenue and Linden Road. There is also an existing school and church located behind the residential areas. This study is based on the existing conditions.

5. Rainfall Information

Rainfall information is obtained from the Soil Conservation Service. The 24-hour rainfalls for the drainage area are as follows:

Frequency (Years)	24 Hour Rainfall (Inches)
1	2.1
2	2.3
5	3.0
10	3.5
25	3.9
50	4.2
100	4.6

It is noted that there have been numerous rainfalls in the mid-Michigan area which have exceeded the 100 year frequency event.

The rainfall intensity curves used were provided by the Genesee County Drain Commissioner's Office.

6. Runoff Coefficients

"The runoff coefficient as used in the Rational Method expresses the percent of rainfall that appears as runoff. The coefficient C combines the effects of infiltration and surface storage of the watershed." (Handbook of Concrete Pipe Hydraulics) Below are the runoff coefficients used in this analysis.

	Land Use	C
A.	Flat undeveloped lands, farms, nonwooded	0.25
B.	Woodlands and sloped undeveloped land	0.30
C.	Residential	0.40
D.	Roads	1.00

7. Quantity of Flow

The methodology used to estimate flows is the Rational Method. This is one of the most widely used techniques for estimating peak runoff in an urbanized watershed. A description of the method as found in the Handbook of Concrete Culvert Pipe Hydraulics follows:

"The rational formula is fundamentally a ratio in which the total quantity of water falling at a uniform rate on an area is related by simple proportion to the total quantity of water that appears as runoff. This can be expressed in instantaneous form as $Q = CiA$ where Q is runoff in cubic feet per seconds, i is rainfall intensity in inches per hour, A is the area of the drainage basin in acres, and C is the ratio expressing the proportional amount of the rainfall that appears as runoff. This formula is only applicable where the rainfall can be assumed to be uniform both in intensity and in aerial distribution throughout the storm. This assumption applies fairly well to areas of less than 200 square miles."

8. Open Channel Design

Based on the following criteria:

Runoff Coefficient (C) = 0.25
Time of Concentration (Tc1) = 43 minutes
Time of Concentration Tc2 = 61.2 minutes
10-Year Storm Event

The flow generated from the upper end of the watershed (east of the existing dwellings) is approximately 15.28 cubic feet per second (cfs). The total watershed generated from the entire drainage basin (82 acres) is approximately 28.74 cfs.

IV. Proposed Improvements

Construct approximately 650 feet of 30-inch diameter reinforced concrete pipe storm sewer constructed between lots 23 and 24 of Hawthorne Estates Subdivision. The storm sewer will turn north at Berkshire Drive right of way and connect to the existing 36" x 18" (30-inch equivalent) arch pipe under the roadway. The proposed 30-inch diameter storm will continue north on the west side of Berkshire Drive, then turn west and traverse between lots 39 and 40. The storm sewer will outlet into a proposed open ditch section and extend westerly to the Pine Run Creek. The proposed 2750 feet of open ditch west of Hawthorne Estates would include existing ditch cleanout and new ditch construction. The ditch would be constructed as follows: 2-foot bottom width, 2-foot run to 1-foot rise side slopes, average channel slopes of 0.50%, and an average channel depth of 1.6 feet.

As an option, an additional 396 feet of 30-inch diameter storm could be constructed from the rear corners of lots 39 and 40, extending westerly to the existing ditch.

IV. Cost Estimate

ENGINEER'S COST ESTIMATE

BERKSHIRE DRAIN #1684

The drain improvement cost estimates are summarized below as follows:

Item No.	Description	Quantity	Unit	Unit Price	Amount
1	30" Dia. RCP Pipe	650	L.F.	$125.00	$81,250.00
2	30" Dia. Flared End Section	2	EACH	$1,800.00	$3,600.00
3	6' Diameter Drainage Structure	6	EACH	$2,500.00	$15,000.00
4	Connect to Existing Drainage Structure	2	EACH	$300.00	$600.00
5	Open Ditch Excavation	800	L.F.	$7.00	$5,600.00
6	Existing Ditch Cleanout	1,950	L.F.	$3.50	$6,825.00
7	Leveling Spoils	2,750	L.F.	$1.00	$2,750.00
8	Seed, Class A (200 lbs. per acre)	60	LB	$4.00	$238.75
9	Seed, Class B (125 lbs. per acre)	158	LB	$4.00	$631.31
10	Mulch	3.1	TON	$500.00	$1,561.07
11	Fertilizer	156	LB	$2.00	$312.21
	TOTAL COST - BASE PROJECT				$118,368.34

BERKSHIRE DRAIN #1684
OPTION #1

The drain improvement cost estimates are summarized below as follows:

Item No.	Description	Quantity	Unit	Unit Price	Amount
1	30" Dia. RCP Pipe	396	L.F.	$125.00	$49,500.00
	TOTAL COST - BASE PROJECT AND OPTION #1				$167,868.34

VI. Reference Materials

1. Computing Flood Discharges for Small Ungaged Watersheds, R.C. Sorrell, P.E., Michigan Department of Environmental Quality, Geological and Land Management Division, July 2003.

2. Genesee County Drain Map, Thetford Township and Vienna Township, February 1964.

3. Genesee County Composite Map, Thetford Township, Section 19 and Vienna Township, Section 24.

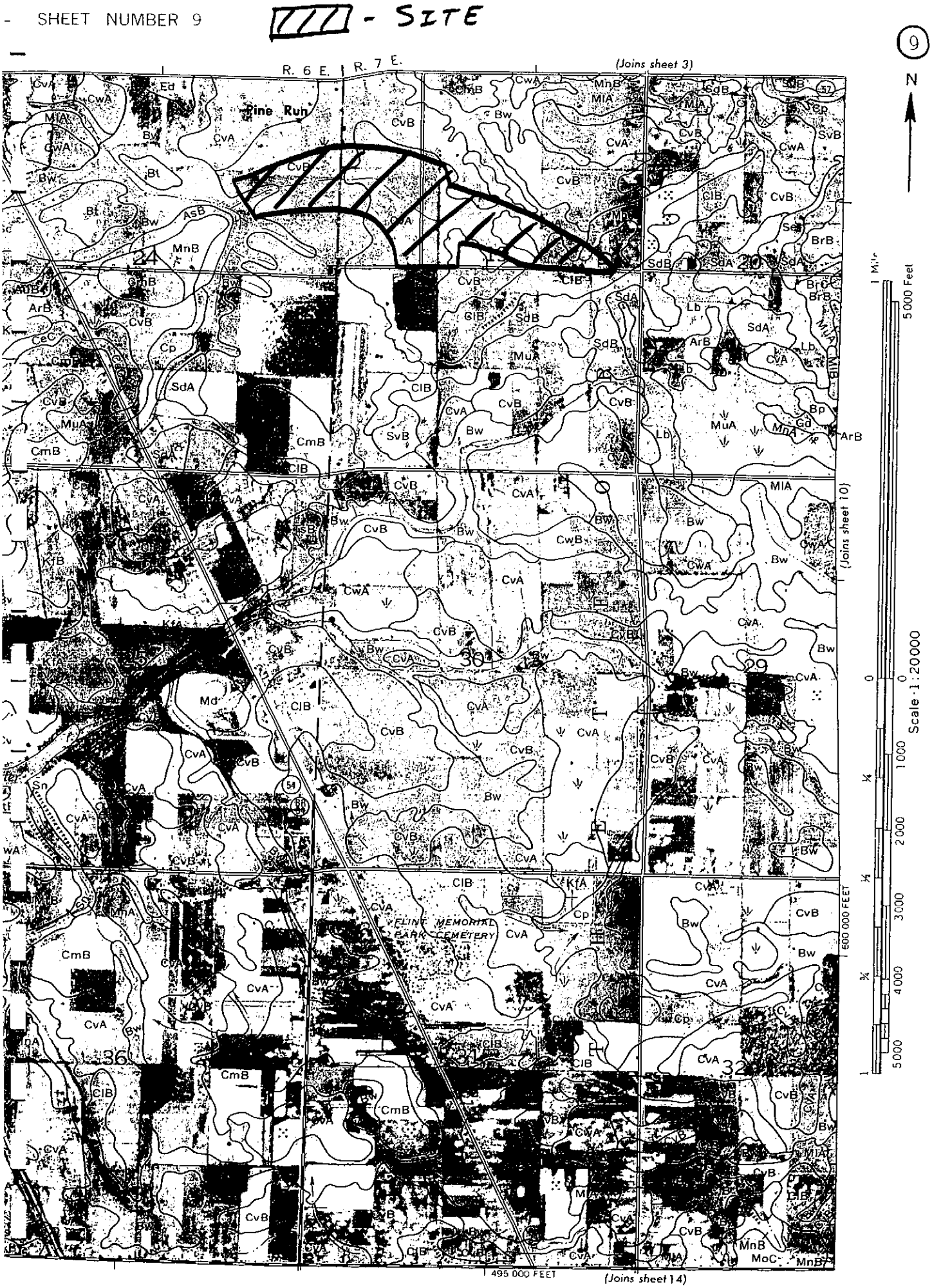
4. Soil Survey of Genesee County, Michigan, United States Department of Agriculture Soil Conservation Service, April, 1972.

5. Handbook of Concrete Culvert Pipe Hydraulics, Portland Cement Association, 1964.

VII. Appendix

Sheet 1	Soil Survey Map
Sheet 2	Time of Concentration Calculations
Sheet 3	Flow Calculations
Sheet 4	Open Channel Calculations
Sheet 5	Drainage District Map and Survey

- SHEET NUMBER 9



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Time of Concentration Calculations — Revised: 3/11/2008

Initial Time			10	minutes
East of Hawthorne Heights				
Surface flow over grass (300 foot maximum)				
upper end elevation =	762			
lower end elevation =	760			
length =	300	feet		
slope =	0.007			
T-Surface flow =	8.89	minutes		
Tc - Grass multiply by:	2		17.8	minutes
Shallow concentrated flow				
upper end elevation =	760			
lower end elevation =	757			
length =	300	feet		
slope =	0.010			
T-Surface flow =	7.59	minutes		
Tc - Grass multiply by:	2		15.2	minutes
Time of Concentration (C1) =			43.0	
Pipe flow				
pipe distance =	650	feet		
design velocity (flowing full) =	2.5	fps	4.3	minutes
Open Channel Flow				
velocity =	3.29	feet per second		
length =	2750	feet		
T-Surface flow =			13.9	minutes
Total Time of Concentration/Peak Flow (C2)			61.2	minutes

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BERKSHIRE DRAIN #1684

Flow Calculations

Date: 11/27/07
Date Revised: 3/11/08

DESIGN FLOOD FREQUENCY = 10 YEAR STORM
INTENSITY CONSTANTS FOR I = A/(T+D)^N

A =	166.37
D =	22.35
N =	1
n =	0.013

DRAINAGE DISTRICT UPPER	LOWER	AREA A (Acres)	RUNOFF COEFF. C	A x C	SUM A x C	TIME OF CONC. (Minutes)	INTENSITY I (In/Hr)	DISCHARGE Q (cfs)
CP1	CP2	24	0.25	6.00	6.00	43.0	2.546	15.28
CP2	OUTLET	58	0.25	14.50	14.50	61.2	1.991	28.87

		PIPE DIAMETER (Inches)	LENGTH L (Feet)	VELOCITY (fps)	HYDR. GRADE LINE	DESIGN GRADE %	DESIGN VELOCITY (fps)	DESIGN CAPACITY (cfs)
CP1	CP2	30	650	3.11	0.14	0.14	3.13	15.39

Trapezoidal Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: Berkshire Branch2

Comment: 2750' open ditch west of Hawthorne Heights

Solve For Discharge

Given Input Data:

Bottom Width.....	2.00 ft
Left Side Slope..	2.00:1 (H:V)
Right Side Slope.	2.00:1 (H:V)
Manning's n.....	0.030
Channel Slope....	0.0050 ft/ft
Depth.....	1.60 ft

Computed Results:

Discharge.....	27.34 cfs
Velocity.....	3.29 fps
Flow Area.....	8.32 sf
Flow Top Width...	8.40 ft
Wetted Perimeter.	9.16 ft
Critical Depth...	1.22 ft
Critical Slope...	0.0158 ft/ft
Froude Number....	0.58 (flow is Subcritical)