PRELIMINARY DESIGN REPORT

AND

COST ESTIMATE

SEYMOUR ROAD EXTENSION #1622

OF COLE CREEK

Submitted To:

Genesee County Drain Commissioner's Office
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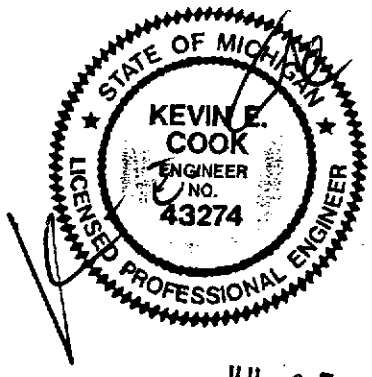

Revised July 2013
Project No. 13002900

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I. Summary

The project consists of the proposed Seymour Road Branch #1622 of Cole Creek located in sections 2, 3, 10, 11 and 15 of Clayton Township. See attached map for drain location. Drain improvements include constructing (from south to north) approximately 5,300 feet of open ditch from the drainage district high point in Section 15 north to the existing drainage ditch at Seymour Road, ¼-mile north Calkins Road. Clear, grub and reshape approximately 9,100 feet of existing drainage ditch north-northeasterly across Sections 2, 10 and 11 of Clayton Township from Seymour Road. Replace and add drainage culverts. As an alternate to the open ditch section along Seymour Road (north of Calkins Road), enclosed pipe was also evaluated. Greater detail of the proposed drain improvements can be found in Section 4 of this report.

The cost to construct the above-described improvements with open ditch is $156,100. The cost to construct the above-described improvements with the section of enclosed pipe along Seymour Road is $300,200. All costs are estimated in year 2013 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 proposed Seymour Road Branch of Cole Creek drainage basin has an area of approximately 780 acres. The ground surface elevations range from 730' to 769'.

The drainage district was surveyed at the three (3) roadway crossings; the intersection of Calkins Road and Seymour Road, McKinley Road ½ mile north of Calkins Road, and Beecher Road 700 feet east of McKinley Road.

Storm sewer and roadway cross culverts were located and invert elevations measured. All pipe invert elevations are noted on the crossing details (Plan Sheet 1). A 21-inch diameter clay tile crosses Calkins Road and extends approximately ¼-mile north to the existing drainage ditch on the east side of Seymour Road. A 48-inch diameter corrugated metal pipe crosses McKinley Road. A 72-inch corrugate metal pipe crosses Beecher Road. Seven (7) driveway culverts were also noted within the drainage course.

B. Existing Conditions

The following problem exists in the basin:

Based on testimony provided in the Board of Determinations minutes, several lots within the proposed drainage district have experienced street and yard flooding in past years.

The existing 21" storm sewer crossing Calkins Road is undersized for the 225 acre drainage area, for both the 10-year and 25-year storm event.

The 48-inch culvert crossing McKinley Road and seven (5) driveway culverts east of the McKinley Road crossing (south of Beecher Road) are undersized for the 490 acre drainage area, 25-year storm event.

The 72-inch culvert crossing Beecher Road and two (2) driveway culverts north of Beecher Road (south of Cole Creek outlet) appear sufficiently sized for the 780 acre drainage area.

III. Basis of Design

A. Hydrology

1. Drainage Area

The drainage area of the district is approximately 780 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
Bw	Brookstone loam	D/B
CvA	Conover loam, 0 to 2% Slopes	C
CvB	Conover loam, 2% to 6% Slopes	C
CeC	Celina load, 6% to 9% Slopes (drain banks)	C
ClA	Celina-Conover loam, 0% to 2% Slopes	C
ClB	Celina-Conover loam, 2% to 6% Slopes	C
MnA	Metea loamy sand 0% to 2% Slopes	B

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 are loam with somewhat poor drainage; seasonal high water table; moderately slow permeability; and wet depressions in some areas.

4. Land Use

The land area is a mix of land is that farmed or idle agricultural land along with large, wooded residential parcels. 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. Design

Based on the following criteria:

Runoff Coefficient (C) = 0.25
Time of Concentration (Tc1) = 63 minutes
Time of Concentration (Tc2) = 87 minutes
Time of Concentration (Tc3) = 95 minutes
Time of Concentration (Tc4) = 106 minutes
10-Year Storm Event for Open Ditch and Enclosed Pipe
25-Year Storm Event for Roadways Crossings/Culverts

The flow generated from the upper end of the watershed south of Calkins Road (225 acres) is approximately 110 cubic feet per second (cfs) (122 cfs for 25-year event). The watershed generated at the McKinley Road crossing (490 acres) is approximately 187 cfs (209 cfs for 25-year event). The watershed generated at the Beecher Road crossing (685 acres) is approximately 232 cfs (259 cfs for 25-year event). The total watershed from the entire drainage basin (780 acres) is approximately 234 cfs (261 cfs for 25-year event).

IV. Proposed Improvements

Drain improvements include constructing approximately 3,700 feet of open ditch that flows north from the drainage district high point near the interior corner of Section 15 flowing to Calkins Road. Remove existing 21" clay storm sewer and construct a 48" diameter culvert under Calkins Road. Continue new drainage ditch north along east side of Seymour Road to the existing open ditch 1,600 feet north of Calkins Road. Construct 18-inch culvert under Seymour Road draining from west to east to capture the stormwater runoff flowing north of Calkins Road on the west side of Seymour Road. Clear, grub and reshape approximately 3,000 feet existing drainage ditch across Section 10 of Clayton Township. Construct a new 48-inch diameter culvert, adjacent to the existing 48-inch culvert under McKinley Road ½-mile north of Calkins Road. Upgrade four (4) driveway crossings east of the McKinley Road crossing by placing a second 48-inch corrugated metal pipe at each location. Remove existing 24" culvert at parcel number 11-100-009 (1422 McKinley Road) and place two (2) 48-inch culverts (or equivalent arch pipe). Place two (2) 48-inch culverts (or equivalent arch pipe) at parcels 10-400-014 (1251 McKinley Road) and 10-400-015 (1213 McKinley Road). Clear, grub, and reshape approximately 6,100 feet existing drain from the improved McKinley Road crossing north across Beecher Road to the outfall at Cole Creek. As previously stated, the existing 72" crossing under Beecher Road and associated drive culverts to the north are sufficiently sized. Place 72-inch culverts along the drainage course for access to vacant parcels 02-100-033 and 02-300-017.

The driveway culvert size and locations are as follows:

Address/Parcel #	Existing	Proposed
1213 McKinley Road (10-400-015)	None	Two (2) 48" CMP
1251 McKinley Road (10-400-014)	None	Two (2) 48" CMP
1330 McKinley Road (11-100-010)	48" CMP	48" CMP
1360 McKinley Road (11-100-012)	48" CMP	48" CMP
1400 McKinley Road (11-100-013)	46" x 64" CMP arch	48" CMP
1422 McKinley Road (11-100-009)	24" CMP	Two (2) 48" CMP
1478 McKinley Road (11-100-008)	60" CMP	48" CMP
2132 McKinley Road (02-300-021)	66" CMP Arch	None
2166 McKinley Road (02-300-018)	72" CMP	None
McKinley Road (02-100-033)	None	72"
McKinley Road (02-300-017)	None	72"

As an alternate to the open ditch along the east side of Seymour Road (north of Calkins Road) a 48-inch diameter enclosed pipe was evaluated.

V. Cost Estimate

ENGINEER'S COST ESTIMATE

OPTION #1

The drain improvement cost estimates are summarized below as follows:

Item No.	Description	Quantity	Unit	Unit Price	Amount
1	18" Dia. CSP Culvert	40	L.F.	$40.00	$1,600.00
2	48" Dia. CSP Culvert	280	L.F.	$75.00	$21,000.00
3	72" Dia. CSP Culvert	40	L.F.	$100.00	$4,000.00
4	Open Ditch Excavation	5,300	L.F.	$7.00	$37,100.00
5	Open Ditch Excavation - Widen & Deepen	9,100	L.F.	$6.00	$54,600.00
6	Leveling Spoils	14,400	L.F.	$1.00	$14,400.00
7	Seed, Class B (125 lbs. per acre)	1,400	LB	$4.00	$5,600.00
8	Mulch	30	TON	$500.00	$15,000.00
9	Fertilizer	1,400	LB	$2.00	$2,800.00
					$156,100.00

OPTION #2 - ENCLOSED PIPE ALTERNATE

The drain improvement cost estimates are summarized below as follows:

Item No.	Description	Quantity	Unit	Unit Price	Amount
1	18" Dia. CSP Culvert	40	L.F.	$40.00	$1,600.00
2	48" Dia. CSP Culvert	280	L.F.	$75.00	$21,000.00
3	72" Dia. CSP Culvert	40	L.F.	$100.00	$4,000.00
4	48" Dia. RCP Storm Sewer	1,600	L.F.	$100.00	$160,000.00
5	Open Ditch Excavation	3,700	L.F.	$7.00	$25,900.00
6	Open Ditch Excavation - Widen & Deepen	9,100	L.F.	$6.00	$54,600.00
7	Leveling Spoils	12,800	L.F.	$1.00	$12,800.00
8	Seed, Class B (125 lbs. per acre)	1,300	LB	$4.00	$5,200.00
9	Mulch	25	TON	$500.00	$12,500.00
10	Fertilizer	1,300	LB	$2.00	$2,600.00
					$300,200.00

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, Clayton Township, February 1964.

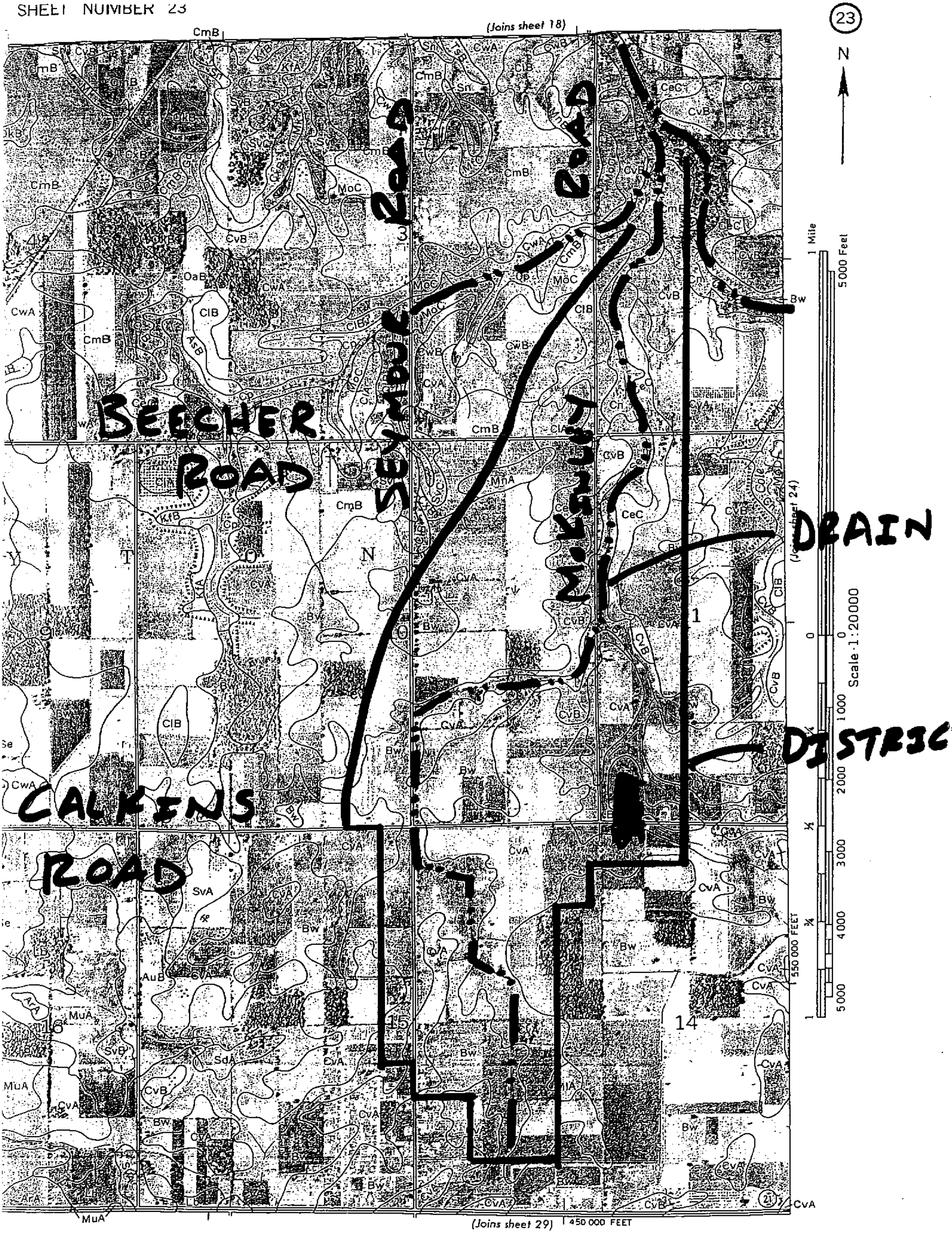
3. Genesee County Composite Map, Clayton Township, Sections 2, 3, 10, 11 and 15.

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

VII. Appendix

Soil Survey Map (1)
Time of Concentration Calculations (1)
Flow Calculations (1)
Open Channel Flow Calculations (2)
Culvert Calculations (3999)
Drainage District Map and Survey (2)

SHEET NUMBER 23



CHMP, INC.
architecture, engineering
planning, interior design
landscapre acrhitecture
surveying

SEYMOUR BRANCH OF COLE CREEK #1622

Flow Calculations

Date: 6/25/13

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

A = 166.37
D = 22.35
N = 1

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	225	0.25	56.25	56.25	63	1.95	109.69
CP2	CP3	265	0.25	66.25	122.50	87	1.53	187.43
CP3	CP6	165	0.25	41.25	163.75	95	1.42	232.53
CP4	CP6	30	0.25	7.50	7.50	30	3.18	23.85
CP5	CP6	35	0.25	8.75	8.75	30	3.18	27.83
CP6	OUTLET	60	0.25	15.00	180.00	106	1.30	234.00
TOTAL DRAINAGE AREA		780						

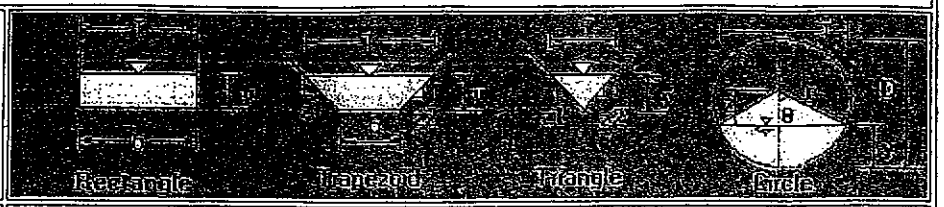
DESIGN FLOOD FREQUENCY = 25 YEAR STORM
INTENSITY CONSTANTS FOR I = A/(T+D)^N

A = 191.76
D = 25.93
N = 1

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	225	0.25	56.25	56.25	63	2.16	121.56
CP2	CP3	265	0.25	66.25	122.50	87	1.71	208.99
CP3	CP6	165	0.25	41.25	163.75	95	1.59	259.71
CP4	CP6	30	0.25	7.50	7.50	30	3.43	25.72
CP5	CP6	35	0.25	8.75	8.75	30	3.43	30.00
CP6	OUTLET	60	0.25	15.00	180.00	106	1.45	261.54

The open channel flow calculator

Select Channel Type: Trapezoid

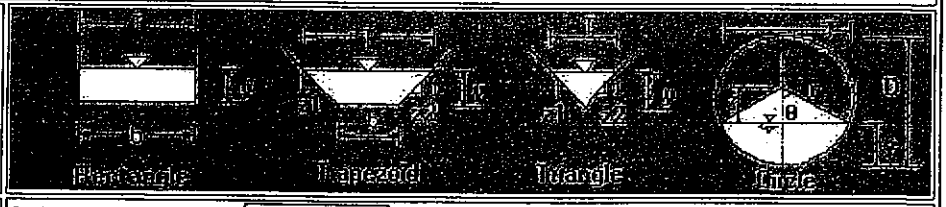


Depth from Q | Select unit system: Feet(ft)

Channel slope: 0.004 ft/ft	Water depth(y): 3.67 ft	Bottom width(b) 5 ft
Flow velocity 5.145 ft/s	LeftSlope(Z1): 2 ft/ft	RightSlope(Z2): 2 ft/ft
Flow discharge 232.53 ft^3/s	Input n value 0.03 or select r	
Calculate!	Status: Calculation finished	Reset
Wetted perimeter 21.39 ft	Flow area 45.19 ft^2	Top width(T) 19.66 ft
Specific energy 4.08 ft	Froude number 0.6	Flow status Subcritical flow
Critical depth 2.83 ft	Critical slope 0.0118 ft/ft	Velocity head 0.41 ft

The open channel flow calculator

Select Channel Type: Trapezoid

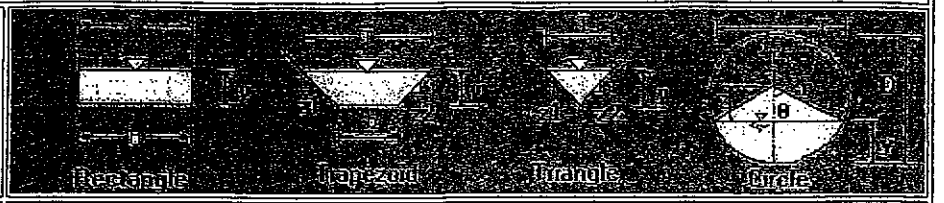


Depth from Q | Select unit system: Feet(ft)

Channel slope: 0.004 ft/ft	Water depth(y): 3.68 ft	Bottom width(b) 5 ft
Flow velocity 5.156 ft/s	LeftSlope(Z1): 2 ft/ft	RightSlope(Z2): 2 ft/ft
Flow discharge 234 ft^3/s	Input n value 0.03 or select r	
Calculate!	Status: Calculation finished	Reset
Wetted perimeter 21.44 ft	Flow area 45.39 ft^2	Top width(T) 19.7 ft
Specific energy 4.09 ft	Froude number 0.6	Flow status Subcritical flow
Critical depth 2.84 ft	Critical slope 0.0118 ft/ft	Velocity head 0.41 ft

The open channel flow calculator

Select Channel Type: Trapezoid

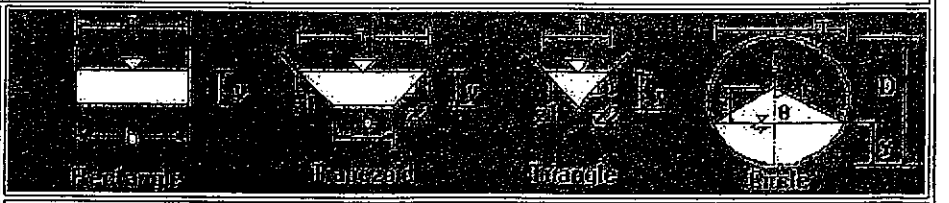


Depth from Q | Select unit system: Feet(ft)

Channel slope: 0.002 ft/ft	Water depth(y): 3.2 ft	Bottom width(b) 4 ft
Flow velocity 3.296 ft/s	LeftSlope(Z1): 2 ft/ft	RightSlope(Z2): 2 ft/ft
Flow discharge 109.69 ft^3/s	Input n value 0.03 or select r	
Calculate!	Status: Calculation finished	Reset
Wetted perimeter 18.31 ft	Flow area 33.27 ft^2	Top width(T) 16.8 ft
Specific energy 3.37 ft	Froude number 0.41	Flow status Subcritical flow
Critical depth 2.05 ft	Critical slope 0.0131 ft/ft	Velocity head 0.17 ft

The open channel flow calculator

Select Channel Type: Trapezoid



Depth from Q | Select unit system: Feet(ft)

Channel slope: 0.003 ft/ft	Water depth(y): 3.72 ft	Bottom width(b) 4 ft
Flow velocity 4.396 ft/s	LeftSlope(Z1): 2 ft/ft	RightSlope(Z2): 2 ft/ft
Flow discharge 187.43 ft^3/s	Input n value 0.03 or select r	
Calculate!	Status: Calculation finished	Reset
Wetted perimeter 20.65 ft	Flow area 42.63 ft^2	Top width(T) 18.9 ft
Specific energy 4.02 ft	Froude number 0.52	Flow status Subcritical flow
Critical depth 2.7 ft	Critical slope 0.0122 ft/ft	Velocity head 0.3 ft

HY-8 Analysis Results

Crossing Summary Table

Culvert Crossing: McKinley Road - Existing 48"

Headwater Elevation (ft)	Total Discharge (cfs)	Culvert 1 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
755.35	150.00	88.88	60.95	8
755.40	165.00	88.98	75.80	4
755.45	180.00	88.77	91.09	4
755.50	195.00	88.38	106.50	4
755.55	210.00	87.82	122.10	4
755.59	225.00	86.73	138.21	4
755.64	240.00	85.77	153.89	3
755.67	250.00	85.17	164.59	3
755.72	270.00	83.91	185.78	3
755.76	285.00	82.77	202.04	3
755.80	300.00	81.65	218.22	3
755.00	82.58	82.58	0.00	Overtopping

HY-8 Analysis Results

Crossing Summary Table

Culvert Crossing: Beecher Road - Existing 72"

Headwater Elevation (ft)	Total Discharge (cfs)	Culvert 1 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
744.45	200.00	200.00	0.00	1
744.66	210.00	210.00	0.00	1
744.88	220.00	220.00	0.00	1
745.09	230.00	230.00	0.00	1
745.35	240.00	240.00	0.00	1
745.67	250.00	250.00	0.00	1
746.00	260.00	260.00	0.00	1
746.08	270.00	262.61	7.07	8
746.14	280.00	264.28	15.47	6
746.19	290.00	265.66	24.04	5
746.23	300.00	266.92	32.90	5
746.00	260.12	260.12	0.00	Overtopping

HY-8 Analysis Results

Crossing Summary Table

Culvert Crossing: McKinley Road - Proposed

Headwater Elevation (ft)	Total Discharge (cfs)	Culvert 1 Discharge (cfs)	Culvert 2 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
753.29	150.00	69.39	80.60	0.00	5
753.61	165.00	76.01	88.96	0.00	3
753.96	180.00	81.92	98.08	0.00	4
754.37	195.00	87.61	107.40	0.00	3
754.82	210.00	94.17	115.68	0.00	17
755.09	225.00	96.99	120.23	7.56	11
755.17	240.00	96.62	121.67	21.42	6
755.22	250.00	96.23	122.48	31.04	5
755.31	270.00	95.41	122.84	51.57	5
755.37	285.00	94.76	122.01	67.85	4
755.43	300.00	94.09	121.17	84.49	4
755.00	215.41	96.67	118.74	0.00	Overtopping