Marshall Megasite
Temporary Construction Stormwater Management Narrative
February 1, 2023

BACKGROUND

The purpose of this narrative is to give a brief orientation to and then describe the proposed temporary stormwater management system for the mass grading of a portion of the Marshall Megasite site and its functioning.

GENERAL SITE CONDITIONS

The project limits will occupy approximately 1,140-acres of what is known as the Marshall Megasite, located in Calhoun County, Michigan. It is situated west of the downtown area of the City of Marshall, southeast of Battle Creek, bounded on the north by Michigan Avenue (M-96), the Kalamazoo River on the south, Ceresco (12 Mile) Road on the West, and Bear Creek on the east. The proposed development pertains to grading approximately 840 acres of the site for immediate development. It is anticipated that the remainder of the site will be occupied by other future developments and the public and private utility facility installations to support their operations.

The Marshall Area Economic Development Alliance (MAEDA) is in the process of acquiring the parcels required to develop the Marshall Megasite within the limits of the project site. A list of the parcels to be included as part of this permit application and timelines for acquisition is summarized in the table attached to this application (*See attached* ***Exhibit C***).

The preparation of this site is on a rigorous timeline, due to numerous factors, which gives it unique aspects regarding stormwater management. Most site development projects involve parcels of land that have a location where stormwater runoff has exited the site to an existing natural drainage course. Typically, the permanent stormwater system, consisting of sewers to collect and one or multiple ponds to detain, then discharge stormwater from the site at pre-existing rates, is installed near the beginning of the site construction process. Runoff from rain events during construction is directed to and managed by the permanent detention ponds, before being discharged in a controlled manner.

The Marshall Megasite site generally drains from north to south toward the Kalamazoo River, its receiving drainage course. The south side of the site is traversed east-west by an Amtrak railroad track and embankment just north of the river. There are three existing stormwater conduits that cross the railroad embankment: two 'farm crossings', and the culvert at Bear Creek. The two farm crossings have collapsed and failed and have virtually no conveyance capability. Consequently, these locations are not available for stormwater conveyance during the initial stages of the site construction.

The third existing culvert at Bear Creek, while in reasonable condition, is not a suitable option for conveyance for construction site runoff. An initial TR-55 analysis, using Calhoun County GIS information, was performed by Stantec for the Bear Creek watershed (*See attached* ***Exhibit A***), which encompasses approximately 9.4 square miles, to estimate the flow to the culvert under the Amtrak railroad embankment and found, even for a 10-yr rain event the flow is greater than 1,000 cfs, showing the culvert to be undersized, likely significantly.

The flow capacity of the culvert can be reasonably estimated knowing its geometry. It is a reinforced concrete culvert, rectangular at the bottom and semi-circular on the top (*See below*), five (5) feet wide, and six (6) feet from invert to crown of the arch, with a flowing-full capacity of about 67.2 cfs (flow calculations shown on attached "*Stormwater Narrative Calculations" **Equation 1***), which is inadequate for the existing Bear Creek storm flow, and not useable for a permanent detention pond outlet.

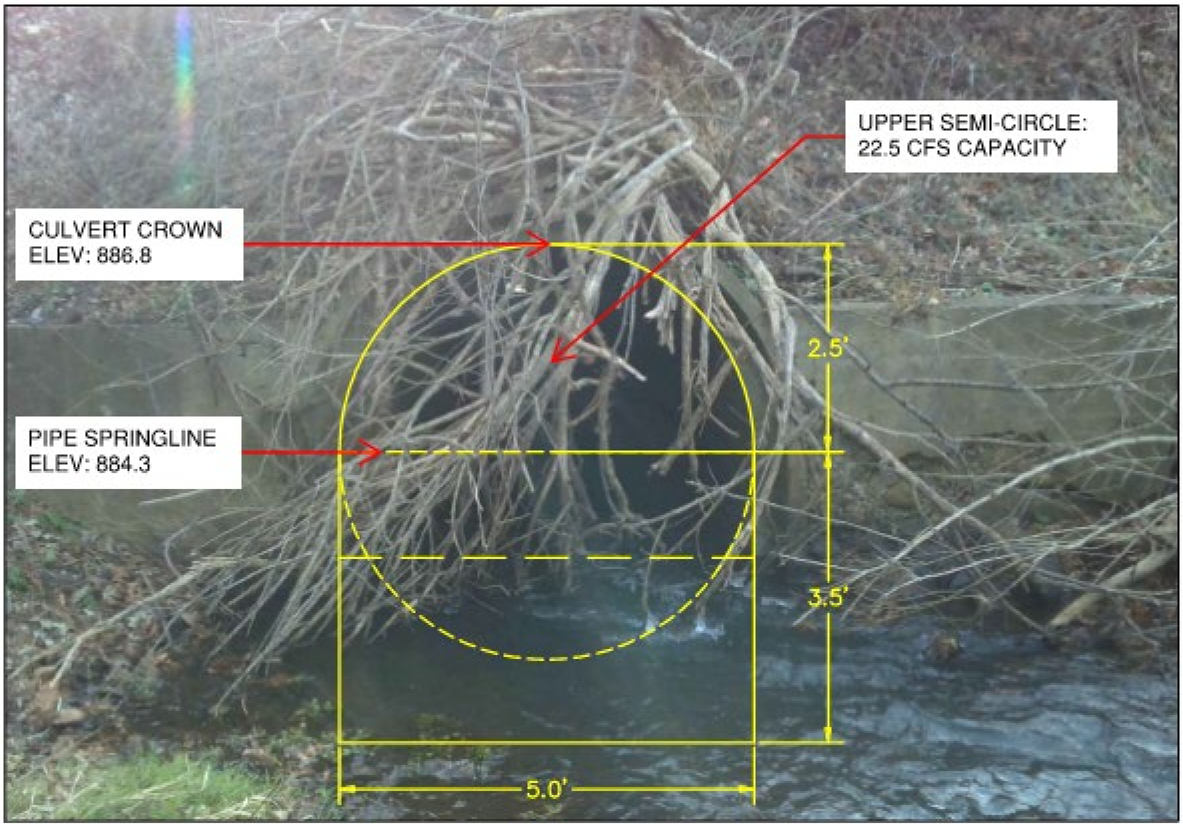

PHOTO OF BEAR CREEK CULVERT, U/S END, WITH DIMENSIONS SUPERIMPOSED: N.T.S.

While a more detailed analysis of the watershed would be useful, it is beyond the scope of this project, but a key point is clear, the Bear Creek culvert is not a suitable outlet for a permanent detention pond for the Marshall Megasite.

RETENTION POND SYSTEM

A workable discharge point for permanent stormwater ponds will not be available when construction starts, to mass grade the defined project site, and won't be for several months. So, a temporary stormwater management regime is needed, which, lacking an outlet point, requires capturing and retaining the runoff on-site in a retention pond system. Retention ponds are typically sized to store an entire 100-yr, 24-hour rain event, which is what Calhoun County requires. The required storage volume is determined by multiplying the tributary area (A) x 24-hr storm rainfall depth (D) x the runoff coefficient (C), which is the percentage of rainfall that turns into runoff. Runoff coefficient (or C Factor) varies with soil types and ground slope, and normally varies across a site. With varying C factors on a site, a weighted average per the acreage of the applicable C factor areas of 0.57 was determined for a composite value and applied to the overall tributary area (*see attached "Stormwater Narrative Calculations"* ***Equation 2***). A retention system is proposed for stormwater control during construction until the permanent outlets can be installed under the railroad embankment and the permanent detention ponds constructed.

Site runoff volumes are typically determined for the pre-development and developed phases of a project, with the C factors determined for existing, undisturbed, still vegetated conditions and built out, paved, stabilized conditions, respectively. This project is unique in that the schedule turns the early construction into a separate phase, with retention ponds, when a significant portion of the site will be disturbed, and not yet stabilized. While runoff coefficient information is readily available for pre-developed and developed conditions, values for disturbed surfaces are scarce. The C Factor used for the disturbed portions of this site was 0.68, from a table of coefficients for Soil Group 'C' (*See attached* ***Exhibit B***). Almost the entire area under consideration consists of Hydrologic 'Type C' soils with smaller, scattered pockets of 'Type A' soils. For simplicity and to be slightly more conservative, Type C soils were assumed over the entire area.

Exhibit D (attached) shows the area divided up into areas per differing C Factors, with the corresponding acreages. The area to be disturbed is outlined in yellow, contains approximately 840 acres, and has an assumed C factor of 0.68. The area outside the disturbed area but within the shown project limits is area not intended to be disturbed during the initial construction phase, so it will be accounted as the existing land use, that is Row Crops on Type C soils, which per the Calhoun County Stormwater Management TRM Spreadsheet, has a C Factor of 0.25. The areas along M-96 drain either along the road right of way, or drain to the north, then into Pigeon Creek then ultimately the Kalamazoo River, and are thus not included in the retention pond tributary area.

Per current National Oceanic and Atmospheric Administration (NOAA) precipitation data, a 100-yr, 24-hr rain event will drop 5.61 inches of rain for this locality. The retention pond volume required to store that amount of runoff would be 13,232,722 cubic feet, (*see attached "Stormwater Narrative Calculations"* ***Equation 3***), or approximately 304 acre-feet of storage. The three temporary ponds will be located south of the industrial site and north of the Amtrak railroad embankment and span a significant portion of the southern site boundary. The western pond will have storage volume of 1,828,465 cf, and a pond bottom elevation of approximately 899.5; the center pond will store 7,951,836 cf, with a bottom elevation of 897.5, and the eastern pond will store 3,663,737 cf, with the bottom at 896.5, for a total of 13,444,038 cf. The pond bottom elevations drop from west to east due to a combination of site topography and top weathered sandstone elevations. There will be erosion-protected overflow swales between the ponds, flowing from west to east.

EMPTYING THE RETENTION POND WATER

During rain events, site runoff will be directed to the western or center retention ponds. Localized soil erosion control measures will be installed (silt fence, mud tracking mats, wattles, riprap berms, etc.) to address point sources of sediment production and other possible types of stormwater pollutants. Any sediment that may make it past those erosion control measures to the retention ponds will settle out there and be removed and disposed of.

Current erosion control practices generally and Calhoun County standards specifically, strongly encourage utilizing the infiltration capabilities of the existing soils as part of the overall stormwater management scheme for site development, providing pollutant filtration, sediment removal, groundwater recharge enhancement, and more fully mimicking the natural hydrologic cycle.

SME performed infiltration testing and test pits at four locations within the planned area of the western pond, five locations within the planned area of the central pond, and four locations within the planned area of the eastern pond between December 14, 2022, and January 26, 2023. Refer to the SME's Supplemental Infiltration Test Report dated January 31, 2023 (SME Project No 091434.01) for evaluation procedures, a summary of observations at the 13 test pit locations, and the results of infiltration tests regarding the expected soil and groundwater conditions within the areas of the three proposed basins.

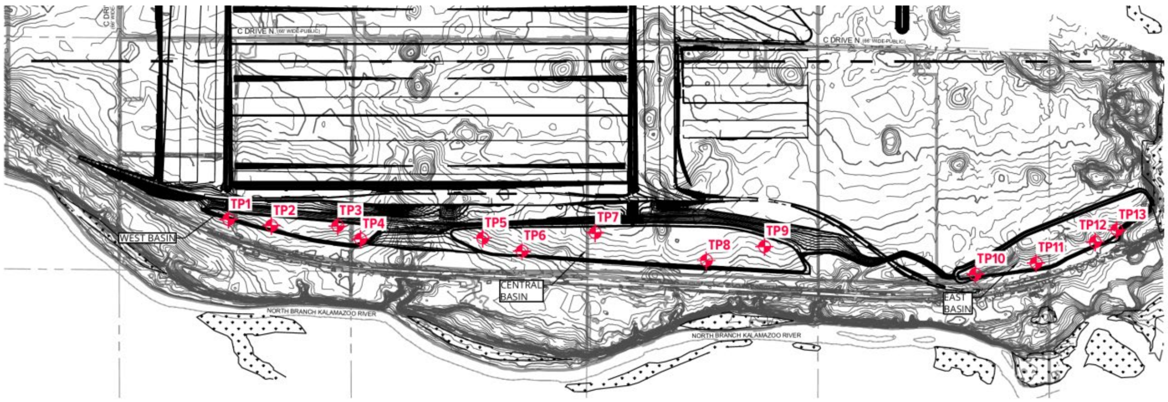

IMAGE 1: Approximate locations of infiltration tests

Table No. 1 below summarizes the locations, test depths and elevations, and the USCS Group Symbols (based on our visual classification) of the soil present at the infiltration interface. The infiltration rates calculated from the double-ring infiltrometer field tests are presented in Table No. 1 below. Median infiltration rates for the west and center pond ranged between 0.5 and 1.4 inches per hour.

TABLE 1: DOUBLE-RING INFILTROMETER FIELD TEST DATA

INFILTRATION TEST LOCATION	CORRESPONDING TEST PIT LOCATION	BASIN LOCATION	TEST ELEVATION (FEET +/-)	USCS GROUP SYMBOL[1]	INFILTRATION RATE[2,3]
IT1	TP1	West	898.8	WC	3/4
IT2	TP2		899.7	WC	1/4
IT3	TP3		899.6	WC	Less than 1/4
IT4	TP4		897.9	WC	16
IT5	TP5	Central	898.5	SM	Less than 1/4
IT6	TP6		897.3	SP-SM	47
IT7	TP7		901.0	SM	Less than 1/4
IT8	TP8		897.0	SM	1-1/2
IT9	TP9		898.7	SP	7
IT10	TP10	East	896.5	SP	44
IT11	TP11		896.5	SP	Greater than 50
IT12	TP12		896.8	SP-SM	38
IT13	TP13		896.5	SP	Greater than 50

NOTES:

1. USCS designation of soil encountered at the depth in the borehole adjacent to the test location. WC represents completely weathered sandstone.
2. Infiltration rate is provided in units of inches per hour (in./hr.).
3. The reported infiltration rate should be considered the maximum rate for the tested soil at the tested location and depth/elevation, under the initial head of 12 inches.

If a conservative median infiltration rate, suggested by SME data above is taken into account (0.5 in/hr), for the west and center ponds, where the tests were performed, the surface levels would drop approximately one-foot per day, infiltrating approximately 5,200,000 cubic-feet of water in three days, which is approximately 59% of the volume of those two ponds combined. Infiltration tests for the eastern pond were performed subsequent to those of the west and central ponds, and the results were added to Table 1 above. The eastern pond infiltration rates were notably higher than those in the other ponds, with a mean rate of approximately 46 in/hr. Because of the size of the pond, the limited number of tests, the variability of local infiltration rates at any given spot, a conservative infiltration rate of 5 in/hr will be assumed for the eastern pond. At an assumed constant infiltration rate of 5” / hour, having a storage depth of five feet, the approximately 4,243,390 cf of storage volume would infiltrate in approximately 12 hours.

After three days of infiltration, it is likely that the infiltration rate in the western and central ponds would decrease with time because of the underlying soils becoming more saturated, as well as the fact that there would be less static head on the column of water as the pond depth decreases. If the infiltration rate dropped to half the rate or 0.25” / hr, the remaining two feet of depth would take 96 hrs or 4 days to infiltrate. If it decreased to a third of the original infiltration rate, 144 hrs or six days would be needed to empty the western and central ponds. Three days after a 100-yr / 24-hr storm at the project site, the eastern pond would likely be empty, and with a 0.5” / hour infiltration rate, in the western and central ponds, the three ponds together would have recovered approximately 8,864,000 cf, of storage volume, (equal to a 3.75” rain event) which is more than the runoff for a 10-yr / 24-hr (3.53” in 24 hrs) storm event, per NOAA rainfall depth information for Marshall, Michigan.

While the Bear Creek culvert has no capacity to receive additional stormwater runoff during notable rainstorms, or immediately thereafter, it remains the only viable receiving watercourse, and would have some limited capacity after the rainfall event peak would have passed and its water surface level dropped. In the statistically unlikely occurrence of a second significant storm, within days after a 100-yr / 24-hr event, and the retention ponds exceeded their storage capacity, the ponds would overflow from west to east, and ultimately flow toward Bear Creek. The discharge from the eastern pond would discharge upland of any wetland area, and flow into the already swollen Bear Creek flood plain and utilize flow capacity through the above-mentioned culvert as it became available as the stream flow rate decreases.

Regards,

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Attachments: Exhibit A: TR-55 Summary for Bear Creek
Exhibit B: C Factors Table
Exhibit C: Parcel Acquisition Table
Exhibit D: Temporary Site Stormwater Runoff Area Map
Narrative Calculation Sheet

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Exhibit C: Parcel Acquisition Table

Owner(s)	Parcel / Tax #	Date Option Exercise	Purchase Closing Date
Matthew/Jennifer Woods	16-290-021-01	1/20/2023	2/20/2023
Thomas/Becki Willard	16-290-021-02	1/20/2023	2/20/2023
Jeremy/Laura Turpin	16-290-021-03	1/20/2023	2/20/2023
Larry/Dena Newman	16-290-021-04	1/20/2023	2/20/2023
Harry Plushnik	16-290-021-05	1/20/2023	2/20/2023
Carol Herman	16-281-015-04	1/20/2023	2/20/2023
Carol Herman	16-281-015-03	1/20/2023	2/20/2023
Kenneth Stautz	16-281-015-02	1/20/2023	2/20/2023
Kenneth Stautz	16-281-015-05	1/20/2023	2/20/2023
Kenneth Stautz	16-281-015-01	1/20/2023	2/20/2023
John Herman	16-281-015-00	1/20/2023	2/20/2023
Garbriel/Michelle Isernia	16-290-012-00	1/20/2023	2/20/2023
Florence Wichowski	16-290-015-00	1/20/2023	2/20/2023
Douglas/Sonja Baldwin	16-201-018-00	1/20/2023	2/20/2023
MAEDA	16-281-024-00	Already Owned	Already Owned
Betty J. Ford, Trust	16-291-015-00	12/27/2022	1/31/2023
Glotfelty	16-291-012-00	1/11/2023	2/7/2023
Glotfelty	16-290-024-00	1/11/2023	2/7/2023
Bauer	16-290-018-00	1/11/2023	2/7/2023
Ceres Farms	16-291-009-00	12/19/2022	1/31/2023
Ceres Farms	16-281-021-00	12/19/2022	1/31/2023
Ceres Farms	16-290-006-00	12/19/2022	1/31/2023
Ceres Farms	16-201-021-00	12/19/2022	1/31/2023
Ceres Farms	16-290-009-00	12/19/2022	1/31/2023
Ceres Farms	16-201-015-00	12/19/2022	1/31/2023
Lapp	16-282-009-00	1/20/2023	2/20/2023
Vanderweg	16-282-003-00	12/21/2022	1/31/2023
Ceres Farms	16-330-015-00	12/19/2022	1/31/2023
Ceres Farms	16-282-006-00	12/19/2022	1/31/2023
Ceres Farms	16-330-003-00	12/19/2022	1/31/2023
Mumaw/Livingston	16-272-009-00	1/20/2023	2/20/2023

SCS-92 Method Discharge Calculations:

Description

Watercourse	Bear Creek - Marshall MI
Drainage Area	9.4 sq. mile
Cont Drainage Area	**9.4** sq. mile
Basin Number	0
Basin Name	Bear Creek - Marshall MI
Quad	Marshall
Section	27
Town/Range	2s/6e
Latitude	42.2631
Longitude	-84.9981
County	Calhoun
Township	Marshall
Location	Marshall Megasite
Job Number	2075154001
By	GJS
Date	Feb-01-2023

Time of Concentration

Flow Type	*Length*	*U/S Elev*	*D/S Elev*	*Slope*	*Velocity*	*Tc*
	feet	*feet*	*feet*	*%*	*ft/s*	*hours*
Sheet Flow	300	924.00	923.92	0.027	0.078	1.06
Sm Trib	2278	923.92	923.28	0.028	0.352	1.80
Sm Trib	524	923.28	923.13	0.029	0.355	0.41
Sm Trib	11172	923.13	920.00	0.028	0.352	8.83
Sm Trib	2567	920.00	916.00	0.156	0.829	0.86
Sm Trib	3671	916.00	911.00	0.136	0.775	1.32
Sm Trib	2297	911.00	907.88	0.136	0.774	0.82
Sm Trib	1381	907.88	906.00	0.136	0.775	0.50
Sm Trib	3103	906.00	902.00	0.129	0.754	1.14
Sm Trib	3967	902.00	900.00	0.050	0.472	2.34
Sm Trib	6331	900.00	896.00	0.063	0.528	3.33
Sm Trib	2380	896.00	884.00	0.504	1.491	0.44
Sm Trib						
Total	39971			0.100	0.597	**22.85**

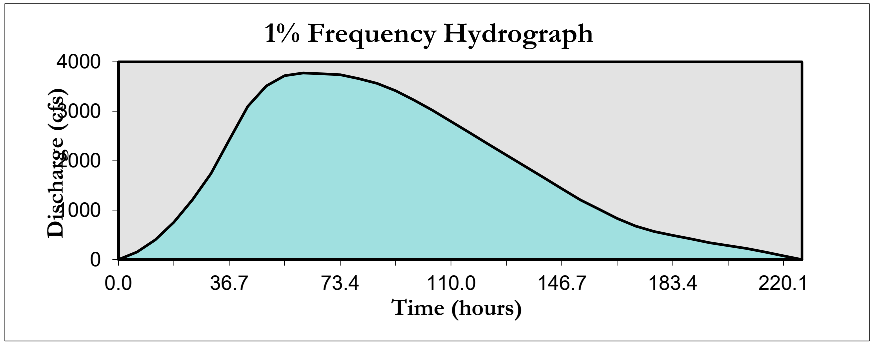
** Portions of the Time of Concentration that were cut off to evaluate alternate travel routes.*

Curve Number

Soils Group	*%*	*Land Use Type*	*%*	*CN*
A	0.15	crop	50	65
		forest	50	45
B	0.57	crop	35	77
		forest	25	60
		swamp	30	78
		res 1	10	68
C	0.03	forest	50	73
		res 1	50	79
D	0.25	swamp	40	78
		forest	60	79

Discharge

Frequency	*10%*	*4%*	*2%*	*1%*	*0.50%*	*0.20%*
Adj Rainfall (inch)	3.43		4.63	5.20		
Avg Runoff (inch)	67.71		67.05	66.73		
Comp Curve Number	0.7		0.7	**0.7**		
Discharge (cfs)	11672	11599	11558	11504	11470	11423
Volume (Acre-ft)	33944	33732	33613	33456	33357	33220
Ponding: throughout	90	90	90	90	90	90
Ponding: upper reaches	90	90	90	90	90	90
Ponding: design point	5	5	5	5	5	5
Ponding Adjustment	0.18	0.23	0.27	0.33	0.36	0.39
Adjusted Flow (cfs)	**2083**	**2621**	**3132**	**3775**	**4090**	**4467**



Unit Hydrograph Peak (cfs/sq. mile-in) 18.34

EXHIBIT B

	Runoff Coefficient, C					
	Soil Group C			Soil Group D		
Slope :	< 2%	2-6%	> 6%	< 2%	2-6%	> 6%
Forest	0.12	0.16	0.20	0.15	0.20	0.25
Meadow	0.26	0.35	0.44	0.30	0.40	0.50
Pasture	0.30	0.42	0.52	0.37	0.50	0.62
Farmland	0.20	0.25	0.34	0.24	0.29	0.41
Res. 1 acre	0.28	0.32	0.40	0.31	0.35	0.46
Res. 1/2 acre	0.31	0.35	0.42	0.34	0.38	0.46
Res. 1/3 acre	0.33	0.38	0.45	0.36	0.40	0.50
Res. 1/4 acre	0.36	0.40	0.47	0.38	0.42	0.52
Res. 1/8 acre	0.38	0.42	0.49	0.41	0.45	0.54
Industrial	0.86	0.86	0.87	0.86	0.86	0.88
Commercial	0.89	0.89	0.90	0.89	0.89	0.90
Streets: ROW	0.84	0.85	0.89	0.89	0.91	0.95
Parking	0.95	0.96	0.97	0.95	0.96	0.97
Disturbed Area	0.68	0.70	0.72	0.69	0.72	0.75

Rational Method Runoff Coefficients - Part II

Source: Knox County Tennessee, Stormwater Management Manual,
http://www.knoxcounty.org/stormwater/pdfs/vol2/3-1-3%20Rational


EXHIBIT D
MDOT STORMWATER AREA NOT INCLUDED IN SITE RUNOFF
PROJECT LIMITS APPROX 1,140 ACRES
MICHIGAN AVENUE
(B.R. I-94, VARIABLE WIDTH - PUBLIC)
13 MILE ROAD
(66' WIDTH - PUBLIC)
C DRIVE NORTH
(66' WIDTH - PUBLIC)
LIMIT OF DISTURBANCE, 840 ACRES
PROPOSED BERM A
PROPOSED BERM B
PROPOSED BERM C
924.00 TOP
6:1 CUT SLOPE, SEED AND STABILIZE AS SPECIFIED
NO DISTURBANCE WITHIN THIS PARCEL UNTIL AFTER 05/07/2023
TRAILER CITY
LAYDOWN AREA
MATCHLINE
PIVOT IRRIGATION PIPE
TRAPEZOIDAL LATERAL DITCH SLOPED @ 0.50%. 8 FT BOTTOM WIDTH WITH 3:1 SIDE SLOPE MAX (3 TYP.)
TRAPEZOIDAL MAJOR DITCH SLOPED @ 0.35%. 10 FT BOTTOM WIDTH WITH 3:1 SIDE SLOPE MAX
DELINEATION LINE BETWEEN WADE TRIM AND SME DESIGN WORK.
WADE TRIM
SME
TEMPORARY SEDIMENT POND
WEST POND
CENTER POND
NORTH LINE R.R.
KALAMAZOO RIVER
DISTANCE TO KALAMAZOO RIVER (TWO TYP.)
691.5'
562.1'
300.0'
TOTAL DISTURBED AREA: 840 AC
811
Know what's below. Call before you dig.
STATE OF MICHIGAN
ERICH VINCENT SMITH
ENGINEER
NO. 45667
LICENSED PROFESSIONAL ENGINEER
N
400 200 0 400 800
SCALE IN FEET
PROJECT MANAGER: -
FIELD BOOK INFORMATION: -
C2.0 - PLOTTED 1/31/2023 2:28 PM BY TILLEY, MIKAYLA
REV# DATE DESCRIPTION BY
WADE TRIM
25251 Northline Rd.
Taylor, MI 48180
734.947.9700
www.wadetrim.com
MARSHALL AREA ECONOMIC DEVEL. ALLIANCE
323 WEST MICHIGAN AVE,
MARSHALL, MI 49068
MASS GRADING OVERALL PLAN
for
MARSHALL MEGA SITE
ISSUED FOR: REVIEW
DATE: 1/31/23
BY: EVS
JOB NO. WAB2004.04H
SHEET C2.0
MASS GRADING & SESC PLAN
© Wade Trim Group, Inc.

Equation 1:

Bear Creek Culver Capacity, using Mannings Equation:

$Q_{cap} = (1.486 / n) ((A_w^{5/3}) / (P_w^{2/3})) (S^{1/2})$

$= (1.49/0.013) \times (27.35^{5/3}/19.85^{2/3}) \times 0.0003^{1/2}$

Q_{cap} = 67.2 cfs

where: Q_{cap} = Flow Capacity, A_w = wetted Area (sf)
P_w = wetted Perimeter (ft)
n = Manning's Roughness Coefficient,
S= Hydraulic Grade Slope

Equation 2:

Construction Phase Compound Runoff Coefficient:

$C_{compound}$ = ((840 acres x 0.68) + (300 acres x 0.25)) / 1140 acres

= 0.567 => 0.57

Equation 3:

Required Construction Phase Retention Pond Volume:

Vol. = Area (A) x Rainfall (R) x C factor (Compound) (C)
= 1140 acres x (43560 sf / acre) x (5.61 in / 12 in / ft) feet x 0.57
= **13,232,722 cf** (cubic feet) of storage

Equation 4:

5-Foot Diameter RC Pipe Capacity, using Mannings Equation:

$Q_{cap} = (0.463 / n) (D^{8/3}) (S^{1/2})$

$= (0.463/0.013) \times (5.0^{8/3}) \times 0.0003^{1/2}$

Q_{cap} = 45.1 cfs

where: Q_{cap} = Flow Capacity,
D = Diameter (ft)
n = Manning's Roughness Coefficient,
S = Hydraulic Grade Slope

Equation 5:

Time to Empty Full Retention Ponds Through Infiltration:

- Assumes 0.5" / hr infiltration rate in the West and Center ponds.
- Assumed infiltration rate for East pond, based upon test data, is 5 in / hr.
- for the East Pond, at 5 in / hr: 60" (5 ') of pond depth would infiltrate in 60" / 5 in/hr = 12 hrs (1/2 day)
- For East and Center ponds, at an infiltration rate of 0.5 in / hr, the pond surfaces would drop 0.5"/hr x 24 hrs = 12" or 1 ft / Day
- In 3 days, ponds would drop 3 feet. Volume in bottom 3 feet of West pond: 950,753 cf; Volume in bottom 3 feet of Center pond: 4,243,386 cf
- Total volume in bottom 3 feet of West and Center ponds: 5,194,139 cf (infiltrated in 3 days)
- Remaining volume to infiltrate after 3 days: 9,780,301 - 5,194,139 = 4,586,162 cf
- The remaining 2 feet of storage in each of the ponds, assuming the infiltration rate fell to half the initial rate, i.e. to 0.25" / hr, would take:

= 24" / 0.25 in/hr = 96 hrs => 4 days