



Vriesman  
& Korhorn

**Mead Johnson Nutrition**  
**Zeeland Modernization Masterplan**  
**Zeeland, MI**  
**Storm Water Narrative**  
Revised 04/02/2026

**Introduction**

This memo summarizes the storm water management plan for the Mead Johnson Nutrition Zeeland Modernization Masterplan. The proposed project involves the construction of two main buildings at the existing Mead Johnson Nutrition facility in Zeeland Michigan, the Specialty building (Buildings 66, 67, 68, 69, 70, 71, & 77) and the ZIPP building addition (Building 73). A significant amount of impervious areas are proposed for the construction of the Specialty building including associated truck docks, employee parking lot, visitor parking lot, loading areas, sidewalks, and pocket park. The ZIPP addition construction will include additional truck docks, loading areas, and access road. A bridge will also be constructed across the Brower Drain to facilitate site logistics to the ZIPP addition building. As a result of this expansion, additional stormwater management infrastructure will be constructed and portions of existing aging storm sewer infrastructure will be replaced including new stormwater piping, outlet control structures, discharge locations to the Brower Drain, and water quality devices. Additionally, two new underground detention systems will replace the two existing stormwater management basins on site. The overall stormwater management design necessary to facilitate this expansion has been designed in accordance with the Ottawa County Water Resources Commission Site Development Rules.

**Existing Conditions**

The existing site is 45.38 acres of developed industrial and residential land that includes the existing Mead Johnson facility and multiple adjacent properties which have been acquired by Mead Johnson. All of the 45.38 acres currently owned by Mead Johnson has been rezoned and is now part of the I-2 industrial district. The current drainage pattern of the site is split into four existing tributaries, North, West, East, and Central. The Lower Grand River Organization of Watersheds (LGROW) design spreadsheet was utilized to size the required detention volumes and release rates for the site. The LGROW spreadsheets assumes existing tributary areas are equal to proposed tributary areas for calculations. Therefore, the boundaries of the existing four tributary areas were maintained in the proposed condition with the only difference being the change in impervious ratio. See Attachment 2 for Existing Tributary Drainage Map.

#### North Tributary

The North tributary collects approximately 5.18 acres of mostly impervious area and discharges to an existing detention basin directly north of the existing ZIPP building. See Attachment 2 for Existing Tributary Drainage Map.

#### West Tributary

The West Tributary is approximately 18.44 acres of existing developed impervious and pervious areas. The West Tributary currently drains the west half of the existing Mead Johnson facility to an existing detention basin directly north of the main employee parking lot. The additional land west of the existing facility now owned by Mead Johnson currently drains to existing onsite wetlands which ultimately discharge to the Brower Drain. This area is included in the existing West Tributary as both areas outlet to the Brower Drain in roughly the same location. In the proposed condition, all of the runoff from this tributary will be detained and released via the West Basin. See Attachment 2 for Existing Tributary Drainage Map.

#### East Tributary

The East Tributary is approximately 0.95 acres of impervious area along the Northeast corner of the existing ZIPP building. Stormwater from this area currently drains to a series of large 36" diameter storm sewer structures and is restricted by a 6" orifice prior to release to the Brower Drain. See Attachment 2 for Existing Tributary Drainage Map.

#### Central Tributary

The Central tributary currently drains the central and southeast portions of the existing Mead Johnson facility including the ZSP building and wastewater treatment plant. Stormwater runoff from the Central Tributary ultimately discharges to the Brower Drain via a 42" mainline storm sewer. See Attachment 2 for Existing Tributary Drainage Map.

#### **Proposed Conditions**

The proposed condition of the overall site will mimic the existing conditions to the greatest extent possible with the addition of two underground stormwater detentions systems to detain the increase in stormwater runoff. The proposed stormwater runoff from the site will be directed via roof, overland, and gutter flow prior to discharging to a series of catch basins, manholes, and pipes that will convey the stormwater to the proposed underground detention area within the given tributary. A summary of the stormwater conveyance design is included in section title "Stormwater Conveyance". The stormwater detention areas have been sized to detain the 100-yr rainfall event with a maximum allowable release rate of 0.13 cfs per acre using the runoff curve method via LGROW spreadsheet. The detention volumes have also been checked using the rational method and are included in Attachment 10 and 11. Extended detention will be utilized to meet the required channel protection volumes generated for the individual tributaries. Required water quality volumes will be met through the use of catch basin sumps, extended detention, and the ADS Storm Tech Isolator Row volume.

#### North Tributary:

The North Tributary (5.18 acres) will increase from an existing curve number of 90 to 95 as a result of the increase in impervious area. A 15-minute minimum developed time of concentration has been used for the North Tributary based on the calculated time of concentration being less than 15-minutes. This results in a required flood control volume of 92,585 cft. The required extended detention volume is 5,271 cft at an allowable release rate

of 0.041 cfs. The standard allowable discharge (0.13 cfs/ac) has been used in calculating the overall allowable release rate of 0.67 cfs. An ADS Storm Tech MC7200 chamber system is proposed as the “North Basin” which will detain the required volume at elevation 651.00. The Storm tech system details are provided in the civil drawings for reference. The North Basin will outlet to the Brower Drain via outlet control structure (OCS) 401. A low flow orifice designed to detain the required extended detention volume and release at a rate less than 0.041 cfs has been provided. Additionally, a flood control orifice has been designed so that the total combined release rate from both the low flow orifice and the flood control orifice is less than 0.67 cfs. See Attachment 6 for LGROW Design Spreadsheet – North Tributary.

West Tributary:

The West Tributary (18.44 acres) will increase from an existing curve number of 74 to 93 as a result of the increase in impervious area. This results in a required flood control volume of 308,780 cft. The required extended detention volume is 71,474 cft at an allowable release rate of 0.55 cfs. The standard allowable discharge (0.13 cfs/ac) has been used in calculating the overall allowable release rate of 2.40 cfs. An ADS Storm tech MC3500 chamber system is proposed as the “West Basin” which will detain the required volume at elevation 647.00. The ADS Storm Tech system details are provided in the civil drawings for reference. The West Basin will outlet to the Brower Drain via outlet control structure (OCS) 101. One orifice has been designed to act as both flood control and channel protection. The low flow through the orifice at the extended detention volume elevation is less than the allowable release rate for channel protection. Additionally, at the flood control elevation the same orifice will discharge at less than the allowable release rate. See Attachment 5 for LGROW Design Spreadsheet – West Tributary.

East Tributary: (Redevelopment Area)

The East Tributary (0.95 acres) is currently comprised completely of existing impervious areas including pavement, roof, and industrial equipment. The proposed condition will include portions of the ZIPP addition truck docks, access road, and bridge. To limit the disturbance in the East Tributary to the furthest extent possible, all roof runoff from the ZIPP addition building will be diverted as to remain in the North Tributary. Therefore, the East Tributary area and curve number will remain the same as the existing condition, 0.95 AC & 98 respectively, and the proposed work will be treated as redevelopment by LGROW definition. The East Tributary currently drains to 480 LF of existing 36” diameter storm sewer pipes restricted by a 6” pipe set in the existing 12” outfall to Brower Drain. This 6” pipe is acting as controlled release orifice and is set at elevation 644.50. The proposed condition will remove portions of this 36” diameter pipe and replace with shorter sections of 42” and 24” diameter pipe. The existing detention volume provided by the current 480 LF of 36” storm sewer is 3392 cft. The proposed condition will include 294 LF of 36”, 98 LF of 42”, and 153 LF of 24” diameter storm sewer resulting in 3502 cft of provided detention volume.

A weir wall with 6” orifice has been designed in OCS-402 to replace the existing 6” grouted pipe orifice. The invert of the proposed orifice will match the existing orifice invert of 644.50. The existing condition does not provide an overflow spillway in the event that the orifice becomes clogged. In this case, the current “overflow” is catch basin grate of CB-3.1 at elevation 650.05. The proposed overflow weir has been designed at elevation 649.00 to prevent this in the future. The maximum top of pipe elevation in the existing system will remain below the overflow elevation so that the full detention volume of the pipes is achieved prior to the overflow.

Central:

No work is planned in the Central Tributary beyond an enabling project that will relocate the existing onsite Nitrogen generation plant. To facilitate the relocation, an existing building and associated concrete sidewalks will be removed and replaced with a new concrete pad where the new nitrogen tank will be placed. The difference in impervious area in this location is negligible and therefore no additional detention has been provided. Two 12” storm sewers will be relocated in the process to maintain the existing overland drainage and conveyance flow pattern.

**Weirs and Overflow Spillways**

Three weir walls have been designed within outlet control structures OCS-101, OCS-203, and OCS-402. Due to the nature of underground detention system, traditional overflow spillways are not feasible. The primary overflow for OCS-101, OCS-203, and OCS-402 is a concrete weir wall which have been modeled as sharp crested weirs. A developed time of concentration of 15 minutes has been used to determine the peak discharge for all three weirs. The peak discharge for OCS-101 and OCS-203 has been determined based on the 10-yr storm in accordance with the Ottawa County Water Resources Commissioner Site Development Rules. OCS-101 and OCS-203 have been outfitted with a 5’ diameter bar grate and placed adjacent to the Brower Drain to serve as the secondary spillway. Rip Rap has been provided around these structures in the overland flow route path. Both paths will drain directly to the Brower Drain in an emergency overflow scenario. See Attachment 7,8, & 9 for weir calculations.

The weir wall within OCS-402 has been designed based on the provided detention volume at the maximum elevation of the proposed system (649.00). The existing release rate was calculated using the existing provided detention volume at the maximum storage elevation of the existing system and the known size of the weir (6”). The proposed orifice will release at a rate just under the existing release rate with the intent being to match existing conditions in the East Tributary to the furthest extent possible. See Attachment 9 and Attachment 12.

**Stormwater Conveyance**

The majority of the proposed site will be impervious surfaces comprised primarily of roof and pavement areas. Stormwater runoff from pavement areas will be directed to curblines and conveyed via gutter flow to catch basins. Runoff from roof areas will be directed to inlets on the roof that will connect to the interior plumbing design prior to discharging from the building below grade. The site stormwater pipes will connect to the designated roof drains via downspout connectors and pipe the stormwater to the underground detention areas. A few areas onsite offer large green spaces which will be drained via overland flow to multiple yard basins that connect to the underground detention system.

The proposed stormwater conveyance system has been designed to convey the 10-yr, 24-hr storm event based on NOAA Atlas 14 rainfall data for Zeeland, MI. The rational method was used to size the storm sewer piping based on regional tributary areas. A tributary area map has been included in the attachments. See Attachment 4 for Proposed Tributary Drainage Map – North Basin and Attachment 3 for Proposed Tributary Drainage Map – West Basin. The stormwater conveyance calculations have also been provided and are included as Attachment 1.

**Michigan Department of Environment, Great Lakes, & Energy (EGLE) & Culvert Design**

The proposed project will include two storm sewer outfalls to the Brower Drain that will require permitting through the Michigan Department of Environment, Great Lakes, & Energy (EGLE). Additionally, a bridge is proposed to cross the Brower Drain near the ZIPP addition building. A 90 LF by 12 LF concrete box culvert (6' deep) has been proposed to span the Brower Drain. The greater tributary drainage area feeding the Brower Drain was analyzed and determined to be less than 2 square miles. Additionally, an existing culvert exists immediately upstream and provides less capacity than the proposed concrete box culvert, therefore, a complete culvert design was not completed at this time.

A complete permit set has been furnished and will be submitted to EGLE spring of 2026.

**Conclusion**

This storm water management plan outlines the stormwater design for the Mead Johnson Nutrition Zeeland Modernization Masterplan which has been designed in accordance with the Ottawa County Water Resources Commission Site Development Rules. The stormwater design includes pipe conveyance, channel protection, flood control, extended detention, EGLE permitting, weir design, and culvert design. Stormwater management for the proposed site will mimic existing conditions by maintaining the overall existing tributary boundaries. Detention for the two impacted tributaries, North and West, will be upgraded through the use of two ADS Storm Tech chamber systems which will replace existing surface detention basins. The two existing outfall locations to the Brower Drain will be replaced and upgraded with outlet control structures including orifices and overflow weirs. A full list of attachments is included on the following pages including maps and calculations used in the complete design of the storm sewer system.

**Attachments**

1. Proposed Storm Sewer Conveyance Calculations
2. Existing Tributary Drainage Map
3. Proposed Tributary Drainage Map – West Basin
4. Proposed Tributary Drainage Map – North Basin
5. LGROW Design Spreadsheet – West Tributary
6. LGROW Design Spreadsheet – North Tributary
7. OCS-101 Weir Calculations
8. OCS-203 Weir Calculations
9. OCS-402 Weir Calculations
10. Detention Volume Check Using Rational Method – West Basin
11. Detention Volume Check Using Rational Method – North Basin
12. East Tributary 25-year Peak Discharge

**PROPOSED STORM SEWER SYSTEM  
STORM SEWER DESIGN TABLE - RATIONAL METHOD**

**Job Information**  
 Description: Reckitt Zeeland - West Tributary  
 Reviewing Entity: Ottawa County  
 Job #: 1471  
 Date: 04/02/26

Design Parameters	
Design Storm:	10-yr

STR.	TO STR.	LENGTH (ft)	PIPE MATERIAL	FLOW			cA INLET	INLET CUM. cA	CASTING Tc (min)	TO INLET Tcum (min)	I INLET	REQUIRED PIPE CAPACITY (CFS)	PIPE DIAMETE R (inches)	PIPE SLOPE (%)	MANNING'S N	PROVIDED PIPE CAPACITY (cfs)	CAPACITY UTILIZATION (%)
				c	AREA (sqft)	AREA (acres)											
CB-9	CB-8	124	HDPE	0.90	12,871	0.30	0.27	0.27	15	15.00	3.98	1.06	12	0.50	0.012	2.73	39%
CB-8	MH-7	77	HDPE	0.90	10,050	0.23	0.21	0.47	15	15.59	3.93	1.86	18	0.40	0.012	7.20	26%
MH-7	MH-6	80	HDPE	0.00	0	0.00	0.00	1.26	15	15.91	3.90	4.91	24	0.40	0.012	15.50	32%
MH-6	MH-5	74	HDPE	0.00	0	0.00	0.00	1.44	15	16.18	3.87	5.59	24	0.40	0.012	15.50	36%
MH-5	MH-4	160	HDPE	0.00	0	0.00	0.00	1.44	15	16.43	3.85	5.56	24	0.40	0.012	15.50	36%
MH-4	MH-3	150	HDPE	0.00	0	0.00	0.00	1.44	15	16.97	3.80	5.48	24	0.40	0.012	15.50	35%
MH-3	CB-2	175	HDPE	0.00	0	0.00	0.00	1.44	15	17.48	3.75	5.42	30	0.40	0.012	28.10	19%
CB-2	CB-1	67	HDPE	0.90	19,635	0.45	0.41	1.85	15	17.99	3.71	6.85	30	0.40	0.012	28.10	24%
CB-1	OUT	5	HDPE	0.90	23,659	0.54	0.49	2.34	15	18.18	3.69	8.62	24	0.40	0.012	15.50	56%
CB-6A	MH-6	28	HDPE	0.90	8,858	0.20	0.18	0.18	15	15.00	3.98	0.73	12	1.00	0.012	3.86	19%
CB-4A	CB-4	13	HDPE	0.90	19,803	0.45	0.41	0.73	15	15.12	3.97	2.89	18	0.80	0.012	10.18	28%
CB-3A	CB-3	13	HDPE	0.90	15,445	0.35	0.32	0.64	15	15.12	3.97	2.56	18	0.80	0.012	10.18	25%
MH-7A	MH-7	100	HDPE	0.90	5,285	0.12	0.11	0.79	15	15.12	3.97	3.12	12	0.80	0.012	3.45	91%
CB-11	CB-10	67	HDPE	0.90	19,294	0.44	0.40	0.40	15	15.00	3.98	1.59	12	1.00	0.012	3.86	41%
CB-10	MH-10A	5	HDPE	0.90	24,018	0.55	0.50	0.89	15	15.23	3.96	3.54	12	1.00	0.012	3.86	92%
CB-13	MH-13A	67	HDPE	0.90	20,265	0.47	0.42	0.42	15	15.00	3.98	1.67	12	1.00	0.012	3.86	43%
CB-12	MH-12A	5	HDPE	0.90	24,108	0.55	0.50	0.50	15	15.00	3.98	1.98	12	1.00	0.012	3.86	51%
CB-14	OUT	5	HDPE	0.90	3,964	0.09	0.08	0.08	15	15.00	3.98	0.33	12	1.00	0.012	3.86	8%
CB-15	OUT	5	HDPE	0.20	25,673	0.59	0.12	0.12	15	15.00	3.98	0.47	12	1.00	0.012	3.86	12%
CB-17	CB-16	152	HDPE	0.90	4,502	0.10	0.09	0.09	15	15.00	3.98	0.37	12	0.50	0.012	2.73	14%
CB-16	OUT	5	HDPE	0.90	4,304	0.10	0.09	0.18	15	15.73	3.91	0.71	24	1.00	0.012	24.51	3%
CB-18	OUT	5	HDPE	0.20	32,670	0.75	0.15	0.15	15	15.00	3.98	0.60	24	1.00	0.012	24.51	2%
CB-19	OUT	5	HDPE	0.90	15,267	0.35	0.32	0.32	15	15.00	3.98	1.26	24	1.00	0.012	24.51	5%
CB-20	OUT	5	HDPE	0.20	60,984	1.40	0.28	0.28	15	15.00	3.98	1.11	24	1.00	0.012	24.51	5%
MH-21A	CB-21	85	HDPE	0.00	0	0.00	0.00	0.58	15	15.12	3.97	2.29	18	0.50	0.012	8.05	28%
CB-21	OUT	5	HDPE	0.90	15,191	0.35	0.31	1.47	15	15.43	3.94	5.77	24	1.00	0.012	24.51	24%
CB-32	MH-31	67	HDPE	0.90	26,779	0.61	0.55	1.29	15	15.09	3.97	5.13	18	0.50	0.012	8.05	64%
MH-31	CB-30	148	HDPE	0.00	0	0.00	0.00	1.29	15	15.34	3.95	5.10	24	0.30	0.012	13.42	38%
CB-30	CB-29	149	HDPE	0.90	5,022	0.12	0.10	1.48	15	15.92	3.90	5.75	24	0.30	0.012	13.42	43%
CB-29	CB-28	135	HDPE	0.90	4,977	0.11	0.10	2.00	15	16.50	3.84	7.67	24	0.30	0.012	13.42	57%
CB-28	CB-27	51	HDPE	0.90	4,363	0.10	0.09	3.06	15	17.03	3.79	11.61	30	0.20	0.012	19.87	58%
CB-27	CB-26	112	HDPE	0.00	0	0.00	0.00	3.20	15	17.24	3.77	12.09	30	0.20	0.012	19.87	61%
CB-26	CB-25	150	HDPE	0.90	21,138	0.49	0.44	3.64	15	17.70	3.73	13.58	30	0.20	0.012	19.87	68%
CB-25	MH-24	76	HDPE	0.90	19,021	0.44	0.39	4.03	15	18.31	3.68	14.82	30	0.17	0.012	18.32	81%
MH-24	MH-23	200	HDPE	0.00	0	0.00	0.00	4.89	15	18.65	3.64	17.82	30	0.17	0.012	18.32	97%
MH-23	CB-22	46	HDPE	0.00	0	0.00	0.00	4.89	15	19.55	3.56	17.42	30	0.17	0.012	18.32	95%
CB-22	OUT	5	HDPE	0.90	0	0.00	0.00	4.89	15	19.75	3.54	17.33	24	1.00	0.012	24.51	71%
CB-36	CB-34	147	HDPE	0.90	6,822	0.16	0.14	0.14	15	15.00	3.98	0.56	12	0.50	0.012	2.73	21%
CB-34	MH-33	67	HDPE	0.90	1,200	0.03	0.02	0.61	15	16.00	3.89	2.37	12	0.50	0.012	2.73	87%
MH-33	OUT	5	HDPE	0.00	0	0.00	0.00	0.61	15	16.32	3.86	2.35	24	1.00	0.012	24.51	10%
CB-35	CB-34	209	HDPE	0.90	21,434	0.49	0.44	0.44	15	15.00	3.98	1.76	12	0.50	0.012	2.73	65%
CB-28A	CB-28	83	HDPE	0.90	5,400	0.12	0.11	0.65	15	15.12	3.97	2.59	18	0.50	0.012	8.05	32%
RDL-1	MH-7A	25	HDPE	0.90	32,817	0.75	0.68	0.68	15	15.00	3.98	2.70	12	0.50	0.012	2.73	99%
RDL-2	CB-4A	25	HDPE	0.90	15,498	0.36	0.32	0.32	15	15.00	3.98	1.27	12	0.50	0.012	2.73	47%
RDL-3	CB-3A	25	HDPE	0.90	15,743	0.36	0.33	0.33	15	15.00	3.98	1.29	12	0.50	0.012	2.73	47%
RDL-4	OUT	25	HDPE	0.90	33,982	0.78	0.70	0.70	15	15.00	3.98	2.79	12	0.50	0.012	2.73	102%
RDL-5	OUT	25	HDPE	0.90	29,396	0.67	0.61	0.61	15	15.00	3.98	2.42	12	0.50	0.012	2.73	89%
RDL-6	MH-21A	25	HDPE	0.90	27,866	0.64	0.58	0.58	15	15.00	3.98	2.29	12	0.50	0.012	2.73	84%
RDL-7	MH-24	25	HDPE	0.90	41,589	0.95	0.86	0.86	15	15.00	3.98	3.42	24	0.50	0.012	17.33	20%
RDL-8	CB-27	25	HDPE	0.90	6,884	0.16	0.14	0.14	15	15.00	3.98	0.57	8	1.00	0.012	1.31	43%
RDL-9	CB-28A	25	HDPE	0.90	26,162	0.60	0.54	0.54	15	15.00	3.98	2.15	12	0.50	0.012	2.73	79%
RDL-10	CB-28	25	HDPE	0.90	7,444	0.17	0.15	0.15	15	15.00	3.98	0.61	8	1.00	0.012	1.31	47%
RDL-11	CB-28	25	HDPE	0.90	8,105	0.19	0.17	0.17	15	15.00	3.98	0.67	8	1.00	0.012	1.31	51%
RDL-12	CB-29	25	HDPE	0.90	5,624	0.13	0.12	0.12	15	15.00	3.98	0.46	8	1.00	0.012	1.31	35%
RDL-13	CB-29	25	HDPE	0.90	14,529	0.33	0.30	0.30	15	15.00	3.98	1.19	8	1.00	0.012	1.31	91%
RDL-14	CB-30	25	HDPE	0.90	3,939	0.09	0.08	0.08	15	15.00	3.98	0.32	8	1.00	0.012	1.31	25%
RDL-15	CB-32	25	HDPE	0.90	35,756	0.82	0.74	0.74	15	15.00	3.98	2.94	12	0.80	0.012	3.45	85%
MH-21A	CB-21	85	HDPE	0.00	0	0.00	0.00	0.58	15	15.12	3.97	2.29	18	1.00	0.012	11.38	20%
CB-37	OUT	5	HDPE	0.90	16,045	0.37	0.33	0.33	15	15.00	3.98	1.32	12	1.00	0.012	3.86	34%

**PROPOSED STORM SEWER SYSTEM**  
**STORM SEWER DESIGN TABLE - RATIONAL METHOD**

**Job Information**

Description: Reckitt Zeeland  
 Reviewing Entity: Ottawa County  
 Job #: 1471  
 Date: 4/2/2026

Design Parameters	
Design Storm:	10-yr

STR.	TO STR.	LENGTH (ft)	PIPE MATERIAL	FLOW			cA INLET	INLET CUM. cA	CASTING Tc (min)	TO INLET Tcum (min)	I INLET (in/hr)	REQUIRED PIPE CAPACITY (CFS)	PIPE DIAMETE R (inches)	PIPE SLOPE (%)	MANNING'S N	PROVIDED PIPE CAPACITY (cfs)
				c	AREA (sft)	AREA (acres)										
MH-306	CB-305	66	HDPE	0.90	35,250	0.81	0.73	0.73	15	25.00	3.06	2.23	12	0.50	0.012	2.73
CB-305	CB-304	57	HDPE	0.90	1,950	0.04	0.04	0.84	15	25.32	3.03	2.53	12	0.50	0.012	2.73
CB-304	CB-303	61	HDPE	0.90	1,100	0.03	0.02	0.86	15	25.59	3.01	2.58	12	0.50	0.012	2.73
CB-303	CB-302	72	HDPE	0.90	0	0.00	0.00	0.86	15	25.88	2.98	2.56	12	0.50	0.012	2.73
CB-302	OUT	5	HDPE	0.90	2,250	0.05	0.05	0.90	15	16.17	3.87	3.50	18	0.50	0.012	8.05
CB-301	OUT	5	HDPE	0.90	3,400	0.08	0.07	0.07	15	15.00	3.98	0.28	12	0.50	0.012	2.73
CB-300	OUT	5	HDPE	0.90	18,250	0.42	0.38	0.38	15	15.00	3.98	1.50	12	0.50	0.012	2.73
CB-307	CB-305	53	HDPE	0.90	3,250	0.07	0.07	0.07	15	15.00	3.98	0.27	12	0.50	0.012	2.73
RDL-1	OUT	25	HDPE	0.90	143,900	3.30	2.97	2.97	15	15.00	3.98	11.83	24	0.50	0.012	17.33
RDL-2	OUT	25	HDPE	0.90	3,213	0.07	0.07	0.07	15	15.00	3.98	0.26	12	1.00	0.012	3.86
CB-406	CB-405	100	HDPE	0.90	2,620	0.06	0.05	0.05	15	15.00	3.98	0.22	24	0.50	0.012	17.33
CB-405	MH-404	22	HDPE	0.90	1,950	0.04	0.04	0.09	15	15.30	3.95	0.37	24	0.50	0.012	17.33
MH-404	MH-403	32	HDPE	0.00	0	0.00	0.00	0.09	15	15.37	3.95	0.37	24	0.50	0.012	17.33
MH-403	OCS-402	32	HDPE	0.00	0	0.00	0.00	0.24	15	15.47	3.94	0.93	36	0.50	0.012	51.09
OCS-402	OUT	28	HDPE	0.90	4,220	0.10	0.09	0.32	15	15.54	3.93	1.28	12	1.00	0.012	3.86
RDL-3	OUT	43	HDPE	0.90	5,000	0.11	0.10	0.10	15	15.00	3.98	0.41	12	0.50	0.012	2.73
CB-403B	MH-403	66	HDPE	0.90	6,918	0.16	0.14	0.14	15	15.00	3.98	0.57	36	0.50	0.012	51.09

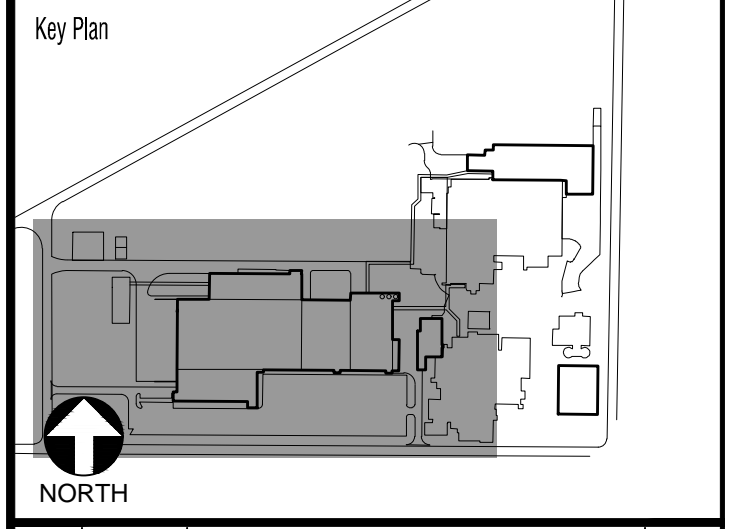




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Approved by

Driller / Designer	mmj/ly
Project Manager	mmj/ly
Quality Representative	mmj/ly
Operation Manager	mmj/ly
Maintenance Representative	mmj/ly
Customer Representative / Document Manager	mmj/ly



REV	DATE	DESCRIPTION	BY



STORMWATER MANAGEMENT PLAN

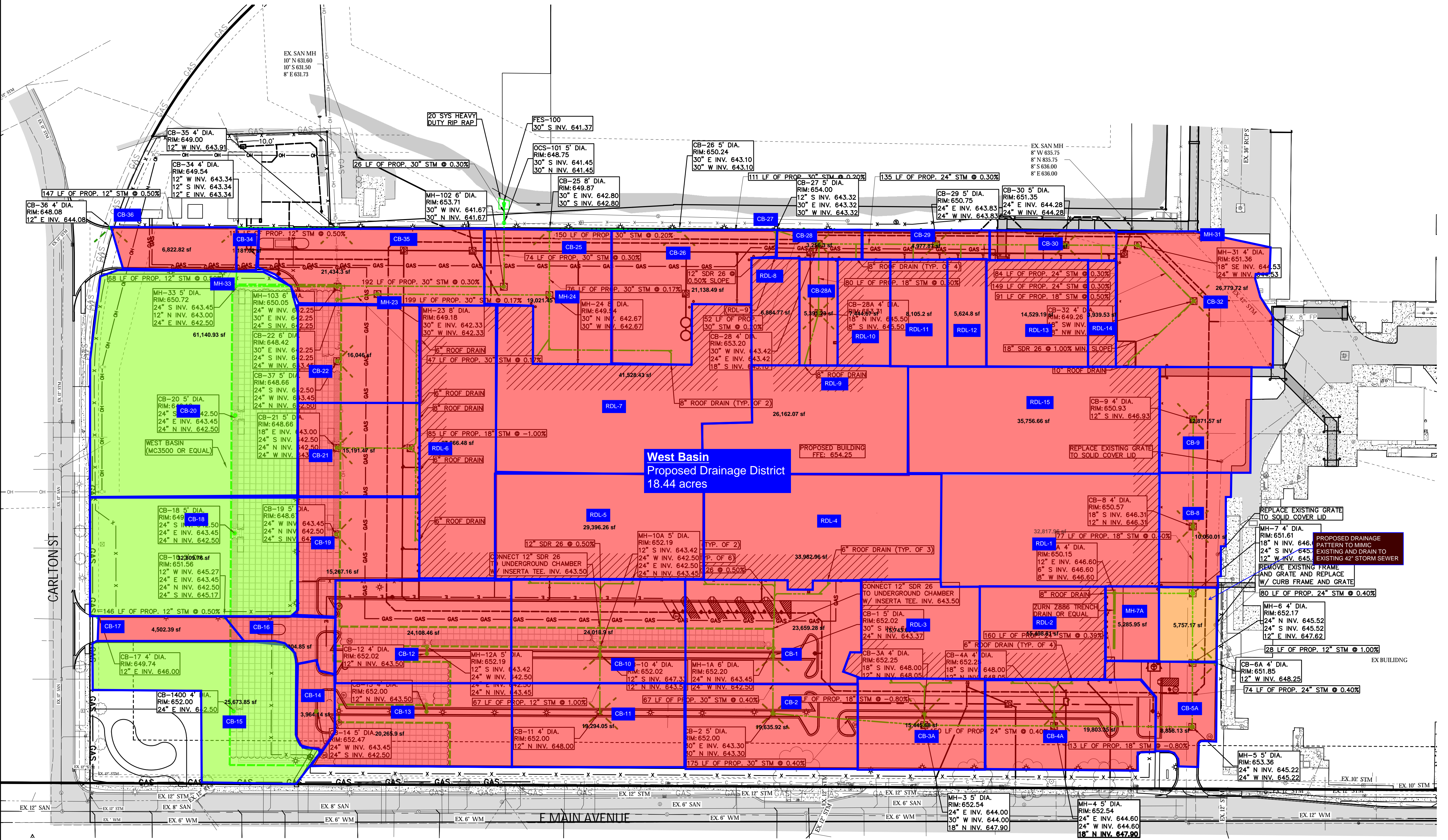


Location: ZEELAND, MI

C.A.R. OR P.O. NUMBER	AS NOTED	DATE	02-APR-2026
SCALE	AS NOTED	DATE	02-APR-2026
PROJECT MANAGER	AJS		
DESIGNER	DGL		
DRAWER	MDS		
VENDOR NAME	INTEGRATED PROJECT SERVICES		
VENDOR PROJECT NUMBER	GL025120		
DISCIPLINE	CIVIL		
SYSTEM NAME			
SYSTEM NUMBER			
EQUIPMENT TYPE			
LEGACY NUMBER			
LEGACY DATE			
LEGACY VENDOR			
CAD FILE NAME			
HARD COPY			
DEPARTMENT			

SHEET #:  
25507-1470-4165 STORMWATER MANAGEMENT PLAN  
DRAWING NUMBER:  
**0415**  
SHEET: 18 OF 36

ATTACHMENT 3



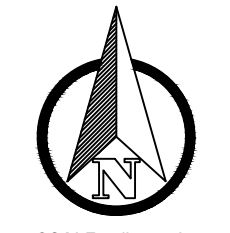
CARLTON ST

F MAIN AVENUE

- LINE LEGEND
- OH - PROPOSED OVERHEAD ELECTRIC
  - E - PROPOSED ELECTRIC
  - GAS - PROPOSED GAS
  - C - PROPOSED COMMUNICATIONS
  - SS - PROPOSED STORM SEWER
  - UD - PROPOSED 6" UNDERDRAIN W/ SOCK
  - FS - PROPOSED FORCE MAIN
  - FM - PROPOSED WATERMAIN



**VK CIVIL** Vriesman & Korhorn  
4664 Campus Dr. Ste 111 Kalamazoo, MI 49008 (269) 697-7120



SCALE: 1" = 60'  
**PRELIMINARY**  
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DATE: \_\_\_\_\_

ENGINEER	ARCHITECT	REV BY	REV
DGL	SRF	MCC	A





# LGROW Design Spreadsheet

## Ottawa County Water Resources Commissioner



Version 3.4

### Instructions

- 1) After opening the spreadsheet you will need to enable the use of an embedded macro. Look for security warning above and click "Enable Content."
- 2) Data is entered in yellow cells. Green cells allow selection of items from pulldown menus or buttons.
- 3) To clear all input data entered in a worksheet, click the Clear Worksheet button at the top of the page and hit the delete key.
- 4) Comments are indicated by red triangles in cells. Further direction is provided in the LGROW Design Spreadsheet Tutorial.
- 5) The spreadsheet can be used to model a single discharge point from the site including structural BMPs in series or parallel.

### Project Description

Development Name	Reckitt - Zeeland - West Tributary	Design Firm	VK Civil
Address/Location	725 E Main Ave, Zeeland, MI 49464	Engineer	Dan Lewis
Developer/Owner	Mead Johnson	Date	4/2/2026

Run

	Select if Yes	Notes
Drainage District	<input type="checkbox"/>	
Watershed Policy	<input type="checkbox"/>	
Redevelopment/Addition	<input checked="" type="checkbox"/>	
MS4	<input type="checkbox"/>	
Hotspot	<input type="checkbox"/>	
Coldwater Stream	<input type="checkbox"/>	

### Sensitive Areas

Description	Notes

### Channel Protection Volume Basis

Pre-development Land Use Definition	Existing	Notes
Not Required	<input type="checkbox"/>	
Provided Offsite	<input type="checkbox"/>	Extended detention provided
Alternative Approach	<input type="checkbox"/>	

### Subcatchment Connectivity

Number of Subcatchments

Subcatchment Name	Downstream Subcatchment	Subcatchment Description
Sub1	Sub2	West Basin



**LGROW Design Spreadsheet**  
Ottawa County Water Resources Commissioner



**Subcatchment Hydrology Summary**

Subcatchment Name	Existing			Developed		
	Area [ac]	% Impervious	Average CN	Area [ac]	% Impervious	Average CN
Sub1	18.44	34%	74	18.44	85%	93
<b>Site Totals and Averages:</b>	<b>18.44</b>	<b>34%</b>	<b>74</b>	<b>18.44</b>	<b>85%</b>	<b>93</b>

**Channel Protection Volume from Structural BMPs**

Subcatchment Name	Channel Protection Volume [cft]			
	Required	Upstream	Credited	Unmet
Sub1	71,474	0	0	71,474
<b>Total</b>	<b>71,474</b>		<b>0</b>	

Percent of Channel Protection Volume met by Onsite Retention	0
Required Extended Detention Volume [cft]	71,474
Required Extended Detention Release Rate [cfs]	0.551
1-year Existing Peak Discharge [cfs]	5.93

**Water Quality Volume and TSS Removal**

Subcatchment Name	Water Quality Volume [cft]	Volume Met	TSS			
			Generated	Upstream	Total	Removed
Sub1	57,045	Yes	57,045	0	57,045	46,104
<b>Total</b>	<b>57,045</b>	<b>No</b>	<b>57,045</b>			<b>46,104</b>

TSS Removal Efficiency [%]	81
80% TSS removal met?	Yes



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**Sub1: West Basin**

**Runoff**

[Click here for documentation](#)

Existing Land Use	HSG	Area	Units	Curve Number	
				Existing	Pre-settlement
Impervious (paved parking lot, roof, driveway, etc.)	B	274,267	sqft	98	69
Open spaces (grass cover) - good	B	518,143	sqft	61	58
Gravel	B	10,790	sqft	93	58
		18.44	acre	74	62

Developed Land Use	HSG	Area	Units	Curve Number	Notes
DIST: Impervious (paved parking lot, roof, driveway, etc.)	B	683,892	sqft	98	
DIST: Open spaces (grass cover) - good	B	119,354	sqft	61	
Notes:		18.44	acre	93	

**Subcatchment Runoff Volume for Developed Land Use**

Rainfall Frequency	1-year	2-year	10-year	25-year	100-year
Volume from this Subcatchment [cft]	116,530	136,732	217,091	281,932	405,776

**Channel Protection Volume**

[Click here for documentation](#)

**Required Channel Protection Volume**

Is Channel Protection Volume required? If no, provide reason.

2-year Runoff Volumes [cft]

	Yes	Developed	Pre-developed
Required this Subcatchment [cft]	71,474	136,732	65,257
Unmet from Upstream Subcatchments [cft]	0		
<b>Required Channel Protection Volume [cft]</b>	<b>71,474</b>		

**Structural BMPs used to meet Channel Protection Volume**

Structural BMP	A Infiltration Area [sqft]	V Storage Volume [cft]	i Design Infiltration Rate [in/hr]	Drain Time [hr]	Volume Retained [cft]
				N.A.	
				N.A.	
				N.A.	
				N.A.	
<b>Totals</b>		0			0

Credited Channel Protection Volume

0

Notes:

Percentage of Channel Protection Volume Met by Retention

0%

**Water Quality Volume**

[Click here for documentation](#)

	Paved [ac]	Pitched Roofs [ac]	Flat Roofs/Unpaved [ac]
Sum of Directly Connected Impervious Area [ac]	15.70	15.70	
Sum of Directly Connected Disturbed Pervious Area [ac]	2.74		
Required Volume this Subcatchment [cft]	57,045		
Volume from Upstream Subcatchments [cft]	0		
<b>Water Quality Volume to be Treated [cft]</b>	<b>57,045</b>		
		TSS Generated this Subcatchment	57,045
		TSS from Upstream Subcatchments	0
		<b>TSS to be Treated</b>	<b>57,045</b>

**TSS Accounting**

BMPs Used in Treatment Train	Treated Water Volume [cft]	TSS Removal Efficiency			TSS Removed
		Tabulated	Third-Party	Effective	
PASS: Detention Basin (extended)	57,045	72		72	41,072
PASS: Catchbasin	57,045	22		22	3,514
PASS: Sediment Forebay	13,900	50		12	1,518
					0
					0
Released Water Volume [cft]	57,045				Total TSS Removed
Water Quality Volume met?	Yes				46,104
					TSS Remaining
					10,941
					<b>TSS Removal Efficiency [%]</b>
					<b>81</b>

Notes:

\*\*Sediment Forebay is actually Isolator Row Volume.



Existing Time-of-Concentration											<a href="#">Click here for documentation</a>
<b>Sheet Flow</b>											
Type	US Elevation [ft]	DS Elevation [ft]	Flow Distance [ft]	Manning's n	Slope [ft/ft]					Travel Time [hr]	
Short grass	653.00	652.50	101.00	0.150	0.0050					0.32	
Short grass	652.50	651.50	75.00	0.150	0.0133					0.17	
Short grass	651.50	651.00	50.00	0.150	0.0100					0.14	
										Subtotal	0.63
<b>Shallow Concentrated Flow (after 300 feet of sheet flow)</b>											
Type	US Elevation [ft]	DS Elevation [ft]	Flow Distance [ft]	Slope [ft/ft]	Velocity [ft/s]					Travel Time [hr]	
Unpaved	651.00	649.00	90.00	0.0222	2.41					0.01	
Unpaved	649.00	648.00	192.00	0.0052	1.16					0.05	
Unpaved	647.00	645.50	101.00	0.0149	1.97					0.01	
										Subtotal	0.07
<b>Open Channels, Swales, and Pipes</b>											
Type	US Elevation [ft]	DS Elevation [ft]	Flow Distance [ft]	Area [sqft]	Wetted Perimeter [ft]	User Specified, n	Manning's n	Slope [ft/ft]	Velocity [ft/s]	Travel Time [hr]	
										Subtotal	0.00
										<b>Existing Time-of-concentration [hr]</b>	<b>0.70</b>

Developed Time-of-Concentration											<a href="#">Click here for documentation</a>
<b>Sheet Flow</b>											
Type	US Elevation [ft]	DS Elevation [ft]	Flow Distance [ft]	Manning's n	Slope [ft/ft]					Travel Time [hr]	
Short grass	654.25	653.65	60.00	0.150	0.0100					0.16	
										Subtotal	0.16
<b>Shallow Concentrated Flow (after 300 feet of sheet flow)</b>											
Type	US Elevation [ft]	DS Elevation [ft]	Flow Distance [ft]	Slope [ft/ft]	Velocity [ft/s]					Travel Time [hr]	
										Subtotal	0.00
<b>Open Channels, Swales, and Pipes</b>											
Type	US Elevation [ft]	DS Elevation [ft]	Flow Distance [ft]	Area [sqft]	Wetted Perimeter [ft]	User Specified, n	Manning's n	Slope [ft/ft]	Velocity [ft/s]	Travel Time [hr]	
Concrete	645.50	645.10	80.00	3.14	6.2	0.012	0.013	0.0050	5.14	0.00	
Concrete	643.32	642.25	755.00	19.6	15.7	0.012	0.013	0.0014	4.99	0.04	
										Subtotal	0.05
										<b>Developed Total without Storage Device [hr]</b>	<b>0.21</b>
<b>Storage Device</b>											
Storage Volume [cft]	10-year Design Discharge [cfs]	Description								Travel Time [hr]	
										Subtotal	0.00
										<b>Developed Time-of-Concentration [hr]</b>	<b>0.21</b>



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**Time-of-Concentration**

[Click here for documentation](#)

	Worksheet	User	Value Used
Existing [hr]	0.70	0.50	0.50
Developed [hr]	0.21	0.25	0.25

Method Selected

Notes:

**Flood Control Volume**

[Click here for documentation](#)

**Detention - Routing Method**

Design Storm

Total Contributing Area [ac]

Developed Peak Discharge [cfs]

Allowable Discharge Worksheet  Select

Standard Discharge [cfs]

Alternate Discharge [cfs]

**Retention - Summary of Volumes**

Design Storm	100-year
Site Runoff Volume [cft]	405,776
BMP Storage Volume [cft]	0
BMP Infiltrating Volume [cft]	0
Total Volume Provided [cft]	0
Runoff Volume Retained by BMPs [cft]	0
Unretained Runoff Volume [cft]	405,776

Credited BMP Retention Volume  ← This should normally be set to "Volume Retained"

Detention Required?

Allowable Discharge [cfs]

Required Storage Volume [cft]

Time to Drain [hrs]

Required Storage Volume [cft]

Minimum "BMP Storage Volume" that results in zero "Unretained Runoff Volume"

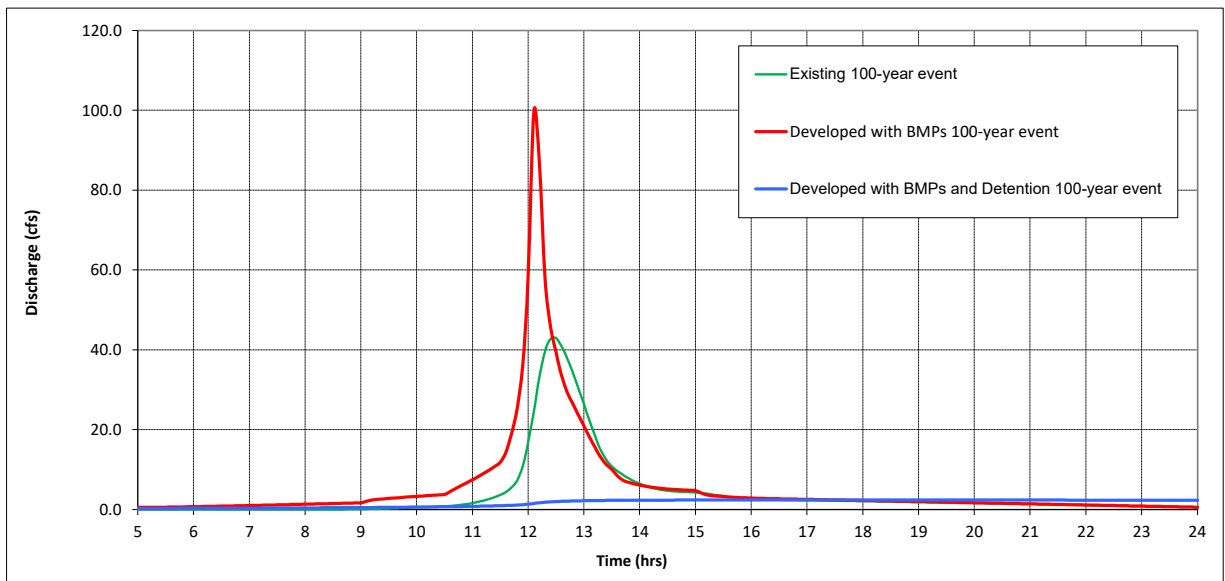
Calculate Detention Storage Volume

Calculated

No Emergency Overflow Routes

Notes:

**Hydrograph**



Plot Event



**LGROW Design Spreadsheet**  
**Ottawa County Water Resources Commissioner**



**Results Summary**

Volume Units cft

**Rainfall**

Source and Distribution	24-hour, NOAA Atlas 14 at West Olive, MI, NRCS MSE4				
Rainfall Frequency	1-year	2-year	10-year	25-year	100-year
Rainfall Depth [in]	2.25	2.59	3.91	4.95	6.90

**Pre-settlement Land Use**

Time-of-Concentration [hr]	0.50				
Average Runoff [in]	0.16	0.26	0.82	1.41	2.71
Peak Discharge [cfs]	0.73	1.43	7.14	13.62	28.55
Runoff Volume [cft]	10,665	17,428	55,150	94,218	181,653

**Existing Land Use**

Time-of-Concentration [hr]	0.50				
Percent Impervious	34%	34%	34%	34%	34%
Average Runoff [in]	0.79	0.97	1.79	2.53	4.05
Peak Discharge [cfs]	5.93	8.29	18.27	26.61	42.92
Runoff Volume [cft]	53,143	65,257	119,945	169,278	271,262

**Developed Land Use**


Time-of-Concentration [hr]	0.25				
Percent Impervious	85%	85%	85%	85%	85%
Average Runoff [in]	1.74	2.04	3.24	4.21	6.06
Peak Discharge [cfs]	30.71	35.83	56.14	71.78	99.72
Runoff Volume [cft]	116,530	136,732	217,091	281,932	405,776
Volume Retained by BMPs [cft]	0	0	0	0	0
BMP Volume Credited to Detention [cft]	0	0	0	0	0
Volume Released [cft]	116,530	136,732	217,091	281,932	405,776
Peak Discharge Released [cfs]	30.71	35.83	56.14	71.78	99.72

**Developed with BMPs and Detention**

Peak Discharge Released [cfs]	1.22	1.33	1.72	1.98	2.40
Maximum Volume Detained [cft]	80,212	95,543	158,719	209,873	308,780


**Disclaimer:**

This spreadsheet is furnished by the Grand Valley Metropolitan Council (GVMC) Lower Grand River Organization of Watersheds (LGROW) and Fishbeck for the convenience of the recipient to show compliance with stormwater standards. Any other use or application of this spreadsheet will be at the user's sole risk.



## LGROW Design Spreadsheet

### Ottawa County Water Resources Commissioner



**Version 3.4**

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- 4) Comments are indicated by red triangles in cells. Further direction is provided in the LGROW Design Spreadsheet Tutorial.
- 5) The spreadsheet can be used to model a single discharge point from the site including structural BMPs in series or parallel.

### Project Description

<b>Development Name</b>	Reckitt - Zeeland - North Tributary	<b>Design Firm</b>	VK Civil
<b>Address/Location</b>	725 E Main Ave, Zeeland, MI 49464	<b>Engineer</b>	Dan Lewis
<b>Developer/Owner</b>	Mead Johnson	<b>Date</b>	4/2/2026

**Run**  

	Select if Yes	Notes
<b>Drainage District</b>	<input type="checkbox"/>	
<b>Watershed Policy</b>	<input type="checkbox"/>	
<b>Redevelopment/Addition</b>	<input checked="" type="checkbox"/>	
<b>MS4</b>	<input type="checkbox"/>	
<b>Hotspot</b>	<input type="checkbox"/>	
<b>Coldwater Stream</b>	<input type="checkbox"/>	

### Sensitive Areas

Description	Notes

### Channel Protection Volume Basis

<b>Pre-development Land Use Definition</b>	Existing	Notes
<b>Not Required</b>	<input type="checkbox"/>	Extended detention provided
<b>Provided Offsite</b>	<input type="checkbox"/>	
<b>Alternative Approach</b>	<input type="checkbox"/>	

### Subcatchment Connectivity

**Number of Subcatchments** 1

Subcatchment Name	Downstream Subcatchment	Subcatchment Description
Sub1	Sub2	West Basin



**LGROW Design Spreadsheet**  
Ottawa County Water Resources Commissioner



**Subcatchment Hydrology Summary**

Subcatchment Name	Existing			Developed		
	Area [ac]	% Impervious	Average CN	Area [ac]	% Impervious	Average CN
Sub1	5.18	82%	91	5.18	95%	96
<b>Site Totals and Averages:</b>	<b>5.18</b>	<b>82%</b>	<b>91</b>	<b>5.18</b>	<b>95%</b>	<b>96</b>

**Channel Protection Volume from Structural BMPs**

Subcatchment Name	Channel Protection Volume [cft]			
	Required	Upstream	Credited	Unmet
Sub1	5,271	0	0	5,271
<b>Total</b>	<b>5,271</b>		<b>0</b>	

Percent of Channel Protection Volume met by Onsite Retention	0
Required Extended Detention Volume [cft]	5,271
Required Extended Detention Release Rate [cfs]	0.041
1-year Existing Peak Discharge [cfs]	6.68

**Water Quality Volume and TSS Removal**

Subcatchment Name	Water Quality Volume [cft]	Volume Met	TSS			
			Generated	Upstream	Total	Removed
Sub1	17,563	Yes	17,563	0	17,563	14,110
<b>Total</b>	<b>17,563</b>	<b>No</b>	<b>17,563</b>			<b>14,110</b>

TSS Removal Efficiency [%]	80
80% TSS removal met?	Yes



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**Ottawa County Water Resources Commissioner**



**Sub1: West Basin**

**Runoff**

[Click here for documentation](#)

Existing Land Use	HSG	Area	Units	Curve Number	
				Existing	Pre-settlement
Impervious (paved parking lot, roof, driveway, etc.)	B	184,003	sqft	98	69
Open spaces (grass cover) - good	B	41,500	sqft	61	58
		5.18	acre	91	67

Developed Land Use	HSG	Area	Units	Curve Number	Notes
DIST: Impervious (paved parking lot, roof, driveway, etc.)	B	213,593	sqft	98	
DIST: Open spaces (grass cover) - good	B	12,000	sqft	61	
		5.18	acre	96	

**Subcatchment Runoff Volume for Developed Land Use**

Rainfall Frequency	1-year	2-year	10-year	25-year	100-year
Volume from this Subcatchment [cft]	36,125	42,234	66,186	85,232	121,192

**Channel Protection Volume**

[Click here for documentation](#)

**Required Channel Protection Volume**

Is Channel Protection Volume required? If no, provide reason.	Yes	2-year Runoff Volumes [cft]	
		Developed	Pre-developed
Required this Subcatchment [cft]	5,271	42,234	36,963
Unmet from Upstream Subcatchments [cft]	0		
<b>Required Channel Protection Volume [cft]</b>	<b>5,271</b>		

**Structural BMPs used to meet Channel Protection Volume**

Structural BMP	A Infiltration Area [sqft]	V Storage Volume [cft]	i Design Infiltration Rate [in/hr]	Drain Time [hr]	Volume Retained [cft]
				N.A.	
				N.A.	
				N.A.	
				N.A.	
<b>Totals</b>		<b>0</b>			<b>0</b>

Credited Channel Protection Volume

0

**Notes:**

Percentage of Channel Protection Volume Met by Retention

0%

Channel protection volume met within UG detention w/ use of low flow orifice. In-situ soils no conducive to infiltration.

**Water Quality Volume**

[Click here for documentation](#)

	Paved [ac]	Pitched Roofs [ac]	Flat Roofs/Unpaved [ac]
Sum of Directly Connected Impervious Area [ac]	4.90	4.90	
Sum of Directly Connected Disturbed Pervious Area [ac]	0.28		
<b>Required Volume this Subcatchment [cft]</b>	<b>17,563</b>		
<b>Volume from Upstream Subcatchments [cft]</b>	<b>0</b>		
<b>Water Quality Volume to be Treated [cft]</b>	<b>17,563</b>		
		<b>TSS Generated this Subcatchment</b>	<b>17,563</b>
		<b>TSS from Upstream Subcatchments</b>	<b>0</b>
		<b>TSS to be Treated</b>	<b>17,563</b>

**TSS Accounting**

BMPs Used in Treatment Train	Treated Water Volume [cft]	TSS Removal Efficiency			TSS Removed
		Tabulated	Third-Party	Effective	
PASS: Catchbasin	17,706	22		22	3,864
PASS: Detention Basin (extended)	17,706	72		72	9,864
PASS: Sediment Forebay	3,500	50		10	382
					0
					0
<b>Released Water Volume [cft]</b>	<b>17,563</b>				<b>Total TSS Removed</b>
<b>Water Quality Volume met?</b>	<b>Yes</b>				<b>14,110</b>
					<b>TSS Remaining</b>
					<b>3,454</b>
					<b>TSS Removal Efficiency [%]</b>
					<b>80</b>

**Notes:**

\*Sediment forebay is Isolator Row volume.



Existing Time-of-Concentration											<a href="#">Click here for documentation</a>
<b>Sheet Flow</b>											
Type	US Elevation [ft]	DS Elevation [ft]	Flow Distance [ft]	Manning's n	Slope [ft/ft]					Travel Time [hr]	
Paved	654.00	652.75	56.00	0.011	0.0223						0.01
Short grass	652.75	652.00	25.00	0.150	0.0300						0.05
Short grass	652.00	649.00	24.00	0.150	0.1250						0.03
Subtotal											0.09
<b>Shallow Concentrated Flow (after 300 feet of sheet flow)</b>											
Type	US Elevation [ft]	DS Elevation [ft]	Flow Distance [ft]	Slope [ft/ft]	Velocity [ft/s]					Travel Time [hr]	
Unpaved	649.50	648.00	648.00	0.0023	0.78						0.23
Subtotal											0.23
<b>Open Channels, Swales, and Pipes</b>											
Type	US Elevation [ft]	DS Elevation [ft]	Flow Distance [ft]	Area [sqft]	Wetted Perimeter [ft]	User Specified, n	Manning's n	Slope [ft/ft]	Velocity [ft/s]	Travel Time [hr]	
Subtotal											0.00
<b>Existing Time-of-concentration [hr]</b>											<b>0.32</b>

Developed Time-of-Concentration											<a href="#">Click here for documentation</a>
<b>Sheet Flow</b>											
Type	US Elevation [ft]	DS Elevation [ft]	Flow Distance [ft]	Manning's n	Slope [ft/ft]					Travel Time [hr]	
Paved	701.00	700.00	100.00	0.011	0.0100						0.03
Subtotal											0.03
<b>Shallow Concentrated Flow (after 300 feet of sheet flow)</b>											
Type	US Elevation [ft]	DS Elevation [ft]	Flow Distance [ft]	Slope [ft/ft]	Velocity [ft/s]					Travel Time [hr]	
Subtotal											0.00
<b>Open Channels, Swales, and Pipes</b>											
Type	US Elevation [ft]	DS Elevation [ft]	Flow Distance [ft]	Area [sqft]	Wetted Perimeter [ft]	User Specified, n	Manning's n	Slope [ft/ft]	Velocity [ft/s]	Travel Time [hr]	
Concrete	652.40	648.25	414.00	1.77	4.71		0.013	0.0100	5.96	0.02	
Concrete	648.25	647.00	190.00	3.14	6.28		0.013	0.0066	5.84	0.01	
						0.012					
Subtotal											0.03
Developed Total without Storage Device [hr]											0.06
<b>Storage Device</b>											
Storage Volume [cft]	10-year Design Discharge [cfs]	Description								Travel Time [hr]	
Subtotal											0.00
<b>Developed Time-of-Concentration [hr]</b>											<b>0.06</b>



**LGROW Design Spreadsheet**  
Ottawa County Water Resources Commissioner



**Time-of-Concentration**

[Click here for documentation](#)

	Worksheet	User	Value Used
Existing [hr]	0.32	0.32	0.32
Developed [hr]	0.06	0.25	0.25

Method Selected
User

Notes:

\_\_\_\_\_

**Flood Control Volume**

[Click here for documentation](#)

**Detention - Routing Method**

Design Storm	100-year
Total Contributing Area [ac]	5.18
Developed Peak Discharge [cfs]	28.35

Allowable Discharge Worksheet	Select
Standard Discharge [cfs] - 0.13 [cfs/ac]	<input checked="" type="radio"/> 0.67
Alternate Discharge [cfs]	<input type="radio"/>

Credited BMP Retention Volume	Volume Retained
Detention Required?	Yes
Allowable Discharge [cfs]	0.67
Required Storage Volume [cft]	92,584
Time to Drain [hrs]	76.3

← This should normally be set to "Volume Retained"

Calculate Detention Storage Volume

No Emergency Overflow Routes

Notes:

\_\_\_\_\_

**Retention - Summary of Volumes**

Design Storm	100-year
Site Runoff Volume [cft]	121,192
BMP Storage Volume [cft]	0
BMP Infiltrating Volume [cft]	0
Total Volume Provided [cft]	0
Runoff Volume Retained by BMPs [cft]	0
Unretained Runoff Volume [cft]	121,192

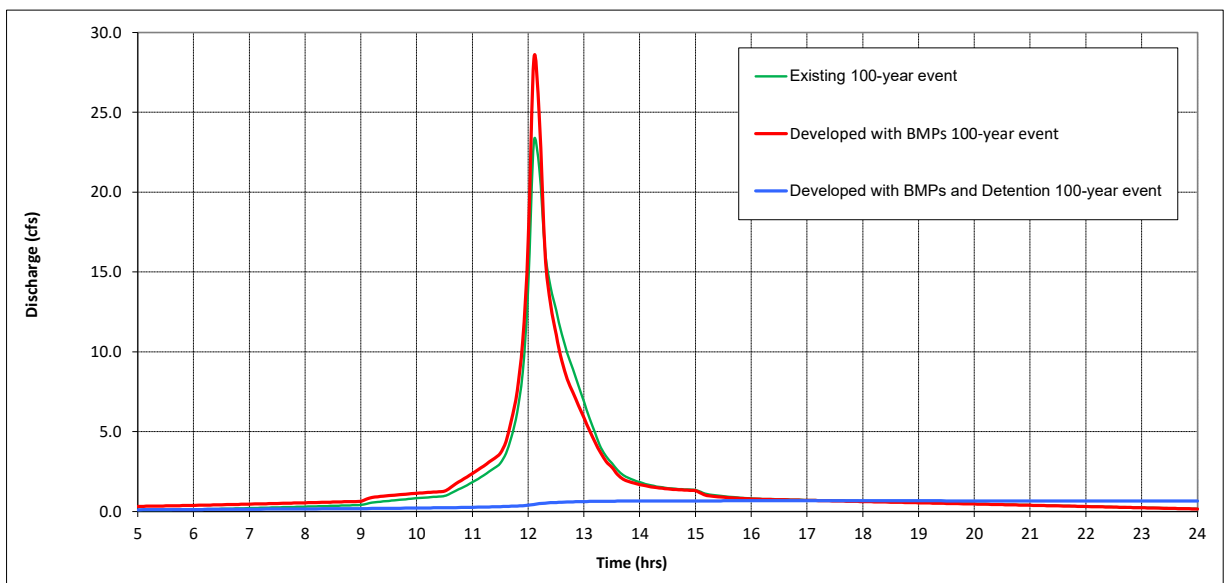
Required Storage Volume [cft] \_\_\_\_\_

Minimum "BMP Storage Volume" that results in zero "Unretained Runoff Volume"

Time to Drain exceeds 72 [hrs]

Calculated

**Hydrograph**



Plot Event: 100-year



**LGROW Design Spreadsheet**  
**Ottawa County Water Resources Commissioner**



**Results Summary**

Volume Units cft

**Rainfall**

Source and Distribution	24-hour, NOAA Atlas 14 at West Olive, MI, NRCS MSE4				
Rainfall Frequency	1-year	2-year	10-year	25-year	100-year
Rainfall Depth [in]	2.25	2.59	3.91	4.95	6.90

**Pre-settlement Land Use**

Time-of-Concentration [hr]	0.32				
Average Runoff [in]	0.27	0.41	1.10	1.78	3.23
Peak Discharge [cfs]	0.52	1.02	3.87	6.61	12.57
Runoff Volume [cft]	5,068	7,632	20,691	33,405	60,725

**Existing Land Use**

Time-of-Concentration [hr]	0.32				
Percent Impervious	82%	82%	82%	82%	82%
Average Runoff [in]	1.67	1.97	3.14	4.09	5.92
Peak Discharge [cfs]	6.68	7.98	12.71	16.52	23.17
Runoff Volume [cft]	31,453	36,963	59,009	76,902	111,232

**Developed Land Use**

Time-of-Concentration [hr]	0.25				
Percent Impervious	95%	95%	95%	95%	95%
Average Runoff [in]	1.92	2.25	3.52	4.53	6.45
Peak Discharge [cfs]	9.25	10.63	16.02	20.30	28.35
Runoff Volume [cft]	36,125	42,234	66,186	85,232	121,192
Volume Retained by BMPs [cft]	0	0	0	0	0
BMP Volume Credited to Detention [cft]	0	0	0	0	0
Volume Released [cft]	36,125	42,234	66,186	85,232	121,192
Peak Discharge Released [cfs]	9.25	10.63	16.02	20.30	28.35

**Developed with BMPs and Detention**

Peak Discharge Released [cfs]	0.35	0.38	0.49	0.56	0.67
Maximum Volume Detained [cft]	25,364	29,849	48,158	63,236	92,584

**Disclaimer:**

This spreadsheet is furnished by the Grand Valley Metropolitan Council (GVMC) Lower Grand River Organization of Watersheds (LGROW) and Fishbeck for the convenience of the recipient to show compliance with stormwater standards. Any other use or application of this spreadsheet will be at the user's sole risk.

**PROPOSED STORMWATER SYSTEM  
DETENTION POND VOLUME**

**Job Information**

**Description:** Reckitt Zeeland - West Basin  
**Reviewing Entity:** Ottawa County  
**Job #:** 1471  
**Date:** 4/2/2026

Elevation (ft)	Area (sf)	Incremental Volume (cf)	Total Volume (cf)
641.50	89800	0.0	0.0
642.50	89800	46507.0	46507.0
643.50	89800	75973.0	122480.0
644.50	89800	70328.0	192808.0
645.50	89800	59418.0	252226.0
646.50	89800	38618.0	290844.0
647.00	89800	17964.0	308808.0

> 308,780 (cf) Required

**OCS-101**

Orifice Equation based on pipe invert elevation and 100-year Storm Event

$Q=cA((2gh)^{(1/2)})$

**Channel Protection**  
Required: 71,474 cft

Size (in.)	c	A (ft <sup>2</sup> )	g (ft/s <sup>2</sup> )	h - water el to inv. of pipe (ft)	Flow (cfs)	Allowable Release Rate (cfs)
6.625	0.6	0.239	32.200	0.31	0.212	< 0.551

Invert: 642.25

**Flood Control**

Required: 308,780 cft

$Q=cA((2gh)^{(1/2)})$

Size (in.)	c	A (ft <sup>2</sup> )	g (ft/s <sup>2</sup> )	h - water el to inv. of pipe (ft)	Flow (cfs)	Allowable Release Rate (cfs)
6.625	0.6	0.239	32.200	4.47	2.361	< 2.400

Invert: 642.25

**\* One 6-5/8" orifice will act as both channel protection and flood control orifices.**

**Weir Wall**

10-yr flow = 56.14 cfs

$Q=CLH^{(3/2)}$

Length	Height	C from table based on height and breadth	h - water el to weir elev (ft)	Flow (cfs)	25 Yr Overflow Rate (cfs)
8	0	3.270	1.75	60.561	> 56.140

**PROPOSED STORMWATER SYSTEM  
DETENTION POND VOLUME**

**Job Information**

**Description:** Reckitt Zeeland - West Tributary  
**Reviewing Entity:** Ottawa County  
**Job #:** 1471  
**Date:** 4/2/2026

Elevation (ft)	Area (sf)	Incremental Volume (cf)	Total Volume (cf)
644.25	21900	0.0	0.0
645.25	21900	11253.0	11253.0
646.25	21900	18383.0	29636.0
647.25	21900	17579.0	47215.0
648.25	21900	16269.0	63484.0
649.25	21900	14122.0	77606.0
650.25	21900	9948.0	87554.0
651.00	21900	6576.0	94130.0

> 92,585 (cf) Required

**OCS-203**

Office Equation based on pipe invert elevation and 100-year Storm Event

$Q=cA((2gh)^{(1/2)})$

**Channel Protection**  
 Required: 5,271 cft  
 El: 644.92

Size (in.)	c	A (ft <sup>2</sup> )	g (ft/s <sup>2</sup> )	h - water el to inv. of pipe (ft)	Flow (cfs)	Allowable Release Rate (cfs)
1.75	0.6	0.017	32.200	0.28	0.037	< 0.041

Invert: 644.57

**Flood Control**

Required: 92,585 cft  
 El: 651.00

$Q=cA((2gh)^{(1/2)})$

Size (in.)	c	A (ft <sup>2</sup> )	g (ft/s <sup>2</sup> )	h - water el to inv. of pipe (ft)	Flow* (cfs)	Allowable Release Rate (cfs)
1.75	0.6	0.017	32.200	6.36	0.202	< 0.670

CPV @ 651.00

Invert: 644.92

\*CPV @ 651.00

$Q=cA((2gh)^{(1/2)})$

Size (in.)	c	A (ft <sup>2</sup> )	g (ft/s <sup>2</sup> )	h - water el to inv. of pipe (ft)	Flow** (cfs)	Allowable Release Rate (cfs)
2.625	0.6	0.038	32.200	5.96	0.639	< 0.670

FC + CPV @ 651.00

Invert: 644.92

\*\* + 0.202 CFS

**Weir Wall**

10-yr flow = 16.02 cfs

$Q=CLH^{(3/2)}$

Length	Height	C from table based on height and breadth	h - water el to weir elev (ft)	Flow (cfs)	25 Yr Overflow Rate (cfs)
5	0	3.270	1	16.350	> 16.020

**PROPOSED STORMWATER SYSTEM**  
**DETENTION POND VOLUME**

**Job Information**

**Description:** Reckitt Zeeland - East Tributary  
**Reviewing Entity:** Ottawa County  
**Job #:** 1471  
**Date:** 4/2/2026

**OCS-402**

Office Equation based on pipe invert elevation and the existing detention volume provided

$Q=cA((2gh)^{(1/2)})$

**Detention Volume**  
Existing 3,392 cft  
El: 648.00

Size (in.)	c	A (ft <sup>2</sup> )	g (ft/s <sup>2</sup> )	h - water el to inv. of pipe (ft)	Flow (cfs)	Existing Release Rate (cfs)
6	0.6	0.196	32.200	3	1.568	equals 1.568

Invert: 645.00

$Q=cA((2gh)^{(1/2)})$

Proposed: 3,502 cft  
El: 649.00

Size (in.)	c	A (ft <sup>2</sup> )	g (ft/s <sup>2</sup> )	h - water el to inv. of pipe (ft)	Flow (cfs)	Existing Release Rate (cfs)
5.5	0.6	0.165	32.200	4	1.543	equals 1.543

Invert: 645.00

$Q=CLH^{(3/2)}$

**Weir Wall**  
25-yr flow = 4.28 cfs

Length	Height	C from table based on height and breadth	h - water el to weir elev (ft)	Flow (cfs)	25 Yr Overflow Rate (cfs)
5	0		0.5	5.887	> 4.280

\*See rational method check for 25yr flow

**STORM STORAGE VOLUME  
RATIONAL METHOD**

**Job Information**

Description: Reckitt Zeeland - West Tributary  
 Reviewing Entity: Ottawa County  
 Job #: 1471  
 Date: 4/2/2026

Design Parameter:	0.13 cfs / acre
Design Storm:	100-yr
Proposed Inflow Runoff Coefficient:	0.80
Inflow Drainage Area (ac):	18.44
Allowable Release Rate (cfs):	2.40

0.13 cfs / acre

Detention Volume Required: 211,789 cft 264736.626

Storm Duration		Intensity (in./hr)	Inflow Rate (cfs)	Outflow Rate (cfs)	Required Storage	Required Storage
(min)	(hr)				(ac-ft)	(cft)
5	0.08	8.88	131.00	2.397	0.893	38901.7
10	0.17	7.74	114.18	2.397	1.553	67628.9
15	0.25	6.95	102.45	2.397	2.084	90800.3
20	0.33	6.15	90.72	2.397	2.454	106876.4
25	0.42	5.36	79.00	2.397	2.660	115857.1
30	0.50	4.56	67.27	2.397	2.703	117742.5
35	0.58	4.28	63.16	2.397	2.954	128671.9
40	0.67	4.00	59.06	2.397	3.148	137117.1
45	0.75	3.73	54.95	2.397	3.285	143078.3
50	0.83	3.45	50.85	2.397	3.364	146555.3
55	0.92	3.17	46.74	2.397	3.387	147548.2
60	1.00	2.89	42.63	2.397	3.353	146057.0
65	1.08	2.80	41.27	2.397	3.509	152862.3
70	1.17	2.71	39.90	2.397	3.647	158842.0
75	1.25	2.61	38.54	2.397	3.765	163996.1
80	1.33	2.52	37.18	2.397	3.864	168324.7
85	1.42	2.43	35.81	2.397	3.945	171827.8
90	1.50	2.34	34.45	2.397	4.006	174505.3
95	1.58	2.24	33.08	2.397	4.049	176357.2
100	1.67	2.15	31.72	2.397	4.072	177383.6
105	1.75	2.06	30.35	2.397	4.077	177584.4
110	1.83	1.97	28.99	2.397	4.062	176959.6
115	1.92	1.87	27.62	2.397	4.029	175509.3
120	2.00	1.78	26.26	2.397	3.977	173233.5
125	2.08	1.74	25.68	2.397	4.042	176082.0
130	2.17	1.70	25.10	2.397	4.100	178581.0
135	2.25	1.66	24.53	2.397	4.149	180730.4
140	2.33	1.62	23.95	2.397	4.190	182530.3
145	2.42	1.58	23.37	2.397	4.224	183980.6
150	2.50	1.55	22.79	2.397	4.249	185081.4
155	2.58	1.51	22.21	2.397	4.266	185832.5
160	2.67	1.47	21.64	2.397	4.275	186234.2
165	2.75	1.43	21.06	2.397	4.277	186286.2
170	2.83	1.39	20.48	2.397	4.270	185988.7
175	2.92	1.35	19.90	2.397	4.255	185341.7
180	3.00	1.31	19.33	2.397	4.232	184345.0
185	3.08	1.30	19.10	2.397	4.293	186989.1
190	3.17	1.28	18.88	2.397	4.350	189499.2
195	3.25	1.27	18.66	2.397	4.405	191875.5
200	3.33	1.25	18.44	2.397	4.456	194117.9
205	3.42	1.24	18.22	2.397	4.505	196226.4
210	3.50	1.22	18.00	2.397	4.550	198201.0
215	3.58	1.21	17.78	2.397	4.592	200041.8
220	3.67	1.19	17.55	2.397	4.632	201748.7
225	3.75	1.18	17.33	2.397	4.668	203321.7
230	3.83	1.16	17.11	2.397	4.701	204760.9
235	3.92	1.15	16.89	2.397	4.731	206066.2
240	4.00	1.13	16.67	2.397	4.758	207237.6
245	4.08	1.12	16.45	2.397	4.781	208275.1
250	4.17	1.10	16.23	2.397	4.802	209178.8
255	4.25	1.09	16.01	2.397	4.820	209948.5
260	4.33	1.07	15.78	2.397	4.834	210584.4
265	4.42	1.06	15.56	2.397	4.846	211086.5
270	4.50	1.04	15.34	2.397	4.854	211454.6
275	4.58	1.03	15.12	2.397	4.860	211688.9
280	4.67	1.01	14.90	2.397	4.862	211789.3
285	4.75	1.00	14.68	2.397	4.861	211755.8
290	4.83	0.98	14.46	2.397	4.857	211588.5
295	4.92	0.97	14.24	2.397	4.850	211287.3
300	5.00	0.95	14.01	2.397	4.841	210852.2
305	5.08	0.94	13.79	2.397	4.827	210283.2
310	5.17	0.92	13.57	2.397	4.811	209580.4
315	5.25	0.91	13.35	2.397	4.792	208743.7
320	5.33	0.89	13.13	2.397	4.770	207773.1
325	5.42	0.88	12.91	2.397	4.744	206668.6
330	5.50	0.86	12.69	2.397	4.716	205430.3
335	5.58	0.85	12.47	2.397	4.685	204058.1
340	5.67	0.83	12.24	2.397	4.650	202552.0
345	5.75	0.82	12.02	2.397	4.612	200912.0
350	5.83	0.80	11.80	2.397	4.572	199138.2
355	5.92	0.79	11.58	2.397	4.528	197230.5
360	6.00	0.77	11.36	2.397	4.481	195188.9
720	12.00	0.44	6.49	2.397	4.094	178320.7
1440	24.00	0.26	3.84	2.397	2.877	125306.4

**STORM STORAGE VOLUME**  
**RATIONAL METHOD**

**Job Information**

Description: Reckitt Zeeland - North Tributary  
 Reviewing Entity: Ottawa County  
 Job #: 1471  
 Date: 4/2/2026

Design Parameter:	0.13 cfs / acre
Design Storm:	100-yr
Proposed Inflow Runoff Coefficient:	0.88
Inflow Drainage Area (ac):	5.18
Allowable Release Rate (cfs):	0.673

0.13 cfs / acre

Detention Volume Required: 66,594 cft 83242.6518 w/ 1.25 multiplier

Storm Duration		Intensity (in./hr)	Inflow Rate (cfs)	Outflow Rate (cfs)	Required Storage (ac-ft)	Required Storage (cft)
(min)	(hr)					
5	0.08	8.88	40.48	0.673	0.276	12041.1
10	0.17	7.74	35.28	0.673	0.481	20938.2
15	0.25	6.95	31.66	0.673	0.646	28118.6
20	0.33	6.15	28.03	0.673	0.760	33106.5
25	0.42	5.36	24.41	0.673	0.824	35902.0
30	0.50	4.56	20.79	0.673	0.838	36504.9
35	0.58	4.28	19.52	0.673	0.916	39902.5
40	0.67	4.00	18.25	0.673	0.976	42532.5
45	0.75	3.73	16.98	0.673	1.019	44394.8
50	0.83	3.45	15.71	0.673	1.044	45489.6
55	0.92	3.17	14.44	0.673	1.052	45816.8
60	1.00	2.89	13.17	0.673	1.042	45376.4
65	1.08	2.80	12.75	0.673	1.090	47499.6
70	1.17	2.71	12.33	0.673	1.133	49367.7
75	1.25	2.61	11.91	0.673	1.170	50980.7
80	1.33	2.52	11.49	0.673	1.202	52338.6
85	1.42	2.43	11.07	0.673	1.227	53441.5
90	1.50	2.34	10.64	0.673	1.246	54289.2
95	1.58	2.24	10.22	0.673	1.260	54881.8
100	1.67	2.15	9.80	0.673	1.268	55219.3
105	1.75	2.06	9.38	0.673	1.270	55301.7
110	1.83	1.97	8.96	0.673	1.266	55129.1
115	1.92	1.87	8.54	0.673	1.256	54701.3
120	2.00	1.78	8.11	0.673	1.240	54018.4
125	2.08	1.74	7.94	0.673	1.261	54919.0
130	2.17	1.70	7.76	0.673	1.279	55711.5
135	2.25	1.66	7.58	0.673	1.295	56396.1
140	2.33	1.62	7.40	0.673	1.308	56972.6
145	2.42	1.58	7.22	0.673	1.319	57441.1
150	2.50	1.55	7.04	0.673	1.327	57801.7
155	2.58	1.51	6.86	0.673	1.333	58054.1
160	2.67	1.47	6.69	0.673	1.336	58198.6
165	2.75	1.43	6.51	0.673	1.337	58235.1
170	2.83	1.39	6.33	0.673	1.335	58163.5
175	2.92	1.35	6.15	0.673	1.331	57983.9
180	3.00	1.31	5.97	0.673	1.325	57696.4
185	3.08	1.30	5.90	0.673	1.344	58533.7
190	3.17	1.28	5.83	0.673	1.362	59329.7
195	3.25	1.27	5.77	0.673	1.379	60084.4
200	3.33	1.25	5.70	0.673	1.396	60797.7
205	3.42	1.24	5.63	0.673	1.411	61469.6
210	3.50	1.22	5.56	0.673	1.426	62100.1
215	3.58	1.21	5.49	0.673	1.439	62689.3
220	3.67	1.19	5.42	0.673	1.452	63237.1
225	3.75	1.18	5.36	0.673	1.463	63743.5
230	3.83	1.16	5.29	0.673	1.474	64208.6
235	3.92	1.15	5.22	0.673	1.484	64632.3
240	4.00	1.13	5.15	0.673	1.493	65014.6
245	4.08	1.12	5.08	0.673	1.500	65355.6
250	4.17	1.10	5.01	0.673	1.507	65655.2
255	4.25	1.09	4.95	0.673	1.513	65913.4
260	4.33	1.07	4.88	0.673	1.518	66130.3
265	4.42	1.06	4.81	0.673	1.522	66305.8
270	4.50	1.04	4.74	0.673	1.525	66439.9
275	4.58	1.03	4.67	0.673	1.527	66532.7
280	4.67	1.01	4.60	0.673	1.529	66584.1
285	4.75	1.00	4.54	0.673	1.529	66594.1
290	4.83	0.98	4.47	0.673	1.528	66562.8
295	4.92	0.97	4.40	0.673	1.526	66490.1
300	5.00	0.95	4.33	0.673	1.524	66376.0
305	5.08	0.94	4.26	0.673	1.520	66220.6
310	5.17	0.92	4.19	0.673	1.516	66023.8
315	5.25	0.91	4.13	0.673	1.510	65785.6
320	5.33	0.89	4.06	0.673	1.504	65506.0
325	5.42	0.88	3.99	0.673	1.496	65185.1
330	5.50	0.86	3.92	0.673	1.488	64822.8
335	5.58	0.85	3.85	0.673	1.479	64419.2
340	5.67	0.83	3.78	0.673	1.469	63974.2
345	5.75	0.82	3.72	0.673	1.457	63487.8
350	5.83	0.80	3.65	0.673	1.445	62960.1
355	5.92	0.79	3.58	0.673	1.432	62390.9
360	6.00	0.77	3.51	0.673	1.418	61780.5
720	12.00	0.44	2.01	0.673	1.332	58034.8
1440	24.00	0.26	1.19	0.673	1.024	44586.6

**STORM STORAGE VOLUME  
RATIONAL METHOD**

**Job Information**

**Description:** Reckitt Zeeland - East Tributary  
**Reviewing Entity:** Ottawa County  
**Job #:** 1471  
**Date:** 4/2/2026

<b>Design Parameter:</b>	0.13 cfs / acre
<b>Design Storm:</b>	25-yr
<b>Proposed Inflow Runoff Coefficient:</b>	0.90
<b>Inflow Drainage Area (ac):</b>	0.95
<b>Allowable Release Rate (cfs):</b>	0.12

0.13 cfs / acre

Storm Duration		Intensity (in./hr)	Inflow Rate (cfs)	Outflow Rate (cfs)	Required Storage	
(min)	(hr)				(ac-ft)	(cft)
5	0.08	6.36	5.44	0.124	0.037	1607.6
10	0.17	5.58	4.77	0.124	0.065	2811.7
15	0.25	5.01	4.28	0.124	0.087	3775.2
20	0.33	4.44	3.80	0.124	0.102	4444.0
25	0.42	3.87	3.31	0.124	0.111	4817.8
30	0.50	3.30	2.82	0.124	0.112	4896.9
35	0.58	3.10	2.65	0.124	0.123	5347.9
40	0.67	2.90	2.48	0.124	0.131	5694.6
45	0.75	2.70	2.30	0.124	0.136	5937.0
50	0.83	2.49	2.13	0.124	0.139	6075.1
55	0.92	2.29	1.96	0.124	0.140	6108.9
60	1.00	2.09	1.79	0.124	0.139	6038.3