MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY
WATER RESOURCES DIVISION
MARCH 2017

STAFF REPORT

ROUGE RIVER CONTINUOUS MONITORING DISSOLVED OXYGEN STUDY IN AREAS UPSTREAM OF SEPARATED COMBINED SEWER OVERFLOWS WAYNE AND OAKLAND COUNTIES JUNE-AUGUST 2015

INTRODUCTION

The Rouge River is currently listed on the Michigan Department of Environmental Quality's (MDEQ) 2014 Section 303(d) list (Goodwin et al., 2014) for nonattainment of the minimum warmwater dissolved oxygen (DO) water quality standard (WQS) of 5.0 milligrams per liter (mg/l) during wet-weather events and/or critical periods during the summer months.

Past studies have shown sharp DO depressions due to easily oxidizable material discharged through Combined Sewer Overflows (CSO). The MDEQ contracted with LimnoTech to conduct in-stream DO monitoring from June 23 to August 26, 2015, at eight continuous monitoring sites (Table 1; Figure 1). The purpose of the monitoring was to determine whether the minimum DO WQS were met during significant wet-weather events near the segments where separations of CSOs had been completed.

The MDEQ selected monitoring sites (Figure 1) based on where the CSO controls (detention basins) were located, and therefore were most likely attaining the 5.0 mg/l DO WQS.

Table 1. Location of eight monitoring sites for the June-August 2015 DO study.

Site	Road	Location	Latitude	Longitude
1	Hannan Road	Lower Branch of Rouge River	42.2842	-83.4273
2	Henry Ruff Road	Lower Branch of Rouge River	42.2905	-83.3388
3	Inkster Road	Middle Branch of Rouge River	42.3485	-83.3123
4	Haggerty Road	Middle Branch of Rough River	42.3717	-83.4455
5	Power Road	Upper Branch of Rouge River (by Farmington Hills)	42.4617	-83.3667
6	Beech Road	Main Branch of Rouge River	42.4479	-83.2977
7	Maple Road	Main Branch of Rouge River (by Birmingham)	42.5455	-83.2248
8	Wattles Road	Main Branch of Rouge River (by Bloomfield Hills)	42.5761	-83.2003

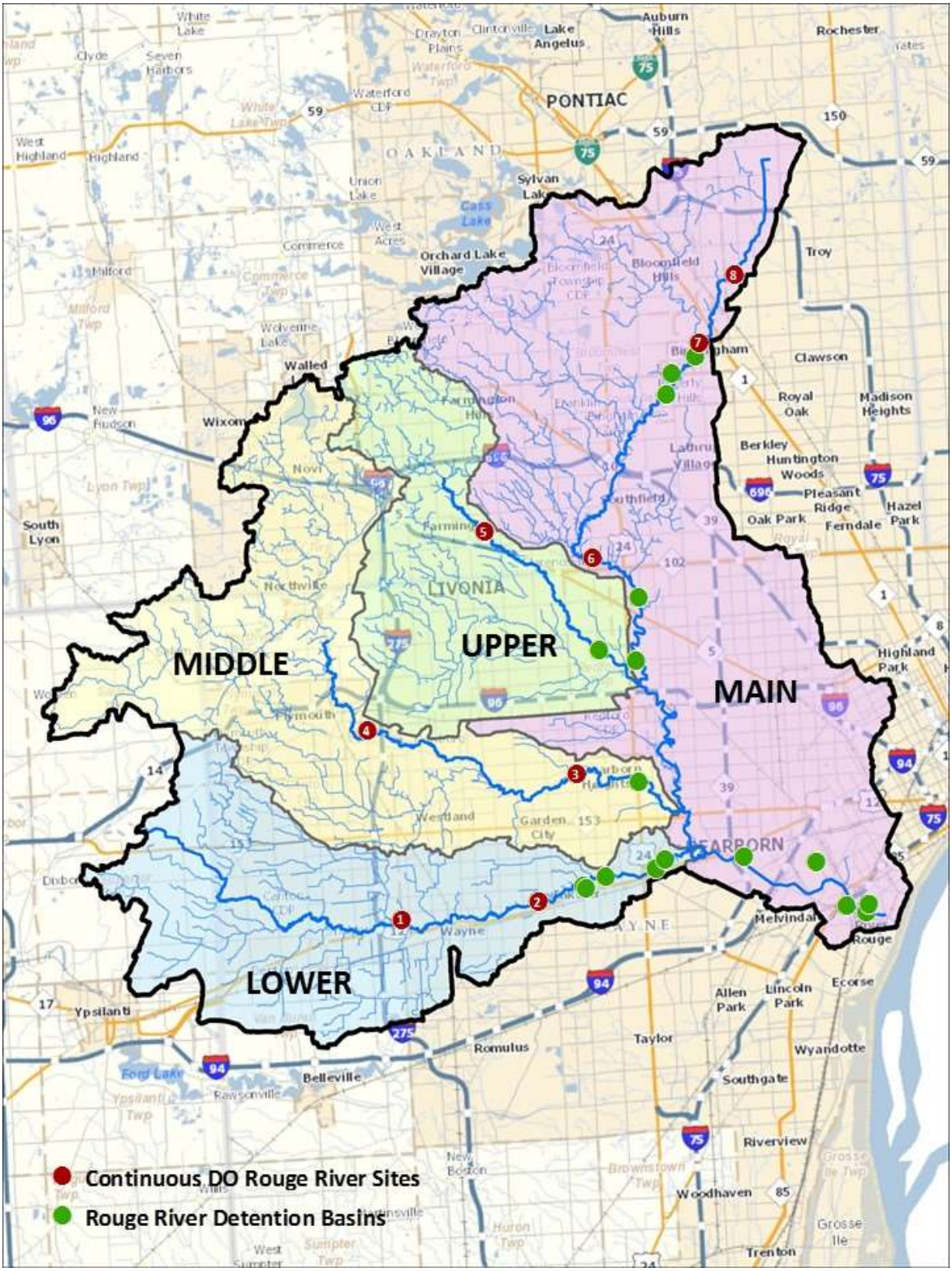

Figure 1. Continuous DO Monitoring Sites and Retention Basins in the Rouge River Watershed, June-August 2015.

The overall findings of the 2015 DO study are outlined below.

SUMMARY

1. The DO measured at Hannan Road (Site 1) varied from 5.22 to 9.0 mg/l. Diurnal variation of DO ranged from 0.05 to 1.26 mg/l. No warmwater DO WQS violations were recorded during the monitoring period.

2. The DO measured at Henry Ruff Road (Site 2) varied from 5.54 to 9.15 mg/l. Diurnal variation of DO ranged from 0.035 to 1.71 mg/l. No warmwater DO WQS violations were recorded during the monitoring period.

3. The DO measured at Inkster Road (Site 3) varied from 4.04 to 8.26 mg/l. Diurnal variation of DO ranged from 0.1 to 2.15 mg/l. One brief warmwater DO WQS violation occurred on July 30 over a 16-hour period. This would not be listed as a violation since less than 10% of the samples during the study period were less than the minimum 5.0 mg/l DO WQS.

4. The DO measured at Haggerty Road (Site 4) varied from 5.48 to 8.83 mg/l. Diurnal variation of DO ranged from 0.27 to 1.23 mg/l. No warmwater DO WQS violations were recorded during the monitoring period.

5. The DO measured at Power Road (Site 5) varied from 7.07 to 10.63 mg/l. Diurnal variation of DO ranged from 0.205 to 1.29 mg/l. No warmwater DO WQS violations were recorded during the monitoring period.

6. The DO measured at Beech Road (Site 6) varied from 5.27 to 9.36 mg/l. Diurnal variation of DO (daily average concentration minus daily minimum concentration) ranged from 0.084 to 1.29 mg/l. No warmwater DO WQS violations were recorded during the monitoring period.

7. The DO measured at Maple Road (Site 7) varied from 5.27 to 9.36 mg/l. Diurnal variation of DO ranged from 0.221 to 0.904 mg/l. No warmwater DO WQS violations were recorded during the monitoring period.

8. The DO measured at Wattles Road (Site 8) varied from 5.27 to 9.36 mg/l. Diurnal variation of DO ranged from 0.357 to 1.65 mg/l. No warmwater DO WQS violations were recorded during the monitoring period.

The largest diurnal variation (2.15 mg/l) was seen at the Inkster Road site where a large patch of debris in the river upstream of the monitoring location likely slowed the water and thereby may have decreased the DO.

HISTORICAL SAMPLING EFFORTS

The Rouge River has been the subject of several DO monitoring studies under the Rouge River National Wet Weather Demonstration Project (NWWDP) funded, in part, by United States Environmental Protection Agency grants. Yearly progress reports show the trends of various pollutants in the Rouge River.

One focus of the Rouge River NWWDP was on the control of CSOs in the watershed and evaluating progress regarding the separation of CSOs. CSO controls were initially consistent with the Bulkley agreement, achieved with the involvement of Federal Judge Feiken, and carried

out as required by National Pollutant Discharge Elimination System (NPDES) permits. Additional CSO controls over the last two decades have been established in NPDES permits. However, storm water runoff, discharges from illicit connections, and other sources continued to contribute to the degradation of the watershed. Sharp DO depressions occurred during large rain events due to easily oxidizable material that was discharged through CSOs, leading to impacts on fish and other aquatic resources.

In September-October 1994, the MDEQ conducted a continuous DO study on the Main Branch Rouge River (MDEQ, 1994). As predicted, large rain events severely depressed DO in the river. During the rain events, the DO fell to 1.1 mg/l in about 3.5 hours and did not recover for over 24 hours. The sharp declines in DO were believed to be caused by a combination of CSOs (from various jurisdictions), storm water, and/or resuspension into the water column of previously deposited material. In 1994, a Rouge River Storm Water Advisory group was formed to develop and guide the implementation of a cooperative strategy to restore the river throughout the watershed. This group was further subdivided, based on the size of the watershed, into different watershed advisory groups to develop a general storm water permit. In addition to the issuance of NPDES permits for CSOs as called for under the Bulkley agreement, the subwatershed plans identified other steps needed to address remaining problems associated with CSOs, sanitary sewer overflows, storm water, failing septic systems, and nonpoint sources. Coordination was accomplished through a watershed-wide steering committee called the Alliance of Rouge Communities (ARC) http://www.allianceofrougecommunities.com. ARC members in 2013 included 35 municipal governments (i.e., cities, townships, and villages), three counties (Wayne, Oakland, and Washtenaw), and colleges.

According to the 2013 Rouge River Progress Report, the Rouge River NWWDP has been, and continues to be, a success. Major progress has been made in the control of pollution being discharged to the Rouge River (Wayne County, 2013). CSO pollutant loads to the river have been cut by 90-100%.

Recent monitoring summarized in the 2013 Rouge River Progress Report suggests that DO values in the Upper, Lower, and the Middle Rouge River, and the upper half of the Main Rouge River have either remained the same, or improved. The lower half of the Main Rouge River has shown decreasing DO values. Since low DO is evident during wet-weather events and critical conditions in the summer, this study was conducted with the objective of capturing at least two summer wet-weather events. Wet weather is defined as 0.25 inches or greater of precipitation within 24 hours. The intent was to collect a variety of critical weather events, including dry baseflow conditions, large individual rain events, and cumulative large rain events in the summer to determine if the Rouge River can meet the warmwater WQS in all conditions.

FIELD METHODS AND OBSERVATIONS

A Quality Assurance Project Plan (QAPP) was approved for the continuous monitoring project (Appendix A [available upon request]).

EXO YSI sondes (Figure 2) were used at all eight sites and for the side-by-sides (grab samples) by LimnoTech. All continuous sondes were placed close to mid-stream to capture uniform flow across a cross section. Coordinates of all sites were obtained on-site using the World Geodetic System 1984 coordinate system. Latitude and longitude coordinates were recorded. As outlined in the QAPP, the objective of the study was to assess the Rouge River's compliance with the warmwater DO WQS and, if possible, delist portions that have had significant improvement and now meet the 5.0 mg/l minimum WQS.

Figure 2. EXO YSI sondes.

Data were collected consistent with the QAPP, which outlined accuracy, precision, representativeness, and reliability of the data. The sondes were calibrated on a weekly basis when the data were downloaded. All calibration readings followed the manufacturer's specifications for both the MDEQ and LimnoTech grab sampling. The accuracy of the data was verified (Appendix B [available upon request]) based on the fact that all calibrations were within 10% of the expected value. The data were representative of site conditions due to the number of samples and how extensive the study was. There were thousands of sampling points at each location. For quality control purposes, data were compared by recording grab samples throughout the study. The MDEQ and LimnoTech made several trips to collect grab samples at the sites. The average difference between the continuous sondes and the hand-held sondes at each site was 0.5 mg/l or less; the maximum difference at any visit was < 0.88 mg/l.

RESULTS

The overall results of the study show that DO levels went below the 5.0 mg/l minimum WQS only once at one site for a period of 16 hours (Figure 3) over the entire 9-week monitoring period. The raw data is reported in Appendix C (available upon request). That dip in the DO was not after a rain event, and sites upstream and downstream did not exhibit this same dip below the 5.0 minimum WQS. This was the only exception; all other sites met the warmwater WQS 100% of the time during the entire study.

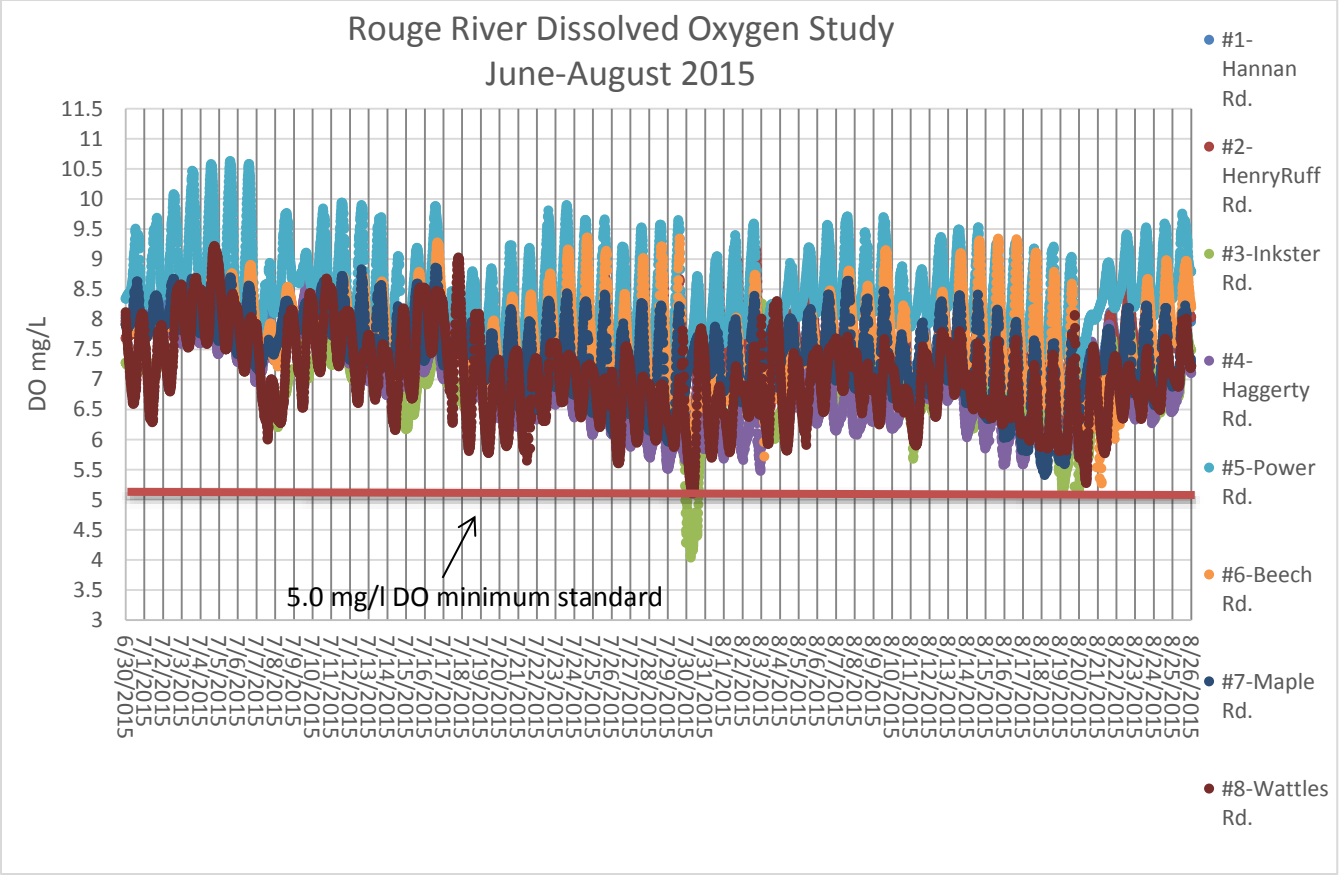

Figure 3. Trend Analysis of the Rouge River Dissolved Oxygen Data (All Eight Sites).

The sondes were originally installed on the afternoon of June 23. Due to a heavy rain event, several sondes recorded intermittently and had to be physically moved so they were not out of the water after the rain subsided. From June 23 to June 30, there were no violations of the 5.0 mg/l minimum DO WQS at any of the eight sites. The data seemed to stabilize and complete readings were recorded around June 30. The data presented in the figures in this report begin on June 30, 2015.

Figure 4 displays DO for the Hannan Road (Site 1) continuous monitoring station. The triangles are grab samples measured by the MDEQ and the circles are grab samples measured by LimnoTech. The minimum DO recorded throughout the entire study period is 6.14 mg/l at 21.4°C (59.1% saturation) on June 23 at 10:30 a.m. The maximum DO level from the study period is 8.5 mg/l at 21.0°C (95.4% saturation) on July 6 at 4:00 p.m. No warmwater DO WQS violations were recorded during the 9-week monitoring period.

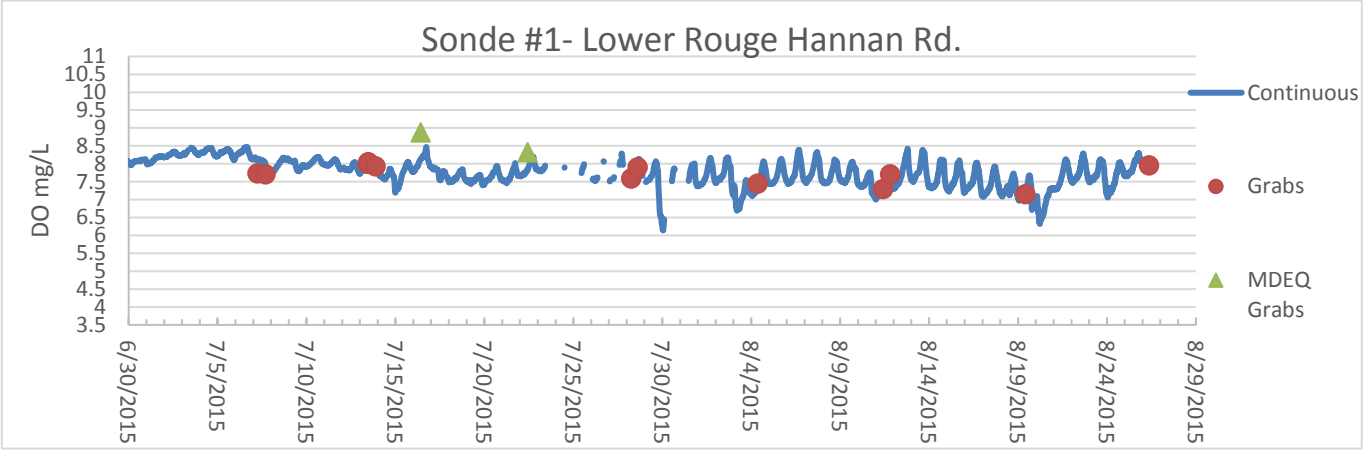

Figure 4. Continuous Data on the Lower Rouge at Hannan Road.

Figure 5 displays DO for the Henry Ruff Road (Site 2) continuous monitoring station. The minimum DO recorded throughout the entire study period is 5.5 mg/l at 21.8°C (63.3% saturation) on July 30 at 9:30 a.m. and the maximum DO level from the study period is 9.2 mg/l at 22.8°C (106.5% saturation) on August 2 at 5:30 p.m. No warmwater DO WQS violations were recorded during the 9-week monitoring period.

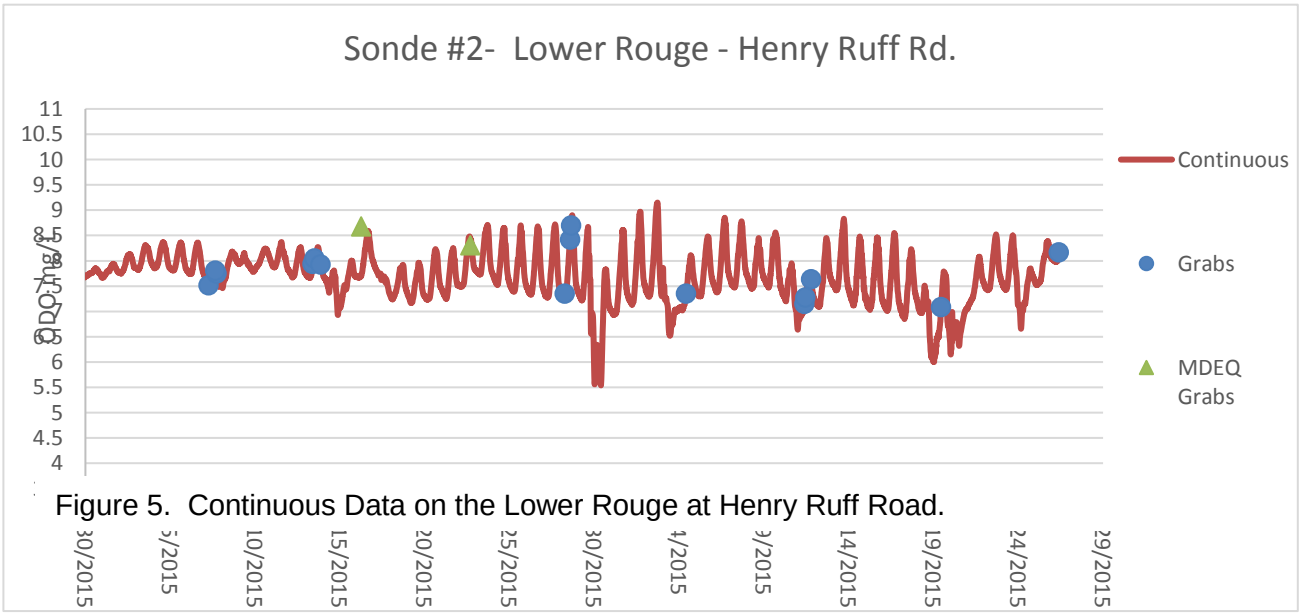

Figure 5. Continuous Data on the Lower Rouge at Henry Ruff Road.

Figure 6 displays DO for the Inkster Road (Site 3) continuous monitoring station. The minimum DO recorded throughout the entire study period is 4.0 mg/l at 25.3°C (49.3% saturation) on July 30 at 5:30 a.m. and the maximum DO level from the study period is 8.3 mg/l at 20.7°C (92.2% saturation) on August 3 at 1:15 a.m. The DO readings below the 5.0 WQS occurred over a period of 16 hours starting at 10:45 p.m. on July 29 until 3:15 p.m. on July 30. It should be noted there was a large amount of floating debris upstream of the Inkster Road site that could get dislodged during a wet-weather event and disrupt the reading (Figure 7).

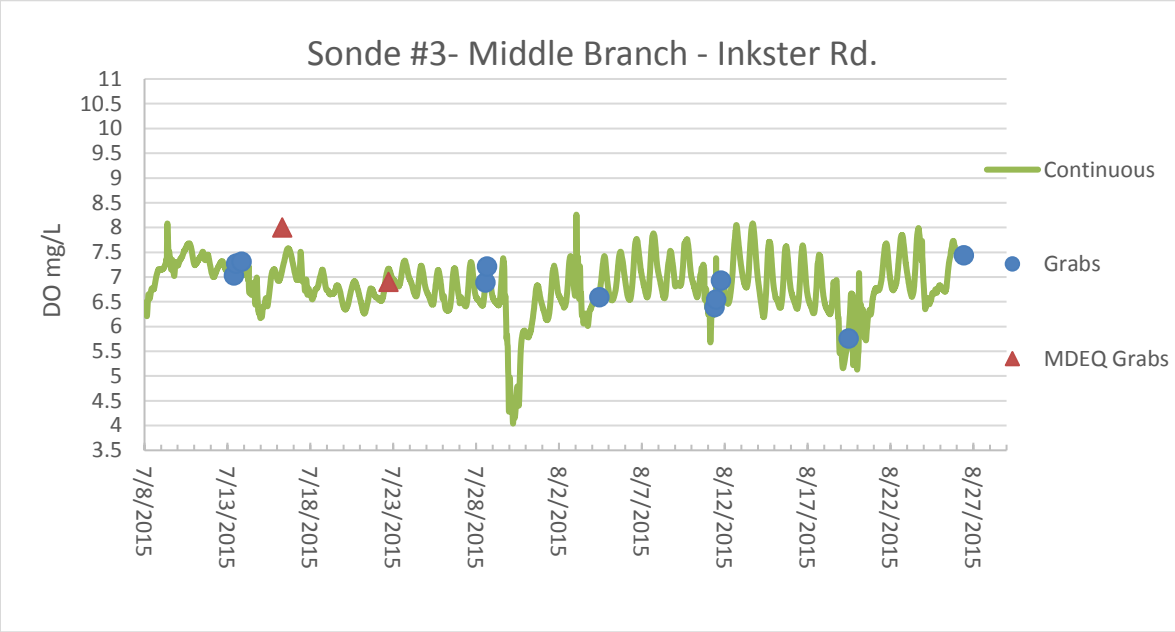

Figure 6. Continuous Data on the Middle Rouge at Inkster Road.

Figure 7. Inkster Road Debris.

Figure 8 displays DO for Haggerty Road (Site 4) continuous monitoring station. The minimum DO recorded throughout the entire study period is 5.5 mg/l at 25.4°C (67% saturation) on August 2 at 11:00 p.m. and the maximum DO level from the study period is 8.8 mg/l at 19.9°C (97.1 % saturation) on July 10 at 1:15 p.m. No warmwater DO WQS violations were recorded during the 9-week monitoring period.

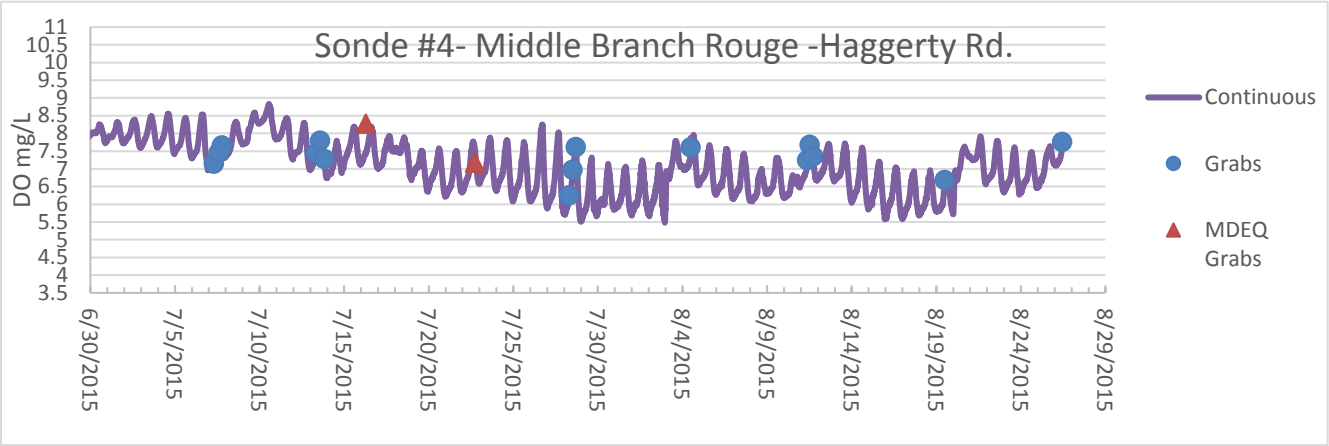

Figure 8. Continuous Data on the Middle Rouge at Haggerty Road.

Figure 9 displays D.O for Power Road (Site 5) continuous monitoring station. The minimum DO recorded throughout the entire study period is 7.1 mg/l at 23.4°C (83.4% saturation) on July 25 at 8:15 p.m. and the maximum DO level from the study period is 10.6 mg/l at 19.4°C (116.1% saturation) on July 5 at 2:00 p.m. No warmwater DO WQS violations were recorded during the 9-week monitoring period.

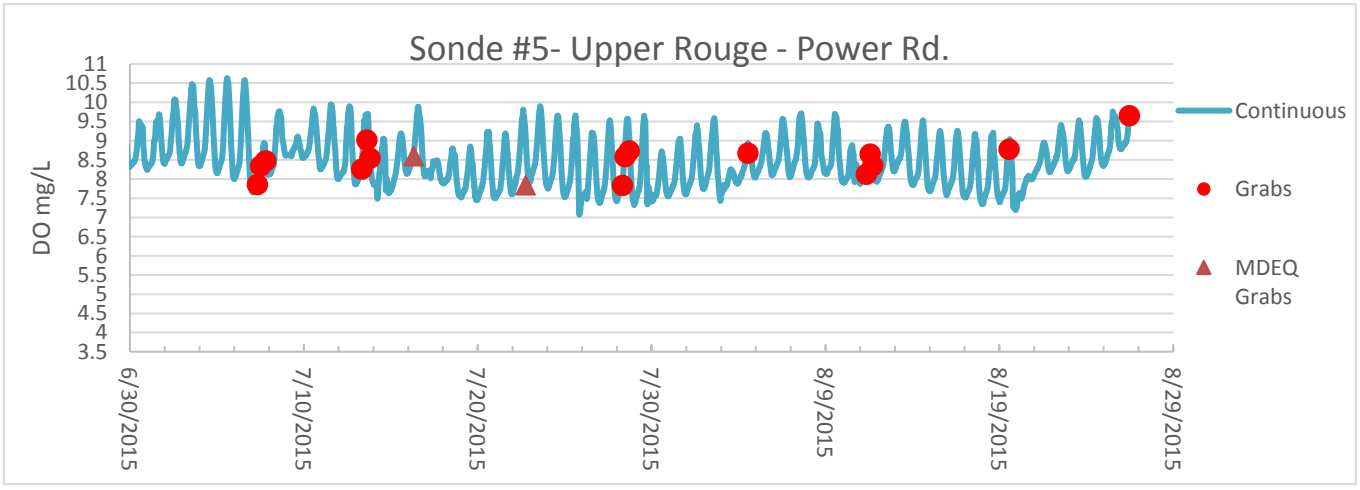

Figure 9. Continuous data on the Upper Rouge at Power Road.

Figure 10 displays DO for the Beech Road (Site 6) continuous monitoring station. The minimum DO recorded throughout the entire study period is 5.3 mg/l at 21.1°C (59.4% saturation) on August 21 at 5:15 a.m. and the maximum DO level from the study period is 9.4 mg/l at 23.2°C (110.1% saturation) on July 24 at 4:30 p.m. No warmwater DO WQS violations were recorded during the 9-week monitoring period.

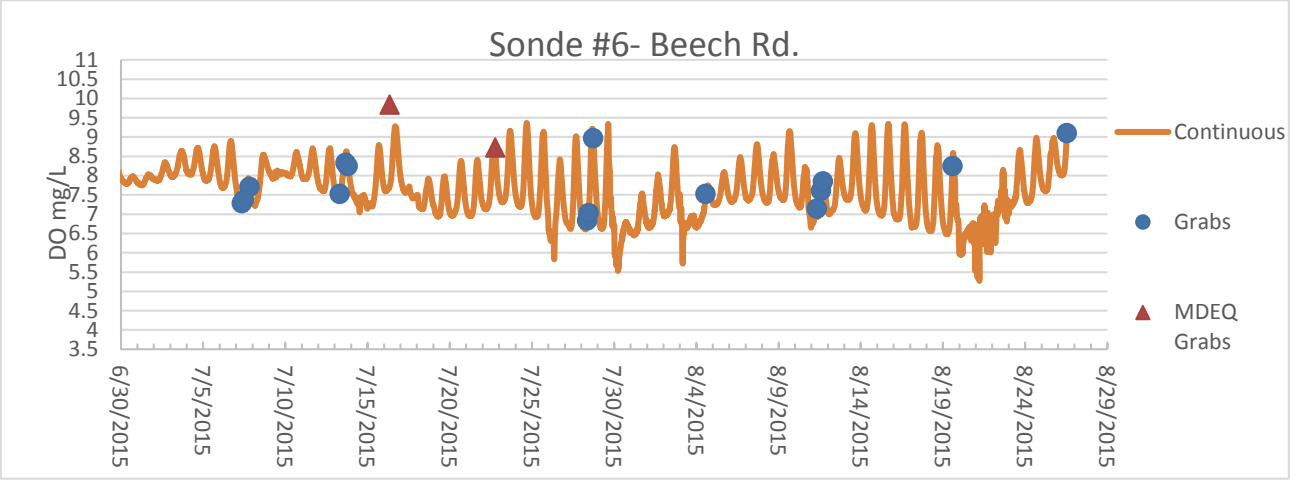

Figure 10. Continuous Data on Beech Road.

Figure 11 displays DO for the Maple Road (Site 7) continuous monitoring station. The minimum DO recorded throughout the entire study period is 5.4 mg/l at 24.9°C (65.7% saturation) on August 18 at 4:00 a.m. and the maximum DO level from the study period is 8.9 mg/l at 21.3°C (100.3% saturation) on July 16 at 1:45 p.m. No warmwater DO WQS violations were recorded during the 9-week monitoring period.

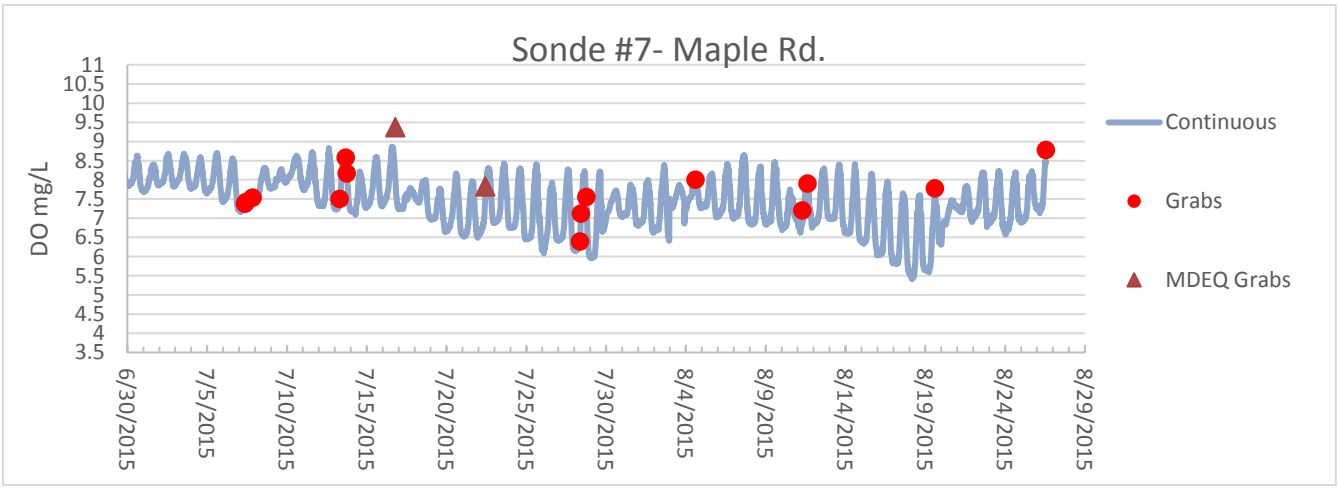

Figure 11. Continuous Data on Maple Road.

Figure 12 displays DO for the Wattles Road (Site 8) continuous monitoring station. The minimum DO recorded throughout the entire study period is 5.1 mg/l at 22.9°C (59.6% saturation) on July 30 at 7:45 a.m. and the maximum DO level from the study period is 9.6 mg/l at 21.5°C (109.3% saturation) on July 28 at 8:15p.m. No warmwater DO WQS violations were recorded during the 9-week monitoring period.

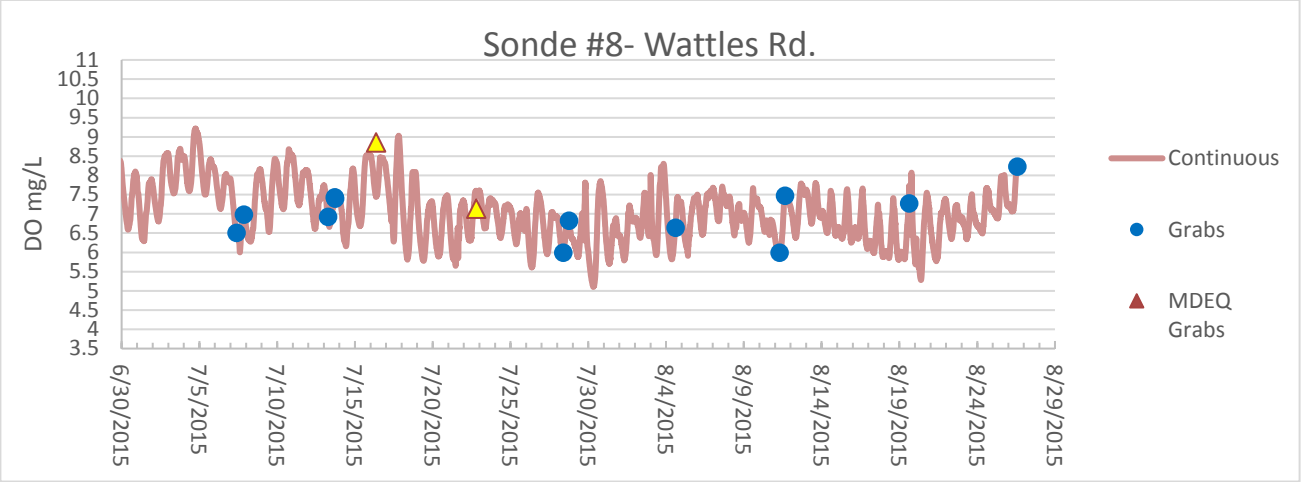

Figure 12. Continuous Data on Wattles Road.

In addition to the continuous DO data, precipitation data were collected from the United States Geological Survey (USGS) (http://waterdata.usgs.gov/mi/nwis/current/?type=precip) at gage 422239083032401 (Appendix D). Twelve rain events were captured that were over 0.25 inches in 24 hours (the designated precipitation required in the study to qualify as a rain event). These rain events occurred on June 23, June 27, July 9, July 17, July 25, July 29, August 2, August 3, August 10, August 19, August 20, and August 23 (Figure 13).

The largest precipitation event, which occurred August 2-3, 2015, did not result in the lowest DO as shown in Figure 13, nor was it followed by a subsequent large dip in DO. This suggests that hot, dry weather during the critical low flow summer months are affecting the DO as much as wet-weather events in reaches where CSO controls have been implemented. A list of current CSO basins is located in Appendix E. Sharp DO depressions are still likely occurring in the remaining CSO-dominated areas of the Main and parts of the Lower branches of the Rouge River. Work should be continued on these areas to improve water quality.

The DO study conducted throughout the summer months of 2015 verified that the Rouge River, in the areas where CSO separations have been completed, is now in attainment with the 5.0 mg/l minimum DO WQS.

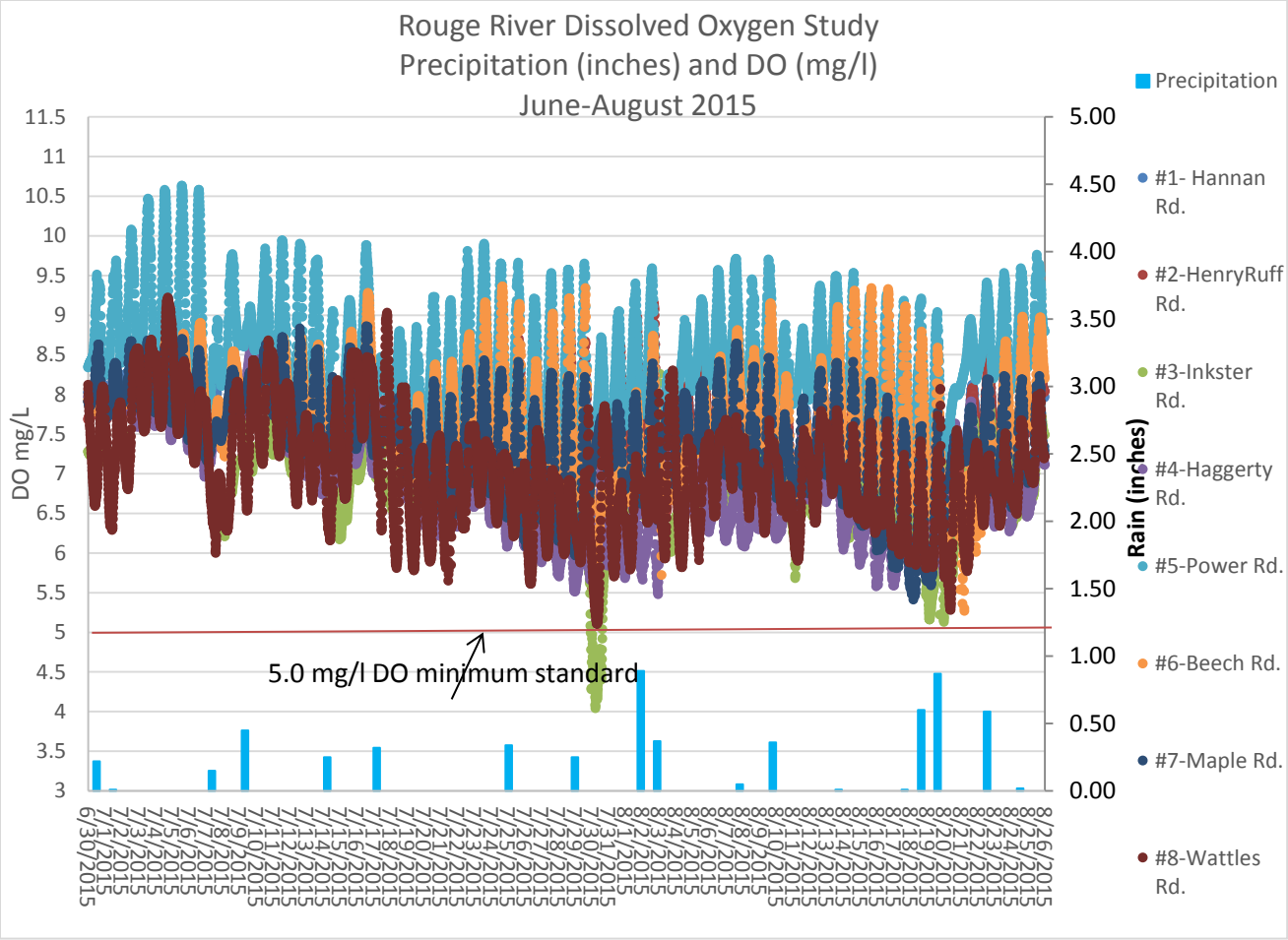

Figure 13. Continuous DO Data with Precipitation Values.

REFERENCES

Goodwin, K., S. Noffke, and J. Smith. 2014. Water Quality and Pollution Control in Michigan 2014 Sections 303(d), 305(b), and 314 Integrated Report. DEQ Staff Report #MI/DEQ/WRD-14/001.

MDEQ. 1994. Continuous Dissolved Oxygen Monitoring of the Rouge River at Greenfield Road (September 14-October 10, 1994), Wayne County. MDEQ Staff Report #MI/DEQ/SWQ-97/022.

Wayne County. 2013. Rouge River National Wet Weather Demonstration Project. 2013 Rouge River Progress Report. http://www.waynecounty.com/doe/rouge/index.htm.

Appendix D. Precipation Data Collected from the U.S. Geological Survey Gage 422239083032401.

Date		Rain Event (inches)
6/30/2015	0.22	0.22[P]
7/1/2015	0.01	0.01[P]
7/2/2015	0.00	0.00[P]
7/3/2015	0.00	0.00[P]
7/4/2015	0.00	0.00[P]
7/5/2015	0.00	0.00[P]
7/6/2015	0.00	0.00[P]
7/7/2015	0.15	0.15[P]
7/8/2015	0.00	0.00[P]
7/9/2015	0.45	0.45[P]
7/10/2015	0.00	0.00[P]
7/11/2015	0.00	0.00[P]
7/12/2015	0.00	0.00[P]
7/13/2015	0.00	0.00[P]
7/14/2015	0.25	0.25[P]
7/15/2015	0.00	0.00[P]
7/16/2015	0.00	0.00[P]
7/17/2015	0.32	0.32[P]
7/18/2015	0.00	0.01[P]
7/19/2015	0.00	0.00[P]
7/20/2015	0.00	0.00[P]
7/21/2015	0.00	0.00[P]
7/22/2015	0.00	0.00[P]
7/23/2015	0.00	0.00[P]
7/24/2015	0.00	0.00[P]
7/25/2015	0.34	0.34[P]
7/26/2015	0.00	0.00[P]
7/27/2015	0.00	0.00[P]
7/28/2015	0.00	0.00[P]
7/29/2015	0.25	0.25[P]
7/30/2015	0.00	0.00[P]
7/31/2015	0.00	0.00[P]
8/1/2015	0.00	0.00[P]
8/2/2015	0.89	0.89[P]
8/3/2015	0.37	0.37[P]
8/4/2015	0.00	0.00[P]
8/5/2015	0.00	0.00[P]
8/6/2015	0.00	0.00[P]
8/7/2015	0.00	0.00[P]
8/8/2015	0.05	0.05[P]
8/9/2015	0.00	0.00[P]

Appendix D. Precipation Data Collected from the U.S. Geological Survey Gage 422239083032401.

Date		Rain Event (inches)
8/10/2015	0.36	0.36[P]
8/11/2015	0.00	0.00[P]
8/12/2015	0.00	0.00[P]
8/13/2015	0.00	0.00[P]
8/14/2015	0.01	0.01[P]
8/15/2015	0.00	0.00[P]
8/16/2015	0.00	0.00[P]
8/17/2015	0.00	0.00[P]
8/18/2015	0.01	0.01[P]
8/19/2015	0.60	0.60[P]
8/20/2015	0.87	0.87[P]
8/21/2015	0.00	0.00[P]
8/22/2015	0.00	0.00[P]
8/23/2015	0.59	0.59[P]
8/24/2015	0.00	0.00[P]
8/25/2015	0.02	0.02[P]
8/26/2015	0.00	0.00[P]

Appendix E. CSO Retention Basins.

CSO Retention Basin	Latitude	Longitude
Birmingham CSO RTB	42.539444	-83.227777
Bloomfield Hills CSO RTB	42.531666	-83.24306
Hubbell-Southfield RTB	42.30806	-83.20667
Puritan/Fenkell CSO RTB	42.39972	-83.27194
Seven Mile CSO RTB	42.42889	-83.26917
Oakwood RTB	42.283611	-83.141944
Inkster-Dearborn Hts CSO RTB	42.300833	-83.295833
Oakland Co-Acacia Park	42.521944	-83.246666
River Rouge CSO RTB	42.28056	-83.12944
Baby Creek Screening and Disinfection Facility	42.28417	-83.12806
Wayn Co/Inkster CSO RTB (MI0051471) - West	42.296979	-83.310093
Wayn Co/Inkster CSO RTB (MI0051471) - East	42.296067	-83.308444
Dearborn CSO (MI0025542)	42.30444	-83.16028
Wayne Co/Dearborn Heights CSO RTB (MI0051489)	42.34388	-83.273055
Dearborn CSO 006 (MI0025542)	42.30389	-83.26333
Dearborn CSO 008 (MI0025542)	42.30778	-83.25722
Wayne Co/RDFrd/Livonia CSO RTB (MI0051535)	42.40538	-83.295