Michigan Department of Environmental Quality
Water Bureau
August 2007

Total Maximum Daily Load for Dissolved Oxygen for Johnson Creek Wayne and Washtenaw Counties

INTRODUCTION

Section 303(d) of the federal Clean Water Act and the United States Environmental Protection Agency's (USEPA's) Water Quality Planning and Management Regulations (Title 40 of the Code of Federal Regulations, Part 130) require states to develop Total Maximum Daily Loads (TMDLs) for water bodies that are not meeting water quality standards (WQS). The TMDL process establishes the allowable loadings of pollutants for a water body based on the relationship between pollution sources and in-stream water quality conditions. TMDLs provide states a basis for determining the pollutant reductions necessary from both point and nonpoint sources to restore and maintain the quality of their water resources. The purpose of this TMDL is to identify the allowable levels of oxygen demanding pollutants so that the coldwater dissolved oxygen (D.O.) standard of 7 milligrams per liter (mg/l) as a minimum can be met in Johnson Creek.

Johnson Creek is the only designated trout stream in the Rouge River watershed and in Wayne County. The watershed is a mix of agricultural, low and medium density residential, industrial, and commercial land use. The channel has historically been highly modified through past drainage projects. Dredge spoils can be seen along the banks at numerous locations along the watercourse. In most cases the banks are now wooded indicating that the most recent dredging was decades ago. A map of the watershed is presented in Figure 1.

Based on miscellaneous flow measurements and long-term stream flow records on area gages, the low flow statistics have been estimated for several locations on the stream and are presented in Appendix A. These statistics indicate that the lower part of the watershed starting at Salem Road (drainage area of 11 square miles) has a much higher base flow than the upper watershed.

PROBLEM STATEMENT

The TMDL reach for Johnson Creek appears on the Section 303(d) list as:

Johnson Creek WBID#: 061304I
County: Wayne/ Washtenaw Size: 7 Miles
Location: From the confluence with the Walled Lake Branch upstream to 5 Mile Rd. West of Currie Rd.
NHD Reach Code: 04090004000067
Problem Summary: Dissolved Oxygen
TMDL YEAR(s): 2007

Johnson Creek was placed on the 2006 Section 303(d) list (Edly and Wuycheck, 2006) due to measured D.O. values at multiple locations on multiple days that are less than the standard of 7 mg/l as a minimum. During initial analysis of this reach it became apparent that the level of pollutant reduction needed to meet the 7 mg/l D.O. standard throughout the stream reach was unachievable due to extremely low stream flow characteristics under drought conditions. Therefore, this reach of river will be divided into two reaches. The first reach will be two miles long and extends from the confluence with the Walled Lake Branch of the Rouge River upstream to 6 Mile Road. This TMDL will prescribe loads to meet the D.O. standard in this reach. The second reach will be 9.4 miles long and extend from 6 Mile Road upstream to the 5 Mile Road crossing upstream of Currie Road. Note that while this TMDL addresses only the lower reach of Johnson Creek, loadings of oxygen demanding substances from the upper reach must also be considered in the TMDL development and are further discussed in the Data Discussion section.

The upper part of the watershed (upstream of Napier Road), although designated for the protection of coldwater fish, has a flow yield of only 0.01 cubic feet per second (cfs) per square mile at the lowest monthly 95 percent exceedance flow (Appendix A). Southeastern Michigan trout streams typically have low flow yields of 0.03 to 0.16 cfs at the lowest monthly 95 percent exceedance flow. The extremely low flow yields upstream of Napier Road contribute to the D.O. problem by reducing stream flow velocity and reaeration in the reach. The resulting wide and shallow characteristics at low flow, further contributes to the D.O. demand from the suspended solids on the stream bottom. The lack of flow is not an issue that can be addressed by a TMDL.

When the Section 303(d) list is updated in 2008, the Johnson Drain listing will be split as described above with the upstream reach rescheduled for a TMDL at a future date. This will allow sufficient time to evaluate flow conditions and model assumptions in more detail and to determine whether portions of the upstream reach of river are appropriately designated for coldwater fish protection.

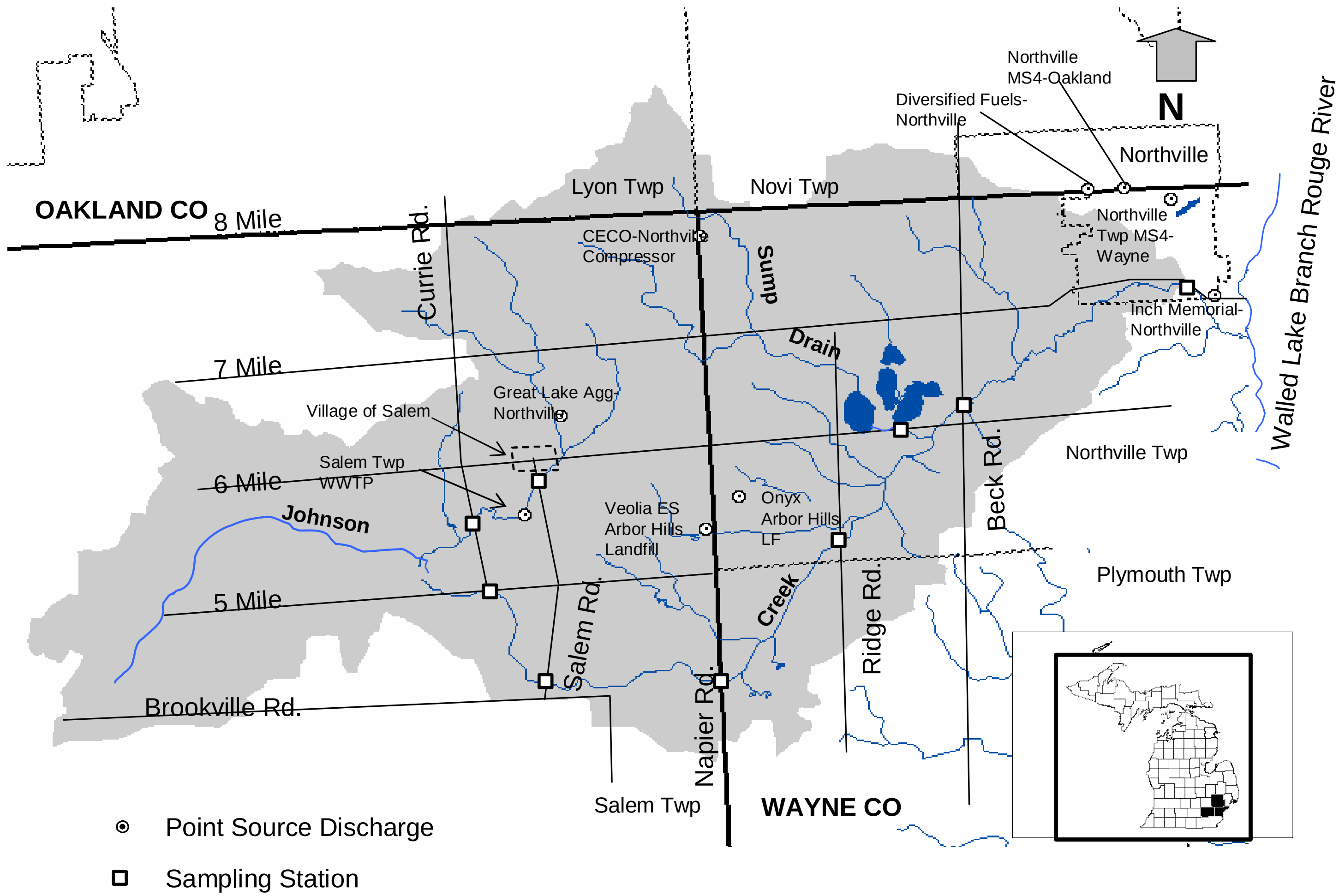

Figure1. Johnson Creek Watershed, Oakland, Washtenaw, and Wayne Counties.

NUMERIC TARGET

The D.O. rule (R 323.1064 (1) of the Part 4 rules, WQS, promulgated under Part 31, Water Resources Protection, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended (NREPA)) states, in part, that “a minimum of 7 mg/l of dissolved oxygen shall be maintained at all times in all inland waters designated by these rules to be protected for coldwater fish.” Johnson Creek and all of its tributaries are protected for coldwater fish because it appears on the designated trout stream list established by the Department of Natural Resources, Director’s Order No. DFI-101.97. However, as stated in the Problem Statement section of this document, this TMDL will determine pollutant loads needed to meet the coldwater stream D.O. standard only in the lower reach of river downstream from 6 Mile Road.

The D.O. WQS is defined as follows:

> R 323.1064 Dissolved oxygen in Great Lakes, connecting waters, and inland streams.
> Rule 64. (1) A minimum of 7 milligrams per liter of dissolved oxygen in all Great Lakes and connecting waterways shall be maintained, and, except for inland lakes as prescribed in R 323.1065, a minimum of 7 milligrams per liter of dissolved oxygen shall be maintained at all times in all inland waters designated by these rules to be protected for coldwater fish. In all other waters, except for inland lakes as prescribed by R 323.1065, a minimum of 5 milligrams per liter of dissolved oxygen shall be maintained. These standards do not apply for a limited warmwater fishery use subcategory or limited coldwater fishery use subcategory established pursuant to R 323.1100(11) or during those periods when the standards specified in subrule (2) of this rule apply.
> (2) Surface waters of the state which do not meet the standards set forth in subrule (1) of this rule shall be upgraded to meet those standards. The department may issue permits pursuant to R 323.2145 which establish schedules to achieve the standards set forth in subrule (1) of this rule for point source discharges to surface waters which do not meet the standards set forth in subrule (1) of this rule and which commenced discharge before December 2, 1986. For point source discharges which commenced before December 2, 1986, the dischargers may demonstrate to the department that the dissolved oxygen standards specified in subrule (1) of this rule are not attainable through further feasible and prudent reductions in their discharges or that the diurnal variation between the daily average and daily minimum dissolved oxygen concentrations in those waters exceeds 1 milligram per liter, further reductions in oxygen consuming substances from such discharges will not be required, except as necessary to meet the interim standards specified in this subrule, until comprehensive plans to upgrade these waters to the standards specified in subrule (1) of this rule have been approved by the department and orders, permits, or other actions necessary to implement the approved plans have been issued by the department. In the interim, all of the following standards apply:
> (a) For surface waters of the state designated for use for coldwater fish, except for inland lakes as prescribed in R 323.1065, the dissolved oxygen shall not be lowered below a minimum of 6 milligrams per liter at the design flow during the warm weather season in accordance with R 323.1090(2) and (3). At the design flows during other seasonal periods, as provided in R 323.1090(3), a minimum of 7 milligrams per liter shall be maintained. At flows greater than the design flows, dissolved oxygen shall be higher than the respective minimum values specified in this subdivision.
> (b) For surface waters of the state designated for use for warmwater fish and other aquatic life, except for inland lakes as prescribed in R 323.1065, the dissolved oxygen shall not be lowered below a minimum of 4 milligrams per liter, or below 5 milligrams per liter as a daily average, at the design flow during the warm weather season in accordance with
> R 323.1090(3) and (4). At the design flows during other seasonal periods as provided in

R 323.1090(3), a minimum of 5 milligrams per liter shall be maintained. At flows greater than the design flows, dissolved oxygen shall be higher than the respective minimum values specified in this subdivision.

(c) For surface waters of the state designated for use for warmwater fish and other aquatic life, but also designated as principal migratory routes for anadromous salmonids, except for inland lakes as prescribed in R 323.1065, the dissolved oxygen shall not be lowered below 5 milligrams per liter as a minimum during periods of migration.

(3) The department may cause a comprehensive plan to be prepared to upgrade waters to the standards specified in subrule (1) of this rule taking into consideration all factors affecting dissolved oxygen in these waters and the cost effectiveness of control measures to upgrade these waters and, after notice and hearing, approve the plan. After notice and hearing, the department may amend a comprehensive plan for cause. In undertaking the comprehensive planning effort the department shall provide for and encourage participation by interested and impacted persons in the affected area. Persons directly or indirectly discharging substances which contribute towards these waters not meeting the standards specified in subrule (1) of this rule may be required after notice and order to provide necessary information to assist in the development or amendment of the comprehensive plan. Upon notice and order, permit, or other action of the department, persons directly or indirectly discharging substances which contribute toward these waters not meeting the standards specified in subrule (1) of this rule shall take the necessary actions consistent with the approved comprehensive plan to control these discharges to upgrade these waters to the standards specified in subrule (1) of this rule.

This TMDL will be considered the comprehensive plan for this reach.

DATA DISCUSSION

Available D.O. data for Johnson Creek include a summer 2000 study by the Michigan Department of Environmental Quality (MDEQ) (Trapp, 2002) and data from the Rouge River National Wet Weather Demonstration Project (RRNWWDP), which is available on the Web at http://www.waynecounty.com/doe/rouge-river-project.htm. Both data sources demonstrate D.O. values less than the standard of 7 mg/l at multiple locations and on multiple days in the watershed. The available D.O. data for Johnson Creek and tributaries to Johnson Creek are summarized in Table 1.

In July 2000, the MDEQ monitored D.O. and temperature continuously at Salem Road for 13 days. For all but 1 day, the minimum D.O. was less than 7 mg/l. The period monitored included wet and dry weather although weather did not appear to substantially affect D.O. except for a possible tendency for the D.O. to be higher after a heavy rain, which substantially increased flow in the stream. The lowest D.O. recorded was 5.1 mg/l. Twelve grab samples were also collected at 4 additional locations both upstream and downstream of Salem Road on 4 different days and analyzed for D.O. Six of the 12 samples were less than 7 mg/l with the minimum being 5.6 mg/l, which was recorded at the most upstream station in the watershed (in the unnamed creek flowing from the village of Salem). This station is upstream of all point sources and upstream from the village of Salem.

The RRNWWDP has collected D.O. data on Johnson Creek including continuously monitored stations at Salem Road and at 7 Mile Road near the mouth of Johnson Creek with over 43,000 hourly observations recorded at 7 Mile Road from 1994-2001 (although all but 42 values were collected from 1994 to 1996). An additional 50 grab samples were collected at 7 different locations from 1998 through 2001.

The continuous data at 7 Mile Road demonstrated compliance with the 7 mg/l standard for all but 1 observation in 1994 and 1996. In 1995, 93 percent of the hourly observations were greater than 7 mg/l with the minimum observed D.O. at 7 Mile Road being 6 mg/l. From 1997 to 2001, 2 of the 42 values were less than 7 mg/l. Even though the data spanned an 8-year period, no trends could be discerned because of the uneven distribution of data in time and because exceedances of the 7 mg/l standard occurred throughout this time period indicating no apparent change. In addition, although the D.O. values observed were strongly correlated to temperature because of saturation values being influenced by temperature, there was no apparent influence from wet weather on the observed values less than 7 mg/l.

Table 1. Summary of D.O. Data from Johnson Creek and its Tributaries.

Collecting Agency	Location	Period of Record (mm/yr – mm/yr)	Number of Observations	Minimum (mg/l)	Average (mg/l)	% less than 7 mg/l
DEQ	Tributary at Salem Rd.	07/00 – 08/00	3	5.6	6.6	66%
RRNWWDP	Tributary at Currie Rd.	06/01 – 10/01	4	5.5	6.4	50%
RRNWWDP	Currie Rd.	09/98 – 09/98	1	2.6	2.6	100%
DEQ	Salem Rd.	07/00 – 08/00	838	5.1	6.7	56%
RRNWWDP	Salem Rd.	06/98 – 09/98	2	8.5	8.8	0%
RRNWWDP	Napier Rd.	06/01 – 10/01	5	5.0	6.0	100%
DEQ	Ridge Rd.	07/00 – 07/00	2	6.8	6.9	100%
RRNWWDP	Ridge Rd.	06/98 – 11/01	34	4	7.3	41%
DEQ	6 Mile Rd.	07/00 – 08/00	3	6.2	6.8	33%
RRNWWDP	6 Mile Rd.	06/98 – 09/98	2	8.3	8.9	0%
DEQ	Beck Rd.	07/00 – 08/00	4	6.5	7.7	25%
RRNWWDP	Sump Drain at 6 Mile Rd.	08/01 – 10/01	2	5.4	6.9	50%
RRNWWDP	7 Mile Rd.	04/94 – 11/01	43,895	6.0	9	3%

Of 50 grab samples collected by the RRNWWDP from 1998 to 2001, 22 were less than 7 mg/l of D.O., 10 were less than 6 mg/l of D.O., and 3 were less than 5 mg/l of D.O. with the minimum observed being 2.6 mg/l at Currie Road in the upper part of the watershed.

Collectively these data show a pattern of intermittent but persistently recurring periods of D.O. less than the standard of 7 mg/l with a tendency for the lowest values being in the upper part of the watershed where stream flows and flow yields (flow per unit area) are lowest. Based on a comparison between wet and dry weather D.O. measurements at the 7 mile Road station and at the Salem Road station, there appear to be no wet weather D.O. sags occurring in the watershed following rainfall events. These two stations were the locations where data were collected hourly over multiple days. Values less than 7 mg/l were recorded at both stations, but these low D.O. values occurred during both wet and dry weather.

The diurnal variation in D.O. concentration gives an indication of the density of aquatic plants in Johnson Creek and can be an important consideration in D.O. models. The diurnal D.O. variation in Johnson Creek can be evaluated at two stations (Salem Road and 7 Mile Road) where continuous measurements (hourly) were made. The diurnal variation in this analysis is defined as the daily average minus daily minimum concentration. At Salem Road the diurnal variation during the monitoring period (July-August 2000) varied between 0.4 and 0.9 mg/l and averaged 0.6 mg/l. At 7 Mile Road the diurnal variation during the summer low flow period (June-August of 1994-1996) varied between 0.2 and 1.4 mg/l with an average of 0.6 mg/l.

Other water chemistry data were also collected during the MDEQ survey of 2000 and the RRNWWDP sampling. These data will be useful for determining nonpoint source loads of carbonaceous biochemical oxygen demand (CBOD) and ammonia.

LINKAGE BETWEEN D.O. AND POLLUTANTS

Factors, which deplete oxygen in Johnson Creek include the following:

1. CBOD, which is a measure of the amount of oxidizable organic matter in a sample of water.
2. Nitrogenous Oxygen Demand is a measure of nitrogenous material, which is oxidizable and is primarily in the form of ammonia.
3. Sediment oxygen demand (SOD), which is the oxidation of organic material on the stream bottom.
4. Plant respiration, which is the oxidative process by which energy-rich molecules such as glucose are converted into the energy needed to sustain the life of a plant.

CBOD and ammonia from point sources directly exert a D.O. demand on Johnson Creek. SOD and plant respiration are D.O. demands that are created indirectly by loads of suspended solids and nutrients respectively. SOD is created by loads of oxygen demanding suspended solids that are usually delivered to the stream during runoff after which they settle and concentrate on the stream bottom and exert their oxygen demand at a more or less steady rate, which is dependent primarily on temperature and sediment depth (USEPA, 1978). Plant respiration is an oxygen demand, which is created by a standing crop of aquatic plants. If nutrient discharges to the stream are excessive then the nutrients become pollutants of concern for a D.O. TMDL when they stimulate excessive plant growths, which contribute significantly to a D.O. problem by their respiration.

The relative importance of these multiple pollutants to the oxygen budget of a stream can be evaluated with a D.O. model that quantifies each oxygen demand present. For Johnson Creek, the oxygen budget of the stream was evaluated with a multi reach Streeter-Phelps model that incorporates SOD on an aerial basis in each reach and plant respiration by subtracting the observed difference between daily average and daily minimum D.O. from the simulated daily average D.O. values (Thomann and Mueller, 1987).

The available D.O. data indicate that the D.O. standard exceedances in Johnson Creek are not related to storm water sags. The only indication that runoff has an immediate affect on D.O. in the stream is that D.O. may be higher as the stream flow increases from runoff (Trapp, 2002). Therefore, for purposes of modeling the stream, two categories of pollutants will be considered: 1) point source discharges of CBOD and ammonia that are not storm water related, which would have an immediate effect on the D.O. of the stream; and 2) suspended solids, which are primarily discharged during runoff events but have their adverse oxygen consuming effect after they have settled and the stream flow has decreased. CBOD and ammonia are already controlled by National Pollutant Discharge Elimination System (NPDES) permits to the maximum extent possible and therefore are considered in the oxygen balance but not pollutants to be addressed by this TMDL.

Since the diurnal variation in stream D.O. was not excessive, plant nutrients including phosphorus will not be pollutants of concern for this TMDL. However, the diurnal variation in D.O. will still be considered in the model.

The D.O. concentration in permitted discharges is also relevant to the D.O. TMDL and will be addressed along with the other pollutants because of its importance to the overall oxygen balance in the stream.

TMDL DEVELOPMENT

D.O. levels in a stream typically reach their minimum level seasonally during warm weather, low flow conditions in the stream. The available D.O. data for Johnson Creek confirm that low D.O. occurs primarily during low flow non-runoff conditions. Therefore, the acceptable levels of oxygen demand in the stream were determined with the D.O. model at drought flow as defined in the Michigan WQS. The drought flow is the lowest of the 12-monthly 95 percent exceedance flows and was determined to be 0.03 cfs at the upstream end of Johnson Creek and 1.42 cfs at the downstream end of the creek (Appendix A).

The D.O. model was first calibrated to conditions observed on July 24, 2000 (Trapp, 2002). This date was chosen for calibration because of the availability of stream chemistry data at multiple locations and point source loading data; and because of the presence of steady low flow conditions in the stream. Calibration involved setting stream flow, temperature, point source water quality and upstream water quality to levels actually observed on that day and then adjusting the SOD rate to a level that would best predict observed D.O. throughout the stream. The SOD rate that best predicted D.O. in the stream was 1 gram per square meter (gm/square meter) per day. The median relative error in predicted D.O. was 0.05 mg/l.

Next, the model was verified by predicting D.O. at conditions of stream flow, temperature, point source loads, and background loads that occurred on July 27, 2000. This date was chosen for verification because of the availability of stream chemistry data at multiple locations and point source loading data; and because of the presence of steady low flow conditions in the stream. The SOD rate was kept at 1 gm/square meter per day. The median relative error in predicted D.O. was 0.4 mg/l, which is less than 6 percent. Median relative errors of 10 percent for D.O. modeling are typical and levels below that are considered acceptable (Thomann, 1982).

The calibrated and verified model was then used to predict D.O. under a design scenario, which included drought flow, 90 percent occurrence stream temperature as determined from the three years of continuous temperature data collected by the RRNWWDP, 1 gm/square meter per day of SOD, and the presently permitted point source discharge levels of CBOD, ammonia, and D.O. The result for this simulation indicated that the D.O. standard would not be met.

The relative importance of each oxygen demand (SOD, CBOD, and ammonia) was evaluated in the model for 15 different locations throughout the length of Johnson Creek. The results did not vary appreciably from location to location. The model indicated that SOD was by far the greatest oxygen demand in the stream followed by CBOD and then ammonia as shown in Table 2.

Table 2. Relative Importance of Factors that Deplete Oxygen in Johnson Creek.

Oxygen Demand	As a % of Total D.O. Deficit	
	Minimum	Maximum
SOD	80%	94%
CBOD	5%	12%
Ammonia	1%	8%

The model analysis continued by decreasing the SOD incrementally in the model until the D.O. standard was met in the lower two miles of Johnson Creek from 6 Mile Road down to the confluence with the Walled Lake Branch of the Rouge River. This required reducing SOD by 85 percent. Point source discharges of CBOD and ammonia with individual NPDES permits were not reduced beyond currently permitted levels because the currently permitted levels are already at the maximum treatment level achievable (10 mg/l of $CBOD_5$ and 2 mg/l ammonia as a maximum). This was the scenario from which the TMDL was developed.

The rate of SOD per unit area is dependent upon sediment depth when depth is less than a critical value of 10 to 20 centimeters (USEPA, 1978). The amount of D.O. consumed in a reach from SOD is also dependent upon the surface area that is covered by oxygen demanding sediment. Both of these parameters (sediment depth and areal coverage) can be expected to decrease as suspended solids loads are decreased to a stream. Modeling the fate of suspended solids discharged to Johnson Creek is well beyond the scope of this TMDL and is not necessary since the magnitude of the reduction needed is so large. To achieve an 85 percent reduction in SOD in Johnson Creek, a proportionate reduction in the suspended solids discharges is therefore needed.

SOURCE ASSESSMENT

The pollutant of concern for D.O. in Johnson Creek is suspended solids. For suspended solids, the effect on D.O. is a secondary effect. Suspended solids discharged primarily during high flow conditions settle on the stream bottom and have the greatest adverse effect under low flow conditions. Therefore, suspended solids should be regulated as a monthly average.

Sources of suspended solids to the stream include:

- Point sources with individual NPDES permits.
- Permitted storm water sources, which include facilities and land uses covered by general permits and construction sites covered by Permits-by-Rule.
- Runoff from agricultural, wetlands and forest land.

Collectively, the existing suspended solids load from these sources must be reduced by 85 percent to achieve the D.O. standard from 6 Mile Road downstream to the confluence with the Walled Lake Branch of the Rouge River. A list of individual and general NPDES permits is contained in Appendix B. A list of all 171 construction sites covered by a Permit-by-Rule that occur in the five townships encompassing Johnson Creek is shown in Appendix C. We estimate that approximately 21 of these sites are located in the Johnson Creek watershed. The suspended solids loads from point sources with individual permits were estimated from monitoring data and are presented in Table 3. The loads for $CBOD_5$, ammonia, and D.O. in Table 3 are based on permit limitations.

The suspended solids loads from all sources except those point sources described in the previous paragraph were estimated from 2000 land use data available from the Southeast Michigan Council of Governments and the USEPA's Simple Method model (USEPA, 2001). These loads are presented in Table 3. The Simple Method is an empirical approach for estimating pollutant loadings, using the following equation:

$$L_P = \Sigma_u(P*P_J*R_{VU}*C_U*A_U*2.7/12)$$

Where:

L_P = Pollutant load, lbs.
u = Land use type
P = Precipitation, inches/year
P_J = Ratio of storms producing runoff (default = 0.9)
R_{VU} = Runoff Coefficient for land use type u, $inches_{run}/inches_{rain}$, = 0.05 + (0.9 *$I_U$)
I_U = Percent Imperviousness
C_U = Event Mean Concentration for land use type u, mg/L
A_U = Area of land use type u, acres

Table 3. Johnson Creek Estimated Loads for all Pollutant Sources Covered in the TMDL.

Permit Type or Source		Daily Composite Maximum $CBOD_5$ lb/day	Daily Composite Maximum Ammonia (lbs/day)	Dissolved Oxygen Minimum (mg/l)	Daily Average Suspended Solids (lbs/day)
Individual	Salem Twp	5.8	1.2	8	2.4
Individual	Onyx Arbor Hills	8.3	1.7	7	7.9
General Permit	Diversified Fuels - Northville	Load of oxygen consuming materials not expected			
Industrial		N.A.	N.A.	N.A.	1592
Transportation					10
Commercial		N.A.	N.A.	N.A.	217
Urban Open		N.A.	N.A.	N.A.	108
Residential high density		N.A.	N.A.	N.A.	49
Residential medium density		N.A.	N.A.	N.A.	1577
Agriculture		N.A.	N.A.	N.A.	711
Forest		N.A.	N.A.	N.A.	294
Water and Wetland		N.A.	N.A.	N.A.	111
Total		14.1	2.9	N.A	4680

N.A. = Not applicable because these sources only contribute flow during runoff conditions and the TMDL is based on meeting the D.O. standard under a worst-case scenario of low flow, non-runoff conditions.

ALLOCATIONS

The loading capacity (LC) is the sum of individual waste load allocations (WLAs) for point sources and load allocations (LAs) for nonpoint sources and natural background levels. In addition, the LC must include a margin of safety (MOS), either implicitly within the WLA or LA, or explicitly, that accounts for uncertainty in the relation between pollutant loads and the quality of the receiving water body. Conceptually, this definition is denoted by the equation:

$$LC = \sum WLAs + \sum LAs + MOS$$

The term LC represents the maximum loading that can be assimilated by the receiving water while still achieving WQS.

<u>WLAs</u>

There are three individual NPDES permitted point source discharges to Johnson Creek. These are the Salem Township Wastewater Treatment Plant (WWTP) (MI0054798), the Onyx Arbor Hills Landfill discharge (MI0045713), and the Michigan Department of Transportation (MDOT) MS4 (MI0057364). The WLAs for these permits are shown in Table 4 (note that the MDOT permit is addressed by the transportation land use category). The WLAs for Salem Township and Onyx Arbor Hills are based on their existing loads.

With the exception of the Diversified Fuels NPDES permitted discharge, the other entities in the WLA are storm water sources covered under NPDES permits under the following land use categories: residential, commercial, industrial, transportation, and urban open. The Diversified Fuels discharge originates from a petroleum cleanup and is not expected to be a source of suspended solids.

<u>LAs</u>

The LAs are shown in Table 4 for agricultural and forest land, and water/wetland. The LAs are 15 percent of the estimated existing loads of suspended solids from these sources.

Table 4 summarizes the existing loads and numeric targets for all sources and all pollutants of concern to the D.O. TMDL.

Table 4. Existing Loads of and Numeric Targets for Suspended Solids for the Johnson Creek D.O. TMDL.

Source Category	Existing Load (lbs/day)	WLA (lbs/day)	LA (lbs/day)	Numeric Target (lbs/day)
Salem Twp. Individual Permit	2.4	2.4		2.4
Onyx Arbor Hills Individual Permit	7.9	7.9		7.9
Diversified Fuels – Northville general permit	0	0		0
Industrial	1592	235.9		235.9
Transportation	10	1.4		1.4
Commercial	217	32.2		32.2
Urban Open	108	16.1		16.1
Residential high density	49	7.3		7.3
Residential medium density	1577	233.6		233.6
Agriculture	711		105.3	105.3
Forest	294		43.5	43.5
Water and Wetland	111		16.5	16.5
Total	**4679.3**	**536.8**	**165.3**	**702.1**

<u>MOS</u>

The MOS accounts for any uncertainty or lack of knowledge concerning the relationship between pollutant loading and water quality. This TMDL uses an implicit MOS due to very conservative assumptions incorporated in D.O. modeling. Background flows and tributary inflows are represented at the 95 percent exceedance summer low flow as determined by the MDEQ, Land and Water Management Division. The summer 95 percent exceedance flow is a stream flow that would be expected only during periods of severe drought. Stream flows would be expected to be this low for only five percent or less of the time during the driest summer month. Michigan WQS (R 323.1090), specify that WQS apply at all flows equal to or exceeding the lowest monthly 95 percent exceedance flow. Similarly, river temperatures are represented at the highest monthly 90 percent occurrence temperature for the summer season. This temperature would be expected to be exceeded only ten percent of the time during the summer months. Such high temperatures result in lower D.O. saturation concentrations and increased rates of in-stream oxygen utilization. The conservative assumptions regarding stream flow and water temperature are the same as those employed in the determination of water quality-based effluent limits in NPDES WLAs at critical design conditions. For design condition TMDL modeling, the Salem Township WWTP and the Onyx Arbor Hills Landfill discharge were represented as discharging their maximum design flows, which would not normally occur. This is an extremely unlikely scenario and further lends to the conservative assumptions of the modeling. A large degree of uncertainty in the D.O. modeling is also removed, as the models used, were calibrated to observed data and verified with an independent set of data.

SEASONALITY

The reduction in suspended solids loads recommended in this TMDL must apply year-round since suspended solids discharged at any time of the year could settle to the stream bottom and exert an oxygen demand during the summer low flow, high temperature period. Consequently, the reduced SOD will also occur year-round. Monitoring and modeling indicates that the summer season represents the most critical conditions for D.O. standard attainment in Johnson Creek. Since this TMDL was developed to meet the D.O. standard in the summer, the D.O. standard will also be met in other seasons without any further reductions of pollutants other than the suspended solids reductions recommended and the existing NPDES permit loads for $CBOD_5$ and ammonia.

MONITORING

Future monitoring will be conducted to assess whether activities implemented under the TMDL result in water quality improvements. This monitoring will be conducted as resources allow. Typically, the MDEQ monitors watersheds in accordance with the five-year NPDES permit review process. D.O. standard attainment will result in the water bodies being removed from the Section 303(d) list, while continued nonattainment will result in further evaluation under the TMDL process.

REASONABLE ASSURANCE ACTIVITIES

Under the NPDES permit program, the Salem Township WWTP and the Onyx Arbor Hill's discharges are required to meet limitations for CBOD, ammonia, and D.O. To ensure meeting these limitations at all times, the facilities typically achieve a much better effluent quality than required by their permits. Any violations of the permit limits are dealt with by a well established compliance and enforcement program administered by the MDEQ's Southeast Michigan and Jackson District Offices.

Erosion from construction sites is regulated under the Soil Erosion and Sedimentation Control (SESC) Program (Part 91, SESC, of the NREPA), by Wayne and Washtenaw Counties. This program aims to reduce sedimentation in rivers, lakes, and streams by controlling sediments in runoff from construction sites greater than one acre in area, or those located within 500 feet of a water of the state. Temporary (silt fences) and permanent control measures (such as vegetated buffer strips) are employed. The MDEQ, Water Bureau, oversees the counties' programs to ensure that they are effectively enforcing SESC regulations.

Johnson Creek is part of the Rouge River watershed, which is the site of a national demonstration project that seeks to restore and protect the Rouge River watershed through pollution control activities that are guided by a watershed management process (RRNWWDP, 2007). Johnson Creek has unusually high water quality for the Rouge River watershed; however, many of the initiatives of the Rouge River project such as identification of illicit connections, erosion control programs, and storm water runoff management will benefit Johnson Creek also.

In an effort to improve the water quality of Johnson Creek and the Rouge River, Northville Township, with help from several other organizations, facilitated the creation of the Johnson Creek Protection Group. In this organization, residents, businesses, and local officials can work together to identify actions in which the community can partake to preserve and restore water quality as well as educate the public regarding their role in this ongoing endeavor. The group mobilizes the public to protect Johnson Creek through hosting educational events and supporting volunteer inventory, restoration, and advocacy work.

The Washtenaw Conservation District serves farmers and landowners in the Johnson Creek watershed, which includes both Washtenaw and Wayne Counties, with conservation planning and erosion control through various programs by providing assistance and educational information related to conservation.

Federal regulations require certain industries to apply for an NPDES permit if storm water associated with industrial activity at the facility discharges into a separate storm sewer system or directly into a surface water. There are three industrial facilities with storm water discharge authorization within the Johnson Creek watershed. Prior to obtaining permit coverage, applicants must certify that they do not have any unauthorized discharges. MDEQ staff conduct inspections of a percentage of permitted, and all regulated, industrial facilities annually. Inspections are utilized to ensure that facilities comply with the regulations, and result in a further reduction in unauthorized discharges and illicit connections. Additionally, as additional facilities obtain industrial storm water permits, more illicit discharges will be eliminated. There are other industrial facilities that have not yet obtained storm water permit authorization.

Within Johnson Creek there are two local jurisdictions that have obtained Phase II municipal separate storm sewer (MS4) permit coverage (see Appendix B). Long-term watershed management plans were developed in 2001 under these permits and implementation of BMPs and other pollution prevention activities are under way. Among other things, these permits require:

1. Watershed planning that specifically addresses any TMDLs in the watershed, including identification of priority problems and opportunities (including any TMDL established for a parameter within the watershed that may be affected by storm water).

2. Development of a Storm Water Pollution Prevention Initiative that contains long-term goals for the watershed (which shall include both the protection of designated uses of the receiving waters as defined in Michigan's WQS, and attaining compliance with any TMDL established for a parameter within the watershed).

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Michigan Department of Environmental Quality
August 22, 2007

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Appendix A

Low Flow Statistics for Johnson Creek.

			Flows in cubic feet per second											
Location	**Drainage Area (Sq. Mi.)**	**% Exceedance**	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**
Trib to Johnson Creek at Salem Rd Center of section 14 T 1S, R 7E	3.2	95 %	0.07	0.10	0.14	0.12	0.16	0.54	0.86	0.31	0.10	0.03	0.04	0.06
		50 %	0.42	0.84	1.12	1.05	1.19	3.66	3.54	1.71	0.75	0.35	0.24	0.26
Johnson Creek Downstream of confluence with trib from Salem NW ¼, SE ¼ Sec 15 T 1S, R 7E	8.0	95 %	0.18	0.26	0.36	0.31	0.41	1.36	2.15	0.77	0.24	0.08	0.09	0.14
		50 %	1.05	2.09	2.81	2.64	2.97	9.14	8.86	4.28	1.88	0.87	0.61	0.64
Johnson Creek Downstream of confluence with trb from west SW ¼, SE ¼ Sec 15 T 1S, R 7E	10.1	95 %	0.22	0.33	0.45	0.39	0.52	1.71	2.72	0.97	0.30	0.10	0.11	0.18
		50 %	1.32	2.64	3.54	3.33	3.74	11.54	11.19	5.41	2.37	1.10	0.77	0.81
Johnson Creek Salem Rd SW ¼ 23 T 1S, R 7E	11	95 %	0.24	0.36	0.49	0.42	0.56	1.86	2.96	1.05	0.33	0.11	0.12	0.19
		50 %	1.44	2.88	3.86	3.62	4.08	12.57	12.18	5.89	2.58	1.19	0.84	0.88
Johnson Creek Ridge Rd SE ¼ 18 T1S, R 8E	15	95 %	0.69	0.90	1.12	1.01	1.24	3.03	4.37	1.96	0.85	0.41	0.43	0.59
		50 %	2.48	4.28	5.42	5.15	5.67	14.68	14.29	7.68	3.92	2.15	1.65	1.71
Johnson Creek Beck Rd. SE ¼ 8 T1S, R 8E	22.1	95 %	1.64	2.05	2.45	2.25	2.65	5.33	7.03	3.81	1.95	1.05	1.11	1.44
		50 %	4.58	6.92	8.26	7.95	8.54	17.31	16.97	10.71	6.47	4.10	3.33	3.43
Johnson Creek At confluence with Walled Lk. Branch SE ¼ 3 T1S, R 8E	26.1	95 %	2.19	2.70	3.21	2.96	3.45	6.64	8.54	4.86	2.58	1.42	1.49	1.92
		50 %	5.77	8.42	9.88	9.55	10.18	18.81	18.50	12.44	7.93	5.21	4.29	4.40

Note: These statistics were derived by the MDEQ Land and Water Management Division hydrologists from flow yields observed during 1958 through 2004 at the United States Geological Survey stream flow gage on the Upper Rouge River at Farmington using correlations derived from 11 flow measurements on Johnson Creek at Napier Road and 34 flow measurements on Johnson Creek at Hines Drive.

Appendix B

List of Facilities in Johnson Creek Watershed that have Individual or General Permits.

NAME	Design Flow (MGD)	PERMIT NO.	COUNTY	TOWNSHIP	RECEIVING WATER
Diversified Fuels-Northville	no data	MIG081077	Oakland	Novi	Unnamed tributary of Rouge River
Great Lakes Agg-Northville	NA	MIS210732	Washtenaw	Salem	Johnson Creek
Inch Memorials-Northville	NA	MIS210685	Wayne	Plymouth	Johnson Creek
Oakland Co. Watershed wide Storm water (MS4)	NA	MIG610042	Oakland	--	Johnson Creek
Wayne Co. Watershed wide Storm water (MS4)	NA	MIG610040	Wayne	--	Johnson Creek
Washtenaw Co. Rd. Comm. Watershed wide Storm water (MS4)	NA	MIG610314	Washtenaw	--	Johnson Creek
Washtenaw Co. Drain Comm. Watershed wide Storm water (MS4)	NA	MIG610039	Washtenaw	--	Johnson Creek
MDOT Statewide Storm water (MS4)	NA	MI0057364	Multple	--	Johnson Creek
Northville Schools Jurisdictional Storm water (MS4)	NA	MIS040078	Wayne	Northville	Johnson Creek
Plymouth Twp. Watershed wide Storm water (MS4)	NA	MIG610038	Wayne	Plymouth	Johnson Creek
Salem Twp. Jurisdictional Storm water (MS4)	NA	MIS040068	Washtenaw	Salem	Johnson Creek
Novi Watershed wide Storm water (MS4)	NA	MIG610030	Oakland	Novi	Johnson Creek
Lyon Twp. Watershed wide Storm water (MS4)	NA	MIG610034	Oakland	Lyon	Johnson Creek
Northville MS4-Oakland	NA	MIG610024	Oakland	Novi	Rouge River, Johnson Drain and others
Northville Twp MS4-Wayne	NA	MIG610025	Oakland	Novi	Rouge River, Johnson Drain and others
Onyx Arbor Hills LF	0.10	MI0045713	Wayne	Plymouth	Unnamed tributary to Johnson Creek
Salem Twp WWTP	0.07	MI0054798	Washtenaw	Salem	Unnamed tributary to Johnson Creek
Veolia ES Arbor Hills Landfill	NA	MIS210766	Washtenaw	Salem	Unnamed tributary to Johnson Creek

Appendix C

List of Permit-by-Rule Construction Sites in the Townships Encompassing Johnson Creek.

Facility Location Address	Facility Location City	Facility Location Zip	County	Township Name
Lyon Center Drive	Unknown	0	Oakland	Lyon
Nine Mile Road	Northville	48167	Oakland	Lyon
Pontiac Trail, north of 11 Mile Road	Unknown	0	Oakland	Lyon
10 Mile Road	South Lyon	48178	Oakland	Lyon
31001 Lahser Road	Beverly Hills	48025	Oakland	Lyon
5201 Knobby Hill Drive	Highland	48357	Oakland	Lyon
10 Mile Road	South Lyon	48178	Oakland	Lyon
49397 Shafer Avenue	Wixom	48393	Oakland	Lyon
26740 Pontiac Trail	South Lyon	48178	Oakland	Lyon
51830 Grand River	Wixom	48393	Oakland	Lyon
345 South Warren Street	South Lyon	48178	Oakland	Lyon
51490 Pontiac Trail	Wixom	48393	Oakland	Lyon
345 South Warren	South Lyon	48178	Oakland	Lyon
31731 Northwestern Highway	Farmington Hills	48334	Oakland	Lyon
403b East Grand River Avenue	Brighton	48116	Oakland	Lyon
Napier & 9 Mile Road	Novi	48374	Oakland	Lyon
345 South Warren Street	South Lyon	48178	Oakland	Lyon
Martindale Road & 11 Mile Road	South Lyon	48178	Oakland	Lyon
Lake Street (10 Mile Road)	West Bloomfield	48325	Oakland	Lyon
Beck Road	Wixom	48393	Oakland	Lyon
Eleven Mile Road West of Milford Road	New Hudson	48165	Oakland	Lyon
11 Mile and Martindale Road	South Lyon	48178	Oakland	Lyon
Ten Mile Road at Johns Road	Unknown	0	Oakland	Lyon
Ten Mile and Johns Road	South Lyon	48178	Oakland	Lyon
Ten Mile Road and Currie Road	South Lyon	48178	Oakland	Lyon
Martindale Street	New Hudson	48165	Oakland	Lyon
Pontiac Trail and Nine Mile Road	South Lyon	48178	Oakland	Lyon
Dixboro Road	South Lyon	48178	Oakland	Lyon
Between Spaulding Road and Milford Road	New Hudson	48165	Oakland	Lyon
Eleven Mile Road	New Hudson	48165	Oakland	Lyon
William K Smith Drive	New Hudson	48165	Oakland	Lyon
28140 Lakeview Drive	Wixom	48393	Oakland	Lyon
Milford Road	South Lyon	48178	Oakland	Lyon
South side of Ten Mile Road, East of Currie Road	Unknown	0	Oakland	Lyon
Nine Mile Road (vacant property)	South Lyon	48178	Oakland	Lyon
Ten Mile Road and Matindale Road	New Hudson	48165	Oakland	Lyon

Facility Location Address	Facility Location City	Facility Location Zip	County	Township Name
Coach House Lane	Southfield	48034	Oakland	Lyon
30729 Lyon Center Drive East	New Hudson	48165	Oakland	Lyon
22727 Griswold Road	Unknown	0	Oakland	Lyon
Northwest corner of 10 Mile Road and Milford Road	New Hudson	48165	Oakland	Lyon
Haggerty Road	Novi	48375	Oakland	Lyon
10 Mile Road and Martindale Road	Unknown	0	Oakland	Lyon
55500 Grand River Avenue	New Hudson	48165	Oakland	Lyon
32400 Telegraph Road, Suite 100	Bingham Farms	48025	Wayne	Northville
3005 University Drive, Suite 100	Auburn Hills	48326	Wayne	Northville
30100 Telegraph Road, Suite 366	Bingham Farms	48025	Wayne	Northville
740 Salem Road	Northville	48167	Wayne	Northville
6024 West Maple Road, Suite 106	West Bloomfield	48322	Wayne	Northville
34018 Beacon Street	Livonia	48150	Wayne	Northville
46680 West Seven Mile Road	Northville	48167	Wayne	Northville
1330 Goldsmith	Plymouth	48170	Wayne	Northville
30500 Northwestern Highway, Suite 400	Farmington Hills	48334	Wayne	Northville
30500 Northwestern Highway, Suite 400	Farmington Hills	48334	Wayne	Northville
Southeast corner of Ridge Road & Six Mile Road	Northville	48167	Wayne	Northville
Southeast corner of Ridge Road and Six Mile Road	Northville	48167	Wayne	Northville
46670 Six Mile Road	Northville	48167	Wayne	Northville
Northwest corner of 12 Mile and Dixon Road	Novi	48375	Oakland	Novi
Northwest corner of 12 Mile Road & Dixon Road	Novi	48375	Oakland	Novi
32070 Lahser Road	Beverly Hills	48025	Oakland	Novi
1330 Goldsmith	Plymouth	48170	Oakland	Novi
31731 Northwestern Highway, Suite 250	Farmington Hills	48334	Oakland	Novi
26699 West 12 Mile Road, Suite 200	Southfield	48034	Oakland	Novi
31000 Northwestern Highway, Suite 220	Farmington Hills	48334	Oakland	Novi
Unknown	Farmington Hills	48333	Oakland	Novi
41200 Bridge Street	Novi	48375	Oakland	Novi
45175 West 10 Mile Road	Novi	48375	Oakland	Novi
30500 Northwestern Highway, Suite 400	Farmington Hills	48334	Oakland	Novi
32400 Telegraph Road	Bingham Farms	48025	Oakland	Novi
32400 Telegraph Road	Bingham Farms	48025	Oakland	Novi
1330 Goldsmith	Plymouth	48170	Oakland	Novi

Facility Location Address	Facility Location City	Facility Location Zip	County	Township Name
111 South Telegraph Road	Pontiac	48341	Oakland	Novi
45175 West 10 Mile Road	Novi	48375	Oakland	Novi
39000 Country Club Drive	Farmington Hills	48331	Oakland	Novi
30500 Northwestern Highway, Suite 400	Farmington Hills	48334	Oakland	Novi
7125 Orchard Lake Road, Suite 200	West Bloomfield	48322	Oakland	Novi
31300 Orchard Lake Road, Suite 100	Farmington Hills	48334	Oakland	Novi
41115 Jo Drive	Novi	48375	Oakland	Novi
45380 West 10 Mile Road, Suite 135	Novi	48375	Oakland	Novi
45175 West Ten Mile Road	Novi	48375	Oakland	Novi
39575 Thirteen Mile Road	Novi	48377	Oakland	Novi
30100 Telegraph Road, Suite 220	Bingham Farms	48025	Oakland	Novi
45380 West 10 Mile Road, Suite 135	Novi	48375	Oakland	Novi
30500 Northwestern Highway, Suite 400	Farmington Hills	48334	Oakland	Novi
30500 Northwestern Highway, Suite 400	Farmington Hills	48334	Oakland	Novi
30100 Telegraph Road, Suite 220	Bingham Farms	48025	Oakland	Novi
2617 Beacon Hill Drive	Auburn Hills	48326	Oakland	Novi
39000 Country Club Drive	Farmington Hills	48331	Oakland	Novi
42355 Grand River	Novi	48375	Oakland	Novi
Unknown	West Bloomfield	48325	Oakland	Novi
14200 Breakfast Drive	Redford	48239	Oakland	Novi
30078 Schoenherr, Suite 300	Warren	48088	Oakland	Novi
31300 Orchard Lake Road	Farmington Hills	48334	Oakland	Novi
43700 Expo Drive	Novi	48375	Oakland	Novi
39000 Country Club Drive	Farmington Hills	48331	Oakland	Novi
30500 Northwestern Highway	Farmington Hills	48334	Oakland	Novi
45175 West Ten Mile Road	Novi	48375	Oakland	Novi
45175 West Ten Mile Road	Novi	48375	Oakland	Novi
49232 Hunt Club Court	Plymouth	48170	Oakland	Novi
Unknown	Lansing	48909	<UNKNOWN>	Novi
31550 Northwestern Highway, Suite 200	Farmington Hills	48334	Oakland	Novi
41115 Jo Drive	Novi	48375	Oakland	Novi
Meadowbrook Road	Novi	48375	Oakland	Novi
Northwest corner of 12 Mile Road and Dixon Road	Novi	48375	Oakland	Novi
Meadowbrook Road	Novi	48374	Oakland	Novi
Haggerty Road	Novi	48375	Oakland	Novi
Eight Mile Road and Garfield	Novi	48374	Oakland	Novi
Napier and 12 Mile Roads	Novi	48374	Oakland	Novi
10 Mile Road	Novi	48375	Oakland	Novi

Facility Location Address	**Facility Location City**	**Facility Location Zip**	**County**	**Township Name**
Grand River Avenue and Wixom Road	Novi	48376	Oakland	Novi
27875 Cabot Drive	Novi	48377	Oakland	Novi
North of Eight Mile Road, Between Garfield Road & Beck Road	Novi	48374	Oakland	Novi
12 1/2 Mile Road	Novi	48375	Oakland	Novi
12 Mile Road	Novi	48375	Oakland	Novi
South of Chattman Road, West of Meadowbrook Road	Novi	48375	Oakland	Novi
Saybrook Court	Novi	48375	Oakland	Novi
Nine Mile Road	Novi	48375	Oakland	Novi
50200 Ten Mile Road	Novi	48374	Oakland	Novi
39450 12 Mile Road	Novi	48377	Oakland	Novi
25500 Meadowbrook Road	Novi	48375	Oakland	Novi
Southwest corner of Grand River and Beck Road	Wixom	48393	Oakland	Novi
Northwest corner of Twelve Mile and Dixon Roads	Novi	48375	Oakland	Novi
Northwest corner of Twelve Mile and Dixon Roads	Novi	48375	Oakland	Novi
Ten Mile Road	Novi	48374	Oakland	Novi
Various	Novi	48375	Oakland	Novi
Southwest corner of Grand River and Beck Road	Novi	48374	Oakland	Novi
Northeast corner of 12 Mile and West Park Drive	Novi	48374	Oakland	Novi
45625 Grand River Avenue	Novi	48375	Oakland	Novi
Northwest corner of 12 Mile Road and Dixon Road	Novi	48375	Oakland	Novi
27500 Novi Road	Novi	48377	Oakland	Novi
Taft Road	Novi	48375	Oakland	Novi
44150 12 Mile Road	Novi	48375	Oakland	Novi
Unknown	Novi	48374	Oakland	Novi
Ten Mile Road and Wixom Road	Novi	48375	Oakland	Novi
51000 Grand River Avenue	Wixom	48393	Oakland	Novi
41787 Grand River Avenue	Novi	48375	Oakland	Novi
41720 and 41750 8 Mile Road	Novi	48375	Oakland	Novi
48201 Grand River Avenue	Novi	48374	Oakland	Novi
Southwest corner of Grand River and Beck Road	Unknown	0	Oakland	Novi
32535 Schoolcraft	Livonia	48150	Oakland	Novi
Nine Mile Road	Novi	48374	Oakland	Novi
North side of Grand River, East of Novi Road	Novi	48374	Oakland	Novi
243 West Grand River	East Lansing	48823	Wayne	Plymouth
243 West Grand River	East Lansing	48823	Wayne	Plymouth
McClumpha Road and Ann	Plymouth	48170	Wayne	Plymouth

Facility Location Address	Facility Location City	Facility Location Zip	County	Township Name
Arbor Road				
Haggerty Road	Plymouth	48170	Wayne	Plymouth
M-14 from Napier Road to Haggerty Road	Plymouth	48170	Wayne	Plymouth
North Territorial Road	Plymouth	48170	Wayne	Plymouth
220 North Smith Street, Suite 300	Palatine	60067	Wayne	Plymouth
45501 Helm Street	Plymouth	48170	Wayne	Plymouth
14270 Livonia Crescent	Livonia	48154	Wayne	Plymouth
15075 Beck Road	Plymouth	48170	Wayne	Plymouth
15000 Haggerty Road	Plymouth	48170	Wayne	Plymouth
Napier Road to Haggerty Road	Plymouth	48170	Wayne	Plymouth
15726 Penderbrook Lane	Northville	48168	Wayne	Plymouth
Five Mile and Sheldon Roads	Northville	48167	Wayne	Plymouth
5 Mile Road and Sheldon Road	Unknown	0	Wayne	Plymouth
East of Sheldon, north of 5 Mile Road	Northville	48167	Wayne	Plymouth
Ridge Road	Northville	48167	Wayne	Plymouth
Ridge Road and 7 Mile Road	Northville	48167	Wayne	Plymouth
Ridge Road, 5 Mile Road, Sheldon Road	Northville	48167	Wayne	Plymouth
40440 Palmer Road	Canton	48188	Wayne	Plymouth
34333 Michigan Avenue	Wayne	48184	Wayne	Plymouth
From Meyers Road to Greenfield Road	Unknown	0	Wayne	Plymouth
Pontiac Trail	South Lyon	48178	Washtenaw	Salem
7 Mile & Chubb Roads	Unknown	0	Washtenaw	Salem
55815 8 Mile Road	Northville	48167	Washtenaw	Salem
5755 Vorhies Road	Ann Arbor	48105	Washtenaw	Salem