Michigan Department of Environmental Quality

Water Division

June 2003

Total Maximum Daily Load for Biota for the Grand River

Jackson County

INTRODUCTION

Section 303(d) of the federal Clean Water Act (CWA) and the United States Environmental Protection Agency's (USEPA) 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 Michigan's Water Quality Standards (WQS). The TMDL process establishes the allowable loads of a pollutant to a water body based on the relationship between pollutant sources and in-stream water quality conditions. TMDLs provide states a basis for determining the pollutant reduction necessary from both point and/or nonpoint sources (NPS) to maintain and/or restore the quality of their water resources.

The purpose of this TMDL is to establish a biota TMDL for the Grand River and its tributary, the Portage River, so as to restore the warmwater fish and other aquatic life designated use support of this stream, thereby resulting in WQS attainment.

PROBLEM STATEMENT

The Grand River and Portage River, a major tributary to the Grand River, are both warmwater designated water bodies and located in Jackson County due north of the city of Jackson (Figure 1). The TMDL reach is identified in Michigan's Year 2002 Section 303(d) report (Creal and Wuycheck, 2002) as follows:

GRAND RIVER AND PORTAGE RIVER WBID# **082816H**
County: JACKSON HUC: 04050004 Size: 25 M
Location: Grand River from Tompkins Road upstream to the city of Jackson
and Portage River from the Grand River confluence upstream to Wooster Road.
Problem: **Untreated sewage discharge, pathogens (Rule 100); WQS exceedances for DO; Macroinvertebrate and fish communities rated poor.**
TMDL Year(s): 2003 RF3RchID: 4050004

The presence of a poor rated fish and/or macroinvertebrate community in the TMDL reach was a basis for including the Grand River reach on Michigan's Year 2002 CWA Section 303(d) list of impaired water bodies requiring the development of a TMDL. In addition, dissolved oxygen (DO) and *Escherichia coli* bacteria TMDLs are being developed for about a 25-mile reach due to WQS exceedances in each case.

The Grand River is designated for the protection of a warmwater fishery and other indigenous aquatic life as provided by Michigan's WQS (Rule 100[1]). This document represents the basis for the development of a biota TMDL that focuses on the restoration of the biological communities of the impacted reach so as to meet Michigan's WQS designated uses. The biota

TMDL reach, as herein described, extends upstream about eight miles from US-127 to the confluence of Portage River (Figure 1).

The biota TMDL reach is defined based on results from the Great Lakes and Environmental Assessment Section Procedure 51 (May 2002, as revised) assessments of fish communities and/or macroinvertebrate communities of the upper Grand River Watershed during 1991, 1996, 2001, and 2002 (Oemke, 1992; Kosek, 1997; Goodwin, 2000; Rockafellow, 2003; and Wuycheck, 2003). The Procedure 51 protocol involves the assessment of nine specific metrics for either the fish and/or macroinvertebrate communities. Fish or macroinvertebrate community assessments with metric accumulative scores of 5 to 9 are rated as excellent; scores of 4 to -4 represent acceptable biological communities, and scores of -4 to -9 are rated as poor; the latter is classified as not attaining WQS.

A biological assessment of the Grand River in August 1977, using multi-plate artificial substrate samplers, defined a 14-mile zone of biological impairment that extended from Lewis Street (city of Jackson) downstream to about US-127 (Sylvester and Grant, 1979). The impairments were attributed to pollutant loads from industrial, municipal, storm water, and combined sewer overflow (CSO) discharges to the affected reach. CSOs (prior to 2000) and Jackson Wastewater Treatment Plant (WWTP) discharges (prior to 1985) once contributed to fish kills, solids loads, sediment contaminant buildup, and sediment oxygen demand (SOD) in sediments of the biota TMDL reach (Willson, 1970; Sylvester and Grant, 1979; Sunday, 2002; Argiroff, 1999; and Argiroff, 1995). The survey of August 1977 demonstrated improvement in river quality when compared to a 22-mile zone of degradation downstream of the city of Jackson during a 1970 survey (Willson, 1970). The reduction in the biologically impaired reach length to a 14-mile reach downstream of the city of Jackson indicated that pollution abatement efforts employed during the intervening years, between surveys, improved the water quality of the Grand River. CSOs eliminated in 2000 included those located at the Lewis Street and Bridge Street tributary to the Grand River at Jackson. Michigan Department of Environmental Quality (MDEQ) district staff indicate that there may continue to be illicit connections to storm sewers that discharge from the vicinity of Jackson.

A review of the Procedure 51 electrofishing community assessments of the Grand River conducted in September 1991 indicated an insufficient number of fish (four) at the Berry Road site and, therefore, the reach was rated poor (Oemke, 1992). The fish community at Dixon Road, located 8.6 miles further downstream, scored a -1 and was rated acceptable. The MDEQ also assessed the fish communities of the Portage River in August 1996 at Wooster Road (Root Station Road) and further downstream at Hawkins Road (Kosek, 1997). The fish communities scored a 2 and -1, respectively, both rated as acceptable. During October 2002, the integrity of the fish communities of the Grand River was assessed by the MDEQ at two sites, Maple Grove Road and Tompkins Road (Wuycheck, 2002). The fish community scores and ratings for these two sites were -5 (poor) and 1 (acceptable), respectively.

The September 1991 MDEQ macroinvertebrate community assessments of the Grand River scored -5 with a rating of poor at Berry Road and -1 with a rating of acceptable at Dixon Road (Oemke, 1992). A September 1996 MDEQ macroinvertebrate community assessment of the Grand River at the Maple Grove Road station scored a -5 and rating of poor (Goodwin, 2000). In August 2001, the macroinvertebrate communities were assessed at five sites on the upper Grand River that included sites within the defined TMDL reach (Rockafellow, 2003). The river locations assessed extended from the city of Jackson downstream and included High Street, West Monroe Street, Parnall Road, Maple Grove Road, and Churchill Road. The macroinvertebrate community assessment scores and (ratings) at each site were 5 (excellent), 1 (acceptable), 1 (acceptable), -7 (poor), and -1 (acceptable), respectively. The results

indicated continued impaired macroinvertebrate community in the Maple Grove Road reach of the Grand River.

The biological communities and habitat of the Portage River were assessed in August 1996 (Kosek, 1997). The Procedure 51 macroinvertebrate community assessment scores and ratings at Wooster Road (Root Station Road), Hawkins Road, and M-106 (0.5 miles upstream of the Grand River confluence) were 1, 0, and 0, all rated as acceptable. Fish communities of the Portage River assessed at Wooster Road and Hawkins Road had metric scores of 2 and -1 (acceptable), respectively.

Overall, the biological assessments of the upper Grand River collectively indicate improvement in river quality based on further reduction of the 14-mile zone of impairment of the biological community observed in 1977 (Sylvester and Grant, 1979). Findings from the 1977 survey and a 1996 habitat survey by Goodwin (2000), demonstrate 80% muck present at Maple Grove Road during the 1977 survey and low scores among specific metrics of the 1996 Procedure 51 habitat evaluation: Embeddedness with a very low score of 1 out of a possible maximum score of 20 and a Bottom Deposition metric low score of 3 out of a possible maximum score of 15. Both surveys indicated impaired habitat due to deposition.

Currently, the biological community impaired zone applies to a river reach that extends from the Portage River confluence downstream to US-127, an eight mile reach.

Numeric Targets: The impaired designated use for the Grand River is aquatic life. Michigan's WQS require, as a minimum, the protection of a variety of designated uses including aquatic life (Rule 100[1][f] - Other indigenous aquatic life and wildlife). Since the biota in the Grand River are impacted due to habitat loss by excessive sedimentation, achievement of WQS for the aquatic life designated use is to be demonstrated via assessments of the integrity of the fish and macroinvertebrate communities and habitat quality.

The "primary" numeric targets involve the use of Michigan's biological community and habitat quality assessment, Procedure 51. The biota TMDL targets are to achieve, for both the fish and macroinvertebrate communities, an acceptable, reproducible Procedure 51 score equal to or greater than -4. The fish and macroinvertebrate community scores will both be evaluated based on a minimum of two Procedure 51 biological assessments conducted in two consecutive years following the implementation of Best Management Practices (BMPs) to minimize sediment loads to the subject TMDL reach.

A stream habitat quality assessment will also be used. Historically, a minimum habitat quality score of 65 (approaching the upper end of the fair habitat score range of 35 to 70 out of a possible total of 135 points) would have been established as the minimum target for the habitat quality at all locations assessed. The habitat assessment target score of 65 was previously used in the TMDL development process to represent adequate control of anthropogenic sediment sources so as to improve habitat quality and the biological community. This targeted score is closely associated with macroinvertebrate community scores of -3 or greater, potentially providing better results than a minimally acceptable value of -4. This level of conservation is appropriately high enough to minimize both temporal and spatial variability within the watershed and buffer variability within the macroinvertebrate and habitat assessment protocol. A habitat score of 65 represents a 40% and 55% increase over the previous habitat quality assessment scores of 39 (poor) and 29 (poor) at Maple Grove Road during the September 1996 and August 2001 surveys (Goodwin, 2000 and Rockafellow, 2003), respectively. However, the MDEQ Procedure 51 stream habitat quality assessment procedure was updated and revised in 2002 (MDEQ, 2002). The Procedure 51 revised habitat target score of 96 approaches the upper

range of a marginal score range of 56 to 104 (out of a possible 200-point score), which equates to the 65-point score and 35 to 70 point-score range of the previous habitat rating system. Therefore, the habitat target score of 96 or greater will be used to demonstrate acceptable stream quality conditions and represent adequate control of anthropogenic sediment sources to assure improved habitat quality and the biological communities.

A "secondary" numeric target for total suspended solids (TSS) will be used to further assess improvements in the Grand River. The secondary target goal is applied as a mean annual value, in-stream TSS concentration of 80 milligrams per liter (mg/l), to be applied during wet weather and snow melt runoff/washoff events. The mean annual target concentration of 80 mg/l TSS is based on a review of existing conditions and published literature on the effects of TSS. Vohs et al. (1993) indicated that chemically inert suspended solids of 100 mg/l appears to separate those streams with a fish population from those without. The European Inland Fisheries Advisory Commission stated that, in the absence of other pollution, a fishery would not be harmed at suspended solids concentrations less than 25 mg/l. Good to moderate fisheries can be found at 25 to 80 mg/l suspended solids, good fisheries were unlikely to be found at 80 to 400 mg/l, while only poor fisheries would be found at 400 mg/l (Alabaster, 1972). Decreases were demonstrated in the standing crop of both fish and macroinvertebrates in an area receiving suspended solids load concentrations of no more than 40 mg/l (Gammon, 1970).

Sunday (2003), as part of the DO TMDL developed for the upper Grand River and Portage River Watersheds, estimated TSS loads based on various land use export coefficients. The current estimated annual TSS loads to the biota TMDL reach from the Grand River and Portage River Watersheds are 9.4 million pounds and 7.07 million pounds, respectively. As a phased approach, a 50% reduction of the 16.47 million pounds TSS annual loads to 8.25 million pounds plus 1.72 million pounds from individual and general permitted facilities (Table 5) is expected to restore conditions in the TMDL reach and meet WQS for both DO and biota.

This secondary numeric target may be overridden by achievement of the biological and habitat numeric targets. However, if the TSS numeric target is achieved but the biota or habitat numeric targets are not achieved, then the TSS target may have to be reevaluated. Achievement of the secondary numeric target will help guide proper control over industrial and municipal storm water runoff/washoff and NPS of excessive suspended solids loadings, as well as the runoff/washoff discharge rates and instantaneous runoff volumes that affect increased stream flow instability, stream bank erosion, and increased suspended solids concentrations. The achievement of the wet weather mean annual average value of 80 mg/l will require reductions in the stormwater runoff/washoff TSS loads to the Grand River from the municipal/industrial storm sewers in the city of Jackson, among other actions. Available wet weather monitoring data indicates in-stream TSS concentrations in the Grand River of 400 mg/l.

A numeric target of 5.0 mg/l (as a minimum daily value) for DO also applies to the biota TMDL reach in order to achieve Michigan's WQS Rule 64. A specific DO TMDL has been developed that addresses this issue (Sunday, 2003).

Source Assessment: Overall, the causes of impairment in the TMDL reach that contribute to impaired biological communities include the following: sedimentation; periodic DO violations and high SOD; and historic CSO discharges. The eight-mile biota TMDL reach represents a zone in the Grand River where the gradient declines from 3.4 feet per mile, upstream of the Portage River confluence, to 0.85 feet per mile, and velocities are typically reduced to less than 0.5 feet per second, thereby, fostering sedimentation of suspended solids on available habitat.

Sedimentation:

In 1977, the primary sources of TSS to the Grand River upstream of the Portage River confluence were the Jackson WWTP, CSOs, and industrial/municipal storm water outfalls at and upstream of Monroe Street (Willson, 1970). The Jackson WWTP was required to implement an industrial pretreatment program in April 1985 so as to collect and eliminate direct discharges of improperly treated industrial wastewater and solids to the Grand River.

The sources of elevated TSS loads to the biota TMDL reach are attributable to: 1) historical loadings of solids that have accumulated in the reach; 2) recent periods of urban/municipal and industrial storm water runoff/washoff from the city of Jackson during wet weather runoff events in the city of Jackson area; and 3) NPS-related loads from predominately agricultural landuse sources in the Portage River Watershed (LTI, 2003 draft).

Storm water runoff/washoff source loadings occur during major storm and runoff/washoff events that discharge to the Grand River from designed impervious surface area in the city of Jackson via the numerous industrial and municipal storm sewer outfalls. Results from urban runoff investigations confirm that urban areas can contribute substantial loads of solids, heavy metals, and other contaminants to receiving waters (USEPA, 1983; Novotny, 1991; and Novotny, 1992). The Grand River Inter-County Drainage Board initiated an assessment of the need for street sweeping in minimizing loadings of various solids and contaminants, primarily heavy metals, to the Grand River from the city of Jackson (Tetra-Tech, MPS, 2001). It was concluded that an annual reduction of 63 to 87% of annual washoff of total solids loads and contaminants could be achieved if street cleaning and clean catch basin management were conducted every 14 or 30 days. The washoff typically contained elevated levels of chemical oxygen demand (CBOD), total phosphorus, cadmium, chromium, copper, lead, and zinc.

The Portage River has been substantially dredged and channelized over the past 50 years in order to facilitate drainage and transform wetlands to agriculturally workable land. A drain district evaluation and corridor study of the Portage River inter-county drain was completed in 1999 by HRC (1999). Findings concluded that channelization, levees, and increased runoff have had hydraulic impacts on the river. It has become broader and shallower and prone to increased stream bank erosion, slower flow velocities, and extensive sedimentation. Logjam obstructions occur, suggesting the periodic, maybe seasonal, occurrence of substantially high flow events capable of transporting large woody debris downstream. Selective removal is proposed to facilitate flow that may facilitate the movement of sediment deposition.

Dissolved Oxygen:

CSOs in the city of Jackson discharged pollutants to the Grand River during storm events prior to their elimination in 2000 (MDEQ, Water Division District) as part of the city of Jackson's Phase 1 Storm Sewer Separation program. Willson (1970) documented the wet weather discharge of untreated sanitary waste and elevated bacterial counts from the CSOs of Jackson to the Grand River from locations between Losey Street and the Jackson WWTP. Such loadings of sanitary waste served as a source of oxygen demanding materials that degraded conditions in the biota TMDL reach, including biological communities and increased SOD. Wet weather discharges were responsible for a 1988 fish kill in the Grand River upstream of Lansing Avenue some 14 miles downstream of the city of Jackson. The fish kill prompted DO monitoring studies of the Grand River in 1988 and 1991 (Argiroff, 1999 and 1995). The 1988 study documented wet weather DO levels below 1.0 mg/l, while the 1991 study indicated wet weather DO minima below 3.0 mg/l downstream of the influence of the Jackson CSO discharges. It was

concluded that periodic wet weather runoff and CSO discharges from the city of Jackson were the major sources responsible for reductions in DO.

DO surveys of 2002 and 2003 indicate periodic WQS DO violations (minimum DO of less than 5.0 mg/l) do occur in the Grand and Portage Rivers (Sunday, 2002 and LTI, 2003 – in draft). Such violations occur within and beyond the biota TMDL reach. Historically, DO exceedances were in response to CSO discharges, point source and/or storm water discharges. Since the CSOs were reportedly eliminated and National Pollutant Discharge Elimination System (NPDES) permitted point sources are meeting their NPDES permit limits, recent DO standard exceedances in the Grand River appear to be related to precipitation and impervious surface washoff and resultant SOD within and beyond the biota TMDL reach. The discharge from the Portage River Watershed is also recognized as contributing to depressed DO conditions in the biota TMDL reach and beyond. Solids loadings and sedimentation contribute to a substantial zone of river where SOD increases, thereby contributing to DO WQS violations during portions of the summer months.

SOD that exists in the TMDL reach is substantial and is associated with characteristic deposits of fine sediment material that represents the major substrate in the reach (Sunday, 2002). Sources of the fine sediment accumulations in the biota TMDL reach appear to be associated with urban runoff and organic rich sediments from NPS within the watershed. Again, the slope or gradient within the TMDL reach is low ranging from 0.85 to 1.5 feet per mile with associated low flow velocities in the Grand River of less than 0.5 feet per second and even less in the Portage River base flow conditions during the summer months. Such languid conditions enhance the deposition of suspended solids discharged to the river from urban runoff, agricultural, modified wetlands, and/or construction sites during substantial precipitation and runoff events. The TMDL reach serves as a depositional zone for fine particulate solids resulting in a storage reach of homogeneous sediments that appears to be resistant to downstream transport.

The absence of acceptable fish and macroinvertebrate communities in the defined biota TMDL reach is attributable, in part, to: 1) excessive sedimentation of fine particulate organic materials; 2) sediment obscured and impaired habitat suitable for sustaining either an acceptable fish and/or macroinvertebrate community; and 3) summer minimum DO concentrations of less than the minimum WQS of 5.0 mg/l that is attributed to SOD and pollutant loadings during storm/runoff events at the city of Jackson. A low gradient (1.5 to 0.85 feet per mile) and associated low stream flow velocity (<0.5 feet per seconds) in the TMDL reach facilitate sedimentation of the pollutant loads that contribute to the impaired biological communities and habitat quality of the reach. The resulting conditions generally minimize the potential for suitable fish spawning areas, refugia habitat, and reduced habitat for feeding resources (macroinvertebrate community).

Wooded and emergent wetlands dominated the adjacent land use corridors of the upper Grand River and Portage River Watershed prior (circa 1800) to settlement and land use development (Michigan Resource Information Systems [MIRIS], 2003). Extensive reaches of both rivers have since been substantially channelized to facilitate drainage of the streams and foster settlement and agricultural land use development. The Portage River has been highly modified by dredging to maximize and facilitate upland drainage.

The 1978 land use inventory (MIRIS, 2003) indicates that the Grand River and Portage River corridors are dominated by wooded and/or emergent wetlands, agricultural and urbanized residential, industrial, and commercial areas associated with the city of Jackson. Runoff and washoff from the impervious surfaces of the city of Jackson serve as the major source of TSS

loads to the biota TMDL reach. Extensive use of structural features, including impervious surface areas (e.g., roads, roof, and parking lots), curb and gutter, and numerous direct storm water discharges contribute to rapid precipitation runoff rates to and flashy flow events in the Grand River. Therefore, the major contributing source of solids loads to the Grand River in the biota TMDL reach appears to be from urban, residential, industrial, commercial, suburban, and agricultural land uses, the latter primarily associated with the Portage River Watershed.

Monthly mean (50%) and 95% exceedance design flow estimates characterize the Grand and Portage Rivers as water bodies having sustained, perennial stream flows (Lesmez, 2002). The soil in the corridor adjacent to the biota TMDL reach of the Grand River is dominated by poorly drained, Cohoctah fine sandy loam common to this floodplain (McLeese, 1981 and MIRIS, 2003). The vegetative cover associated with the floodplain is mixed hardwood growth dominated by oak, hickory, beech, and silver maple. The Portage River corridor is dominated by hydric soils; including Palm muck, Houghton muck, and Edwards muck, that are all poorly drained soils subject to ponding and common to emergent wetlands and drainageways (McLeese, 1981). Extensive channelization of the Portage and Grand Rivers was completed over the past 50 years or more to facilitate agricultural, urban, and other landuse development.

Background TSS Loadings:

Background (upstream of the city of Jackson) TSS loadings were derived based on a review of available TSS monitoring data (Storage and Retrieval System [STORET] database since 1976) for the Grand River at Hague and Draper Roads in addition to results from a July 28-31, 2002, wet weather event monitoring of the north branch Grand River at Fahalee Road (LTI, 2003 - in draft). An overall average TSS concentration of 7 mg/l (range 1 to 27 mg/l, N=21) characterized the Hague and Draper Roads sampling sites. An average TSS concentration of 8.2 mg/l (range 5 to 12, N= 9) characterized stream conditions at Falahee Road that presumably had experienced a 4.93-inch rainfall during the sampling period of July 26-31, 2002 (Jackson Airport weather monitoring station database). Rockafellow (2003 - in draft) reports TSS concentrations during stable flow conditions (49 cubic feet per second [cfs] at the United States Geological Survey [USGS] Jackson gage) at High Street and Falahee Road of 11 and 8 mg/l, respectively. Overall, the TSS results for the reach of river upstream from the city of Jackson imply fairly stable flow conditions and slow response to storm events.

Background TSS concentrations are typically less than 15 to 20 mg/l during stable flow conditions (STORET database retrievals). For the wet weather events monitored during July 2002, the average background TSS concentration was assumed to be 15 mg/l (during the three monitored runoff events assessed) with pre-storm event stream flows, upstream of the city of Jackson of 45 (29.1 million gallons per day [mgd]), 44 (28.4 mgd), and 33 cfs (21.3 mgd). The resulting background estimates of TSS loads for the three storm runoff events are 3,640; 3,555; and 2,666 pounds per day.

Individual and General NPDES Permitted TSS Loadings:

The NPDES permitted sources of TSS contributing to the immediate watershed influencing the biota TMDL reach include: 10 facilities covered by individual permits; 11 facilities covered by general permits (Table 1); numerous (90) industrial storm water permits (Table 2); about 40 construction sites covered by notices of coverage (Table 3); and 42 municipal storm water outfalls (Table 4) that discharge to the upper Grand River Watershed (Figure 2). The municipal storm water outfall locations were provided by the city of Jackson as part of their Phase II Municipal Separate Storm Sewer Systems (MS4) application (Figure 3).

The 10 facilities with individual NPDES permits have a combined daily maximum design flow discharge volume of 23.0 mgd or 8,290 million gallons per year (mgy). Two of the facilities (Jackson WWTP - permit number MI0023256 and Leoni Township (Twp.) WWTP – permit number MI0045942) have two seasonal daily maximum TSS limits of 25 and 30 mg/l and 20 and 30 mg/l, respectively. These seasonal limits were used to estimate annual TSS loads for the seasonal dischargers (Table 5). For the other eight facilities, a worst-case estimate of total TSS loadings was made assuming a TSS monthly average concentration of 30 mg/l (Table 5). The estimated daily maximum total TSS loading from the ten facilities is 4,324 pounds or 1.58 million pounds per year. Facility daily monitoring reports indicate that monthly average TSS concentrations and loadings are substantially less. This is especially true of the Jackson WWTP, which is maintained and operated as an advanced wastewater treatment facility (currently discharges an average flow of 12 mgd and has for the years 2000, 2001, and 2002) and had effluent monthly average TSS concentrations that ranged from 3 to 10 mg/l.

Of the 11 facilities with general discharge permits, the four wastewater sewage lagoon (WWSL) dischargers have seasonal effluent limits of 40 and 70 mg/l TSS. The other seven permits are not required to measure TSS; however, an estimate of TSS loadings was derived using an assumed monthly mean of 30 mg/l TSS and a combined total design discharge (for the 11 facilities) of about 1.5 mgd. The estimated daily TSS loading is 397 pounds or 144,905 pounds per year (Table 5). The sum of estimated TSS loadings from the facilities with the individual NPDES permits and general permits combined represents a daily TSS loading of 4,721 pounds or 1.72 million pounds per year.

NPDES Permitted Construction Site TSS Loadings:

TSS loadings are unknown and in the absence of complaints are regarded minimal as far as TSS loadings to the Grand River and biota TDML reach. Therefore, in the absence of sufficient information to implicate in the TSS loadings to the Grand River, their collective loadings estimate equals zero. An alternative is to include these potential sources in with the storm water TSS loadings estimates for wet weather events (below).

Industrial and Municipal Storm Water TSS Loadings:

The influence on the Grand River by wet weather runoff events associated with industrial and municipal storm water runoff from the vicinity of the city of Jackson were assessed as follows: TSS monitoring data (Rockafellow, 2003) indicates that during stable flow conditions (instantaneous flow measure of 48 cfs) at the USGS Jackson gage, in-stream concentrations of TSS ranged from 9 to 15 mg/l (Monroe Street and Parnall Road, respectively) in the reach commonly influenced by storm water runoff/washoff from the city of Jackson and industrial sites. Available TSS monitoring data from several STORET stations located from Hague Road downstream to the Michigan Department of Corrections (MDC) Cooper Street prison site (380164, 380256, 380258, 380084, 380262, 380257, 380225, 380085, 380086, and 380259) indicates TSS concentrations commonly range from 10 to 27 mg/l during stable flow conditions.

A July 2002 wet weather assessment of the Grand River Watershed (LTI, 2003 - in draft) showed substantial increases in several parameters in the Grand River at the MDC Cooper Street prison site including TSS (Table 6). Substantial increases occurred in river flows measured at the USGS Jackson gage of 77 cfs (increase from 45 to 122 cfs) in response to a 0.93-inch rainfall (July 9, 2002); 106 cfs (increase from 44 to 150 cfs) in response to a 0.16-inch rainfall (July 18, 2002); and 370 cfs increase (increase from 33 to 403 cfs) in response to a 1.33-inch rainfall (July 26, 2002). Instantaneous TSS concentrations collected at the MDC Cooper Street prison site during these same wet weather, runoff events ranged (average) from

10 to 140 mg/l (65 mg/l), 30 to 170 mg/l (79 mg/l), and 14 to 400 mg/l (203 mg/l) for the first three rainfall events, respectively (Table 7).

Estimating the wet weather washoff/runoff influence from the city of Jackson on the Grand River TSS loads involved two major assumptions: 1) that background flow conditions and TSS concentrations (upstream of the city of Jackson) are relatively stable and slow in response to storm events, and 2) that the observed increases in Grand River flows and TSS increases measured at the MDC Cooper Street prison site during the three storm events assessed in July 2002, are 100% attributable to industrial and municipal storm water runoff/washoff sources in the vicinity of the city of Jackson and, in part, resuspension of in-place solids. Instantaneous river flows for the MDC Cooper Street prison site were based on the time of passage (2.5 to 3.0 hours) between the USGS Jackson gage values and the MDC Cooper Street prison site. TSS sample results from the MDC Cooper Street prison site were used to derive storm event-related response increases in Grand River flow and TSS loadings (Table 8). The Grand River response to wet weather events increased river flows at the USGS gage site by 77, 106, and 370 cfs, respectively, and daily mean TSS loads by 93% (64,191 pounds per day) on July 9, 2002; 90% (47,559 pounds per day) on July 18, 2002; and 99% (379,103 pounds per day) on July 26, 2002, respectively (Table 9). Additional wet weather runoff/washoff and river monitoring is required to better define the seasonal contributions of both runoff volume and washoff TSS loadings to the Grand and Portage Rivers that affect the biota TMDL reach.

Sunday (2003) estimated the annual loads of TSS to the Grand River reach from combined industrial and municipal storm water runoff of 4.6 million pounds.

In summary, excessive sedimentation of the Grand River is primarily associated with elevated levels of impervious surface runoff/washoff from industrial sites, the city of Jackson, other land development activities, soil erosion from agricultural sources in the Portage River Watershed, and stream bank erosion due to the erosive effects of excessive runoff rates. Upland development and channelization of the Grand River and Portage River reaches has disrupted the "natural" hydrology throughout the watershed resulting in periodic erosive, flashy flows following wet weather runoff events. These alterations to the Grand River Watershed have destabilized stream banks, increased sediment loads, and reduced or eliminated desirable fish and macroinvertebrate habitat.

Linkage Analysis: Linkage is defined as the cause and effect relationship between the selected sources and indicators. The linkage between the presence of acceptable fish and macroinvertebrate communities in the biota TMDL reach is related to improved habitat quality through the reduction in siltation and sedimentation.

The primary source of accumulated silts and sedimentation in the biota TMDL reach is attributed to the historic discharge of organic material from CSOs, eroded organic materials from the Portage River reach, point sources, and solids loadings from wet weather runoff/washoff from impervious surface areas in the urban area of the city of Jackson. Severe embeddedness and bottom deposition of fine organic/silt materials at Maple Grove Road have impaired habitat conditions. Siltation, sedimentation, and embeddedness of colonizable substrates have been demonstrated to impair the biological integrity of rivers by obscuring or reducing the suitability of colonizable or useable substrate by stream biota (Waters, 1995). With a reduction in sedimentation, the fish and macroinvertebrate communities typically respond with an increase in species diversity and an increase in the number of individuals of each species. This commonly results from increased habitat diversity as sedimentation rates decline. As a result, the Procedure 51 assessment scores and ratings for fish and macroinvertebrate communities and habitat quality are expected to increase as siltation and sedimentation rates decline,

embeddedness decreases, and habitat diversity increases. These latter characteristics will serve to demonstrate improvement in habitat conditions, WQS attainment, and overall stream quality as expressed through an acceptably rated biological community.

TMDL DEVELOPMENT

The TMDL represents the maximum loading that can be assimilated by a water body while still achieving WQS. Because the biotic community has been impaired by excessive sedimentation and flow instability, this TMDL will be based on the response of the fish and macroinvertebrate communities to the reduction of sedimentation. The TMDL is based on reducing sediment loads throughout the watershed to a level that supports a biological community of the stream that meets WQS. Using the metrics from Procedure 51, a numeric score of -4 for both fish and macroinvertebrate communities and a habitat score of 96 or greater will serve as primary targets for this biota TMDL.

Concurrent with the selection of numeric endpoints, TMDL development also defines the environmental conditions that will be used when defining allowable levels. Some TMDLs are designed around the concept of critical condition. A critical condition is defined as the set of environmental conditions that, if controls are designed to protect, will ensure attainment of objectives for all other important conditions. For example, the critical conditions for the control of point sources in Michigan are provided in Rules 323.1082 and 323.1090 of Michigan's WQS. In general, the lowest monthly 95% exceedance flow for a stream is used to establish effluent limits for point sources. However, the primary sediment inputs to the Grand River and Portage River are attributable to wet weather driven discharges. As such, there is no single condition that is protective for all conditions but efforts will be directed towards wet weather runoff/washoff events.

The target of 80 mg/l TSS was used to develop a secondary TMDL loading goal for TSS loads during wet-weather runoff/washoff events, especially from the urban/industrial/built-up land use categories and agricultural land use source areas.

Allocations: TMDLs are comprised of the sum of individual waste load allocations (WLAs) for point sources and load allocations (LAs) for NPS and natural background levels. A margin of safety (MOS), either implicit or explicit, is also a component or accounts for uncertainty in the relationship between pollutant loads and the quality of the receiving waters. Conceptually, this relationship is defined by the equation:

$$TMDL = S^{WLAs} + S^{LAs} + MOS$$

where the acronym TMDL refers to a maximum loading of a pollutant or stressor that can be discharged to a receiving water and still meet WQS. The overall loading capacity is subsequently allocated into the TMDL components of WLAs for point sources, LAs for NPS, and the MOS.

A phased-approach was selected to address both the biota TMDL and DO TMDL (Sunday, 2003) reaches with a target reduction in land use-related TSS loads of 50% to the Grand River in the vicinity of Jackson and Portage River. The 50% TSS load reduction was chosen in part due to the results of DO modeling, which indicates that SOD in the reaches of concern should be reduced by approximately 30 to 85%, depending on the reach under consideration, in order to achieve the DO standard. The existence of considerable uncertainties, which make it difficult to quantify the effects of TSS loads on in-stream DO levels, make the proposed 50% reduction a reasonable objective. Subsequent phases of the TMDL may lead to changes in this target. A

wet weather event in-stream numeric target of 80 mg/l TSS (as an annual average during wet weather events) is, herein, established to reduce TSS loads to the biota TMDL reach.

In preparation of a DO TMDL for the upper Grand River, Sunday (2003) estimated the total annual contribution of TSS from the various categories of land use in the immediate Grand River and Portage River Watersheds upstream of the biota TMDL to be 9.4 million pounds and 7.07 million pounds, respectively (Table 10).

Municipal and industrial storm sewer runoff/washoff to the Grand River (16% of the land use area) accounts for 49% or 4.59 million pounds of the annual TSS load contribution to the Grand River (Sunday, 2003). The NPS (84% of the land use area) accounts for 51% or 4.81 million pounds of the annual TSS load contribution to the Grand River reach. An annual permitted total TSS load of 1.7 million pounds represents contributions by the individual and general NPDES permitted facilities that discharge to the biota TMDL reach (Table 5).

Of the estimated 7.07 million pounds of TSS composing the annual load to the Portage River, less than 7,000 pounds (herein expressed as 0.01 million pounds) are annually discharged from the three WWSLs in the watershed (Table 5). Therefore, since there are no permitted industrial and municipal storm water discharges to the Portage River, approximately 100% of the storm water TSS loads to the Portage River are from NPS.

The proposed 50% reduction in the current estimated land use annual TSS loads for the Grand and Portage Rivers will result in total annual TSS load reduction targets of 6.42 and 3.55 million pounds (total of 9.97 million pounds), respectively (Table 10).

WLAs: The WLA defines the load capacity for a pollutant that are NPDES permitted in origin. This includes individual, general permitted facilities, and permitted industrial and municipal storm water outfalls (those as part of the Phase II MS4 storm water permitting program).

The annual TSS numeric target load for the Grand River reach is 4.01 million pounds for the WLA. This includes 1.71 million pounds for individual/general permitted facilities as allocated in Table 5 plus 2.3 million pounds for the industrial/municipal storm water sources. The storm water sources include both industrial outfalls and the city of Jackson's municipal Phase II MS4 outfalls (Tables 2 and 4).

LA: The LA defines the load capacity for a pollutant that is nonpoint in origin, including natural background sources.

The LA annual TSS allocation to the Grand River of 2.41 million pounds involves the townships of Summit, Blackman, and Leoni located in Jackson County (Table 10). This allocation includes storm water and snowmelt runoff from these townships to the Grand River Watershed primarily in the developed areas tributary to the reach north of the city limits of Jackson. This includes runoff drainage to the Hurd-Marvin and Tobin-Snyder Drains.

The annual LA TSS numeric target load for the Portage River is 3.54 million pounds. This is based on a 100% land use coverage that is NPS in origin that includes contributions from the following townships: Blackman, Leoni, Grass Lake, Waterloo, Henrietta, Bunkerhill, Ingham, Stockbridge, Lyndon, and Sylvan (Figure 2).

MOS: The MOS in a TMDL is used, in part, to account for variability of source inputs to the system and is either implicit or explicit. An MOS is implicit for a biota TMDL because the quality

of the biological community, its integrity, and overall composition represent an integration of the effects of the spatial and temporal variability in sediment loadings to the aquatic environment.

The habitat target score of 96 or greater will be used to demonstrate acceptable stream quality conditions and represent adequate control of anthropogenic sediment sources to assure improved habitat quality and the biological communities. This targeted score is closely associated with macroinvertebrate community scores of -3 or greater, potentially providing better results than a minimally acceptable value of -4.

For comparison of survey assessment with results from August 2001, follow-up biological and habitat quality assessments will be conducted during stable flow conditions within the months of June through September. The results will best reflect an MOS that is implicit and express an integration of the effects of the variability in sediment loads in the aquatic environment and minimize seasonal variability.

Seasonality: Seasonality is addressed in the TMDL in terms of sampling periods for fish and macroinvertebrate communities. To minimize temporal variability in the biological community, sampling will be conducted during June through September of each year during stable flow conditions. For assessing TSS loads to the Grand River, seasonal event monitoring will be conducted to define and characterize both hydraulic and TSS loads to the Grand River and Portage Creek Watersheds that influence the biota TMDL reach.

Monitoring Plan: Monitoring will be conducted by the MDEQ to assess progress towards meeting the biota TMDL targets, following implementation of applicable BMPs and control measures. Annual sampling of the macroinvertebrate community and habitat quality at High Street, Monroe Street, Parnall Road, Maple Grove Road, and US-127, as a minimum, will be conducted until assessment results from two consecutive years demonstrate attainment of TMDL targets at these sites. Fish communities will also be assessed at Maple Grove Road to assess response to TSS load reductions. For best comparative purposes, follow-up biological and habitat assessments will be conducted between June and September, during stable flow conditions. Every effort will be made to assess the same sampling locations and sample during similar river flow conditions.

Once the BMPs are in place to minimize the effects of urban and agricultural runoff rates and TSS loads, stream flow and TSS sampling can be implemented to measure progress towards the secondary numeric target of 80 mg/l as a mean annual TSS value during wet weather events. Multiple sampling during seasonal, critical high flow events, as well as low flow events, need to be conducted to better estimate TSS loads to the biota TMDL reach from both the Grand River and Portage River Watersheds.

Reasonable Assurance: The focus of the actions to protect the biota TMDL reach of the Grand River is directed toward installing BMPs and other control measures to reduce and minimize controllable source sediment loads and excessive runoff discharge rates. The actions are to reduce sedimentation impacts on available habitat and biological communities and minimize and stabilize flow conditions in the Grand River in response to wet weather runoff/washoff events. Overall control measures include: complete CSO elimination, individual and general NPDES permit limits maintained, and storm water permits that include BMPs and BMPs for areas not under any permit.

For the WLA, existing NPDES permit requirements will be adequate to meet the target. Storm water permits require the units of government to develop a plan that includes the detailing of short- and long-term goals and attainment actions; public education plans; illicit discharge

elimination plans; and the development of individual storm water pollution prevention plans by each local unit of government.

A watershed management plan for the upper Grand River Watershed has been developed by the upper Grand River Watershed Planning Initiative Steering Committee (Tetra-Tech, 2003 - in draft). The final plan is to be received by the MDEQ by September 2003 and reviewed to determine eligibility for funding by Michigan's Clean Michigan Initiative grant.

MDEQ Jackson District staff will continue to work with and assist interest groups in the upper Grand River Watershed. MDEQ involvement is to assist in defining and designing approvable actions and programs that assess, develop, plan, and implement BMPs and control measures that best minimize or prevent soil erosion and excessive runoff rates to the upper Grand River and Portage River Watersheds.

The MDEQ's Guidebook of BMPs for Michigan Watersheds (Peterson et al., 1993, as modified) can be used to develop BMP elements that should include:

- Upgrade and maintain the current vegetative riparian zone to reduce soil erosion and loads to the Portage River from farmland, subdivision, and urban sources. BMPs need to be employed within the riparian zone adjacent to the farmland to minimize the loss, through erosion and direct runoff, thereby minimizing habitat impairment and preserving farmland soils.

- Implementation of BMPs in the storm water permit program that reduces sediment loads and moderate runoff/washoff release rates and excessive runoff to the Grand River and Portage River Watersheds are expected to improve and protect designated use support throughout the watershed. The goals reduce solids loads and provide greater flow stability (reduced release rates) throughout the watershed so that WQS are restored and protected. Recent guidance regarding runoff detention and stream protection is provided by Fongers and Fulcher, 2001.

MDEQ approval of BMPs and implementation plans will be required prior to implementation of proposed structural improvements. These reasonable assurance actions will proceed to implement this TMDL under the phased approach. The collection of additional data is to determine if anticipated improvements in WQS are occurring or attained. If the numeric target is not met, the TMDL will be reevaluated and modified as appropriate.

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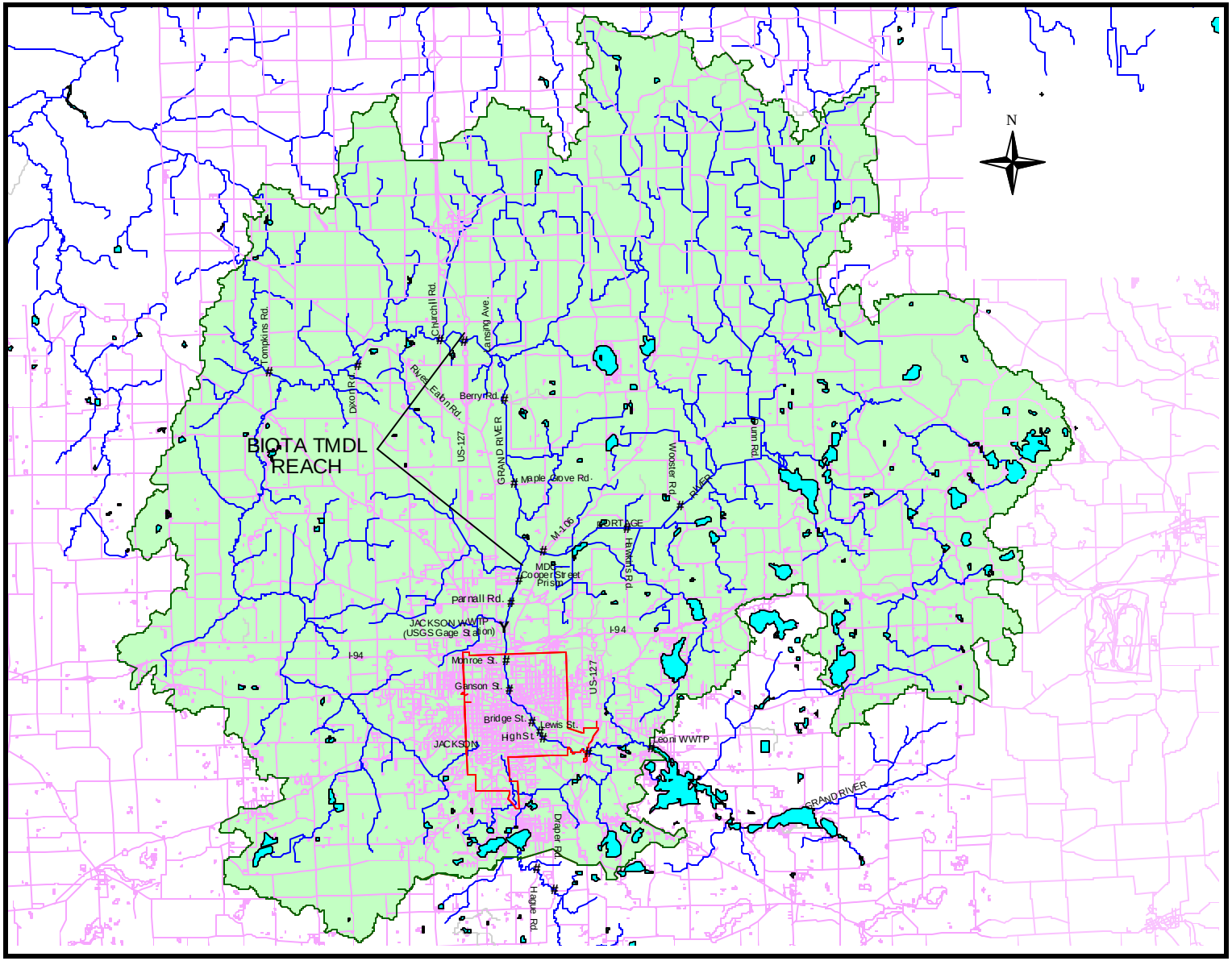

Figure 1. Biota TMDL reach in the vicinity of the city of Jackson and downstream of the confluence of the Grand River and Portage River, Jackson County, Michigan

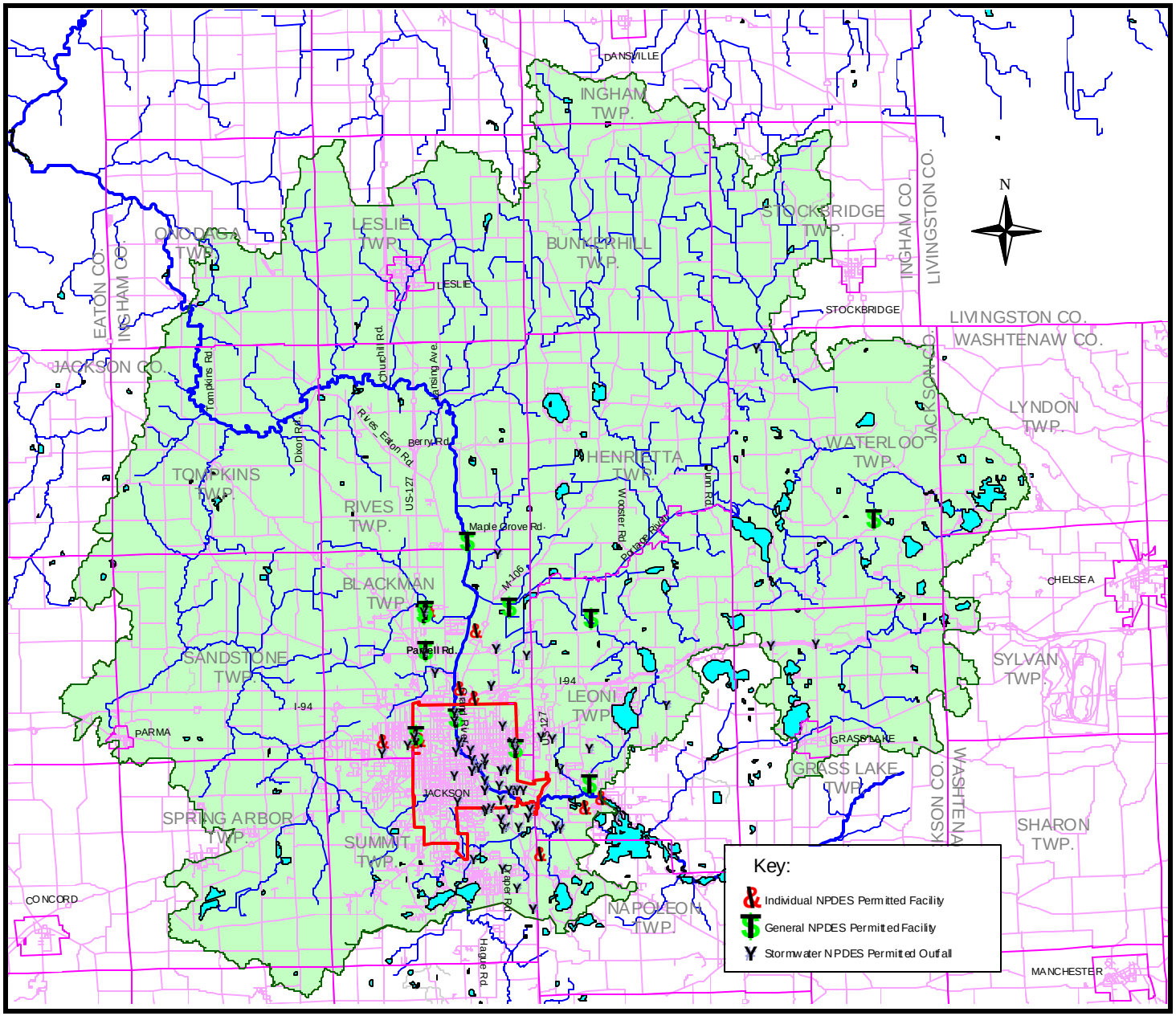

Figure 2. NPDES permitted (individual, general, and storm water) discharges in the upper Grand River Watershed, vicinity of Jackson, Michigan.

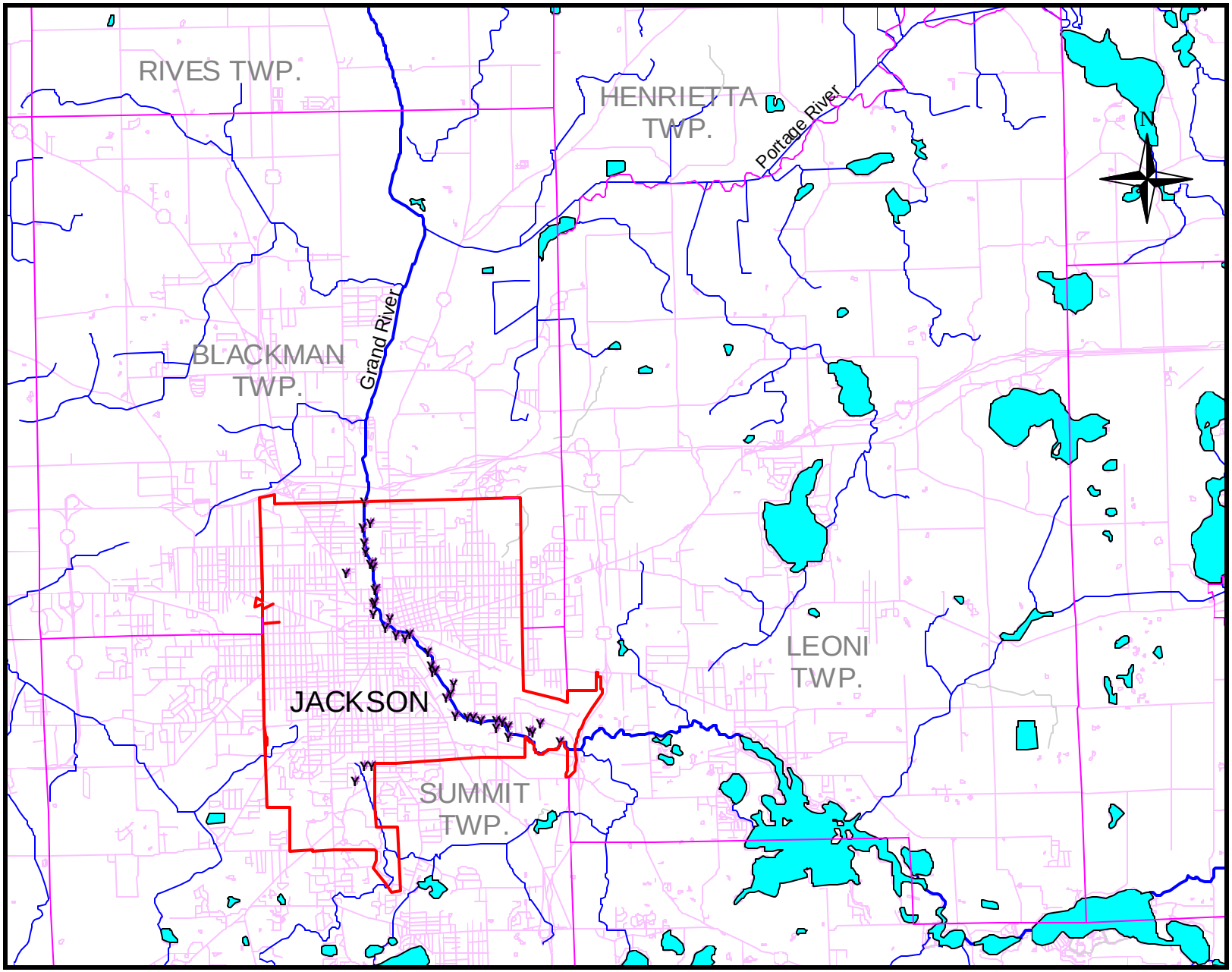

Figure 3. City of Jackson's municipal storm water outfalls to the upper Grand River Watershed, Jackson County, Michigan.

Table 1. Individual and general NPDES permitted outfalls to the Grand River and Portage River Watersheds in the vicinity of Jackson. Source: MDEQ/WD's NPDES Permit Management System (NMS); *MGY = million gallons per year.

PERMIT NUMBER	FACILITY	RECEIVING WATERS	DESIGN FLOW (MGY*)	LATDD	LONGDD
Individual NPDES Permits:					
MI0023256	Jackson WWTP	Grand River	6935.00	42.27611	-84.40611
MI0028461	Quanex Corp-Mac Steel Division	Grand River via wetland and Akerson Drain	55.00	42.20556	-84.36222
MI0041998	Mich Center School District	Murray Lake	0.12	42.22444	-84.33694
MI0045403	Marathon Ashland Petro-Jacks	Grand River via Tobin Snyder Drain	39.00	42.31028	-84.42361
MI0045942	Leoni Twp WWTP	Grand River at Center Lake outlet	949.00	42.23860	-84.25750
MI0046809	Citgo Corp-Jackson	Grand River via Tobin Snyder Drain	171.00	42.30889	-84.42250
MI0051683	Mechanical Products	Grand River via storm sewer	33.00	42.27167	-84.39861
MI0054976	MDC-SPSM-GWCU	Grand River	26.00	42.30000	-84.39583
MI0055042	Plastigage Corp	Hurd Marvin Drain via storm sewer	64.00	42.25417	-84.45000
MI0056006	TRW Inc-Jackson	Grand River	18.30	42.25417	-84.42917
		Total Design Discharge (mgy):	**8290**		
General Permits:					
MIG080265	Wolverine Pipeline Co-Jackson	Tobin Snyder Drain	10.50	42.30722	-84.42528
MIG250042	Industrial Steel Treating Co	Grand River	100.40	42.25583	-84.43194
MIG250355	ADCO Products Inc	Grand River	27.40	42.23417	-84.33389
MIG250360	Lefere Forge & Machine	Grand River	4.40	42.25000	-84.37500
MIG250365	Mid-American Products	Grand River	21.90	42.26250	-84.40833
MIG250396	B & H Machine Inc	Tobin Snyder Drain	18.30	42.29167	-84.42556
MIG580001	MDC-Waterloo WWSL	unnamed trib. to Portage River	10.95	42.34361	-84.17000
MIG580258	MDC-SPSM-Wing WWSL	Portage River	3.00	42.30972	-84.37778
MIG580259	MDC-SPSM-Dale Foltz TC WWSL	Wildcat Creek	0.50	42.30417	-84.33194
MIG580274	Sherman Oaks MHP WWSL	Grand River	34.00	42.33750	-84.40000
MIG670278	Equilon Enterprises-Jackson	Rives-Blackman Drain	307.00	42.30861	-84.42444
		Total Design Discharge (mgy):	**538**		

Table 2. NPDES permitted industrial storm water outfalls to the Grand River and/or Portage River Watersheds in the vicinity of Jackson.

PERMIT NUMBER	FACILITY	TYPE	LATDD	LONGDD
Storm Water NPDES Permits:				
MIR011159	Eaton Hydraulics Inc	Industrial Stormwater Only	42.20000	-84.38333
MIR011220	Wolverine Vinyl Siding	Industrial Stormwater Only	42.24417	-84.39250
MIR011324	Jackson County Airport	Industrial Stormwater Only	42.25972	-84.45917
MIR011327	Thompson-McCully Co-Jackson	Industrial Stormwater Only	42.27722	-84.38833
MIR011332	Legends Mfg Inc	Standard	42.25389	-84.47583
MIR011338	Tenneco Auto Grass Lk	Industrial Stormwater Only	42.29167	-84.22917
MIR011339	Midbrook Inc	Industrial Stormwater Only	42.22444	-84.39306
MIR011340	Camshaft Machine Co	Industrial Stormwater Only	42.28306	-84.41972
MIR011341	Fourway Machine	Industrial Stormwater Only	42.25528	-84.36028
MIR011342	Hydraulic Systems Inc	Industrial Stormwater Only	42.22611	-84.38917
MIR011343	USF Holland Inc-Jackson	Industrial Stormwater Only	42.25222	-84.47833
MIR011344	C & K Box Company	Industrial Stormwater Only	42.25306	-84.43528
MIR011345	Production Engr Inc	Industrial Stormwater Only	42.21778	-84.38083
MIR011347	Worthington Specialty Proc	Industrial Stormwater Only	42.19167	-84.37500
MIR011348	Mich Auto Compressor Inc	Industrial Stormwater Only	42.26722	-84.54167
MIR011350	Blu-Surf Inc	Industrial Stormwater Only	42.25833	-84.55000
MIR011351	Pioneer Foundry Co Inc	Industrial Stormwater Only	42.24278	-84.39750
MIR011352	O' Briens Trading Post	Industrial Stormwater Only	42.22139	-84.31944
MIR011353	Edscha Jackson	Industrial Stormwater Only	42.25306	-84.37611
MIR011405	UPS-Jackson	Industrial Stormwater Only	42.21667	-84.38333
MIR011418	United Metal Technology Inc	Industrial Stormwater Only	42.26750	-84.28861
MIR011419	Willbee Transit Mix	Industrial Stormwater Only	42.25417	-84.50833
MIR011441	Crankshaft Machine Group	Industrial Stormwater Only	42.24972	-84.40833
MIR011445	Michner Plating-Angling Road	Industrial Stormwater Only	42.22917	-84.38333
MIR011447	Elm Plating Co Plt 2	Industrial Stormwater Only	42.23333	-84.37639
MIR011448	Elm Plating Co-Plt 1	Industrial Stormwater Only	42.22500	-84.39167
MIR011449	H & M Welding & Fab	Industrial Stormwater Only	42.24167	-84.35000
MIR011450	McGill Road Landfill	Industrial Stormwater Only	42.28944	-84.36750
MIR011451	Jackson Co Dalton Road LF	Industrial Stormwater Only	42.29306	-84.38472
MIR011452	Jackson Co RRF	Industrial Stormwater Only	42.29306	-84.38472
MIR011453	Conway Central Express-XJA	Industrial Stormwater Only	42.25000	-84.33333
MIR011455	Mich ARNG Jack Armory OMS12	Industrial Stormwater Only	42.25000	-84.40000
MIR011456	American Tooling Center Inc	Industrial Stormwater Only	42.29167	-84.20417
MIR011457	Miller Tool & Die Co	Industrial Stormwater Only	42.23333	-84.39167
MIR011458	Clarklake Machine Inc	Industrial Stormwater Only	42.18333	-84.36667
MIR011459	Allied Chucker & Engr Co	Industrial Stormwater Only	42.27500	-84.48750

Table 2. (cont.)

PERMIT NUMBER	FACILITY	TYPE	LATDD	LONGDD
MIR011460	Way Bakery Div	Industrial Stormwater Only	42.23333	-84.37083
MIR011461	Dawn Food Products	Industrial Stormwater Only	42.22500	-84.36667
MIR011462	Advance Packaging Corp-Jac	Industrial Stormwater Only	42.23333	-84.37500
MIR011464	Michner Plating-N Mechanic	Industrial Stormwater Only	42.25417	-84.40417
MIR011465	Worthington Steel	Industrial Stormwater Only	42.24167	-84.38333
MIR011466	TAC Manufacturing	Industrial Stormwater Only	42.27500	-84.47917
MIR011467	Wolverine Metal Specialties	Standard	42.25417	-84.48333
MIR011468	Dawlen Corp	Industrial Stormwater Only	42.22500	-84.36667
MIR011469	John Crowley Inc	Industrial Stormwater Only	42.24167	-84.40000
MIR011470	Mich Extruded Aluminum	Industrial Stormwater Only	42.25417	-84.35417
MIR011471	C & H Stamping Inc	Industrial Stormwater Only	42.41667	-84.23333
MIR011472	Storey Stone Co	Industrial Stormwater Only	42.20417	-84.40000
MIR011473	Michigan Seat Co	Industrial Stormwater Only	42.22083	-84.38333
MIR011474	Chemical Technologies	Industrial Stormwater Only	42.23333	-84.37917
MIR011475	Liberty Environmentalists	Industrial Stormwater Only	42.18333	-84.36667
MIR011476	Jackson Iron & Metal #1	Industrial Stormwater Only	42.24167	-84.37917
MIR011477	Jackson Iron & Metal #2	Industrial Stormwater Only	42.23750	-84.39167
MIR011478	Andys Airport Auto Parts	Industrial Stormwater Only	42.25000	-84.45000
MIR011482	Miller Truck & Storage	Industrial Stormwater Only	42.24167	-84.38333
MIR011483	Boone's Welding & Fab	Industrial Stormwater Only	42.22917	-84.40833
MIR011484	Mag-Tec Casting Corp	Industrial Stormwater Only	42.21667	-84.35000
MIR011485	Norfolk Southern Jackson	Industrial Stormwater Only	42.24583	-84.40000
MIR011486	Jackson Auto Salvage	Industrial Stormwater Only	42.25417	-84.50000
MIR011491	International Foam & Trim	Industrial Stormwater Only	42.25000	-84.47917
MIR011512	Riverside Grinding Co	Industrial Stormwater Only	42.22472	-84.37917
MIR011513	Specialty Castings Inc	Standard	42.37500	-84.69583
MIR011520	Lefere Forge & Machine	Standard	42.25000	-84.37500
MIR011526	B & H Machine Inc	Standard	42.29167	-84.42556
MIR011527	Mid-American Products	Standard	42.26250	-84.40833
MIR011563	Jackson Iron & Metal-Elm Div	Industrial Stormwater Only	42.23556	-84.38417
MIR011609	Orbitform	Industrial Stormwater Only	42.22139	-84.36861
MIR011610	South Street Automotive	Industrial Stormwater Only	42.21778	-84.35250
MIR011617	Emmons Service Inc	Industrial Stormwater Only	42.23972	-84.40972
MIR011618	Linear Automatic Systems	Industrial Stormwater Only	42.25389	-84.40639
MIR011619	Industrial Steel Treating Co	Standard	42.25583	-84.43194
MIR011641	Bailey Sand & Gravel Co	Industrial Stormwater Only	42.25000	-84.51278
MIR011659	Sams Iron & Metal Co	Industrial Stormwater Only	42.26583	-84.40833
MIR011673	Kaneka Texas Corp	Industrial Stormwater Only	42.27417	-84.48056
MIR011710	Eaton Aeroquip Inc	Industrial Stormwater Only	42.24694	-84.39250

Table 2. (cont.)

PERMIT NUMBER	FACILITY	TYPE	LATDD	LONGDD
MIR011712	Miller Industrial Products	Industrial Stormwater Only	42.24278	-84.39583
MIR011718	Professional Assembly Corp	Industrial Stormwater Only	42.21750	-84.37333
MIR011727	D-CO Limestone LLC	Industrial Stormwater Only	42.33292	-84.38182
MIR020005	Equilon Enterprises-Jackson	Standard	42.30861	-84.42444
MIR020014	Koch Materials Co-Jackson	Industrial Stormwater Only	42.24583	-84.40000
MIR020032	Jackson Power Facility	Industrial Stormwater Only	42.26022	-84.38192
MIS310004	Allied Chucker & Engr Co	Industrial Stormwater Only	42.27500	-84.48750
MIS310007	International Foam & Trim	Industrial Stormwater Only	42.25000	-84.47917
MIS310010	Miller Tool & Die Co	Industrial Stormwater Only	42.23333	-84.39167
MIS310012	Riverside Grinding Co	Industrial Stormwater Only	42.22472	-84.37917
MIS310013	Orbitform	Industrial Stormwater Only	42.22139	-84.36861
MIS310022	Willbee Transit Mix	Industrial Stormwater Only	42.25417	-84.50833
MIS310023	Jackson Auto Salvage	Industrial Stormwater Only	42.25417	-84.50000
MIS310030	Thompson-McCully Co-Jackson	Industrial Stormwater Only	42.27722	-84.38833
MIS310032	John Crowley Inc	Industrial Stormwater Only	42.24167	-84.40000
MIS310033	Michigan Seat Co	Industrial Stormwater Only	42.22083	-84.38333

Table 3. Active NPDES permit notices of coverage for construction sites in Jackson County, Michigan.

PERMIT NUMBER	FACILITY	LOCATION	TWP.	RANGE	SECTION	DATE RECEIVED	EFFECTIVE DATE
MIR102805	SCHOTT-HICKORY HILLS GOLF CLUB	2540 PAR VIEW DR, JACKSON				01/30/1998	01/30/1998
MIR102912	MDOT-M60-JACKSON COUNTY	SPRING ARBOR, SUMMT, AND BLACKMAN TWPS				03/24/1998	03/24/1998
MIR103006	IPL TOLEDO-HANNAWALD STRG YD	M-52, WATERLOO	T1S	R2E	1	05/11/1998	05/11/1998
MIR103095	WATERLOO GOLF COURSE EXPANSION	11800 TRIST RD, GRASS LAKE	T1S	R2E	33	06/17/1998	06/17/1998
MIR103498	KARVOL-TIMS LAKE PRESERVE	KNIGHT RD - MT HOPE RD, GRASS LAKE	T2S	R2E	21	12/15/1998	12/15/1998
MIR103980	GILLESPIE-GALLERY PLACE	PARNALL RD, NE CORNER OF PARNALL AND LANSING RD	T2S	R1W	15	08/11/1999	08/11/1999
MIR104072	STERLING-ASHTON RIDGE APTS	2905 BLAKE RD, JACKSON BETWEEN N ELM AND DETTMAN RD	T2S	R1W	25	09/28/1999	09/28/1999
MIR104174	JMK-ART MOEHN CHEVROLET/HONDA	SEYMOUR RD N OR I-94				11/29/1999	11/29/1999
MIR104208	NORFOLK-SUMMIT GLEN/RIDGE CNDO	BETWEEN MC CAIN AND MORRELL ST NEAR ROBINSON	T3S	R1E	5	11/17/1999	12/29/1999
MIR104362	JCRC-BOARDMAN ROAD EXTENSION	LONGFELLOW TO MAYNARD TO AIRPORT RD				03/08/2000	03/20/2000
MIR104382	JCRC-WILDWOOD/GANSON RECONST	MICHIGAN AVE TO BROWN	T2S	R1W	32,33	03/24/2000	03/24/2000
MIR104492	SUMMIT GLEN/SUMMIT RIDGE	MCCAIN RD, JACKSON	T3S	R1E	5	04/19/2000	05/15/2000
MIR104558	COLBROOK-COLBROOK MEADOWS	JEFFERSON RD AND TIFFANY RD	T4S	R1E	24	06/05/2000	06/05/2000
MIR104644	MOLTON GROUP-CORONADO	NAPOLEON RD & DORRELL RD	T3S	R1E	14	07/07/2000	07/11/2000
MIR104814	BULLINGER/WANDERING CK CONDO	S JACKSON RD S OF FERGUSON	T3S	R1W	21	09/19/2000	09/19/2000
MIR104943	KIRK MERCER	8049 S JACKSON RD	T4S	R1W	3	11/17/2000	11/29/2000
MIR105057	KINDER MORGAN-ORION PLANT	2219 CHAPIN ST, JACKSON	T3S	R1W	36	01/22/2001	01/22/2001
MIR105198	JACKSON CON ENRGY HEADQUARTER	BETWEEN FRANCIS ST ON AIRLINE DR	T3S	R1W	2	03/28/2001	03/28/2001
MIR105197	PENMARK GOODYR TIRE DEMOLITION	1304 PAGE ST, JACKSON	T2S	R1W	36	03/28/2001	03/28/2001
MIR105238	ECCLESIA RIDGE VIEW ESTATES	MICHIGAN AVE, MT. HOPE ROAD, GRASS LAKE TWP	T2S	R2E	33	04/24/2001	04/24/2001
MIR105297	MDOT CS 38111	JN 55900A				05/17/2001	05/17/2001
MIR105301	SCENIC HILLS	SCENIC HILLS DRIVE	T2S	R1E	29	05/18/2001	05/21/2001
MIR105498	DRS-MYSTIC HILLS-GRANDE GOLF	FLOYD RD NEAR US-127			24, 25	07/30/2001	08/24/2001
MIR105566	GANTON'S-TERRACE HILLS 1A & 1B	ROBINSON & SPRING ARBOR RD, JACKSON	T3S	R1W	7	09/21/2001	09/21/2001
MIR105586	LEFERE-SPEEDWAY-KART TRACK	PAGE AVE, JACKSON	T3S	R1E	6	09/17/2001	10/03/2001
MIR105614	MDOT-US127 RECONSTRUCTION		T3S	R1E		10/17/2001	10/17/2001
MIR105665	SUN COMM-WINDHAM HILLS	COUNTY FARM RD, JACKSON	T2S	R1W	19	11/20/2001	11/20/2001
MIR105695	JACKSON CO-FRANCIS ST RECONST	FRANCIS ST MCDEVITT TO SOUTH ST, JACKSON	T3S	R1W	10,11,14,22,23	11/26/2001	12/04/2001
MIR105704	TAC-MFG PLANT ADDITION	4111 COUNTY FARM RD	T2S	R1W	30	11/30/2001	12/07/2001
MIR105886	MJ FARMS-GREENBRIAR PH 2	KING RD, SPRING ARBOR	T3S	R2W	9	03/25/2002	03/25/2002
MIR105925	MDOT-M50 / US127 BL	NORTH ST TO BOARDMAN RD	T2S	R1W	27,28,33,4	04/05/2002	04/05/2002
MIR105996	VISTA GRANDE VILLA EXPANSION	2251 SPRINGPORT RD	T20S	R1W	28	05/08/2002	05/08/2002
MIR106096	HOME DEPOT-INSTALLMENTS	1400 W MONROE ST	T2N	R1W	28	06/14/2002	06/14/2002
MIR106113	SD-ARBORS @ THE WOODS	DETLMAN & AMOS, JACKSON	T2S	R1W	36	06/19/2002	06/19/2002
MIR106173	HOME DEPOT STORE 2770-JACKSON	NW CORNER OF MONROE & WISNER ST	T2N	R1W	28	07/18/2002	07/18/2002
MIR106172	NORFOLK-SUMMIT GLEN/OAK GROVE	BARRINGTON CIRCLE, JACKSON	T3S	R1E	5	07/18/2002	07/18/2002
MIR106194	SANCTUARY OF BRILLS LK PH 2	3650 WHIPPLE RD, JACKSON	T2S	R1E	22	07/30/2002	07/30/2002
MIR106265	WELLHOFF-BRENDAN ESTATES	M-50, NAPOLEON	T4S	R1E	1	08/21/2002	08/21/2002
MIR106529	MDOT-US127, JACKSON		T4S	R1W	13	01/16/2003	01/16/2003

Table 4. City of Jackson identified municipal storm water outfall locations to the Grand River. Provided as part of Phase II MS4 storm water permit program.

OUTFALL LOCATION DESCRIPTION	LATDD	LONGDD
E. of N. Blackstone St.	42.26925	-84.40983
E. Monroe St. (W. Price St.)	42.26576	-84.40851
W. Monroe St.	42.26495	-84.41011
Adams St. (W)	42.26243	-84.40997
Myrtle St. (W)	42.26102	-84.40969
North St. (NE)	42.25913	-84.40813
North St. (NW)	42.25892	-84.40859
North St. (SE)	42.25840	-84.40767
Mongomery St.	42.25739	-84.41426
Gauson St. (NE)	42.25475	-84.40725
Gauson St. (NW)	42.25460	-84.40771
W. Trail St. (NW)	42.25247	-84.40813
W. Trail St. (NE)	42.25268	-84.40754
N. Jackson St. (N of RR)	42.25040	-84.40822
Oak St. (N of Detroit St.)	42.24978	-84.40448
Mechanic St. (E) (N of Mich. Ave.	42.24806	-84.40541
Francis St. (@ W. Cortland Ave.)	42.24692	-84.40323
S. Airline Dr. (S. Louis Glick Hw	42.24630	-84.40134
Hupp Ave. (N)	42.24711	-84.40001
Hupp Ave. (S)	42.24396	-84.39608
Amur St.	42.24182	-84.39538
Bridge St. (NW)	42.24075	-84.39502
Bridge St. (NE)	42.24096	-84.39437
Mitchell St. (ext. W)	42.23854	-84.39040
Louis St. (SW)	42.23630	-84.39188
Louis St. (NE)	42.23692	-84.39105
High St. (W)	42.23320	-84.38994
High St. (SW)	42.23293	-84.38745
High St. (SE)	42.23282	-84.38615
S. Elm Ave.	42.23245	-84.38435
Losey Ave. (N)	42.23238	-84.38089
Losey Ave. (S)	42.23117	-84.38089
Gorham St.	42.23221	-84.37946
Clara St. (N)	42.23117	-84.37794
Clara St. (S)	42.22962	-84.37803
Research Ave. (NW)	42.23042	-84.37355
Research Ave. (SE)	42.23004	-84.37290
E. High St. (S)	42.23162	-84.37078
Dirlam Dr.	42.22856	-84.36653
Goodrich St. & W. South St. (S)	42.22515	-84.41094
S. Jackson St. & W. South St. (S)	42.22504	-84.40915
Oakwood Dr. (E) at Colfax St.	42.22270	-84.41288

Table 5. Individual and general NPDES permitted facilities in the upper Grand River Watershed and estimated total suspended solids loads.

Permit Number	Permitted Facility Name		Annual Design Flow (mgy)	Maximum Monthly Average Limit TSS (mg/l)	Annual TSS Loads (pounds)
Individual NPDES Permits:					
MI0023256	Jackson WWTP		6935	20 and 25	1288800*
MI0028461	Quanex Corp-Mac Steel Div		55	25	11415
MI0041998	Michigan Center School Dist		0.1	30**	30
MI0045403	Marathon Ashland Petro-Jackson		39	30**	9758
MI0045942	Leoni Twp WWTP		949	20 and 30	190170*
MI0046809	Citgo Corp-Jackson		171	30**	42784
MI0051683	Mechanical Products		33	30**	8257
MI0054976	MDC-SPSM-GWCU		26	30**	6505
MI0055042	Plastigage Corp		64	30**	16013
MI0056006	TRW Inc-Jackson		18.3	30**	4579
		Total:	**8,290**		**1,578,311**
General NPDES Permits:					
MIG080265	Wolverine Pipeline Co-Jackson		10.5	30**	2629
MIG250042	Industrial Steel Treating Co		100.4	30**	25135
MIG250355	ADCO Products Inc		27.4	30**	6860
MIG250360	Lefere Forge & Machine		4.4	30**	1102
MIG250365	Mid-American Products		21.9	30**	5483
MIG250396	B & H Machine Inc		18.3	30**	4581
MIG670278	Equilon Enterprises-Jackson		307	30**	76857
MIG580001	MDC-Waterloo WWSL		11	40 and 70	5049***
MIG580258	MDC-SPSM-Wing WWSL		3	40 and 70	1375***
MIG580259	MDC-SPSM-Dale Foltz TC WWSL		0.5	40 and 70	229***
MIG580274	Sherman Oaks MHP WWSL		34	40 and 70	15603***
		Total:	**538**		**144,801**
				Grand Total:	**1,723,112**

- Total TSS loadings estimates for 5/1 to 11/30 plus 12/1 to 4/30; ** Not limited but assumed maximum monthly TSS concentration; *** Combined total TSS loadings for permitted discharge periods 3/1 to 5/31 and 10/1 to 12/31.

Table 6. Wet weather data: minimum-maximum range and (average) parameter concentrations (mg/l). (Source: excerpt from LTI, 2003 – in draft).

Parameter	Date (rainfall as inches)	North Branch Grand River at Falahee Rd.	Grand River d/s Parnall Rd. at Prison	Portage River at M -106
$CBOD_5$ (mg/l)	July 9-10 (0.93)	No data	2 – 17 (6.71)	3 – 4 (3.14)
	July 18-19 (0.16)	No data	3 – 6 (4.2)	2 – 2 (2)
	July 26-29 (4.93)	2 – 3 (2.39)	2 – 4 (2.71)	2 – 3 (2.25)
Total organic carbon (mg/l)	July 9-10 (0.93)	No data	8.35 – 22 (11.79)	10.3–12.7 (11.79)
	July 18-19 (0.16)	No data	9 – 15 (11.88)	9.5 – 12 (7.76)
	July 26-29 (4.93)	8.56 – 10.40 (9.36)	4.5 – 7.6 (6.29)	3.19 – 12 (7.76)
Total suspended solids (mg/l)	July 9-10 (0.93)	No data	10 – 140 (64.9)	10 – 37 (19.93)
	July 18-19 (0.16)	No data	30 – 170 (79)	11 – 26 (15.75)
	July 26-29 (4.93)	5 – 12 (8.17)	13 – 400 (175.9)	9 – 190 (59.25)
Total ammonia (mg/l)	July 9-10 (0.93)	No data	0.03 – 0.14 (0.08)	0.04 – 0.15 (0.09)
	July 18-19 (0.16)	No data	0.1 – 0.2 (0.14)	0.03 – 0.29 (0.13)
	July 26-29 (4.93)	0.01 – 0.07 (0.03)	0.04 – 0.18 (0.09)	0.04 – 0.2 (0.08)
Nitrate + nitrite (mg/l)	July 9-10 (0.93)	No data	1.76 – 4.29 (2.9)	0.18 – 2.41 (0.61)
	July 18-19 (0.16)	No data	2.9 – 6 (4.9)	0.19 – 0.52 (0.30)
	July 26-29 (4.93)	0.07 – 0.37 (0.22)	1.41 – 4.58 (3.17)	0.24 – 3.5 (0.94)
Orthophosphate (mg/l)	July 9-10 (0.93)	No data	0.01 – 4.2 (0.72)	0.02 – 0.10 (0.04)
	July 18-19 (0.16)	No data	0.06 – 0.29 (0.21)	0.01 – 0.02 (0.12)
	July 26-29 (4.93)	0.02 – 0.09 (0.04)	0.04 – 0.3 (0.16)	0.01 – 0.11 (0.03)
Total phosphorus (mg/l)	July 9-10 (0.93)	No data	0.28 – 0.65 (0.42)	0.1 – 0.19 (0.12)
	July 18-19 (0.16)	No data	0.45 – 0.72 (0.57)	0.09 – 0.12 (0.10)
	July 26-29 (4.93)	0.09 – 0.15 (0.12)	0.31 – 2.04 (0.75)	0.06 – 0.45 (0.19)

Table 7. Wet weather data: Minimum-maximum range (average) of TSS concentrations (mg/l). (Source: excerpt from LTI, 2003 – in draft).

Wet Weather Event (Date and Rainfall)	Grand River TSS (mg/l) u/s of Jackson Falahee Road	Grand River TSS (mg/l) MDC Cooper Street Prison	GrandRiver Flow Increase (cfs) MDC Cooper Street Prison	Portage River TSS (mg/l) M-106
July 9-10 (0.92 inches)	no data	10 to 140	77	10 – 37 (20)
July 18-19 (0.16 inches)	no data	30 to 170	106	11 – 26 (15.8)
July 26 – 29 (4.93 inches)	5 – 12 (8.17)	13 to 400	370	9 – 190 (59.3)

Table 8. Wet weather event increase in flow and TSS loadings to the Grand River at MDC Cooper Street location) as affected by storm water runoff/washoff events from the city of Jackson.

Wet Weather Event (Date and Rainfall)	Jackson USGS Gage Flow cfs (mgd)	MDC Cooper St. Prison Flow cfs (mgd)	MDC Cooper St. TSS Range (mg/l)	MDC Cooper St. TSS Loadings (pounds/day)	Background TSS Loads (pounds/day)	Percent TSS Load Increase
Pre-Storm Event	45 (29)	45 (29)	15*		3630	5
July 9 (0.93 inches)	45 to 179 (29 to 116)		16 to 140	64,191		95
Pre-Storm Event	44 (28)	44 (28)	15*		3505	7
July 18, 2002 (0.16 inches)	44 to 150 (28 to 97)		30 to 170	47,559		93
Pre-Storm Event	33 (21)	33 (21)	15*		2629	1
July 26, 2002 (1.33 inches)	33 to 403 (21 to 260)		14 to 400	365,638		99

* Typical background concentration during stable flow conditions; ** Includes storm water runoff loadings and resuspension of in-place TSS.

Table 9. Gross estimate of daily TSS loadings to the Grand River contributed by background, point sources, and storm water during the July wet weather monitoring of July 2002 (LTI, 2003 – in draft).

Wet Weather Event (Date and Rainfall Event and Sources)	Daily TSS Loadings (pounds/day)	Relative Percent Contribution
July 9 (0.93 inches)		
Background:	3630*	4
Facilities:	1,878**	3
Urban Stormwater/Resuspension	64,191	93
Total Loadings:	69,699	
July 18, 2002 (0.16 inches)		
Background:	3505*	6
Facilities:	1,878**	4
Urban Stormwater/Resuspension	47559	90
Total Loadings:	52,942	
July 26, 2002 (1.33 inches)		
Background:	2629*	<1
Facilities:	1,878**	<1
Urban Stormwater/Resuspension	374596	99
Total Loadings:	379,103	

* Derived based on TSS of 15 mg/l* pre-storm river flows*8.345; ** Jackson WWTP TSS loadings based on 13.2 mgd* 5 mg/l TSS*8.345 to characterize real loads. No TSS loads were applied to the Leoni WWTP or WWSLs since they were not discharging at the time. All other permitted point source contributions were based on daily facility design flows*30 mg/l TSS*8.345.

Table 10. Annual total suspended solids load source allocations and numeric targets.

Water body	Current Annual TSS Load (million pounds)	Annual TSS Load Numeric Target (million pounds)	WLA Annual TSS Load (million pounds)	LA Annual TSS Load (million pounds)
GRAND RIVER:				
Industrial/Municipal Storm Water Permitted Outfalls*	4.59	2.30	2.30	-
Other Land Use Related Sources**	4.81	2.41	-	2.41
Existing Ind./Gen NPDES Permitted Facilities	1.71	1.71	1.71	-
Grand River Total Annual Loads	11.11	6.42	4.01	2.41
PORTAGE RIVER:				
Land Use Related Sources***	7.07	3.54	-	3.54
Existing Ind./Gen NPDES Permitted Facilities	0.01	0.01	0.01	-
Portage River Total Annual Loads	7.08	3.55	0.01	3.54
Total:	18.19			
Annual TSS Load Numeric Target To Biota TMDL Reach	-	9.97	4.02	5.95

* Primarily attributed to urban or built-up land uses in the city of Jackson; ** Attributed to nonurbanized/built-up land uses in the Twps of Leoni, Blackman, and Summit; *** Attributed to nonurban or built-up land uses in the Portage River Watershed.