Michigan Department of Environmental Quality
Water Bureau
August 2005

Total Maximum Daily Load for Biota for the Bass River Ottawa County

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 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 nonpoint sources (NPS) to restore and maintain the quality of their water resources. The purpose of this TMDL is to identify appropriate actions to achieve the fish community target for Bear Creek, which can be accomplished by a reduction in sediment loadings from sources in the Bass River watershed. This TMDL follows the phased approach due to inherent uncertainties in deriving numeric targets and estimating loading from NPS. Under the phased approach, load allocations (LAs) and waste load allocations (WLAs) are calculated using the best available data and information, recognizing the need for additional monitoring data to determine if the load reductions required by the TMDL lead to attainment of WQS. The phased approach provides for the implementation of the TMDL while additional data are collected to reduce uncertainty.

PROBLEM STATEMENT

The TMDL reach of the Bass River, a warmwater designated water body tributary to the Grand River (Figure 1), is located within Ottawa County (Allendale, Blendon, Georgetown, Grand Haven, Olive, Port Sheldon, and Robinson Townships). The designated uses (Rule 100(7) 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) identified as impaired are the support of fish and other indigenous aquatic life (macroinvertebrate communities). The impairment of fish and macroinvertebrate communities was identified as the basis for placing the Bass River on Michigan's Section 303(d) list of impaired water bodies requiring the development of a TMDL. The TMDL is identified on the Section 303(d) list (Wolf and Wuycheck, 2004) as follows:

BASS RIVER WBID#: **082801H**
County: OTTAWA Size: 33 M
Location: Grand River confluence u/s to 92nd Street crossing of Bass and Little Bass rivers.
HUC: 4050006 RF3RchID: 4050006 4
Problem: **Pathogens (Rule 100); Fish and macroinvertebrate communities rated poor.**
TMDL YEAR(s): 2005

This document represents the basis for the development of a biota TMDL that focuses on the maintenance and protection of threatened biological communities of the Bass River watershed

and the restoration and maintenance of an acceptable fish community within the Bear Creek tributary of the Bass River to meet Michigan's WQS.

The Bass River watershed is approximately 50 square miles (32,020 acres) in area, containing about 66 miles (42 perennial and 24 intermittent) of stream channel as classified by the United States Geological Survey (USGS) (Marne and Grandville Quads) and depicted in Figure 1. The Bass River watershed is comprised primarily of the Bear Creek, Bass Creek, and Little Bass Creek (identified as Little Bass River in the listing) subwatersheds. The Bear Creek watershed is about ten square miles in area, which is one-fifth of the Bass River watershed area.

A determination of the warmwater designation impairment of both the fish and macroinvertebrate communities within the TMDL reach was based on a prepublication evaluation of data from a survey conducted in August 1999. However, when published, the August 1999 survey contained no fish survey results and the macroinvertebrate community for the three Bass River watershed survey sites were found to be acceptable at all sites (Rockafellow, 2003). Therefore, the reach of the Bass River depicted as not meeting WQS in the 2000, 2002, and 2004 Section 303(d) TMDL listings, was incorrectly listed based on the prepublication evaluation of the August 1999 survey data.

Fish and macroinvertebrate community assessments were conducted in the Bass River watershed in 2004, to assess recent conditions. The Great Lakes and Environmental Assessment Section (GLEAS) Procedure 51 (MDEQ, 1990) used for the 2004 surveys recommends that at least 100 individual fish be collected from each survey station. When less than 50 fish individuals are collected, the reach is automatically rated poor (WQS not met). The Procedure 51 survey process involves the assessment of ten specific metrics for the fish community and nine metrics for the macroinvertebrate community (Creal, 1996). Fish community assessments with metric accumulative scores of 5 to10 are rated as excellent; scores of 4 to -4 are rated as acceptable; and scores of -5 to -10 are rated as poor (not attaining WQS). Macroinvertebrate community metric accumulative scores of 5 to 9 are rated as excellent; scores of 4 to -4 are rated acceptable; and scores of -5 to -9 are rated poor (not attaining WQS).

The Procedure 51-based stream survey of July 2004, demonstrated the presence of acceptable warmwater fish (scores of -2 and -3) and macroinvertebrate (scores of 1 and 2) communities in Bass Creek at 92nd Avenue (identified as 92nd Street in the listing) and further downstream in the Bass River at Buchanan Street, respectively (Rockafellow, 2005). However, Bear Creek, a tributary to the Bass River, was rated poor for fish communities at 104th Avenue because standard survey techniques and sampling duration resulted in the collection of less than 50 individual fish (31). The macroinvertebrate community assessment (score of -2) was rated acceptable at the 104th Avenue site. As a result of the 2004 surveys, the 2004 Section 303(d) listing will be amended in the 2006 Integrated Report to delist Bass River reaches for poor fish and macroinvertebrate communities and specifically identify Bear Creek as having a "fish community rated poor."

The habitat assessment protocol used during the August 1999 assessments (Procedure 51 – revised June 1991 (MDEQ, 1990)), involved habitat score ranges of less than 35, 35 to 70, 71 to 106, and 107 to 135 points that rated habitat quality as poor, fair, good, and excellent, respectively. Bass River habitat quality assessed in August 1999, at Buchanan Street, Bass Creek at 92nd Avenue, and Bear Creek at 104th Avenue resulted in habitat scores of 41, 54, and 66, respectively, indicative of fair habitat (Rockafellow, 2003). The habitat assessment protocol used during the July 2004 assessment (Procedure 51 - revised May 2002 [MDEQ, 1990]),

involved habitat score ranges of less than 56, 56 to 104, 105 to 154, and 155 to 200 points that rated habitat quality as poor, marginal, good, and excellent, respectively. The July 2004 habitat quality assessment of the Bass River at Buchanan Street, Bass Creek at 92nd Avenue, and Bear Creek at 104th Avenue scored 118, 142, and 148, respectively, and were rated as good based on the evaluation of the Bass River as a glide/pool versus a riffle-pool system (Rockafellow, 2005). However, both the 1999 and 2004 habitat quality assessment scores of specific habitat metrics, specifically, embeddedness, flow stability, bottom deposition, and bank stability, indicated excessive sedimentation as a threat to an acceptable biological community throughout the watershed.

A USEPA funded wet-weather event monitoring assessment of total suspended solids (TSS) and stream flow in the Bass River watershed was conducted at a total of six sites located on the Bass River, Bass Creek, Little Bass Creek, and Bear Creek (Figure 1). The monitoring was conducted during the months of June through November 2004, by staff from the Grand Valley State University's Water Research Institute (funded by USEPA contract: 68-C8-0010) (Cadmus Group, 2005). The project, designed by the Michigan Department of Environmental Quality (MDEQ), required monitoring for a minimum of three times at each station to characterize dry-weather TSS concentrations during stable flow conditions and a minimum of three wet-weather runoff events to assess responses in in-stream TSS concentrations and flow during wet-weather precipitation events of 0.1 inches or greater. Attention was directed towards sampling TSS and flow during both the rise and fall of the Bass River hydrograph to characterize TSS in response to increases and subsidence in resulting runoff/stream flow regimes.

Results from the study indicated a TSS concentration range, among the six stations assessed, of 3 to 21 milligrams per liter (mg/l) during the June 28, July 15, and July 29, 2004 dry-weather events indicating relatively low TSS in transport during stable and base flow conditions (Cadmus Group, 2005). The TSS concentrations measured at the most downstream station at Warner Street, during the three dry-weather sampling dates, were 21, 11, and 6 mg/l, respectively. These concentrations are low and characterize low volume, stable, dry-weather, instantaneous stream-flow conditions of 32.1, 16.9, and 13.4 cubic feet per second (cfs), respectively.

Wet-weather event monitoring at the most downstream station located at Warner Street (Bass Drive), in response to 0.1, 1.1, and 1.3 inch precipitation events of August 25, August 28, and November 1, 2004, respectively, resulted in peak flows of 12.01, 31.07, and 43.68 cfs, respectively. In-stream flows showed stream increases of 11.3 to 12.01 cfs (a negligible increase of 0.7 cfs over a one- to two-hour period), 9.89 to 31.07 cfs (a 21.2 cfs response increase over a five-hour period) and 17.3 to 43.68 cfs (a 26.4 cfs response increase over a four-hour period) demonstrating a flashy flow response to the 1.1 and 1.3 inch precipitation events monitored, respectively. The TSS maximum values for the 0.1, 1.1, and 1.3 inch wet-weather events showed TSS maximums of 16, 198, and 325 mg/l, respectively. TSS concentrations during the 1.1 and 1.3 inch wet-weather precipitation/runoff events were greater than 80 mg/l, the mean annual wet-weather in-stream target value (see numeric target section). This information indicates that precipitation runoff events in the watershed can substantially increase the amount of TSS in transport in the Bass River and increase the potential for impacts to habitat quality and the biological community.

A similar review of the TSS and flow conditions for Bear Creek at the 104th Avenue site indicated a TSS concentration range of 1 to 8 mg/l during flow ranges of 2.8 to 8.5 cfs, stable, dry-weather flow conditions. During the wet-weather runoff events of 0.1, 1.1, and 1.3 inches,

TSS maximum values of 21, 308, and 479 mg/l were observed. These data indicate that TSS concentrations increase greatly in response to greater (1.1 and 1.3 inch) precipitations events.

Storm water runoff to the Bass River from the various land uses in the watershed, during substantive precipitation/runoff events, is a potential cause of the threatened and impaired biological community due to excessive solids loadings from runoff, resuspension, stream bank erosion, and sedimentation of stream habitat. The MDEQ National Pollutant Discharge Elimination System (NPDES) permit tracking system (NMS, 2005) indicates that there are nine construction certificates of coverage, one industrial storm water permitted facility, and five MS4 certificate of coverages (under general permit #MIG619000) in the Bass River watershed (Table 1). Storm water discharges throughout the Bass River watershed contribute to unstable, sedimented habitat conditions. Areas of impervious surfaces (e.g., parking lots) are commonly designed to divert and direct precipitation directly to nearby water bodies to facilitate rapid drainage. Substantial degradation in biological communities has been demonstrated to occur in watersheds containing 10 to 20 percent impervious surface areas that directly discharge to a water body and create unstable, flashy flow conditions (WPT, 1994).

The primary contributor to the threatened or impaired stream quality is excessive runoff volumes during precipitation events of greater than one inch that results in excessive sedimentation in this agricultural (52 percent by area) and growing residential (20 percent) dominated watershed. Excessive runoff results in increased sediment loads, stream bank erosion, sediment-induced erosivity of both habitat and colonizing organisms, siltation, and sedimentation impacts on biologically important and desirable habitat. Reductions in storm sewer runoff rates, flashy stream flow conditions, and reduced stream bank erosion through more stable flow management are necessary to reduce impacts on the aquatic life and meet or maintain the WQS.

NUMERIC TARGETS

The threatened designated use for the Bass River and the impaired use for the Bear Creek relates to impaired macroinvertebrate and/or warmwater fish population(s). Michigan's WQS require the protection of all streams for warmwater fish populations and other indigenous aquatic life [R 323.1100(1)]. The primary numeric target is based on the GLEAS Procedure 51. The biota TMDL target is to establish an acceptable warmwater fisheries community in Bear Creek and maintain acceptable fish and macroinvertebrate communities in the remainder of the TMDL reach. Fish and macroinvertebrate communities will be evaluated based on a minimum of Procedure 51 biological assessments conducted in two successive years, following the implementation of Best Management Practices (BMPs) intended to stabilize runoff discharges and minimize excessive sedimentation, bank erosion, and sediment loadings to the TMDL reach.

A secondary numeric target based on TSS will be used to further assess improvements in the Bass River TMDL reach. The secondary target goal is a mean annual in-stream TSS concentration of 80 mg/l for wet-weather runoff events. This secondary numeric target may be overridden by achievement of the biological numeric target. However, if the TSS numeric target is achieved but the biota numeric target is not achieved, then the TSS target may have to be reevaluated. The secondary numeric target is intended to help guide proper control over NPS of excessive suspended solids loads from runoff, as well as the runoff discharge rates and instantaneous runoff volumes that affect increased stream flow instability, stream bank erosion, and increased suspended solids concentrations.

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 to aquatic life. Vohs et al. (1993) indicated that a chemically inert suspended solids concentration of 100 mg/l appears to separate those streams with a fish population (e.g., >100 mg/L) from those without. Gammon (1970) demonstrated decreases in the standing crop of both fish and macroinvertebrates in river reaches continuously receiving suspended solids loadings of less than 40 mg/l. 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 (EIFAC, 1980).

Alabaster (1972) provided the following water quality goals for suspended solids (finely divided solids) for the protection of fish communities:

Optimum	= $\leq$ 25 mg/l
Good to Moderate	= >25 to 80 mg/l
Less than moderate	= >80 to 400 mg/l
Poor	= >400 mg/l

Since the TMDL purpose is to restore the warmwater fish community to an acceptable condition and attain WQS, a value of 80 mg/l as a mean annual TSS target for wet-weather events was chosen for Bass River as a secondary target.

Overall, the secondary target of 80 mg/l TSS is intended to evaluate solids load effects and assist in orienting and focusing corrective actions for source reductions. Additional TSS targets, based on flow-related considerations, may be developed as additional data on the Bass River become available. At this time, sufficient, site-specific data are unavailable regarding the flow and TSS concentration relationship associated with storm water sources during wet-weather runoff periods to establish source-specific numeric targets. Therefore, to allow for additional data collection, this TMDL is established as a phased TMDL.

SOURCE ASSESSMENT

Stream flow conditions of the Bass River, including Bear Creek, were flashy in response to the 1.1 and 1.3 inch precipitation storm events on August 28 and November 1, 2004, respectively, and TSS concentrations increased greatly during these precipitation events (Cadmus Group, 2005).

From the Grand River confluence upstream, land use acres (Table 2) in the Bass River watershed include agricultural (52 percent); forest, open fields, and wetlands (24 percent); and residential (20 percent). Increased residential and urban development within a watershed alters its hydrologic characteristics because increased areas of impervious surface result in increased runoff of solids and pollutant loads being discharged to stream reaches within the watershed (Fongers and Fulcher, 2001; and Schueler and Holland, 2000). Substantial reductions in vegetative riparian zones and pervious areas throughout the watershed of Bass River and the extensive use of structural features, including paved impervious surface areas (e.g., roads and parking lots), curb and gutter, and numerous direct storm sewer discharges, dominate the urbanized landscape and contribute to rapid precipitation runoff rates to the stream. The Bear Creek watershed is dominated by agricultural land uses such as cropland, orchards, and nurseries (Figure 2).

There is currently one NPDES industrial storm water discharger, nine certificates of coverage for storm water discharges from construction sites, and five township municipal separate storm

sewer systems (MS4) certificates of coverage in the Bass River watershed (Table 1). The MS4 permitted outfalls require plan development to achieve the TMDL by minimizing pollutant and volume loads to the "maximum extent practicable."

Determination of the annual TSS loads to the Bass River watershed from the various land use categories involved estimates of the acres of each land use category (Cadmus Group, 2005), a mean annual rainfall of 32 inches, and the USEPA's Simple Method model approach (USEPA, 2001). These aspects were used in conjunction with TSS export coefficients derived from the Rouge River Project (Cave et al., 1994).

The estimated total current annual TSS load from all sources in the Bass River watershed is 2,714,257 pounds. This annual total represents the sum of estimated NPDES permitted storm water TSS loads (WLA) of 1,461,996 pounds plus the NPS land use category TSS loads (LA) of 1,252,261 pounds (Table 2). The total estimated annual TSS load of 2,714,257 to the Bass River consists of the following sources: NPDES non-storm water point sources (WLA) of which there are none, NPDES storm water sources (WLA), and NPS (LA). This represents 0 percent, 54 percent, and 46 percent of current estimated contributions, respectively. The use of annual load estimates for TSS is used to define the most probable sources and their relative contribution to TSS loads to the Bass River and allows for a comparison when the annual average 80 mg/l TSS concentration target is used to estimate recommended annual TSS load reductions.

LINKAGE ANALYSIS

A suitable method used to develop a TMDL that addresses the severity of the impacts of sedimentation to a biological community is to measure sediment impacts on stable, colonizable substrates in the stream channel and the associated changes in the biological community.

Increased siltation and embeddedness of colonizable substrates resulting from excessive bank erosion and sedimentation has been demonstrated to impair the biological integrity of rivers (Waters, 1995) by obscuring or reducing the suitability of colonizable or useable substrate by stream biota. With improved habitat through the reduction in TSS loads and the resulting sedimentation, both fish and macroinvertebrate communities respond with an increase in species diversity and an increase in the number of individuals of each species. As a result, the Procedure 51 assessment scores and ratings for quality of the fish and macroinvertebrate communities and habitat are expected to increase as sedimentation rates decline, embeddedness decreases, and habitat diversity increases.

TMDL DEVELOPMENT

The TMDL represents the maximum loading that can be assimilated by a water body while still achieving WQS. The Bass River watershed biotic community is threatened and/or impaired (Bear Creek) by excessive bank erosion and excessive sedimentation of suitable habitat as affected by excessive runoff. Therefore, the TMDL is based on reducing sediment loads throughout the watershed to a level that supports a biological community that meets or maintains WQS. Using the metrics from Procedure 51, an acceptable rating for the warmwater fish community will serve as the primary target for Bear Creek. The TMDL will also focus on maintaining the acceptable macroinvertebrate and fish communities for the remainder of the watershed. A secondary target of 80 mg/l TSS is the TMDL goal for TSS during wet-weather runoff events.

Concurrent with the selection of numeric endpoints, this TMDL 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 (Mixing zones) and 323.1090 (Applicability of water quality standards) of Michigan's WQS. Assessments of the biological community are conducted during low flow stream conditions that occur during the summer season. Low flows, combined with elevated stream temperatures during this time period, tend to produce the most stressful conditions for fish and macroinvertebrate communities. If the numeric targets are achieved for fish and macroinvertebrates during the summer critical conditions, they are expected to be protected during all other seasonal conditions. Therefore, the critical condition is summer low flows.

ALLOCATIONS

TMDLs typically consist of pollutant loads from each individual WLA for permitted point sources and LA for NPS and natural background levels. A margin of safety (MOS), either implicit or explicit, accounts for uncertainty in the relationship between pollutant loads and the quality of the receiving waters. Conceptually, this overall relationship is defined by the equation:

$$TMDL = \Sigma^{WLAs} + \Sigma^{LAs} + MOS$$

The TMDL represents a maximum load of a pollutant or stressor that can be discharged to a receiving water and still meet WQS. The overall TMDL capacity is allocated among the three TMDL components: WLA for point sources, LA for NPS and background loads, and the MOS.

WLA

The estimated total annual TSS load from non-storm water NPDES permitted point sources is zero pounds since there are none in the watershed (Table 2).

Based on acres of land use categories listed under "Urban/Industrial/Built-Up" and TSS export coefficients derived from the Rouge River Storm Water Demonstration Project (Cave et al., 1994), a total annual TSS load estimate of approximately 1,461,261 pounds is attributable to NPDES municipal, industrial, and construction site permitted storm water runoff discharges to the Bass River watershed. All the categories listed are predicted to meet the 80 mg/L secondary target, with the exception of the industrial category, which is projected to be contributing an average of 149 mg/L TSS to the Bass River based on estimates derived from Cave et al. (1994). To achieve the goal of 80 mg/L as an annual average during wet-weather events from all point sources, a reduction of 45 percent from industrial sources or 3 percent overall in TSS loads in the NPDES regulated point sources is necessary, resulting in a projected annual WLA of 1,410,751 pounds of TSS (Table 2).

LA

The LA component of the TMDL defines the load capacity for a pollutant that is nonpoint in origin that includes the following land use categories: agricultural, forested/shrub/open land, and/or water bodies (Table 1). An estimated annual TSS load of 1,252,261 pounds (LA) is attributed to these categories of NPS in the watershed. All but the agricultural land uses are treated as background load sources because runoff concentrations of TSS are typically less

than 80 mg/l. Therefore, the only targeted load reduction source is from agricultural-related land use sources, which has a runoff average TSS concentration of 145 mg/l (Cave et al., 1994). A 45 percent annual reduction (from 1,065,967 to 588,120 pounds) from agricultural areas in the watershed is recommended resulting in a LA TSS target of 774,414 pounds based on achieving a runoff mean annual average concentration of 80 mg/l TSS, which is the target concentration during wet-weather runoff events.

In summary, the proposed accumulative annual TSS load estimated target to the Bass River (WLA + LA) is 2,185,165 pounds per year, representing an overall 20 percent reduction from existing estimated annual load of 2,714,257 pounds. About 65 percent (1,410,751 pounds per year) is the WLA associated with the NPDES permitted industrial storm water outfalls, and 35 percent (774,414 pounds per year) is attributed to the LA.

To achieve the primary and secondary TMDL targets, a reduction in the wet-weather runoff of TSS load through controls in the runoff rates and volume discharges is necessary. The reduction will require employing BMPs that attenuate the runoff delivery rates and volume inputs to the Bass River watershed in order to reduce flashiness, better stabilize and normalize stream flow conditions, and minimize stream bank erosion, TSS resuspension, and excessive sedimentation that impacts habitat quality and biological integrity of the stream.

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 loads to the aquatic environment.

To determine progress in meeting the biological target scores in the Bass River watershed, including Bear Creek, follow-up biological assessments will be conducted during stable flow conditions during the months of June through September. The biological community assessment results will best reflect an MOS that is implicit by expressing integration of the effects of the variability in sediment loads in the aquatic environment and minimizing seasonal variability.

SEASONALITY

Seasonality is addressed in the TMDL in terms of sampling periods for fish and macroinvertebrate communities. To avoid disparate sampling results due to temporal variability in the biological community, sampling will be conducted during June through September of each year during stable, low flow conditions.

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. Subsequent assessments of the fish and macroinvertebrate communities at the Bass River, Little Bass Creek, Bass Creek, and Bear Creek locations will be conducted until results from two successive years demonstrate attainment of TMDL targets. For best comparative purposes, follow-up biological assessments will be conducted during the June to September time frame and stable flow conditions. Every effort will be made to sample during similar stream conditions and assess the same sampling locations.

Once the BMPs are in place to minimize the effects of runoff and flashy conditions that exist in Bass River, stream flow and TSS sampling may be implemented so as to measure progress towards the secondary numeric target of 80 mg/l as a mean annual TSS value during wet-weather runoff events if the biota target is not achieved. In-stream monitoring of TSS, stream flow, and representative land use runoff characteristics for a variety of stable flow and wet-weather events will be necessary to refine the TSS loadings estimates for the Bass River watershed. This information will further define the level of TSS load reduction necessary, seasonally, climatologically, and annually.

REASONABLE ASSURANCE

The actions to protect the Bass River watershed are directed towards installing BMPs and other control measures to reduce and minimize solids loads and runoff peak flows that substantially increases TSS concentrations from resuspension, bank erosion, and upland sources. Control measures potentially include limits on storm water discharge volume, chemical-specific permit limits, and approved BMPs for areas currently not under any permit.

Rule 323.2161a(8), which addresses municipal storm water discharges, states that "A permittee shall comply with any more stringent effluent limitations in the national permit, including permit requirements that modify or are in addition to, the minimum measure based on a total maximum daily load (TMDL) or equivalent analysis." In addition, Rule 323.2161a(10) states that the "department may establish monitoring requirements in accordance with state or watershed specific monitoring plans or as needed for a permittee to demonstrate the pollution reduction achieved by implementing best management practices." For sites of new construction, the rules specifically require development of a program to evaluate the post-construction storm water runoff from projects, including an ordinance designed to prevent or minimize water quality impacts including extreme flow volumes and conditions.

The regulatory mechanisms are available to reduce the storm water impacts of the urban/industrial/built-up sources within the Bass River Watershed. Where the necessary data are available, permit requirements will be established in the NPDES permits. Where necessary, additional data to determine specific loadings and flow volumes associated with these sources will be collected through the NPDES permit requirements.

Although TSS load reductions appear unnecessary for the MS4 permittees, these facilities are required to develop watershed management plans that includes the detailing of short- and long-term goals and attainment actions, public education plans, illicit discharge elimination plans, and the development (by each local unit of government within the Bass River watershed) of their individual storm water prevention plans. A master plan for Ottawa County, Wright Township, Chester Township, Tallmadge Township, Alpine Township, and the city of Walker needs to acknowledge that proposed actions for the Bass River watershed are needed to manage both quality and quantity issues to be consistent with Phase I and II water practices for construction and postconstruction activities.

Georgetown, Allendale, and Blendon Townships are under MS4 permits. These townships are participating with other communities with MS4s in a watershed-based storm water program for the lower Grand River. These partnerships will aid in implementing the required activities that will likely reduce suspended solids inputs to surface waters and attenuate storm water flows through public education and a storm water management plan.

Blendon Township is in the process of developing a storm water management plan. They expect full implementation of their plan by December 1, 2008. The plan contains six minimum measures, and includes a public education program, a public participation component, an illicit discharge elimination program, a post-construction storm water management program for new and redeveloped sites, development of construction storm water runoff controls, and pollution prevention/good housekeeping for municipal operations. These activities will improve water quality to the TMDL watershed by focusing on educating the public on how their activities affect water quality, and will also require improved management of activities under municipal control (i.e., controlling storm water runoff from new development and better management of municipal facilities, such as parks and equipment garages).

The MDEQ district staff will continue to work with and assist interest groups in the Bass River watershed to define and design 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 Bass River watershed.

Recommended actions include:

- Focused monitoring of NPDES permitted outfalls, and identify and regulate sources of excessive wet-weather TSS loadings and runoff flow volumes to Bass River through NPDES permit conditions. Establish permit conditions as necessary.

- Upgrade and maintain the current vegetative riparian zone to reduce soil erosion and loadings to Bass River from sources within the watershed. BMPs need to be employed within the riparian zone adjacent to the urbanized, residential, industrialized, agricultural, and commercial areas to minimize soil loss through erosion and direct runoff to minimize habitat impairment of the Bass River Watershed.

- Implementation of BMPs in the storm water permits program that reduces sediment loadings and moderate runoff release rates and excessive runoff to the Bass River watershed. The goals are for reduced solids loadings and greater flow stability throughout the watershed so that WQS are restored and protected. Available guidance regarding runoff detention and stream protection is provided by Fongers and Fulcher, 2001; and Schueler and Holland, 2000.

Prepared By: John Wuycheck
Surface Water Assessment Section
Water Bureau
Michigan Department of Environmental Quality
August 5, 2005

REFERENCES:

Alabaster, J.S. 1972. Suspended Solids and Fisheries. Proceedings of the Royal Society of London, Series B 180:395-406.

Cadmus Group. 2005. Total Suspended Solids, Stable Flow, and Wet Weather Event Monitoring in the Bass River Watershed. MDEQ Staff Report No. MI/DEQ/WB-05/018.

Cave, K., T. Quarsebarth, and E. Harold. 1994. Selection of Storm Water Pollutant Loading Factors. Rouge River National Wet-Weather Demonstration Project Technical Memorandum RPO-MOD-TM34.00. Detroit, Michigan.

Creal, W., S. Hanshue, and S. Kosek. 1996. Update of GLEAS Procedure 51 Metric Scoring and Interpretation. MDEQ Staff Report No. MI/DEQ/SWQ-96/068.

EIFAC (European Inland Fisheries Advisory Commission). 1980. Water quality criteria for European freshwater fish; report on combined effects on freshwater fish and other aquatic life of mixtures of toxicants in water. SH 328 .E85 NO.37

Fongers, D. and J. Fulcher. 2001. Hydrologic Impacts Due to Development: The Need for Adequate Runoff Detention and Stream Protection. MDEQ, Land and Water Management Division. 20 pp.

Gammon, J.R. 1970. The Effect of Inorganic Sediment on Stream Biota. Water Pollut. Contr. Research Series. Water Quality 18050 DWC12/70. USEPA Printing Office. 145 pp.

MDEQ. 1990. GLEAS Procedure 51 - Qualitative Biological and Habitat Survey Protocols for Wadable Streams and Rivers, April 24, 1990. Revised June 1991, August 1996, January 1997, and May 2002.

MIRIS. 2005. Database Coverages from the Michigan Resource Information Database.

NMS. 2005. NPDES Management System. MDEQ Permit Tracking System Database.

Rockafellow, D. 2003. A Biological Survey of the Bass River Watershed. Ottawa County, Michigan. July 1999. MDEQ Staff Report No. MI/DEQ/WD-03/056.

Rockafellow, D. 2005. A Biological Survey of Selected Tributaries to the Lower Grand River and Water Chemistry Data from the Lower Grand River, Ionia, Ottawa, Newaygo and Ottawa Counties, Michigan, June, July, and August 2004. DRAFT MDEQ Report.

Schueler, T. and H. Holland. 2000. The Practice of Watershed Protection: Techniques for Protecting Our Nation's Streams, Lakes, Rivers, and Estuaries. Published by the Center for Watershed Protection.

Vohs, P., I. Moore, and J. Ramsey. 1993. A Critical Review of the Effects of Turbidity on Aquatic Organisms in Large Rivers. Report by Iowa State University, Ames, Iowa, for the U.S. Fish and Wildlife Service, Environmental Management Technical Center, Onalaska, Wisconsin. EMTC 93-s002. 139 pp.

Waters, T. 1995. Sediment in Streams - Sources, Biological Effects and Control. American Fisheries Society Monograph 7, American Fisheries Society, Bethesda, MD.

Wolf, S. and J. Wuycheck. May 2004. Water Quality and Pollution Control in Michigan: 2004 Sections 303(d) and 305(b) Integrated Report. MDEQ Staff Report No. MI/DEQ/WD-04/029.

WPT (Watershed Protection Techniques). 1994 - The Importance of Imperviousness. Vol. 1, No. 3.

USEPA. 2001. PLOAD Version 3.0 – An ArcView GIS Tool to Calculate NPS of Pollution in Watershed and Storm Water Projects – User Manual. 48 pp.

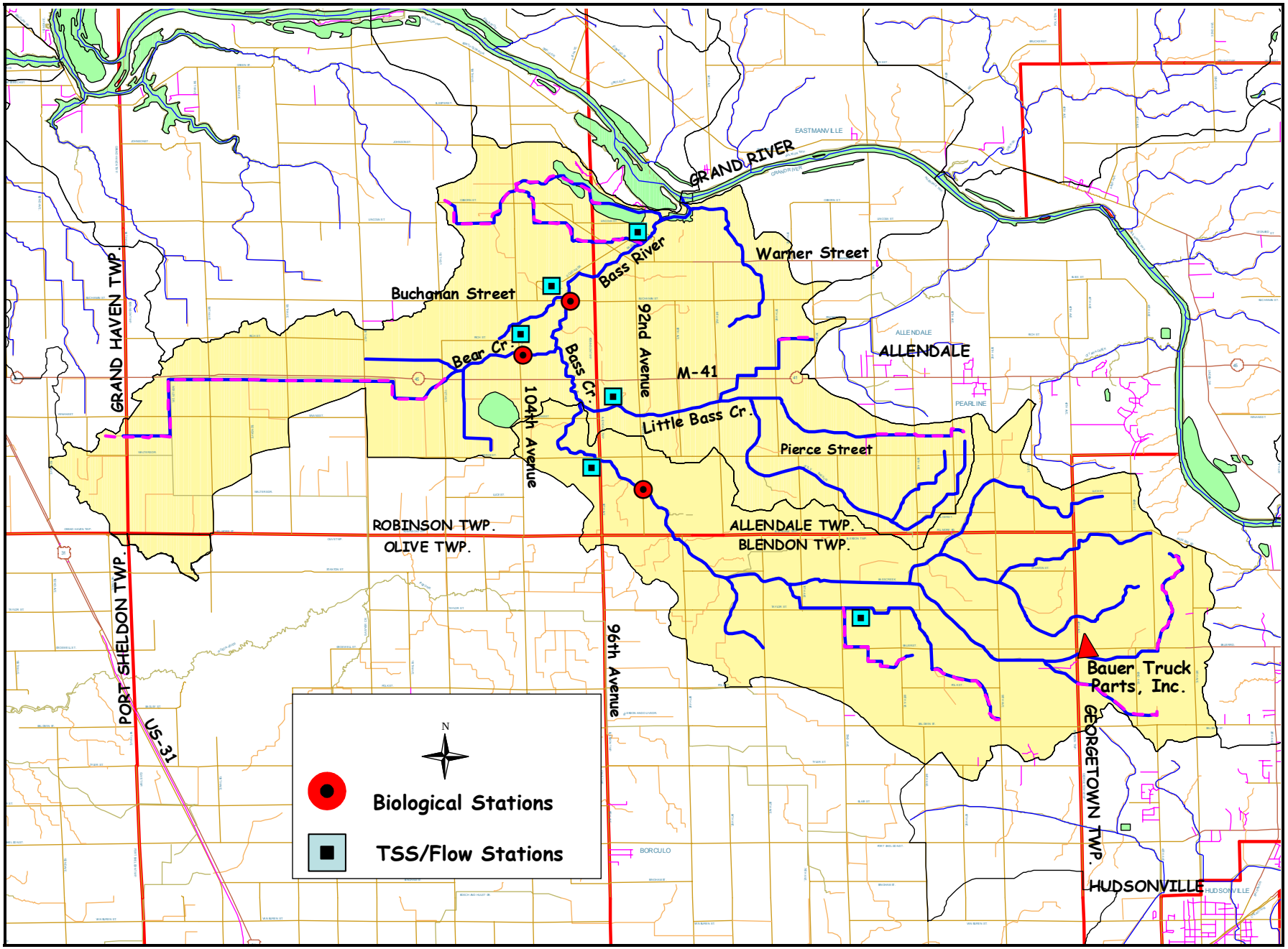

Figure 1. Biological assessment sites, TSS/flow monitoring sites and NPDES permitted sites in the Bass River watershed.

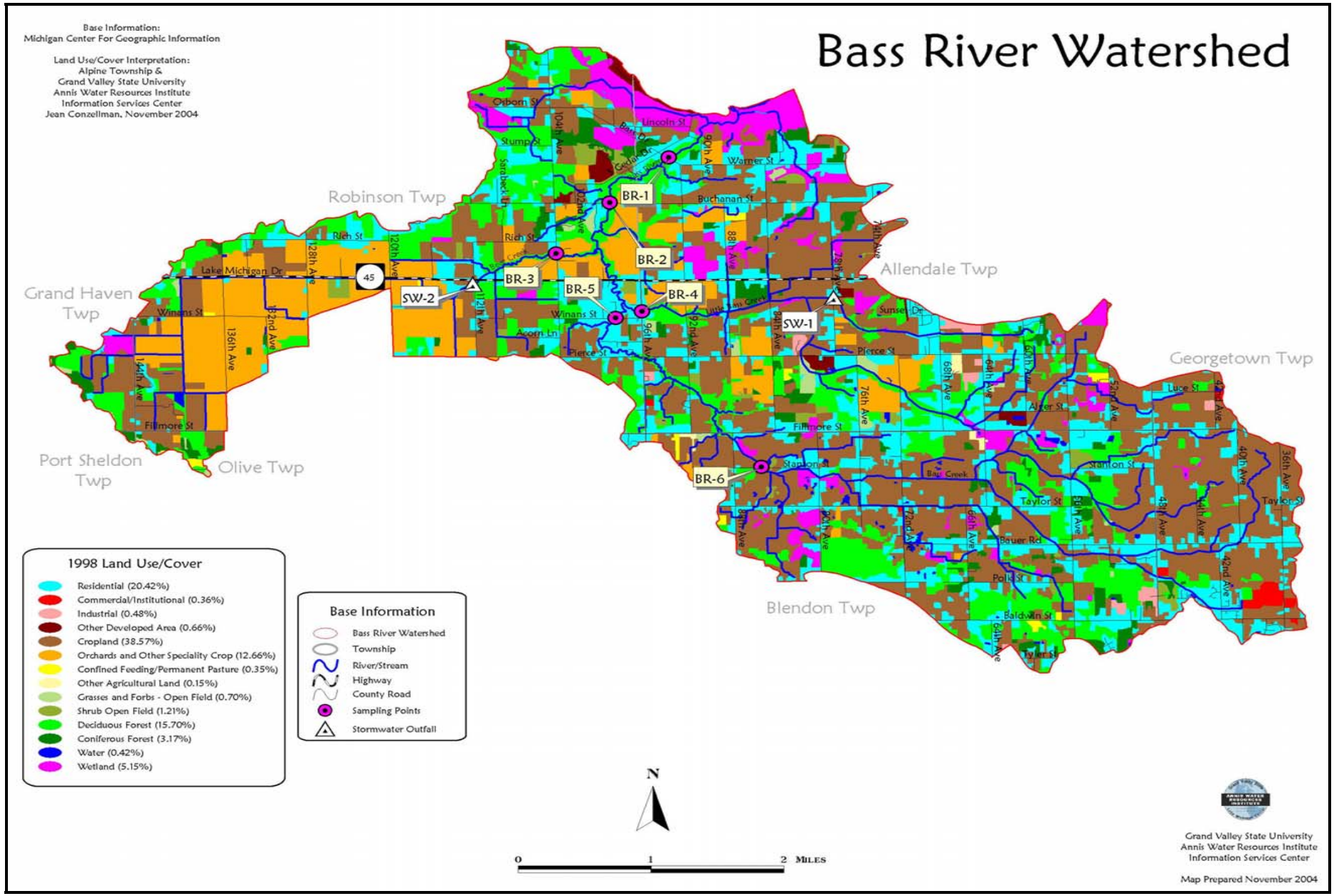

Figure 2. Bass River watershed detailing land use categories (1998 coverage) provided by the Cadmus Group (2005) (MIRIS, 2005).

Table 1. NPDES permitted facilities located in the Bass River watershed, Ottawa County, Michigan. Source: MDEQ, Water Bureau's NPDES Permit Management System (NMS, 2005).

Facility	Permit Number	Township
Industrial Storm Water		
Bauer Truck Parts, Inc.	MIS210110	Georgetown
Construction Storm Water		
CS & Z – Arcadia Woods	MIR104463	Allendale
Georgetown Township Ice Arena	MIR106759	Georgetown
GVD – Hidden Shores	MIR105822	Allendale
GVI – Schepers Farms Sanitary Sewer	MIR107098	Georgetown
Hidden Acres – Traders Creek	MIR107610	Allendale
Jay Schippers - Woodbriar	MIR107344	Allendale
JBS Ltd. LLC - Arcadia Woods #2	MIR107906	Allendale
Quest-Bittersweet Estates #3	MIR105056	Allendale
Equite Real Estate – Bauer Crossings	MIR108471	Allendale
MS4 Storm Water		
Allendale Township MS4 (watershed)	MIG610120	Allendale
Blendon Township MS4 (jurisdictional)	MIS040007	Blendon
Georgetown Township MS4 (watershed)	MIG610209	Georgetown
Grand Haven Township MS4 (watershed)	MIG610207	Grand Haven
Robinson Township MS4 (jurisdictional)	MIS040059	Robinson

Table 2. Land use categories and estimated current TSS loads and TSS load reductions in the Bass River watershed, Ottawa County, Michigan.

Source Category	Acres	Estimate Current TSS (pounds/year)*	TMDL TSS Target Load TSS (pounds/year)
WLA Components:			
NPDES Non-Storm Water TSS Load		none	none
NPDES Storm Water TSS Load (Urban/Industrial/Built-Up)			
Residential	6,537	1,260,832	1,260,832
Commercial and Service	114	31,746	31,746
Industrial	155	110,661	59,415 (46% reduction)
Transportation/Comm/Util.	211	58,757	58,757
Subtotal:	**7,017**	**1,461,996**	**1,410,751**
WLA Total:	**7,017**	**1,461,996**	**1,410,751 (WLA)** (3% reduction)
LA Components:			
Agricultural Land			
Cropland	12,349	794,857	438,542 (45% reduction)
Orchards and Other Specialty Crops	4,053	260,876	143,931 (45% reduction)
Confined Feeding/Pasture	111	7,145	3,942 (45% reduction)
Other Agricultural Land	48	3,090	1,705 (45% reduction)
Subtotal:	**16,561**	**1,065,967**	**588,120** (45% reduction)
(Background Sources)			
Forested/Shrub/Open Land			
Open Land/Shrub/Range Land	614	13,900	13,900
Deciduous Forest	5,027	113,807	113,807
Coniferous Forest	1,016	23,001	23,001
Water Body			
Water (Streams/Lakes/Ponds)	135	2,691	2,691
Wetlands	1,650	32,895	32,895
Subtotal:	**8,442**	**186,294**	**186,294**
LA Subtotal:	**25,003**	**1,252,261**	**774,414 (LA)**
WLA and LA Totals:	**32,020**	**2,714,257**	**2,185,165** (20% reduction)

**TSS load estimates based on PLoad Version 3 model (USEPA, 2001), land use acres derives from 1998 land use database coverage (Cadmus Group, 2005) and a mean annual rainfall value of 32 inches.*