# Carver Creek Lakes Excess Nutrients TMDL Report

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Prepared by: Carver County Land and Water Services Government Center, Administration Building 600 East Fourth Street Chaska, Minnesota 55318 (952) 361-1820

> In cooperation with: WENCK ASSOCIATES, INC. 1800 Pioneer Creek Center P.O. Box 249 Maple Plain, Minnesota 55359-0249 (763) 479-4200



Cover Photo By Shannon Wing Hydes Lake July 22, 2008

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TMDL Summary Table				
EPA/MPCA Required Elements	Sum	TMDL Page #		
Waterbody Name & DNR ID	Goose Lake – 10-0089 Hydes Lake – 10-0088 Miller Lake – 10-0029 Winkler Lake – 10-0066			
Location	Carver County, West Metro, drains to Minnesota River via Carver Creek			
303(d) Listing Information	<ul> <li>Describe the waterbody as it is identified on the State/Tribe's 303(d) list:</li> <li>Waterbody name, description and ID# for each river segment, lake or wetland</li> <li>Aquatic recreation (swimming)</li> <li>Excess nutrients</li> <li>Priority ranking is based on scheduling of completing project. These TMDLs were scheduled to begin in years ranging from 2003 to 2006 and be complete in 2010.</li> <li>All lakes listed in 2002, except Winkler (2004)</li> </ul>			
Applicable Water   Parameter		Concentration (µg/L)	3	
Quality Standards/ Numeric Targets	Total Phosphorous	40 for Hydes; 60 for others		
Loading Capacity (expressed as daily load)	Identify the waterbody's loading capacity for the applicable pollutant. Identify the critical condition. For each pollutant: LC = X/day; and Critical Condition Summary			
	Goose	See Table 6.2		
	Hydes	See Table 6.4	-	
	Winkler	See Table 6.6	-	
Wasteload Allocation	<ul> <li>Portion of the loading capacity allocated to existing and future point sources [40 CFR §130.2(h)].</li> <li>Total WLA = X/day, for each pollutant</li> </ul>		57-65	
	Goose Hydes	See Table 6.2 See Table 6.4	-	
	Miller	See Table 6.6	]	
	Winkler See Table 6.8			

	Reserve Capacity (and		
	related discussion in	NA	54
	report)		
Load Allocation	Identify the portion of the loading capacity allocated		
	to existing and future non	point sources and to	
	natural background if possible [40 CFR §130.2(g)].		
	Total LA = X/day, for each pollutant		
	Goose	See Table 6.2	
	Hydes	See Table 6.4	
	Miller	See Table 6.6	
	Winkler	See Table 6.8	
Margin of Safety	Include a MOS to account for any lack of knowledge concerning the relationship between load and wasteload allocations and water quality [CWA §303(d)(1)(C), 40 CFR §130.7(c)(1)]. Identify and explain the implicit or explicit MOS for each pollutant An implicit MOS was used for all of the lakes based on conservative modeling assumptions.		
Seasonal Variation	Statute and regulations require that a TMDL be established with consideration of seasonal variation. The method chosen for including seasonal variation in the TMDL should be described [CWA §303(d)(1)(C), 40 CFR §130.7(c)(1)] Seasonal Variation Summary for each pollutant		54
Reasonable Assurance	nce Summarize Reasonable Assurance		76
	Note: In a water impaired by both point and nonpoint sources, where a point source is given a less stringent WLA based on an assumption that NPS load reductions will occur, reasonable assurance that the NPS reductions will happen must be explained. In a water impaired solely by NPS, reasonable assurances that load reductions will be achieved are not required (by EPA) in order for a TMDL to be approved.		
	Approach	Specific Approach	
	Regulatory	Watershed Rules	

		NPDES Phase II	
		Stormwater Permits	
		NPDES Permits	
		Feedlot Permitting	
		County ISTS Ordinance	
		Education	
	Non-regulatory	Incentives	
Monitoring	Monitoring Plan inclu	ded?	80
	Note: EPA does not approve effectiveness monitoring plans but providing a general plan is helpful to meet reasonable assurance requirements for nonpoint source reductions. A monitoring plan should describe the additional data to be collected to determine if the load reductions provided for in the TMDL are occurring and leading to attainment of water quality standards.		
Implementation	<ul> <li>1. Implementation Strategy included? The MPCA requires a general implementation strategy/framework in the TMDL.</li> <li>Note: Projects are required to submit a separate, more detailed implementation plan to MPCA within one year of the TMDLs approval by EPA.</li> <li>2. Cost estimate included? The Clean Water Legacy Act requires that a TMDL include an overall approximation ("a range of estimates") of the cost to implement a TMDL [MN Statutes 2007, section 114D.25].</li> <li>Note: EPA is not required to and does not approve TMDL implementation plans.</li> </ul>		
Public Participation	<ul> <li>Public Comment period (dates)</li> <li>Comments received?</li> <li>Summary of other key elements of public participation process</li> <li>Note: EPA regulations require public review [40 CFR §130.7(c)(1)(ii), 40 CFR §25] consistent with State or Tribe's own continuing planning process and public participation requirements</li> </ul>		66

### **Executive Summary**

This Total Maximum Daily Load (TMDL) study addresses a nutrient impairment in four lakes in the Carver Creek watershed. The goal of this TMDL is to quantify the pollutant reductions needed to meet State water quality standards for nutrients in the lakes of Goose (10-0089), Hydes (10-0088), Miller (10-0029), and Winkler (10-0066).

The Carver Creek Lakes are located in Carver County, west of the Twin Cities Metro. The lakes are in areas that are primarily rural. The western suburbs of the Twin Cities Metropolitan area are experiencing moderate to high levels of development and there is increasing awareness of water quality issues by the public. The lakes are not currently used for recreation beyond their aesthetic values, fishing, and some boating, although there is interest from local citizens to improve the lakes for swimming.

The entire Carver Creek Watershed area is 55,076 acres, roughly 54 percent is agricultural land and 10 percent being developed acreage. The lakes are connected by channels of varying lengths and Carver Creek, which has been identified by the Minnesota Pollution Control Agency (MPCA) as turbidity impaired and is part of a current TMDL study. The lake system and Carver Creek flow to the southeast, ultimately discharging into the Minnesota River.

Water quality in all four lakes is considered poor with frequent algal blooms. Monitoring data in the Carver Creek chain of lakes suggest that it is a highly productive system, with the greatest water quality problems occurring in Winkler Lake.

Goose Lake is a hypereutrophic lake located west of Lake Waconia. Phosphorus loadings have significant sources from inlets to the lake. These sources include the direct watersheds of Swan, Donders, and Rutz Lakes all contributing to Goose Lake.

Both internal and external sources have significant phosphorus loadings to Hydes Lake. This lake is hypereutrophic and located southwest of the City of Waconia.

Miller Lake, located northeast of the City of Cologne, is a hypereutrophic lake. Agriculture is the primary land use and is the major contributor to the external phosphorus load to Miller Lake.

Winkler Lake, located northwest of the City of Cologne, is a hypereutrophic lake. External phosphorus loading from agricultural land uses are the major source of phosphorus to the lake. Rice Lake also contributes to the phosphorus loading of Winkler Lake.

Wasteload and Load Allocations for all lakes to meet State standards for the North Central Hardwood Forest ecoregion translate to phosphorus load reductions ranging from 58 to 97 percent. Various activities and strategies are outlined within this TMDL to meet these reduction goals. Activities are in two categories: external load reduction strategies and internal load reduction strategies. External load reduction activities include, but are not limited to, installation of best management practices (BMPs) throughout each subwatershed, landowner education, wetland restoration, installation of buffer strips, incorporating rain gardens into residential landscapes, and impervious disconnection. Internal load reduction strategies include, but are not limited to, alum treatments, aquatic plant management, and landowner education.

### 1.0 Target Identification and Determination of Endpoints

#### **1.1 Purpose**

This Total Maximum Daily Load (TMDL) study addresses a nutrient impairment in the Carver Creek lakes. The goal of this TMDL is to provide wasteload allocations (WLAs) and load allocations (LAs) and quantify the pollutant reductions needed to meet the state water quality standards for nutrients in Goose, Hydes, Miller, and Winkler Lakes, in Carver County, Minnesota. The Carver Creek Lakes TMDL for nutrients is being established in accordance with section 303(d) of the Clean Water Act, because the State of Minnesota has determined these waters in the Carver Creek watershed exceed the state established standards for nutrients.

#### **1.2 Impaired Waters**

All four of the lakes in this project are on the 2010 State of Minnesota 303(d) list of impaired waters. Goose, Hydes, and Miller Lakes were originally listed in 2002 and Winkler Lake was listed in 2004 (Table 1.1). The lakes are impaired for excess nutrients, which inhibit the beneficial use of aquatic recreation. Excess nutrients have led to increases in algal blooms in all lakes, discoloration of the water, and nuisance odors. All of which have impaired the designated use of aquatic recreation, including swimming.

LAKE	DNR LAKE	AFFECTED USE	YEAR	POLLUTANT OR
	#		LISTED	STRESSOR
Goose	10-0089	Aquatic recreation	2002	Excess nutrients
Hydes	10-0088	Aquatic recreation	2002	Excess nutrients
Miller	10-0029	Aquatic recreation	2002	Excess nutrients
Winkler	10-0066	Aquatic recreation	2004	Excess nutrients

#### Table 1.1 Impaired waters in the Carver Creek chain of lakes.

The MPCA projected schedule for TMDL report completion, as indicated on Minnesota's 303(d) impaired waters list, implicitly reflects Minnesota's priority ranking of these TMDLs. These TMDLs were scheduled to begin in years ranging from 2003 to 2006 and be complete in 2010. Ranking criteria for scheduling TMDL projects include, but are not limited to: impairment impacts on public health and aquatic life; public value of the impaired water resource; likelihood of completing the TMDL in an expedient manner, including a strong base of existing data and restorability of the water body; technical capability and willingness locally to assist with each TMDL; and appropriate sequencing of TMDLs within a watershed or basin.

#### **1.3 Defining Minnesota Water Quality Standards**

Water quality in Minnesota lakes is evaluated using three parameters: TP, chlorophyll-a, and Secchi depth. Phosphorus is typically the limiting nutrient in Minnesota lakes, meaning that algal growth will increase with increased phosphorus. Chlorophyll-a is the primary pigment in aquatic algae and has been shown to have a direct correlation with

algal biomass. Secchi depth is a physical measurement of water clarity taken by lowering a white disk until it can no longer be seen from the surface. Greater Secchi depths indicate less light-refracting particulates in the water column and better water quality; conversely, high TP and chlorophyll-a concentrations point to poor water quality.

The protected beneficial use for all lakes is aquatic recreation (swimming). Table 1.2 outlines the previous state standards that were used to determine that Goose, Hydes, Miller, and Winkler Lakes should be placed on the 303(d) list of impaired waters in Minnesota. In May 2008, the MPCA approved new numerical thresholds based on ecoregion and lake morphometry. The new rules take into account geographic differences across the state and nutrient cycling differences between shallow and deep lakes, resulting in more refined standards for Minnesota lakes (MPCA 2005).

Impairment Designation	TP (µg/L)	Chlorophyll- a (µg/L)	Secchi Depth (m)
Full Use	<40	<15	<u>&gt;</u> 1.6
Review	40 - 45	NA	NA
Impaired	>45	>18	<1.1

#### Table 1.2 Previous state standards for lakes (NCHF ecoregion).

According to the MPCA, Goose, Miller, and Winkler are considered "shallow" lakes, and Hydes is a "deep" lake. Because Carver County falls within the North Central Hardwood Forest (NCHF) ecoregion (Figure 1.1), those standards were used to determine impairment.



Figure 1.1 Map of Minnesota's ecoregions.

Table 1.3 MPCA lake water quality standards for North Central Hardwood Fo	orest
Ecoregion. Values are summer averages (June 1 through September 30).	

	NORTH CENTRAL HARDWOO FORESTS		
Parameters	Shallow <sup>1</sup>	Deep	
TP concentration (µg/L)	60	40	
Chl-a concentration (µg/L)	20	14	
Secchi disk transparency (meters)	>1.0	>1.4	

<sup>1</sup>Shallow lakes are defined as lakes with a maximum depth of 15 feet or less, or with 80 percent or more of the lake area shallow enough to support emergent and submerged rooted aquatic plants (littoral zone).

This TMDL has been established with the intent to implement all the appropriate activities that are not considered greater than extraordinary efforts. These proposed goals will require aggressive action. If all appropriate BMPs and activities have been implemented and the lakes still do not meet their goals, Carver County staff will reevaluate the TMDL and work with the MPCA to evaluate whether more appropriate site-specific standards for the lakes could be pursued and developed.

Inherent in the numerical water quality goals for shallow lakes are desired ecological endpoints. Carver County's management strategies are focused on these endpoints which are restoring the lakes to a diverse, native aquatic plant (macrophyte) dominated state across much of the lake. This type of lake is characterized by low rough fish populations, clearer water, higher wildlife values and positive feedback mechanisms that maintain the lake in this condition (Scheffer 1998). A shift from the algae/invasive macrophyte dominated state to the clear water, native macrophyte dominated state should be a qualitative goal for Carver Creek Lakes.

Another goal is to improve public perception of the recreational suitability of Hydes, Miller, and Winkler Lakes. Public surveys were conducted to assess public perception of the recreational suitability of these lakes. The results of the surveys will be used to identify goals appropriate for increasing the public perception of recreational suitability. Currently, public perception of these lakes range from 70 to 89 percent of respondents believing that either "swimming is impaired but boating ok" or "no aesthetics possible".

While a high percentage of respondents feel that the lakes cannot be used for recreation, all lakes were viewed as potentially having some type of recreation available. For Goose Lake, a skiing club uses the lake and accounts for the majority of boat traffic. Fishing is limited and wildlife observation has been listed as a recreational activity for the lake.

Residents around Hydes Lake have listed fishing as the top recreational activity on the lake. Other recreational opportunities on the lake include swimming, waterskiing, and wildlife observation. It is projected that the majority of users participating in these types of recreation live on the lake.

While close to 90 percent of the respondents within the Miller Lake Direct Watershed indicated that their perception of usability was "no swimming- boating ok" to "no possible usage", limited fishing was indicated as the top use. Other recreational opportunities listed were waterfowl hunting, wildlife observation, and canoeing. While there is currently little opportunity for recreation, interviews with landowners indicated that the lake was historically used for waterskiing, swimming, and fishing.

While lake perception surveys have not been collected for Winkler Lake, the Minnesota DNR classified this water body as best suited for waterfowl and aquatic furbearers. As such the only recreational use for the lake is hunting/trapping associated with the wildlife present.

### 2.0 Watershed and Lake Characterization

#### 2.1 Carver Creek Lakes Watershed Description

Carver Creek Watershed is located in central Carver County, encompassing 55,076 acres and parts of three cities (Figure 2.1). Land use in the watershed is predominately agriculture (54 percent), with small portions of developed and natural areas scattered throughout (10 percent and 18 percent, respectively) (Table 2.1).



Figure 2.1 Carver Creek lakes and watershed.

Land Use	<b>Carver Cree</b>	k Watershed
Lanu Use	Acres	Percent
Agriculture	29,880	54%
Developed	5,291	10%
Forest/Grassland	9,699	18%
Wetland	5,122	9%
Water	5,084	9%
Total	55,076	100%

#### Table 2.1 2005 Carver Creek Watershed Land Use.

The Goose Lake Subwatershed is located in the northwestern portion of Carver Creek Watershed. The Hydes Lake Subwatershed is located within the western portion of Carver Creek Watershed. Miller Lake has the largest direct drainage area of all lakes included in this TMDL. The Winkler Lake Subwatershed is southeast of Hydes Lake, but still within the western end of Carver Creek Watershed. Winkler Lake outlets to Carver Creek and eventually drains to Miller Lake, the last significant body of water for Carver Creek before emptying into the Minnesota River.

Parameter	Goose Lake	Hydes Lake	Miller Lake	Winkler Lake
Surface Area (ac)	333	216	141	73
Average Depth (ft)	4.5	8	7	2 (est.)
Maximum Depth (ft)	10	18	14	3 (est.)
Volume (ac-ft)	1,443	1,788	1,038	137
Residence Time (days)	182 - 256	109 - 186	15 - 37	15 - 27
Littoral Area (%)	100	76	100	100
Direct Watershed (excluding lake)(ac)	2,028	839*	14,645	3,118**
Lake Area:Direct Watershed	1:7	1:4	1:104	1:43

 Table 2.2 Lake characteristics of the Carver Creek Lakes.

\*Includes Subwatershed H2

\*\*Includes Subwatersheds "inlets" 1, 2, and 3

#### 2.1.1 Goose Lake

Goose Lake has a direct watershed of 2,001 acres, excluding the lake. The indirect watersheds are made up of three shallow lake/wetlands that flow intermittently into Goose Lake via the tributaries (Figure 2.2). Goose Lake discharges into a series of wetlands before entering Lake Waconia which then discharges into Carver Creek before flowing southeast into the Minnesota River.



Figure 2.2 Map of Goose Lake watershed and sub-watersheds.

#### 2.1.2 Hydes Lake

Hydes Lake has a direct watershed of 839 acres, excluding the lake and an indirect watershed from Patterson Lake, a shallow lake/wetland that is located less than one mile away, which is 2,292 acres. Only one major inlet flows intermittently into Hydes Lake from Patterson Lake (Figure 2.3).



Figure 2.3 Hydes Lake watershed with Patterson Lake watershed to the north.

#### 2.1.3 Miller Lake

Miller Lake has a direct watershed of 14,654 acres, excluding the lake (Figure 2.4). The lake area to direct watershed area ratio is 1:104, indicating that the direct watershed has the potential to contribute extremely high nutrient loads to the lake. The Miller Lake direct watershed contains one major inlet, Carver Creek, which drains a majority of the watershed (14,260 acres). Miller Lake has another much smaller, intermittent, low-flow inlet draining a small area to the west of the lake. Ultimately, four lakes drain directly to Miller Lake via the tributaries of Carver Creek (Burandt, Benton, Winkler, and Reitz).



Figure 2.4 Miller Lake watershed and sampling points.

#### 2.1.4 Winkler Lake

Winkler Lake has a direct watershed of 3,118 acres, excluding the lake (Figure 2.5). Within this area there are three inlets (drainage ditches) entering from the NW, SW and E parts of the lake. The northwest inlet flows in from Rice Lake, a public ditch to the southwest discharges treated wastewater from Bongards' wastewater treatment plant into Winkler Lake, and a small wetland drains in from the east. Rice Lake drains to Winkler Lake via the northwest sub-watershed. This indirect drainage into Winkler Lake is roughly 4,580 acres in size and contains both Rice Lake and its subwatersheds.



Figure 2.5 Winkler Lake watershed, subwatershed, and sampling points.

#### 2.2 Land Use

Land use percentages are similar for the four direct watersheds compared to Carver Creek Watershed. Agriculture is the major land usage for the entire area ranging from 54 percent in Goose Lake to 74 percent in Winkler Lake. In this report direct watersheds are considered to be those areas draining to the lake without first passing through another lake.

Land use changes between 2005 and 2020 are partly due to the different methodology used to determine each classification. Any changes seen in wetland land use or developed land are largely a reflection of this difference in methodology. Wetland "reductions" in 2020 do not account for any mitigation of wetlands lost during development. Developed land use does not include farmsteads, which were classified as agricultural land use for the 2020 Land Use data.

#### 2.2.1 Goose Lake

Land use in the direct watershed is primarily tilled agriculture (Figure 2.6, Table 2.3). There are approximately 41 homes in the direct watershed with subsurface sewage treatment systems (SSTS). A GIS review showed that 13 of those 41 SSTS had no permits on file. According to the 2000 feedlot inventory data, three feedlots exist in the

direct watershed with 148 animal units. 2020 Land use projections indicate that there will be minimal to no change (Table 2.4).



Figure 2.6 Goose Lake Watershed 2005 Land Use.

Land use surrounding lakes in the indirect watershed that flow into Goose Lake ultimately impact its water quality. As such, a GIS review was conducted to determine land use characteristics in these areas. During this review, it was determined that three separate subwatersheds ultimately drain to Goose Lake: Rutz lake, Swan lake and Donders Lake. Nearly 50 percent of the indirect watersheds are in agricultural conditions and to this point there are no plans for future development (Table 2.4). In addition there are approximately 34 homes within the three indirect watersheds collectively, all with onsite SSTS. Two homes with SSTS did not have permits on file. According to the feedlot inventories done in 2000, five feedlots containing approximately 1057 animal units are located within the indirect watersheds.

Landuca	Goose La	ke Direct	Rutz	z Lake	Swar	n Lake	Donde	rs Lake
Lanu use	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent
Agriculture	1,250	54%	225	67%	166	40%	284	42%
Developed	117	5%	25	8%	20	5%	31	5%
Forest/Grassland	255	11%	21	6%	59	14%	92	14%
Wetland	327	14%	6	2%	68	17%	138	20%
Water	362	16%	57	17%	97	24%	128	19%
Total	2,311	100%	335	100%	411	100%	673	100%

#### Table 2.3 Goose Lake Watershed 2005 Land Use.

#### Table 2.4 Goose Lake Watershed 2020 Land Use.

Landuca	Goose La	ke Direct	Rutz	z Lake	Swar	1 Lake	Donde	rs Lake
Land use	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent
Agriculture	1,373	59%	245	73%	196	48%	301	45%
Developed	64	3%	20	6%	20	5%	30	4%
Forest/Grassland	262	11%	60	18%	45	11%	82	12%
Wetland	309	13%	7	2%	113	28%	183	27%
Water	303	13%	3	1%	37	9%	78	12%
Total	2,311	100%	335	100%	411	100%	673	100%

#### 2.2.2 Hydes Lake

Current land use in the direct watershed is primarily tilled agriculture. There are approximately 28 homes existing in the watershed, all with on-site SSTSs. Nineteen of the homes are on the lake front (within 300 feet of the shoreline). One feedlot exists in the watershed containing approximately 47 animal units. In looking at land use in 2020, agricultural land uses will increase slightly. It should be noted that wetlands show a decrease, but this land use study did not take into account mitigation for lost wetland acres. (Figure 2.7, Table 2.5, Table 2.6).

Land Use	Hydes Lake				
Land Use	Acres	Percent			
Agriculture	562	53%			
Developed	64	6%			
Forest/Grassland	79	8%			
Wetland	128	12%			
Water	220	21%			
Total	1,053	100%			

#### Table 2.5 2005 land use in the Hydes Lake watershed.

#### Table 2.6 2020 land use in the Hydes Lake watershed.

I and Usa	Hydes Lake				
Lanu Use	Acres	Percent			
Agriculture	628	60%			
Developed	45	4%			
Forest/Grassland	80	8%			
Wetland	82	8%			
Water	219	21%			
Total	1,054	100%			



Figure 2.7 Hydes Lake 2005 land use.

#### 2.2.3 Miller Lake

Current land use in the watershed is primarily tilled agriculture (Figure 2.8, Table 2.7, Table 2.8). The city of Waconia is partially within the direct watershed boundaries. Approximately 5,500 property parcels exist in the direct watershed; however, the land surrounding Miller Lake is minimally developed with only one home located within 300 feet of the lake. Currently 29 feedlots exist in the watershed containing approximately 2,279 animal units. None of the existing feedlots are regulated under the National Pollutant Discharge Elimination Permit System (NPDES) permit system. 2020 Comprehensive Plans indicate that there will be an increase in development reducing both the percent wetland and natural areas. As in previous sections, the reduction in wetlands should not be a point of concern due to the lack of accounting for mitigation in this study.

Land Uga	Miller Lake				
	Acres	Percent			
Agriculture	8,806	60%			
Developed	1,774	12%			
Forest/Grassland	2,553	17%			
Wetland	1,512	10%			
Water	143	1%			
Total	14,788	100%			

#### Table 2.7 Miller Lake Watershed 2005 Land Use.

#### Table 2.8Miller Lake Watershed 2020 Land Use.

I and Usa	Miller Lake			
Lanu Use	Acres	Percent		
Agriculture	9,445	64%		
Developed	2,094	14%		
Forest/Grassland	2,108	14%		
Wetland	992	7%		
Water	153	1%		
Total	14,792	100%		



Figure 2.8 Miller Lake 2005 land use.

#### 2.2.4 Winkler Lake

The 3,198-acre watershed surrounding Winkler Lake is and has been since European settlement predominantly agricultural (Figure 2.9, Table 2.9, Table 2.10). Looking at future land use (2020), a slight increase in agriculture will occur. There are currently 69 homes in the direct watershed all with on-site septic systems. In addition, there are 11 feedlots in the watershed containing approximately 1,373 animal units.

Land Use	Winkler Lake			
Lanu Use	Acres	Percent		
Agriculture	2,366	74%		
Developed	204	6%		
Forest/Grassland	289	9%		
Wetland	266	8%		
Water	73	2%		
Total	3,198	100%		

#### Table 2.9 Winkler Lake Direct Watershed 2005 Land Use.

Land Use	Winkler Lake			
Lanu Use	Acres	Percent		
Agriculture	2,506	78%		
Developed	87	3%		
Forest/Grassland	267	8%		
Wetland	266	8%		
Water	73	2%		
Total	3,201	100%		

 Table 2.10
 Winkler Lake Direct Watershed 2020 Land Use.



Figure 2.9 Winkler Lake 2005 land use.

#### 2.3 Fish Populations and Fish Health

A general understanding of a lake's fishery is useful as it can have a significant influence on water quality. Fish species presence is summarized in Table 2.11. Hydes Lake has the most expansive survey history of all lakes within this TMDL report. Four full surveys were conducted between 1980 and 2001. During this time, a shift has been evident because of the increase in rough fish (carp and black bullhead) biomass. Winkler Lake has not been surveyed by the DNR and the indication of only one species (carp) is based on reporting by County Staff, and thus it is not an all-inclusive list for the lake.

Diversity of fish species is greatest within Goose Lake, which has ten species identified within previous fish surveys. Both Miller and Hydes Lake have the second most diversity, each with eight species identified. Carp has been reported in all lakes, a rough fish that can tolerate poorer water quality. Both abundance and biomass estimates from fish surveys show, in general, that carp has been increasing over the years, as well as another rough fish, black bullhead.

Goose Lake have evidence of past fish kills within the lake, mainly winterkills. As many as 10 winterkills have been identified in Goose Lake. Fish kills occur when dissolved oxygen (DO) levels are so low that fish begin to die from the lack of oxygen. Fish kills commonly occur during the summer or winter. Summer kills are the result of high productivity of algae and macrophytes that eventually die back and are subsequently broken down by bacteria. The breakdown by bacteria demands oxygen, which depletes it from the water column. Winter fish kills are the result of snow-covered ice that shades out photosynthesis under the ice. These conditions, coupled with a high sediment oxygen demand can deplete the DO under the ice and result in a fish kill. Sediment oxygen demand is defined as the biological, biochemical, and chemical processes that occur at the sediment-water juncture that uses oxygen. More detailed summaries are available from the county upon request.

	GOOSE	HYDES	MILLER	WINKLER
Bigmouth buffalo			Х	
Black bullhead	Х	Х	Х	
Black crappie		Х	Х	
Bluegill	Х	Х	Х	
Carp	Х	Х	Х	Х
Channel catfish	Х			
Crappie	Х			
Green sunfish	Х			
Largemouth bass	Х	Х		
Northern pike	Х	Х	Х	
Pumpkinseed sunfish	Х			
Walleye		Х		
White sucker			Х	
Yellow perch	Х	Х	Х	

#### Table 2.11 Fish species present within Carver Creek Lakes (1980 – 2006).

#### 2.4 Aquatic Plants

Native aquatic plants benefit lake ecosystems by providing spawning and cover for fish, habitat for macroinvertebrates, refuge for prey, and stabilization of sediments. Broadleaf plants present in the lake provide cover for fish, food for waterfowl, and support invertebrates and other small animals that both waterfowl and fish eat. In addition to the mentioned benefits, studies have shown that both emergent and submersed aquatic plants reduce the wind mixing activity that promotes sediment re-suspension in shallow lakes (James, W.F and J.W. Barko, 1994). However, in excess they limit recreation activities such as boating and swimming as well as aesthetic appreciation.

Excess nutrients in lakes can create an environment primed for the takeover by aquatic weeds and exotic plants. Some exotics can lead to special problems in lakes. For example, Eurasian water milfoil can reduce plant biodiversity in a lake because it grows in great densities and squeezes other plants out. Ultimately, this can lead to a shift in the fish community because these high plant densities favor panfish over larger game fish. Species such as curlyleaf pondweed can cause very specific problems by changing the dynamics of internal phosphorus loading. All in all, there is a delicate balance in the aquatic plant community in any lake ecosystem.

Carver County staff conducted simplified macrophyte surveys of all lakes during the 2005 monitoring season. These surveys were conducted once in the spring and once in the fall. Curlyleaf pondweed was found to be in Hydes and Miller Lakes and Eurasian water milfoil was found in Miller Lake. Aquatic plant diversity was low in all lakes sampled. More detailed aquatic sampling reports are available from the county.

#### 2.5 Shoreline and Habitat Conditions

Naturally vegetated shorelines with abundant amounts of vegetation provide numerous benefits to both lakeshore owners and users. The shoreline areas as defined in this report are areas adjacent to the lake's edge with hydrophytic vegetation and water up to 1.5 feet deep or a water table within 1.5 feet from the surface. Water quality is often improved, plant and animal biodiversity increases, they provide habitat for aquatic and terrestrial species, shorelines are more stable and erosion is decreased, there is a significant reduction in required maintenance, and an increase in aesthetic value. Therefore, identifying projects where natural shoreline habits can be restored or protected will enhance the overall lake ecosystem.

Carver County staff conducted a shoreline survey in June 2005 utilizing a Trimble GPS unit and ArcPad program. Staff circumnavigated the lake, mapping and recording shoreline type such as natural vegetation, sand beach, turf grass to shoreline, pasture, and/or retaining wall (Table 2.12 and Table 2.13). Results from this survey indicate that nearly 90 percent of all shorelines have "natural vegetation" for all four lakes. Hydes Lake has the least amount, in percentage, of "natural vegetation", with only 74 percent. In linear length, Goose Lake has almost 4.4 miles of shoreline in a "natural" condition.

Lake	Shoreline %						Total
	Natural Vegetation	Lawn	<b>Retaining Wall</b>	Pasture	Sand Shore	Agriculture	Total
Goose Lake	89.61%	6.42%		1.73%	0.24%	2.00%	41.48%
Hydes Lake	73.76%	26.24%	3.89%				21.17%
Miller Lake	100.00%						17.31%
Winkler Lake	100.00%						11.01%
Total	89.58%	8.78%	0.82%	0.72%	0.10%	0.83%	100.00%

# Table 2.12 Percentage of shoreline habitats around Goose, Hydes, Miller, andWinkler Lakes.

# Table 2.13 Linear Length of shoreline habitats around Goose, Hydes, Miller, andWinkler Lakes.

Lake	Miles of Shoreline						Total
	Natural Vegetation	Lawn	<b>Retaining Wall</b>	Pasture	Sand Shore	Agriculture	TULAT
Goose Lake	4.39	0.31		0.08	0.01	0.10	4.89
Hydes Lake	1.84	0.66	0.10				2.60
Miller Lake	2.04						2.04
Winkler Lake	1.30						1.30
Total	9.57	0.97	0.10	0.08	0.01	0.10	10.83
# **3.0 Assessment of Water Quality Data**

# 3.1 Data Sources and Methodology

#### 3.1.1 Carver County Environmental Services

Carver County and its Water Plan act to coordinate monitoring of county lakes and streams. Monitoring of lakes follows the Water Plan management goal of creating and maintaining a comprehensive, accurate assessment of surface and groundwater quality trends over the long term. In order to establish baseline water quality, Carver County set up a network of sampling sites in the 1990s. In accordance with the County Water Plan, watersheds were given a priority (high, medium, low) based on funding available, need for monitoring data, current water quality conditions, current land use, and staff availability. In addition, Carver County promotes volunteer monitoring efforts in an attempt to broaden the public's awareness and expand our monitoring network. Goose, Hydes, and Miller have been given a high priority and have been monitored by both volunteer and county staff annually since 1999.

Carver County follows the monitoring techniques set up by the Metropolitan Council Environmental Services for the Citizens Assisted Monitoring Program (CAMP) program. This program includes bi-weekly in-lake samples that are analyzed for TP, chlorophyll-a, and total Kjeldahl nitrogen (TKN). Additionally, Secchi depth measurements are taken and user perception surveys are filled out during each monitoring event. Monitoring takes place from April to October each year.

#### 3.1.2 Metropolitan Council Environmental Services

Carver Creek Lakes are also periodically monitored by the volunteer program CAMP, which is operated by the Metropolitan Council Environmental Services (MCES). Citizen volunteers collect a water sample to be submitted to the Met Council for analysis of total phosphorous, total Kjeldahl nitrogen, and chlorophyll-a. Also collected is a Secchi disk reading and general user perceptions of the lake. Each lake is sampled bi-weekly from April to October for a total of 14 samples.

#### 3.1.3 Minnesota Pollution Control Agency

The Carver Creek Lakes have been monitored periodically by the Minnesota Pollution Control Agency (MPCA) Citizen Lake Monitoring Program (CLMP). The CLMP is similar to the Metropolitan Council's CAMP program as it employs the help of citizen volunteers who live on or near the lake to take measurements. However, this program relies on citizens to only collect a Secchi disk reading.

# 3.2 Phosphorus, Chlorophyll-a, and Secchi Depth

#### 3.2.1 Goose Lake

Monitoring conducted over the past ten years has depicted in-lake conditions as hypereutrophic (Table 3.1). In fact, TP has remained at levels nearly three times that used to list the lake as impaired (40  $\mu$ g/L; prior to State rule adoption of the shallow lake standard of 60  $\mu$ g/L). Figure 3.1 and 3.2 show nutrient variation during the monitored

period and yearly seasonal variation. No hypolimnetic samples have been collected because the lake does not stratify.

	ТР	Chlorophyll-a	Secchi disk	TUN
Year	Concentration	Concentration	transparency	I K I N
	$(\mu g/L)(n)$	$(\mu g/L)(n)$	(meters) (n)	(mg/L) (n)
1979	159 (4)	N/A	0.7 (10)	2.3 (4)
1980	142 (2)	N/A	0.6 (9)	2.9 (2)
1995	120 (7)	40 (N/A)	0.5 (7)	2.7 (7)
1996	N/A	N/A	1.0 (4)	N/A
1997	164 (9)	68 (N/A)	0.4 (9)	2.4 (9)
1998	116 (9)	47 (9)	1.3 (9)	2.3 (9)
1999	173 (10)	64 (13)	0.4 (9)	3.1 (10)
2000	216 (7)	81 (11)	0.3 (7)	3.1 (7)
2001	125 (9)	60 (4)	0.7 (9)	3.0 (9)
2002	110 (9)	34 (9)	0.5 (9)	2.4 (9)
2003	176 (8)	95 (8)	0.3 (9)	2.8 (8)
2004	134 (9)	53 (9)	0.4 (9)	2.2 (9)
2005	114 (14)	94 (14)	0.4 (14)	2.1 (14)
2006	111 (12)	94 (14)	0.4 (14)	3.1 (14)
2007	103 (13)	134 (13)	0.4 (12)	4.4 (13)
10 yr avg.	138	76	0.5	2.9

Table 3.1 Growing season (June 1 – September 30) mean lake water quality for Goose Lake.

n is the number of samples collected each season







Figure 3.2 Goose Lake phosphorus and chlorophyll-a summer results from 1999 to 2004.

Chlorophyll-a concentrations generally track TP concentrations and increase throughout the spring and early summer. If the lake was nitrogen limited, increases in chlorophyll-a levels likely would not be in response to a rise in phosphorus levels. TP does show response to precipitation on a daily basis, typical of a lake that is affected by external pollution (Figure 3.3). However, evaluating yearly seasonal TP trends provides indications of internal phosphorus cycling.





Figure 3.3 Goose Lake TP response to daily precipitation in 2001 and 2004.

Increases in TP over each growing season suggest that internal loads of phosphorus play a role in water quality since inflow is naturally low during this period (Welch & Cooke 1995). Thus, it is likely that Goose Lake water quality is affected by both internal and external phosphorus sources.

Monitoring data for Goose Lake suggests that the lake is and has historically been a highly productive system. Goose Lake is hypereutrophic with both internal and external phosphorus sources contributing to the overall nutrient load. The benthic environment in Goose Lake periodically becomes anoxic resulting in the incidence of phosphorus release from the sediments.

#### 3.2.2 Hydes Lake

Monitoring conducted over the past ten years has depicted in-lake conditions which are highly eutrophic (Table 3.2). As seen in the Hydes Lake water quality data, Secchi depth is not always reduced by increases in TP or chlorophyll-a, which could be due to the algae species present. TP has ranged from 456  $\mu$ g/L in 1979 to 84  $\mu$ g/L in 2003. Figure 3.4 shows typical TP response to precipitation.

	ТР	Chlorophyll-a	Secchi disk	
Year	Concentration	Concentration	transparency	TKN (mg/L)/(n)
	$(\mu g/L)/(n)$	$(\mu g/L)/(n)$	(meters)/(n)	
1979	456 (3)	N/A	N/A	3.4 (3)
1985	294 (3)	90 (N/A)	0.8 (4)	2.7 (7)
1991	200 (12)	75 (N/A)	0.8 (12)	2.3 (15)
1993	216 (9)	30 (N/A)	1.9 (9)	1.8 (9)
1995	362 (8)	138 (N/A)	0.6 (2)	2.9 (2)
1996	222 (8)	51 (N/A)	1.6 (8)	1.8 (7)

Table 3.2 Growing season (June 1 – September 30) mean lake water quality for Hydes Lake.

1997	326 (7)	52 (N/A)	1.0 (14)	2.3 (7)
1999	146 (11)	22 (N/A)	1.6 (11)	2.1 (11)
2000	174 (7)	28 (7)	1.5 (7)	2.1 (7)
2001	184 (9)	25 (9)	3.5 (9)	2.4 (9)
2002	106 (13)	33 (13)	0.5(9)	2.1 (13)
2003	84 (14)	39 (14)	1.1 (14)	1.7 (14)
2004	131 (14)	51 (14)	1.0 (14)	2.0 (14)
2005	155 (14)	63 (14)	2.1 (14)	2.3 (14)
2006	182 (14)	90 (14)	1.6 (14)	2.3 (14)
2007	155 (13)	53 (13)	1.4 (13)	2.5 (13)
10 yr avg.	164	46	1.5	2.2

n is the number of samples collected each season



Figure 3.4 Hydes Lake TP and daily precipitation for summer 2002 and 2004.

In 2004 TP increased in mid-June and again in mid-July following precipitation events. These incidences point to increased phosphorus in the water column due to runoff from

surrounding land. However, external loading is not the only contributor to water quality. When in-lake TP versus precipitation plots were examined from previous years, it was determined that TP did not always increase following rain events (Figure 3.5). High phosphorus levels witnessed during dry conditions can be attributed to internal loading. Internal loading in the lake is caused by curlyleaf pondweed senescence in the early growing season and phosphorus release from anoxic sediments due to wind mixing, boat prop disturbance and rough fish rooting during the growing season.

Research indicates that increases in TP in shallow lakes during the summer growing season are typical. Inflow is naturally low during this period and the increase in phosphorus can be attributed to internal loading (Welch & Cooke 1995). Increases in Secchi depth coinciding with increases in TP and chlorophyll-a are due to the specific algae species present in the lake, which if the lake had algae species similar to other lakes within the Carver Creek Watershed would have responded with a decrease in Secchi disk readings. The dominant algae species in the lake is Aphanizomenon, a species which forms pods in the water column, thereby leaving the water itself clear.



Figure 3.5 In-lake TP and annual precipitation for Hydes Lake.





Figure 3.6 2002 and 2004 summer TP, chlorophyll-a, and Secchi depth for Hydes Lake.

Water quality in Hydes Lake is that of a eutrophic system. Evidence suggests internal sources effect water quality. Land uses within the agriculturally dominated watershed contribute nutrient rich sediment runoff into the major tributary, which ends up accumulating in the lake.

#### 3.2.3 Miller Lake

The watershed which includes Miller Lake has been heavily studied since the early 1990s. Data has been collected throughout the watershed and at the inlet (CA 10.4) and

outlet (CA 8.7) to Miller Lake. Monitoring has continued to show that the tributary, Carver Creek (CA 10.4), is laden with excess sediment and phosphorus. By comparing the two sites and having data from multiple years and continuous flow, we can estimate the effects of upstream land use management to the lake. To this point Miller Lake acts as a large sediment pond for the entire watershed. In fact, it has been measured that in years of heavy rainfall, there is nearly one inch of sediment deposited to the lake bottom.

Miller Lake Removal							
Year	TP (pounds)	TSS (pounds)	% TP	% TSS			
1997	22890	14423440	50	80			
1998	15279	6311783	51	72			
1999	39112	59725389	73	83			
2000	1284	625982	38	82			
2001	1454	108602	8	21			
2002	2047	3246719	7	51			
2003	6404	6490773	38	74			
2004	4376	4213422	-21	-56			
2005	6444	28372511	18	61			

 Table 3.3 Miller Lake TP and total suspended solids removal.

Furthermore, data collected from CA 10.4 and CA 8.7 from 1997-2005 shows that the lake has reduced the total suspended solids (TSS) and TP at the outflow by an average of 52 percent and 29 percent respectively (Table 3.3). It is clear that the major tributary (CA 10.4) is dramatically impacting Miller Lake and that the portion of the watershed above the lake is a major contributor of TSS and TP.

Monitoring conducted over the past ten years has depicted in-lake conditions as highly eutrophic to hypereutrophic. TP has ranged from 150  $\mu$ g/L in 2005 to over 460  $\mu$ g/L in 2001 (Table 3.4). Figure 3.7 shows nutrient variation from year to year. Figure 3.8 shows typical TP response to precipitation. Figure 3.9 shows summer TP, chlorophyll-a, and Secchi depth for Miller Lake.

Year	TP Concentration (µg/L)/(n)	Chlorophyll-a Concentration (µg/L)/(n)	Secchi disk transparency (meters)/(n)	TKN (mg/L)/(n)
1994	193 (N/A)	19 (N/A)	1.2 (N/A)	1.9 (N/A)
1995	362 (8)	138 (N/A)	0.6 (2)	2.9 (2)
1997	326 (7)	52 (N/A)	1.0 (14)	2.3 (7)
1999	149 (12)	65 (12)	1.0 (12)	2.3 (12)
2000	403 (13)	48 (13)	0.8 (13)	2.3 (13)
2001	462 (13)	37 (13)	1.4 (13)	2.9 (13)
2002	298 (13)	28 (13)	1.2 (13)	N/A

 Table 3.4 Growing season (June 1 – September 30) lake water quality for Miller Lake.

2003	213 (14)	63 (14)	0.6 (14)	1.9 (14)
2004	184 (14)	49 (14)	0.7 (14)	1.9 (14)
2005	152 (14)	50 (14)	0.7 (14)	2.0 (14)
2006	172 (12)	89 (12)	0.7 (12)	2.7 (12)
2007	226 (13)	78 (13)	0.6 (12)	2.8 (13)
10 yr avg.	259	56	0.9	2.3

n is the number of samples collected each season



Figure 3.7 Miller Lake historical precipitation and summer TP.





Figure 3.8 Miller Lake TP and daily precipitation for 2002 and 2003.

External loading due to runoff can be seen following precipitation events in June and July of 2003 (5.53 inches); TP increased from 169  $\mu$ g/L to 344  $\mu$ g/L (Figure 3.8). Chlorophylla production decreased following the event, likely due to an increase in TSS which would have limited the light needed for algal survival.

In response to the large sediment load accumulating in the lake bottom, internal loading likely influences the water quality of Miller Lake. The large sediment loads carried into and removed from Miller Lake contain high nutrient levels. The nutrients can be released by sediments during periods of anoxia, during rooting by rough fish, curlyleaf pondweed senescence, and wind driven events. Research indicates that increases in TP in shallow lakes during the summer growing season are typical. Inflow is naturally low during this period and the increase in phosphorus can be attributed to internal loading (Welch & Cooke 1995).





Figure 3.9 2002 and 2003 Summer TP, chlorophyll-a, and Secchi depth for Miller Lake.

Water quality in Miller Lake is that of a highly eutrophic to hypereutrophic system. Evidence suggests external sources dominate water quality. Land uses within the agriculturally dominated watershed contribute nutrient rich sediment runoff into the major tributary, which ends up accumulating in the lake. Internal loading also influences water quality, however at this point it is difficult to distinguish just how large a role it plays.

#### 3.2.4 Winkler Lake

Analysis of in-lake conditions depicts Winkler Lake as a highly eutrophic to hypereutrophic system. TP has remained above 170  $\mu$ g/L for the last ten years (Table 3.5). Figure 3.10 show typical nutrient variation from the 2003 and 2005 summer seasons, and Figure 3.11 shows within-year TP response to precipitation in Winkler Lake. While TP has shown a slight response to precipitation, it decreased following a large rain event (4.6") in October of 2005.

	TP	Chlorophyll-a	Secchi disk	TVN
Year	Concentration	Concentration	transparency	$I \mathbf{N} $ (mg/L)(n)
	$(\mu g/L)(n)$	$(\mu g/L)(n)$	(meters)(n)	(ing/L)(ii)
1976	2580(1)	160 (1)	0.2 (1)	4.7 (1)
1994	488 (1)	7 (1)	1.0(1)	2.1 (1)
1995	869 (2)	78 (2)	0.5 (2)	4.7 (3)
1999	173 (6)	55 (6)	0.4 (6)	1.8 (6)
2000	1193 (4)	291 (4)	0.3 (4)	8.1 (4)
2001	297 (6)	56 (6)	0.5 (6)	2.0 (6)
2003	471 (9)	96 (9)	0.4 (9)	4.0 (9)

Table 3.5	<b>Growing season</b>	( <b>June 1</b> –	September	<b>30) mear</b>	n lake wa	ater quality in
Winkler L	lake.					

2005	281 (10)	67 (10)	0.6 (9)	3.2 (10)
2007	381 (13)	31 (13)	0.5 (12)	2.4 (13)
10 yr avg.	466	99	0.5	3.6

n is the number of samples collected each season



Figure 3.10 2003 and 2005 summer TP, chlorophyll-a, and Secchi depth for Winkler Lake.

Typically in a lake with high external loading, TP would increase following a precipitation event. The phosphorus responses show a steady increase typical in shallow lakes during the summer growing season. Inflow is naturally lower during this period and the increase in phosphorus can be attributed to internal loading (Welch & Cooke 1995). In addition to high phosphorus levels, over the last ten years TKN has remained above 2.0 mg/L, the threshold marking a negative response in water quality (MPCA 2005).



Figure 3.11 TP and daily precipitation during Winkler's 2005 summer growing season.



Figure 3.12 In lake TP and annual precipitation for Winkler Lake.

Changes in TP from year to year are shown in Figure 3.12. During years of below average precipitation (2000) TP increased while years of average to above average precipitation (2005) did not result in increased phosphorus.

In a somewhat unusual occurrence, during the 2005 monitoring season there were several instances where the Secchi disk could be seen at the lake's bottom. A filamentous algae mat was noted on the lake bottom, which may account for the unusual water clarity in 2005 relative to other years.

# 4.0 Phosphorus Source Assessment

# 4.1 Introduction

Understanding the sources of nutrients is a key component in developing a TMDL. This section provides a brief description of the potential sources of phosphorus to the lakes.

# 4.2 Point Sources

There is one point source in the Carver Creek watershed. Bongards' Creamery, Inc. is currently permitted to discharge into the south inlet (CC9) of Winkler Lake (Figure 2.5). Bongards' Creamery currently has a wastewater pond discharge (NPDES # MN0002135 – SD002).

A NPDES Phase II permit for small municipal separate storm sewer systems (MS4) has been issued to Waconia, a member city in the watershed. EPA requires that stormwater discharges regulated under NPDES be allocated into the wasteload allocation or point source portion of the TMDL. Although these sources of phosphorus in the watershed are nonpoint in nature, they are allocated in the wasteload allocation in this TMDL. However, the discussion of the sources maintains the nonpoint source nature of phosphorus.

Knowledge of the lakes tells us that high levels of phosphorus are likely present in the lake sediments due to historical land use, point source discharges, and surrounding inflows. There is inadequate understanding of the longevity and mechanisms of internal loading resulting from diverted effluent, as is the case with the Waconia Sewage Treatment Plant. Internal loading in some lakes following the diversion of external loading is expected to last over 30 years (Welch & Cooke 1995).

# 4.2.1 Winkler Lake

Bongards' Creamery, Inc. is currently permitted to discharge into the south inlet (CC9) of Winkler Lake. Bongards' Creamery has three discharges including two non-contact cooling water discharges (NPDES # MN0002135 – SD001 & SD003) and one wastewater pond discharge (NPDES # MN0002135 – SD002). Table 4.1 provides the TP data measured in the discharges in recent years as obtained from the MPCA.

The wastewater pond discharge (SD002) is regulated under NPDES and is only permitted to discharge for short durations during the year. Typically, discharging of the ponds should occur from April 1 through June 15 and September 15 through December 15. The maximum daily discharge allowed is 1.87 MGD. Phosphorus limits were 3.0 mg/L prior to the fall of 2004 but were reduced to 1.0 mg/L thereafter. An upgraded WWTP was designed to meet the lower phosphorus requirements which consisted of the addition of alum and/or ferric sulfate added continuously at the outfall which is followed by a sand filter to reduce the TP content in the discharge. The non-contact cooling water sites discharge year-round and do not have to meet any standards; however they are monitored monthly for both flow and TP. No chemicals are added to the non-contact cooling water and neither site should contribute to phosphorus loading except for what may be present in groundwater. As of April of 2006, one non-contact cooling water stream is in a state of

no discharge, thus reducing the amount of phosphorus that is discharging due to noncontact cooling water.

	SD001 (cooling water)		SD002 <sup>1</sup> (process wastewater)		SD003 (cooling water)	
Year	Avg Flow (mgd)	TP Load (kg/yr)	Avg Flow (mgd)	TP Load (kg/yr)	Avg Flow (mgd)	TP Load (kg/yr)
2008*	0	0	0.039	21	0.021	5
2007	0	0	0.11	90	0.03	8
2006	0.025	6.6	0.063	68	0.011	3
2005	0.245	53	0.758	174	0.161	40
2004	0.282	115	0.753	253	0.05	42
2003	0.403	198	1.35	291	0.232	64
2002	0.492	145	1.44	291	0.123	25

 Table 4.1 Bongards' Creamery TP load from 2002 to 2008 (MPCA data).

<sup>1</sup> PCA permit allows for maximum 1 mg/L TP as of January 2004, prior to this the standard was 3 mg/L. At the 1-mg/L limit, the permitted TP load is 481 kg/yr at a flow of 0.756 mgd, and 1272 kg/yr at a flow of 2 mgd (mgd = millions of gallons per day).

\*2008 had reports up to the month of October.

Due to the close proximity of Bongards' Creamery to Winkler Lake, and the fact that the discharge is to a ditch system, we assume that essentially the entire load from the plant reaches the lake. In addition, there are no wetlands or basins to intervene between the discharge and the lake.

Effluent discharge from Bongards' Creamery appears to have been a significant source of phosphorus to Winkler Lake prior to 2004. Wastewater discharged from the creamery is now required to meet a 1.0 mg/L total phosphorus effluent limit. New data collected from 2006 to 2008 show that non-contact cooling water does not contribute a large portion of total phosphorus to Winkler Lake with an average of roughly 5 kg per year during that time frame. This TMDL establishes a total phosphorus loading cap for all discharges from the creamery.

# **4.3 Nonpoint Sources**

#### 4.3.1 Internal Phosphorus Release

Internal phosphorus loading has been demonstrated to be an important aspect of the phosphorus budgets of lakes, especially when lakes are shallow and well-mixed. However, measuring or estimating internal loads can be difficult, especially in shallow lakes that may mix many times throughout the year. Various factors that contribute to the recycling of internal phosphorus include: die-off of curlyleaf pondweed which releases phosphorus during the early summer growing season (late June to early July), frequent wind mixing that entrains P-rich sediments back into the water column, bioturbation from benthivorous fish such as carp and bullhead, increased temperatures that promote

bacterial decomposition, and internal phosphorus release when sediment anoxia releases poorly bound phosphorus in a form readily available for phytoplankton production (MPCA 2006).

#### 4.3.2 Urban/Development Runoff

The development of stormwater sewer systems has increased the speed and efficiency of transporting urban runoff to local water bodies. This runoff carries materials like grass clippings, fertilizers, leaves, car wash wastewater, soil, oil and grease and animal waste; all of which contain phosphorous. These materials may add to increased internal loads through the breakdown of organics and subsequent release from the sediments. The addition of organic material into the lakes increases the sediment oxygen demand, further exacerbating the duration and intensity of sediment phosphorus release from lake sediments. With a portion of the City of Waconia discharging to Carver Creek, stormwater runoff from developed land uses affects Miller Lake.

#### 4.3.3 Agricultural Runoff

Agricultural runoff can supply a significant phosphorus load to surface waters by transporting eroded soil particles and excess fertilizers.

Nutrients such as phosphorus, nitrogen, and potassium in the form of fertilizers, manure, sludge, irrigation water, legumes, and crop residues are applied to enhance production. When they are applied in excess of plant needs, nutrients can wash into aquatic ecosystems where they can promote excessive plant growth and kill fish.

Animal agriculture can affect water quality, especially nutrients. Animal manure, which contains large amounts of both phosphorus and nitrogen, is often applied to agricultural fields as fertilizer. A regional Minnesota study suggests that the applied manure represents a 74 percent greater amount of phosphorus than the University of Minnesota recommended amounts (Mulla et al. 2001). This can average an extra 35 pounds per acre of phosphorus, which will ultimately be available for runoff. It is believed, however, that in more recent years more efficient use of manure is being achieved in Minnesota due to both economic and environmental concerns (Minnesota Corn Growers Association, Devonna Zeug, pers. comm., 2010). In addition, properly applied manure can improve soil's ability to infiltrate water, thus reducing the potential for runoff (MPCA, 2005). Additionally, runoff from some feedlots can transport animal manure to surface waters.

#### 4.3.4 Septic Systems

Failing or nonconforming direct discharge SSTS can be a significant source of phosphorus to surface waters. Septic systems, also called on-site wastewater disposal systems, can act as sources of nitrogen, phosphorus, organic matter, and bacterial and viral pathogens for reasons related to inadequate design, inappropriate installation, neglectful operation, and/or exhausted lifetime. Inappropriate installation often involves improper sighting, including locating in areas with inadequate separation distances to groundwater, inadequate absorption area, fractured bedrock, sandy soils (especially in coastal areas), inadequate soil permeability, or other conditions that prevent or do not allow adequate treatment of wastewater if not accounted for. Inappropriate installation

can also include smearing of trench bottoms during construction, compaction of the soil bed by heavy equipment, and improperly performed percolation tests (Gordon, 1989; USEPA, 1993). In terms of system operation, as many as 75 percent of all system failures have been attributed to hydraulic overloading (Jarrett et al., 1985). Also, regular inspection and maintenance is necessary and often does not occur. Finally, conventional septic systems are designed to operate over a specified period of time. At the end of the expected life span, replacement is generally necessary. Homeowners may be unaware of this issue or unable to afford a replacement. Based on Carver County survey data, approximately 45 to 65 percent of the systems in the county are likely failing (Carver County 2005).

#### 4.3.5 Atmospheric Deposition

Precipitation contains phosphorus that can ultimately end up in the lakes as a result of direct input on the lake surface or as a part of stormwater runoff from the watershed. Although atmospheric inputs must be accounted for in development of a nutrient budget, direct inputs to the lake surface are very difficult if not impossible to control and are consequently considered part of the background load.

#### 4.3.6 Wetlands

Wetlands have the ability to remove pollutants from runoff passing through the wetland or riparian area by slowing the water and allowing sediments to settle out, acting as a sink for phosphorus, and converting nitrate to nitrogen gas through denitrification (EPA Web). However, wetlands can become contaminated with agricultural and/or urban runoff, thus becoming another source of excess phosphorus that may end up in the lake when large rain events flush through the wetland system resuspending nutrients and sediments. No data has been collected regarding the phosphorus concentrations in the wetlands of Carver Creek watershed.

# **5.0 Linking Water Quality Targets and Sources**

# 5.1 Modeling Introduction

A detailed nutrient budget can be a useful tool for identifying management options and their potential effects on water quality. Additionally, lake response models can be developed to understand how different lake variables respond to changes in nutrient loads. With this information, managers can make educated decisions about how to allocate restoration dollars and efforts, as well as predict the resultant effect of such efforts.

# 5.2 Selection of Models and Tools

Modeling was completed in order to translate the target in-lake phosphorus concentration into load allocations, responses, and reductions goals. The models used throughout the process included a Reckhow-Simpson spreadsheet and the BATHTUB V6.1 (Walker 1999) model.

The major inflows to the lakes were monitored for flow and phosphorus loading; however, for unmonitored subwatersheds, the Reckhow-Simpson model was used to develop runoff volumes and phosphorus loads. This model relies on phosphorus export and runoff coefficients based on land uses to estimate phosphorus loading and runoff. Development of runoff and export coefficients is described in Section 6.3. Outputs from the Reckhow-Simpson model were then utilized as inputs to the BATHTUB model.

BATHTUB is a publicly available model developed by William W. Walker for the U.S. Army Corps of Engineers (Walker 1999). BATHTUB has been used successfully in many lake studies in Minnesota and throughout the United States. It is a steady-state annual or seasonal model that predicts a lake's summer (June - September) mean surface water quality. BATHTUB's time-scales are appropriate because watershed phosphorus loads are determined on an annual or seasonal basis, and the summer season is critical for lake use and ecological health. BATHTUB has built-in statistical calculations that account for data variability and provide a means for estimating confidence in model predictions. The heart of BATHTUB is a mass-balance phosphorus model that accounts for water and phosphorus inputs from tributaries, watershed runoff, the atmosphere, sources internal to the lake, and (if appropriate) groundwater; and outputs through the lake outlet, groundwater (if appropriate), water loss via evaporation, and phosphorus sedimentation and retention in the lake sediments. BATHTUB allows choice among several different mass-balance phosphorus models. For deep lakes in Minnesota, the option of the Canfield-Bachmann lake formulation has proven to be appropriate in most cases. For shallow Minnesota lakes, other options have often been more useful. BATHTUB's in-lake water quality predictions include two response variables. chlorophyll-a concentration and Secchi depth, in addition to TP concentration. Empirical relationships between in-lake TP, chlorophyll-a, and Secchi depth form the basis for predicting the two response variables. Among the key empirical model parameters is the ratio of the inverse of Secchi depth (the inverse being proportional to the light extinction coefficient) to the chlorophyll-a concentration. The ratio's default value in the model is

0.025 meters squared per milligram (m<sup>2</sup>/mg); however, the experience of MPCA staff supports a lower value, as low as 0.015 m<sup>2</sup>/mg, as typical of Minnesota lakes in general.

BATHTUB was used to estimate nutrient inflows from each of the major subwatersheds within the entire Carver Creek Lake watershed area. For Carver Creek Lakes, monitored lake and subwatershed data was used to calibrate models. Unmonitored subwatershed loads estimated via the Reckhow-Simpson Model were input into BATHTUB. After running the BATHTUB model for two years for validation, a phosphorus budget was developed for current conditions. The final BATHTUB model allowed us to estimate the relative contributions of each subwatershed and within the lake. Thus, the development of a benchmark budget allows managers to begin to assess the sources of nutrient loads and target areas for load reductions.

Several models (subroutines) are available for use within the BATHTUB model. The selection of the subroutines is based on past experience in modeling lakes in Minnesota, and is focused on subroutines that were developed based on data from natural lakes. Table 5.1 depicts the model subroutines that were chosen for all lakes modeled within this TMDL. Selection of models is also dependant on data availability. For instance, you cannot reliably use models that require orthophosphorus data if you do not have that data. For more information on these model equations, see the BATHTUB model documentation (Walker 1999).

Model Options	Code	Description
Conservative Substance	0	NOT COMPUTED
Phosphorus Balance	8	CANF & BACH, LAKES
Nitrogen Balance	0	NOT COMPUTED
Chlorophyll-a	1	P, N, LIGHT, T
Secchi Depth	1	VS. CHLA & TURBIDITY
Dispersion	0	None
Phosphorus Calibration	1	DECAY RATES
Nitrogen Calibration	1	DECAY RATES
Error Analysis	1	MODEL & DATA
Availability Factors	0	IGNORE
Mass-Balance Tables	1	USE ESTIMATED CONCS
Output Destination	2	EXCEL WORKSHEET

#### Table 5.1 BATHTUB model options.

# **5.3 Watershed Model Coefficients**

The Reckhow-Simpson model estimates phosphorus loads for a watershed using land-use areas derived from available GIS data, along with runoff coefficients and phosphorus export values (loading rates per unit area) corresponding to the land use classes. These values were used when monitoring was not completed in specific subwatersheds.

#### 5.3.1 Watershed Runoff

Watershed runoff was estimated using runoff coefficients assuming average watershed slopes of less than two percent (Ward And Elliott 1995). Runoff coefficients used are presented in Table 5.2.

Land Lice	Watershed Runoff Coefficients					
Land Use	Goose	Hydes	Miller	Winkler		
Developed	0.27	0.25	0.22	0.22		
Forest/Grassland	0.09	0.07	0.07	0.07		
Water	0	0	0	0		
Agriculture	0.25	0.25	0.25	0.25		
Wetland	0	0	0	0		

	Table 5.2	Runoff	Coefficients	to	estimate	runoff	from	Carver	Creek	Watershed.
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Runoff coefficients were developed by applying literature values to the entire 55,076 acre Carver Creek watershed, and then adjusting the values to better predict monitored annual runoff volumes. Actual watershed runoff was monitored at Carver Creek site CA 1.7, which is monitored continuously by the Metropolitan Council Environmental Services Watershed Outlet Monitoring Program (WOMP). Predicted and monitored annual runoff volumes are presented in Table 5.3. Monitored runoff was very low in 2000 due to low precipitation (25.39 inches) and the timing of precipitation events. Most of the precipitation occurred mid-summer at which time vegetation was present and absorbed the majority of rainfall. Most years had a runoff difference of less than 20 percent and were deemed to be reasonable to apply to the Carver Creek watershed.

	1998	1999	2000	2001	2002	2003	2004	2005
Predicted								
Runoff (ac-ft)	25,632	24,234	21,650	24,822	31,047	20,064	26,400	35,976
Monitored								
Runoff (ac-ft)	26,680	23,190	3,772	28,451	38,155	17,489	20,695	28,704
Percent								
Difference	-4%	4%	83%	-15%	-23%	13%	22%	20%

 Table 5.3 Predicted and monitored annual runoff for the Carver Creek watershed.

The five calendar years 2001 – 2005 included two average-precipitation years, 2001 and 2004. One of these two years was used to determine the TMDL for each lake (Table 5.4). For implementation planning, each lake and its watershed were also modeled for a wet year (either 2002 or 2005) and a dry year (2003).

Lake		Net	Av	erage	Dry		
	Year	Amount (in)	Year	Amount (in)	Year	Amount (in)	
Goose	2002	36.41	2004	30.96	2003	23.53	
Hydes	2002	36.41	2004	30.96	2003	23.53	
Miller	2002	36.41	2004	30.96	2003	23.53	
Winkler	2005	42.18	2001	29.11	2003	23.53	

Table 5.4 Wet, dry, and average annual precipitation amount and year for Goose,Hydes, Miller, and Winkler Lakes.

#### **5.3.2 Watershed Phosphorus Export**

To determine phosphorus export, both for concentrations and total loads, export coefficients were utilized and are outlined in Table 5.5. Calculated concentrations and loads are used within the BATHTUB model to represent subwatersheds that do not have actual monitored sample data. Land use areas and precipitation depths for each year were needed to calculate runoff phosphorus concentrations for each lake. Land use areas were based on GIS files provided by the Carver County GIS Department. Land use loading rates (Table 5.5) were applied to the watershed land use to estimate watershed phosphorus loads. Phosphorus export coefficients were based upon literature values that best represented conditions in the Carver Creek Lakes watershed (EPA 1980). Runoff TP concentrations were computed from runoff depths calculated using runoff coefficients outline in Section 5.3.1 and the resulting land use phosphorus loads derived from export values (Table 5.6). When considering loading rates for the developed areas, it was assumed that no BMPs were in place within the watershed.

Loading Rates (kg/ha/yr)	Low	Average	High
Developed	0.3	0.4	0.6
Forest/Grassland	0.01	0.04	0.08
Agriculture	0.2	0.5	1.0
Septic (kg/capita)	0.7	1.5	3.0
Wetland	0	0	0

#### Table 5.5 Phosphorus export coefficients by land use for all lakes.

#### Table 5.6 Runoff phosphorus concentrations for each lake.

TP Concentration		Developed			Forest/Grassland			Agriculture			
(µg/L)	Low	Average	High	Low	Average	High	Low	Average	High		
Goose	125.2	200.3	300.4	15.0	60.1	120.2	108.2	270.4	540.8		
Hydes	135.2	216.3	324.5	19.3	77.3	154.5	108.2	270.4	540.8		
Miller	153.6	245.8	368.7	19.3	77.3	154.5	108.2	270.4	540.8		
Winkler	153.6	245.8	368.7	19.3	77.3	154.5	108.2	270.4	540.8		
Average	141.9	227.1	340.6	18.2	73.0	145.9	108.2	270.4	540.8		

Based on average precipitation (29.11 inches).

#### 5.3.3 Internal Load

Internal load terms were determined based on a residual process utilizing the BATHTUB model. After accounting for and entering land use and nutrient loads corresponding to the

segment and tributaries using a 1.0 mg/m<sup>2</sup>/day of internal loading, the model was run. Predicted and observed values were evaluated. At this point, if the in-lake predicted phosphorus values remained below that of the observed, additional internal loading was added until the predicted and observed nutrients were within 10 percent of each other. This process suggests that the internal load is the load remaining after all external sources have been accounted for.

#### 5.3.4 Atmospheric Load

Atmospheric loading rates were set at a rate of 20 mg/m<sup>2</sup>/yr based on conversations with the MPCA and literature values (Bruce Wilson personal communication).

#### 5.3.5 Septic System Load

Failing or nonconforming septic systems can be an important source of phosphorus to surface waters. Septic system loads were estimated based on the following: number of septic systems in the watershed, 2.8 capita per residence, standard phosphorus loading rate, and phosphorus retention by the system and soils. The standard phosphorus load rate was assumed to be 1.5 kg/capita/year with a 70 percent retention coefficient. However, this calculation does not account for failing systems in the watershed. Based on County survey data, approximately 45 to 65 percent of the systems in the County are failing (Carver County 2005). The failing systems would have phosphorus retention lower than 70 percent but would still retain a fair amount of phosphorus as it travels to surface waters. Since it is difficult to estimate the export rate for failing systems, it was assumed that the 70 percent retention reasonably represents the watershed with failing septic systems. However, we recognize that we may have slightly underestimated the load from septic systems.

# **5.4 Phosphorus Budget Components**

#### 5.4.1 Goose Lake

#### 5.4.1.1 Internal Load

Using the process outlined in Section 5.3.3, the final internal loading terms were entered at 0.5 mg/m<sup>2</sup>/day and 0.7 mg/m<sup>2</sup>/day for 2001 and 2004, respectively.

An equation utilizing anoxic factor and release rates developed by Gertrud Nurnberg was used to add confidence to the internal load calculated above. Since Goose Lake demonstrates periods of DO stratification where the sediments experience periods of low oxygen or anoxic conditions, we were able to estimate internal loading using an anoxic factor predictive equation and estimate release rates for hypereutrophic lakes (Nurnberg 1987).

#### 5.4.1.2 Atmospheric Load

Using rates determined in Section 5.3.4, the atmospheric loading for Goose Lake is set at 27 kg/yr.

#### 5.4.1.3 Upstream lakes

Because Donders, Rutz, and Swan Lakes flow into Goose Lake, nutrients from the three lakes will end up in Goose Lake. This potential exchange has been included in the

BATHTUB model. To effectively determine phosphorus loading from these water bodies, independent BATHTUB models were set up and calibrated in a similar fashion to Goose Lake. Outputs from the models were then entered into the Goose Lake model as tributaries (Table 5.7).

Limited monitoring was available for Rutz and Swan Lakes and no data was available for Donders Lake. Tributary input data was calculated using methods outlined in Sections 5.3.1 and 5.3.2. To improve the confidence of the models additional monitoring should occur as part of the implementation plan.

I abic 5.7		nouci outputs for com	multing water boules t	0 00050 Lake.
Year	Lake	Lake Watershed Area P		Outflow
		( <b>km</b> <sup>2</sup> )	(µg/L)	(hm³/yr)
	Rutz	1.13	300	0.21
2004	Donders	0.89	517	0.11
	Swan	1.51	380	0.17
	Rutz	1.13	319	0.20
2001	Donders	0.89	550	0.10
	Swan	1.51	404	0.16

Table 5.7 BATHTUB model outputs for contributing water bodies to Goose Lake.

## 5.4.1.4 Tributary or Watershed Load

The tributary load from the watershed was developed using monitored data and the Reckhow-Simpson model as described in Section 5.3. For the monitored inlet, G1, the flow weighted-mean concentration calculated from the five samples collected in 2004 (300  $\mu$ g/L) was used to calibrate the inflow concentration. This concentration was within 7 percent of the Reckhow-Simpson model calculated concentrations for the 2004 modeled year. Based upon this, the Reckhow-Simpson model concentrations were used for all inlets. Also, the Reckhow-Simpson model was utilized to estimate the flow (Table 5.8).

	Direct		G1		Inlet 2		Inlet 3	
Component	2001	2004	2001	2004	2001	2004	2001	2004
Flow (hm <sup>3</sup> /yr)	0.7	0.8	1.00	1.37	0.90	0.11	0.08	0.09
TP Concentration (µg/L)	372	349	341	320	359	338	271	255
TP Load (kg/yr)	126	129	198	199	22	20	22	20

 Table 5.8 BATHTUB model inputs for Goose Lake tributaries.

#### 5.4.1.5 Septic System Load

A total of 75 septic systems are located within the Goose Lake Watershed. Table 5.9 outlines the BATHTUB septic system inputs. Septic systems within the Swan, Rutz, and Donders Subwatersheds were not included within the Goose Lake BATHTUB model due to the inclusion into each lake's individual BATHTUB models that were used to determine outflow and loadings.

	Direct		G1		Inlet 2		Inlet 3	
Component	2001	2004	2001	2004	2001	2004	2001	2004
Flow (hm <sup>3</sup> /yr)	< 0.1	<0.1	<0.1	<0.1	<0.1	< 0.1	< 0.1	<0.1
TP Concentration (µg/L)	554		378		76		25	
TP Load (kg/yr)	5.5	5.5	3.8	3.8	0.8	0.8	0.3	0.3

#### Table 5.9 Septic system BATHTUB model inputs for Goose Lake.

#### 5.4.2 Hydes Lake

#### 5.4.2.1 Internal Load

Using the process outlined in Section 5.3.3, the final internal loading terms were entered at  $0.01 \text{ mg/m}^2/\text{day}$  for both 2004 and 2002.

#### 5.4.2.2 Atmospheric Load

Atmospheric loading rates were determined to contribute 17.5 kg/yr of phosphorus to Hydes Lake for each modeled year.

#### 5.4.2.3 Upstream Lakes

Patterson Lake drains directly to Hydes Lake through a 0.6 mile segment of Carver Creek. Consequently, water and nutrients flow out of Patterson and into Hydes Lake (Table 5.10). As such, the inflow has been included in the BATHTUB modeling using techniques outlined in Section 5.3. To improve the confidence of the models, additional monitoring may occur in Patterson Lake as part of the implementation of the TMDL.

<b>Table 5.10</b>	BATHTUB	model o	outputs for	contributing	water	<b>bodies</b> 1	to Goose	Lake.
		mouri	outputs for	contributing	THE CL	<b>NOTICO</b>		Lunci

Year	Lake	Watershed Area (km <sup>2</sup> )	P Concentration (µg/L)	Outflow (hm <sup>3</sup> /yr)
2004	Patterson	9.5	310	1.23
2002	Patterson	9.5	263	1.45

#### 5.4.2.4 Tributary or Watershed Load

Table 5.11 outlines the inputs used within the BATHTUB model for both the 2001 and 2005 modeled years. These values are calculated using methods as described in Section 5.3.

Year	Watershed	Watershed Area (km <sup>2</sup> )	P Concentration (µg/L)	Outflow (hm <sup>3</sup> /yr)
2004	H2	2.1	321.5	0.30
2004	Direct	2.2	488.6	0.22
2002	H2	2.1	273.3	0.35
2002	Direct	2.2	415.5	0.26

#### Table 5.11 BATHTUB model inputs for Hydes Lake.

#### 5.4.2.5 Septic System Load

28 septic systems are located within the Hydes Lake Watershed. Table 5.12 outlines the septic system BATHTUB model inputs.

	Dir	rect	H2		
Component	2002	2004	2001	2004	
Flow (hm <sup>3</sup> /yr)	0.1	<0.1	0.1	<0.1	
TP Concentration (µg/L)	27	75	75.1		
TP Load (kg/yr)	27.5	2.8	7.5	0.8	

<b>Table 5.12</b>	Septic system	BATHTUB	model inp	outs for Hyd	des Lake.
			P		

# 5.4.3 Miller Lake

#### 5.4.3.1 Internal Load

Using the process outlined in Section 5.3.3, internal loading was determined to be 52 mg/m<sup>2</sup>/day for the 2002 model and 0.5 mg/m<sup>2</sup>/day for the 2004 model.

#### 5.4.3.2 Atmospheric Load

Atmospheric loading rates for both 2002 and 2004 were set at a rate of 20 kg/km<sup>2</sup>/yr and determined to contribute 11.4 kg/yr to the TP in Miller Lake.

## 5.4.3.3 Upstream Lake Load

Reitz, Burandt, Winkler and Benton Lakes drain directly into Carver Creek and therefore eventually into Miller Lake. Consequently, water which may be transporting nutrients flows out of the lakes and into Miller Lake (Table 5.13). As such, the inflow has been included in the BATHTUB modeling using techniques outlined in Section 5.3 and stream monitoring data collected at CA 10\_4 (see Appendix A).

Year	Lake	Watershed Area	P Concentration	Outflow
		$(\mathrm{km}^2)$	(µg/L)	(hm <sup>3</sup> /yr)
	Burandt	43.6	239.1	4.1
2004	Winkler	49.2	256.7	7.2
2004	Reitz	14.7	294.5	1.9
	Benton	9.1	244.1	1.3
	Burandt	43.6	203.5	4.8
2002	Winkler	49.2	218.3	8.4
2002	Reitz	14.7	250.4	2.3
	Benton	9.1	207.6	1.5

 Table 5.13 BATHTUB model outputs for contributing water bodies to Miller Lake.

#### 5.4.3.4 Tributary or Watershed Load

Table 5.14 outlines the inputs used within the BATHTUB model for both the 2002 and 2004 modeled years. These values are calculated using methods as described in Section 5.3.

Year	Watershed	Watershed Area (km <sup>2</sup> )	P Concentration (µg/L)	Flow (hm <sup>3</sup> /yr)
	CA 10.4	57.7	287	8.58
2004	D1	1.2	293	0.18
	D2	0.4	324	0.04
	CA 10.4	57.7	244	10.09
2002	D1	1.2	223	0.21
	D2	0.4	275	0.05

#### Table 5.14 BATHTUB model inputs for Miller Lake.

#### 5.4.3.5 Septic System Load

There are a total of 334 septic systems within Miller Lake direct watershed. Homes within the Waconia and Cologne city boundaries are connected to city sewage disposal infrastructure. Table 5.15 outlines the septic system BATHTUB model inputs

	CA 10.4		D	D1		2
Component	2002	2003	2002	2003	2002	2003
Flow (hm <sup>3</sup> /yr)	0.1	0.1	0.1	0.1	0.1	0.1
TP Concentration (µg/L)	4093		37.5		50.1	
TP Load (kg/yr)	409.3	409.3	3.8	3.8	5.0	5.0

Table 5.15	Septic system	BATHTUB	model inpu	its for	Miller ]	Lake.
	Septie System		mouel mpe			Lunci

# 5.4.4 Winkler Lake

# 5.4.4.1 Internal Load

Using the process outlined in Section 5.3.3, the final internal loading terms were entered as  $5 \text{ mg/m}^2/\text{day}$  for 2001 and  $13 \text{ mg/m}^2/\text{day}$  for 2005.

# 5.4.4.2 Atmospheric Load

Atmospheric loading rates were set at 20 kg/km<sup>2</sup>/yr and determined to contribute approximately 6 kg/yr to Winkler Lake.

# 5.4.4.3 Upstream Lake Load

Rice Lake drains directly to Winkler Lake via inlet CC8 and has been accounted for by utilizing monitored data at stream station CC8 and Reckhow-Simpson Models. Table 5.16 outlines the upstream lake loads to Winkler Lake.

Year	Lake	Watershed Area (km <sup>2</sup> )	P Concentration (µg/L)	Outflow (hm <sup>3</sup> /yr)
	Rice	18.5	222	3.7
2005	Barlous	3.8	207	0.7
	Hydes	9.1	222	2.4
	Rice	18.5	321	2.6
2001	Barlous	3.8	300	0.5
	Hydes	9.1	321	1.6

 
 Table 5.16 BATHTUB model outputs for contributing water bodies to Winkler
 Lake.

#### 5.4.4.4 Tributary or Watershed Load

Table 5.17 outlines the inputs used within the BATHTUB model for both the 2001 and 2005 modeled years. These values are calculated using methods as described in Section 5.3.

Table 5.17 BATHTUB model inputs for Winkler Lake.							
Year	Watershed	Watershed P Concentration		Flow			
		Area (km <sup>2</sup> )	(µg/L)	(hm <sup>3</sup> /yr)			
	Inlet 1	0.5	294	0.09			
2001	Inlet 2 (CC9)	9.3	313	1.49			
2001	Inlet 3 (CC8)	2.0	356	0.27			
	Direct	1.1	410	0.12			
	Inlet 1	0.5	203	0.13			
2005	Inlet 2 (CC9)	9.3	216	2.13			
2005	Inlet 3 (CC8)	2.0	246	0.39			
	Direct	1.1	283	0.17			

#### 5.4.4.5 Septic System Load

There are a total of 63 septic systems within the Winkler Lake Watershed. For BATHTUB modeling purposes, methods outlined in Section 5.3.5 were used to calculate loads within all subwatersheds. Table 5.18 outlines the septic system BATHTUB model inputs.

Table 5.18 Septic system BATHTUB model inputs for Winkler La	<b>fable</b>	8 Septic system	BATHTUB	model inputs fo	r Winkler Lake.
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	Inlet 1		Inlet 2 (CC9)		Inlet 3 (CC8)		Direct	
Component	2001 2005		2001	2005	2001	2005	2001	2005
Flow (hm <sup>3</sup> /yr)	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
TP Concentration (µg/L)	12.5		61	3.3	86	3.6	25	5.0
TP Load (kg/yr)	1.3	1.3	61.3	61.3	86.4	86.4	2.5	2.5

#### 5.4.4.6 Industrial Load

Bongards' Creamery, Inc. is currently permitted to discharge into the south inlet (CC9) of Winkler Lake. Bongards' is the only industrial discharge within the watersheds of the four lakes. See Section 5.2.2 for description of Bongards' discharge.

# **5.5 Model Validation and Benchmark Phosphorus Budgets**

## 5.5.1 Model Validation

#### 5.5.1.1 Goose Lake

BATHTUB model results from 2001 (average year) and 2004 (wet year) are presented as the predicted and observed values and a coefficient of variation (standard error of the mean) in Table 5.19. The focus of the phosphorus budget development will focus on 2004, where the monitoring data set was most complete and precipitation was average.

 Table 5.19 Observed and predicted in-lake water quality for Goose Lake in 2001 and 2004 (June – September).

Voor	Variabla	Pre	dicted	Observed	
1 cal	variable	Mean	CV	Mean	CV
	TP ( $\mu$ g/L)	129.2	0.34	134.0	0.23
2004	Chlorophyll-a (µg/L)	59.5	0.35	53.0	0.42
	Secchi Depth (meters)	0.4	0.19	0.4	0.25
2001	$TP(\mu g/L)$	123.0	0.34	125.0	0.28
	Chlorophyll-a (µg/L)	81.6	0.38	60.3	0.29
	Secchi Depth (meters)	0.6	0.29	1.0	0.74

There is acceptable agreement among predicted and observed TP in both years. The overestimation of chlorophyll-a in 2001 may be due to the fact that water clarity in Goose Lake is often influenced by turbidity caused by suspended sediments and not algae itself.

#### 5.5.1.2 Hydes Lake

Model results from 2002 (wet year) and 2004 (average year) are presented as the predicted and observed values and a coefficient of variation. The model represents reasonable agreement with a slight under prediction for TP in both years (Table 5.20).

Veen	Variable	Prec	licted	Observed	
Tear	variable	Mean	CV	Mean	CV
	$TP(\mu g/L)$	145.3	0.26	146.0	0.46
2004	Chlorophyll-a (µg/L)	67.1	0.29	57.8	0.59
	Secchi Depth (meters)	0.8	0.25	0.9	0.49
2002	$TP(\mu g/L)$	132.2	0.23	129.0	0.43
	Chlorophyll-a (µg/L)	50.0	0.31	42.0	0.52
	Secchi Depth (meters)	0.5	0.18	0.5	0.37

 Table 5.20 Observed and predicted in-lake water quality for Hydes Lake in 2002 and 2004 (June – September).

Chlorophyll-a concentrations were slightly over predicted in both modeled years. Secchi depth was in reasonable agreement in 2004 and exact for 2002. Slight differences can be attributed to numerous factors including sampling frequency and high populations of planktivores which graze zooplankton to the point where they are unable to control algae. In addition, algal species present include Aphanizomenon which forms clusters while the water itself remains clear, therefore increasing Secchi depths.

#### 5.5.1.3 Miller Lake

Model results from the 2002 and 2003 are presented in Table 5.21 as the predicted and observed values and a coefficient of variation. The model represents reasonable agreement in 2002 and 2003. As mentioned in section 3.3 the modeled years were chosen based on similarities in monitored and Canfield-Bachman modeled phosphorus loads. The overestimation of chlorophyll-a in 2001 may be due to the fact that water clarity in Miller Lake is often influenced by turbidity caused by suspended sediments and not algae itself.

Voor	Variabla	Pred	icted	Observed		
1 cal	variable	Mean	CV	Mean	CV	
	TP ( $\mu$ g/L)	397.5	0.17	398.0	0.73	
2002	Chlorophyll-a (µg/L)	52.1	0.28	28.8	0.93	
	Secchi Depth (meters)	0.7	0.19	0.9	0.41	
	TP ( $\mu$ g/L)	198.8	0.15	197.0	0.42	
2004	Chlorophyll-a (µg/L)	44.1	0.29	56.0	0.37	
	Secchi Depth (meters)	0.6	0.17	0.7	0.32	

 Table 5.21 Observed and predicted in-lake water quality for Miller Lake in 2002 and 2003 (June – September).

#### 5.5.1.4 Winkler Lake

Model results from the 2001 and 2005 are presented in Table 5.22 as the predicted and observed values and a coefficient of variation. The model represents reasonable agreement in 2001 and 2005.

Table 5.22 Observed and predicted in-lake water quality for Winkler Lake in 2001and 2005 (June – September).

Veen	Variable	Predicted		Observed		
rear	variable	Mean	CV	Mean	CV	
	TP ( $\mu$ g/L)	282.0	0.10	283	0.53	
2005	Chlorophyll-a (µg/L)	81.9	0.27	71	0.71	
	Secchi Depth (meters)	0.8	0.28	0.5	0.56	
	TP ( $\mu$ g/L)	298.2	0.12	297	0.46	
2001	Chlorophyll-a (µg/L)	56.7	0.27	57	0.83	
	Secchi Depth (meters)	0.5	0.18	0.5	0.34	

Chlorophyll-a concentrations were over-predicted for both modeled years. Secchi depth was slightly over-predicted both years. The differences here can be attributed to the unique processes within shallow lakes.

#### 5.5.2 Benchmark Phosphorus Budgets

One of the key aspects of developing TMDLs is an estimate of the nutrient budget for the current loading to the water body. Monitoring data and modeling were used to estimate the current sources of phosphorus to the Carver Creek Lakes. Nutrient and water budgets are presented below. These budgets do not account for any groundwater exchange. It is assumed that the lake acts as both a groundwater discharge and recharge area so the net effect on the water or nutrient budgets is very small.

#### 5.5.2.1 Goose Lake

The G1 inlet, combined with inflow from Rutz Lake and Swan Lake, make up the upper half of the Goose Lake watershed. Collectively, the three subwatersheds account for nearly 35 percent of the TP load (Table 5.23). They have the largest potential to continue to degrade water quality in Goose Lake, particularly during spring when there is constant flow from all channels. Runoff from direct inflow accounts for 14 percent of external phosphorus loading, the second highest external load. Based on estimates, phosphorus loading from septic systems appears to be low, and accounted for approximately 1 percent of the loading. Finally, internal load estimates were based on a rate of 0.5 mg/m<sup>2</sup>/yr which translates to 37 percent of the TP load.

Subwatershed	Area km <sup>2</sup>	Water Inflow hm <sup>3</sup> /yr	TP Load kg/yr	Percent of Total Load
G1	4.4	0.6	199	21%
Inlet 2	0.4	0.1	20	2%
Inlet 3	0.5	0.1	20	2%
Rutz Lake	1.4	0.2	63	7%
Swan Lake	1.5	0.2	65	7%
Direct inflow	0.9	0.4	129	14%
Donders	0.9	0.1	57	6%
Septic Systems		<0.1	7	1%
Atmospheric Deposition	1.4	1.1	27	2%
Total External		2.8	587	63%
Total Internal			345	37%
TOTAL P LOADING			932	100%

	Table 5.23 Summary of cu	arrent T	P and	water bu	idget for	Goose	Lake	based on
2004 data and BATHTUB modeling.								

#### 5.5.2.2 Hydes Lake

The H2 inlet along with the Patterson Lake subwatershed represents a potentially large external source of nutrients to Hydes Lake, accounting for approximately 79 percent of the phosphorus load in an average year (Table 5.24). Nutrient loading from Patterson Lake is relatively unclear however, which means that additional in-lake monitoring is needed. If Patterson Lake is low in nutrients, there is a possibility that nutrient loading occurs within the portion of the inlet (H2) between the two lakes. This portion of the subwatershed is primarily agricultural. An additional 18 percent of the nutrient load is accounted for in the direct watershed runoff. Internal loads represented 0.5 percent of the load. Septic systems represent a relatively small proportion of the load (0.5 percent).

Subwatershed	Area km <sup>2</sup>	Water Inflow hm <sup>3</sup> /yr	Estimated External TP Load kg/yr	Percent Contributions
H2 (including Patterson Lake)	2.1	0.3	97	16%
D1 (Direct)	2.2	0.2	108	18%
Patterson Lake	9.5	1.2	381	63%
Septic systems		0.02	4	0.5%
Atmospheric Deposition	0.9	0.7	17	3%
Total External		2.4	585	99%
Total Internal			3	0.5%
TOTAL P LOADING			588	100%

Table 5.24 Summary of current TP and water budget for Hydes Lake based on2004 data and BATHTUB modeling.

#### 5.5.2.3 Miller Lake

2004 modeling results show that the majority of nutrient loading into Miller Lake occurs from the major inlet, CA 10.4 (Table 5.25). Additionally, some animal units are maintained in the watershed. Reckhow-Simpson predicted septic system phosphorus loading rates account for approximately 6 percent of the overall phosphorus load.

# Table 5.25Summary of current TP and water budget for Miller Lake based on2004 data and BATHTUB modeling.

Subwatershed	Area km <sup>2</sup>	Water Inflow hm <sup>3</sup> /yr	Estimated TP Load kg/yr	Percent of total Load
CA 10.4 (inlet 1)	57.7	8.6	2,463	37%
D1 (inlet2)	1.2	0.2	53	0.8%
D2 (direct inflow)	0.4	0.01	13	0.2%
Burandt Sub	43.6	4.1	974	14%
Winkler Sub	49.2	7.2	1,835	27%
Reitz Sub	14.7	1.9	565	8%
Benton Sub	9.1	1.3	312	5%
Septic systems		< 0.1	418	6%
Atmospheric Deposition	0.6	0.3	11	0.2%
Total External		23.2	6,646	98%
<b>Total Internal</b>			104	2%
TOTAL P LOADING			6,750	100%

#### 5.5.2.4 Winkler Lake

The two major inlets, CC8 and CC9, contribute the majority of water flowing into Winkler Lake; therefore the water quality of the two inlets greatly influences the conditions within Winkler Lake. The CC8 inlet flows into the lake from a series of lakes which themselves have very high nutrients (Rice and Hydes Lakes), which is broken out into the Rice Subwatershed and Hydes Subwatershed in Table 5.26. With the addition of these upstream lakes, CC8 contributes 51percent of the total load to Winkler Lake. The measured concentration in this inlet is similar to Rice Lake. CC9 contributes the second highest loading; the majority of the watershed here is drained agricultural land, in addition to the point source that drains into the ditch. Internal loading accounts for a major portion of the available phosphorus. Over the years, excess nutrients (from both point and non-point sources) have built up in the lake's sediments and are now easily resuspended by wind mixing and rough fish activity. Although in this model it appears that septic systems are a minor source, failing septic systems near any surface water contribute to phosphorus loads. Table 5.26 summarizes model outputs for Winkler Lake.

Subwatershed	Area km <sup>2</sup>	Water Inflow hm <sup>3</sup> /yr	Estimated External TP Load kg/yr	Percent of Total Load
Inlet CC9	9.3	1.5	467	17%
Inlet CC8	2.0	0.3	96	3%
Direct	1.1	0.1	49	2%
Inlet 1	0.5	0.1	27	0.9%
Rice Subwatershed	18.5	2.6	822	29%
Hydes Subwatershed	12.8	1.6	524	19%
Barlous Subwatershed	3.8	0.5	144	5%
Septic systems		<0.1	151	5%
Atmospheric Deposition	0.3	0.3	6	0.2%
Total External		6.6	2,284	81%
Total Internal			530	19%
TOTAL P LOADING			2,814	100%

Table 5.26 Summary of current TP and water budget for Winkler Lake based on2005 data and BATHTUB modeling.

# 6.0 TMDL Allocations

# TMDL = WLA + LA + MOS + RC

Where:

TMDL = Total Maximum Daily Load WLA = Wasteload Allocation (for permitted sources) LA = Load Allocation (for nonpermitted sources) MOS = Margin of Safety RC = Reserve Capacity

# **6.1 TMDL Allocations Introduction**

The TMDL presented here is developed to be protective of aquatic recreation beneficial uses in lakes, as embodied in the Minnesota lake Water Quality Standards. Loads are expressed both as annual and daily loads; however, an annual load is more relevant to this TMDL study because the growth of phytoplankton is more responsive to changes in the annual load than the daily load. These changes have been made pursuant to 40 CFR 130.2(I) that specifies that TMDLs may be expressed in other terms where appropriate.

#### **6.1.1 Loading Capacity Determinations**

The loading capacity of each of the four lakes was determined by fitting the lake's phosphorus load to the appropriate (shallow or deep) State Standard, using the BATHTUB model. The loading capacity is the same as the TMDL. Section 6.3 presents each lake's TMDL and TMDL allocation.

#### 6.1.2 Critical Condition

The Minnesota lake Water Quality Standards specify as critical the summer growing season (June-September). Minnesota lakes typically demonstrate impacts from excessive nutrients during the summer, including excessive algal blooms and fish kills. Consequently, the lake response models have focused on the summer growing season as the critical condition. Additionally, these lakes tend to have relatively short residence times and therefore respond to summer growing season loads.

#### 6.1.3 Margin of Safety (MOS)

A margin of safety has been incorporated into this TMDL by using a conservative modeling approach to account for an inherently imperfect understanding of the lake system and to ultimately ensure that the nutrient reduction strategy is protective of the water quality standard.

The lake response model for total phosphorus used for this TMDL uses the rate of lake sedimentation, or the loss of phosphorus from the water column as a result of settling, to predict total phosphorus concentration. Sedimentation can occur as algae die and settle, as organic material settles, or as algae are grazed by zooplankton. Sedimentation rates in shallow lakes (such as Goose, Miller, and Winkler) can be higher than rates for deep

lakes. Shallow lakes differ from deep lakes in that they tend to exist in one of two states: turbid water and clear water. Lake response models assume that even when total phosphorus concentration in the lake is at or better than the state water quality standard the lake will continue to be in that turbid state. However, as nutrient load is reduced and other internal load management activities such as fish community management occur to provide a more balanced lake system, shallow lakes will tend to "flip" to a clear water condition. In that balanced, clear water condition, light penetration allows rooted aquatic vegetation to grow and stabilize the sediments, and zooplankton to thrive and graze on algae at a much higher rate than is experienced in turbid waters. Thus in a clear water state more phosphorus will be removed from the water column through settling than the model would predict.

The TMDL is set to achieve water quality standards while still in a turbid water state. To achieve the beneficial use, the lake must flip to a clear water state which can support the response variables at higher total phosphorus concentrations due to increased zooplankton grazing, reduced sediment resuspension, etc. Therefore, this TMDL is inherently conservative by setting allocations for the turbid water state.

The above points, though stated for shallow lakes, also apply in large part to Hydes Lake, due to its large littoral area.

An additional conservative assumption applies to Winkler Lake and relates to loading to it from Bongards' Creamery. Its wastewater pond discharge is limited to two discharge periods: March 1 to June 15 and September 15 to December 31. Thus, the facility's ponds are not discharging during much of the summer critical period each year.

#### 6.1.4 Reserve Capacity (RC)

Reserve Capacity (RC) is that portion of the TMDL that accounts for future growth. This is most relevant for those entities in the WLA category. For the City of Waconia and Laketown Township, regulated MS4s, future growth was accounted for in their WLAs by basing their allocations for stormwater contribution on their developed land area projections for 2030. As land use continues to change within the watershed, the overall phosphorus loading will need to meet the overall allocation provided to the watershed runoff load. Permitted loads for Bongards' Creamery have been established by the MPCA and meet both the goals of this TMDL and future growth needs of the creamery.

#### 6.1.5 Seasonal Variation

Seasonal variation is accounted for through the utilization of annual loads and developing targets for the summer period where the frequency and severity nuisance algal growth will be the greatest. Although the critical period is the summer, lake water quality responds mainly to long-term changes such as changes in the annual load. Therefore, seasonal variation is accounted for in the annual loads. Additionally, by setting the TMDL to meet targets established for the most critical period (summer), the TMDL will inherently be protective of water quality during all other seasons.

# **6.2 TMDL Allocation Approach**

Each lake's TMDL was allocated to a combination of load allocation and wasteload allocation. The approach to making these allocations is described in the following two sections.

#### 6.2.1 Load Allocations (LAs)

Load allocations (LAs) include watershed runoff loading from non-regulated Municipal Separate Storm Sewer System ("non-MS4") areas (i.e., watershed load not covered by a NPDES permit), as well as atmospheric and internal loadings. In addition, the loading from upstream lakes within a lake's watershed are also placed in the LA category. The subdividing of loading allocations (into WLAs, LAs and MOS) to those upstream lakes is done in the separate TMDLs for those upstream lakes.

Atmospheric loadings are set to the benchmark phosphorus budgets (Section 5.3.4) as this is not a load that can be reduced. The atmospheric loading rate was assumed to be 20 kg/km<sup>2</sup>/yr in all cases.

Upstream lake loadings were calculated assuming that water discharging from those lakes meet State Standards of TP concentrations of either 40  $\mu$ g/L or 60  $\mu$ g/L depending upon if it is a deep or shallow lake, respectively. Discharge rates were determined using the runoff coefficients outlined in Section 5.2. From these, a total yearly load was calculated.

Watershed runoff loadings were based upon 2020 Land Use GIS shapefiles within 2030 boundaries for the municipalities in order to account for expected future growth.

Derivation of the LAs for internal loading and non-MS4 area loading, as well as WLAs for MS4 area loading were done as follows:

- 1) Using the total loading capacity (TMDL) as determined per Section 6.1.1 subtracted the following loads:
  - a. any WLAs for wastewater facilities and construction/industrial stormwater
  - b. upstream lake loading (at their respective water quality standard)
  - c. atmospheric allocation

The resulting load is the combined allowable load for the direct watershed runoff and internal loading.

- 2) Determined future external loading to each lake from the direct watershed (if no reductions were to be done) using export coefficients as outlined in Table 5.5 multiplied by 2020 land use areas.
- 3) Estimated future internal loading to each lake (if no reductions were to be done) as the internal loading from benchmark BATHTUB modeling per Section 5.5.2.
- 4) Determined the ratio of combined allowable load calculated in step 1 to the sum of the overall future loading from step 2 plus internal loading from step 3.
- 5) Separated regulated MS4 community area loading out of the direct watershed loading. Regulated MS4 loading was determined using 2020 Land Use GIS
shapefiles using only designated "developed" land use areas within defined 2030 municipal boundaries (i.e., those areas projected to contribute to a stormwater conveyance; specifically, single family, multi-family, commercial and public/industrial).

- 6) Multiplied the following loads by the calculated ratio in step 4:
  - a. non-MS4 area loading (from step 5)
  - b. MS4 area loading (from step 5)
  - c. internal loading (from step 3)

The resulting loads are the non-MS4 area LA, the MS4 area WLA and internal loading LA.

#### 6.2.2 Wasteload Allocations (WLAs)

Wasteload allocations (WLAs) are required for regulated MS4 discharges, municipal and industrial wastewater discharges, and stormwater runoff from both industrial and construction sites.

#### 6.2.2.1 Municipal Separate Storm Sewer Systems (MS4s)

The process for determining WLAs for regulated MS4 areas was described above in Section 6.2.1. The City of Waconia (permit number MS400232) and Laketown Township (permit number MS400142) are partly within the Miller Lake watershed and each is assigned a WLA.

As development occurs within the watershed, the Census Bureau-defined Urban Area may expand. If this occurs, it may be necessary to transfer WLA from one MS4 to another. For example, a segment of state-owned highway may come under permit coverage as the Urban Area expands. In the event that additional stormwater discharges come under permit coverage within the watershed, WLA will be transferred to these new entities based on the process used to set wasteload allocations in the TMDL. MS4s will be notified and will have an opportunity to comment on the reallocation. If and when areas within the watershed designated as LA are developed (urbanized) or become part of the Urban Area and thus fall under an NPDES regulated MS4 framework, the TMDL will be reopened and load will be transferred from the LA to the WLA as appropriate.

#### 6.2.2.2 Municipal and Industrial Wastewater Discharges

One NPDES-permitted facility discharges wastewater within a direct watershed covered by the TMDL (Table 6.1). The WLAs for this facility are further discussed in Section 6.3 under Winkler Lake.

Donmit	Facility	Laka	Permitted TP Load		
rerinit	Facility	Lake	kg/yr	kg/day	
MN0002135	02135 Bongards' Creamery		150.59	0.4	

#### Table 6.1 NPDES-permitted wastewater facilities with currently permitted loads.

#### 6.2.2.3 Construction Stormwater and Industrial Stormwater

Construction storm water activities are considered in compliance with provisions of the TMDL if they obtain a Construction General Permit under the NPDES program and properly select, install, and maintain all BMPs required under the permit, or meet local construction stormwater requirements if they are more restrictive than requirements of the State General Permit.

Industrial storm water activities are considered in compliance with provisions of the TMDL if they obtain an Industrial General Permit under the NPDES program and properly select, install and maintain all BMPs required under the permit.

The land area representing construction and industrial stormwater would be expected to make up a very small portion of the watersheds at any one time. Therefore, WLAs for construction and industrial stormwater combined were conservatively set at 0.1% of the loading capacity (TMDL) for each lake.

#### 6.2.3 Adaptive Management

The WLAs and LAs for the Carver Four Lakes represent aggressive goals. Consequently, implementation will be conducted using adaptive management principals. The County will continue to monitor each lake to identify improvements and adapt implementation strategies accordingly. It is difficult to predict the nutrient reduction that would occur from implemented strategies because we do not know the exact contribution of each pollutant source to the lake, and many of the strategies affect more than one source. Continued monitoring and "course corrections" (in regards to the use of Best Management Practices) responding to monitoring results are the most appropriate strategy for attaining the water quality goals established in this TMDL.

# 6.3 Specific TMDL Allocations

The TMDL and TMDL allocations are described for each of the four lakes in the following sections.

#### 6.3.1 Goose Lake TMDL

The Goose Lake TMDL is set for a shallow lake in the NCHF ecoregion of Minnesota with a standard of 60  $\mu$ g/L phosphorus as a final goal. The selected average precipitation year for the Goose Lake TMDL is 2004. Table 6.2 presents the TMDL and its components, which are discussed in the following subsections.

Note that it suspected that illicit direct-discharge septic systems impact Goose Lake. Such systems must reach a 100 percent reduction. As such, there is no WLA for these discharges.

Load		WLA Construction/	LA	LA	LA Non-	LA Upstream
Units	TIVIDE	Industrial	Atmospheric	Internal	MS4	Lakes
kg/yr	270	0.27	27	111	103	29
kg/day	0.74	0.0007	0.07	0.30	0.28	0.08

Table 6.2 TMDL allocations for Goose Lake. Allowable loads to meet the NCHF shallow lake standard of 60 µg/L. MOS is implicit and RC is zero.

In Table 6.2, the "upstream lakes" load represents the phosphorus discharging from Rutz, Swan, and Donders Lakes. Rutz is listed as impaired and Swan and Donders are suspected to be, based on observation and limited data. TMDLs have not yet been done for these lakes. Therefore, for Goose Lake's future TMDL condition, the upstream lakes are assumed to meet their respective water quality standards. This is the most reasonable way to account for the upstream lakes' effects on Goose Lake under future conditions. It also implies that Goose Lake's TMDL does not affect the TMDLs of the upstream lakes.

#### 6.3.1.1 Load Allocations

Section 6.2.1 outlines the methodology used to determine establishing Load Allocations for Goose Lake. Atmospheric loading is set at 27 kilograms per year (kg/yr). Internal loading has been established to be 111 kg/yr and the non-MS4 loading is limited to 103 kg/yr. Upstream lakes have an allocation of 29 kg/yr.

#### 6.3.1.2 Wasteload Allocations

Construction and Industrial stormwater within the watershed have an assigned WLA of 0.27 kg/yr, per the methodology described in Section 6.2.2.3. No MS4s are designated, nor are there any NPDES permitted wastewater facilities located within the watershed boundaries of Goose Lake.

#### 6.3.1.3 Load Response

In addition to meeting a phosphorus limit of 60  $\mu$ g/L, a lake must either meet or exceed one of two other parameters (chlorophyll-a or Secchi). BATHTUB modeling of the TMDL load results in Goose Lake meeting the Secchi depth requirement of greater than 1 meter (Table 6.3). Chlorophyll-a concentrations are still above the State Standards of 20  $\mu$ g/L. To view BATHTUB inputs and results for this model, see Appendix C.

Results	Goose Lake					
TP Concentration	60					
Chlorophyll-a Concentration	45					
Secchi Depth	1.3					

 Table 6.3 BATHTUB modeling of TMDL Loads for Goose Lake.

#### 6.3.1.4 Modeled Historic Loads

Using the Canfield-Bachmann equation, historic loads and load reductions were calculated for each monitored year (Figure 6.1). Goose Lake requires a 58 to 86 percent reduction to meet the proposed water quality standard of a summer average of

 $60 \ \mu g/L$  TP. Over the past ten years the lowest allowable load on an annual basis was 233 kilograms phosphorus and the maximum allowable load was 294 kilograms of phosphorus.



Figure 6.1 Predicted annual loads for monitored conditions and for the 60  $\mu$ g/L TP standard for NCHF shallow lakes. Percentages represent the necessary reduction to meet the standard.

#### 6.3.2 Hydes Lake TMDL

The Hydes Lake TMDL is set for a deep lake in the NCHF ecoregion of Minnesota with a standard of 40  $\mu$ g/L phosphorus as a final goal. The selected average precipitation year for the Hydes Lake TMDL is 2004. Table 6.4 presents the TMDL and its components, which are discussed in the following subsections.

Note that it suspected that illicit direct-discharge septic systems impact Hydes Lake. Such systems must reach a 100 percent reduction. As such, there is no WLA for these discharges.

top land standard of to peril. 1100 is implicit and NC is 2010.								
Load		WLA Construction/	LA	LA	LA Non-	LA Upstream		
Units	TIVIDE	Industrial	Atmospheric	Internal	MS4	Lakes		
kg/yr	197	0.20	17	76	29	74		
kg/day	0.54	0.0005	0.05	0.21	0.08	0.20		

Table 6.4 TMDL allocations for Hydes Lake. Allowable loads to meet the NCHF deep lake standard of 40 µg/L. MOS is implicit and RC is zero.

In Table 6.4, the "upstream lakes" load represents the phosphorus discharging from Lake Patterson. This lake is suspected to be impaired based on observation and limited data and a TMDL has not yet been done. Therefore, for Hydes Lake's future TMDL condition, the upstream lake is assumed to meet its water quality standard. This is the

most reasonable way to account for the upstream lakes' effects on Hydes Lake under future conditions. It also implies that Hydes Lake's TMDL does not affect the TMDL of the upstream lake.

#### 6.3.2.1 Load Allocations

Section 6.2.1 outlines the methodology used to determine establishing Load Allocations for Hydes Lake. Atmospheric loading is set at 17 kg/yr. Internal loading has been established to be 76 kg/yr and the non-MS4 loading is limited to 29 kg/yr. Upstream lakes have an allocation of 74 kg/yr.

#### 6.3.2.2 Wasteload Allocations

Construction and Industrial stormwater within the watershed have an assigned WLA of 0.20 kg/yr, per the methodology described in Section 6.2.2.3. No MS4s are designated nor are there any NPDES permitted wastewater facilities located within the watershed boundaries of Hydes Lake.

#### 6.3.2.3 Load Response

In addition to meeting a phosphorus limit of 40  $\mu$ g/L, a lake must either meet or exceed one of two other parameters (chlorophyll-a or Secchi). BATHTUB modeling of the TMDL load results in Hydes Lake meeting the Secchi depth requirement of greater than 1 meter (Table 6.5). Chlorophyll-a concentrations are still above the State Standards of 14  $\mu$ g/L. To view BATHTUB inputs and results for this model, see Appendix C.

Results	Hydes Lake
TP Concentration	40
Chlorophyll-a Concentration	24
Secchi Depth	2.3

#### Table 6.5 BATHTUB modeling of TMDL Loads for Hydes Lake.

#### 6.3.2.4 Modeled Historic Loads

Historical loads over the last ten years were estimated for those years with monitoring data using an inverted Canfield-Bachmann model. The model was run for average runoff conditions in each monitored year, although precipitation varies from year to year.

Using the Canfield-Bachmann equation, historic loads and load reductions were calculated for each of the basins (Figure 6.2). Hydes Lake requires a 73 to 94 percent reduction to meet the proposed water quality standard of a summer average of 40  $\mu$ g/L TP. Over the past ten years the lowest allowable load on an annual basis was 172 kilograms phosphorus and the maximum allowable load was 214 kilograms of phosphorus.



Figure 6.2 Hydes Lake predicted annual loads for monitored conditions and predicted loads at the standard NCHF deep lake standard of 40 µg/L TP. Percentages represent the necessary reduction to meet the standard.

#### 6.3.3 Miller Lake TMDL

The Miller Lake TMDL is set for a shallow lake in the NCHF ecoregion of Minnesota with a standard of 60  $\mu$ g/L phosphorus as a final goal. The selected average precipitation year for the Miller Lake TMDL is 2004. Table 6.6 presents the TMDL and its components, which are discussed in the following subsections.

Note that it is suspected that illicit direct-discharge septic systems impact Miller Lake. Such systems must reach a 100 percent reduction. As such, there is no WLA for these discharges.

shallow lake standard of 60 µg/L. MOS is implicit and Reserve Capacity is zero.								
Load		WLA Laketown	WLA	WLA Construction/	LA	LA	LA Non-	LA Upstream
Units		Township	Waconia	Industrial	Atmospheric	Internal	MS4	Lakes
kg/yr	1,738	1	47	1.74	11	530	402	745
kg/day	3.08	0.002	0.13	0.0048	0.03	1.45	1.10	2.04

Table 6.6	TMDL	allocatio	ns for 1	Miller I	Lake. A	llowable	e loads t	to meet t	the NC	HF
shallow la	ke stand	dard of 6	0 μg/L.	MOS i	is <mark>impl</mark> io	cit and <b>H</b>	Reserve	Capacit	y is zer	<b>'0.</b>

In Table 6.6, the "upstream lakes" load represents the phosphorus discharging from Benton, Winkler, Burandt, and Reitz Lakes. These four lakes area currently impaired; however, each has its own TMDL, either previously completed or in progress. Therefore, for Miller Lake's future TMDL condition, the upstream lakes are assumed to meet their respective water quality standards. This is the most reasonable way to account for the upstream lakes' effects on Miller Lake under future conditions. It also implies that Miller Lake's TMDL does not affect the TMDLs of the upstream lakes.

#### 6.3.3.1 Load Allocations

Section 6.2.1 outlines the methodology used to determine establishing Load Allocations for Miller Lake. Atmospheric loading is set at 11 kg/yr. Internal loading has been established to be 530 kg/yr and the non-MS4 loading is limited to 402 kg/yr. Upstream lakes contribute 745 kg/yr to Miller Lake and have been allocated this amount.

#### 6.3.3.2 Wasteload Allocations

As stated in Section 6.2.2, two permitted MS4s are located within the Miller Lake Watershed. The City of Waconia and Laketown Township have WLAs of 47 kg/yr and 1 kg/yr, respectively. These allocations were based upon land use acreages that are classified as "Developed" within the Carver County 2020 Land Use shapefile. These acreages were 1,489 acres for the City of Waconia and 22 acres for Laketown Township.

No NPDES permitted wastewater facilities are located within Miller Lake watershed.

Construction and Industrial stormwater within the watershed have an assigned WLA of 1.74 kg/yr, per the methodology described in Section 6.2.2.3.

#### 6.3.3.3 Load Response

In addition to meeting a phosphorus limit of 60  $\mu$ g/L, a lake must either meet or exceed one of two other parameters (chlorophyll-a or Secchi). BATHTUB modeling of the TMDL load results in Miller Lake meeting the Secchi Depth requirement of greater than 1 meter (Table 6.7). Chlorophyll-a concentrations are still above the State Standards of 20  $\mu$ g/L. To view BATHTUB inputs and results for this model, see Appendix C.

Results	Miller Lake
TP Concentration	60
Chlorophyll-a Concentration	32
Secchi Depth	1.8

#### Table 6.7 BATHTUB modeling of TMDL Loads for Miller Lake.

#### 6.3.3.4 Modeled Historic Loads

Using the Canfield-Bachmann equation, historic loads and load reductions were calculated for each monitored year (Figure 6.3). Miller Lake requires a 65 to 91 percent reduction to meet the proposed water quality standard of a summer average of  $60 \mu g/L$  TP. Over the monitored years the lowest allowable load on an annual basis was 1,367 kilograms phosphorus and the maximum allowable load was 2,290 kilograms of phosphorus.





#### 6.3.4 Winkler Lake

The Winkler Lake TMDL is set for a shallow lake in the NCHF ecoregion of Minnesota with a standard of 60  $\mu$ g/L phosphorus as a final goal. The selected average precipitation year for the Winkler Lake TMDL is 2001. Table 6.8 presents the TMDL and its components, which are discussed in the following subsections.

Note that it suspected that illicit direct-discharge septic systems impact Winkler Lake. Such systems must reach a 100 percent reduction. As such, there is no WLA for these discharges.

shahow lake standard of oo µg/L. MOS is inplicit and KC is zero.									
Load		WLA Bongards'	WLA Construction/	LA	LA	LA Non-	LA Upstream		
Units	Units Creamery		Industrial Atmospheric		Internal	MS4	Lakes		
kg/yr	643	150.59	0.64	6	162	43	281		
kg/day	1.76	0.41	0.0018	0.02	0.45	0.12	0.77		

Table 6.8 TMDL allocations for Winkler Lake. Allowable loads to meet the NCHF shallow lake standard of 60 µg/L. MOS is implicit and RC is zero.

In Table 6.8, the "upstream lakes" load represents the phosphorus discharging from Barlous, Hydes, and Rice Lakes. Hydes is listed as impaired (and is part of this project) and the other two lakes are suspected of being impaired based on observation and limited (and as such TMDLs have not yet been done). Therefore, for Winkler Lake's future TMDL condition, the upstream lakes are assumed to meet their respective water quality standards. This is the most reasonable way to account for the upstream lakes' effects on Winkler Lake under future conditions. It also implies that Winkler Lake's TMDL does not affect the TMDLs of the upstream lakes.

#### 6.3.4.1 Load Allocations

Section 6.2.1 outlines the methodology used to determine establishing Load Allocations for Winkler Lake. Atmospheric loading is set at 6 kg/yr. Internal loading has been

established to be 162 kg/yr and the non-MS4 loading is limited to 43 kg/yr. Upstream lakes have an allocation of 281 kg/yr.

#### 6.3.4.2 Wasteload Allocations

No MS4s are designated within the Winkler Lake watershed.

Bongards' Creamery discharges in the Winkler Lake watershed and is currently covered under an NPDES permit (MN0002135). The current NPDES permit limits the discharge of total phosphorus loading at 150.59 kg/yr, which is protective of Winkler Lake water quality and as such this limit was used within the TMDL.

Construction and Industrial stormwater within the watershed have an assigned WLA of 0.64 kg/yr, per the methodology described in Section 6.2.2.3.

#### 6.3.4.3 Load Response

In addition to meeting a phosphorus limit of 60  $\mu$ g/L, a lake must either meet or exceed one of two other parameters (chlorophyll-a or Secchi). BATHTUB modeling of the TMDL load results in Winkler Lake meeting the Secchi Depth requirement of greater than 1 meter (Table 6.9). Chlorophyll-a concentrations are still above the State Standards of 20  $\mu$ g/L. To view BATHTUB inputs and results for this model, see Appendix C.

Results	Winkler Lake
TP Concentration	60
Chlorophyll-a Concentration	47
Secchi Depth	1.3

# Table 6.9 BATHTUB modeling of TMDL Loads for Winkler Lake.

#### 6.3.4.4 Modeled Historic Loads

Winkler Lake requires reductions between 68 and 97 percent to meet the NCHF proposed water quality standard of summer average of 60  $\mu$ g/L TP (Figure 6.4). Over the monitored years the lowest allowable load was 412 kilograms of phosphorus and the maximum allowable load was 761 kilograms of phosphorus. The variation in loading between years is due to the variability in precipitation from year to year.



Figure 6.4 Winkler Lake predicted annual loads for the summer growing season (June 1-September 30) and for the 60  $\mu$ g/L TP standard for NCHF shallow lakes. Percentages represent the necessary reduction to meet the standard.

# 7.0 Public Participation

# 7.1 Introduction

The County has an excellent track record with inclusive participation of its citizens, as evidenced through the public participation in completion of the Carver County Water Management Plan, approved in 2001. The County has utilized stakeholder meetings, citizen surveys, workshops and permanent citizen advisory committees to gather input from the public and help guide implementation activities. The use of this public participation structure will aid in the development of this and other TMDLs in the County.

# 7.2 Technical Advisory Committee

The Water, Environment, & Natural Resource Committee (WENR) was established as a permanent advisory committee. The WENR is operated under the County's standard procedures for advisory committees. The WENR works with staff to make recommendations to the County Board on matters relating to watershed planning.

The make-up of the WENR is as follows:

County Board Member
 Soil and Water Conservation District Member
 citizens - (1 appointed from each commissioner district)
 City of Chanhassen (appointed by city)
 City of Chaska (appointed by city)
 City of Waconia (appointed by city)
 appointment from all other cities (County Board will appoint)
 township appointments (County Board will appoint- must be on existing township board.)
 other County residents (1 from each physical watershed area - County)

The full WENR committee received updates on the TMDL process from its conception in 2004.

As part of the WENR committee, two sub-committees are in place and have held specific discussions on excess nutrient TMDLs. These are the Technical Sub-committee and the Policy/Finance Sub-committee.

TMDL progress, methods, data results and implementation procedures were presented and analyzed at the WENR meetings mentioned above. Committee members commented on carp removal possibilities, sources, internal loading rates, and future monitoring plans. All issues commented on were considered in the development of the draft TMDL.

# 7.3 Public Involvement

Stakeholders that would be impacted by the Carver Creek Lake TMDL have been given various opportunities to provide input through public surveys, public meetings, and

personal meetings. In addition, an opportunity for public comment on the draft TMDL report was provided via a public notice in the State Register from July 19 to August 18, 2010.

During the public comment period the Minnesota Corn Growers Association requested that the following statement be included: "Lake water quality has likely been influenced by 150 years of development, including construction of roads, businesses (including farms) and homes, sewage and septic systems, and increasing population."

General results from open houses and surveys conducted are described below.

#### 7.3.1 Goose Lake

An open house was held on September 1, 2005, for landowners within the Goose Lake watershed. Prior to that, 132 surveys were sent to landowners inquiring about lake uses and perceptions. Fourteen surveys were returned and of those 81 percent were lakeshore owners. Eleven people attended the meeting and filled out surveys. The following is a summary of the user survey and comments received during the meeting:

- Sources attendees were concerned about were geese, curlyleaf pondweed, feedlots, agricultural and lawn run off, and rough fish.
- The public was very supportive of the process and would like to know what we need from them. They would like to see Goose Lake attain a swimmable status again.
- Some landowners were interested in the dredging and channelization of the water courses that, prior to disturbance, did not allow other watersheds to flow into Goose Lake (Rutz and Swan Lakes).
- The public was very concerned about feedlots and manure management.
- 50 percent of lake users indicated that their uses of the lake are interfered with by aquatic plants and/or algae.
- 43 percent of surveyors indicate that their perception of the lake is currently "no swimming, boating ok" while 21 percent perceive the lake to be unusable.

#### 7.3.2 Hydes Lake

An open house was held on September 1<sup>st</sup>, 2005 for landowners within the Hydes Lake watershed. Previous to the meeting, landowners were sent surveys inquiring upon lake uses and perceptions. Although 107 invitations were sent out, 18 people attended the meeting and completed surveys, with 72 percent of those being lakeshore owners. The following is a summary of the user survey and comments received during the meeting:

- Sources attendees were concerned about were affects of geese, curlyleaf pondweed, feedlots and rough fish.
- Landowners were very supportive but asked "How much money are we as property owners on the lake going to have to pay?" They are concerned that lake property owners would be expected to come up with large sums of money.
- Attendees were hopeful that in the future "their" lake would be swimmable once again.
- Uses of the lake at this point were indicated to be swimming, boating, waterskiing, hunting and wildlife observation.

- 72 percent of users believe that their use of the lake is interfered with by aquatic plants and/or algae.
- Additional management practices brought up were alum treatments and dredging.

#### 7.3.3 Miller Lake

A user perception survey was sent out to landowners inquiring upon lake uses and perceptions in July of 2006. Due to the high volume of homes within the direct watershed and lack of public access on the lake only landowners within one mile of the lake were sent surveys. Seventy five surveys were sent out and 13 surveys were returned. Of the surveys returned, one was a lakeshore owner. Many of the comments were incorporated throughout the TMDL. Below is a list of general comments, concerns respondents had for the lake and thoughts on what may be causing excess nutrients in the lake.

- Should add a public access/boat landing as most of the lake is isolated from general public.
- Tile lines form agriculture/ farms dump nutrients, pesticides and silt into the lake.
- Runoff form fertilizer used in nearby yards contributes to nutrient loading.
- Carp may be causing increased nutrients.

During the public comment period the Minnesota Corn Growers Association requested that the following statement be included: "Urban runoff from the City of Waconia, along with "legacy" phosphorus from decades of sewage discharge, are large potential sources of excess phosphorus."

#### 7.3.4 Winkler Lake

A user perception survey was sent out to landowners inquiring upon lake uses and perceptions in October of 2008. Surveys were sent to homeowners within a one mile radius of the lakeshore. Fifty five surveys were sent out and five were returned. Out of all the surveys, only one was a lakeshore owner. Below is a general list of comments and concerns that homeowners had about the lake.

- Observation of the wildlife around the lake was the most important aspect for recreational use.
- Runoff from adjacent fields is seen as a deterrent to water quality of Winkler Lake.
- Residents within the direct watershed feel that Bongards' Creamery have had a negative impact to Winkler Lake due to discharges from production.

# 8.0 Implementation

### 8.1 Introduction

Carver County, through their Water Management Plan, has embraced a basin wide goal for protecting water quality in the Carver Creek watershed. Currently, Carver County has developed detailed action strategies to address several of the issues identified in this TMDL. The Carver SWCD is active in these watersheds and works with landowners to implement BMPs on their land.

This section broadly addresses the course that Carver County will take to incorporate actions and strategies to achieve the TMDL goals set forth within this document. An Implementation Plan that will lay out specific goals, actions and strategies will be published within one year of the final EPA approval of this TMDL. Any action items pertinent to this TMDL that are not included in the Carver County Water Plan will be identified and amended to the Implementation Plan.

# 8.2 Carver County Water Management Plan

To respond to the County's established goals for Natural Resource Management, the Carver County Water Management Plan describes the set of issues requiring implementation action. MN Rule 8410 describes a list of required plan elements. Carver County has determined the following issues to be of higher priority. Items not covered in this plan will be addressed as necessary to accomplish the higher priority goals. Each issue is summarized in the Carver County Water Management Plan followed by background information, a specific goal, and implementation steps. The issues included in the plan which addresses nutrient TMDL sources and reductions are:

- SSTS
- Feedlots
- Stormwater Management
- Construction Site Erosion & Sediment Control
- Land Use Practices for Rural & Urban Areas
- Water Quality

# 8.3 Source Reduction Strategies

To reach the reduction goals Carver County will rely largely on its current Water Management Plan which identifies the Carver SWCD as the local agency for implementing BMPs. It will list suggested BMPs to be applied in the watershed and the order of importance for which they should be applied. An important aspect of the implementation plan will be public input.

The strategies listed below will be utilized to assist in reducing pollutant loads. It is difficult to predict nutrient reductions that would occur from each strategy. Because of this, an iterative management approach will be applied to the monitoring strategy after implementation of the BMPs.

# 8.4 SWAT Modeling

Although the modeling conducted for this TMDL estimates pollutant sources, we have determined that each lake is much more complex than the models chosen can handle. The MCES is in the process of developing a SWAT model for the Carver Creek watershed for a Turbidity TMDL. As part of the Implementation Plan for the Carver Creek Lakes, we are asking that phosphorus be added to the SWAT model development. This model is much more complex than what was used here and will allow us to better differentiate phosphorus sources. Thus, we will go on with the implementation of BMPs to reduce external loads, however, at the completion of SWAT modeling, we will be able to predict source loads more precisely, thus improving our ability to effectively locate BMPs, increasing the effectiveness of reducing TP.

Upon the implementation of external BMPs, and following the completion of a detailed source analysis from SWAT, internal sources will be targeted as seen fit through the use of adaptive management.

# 8.5 Lake Strategies

Lake restoration activities can be grouped into two main categories: those aimed at reducing external nutrient loads, and those practices aimed at reducing internal loads. Focus of lake strategies will depend upon on each individual lake characteristics and nutrient balances.

As a number of lakes flow into each other (Hydes Lake to Winkler Lake via Rice Lake) improvements in the water quality of upstream lakes are taken into account for the water quality of downstream lakes. Due to this, higher priority will be given to those lakes that are upstream.

Total costs to implement this TMDL, which encompasses internal and external load reduction strategies for Goose, Hydes, Miller, and Winkler Lakes has been estimated between \$2,698,000 to \$4,256,000. Individual strategies and costs associated with them are broken out in the following sections.

# 8.5.1 External Load Reduction Strategies

#### 8.5.1.1 Bongards Creamery

Bongards' Creamery has seen a reduction in effluent discharges in recent years due to a shift of certain production lines to another city in Minnesota. Due to this, the NPDES permit for the site changed in 2007. Current limits are considered to be both protective of water quality and adequate for its future needs.

#### 8.5.1.2 Landowner Practices

Runoff from urban landscapes is potentially a major source of nutrients, particularly phosphorus, entering lakes and streams. These sources include runoff generated from driveways, rooftops, decks, lawn maintenance activities, and washing of cars. Several cost-effective practices are available for landowners to reduce or eliminate phosphorus and nutrient loads.

Goals:

- Landscaping to reduce runoff and promote infiltration, such as vegetated swales or rain gardens.
- Minimizing the amount of impervious surface, either through innovative BMPs, such as porous pavement, or reduction of actual impervious surface.
- Proper application of lawn and garden fertilizers and chemical herbicides.
- Planting and maintaining native vegetation to help water quality by soaking up rainfall, reducing runoff, and retaining sediment.
- Creating/maintaining buffers of at least 50 feet at waterways, with the goal of creating 100 foot buffers to maximize water quality benefits.
- Removal of leaf litter from lakeshore lawns
- Mulching or bagging of grass clippings
- Car washing on lawns instead of on driveways

Total Cost for Implementation: \$450,000 to \$800,000 Goose Lake: \$50,000 to \$150,000 Hydes Lake: \$100,000 to \$150,000 Miller Lake: \$250,000 to \$350,000

Winkler Lake: \$50,000 to \$150,000

#### 8.5.1.4 Stormwater Management

Urban stormwater is a small proportion of nutrient loads within the Carver Creek Watershed. However, in the case of elimination of agricultural and natural areas and construction of residential areas, the potential for urban runoff contributing to nutrient loads would greatly increase. Construction activity in growth areas can deliver phosphorus laden sediment if not controlled properly. In the incidence of unforeseen development, the requirements set forth in the County Water Management Plan and rules should ensure that anticipated increases in urban stormwater runoff do not contribute to nutrient loading.

Goals:

- Attenuate stormwater and minimize degradation of Carver County's water resources by reducing the amount and rate of surface water runoff from agricultural and urban land uses.
- Ensure proper erosion control practices are properly installed on site during construction.

Cost for Implementation: \$175,000 to \$300,000

Goose Lake: \$15,000 to \$25,000 Hydes Lake: \$5,000 to \$15,000 Miller Lake: \$150,000 to \$250,000 Winkler Lake: \$5,000 to \$10,000

#### 8.5.1.5 Feedlots

Feedlots without runoff controls may contribute to nutrient loading during wet conditions. Surface water concerns include contamination by open lot runoff into a water

body, ditch or open tile inlet. Rules addressing proper feedlot management are included in the water management plan and will be addressed here. In order to address this pollution, the County will rely on goals and policies set forth in the County Water Management Plan. Properly managed feedlots will assist in meeting nutrient standards during wet conditions.

Goals:

- Proper management of feedlots to insure that water quality of surface water and groundwater is not impaired.
- Utilize existing regulations and rules (County Feedlot Management Ordinance Chapter 54, and MPCA Rule-Chapter 7020) to ensure compliance.

Cost for Implementation: \$185,000 to \$260,000

Goose Lake: \$35,000 to \$55,000 Hydes Lake: \$45,000 to \$60,000 Miller Lake: \$60,000 to \$80,000 Winkler Lake: \$45,000 to \$65,000

### 8.5.1.6 SSTS

Failing and/or direct discharge septic systems are potentially contributing nutrients to all lakes within the Carver Creek Watershed. These failing and improperly maintained SSTS present a substantial threat to the quality of surface and groundwater resources within Carver County. Actions to ensure that direct discharge systems are eliminated have been taken as part of the Carver and Bevens Fecal Coliform TMDL Implementation Plan. Should any non-conforming systems remain at the time TMDL implementation, action will be taken to ensure of their elimination.

Goals:

- Elimination of all non-conforming systems that are or are likely to become a pollution or health hazard.
- Ensure that all SSTS repairs, replacements, and new systems are properly designed and installed.
- Ensure that all SSTS are properly managed, operated and maintained.

Cost for Implementation: \$210,000 to \$275,000

Goose Lake: \$30,000 to \$40,000 Hydes Lake: \$30,000 to \$40,000 Miller Lake: \$100,000 to \$120,000 Winkler Lake: \$50,000 to \$75,000

#### 8.5.1.7 Agricultural BMPs

Agricultural land is the major land use within the Carver Creek Watershed, thus producing the highest amounts of phosphorus loads entering each lake. Farming practices have greatly reduced the runoff generated from fields. However, new and innovative BMPs are becoming more available for farmers. With these new BMPs and including proven techniques, further reductions in both volume and nutrients are still possible for the agricultural land uses.

Goals:

- Identify and prioritize key erosion and restoration areas
- Educate land owners on new and innovative BMPs and well as proven techniques
- Design and implement cropland BMPs
- Installation of buffer strips in locations identified.

Cost for Implementation: \$950,000 to \$1,600,000 Goose Lake: \$150,000 to \$200,000

Hydes Lake: \$150,000 to \$200,000 Miller Lake: \$500,000 to \$1,000,000 Winkler Lake: \$150,000 to \$200,000

#### 8.5.2 Internal Load Reduction Strategies

#### 8.5.2.1 Aquatic Plant Management

Macrophyte surveys and monitoring efforts throughout the four lakes listed within this TMDL have shown a wide range of aquatic plant communities. Plant diversity in Goose, Hydes, Miller, and Winkler Lakes are low. Curlyleaf pondweed is present in Hydes, and Miller Lakes. Curlyleaf grows under the ice but dies back during late June or early July, releasing nutrients to the water column in summer, possibly leading to algal blooms. For these reasons, it is of importance to control populations of curlyleaf pondweed and establish a native aquatic plant community. Eurasian watermilfoil is present in Miller Lake. While Eurasian watermilfoil, which out-competes native plants, is the current dominant aquatic plant, curlyleaf pondweed can quickly take its place if given the chance.

Aquatic plants stabilize banks and sediment, oxygenate water, protect small fish, create spawning habitats, act as refuges for zooplankton and serve as food sources for water fowl and wildlife. For these reasons, it is of importance to restore native aquatic plant populations within each lake.

Goals:

- Establish a native plant community
- Draw-down to aid in establishing native aquatic plants
- Manual, chemical, or mechanical removal of curl leaf pondweed.
- Monitor the lake to ensure that non-native invasive species are not introduced into the plant community.

Cost for Implementation: \$200,000 to \$245,000 Goose Lake: \$70,000 to \$80,000 Hydes Lake: \$40,000 to \$50,000 Miller Lake: \$60,000 to \$70,000

Winkler Lake: \$30,000 to \$45,000

#### 8.5.2.2 Rough Fish Management

Species such as black bullhead and carp increase the mixing of sediments releasing phosphorus into the water column, and reducing the clarity of water, thereby minimizing the amount of light filtering to aquatic macrophytes. Each lake has either a high population of rough fish or has seen an increase in recent years of rough fish populations. Implementation plans must include the management of rough fish species by following management practices set forth below.

Goals:

- Investigate partnership with U of M in research of effective carp removal methods.
- Stocking of pan fish to assist in reducing carp reproduction through predation of carp eggs.
- Increased surveys to monitor the results of management efforts.
- Installation of fish barriers paired with intensified efforts for removal of carp and black bullheads

Cost for Implementation: \$160,000 to \$220,000 Goose Lake: \$50,000 to \$60,000

Hydes Lake: \$40,000 to \$55,000 Miller Lake: \$40,000 to \$55,000 Winkler Lake: \$30,000 to \$55,000

#### **8.5.2.3 Alum Treatments**

Aluminum sulfate (alum) is a chemical addition that forms a non-toxic precipitate with phosphorus. It removes phosphorus from the lake system so that is not available for algal growth and forms a barrier between lake sediments and the water to restrict phosphorus release from the sediments.

Goals:

- Evaluate whether Alum is a viable option to reduce internal phosphorus loading
- Establish treatment area, dosing amounts and costs needed to treat the lake

Cost for Implementation: \$200,000 to \$300,000 Hydes Lake: \$100,000 to \$150,000 Miller Lake: \$100,000 to \$150,000

#### 8.5.2.4 Boat Traffic Management

At high speeds, boat motors can cause disturbance, not only to the aquatic plant community, but to the sediments on the bottom of the lake, the wave action causing release of phosphorus from disturbed sediments. No wake zones will aid in controlling the disturbance to sediments.

Goals:

- Establish Restricted Areas to protect aquatic resources
- Enforcement and Education of regulations promoting awareness among boaters where slow or no wake zones are ignored.

Cost for Implementation: \$8,000 to \$16,000 Goose Lake: \$2,000 to \$4,000 Hydes Lake: \$2,000 to \$4,000 Miller Lake: \$2,000 to \$4,000 Winkler Lake: \$2,000 to \$4,000

#### 8.5.2.5 Bio-manipulation

For shallow lake ecosystems, switching a lake from algae dominated to a clear water state requires a reverse switch which typically consists of bio-manipulation. This process consists of the complete restructuring of the fish community and works best if nutrient levels (both internal and external) are reduced prior to manipulation. Upon removal of fish, zooplankton such as daphnia populations will increase and graze away phytoplankton thereby allowing for clear water. Clear water will then allow for the growth of aquatic plants, return of healthy zooplankton populations, and the return of a more stable clear-water lake.

Goals:

- External nutrient reductions as indicated by implementation plan.
- Internal nutrient reductions as indicated by implementation plan.
- Manipulation of fish community- and reintroduction following zooplankton and aquatic plant establishment.

Total cost for implementation: \$160,000 to \$240,000 Goose Lake: \$70,000 to \$100,000 Miller Lake: \$50,000 to \$75,000 Winkler Lake: \$40,000 to \$65,000

# 9.0 Reasonable Assurance

# 9.1 Introduction

When establishing a TMDL, reasonable assurances must be provided demonstrating the ability to reach and maintain water quality endpoints. Several factors control such reasonable assurances, including a thorough knowledge of the ability to implement BMPs in an overall effective manner. Carver County is in a position to implement the TMDL and ultimately achieve water quality standards.

# 9.2 Carver County

The Carver County Board of Commissioners (County Board), acting as the water management authority for the former Bevens Creek (includes Silver Creek), Carver Creek, Chaska Creek, East Chaska Creek, and South Fork Crow River watershed management organization areas, has established the "Carver County Water Resource Management Area" (CCWRMA). The purpose of establishing the CCWRMA is to fulfill the County's water management responsibilities under Minnesota Statute and Rule. This structure was chosen because it will provide a framework for water resource management as follows:

- Provides a sufficient economic base to operate a viable program;
- Avoids duplication of effort by government agencies;
- Avoids creation of a new bureaucracy by integrating water management into existing County departments and related agencies;
- Establishes a framework for cooperation and coordination of water management efforts among all of the affected governments, agencies, and other interested parties; and
- Establishes consistent water resource management goals and standards for at least 80 percent of the county.

The County Board is the governing body of the CCWRMA for surface water management and for groundwater management. In function and responsibility, the County Board is equivalent to a joint powers board or a watershed district board of managers. All lakes within the Carver Creek Watershed are part of the CCWRMA.

The County is uniquely qualified through its zoning and land use powers to implement corrective actions to achieve TMDL goals. The County has stable funding for water management each year, but will likely need assistance for full TMDL implementation in a reasonable time frame, and will continue its baseline-monitoring program. Carver County has established a stable source of funding through a watershed levy in the CCWRMA taxing district (adopted 2001). This levy allows for consistent funding for staff, monitoring, engineering costs and also for on the ground projects. The County has also been very successful in obtaining grant funding from local, state and federal sources due to its organizational structure.

Carver County recognizes the importance of the natural resources within its boundaries, and seeks to manage those resources to attain the following goals:

- 1. Protect, preserve, and manage natural surface and groundwater storage and retention systems;
- 2. Effectively and efficiently manage public capital expenditures needed to correct flooding and water quality problems;
- 3. Identify and plan for measures to effectively protect and improve surface and groundwater quality;
- 4. Establish more uniform local policies and official controls for surface and groundwater management;
- 5. Prevent erosion of soil into surface water systems;
- 6. Promote groundwater recharge;
- 7. Protect and enhance fish and wildlife habitat and water recreational facilities; and
- 8. Secure additional benefits associated with the proper management of surface and groundwater.

Water management involves the following County agencies: Carver County Land and Water Services Division, Carver County Extension, and the Carver Soil and Water Conservation District (SWCD). The County Land and Water Services Division is responsible for administration of the water plan and coordinating implementation. Other departments and agencies will be called upon to perform water management duties that fall within their area of responsibility. These responsibilities may change as the need arises. The key entities meet regularly as part of the Joint Agency Meeting (JAM) process to coordinate priorities, activities, and funding.

# 9.3 Regulatory Approach

#### 9.3.1 Watershed Rules

Water Rules establish standards and specifications for the common elements relating to watershed resource management including: Water Quantity, Water Quality, Natural Resource Protection, Erosion and Sediment Control, Wetland Protection, Shoreland Management, and Floodplain Management. Of particular benefit to Nutrient TMDL reduction strategies are the stormwater management and infiltration standards which are required of new development in the CCWRMA. The complete water management rules are contained in the Carver County Code, Section 153.

#### 9.3.2 NPDES Phase II Stormwater Permits

The Stormwater Program for MS4s is designed to reduce the amount of sediment and pollution that enters surface and groundwater from storm sewer systems to the maximum extent practicable. Stormwater discharges associated with MS4s are regulated through the use of NPDES permits which are legal documents. Through this permit, the owner or operator is required to develop a Stormwater Pollution Prevention Program (SWPPP) that incorporates BMPs applicable to their MS4. Applicable MS4s in this project are Waconia and Laketown Township.

Under the stormwater program, MS4s are required to develop and implement a SWPPP. The SWPPP must cover six minimum control measures:

• Public education and outreach;

- Public participation/involvement;
- Illicit discharge, detection and elimination;
- Construction site runoff control;
- Post-construction site runoff control; and
- Pollution prevention/good housekeeping.

The MS4 must identify BMPs and measurable goals associated with each minimum control measure. An annual report on the implementation of the SWPPP must be submitted each year.

Additionally, stormwater permits for construction sites greater than one acre and any industrial site on EPA's list of mandatory industrial facilities, per the Standard industrial code, are required.

#### 9.3.3 NPDES Permits for Municipal and Industrial Wastewater

The MPCA issues NPDES permits for any discharge into waters of the state. These permits have both general and specific limits on pollutants that are based on water quality standards. Permits regulate discharges with the goals of 1) protecting public health and aquatic life, and 2) assuring that every facility treats wastewater. One such permit is held by a facility within the Winkler Lake direct watershed: MN0002135 (Bongards' Creamery).

#### 9.3.4 Feedlot Permitting

The County Feedlot Management Program includes the feedlot permitting process. The permit process ensures that the feedlot meets State pollution control standards and locally adopted standards. The County has had a locally operated permitting process under delegation from the MPCA since 1980. The County adopted a Feedlot Ordinance in 1996. The Feedlot Ordinance incorporates State standards plus additional standards and procedures deemed necessary to appropriately manage feedlots in Carver County.

#### 9.3.5 County SSTS Ordinance

The SSTS ordinance regulates the design, location, installation, construction, alteration, extension, repair, and maintenance of SSTSs. The County currently enforces the ordinance in unincorporated areas; cities are responsible in their jurisdiction. The law gives responsibility to the County throughout the county unless a city specifically develops and implements its own program and SSTS ordinance.

# 9.4 Non-Regulatory Approach

#### 9.4.1 Education

Implementation relies on three overall categories of activities: 1) Regulation, 2) Incentives, and 3) Education. All three categories must be part of an implementation program. The County has taken the approach that regulation is only a supplement to a strong education and incentive based program to create an environment of low risk. Understanding the risk through education can go a long way in preventing problems. In addition, education can be a simpler, less costly and a more community friendly way of achieving goals and policies. It can provide the framework for more of a "grass roots" implementation rather than a "top-down" approach of regulation and incentives. However, education by itself will not always meet intended goals, has certain limitations, and is more of a long-term approach.

Carver County created the Environmental Education Coordinator position in 2000 with the responsibility for development and implementation of the water education work plan. Several issues associated with the water plan were identified as having a higher priority for education efforts. These issues were identified through discussions with the advisory committees, and include ease of immediate implementation, knowledge of current problem areas, and existing programs. The higher priority objectives are not organized in any particular order. The approach to implement the TMDL will mimic the education strategy of the water plan. Each source reduction strategy will need an educational component and will be prioritized based on the number of landowners, type of source, and coordination with existing programs.

#### 9.4.2 Incentives

Many of the existing programs, on which the water management plan relies, are incentive based offered through the County and the Carver and Sibley SWCDs. Some examples include state and federal cost share funds directed at conservation tillage, crop nutrient management, rock inlets, conservation buffers, and low interest loan programs for SSTS upgrades. Reducing nutrient sources will depend upon a similar strategy of incorporating incentives into implementation practices. After the approval of the TMDL by the EPA, and following the County's entrance into the implementation phase, it is anticipated that the County will apply for funding to assist landowners in the application of BMPs identified in the Implementation Plan.

# **10.0 Monitoring**

Monitoring will continue for all Carver Creek TMDL lakes as prioritized by the Water Plan (Table 10.1). However, after implementation of nutrient reduction strategies a stepped-up approach of monitoring will be conducted.

Lake	Priority	Frequency	Schedule		
Goose	High	Bi-Weekly	Annually	April - October	
Hydes	High	Bi-Weekly	Annually	April - October	
Miller	High	Bi-Weekly	Annually	April - October	
Winkler	Moderate	Bi-Weekly	Rotating	April - October	

Table 10.1 Monitoring commitment for Carver Creek Lakes.

Adaptive management relies on the County conducting additional monitoring as BMPs are implemented in order to determine if the implementation measures are effective and how effective they are. This monitoring will assist in evaluating the success of projects and identify changes needed in management strategies. Revision of management and monitoring strategies will occur as needed.

### 10.1 Goose Lake

Additional monitoring may include sampling of inlets not monitored during the initial TMDL study to further refine loading estimates, sampling in the individual bays of Goose Lake to determine interaction within the lake between each bay, or additional in-lake sampling of Donders, Rutz and Swan Lakes to refine loading estimates exiting these lakes.

# 10.2 Hydes Lake

Additional monitoring may include more detailed monitoring at the inlet and outlet to refine loading estimates and monitoring of Patterson Lake to identify its role in nutrient loading to Hydes Lake.

# **10.3 Miller Lake**

Additional areas that may need to be monitored include inlets not monitored during the initial TMDL study and/or sediment samples to further account for internal loading. Furthermore, assessment of the stormwater discharge may be monitored to better grasp the nutrient loads caused by runoff from surrounding land.

# **10.4 Winkler Lake**

Additional areas that may need to be monitored include the short, ditched lake inlet not monitored during the initial TMDL study, sediment core samples to further account for internal loading, land use change monitoring and an assessment of the current fish community will be considered to aid in determining existing rough fish populations.

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# **Appendix A Tributary Monitoring**

Water quality parameters such as temperature, transparency, and DO were measured in the field with a hand-held electronic meter. Nutrient grab samples and composite samples were analyzed for TP, total suspended solids, nitrate + nitrite, total ammonia nitrogen, volatile suspended solids, turbidity, dissolved phosphorus, alkalinity and chemical oxygen demand by the Metropolitan Council Laboratory in St. Paul, MN. Flow was also monitored during water quality sampling events utilizing a hand-held SonTec Flow Tracker.

# A.1 Goose Lake

Water quality was monitored via grab samples at the primary inlet and outlet (G1 and CC1 – Figure A.1) in 2004. The remaining two inlets were not monitored because of the low flow conditions through much of the sampling season. It was decided by the MPCA and Carver County staff at the beginning of the TMDL process not to monitor all of the inlets as the non-monitored, low-flow inlet information could be accurately estimated by the models used to develop the TMDL.



Figure A.1 Goose Lake subwatersheds and sampling points.

Flow measurement was difficult due to minimal or no flow during much of the growing season. Captured flow was compared to modeled flow and it was determined that modeled flow accurately depicted flow at the G1 site.

The G1 inlet accounts for inflow from Rutz Lake watershed, Swan Lake watershed, and the remaining 1,099 acres of land that drain directly to Goose Lake. As such, a rather large portion of the land contributing to the inflow of Goose Lake is captured here. Samples at G1 were targeted at an array of flow conditions ranging from base to high

flows. The most significant flow into Goose Lake via G1 occurs during spring high flow events. Due to minimal flow conditions during the 2004 sampling season only five samples were collected. Therefore it is difficult to determine trends between the inlet and Goose Lake water quality. Data does indicate that the inlet has high TP concentrations (320  $\mu$ g/L average; range 48-990  $\mu$ g/L) which increased throughout the summer growing season (Table A.1). Similar trends are seen in Goose Lake. In addition, inlet phosphorus concentrations appear to increase in response to precipitation events. While there are high phosphorus concentrations in the G1 inlet over the entire summer season, the most water exchange occurs during spring high flows. Upon implementation, an automated sampler with a continuous flow record device will be installed at the inlet and data will be used to refine models.

	TP	DP	OP		Flow
Date	ug/L	ug/L	ug/L	Date	CFS
4/12/2004	~48	<5	59	7/7/2004	1.614
5/27/2004	158	146	139	7/22/2004	0
6/7/2004	234	152	206	9/7/2004	0
7/9/2004	170	107	120		
7/22/2004	990	295	342		

	Table A.1	<b>Goose Lake</b>	inlet (G1)	) monitored	phosphorus	s concentrations	and flow.
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The Goose Lake outlet (CC1) was monitored similarly to the inlet with a range of flows targeted. Samples were collected from the inlet and outlet at the same time. The outlet was sampled an additional three times as well. TP concentrations ranged from 72-434  $\mu$ g/L (average 252 $\mu$ g/L) (Table A.2). Water quality results from the outlet were compared with that of the BATHTUB model outputs in calibration.

Fable A.2	Goose Lake outl	et (CC1)	) monitored	phosphorus	s concentrations	and flow.

	TP	DP	OP		Flow
Date	ug/L	ug/L	ug/L	Date	CFS
4/12/2004	72	26	53	4/12/2004	0.04
5/27/2004	434	348	442	5/27/2004	5.40
6/7/2004	184	~6	~47	6/7/2004	8.58
7/9/2004	198	34	~40	7/7/2004	7.46
7/22/2004	181	~8	~22	7/9/2004	4.00
8/19/2004	318	43	83	7/22/2004	5.22
9/16/2004	376	139	157	8/19/2004	0.09
				9/16/2004	0.57

# A.2 Hydes Lake

Water quality was monitored via grab samples in 2004 at the primary inlet and outlet (H2, H1; Figure A.2). Flow was also monitored but stage was not monitored continuously to develop a daily discharge record. In addition, flow measurement was difficult due to low flow conditions during much of the growing season. When low to no

flow conditions were observed at the inlet, no grab sample was taken. Base and high flows were targeted however due to low flow only seven samples were taken at H2 and six samples taken at H1. The results of tributary monitoring are integrated into BATHTUB models.

Samples at H2 were targeted at an array of flow conditions ranging from base to high flows. The most significant flow into Hydes Lake via H2 occurs during the summer rain events. Seven samples were collected during the 2004 monitoring season. Data does indicate that the inlet has an average TP concentration that is below the 50<sup>th</sup> percentile for the predicted NCHF ecoregion stream concentration of 100  $\mu$ g/L (99  $\mu$ g/L average; range 55 – 131  $\mu$ g/L)(Table A.3).

	TP	DP	OP		Flow
Date	ug/L	ug/L	ug/L	Date	CFS
4/12/2004	56	27	~45	4/12/2004	0.02
5/27/2004	118	133	154	5/27/2004	4.59
6/7/2004	131	131 105		6/7/2004	8.35
7/9/2004	101	49	87	7/7/2004	6.65
7/22/2004	110	64	86	7/9/2004	4.91
8/19/2004	55	24	~34	7/22/2004	5.14
9/16/2004	124 25		~44	7/23/2004	4.09
				8/19/2004	1.09

Table A.3	Hydes Lake inlet	(H2) monitored	phosphorus	concentrations and flow.
			<b>P</b>	

Hydes Lake outlet (H1) was monitored similarly to the inlet with a range of flows targeted. Samples were collected from the inlet and outlet at the same time. Unfortunately, the September  $16^{th}$  sample that was taken at the inlet was not taken at the outlet. TP concentrations ranged from  $48 - 217 \mu g/L$  (average  $128 \mu g/L$ )(Table A.4). Comparisons between the inlet and the outlet concentrations show the influence that Hydes Lake has on water quality discharging, especially during the late summer season. Water quality results from the outlet were compared with that of the BATHTUB model outputs in calibration.

	TP	DP	OP		Flow
Date	ug/L	ug/L	ug/L	Date	CFS
4/12/2004	~48	<5	~15	4/12/2004	0.00
5/27/2004	120	73	153	5/27/2004	0.27
6/7/2004	58	<5	67	6/27/2004	6.04
7/9/2004	147	15	50	6/7/2004	5.75
7/22/2004	180	<5	~32	7/9/2004	4.96
8/19/2004	217 75		99	7/22/2004	4.24
				8/19/2004	0.30

Table A.4 Hydes Lake outlet (H1) monitored phosphorus concentrations and flow.



Figure A.2 Hydes Lake subwatersheds and sampling points.

# A.3 Miller Lake

Water quality and flow have been monitored using automatic sampling and continuous flow equipment since 1998 at the primary inlet (CA 10.4) and outlet (CA 8.7) (Figure A.3) to Miller Lake. In addition, grab samples have been collected at both of these sites since 1998. Water quality was not monitored at the west inlet (D1) of the lake as it typically has low to no flow. Automated, composite samples were collected at high-flow events each year while base flow grab samples were collected bi-weekly during base and low-flow.

The 2003 sampling year was targeted for this study. Miller Lake inlet (CA 10.4) was sampled a total of twelve times during the monitoring season. A total of twelve samples were taken throughout 2003, of those only eleven had all three phosphorus parameters. Both the range and average TP concentrations at CA 10.4 were above the 75<sup>th</sup> percentile for expected NCHF ecoregion stream TP concentrations (430  $\mu$ g/L average; range of 106-1360  $\mu$ g/L)(Table A.5). Composite samples were collected at this site as well. Concentrations for these two samples were significantly higher than grab samples. This discrepancy can be attributed to difference in sampling procedures.

		TP	DP	OP		Flow (est)
Date	Sample Type	ug/L	ug/L	ug/L	Date	CFS
3/25/2003	Grab	281	70	86	3/25/2003	34.7
4/21/2003	Grab	399	38	~48	4/21/2003	51.6
5/9/2003	Grab	332	7	~14	5/9/2003	23.8
5/9/2003	Composite	1360	42	58	5/14/2003	62.6
5/17/2003	Composite	822	31	497	5/20/2003	52.3
6/2/2003	Grab	106	23	~17	6/2/2003	37.0
6/19/2003	Grab	329	129	126	6/19/2003	19.0
7/2/2003	Grab	217	89	99	7/2/2003	14.0
7/17/2003	Grab	233	23	206	7/17/2003	5.6
8/1/2003	Grab	238	52	70	8/1/2003	0.5
9/12/2003	Grab	417	93	114	9/12/2003	0.5
12/1/2003	Grab		~5		12/1/2003	0.5

 Table A.5
 Miller Lake inlet (CA 10.4) monitored phosphorus concentrations.

Eleven samples were taken at Miller Lake outlet (CA 8.7), of which ten had lab results for all three phosphorus parameters. TP concentrations ranged from 119  $\mu$ g/L to 351  $\mu$ g/L and an average concentration of 234  $\mu$ g/L (Table A.6). Comparisons between the inlet and outlet results indicate Miller Lake acting like a settling pond with lower TP concentrations exiting the lake. The results of monitoring are integrated in the computer modeling exercises.

Table A.6	Miller Lake outlet (CA	8.7) monitored	phosphorus	concentrations a	and
flow.					

		TP	DP	OP		Flow (est)
Date	Sample Type	ug/L	ug/L	ug/L	Date	CFS
3/25/2003	Grab	b 280 129 136		3/25/2003	68.8	
4/21/2003	Grab	204	5	~25	4/21/2003	111.8
5/9/2003	Grab	240	5	~40	5/9/2003	62.9
5/10/2003	Composite	299	13	~38	5/14/2003	127.3
5/19/2003	Grab	202	10	~16	5/19/2003	106.4
6/2/2003	Grab	234	8	~35	6/2/2003	74.6
6/19/2003	Grab	127	12	~33	6/19/2003	41.5
7/2/2003	Grab	119	~6	~29	7/2/2003	33.7
7/17/2003	Grab	285	59	105	7/17/2003	12.8
8/1/2003	Grab	351	91	108	8/1/2003	2.5
12/1/2003	Grab		10		12/1/2003	0.5



Figure A.3 Miller Lake watershed and sampling points.

# A.4 Winkler Lake

Water quality and flow were monitored in 2005 at the inlet CC8.2 (Figure A.4). Flow was also monitored in 2006. Site CC9 was monitored in 2004 through 2007 for both water quality and flow. The extent of monitoring at site CC9 has to do with its inclusion in the Carver Creek Turbidity TMDL to be completed in 2009. A total of 7 samples in 2004, 10 samples in 2005, and 7 samples in 2006 were collected, targeting both base and high flows at site CC9. Ten samples targeting both base and high flows were taken at site CC8.2. The results of tributary monitoring are integrated in the computer modeling exercises.

Sampling lab results for Winkler Lake inlet CC 8.2 are summarized in Table A.7. The average TP concentration was 248  $\mu$ g/L which is above the 75<sup>th</sup> percentile for expected NCHF ecoregion stream TP concentrations. The range was between 76  $\mu$ g/L and 394  $\mu$ g/L. Concentrations increased during the summer months, which might be an indication of the influence of Rice Lake that drains to Winkler Lake via CC 8.2.

	TP	DP	OP		Flow
Date	ug/L	ug/L	ug/L	Date	CFS
4/13/2005	161	80	116	4/13/2005	11.43
4/20/2005	118	61	107	4/22/2005	19.58
5/5/2005	76	27	55	4/27/2005	12.01
6/1/2005	207	137	154	5/5/2005	7.87
6/14/2005	219	176	212	5/27/2005	13.34
6/28/2005	254	171	182	6/15/2005	16.21
7/13/2005	334	223	284	7/14/2005	3.52
8/10/2005	394	187	219	8/15/2005	0.67
9/20/2005	361	249	271	9/13/2005	1.84
10/6/2005	351	240	281	9/20/2005	0.68

 Table A.7 Winkler Lake inlet (CC 8.2) monitored phosphorus concentrations and flow.

A - 6

Phosphorus lab results for the Winkler Lake inlet CC 9 ranged from 153  $\mu$ g/L to 1260  $\mu$ g/L during the 2005 monitoring season. An average of 406  $\mu$ g/L was well above the 75<sup>th</sup> percentile of the expected NCHF ecoregion stream TP concentration (Table A.8).

	TP	DP	OP		Flow	
Date	ug/L	ug/L	ug/L	Date	CFS	
4/11/2005	330	204	262	4/20/2005	2.85	
4/20/2005	181	107	155	4/27/2005	3.10	
5/5/2005	318	33	133	5/5/2005	0.64	
6/1/2005	316	266	310	5/27/2005	4.35	
6/14/2005	153	126	187	6/3/2005	1.95	
6/28/2005	235	143	178	6/16/2005	1.91	
7/13/2005	314	263	308	7/14/2005	0.80	
8/10/2005	1260	960	842	9/13/2005	1.88	
9/20/2005	500	327	369	9/20/2005	0.62	
10/6/2005	450	263	297			

Table A.8 Winkler Lake inlet (CC 9) monitored phosphorus concentrations andflow.



Figure A.4 Winkler Lake subwatersheds and sampling points.

# **Appendix B BATHTUB Benchmark Models**

Model Coefficients

#### B.1 Goose Lake B.1.1 2001 Inputs

#### goos B20b12 2001 Mass Balance

File: S:\Water\Water Mon	itoring\TME	LITMDL	Lake TMDLs\	Draft TMD	L to MPC/	A\Five Lake	TMDL\Indiv	idual L	akes\Goose\Mo	dels\goo	se01_12-07.k	otb	Total Phospho	te orus		1.000	0.70
Description:													To tal Nitroger	1 I		1.000	0.55
<u>Global Variables</u>	<u>Mean</u>	<u>cv</u>		<u>M</u>	odel Optic	ons		<u>Code</u>	<u>Description</u>				Chl-a Model			1.000	0.26
Averaging Period (yrs)	1	0.0		Ca	nservative	e Substance		0	NOT COMPUTE	Ð			Secchi Model			1.000	0.10
Precipitation (m)	0.74	0.2		Ph	osphorus	Balance		8	CANF & BACH,	LAKES			Organic N Mo	del		1.000	0.12
Evaporation (m)	0.7	0.3		Ni	trogen Bal	ance		0	NOT COMPUTE	D			TP-OP Model			1.000	0.15
Storage Increase (m)	0	0.0		Ch	lorophyll-	а		1	P, N, LIGHT, T				HODv Model			1.000	0.15
				Se	cchi Depth	n		1	VS. CHLA & TU	RBIDITY			MODv Model			1.000	0.22
<u>Atmos. Loads (kg/km²-yr)</u>	Mean	CV		Di	spersion			1	FISCHER-NUM	ERIC			Secchi/Chla Sl	ope (m²/m	g)	0.015	0.00
Conserv. Substance	0	0.00		Ph	osphorus	Calibration		1	DECAY RATES				Minimum Qs	(m/yr) 		0.100	0.00
To tal P	20	0.50		Ni	trogen Cal	ibration		1	DECAY RATES				Chi-a Flushing	lerm		1.000	0.00
Total N	1000	0.50		Er	ror Analys	is		1	MODEL & DAT	Ą			Avoil Foster	Totol P		0.520	0
Ortho P	15	0.50		Av	ailability F	actors		0	IGNORE				Avail Factor -	Ortho P		1 9 3 0	0
InorganicN	500	0.50		M	ass-Balanc	e Tables		1	USE ESTIMATE				Avail Factor -	Total N		0.590	0
		0100		0	itnut Dest	ination		2		HFFT			Avail, Factor -	Inorganic	N	0.790	ő
					npor best	indion		2	EXCEL PROVINCI								
Segment Morphometry												1	nternal Loads	(mg/m2	2-day)		
	Ou	itflow		Area	Depth	Length M	lixed Depth	(m)	Hypol Depth	N	on-Algal Tur	'b (m <sup>·1</sup> )	Conserv.	Т	otal P	То	tal N
<u>Seg Name</u>	Se	<u>gm ent</u>	Group	<u>km²</u>	<u>m</u>	<u>km</u>	<u>Mean</u>	<u>cv</u>	<u>Mean</u>	CV	<u>Mean</u>	<u>cv</u>	<u>Mean</u>	<u>cv</u>	<u>Mean</u>	<u>cv</u>	<u>Mean</u>
1 Goose		0	1	1.35	1.5	3.5	1.3	0.12	2 0	0	0.53	0.2	0	0	0.5	0	0
Segment Observed Water G	uality Ta	••• 1 17 /mm	ь) Та	hal bl du u bi		The function	e.,	a a la i dua		ania N/m		Orthout		D. du u la dala		)D (nnh(d)	

	Conserv	Total P (ppb)		Total N (ppb)		Chi-a (ppb)		Secchi (m)		0	rganic N (ppb	) П	P - Ortho P (	(ppb) H	HOD (ppb/day)		MOD (ppb/day)		
<u>Seg</u>	<u>Mean</u>	<u>cv</u>	<u>Mean</u>	<u>cv</u>	<u>Mean</u>	<u>cv</u>	<u>Mean</u>	<u>cv</u>	<u>Mean</u>	<u>cv</u>	<u>Mean</u>	<u>cv</u>	<u>Mean</u>	<u>CV</u>	<u>Mean</u>	<u>cv</u>	<u>Mean</u>	<u>cv</u>	
1	0	0	125	0	3020	0	60	0	0.7	0	0	0	0	0	0	0	0	0	

#### Segment Calibration Factors

Dispersion Rate		Total P (ppb)		Total N (ppb)		Chl-a (ppb)		Secchi (m)		Organic N (ppb)			P - Ortho P (	ppb) H	OD (ppb/day)	MOD (ppb/day)		
Seg	<u>Mean</u>	<u>cv</u>	<u>Mean</u>	<u>cv</u>	<u>Mean</u>	<u>cv</u>	<u>Mean</u>	<u>CV</u>	<u>Mean</u>	<u>cv</u>	<u>Mean</u>	<u>CV</u>	<u>Mean</u>	<u>CV</u>	<u>Mean</u>	<u>cv</u>	<u>Mean</u>	<u>cv</u>
1	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0

Tributary Data

				Dr Area	Flow (hm°/yr)	Conserv.		т	otal P (ppb)	Total N (ppb)		Ortho P (ppb)		Inorganic N (ppb)		
<u>Trib</u>	<u>Trib Name</u>	<u>Segment</u>	<u>Type</u>	<u>km²</u>	<u>Mean</u>	<u>cv</u>	<u>Mean</u>	<u>cv</u>	<u>Mean</u>	<u>cv</u>	<u>Mean</u>	<u>cv</u>	<u>Mean</u>	<u>cv</u>	<u>Mean</u>	<u>cv</u>
1	Donders	1	1	0.89	0.1	0.1	0	0	549.6	0.2	0	0	0	0	0	0
2	Swan Trib	1	1	1.51	0.16	0.1	0	0	404	0.2	0	0	0	0	0	0
3	Rutz trib	1	1	1.13	0.2	0.1	0	0	319.3	0.2	0	0	0	0	0	0
4	G1	1	1	4.45	0.58	0	0	0	340.7	0	0	0	0	0	0	0
5	Inlet 2	1	1	0.42	0.06	0	0	0	359	0	0	0	0	0	0	0
6	Inlet 3	1	1	0.5	0.08	0	0	0	271.1	0	0	0	0	0	0	0
7	inlet1 septic	1	3	0	0.01	0	0	0	378	0	0	0	0	0	0	0
8	Inlet2 septic	1	3	0	0.01	0	0	0	75.6	0	0	0	0	0	0	0
9	inlet3 septic	1	3	0	0.01	0	0	0	25.2	0	0	0	0	0	0	0
10	Direct	1	1	2.65	0.34	0	0	0	371.5	0	0	0	0	0	0	0
11	direct septic	1	з	0	0.01	0	0	0	554	0	0	0	0	0	0	0

~

<u>cv</u> 0

<u>cv</u>

<u>Mean</u>
goose 2001 File: S:\Water\Water Monitoring\TMDL\TMDL\Lake TMDLs\Draft TMDL to MPCA\Five Lake TMDL\Individual Lakes\Goose\Models\goose01\_12-07.btb

Over	all Wat	er Ba	lance		Averagi	ng Period =	1.00 y	/ears
				Area	Flow	Variance	cv	Runoff
<u>Trb</u>	Туре	<u>Seg</u>	<u>Name</u>	<u>km<sup>2</sup></u>	hm <sup>3</sup> /vr	<u>(hm3/yr)<sup>2</sup></u>	-	<u>m/yr</u>
1	1	1	Donders	0.9	0.1	1.00E-04	0.10	0.11
2	1	1	Swan Trib	1.5	0.2	2.56E-04	0.10	0.11
3	1	1	Rutz trib	1.1	0.2	4.00E-04	0.10	0.18
4	1	1	G1	4.4	0.6	0.00E+00	0.00	0.13
5	1	1	Inlet 2	0.4	0.1	0.00E+00	0.00	0.14
6	1	1	Inlet 3	0.5	0.1	0.00E+00	0.00	0.16
7	3	1	inlet1 septic		0.0	0.00E+00	0.00	
8	3	1	Inlet2 septic		0.0	0.00E+00	0.00	
9	3	1	inlet3 septic		0.0	0.00E+00	0.00	
10	1	1	Direct	2.7	0.3	0.00E+00	0.00	0.13
11	3	1	direct septic		0.0	0.00E+00	0.00	
PREC	ΙΡΠΑΤΙΟ	ΝС		1.4	1.0	3.99E-02	0.20	0.74
TRIBU	JTARY I	NFLO	N	11.5	1.5	7.56E-04	0.02	0.13
POIN	T-SOUR	CE IN	FLOW		0.0	0.00E+00	0.00	
***T(	OTAL IN	FLOW	/	12.9	2.6	4.07E-02	0.08	0.20
ADVE	CTIVE C	DUTFL	.OW	12.9	1.6	1.21E-01	0.22	0.13
***TOTAL OUTFLOW			W	12.9	1.6	1.21E-01	0.22	0.13
***E'	VAPORA	ATION			0.9	8.04E-02	0.30	

Over	rall Mas noonenf	is Bal	ance Based Upon	Predicted TOTAL P		Reservoir Co	ncentra	ations			
				Load	L	.oad Variand	e		Conc	Export	
<u>Trb</u>	Туре	<u>Seg</u>	Name	<u>kg/yr</u>	<u>%Total</u>	<u>(ka/vr)<sup>2</sup></u>	<u>%Total</u>	<u>cv</u>	<u>ma/m³</u>	ka/km²/vr	
1	1	1	Donders	55.0	6.6%	1.51E+02	20.2%	0.22	549.6	61.8	
2	1	1	Swan Trib	64.6	7.7%	2.09E+02	28.0%	0.22	404.0	42.8	
3	1	1	Rutz trib	63.9	7.7%	2.04E+02	27.3%	0.22	319.3	56.5	
4	1	1	G1	197.6	23.7%	0.00E+00		0.00	340.7	44.4	
5	1	1	Inlet 2	21.5	2.6%	0.00E+00		0.00	359.0	51.3	
6	1	1	Inlet 3	21.7	2.6%	0.00E+00		0.00	271.1	43.4	
7	3	1	inlet1 septic	3.8	0.5%	0.00E+00		0.00	378.0		
8	3	1	Inlet2 septic	0.8	0.1%	0.00E+00		0.00	75.6		
9	3	1	inlet3 septic	0.3	0.0%	0.00E+00		0.00	25.2		
10	1	1	Direct	126.3	15.1%	0.00E+00		0.00	371.5	47.7	
11	3	1	direct septic	5.5	0.7%	0.00E+00		0.00	554.0		
PREC	ΙΡΠΑΤΙ	ON		27.0	3.2%	1.82E+02	24.4%	0.50	27.0	20.0	
INTE	RNAL LO	DAD		246.5	29.5%	0.00E+00		0.00			
TRIB	UTARY I	NFLO	W	550.6	66.0%	5.64E+02	75.6%	0.04	362.2	47.7	
POIN	IT-SOUF	CE IN	FLOW	10.3	1.2%	0.00E+00		0.00	258.2		
***T	OTAL IN	IFLOV	V	834.5	100.0%	7.46E+02	100.0%	0.03	326.1	64.7	
ADV	ECTIVE	OUTFI	OW	198.5	23.8%	5.52E+03		0.37	123.0	15.4	
***T	OTAL O	UTFLO	WC	198.5	23.8%	5.52E+03		0.37	123.0	15.4	
***F	ETENTI	ON		636.0	76.2%	5.98E+03		0.12			
	Overflo	ow Rat	te (m/yr)	1.2	1	Nutrient Resi	d. Time (yrs)		0.2984		
Hydraulic Resid. Time (yrs)			sid. Time (yrs)	1.2546	46 Turnover Ratio				3.4		
Reservoir Conc (mg/m3)			nc (mg/m3)	123	23 Retention Coef.						

# **B.1.3 2001 Predicted vs. Observed**

goose 2001

File: S:\Water\Water Monitoring\TMDL\TMDL\Lake TMDLs\Draft TMDL to MPCA\

Segment:	1 G	oose				
	Predicted Va	lues>	,	Observed Va	lues>	
<u>Variable</u>	<u>Mean</u>	<u>cv</u>	<u>Rank</u>	<u>Mean</u>	<u>cv</u>	<u>Rank</u>
TOTAL P MG/M3	123.0	0.34	85.3%	125.0		85.7%
TOTAL N MG/M3	3020.0		95.8%	3020.0		95.8%
C.NUTRIENT MG/M3	109.4	0.27	91.9%	110.8		92.2%
CHL-A MG/M3	81.6	0.38	99.8%	60.0		99.2%
SECCHI M	0.6	0.29	20.0%	0.7		28.4%
ORGANIC N MG/M3	2056.4	0.36	99.8%			
TP-ORTHO-P MG/M3	153.6	0.39	95.7%			
ANTILOG PC-1	3569.6	0.58	98.0%	2022.6		94.6%
ANTILOG PC-2	18.7	0.13	97.9%	16.2		96.1%
(N - 150) / P	23.3	0.35	67.9%	23.0		67.1%
INORGANIC N / P	963.6	0.77	100.0%			
TURBIDITY 1/M	0.5	0.20	43.7%	0.5	0.20	43.7%
ZMIX * TURBIDITY	0.7	0.23	2.5%	0.7	0.23	2.5%
ZMIX / SECCHI	2.3	0.30	10.2%	1.9	0.12	5.3%
CHL-A * SECCHI	46.5	0.16	98.4%	42.0		97.7%
CHL-A / TOTAL P	0.7	0.27	97.2%	0.5		92.0%
FREQ(CHL-a>10) %	99.9	0.00	99.8%	99.5		99.2%
FREQ(CHL-a>20) %	97.5	0.04	99.8%	92.8		99.2%
FREQ(CHL-a>30) %	90.4	0.11	99.8%	79.0		99.2%
FREQ(CHL-a>40) %	79.9	0.21	99.8%	63.5		99.2%
FREQ(CHL-a>50) %	68.4	0.32	99.8%	49.4		99.2%
FREQ(CHL-a>60) %	57.3	0.42	99.8%	37.8		99.2%
CARLSON TSI-P	73.5	0.07	85.3%	73.8		85.7%
CARLSON TSI-CHLA	73.8	0.05	99.8%	70.8		99.2%
CARLSON TSI-SEC	68.1	0.06	80.0%	65.1		71.6%

# B.1.4 2004 Input

														<u>Model Coeffi</u>	<u>cients</u>		Mea	<u>in CV</u>	Ĺ
P	1 5 2004 Mag	a Bala	nnoo											Dispersion Ra	te		1.00	JO 0.70	)
Goos	1.5 2004 19125 al ake 2004	S Dala	ince											Total Phospho	orus		1.00	JO 0.45	5
File	S:110/ater110/ater Mon	itorin a) Th			l e\Draft TMD	L to MPCA	iFiva Lake		lividual La	kesiGooseiM	odeleiao	05004 12.07	hth	To tal Nitroge	n		1.00	JO 0.55	5
Descr	intion	itorin gan			ESIDIAR HID		IIIVE Lake	: Indeana	II YIMUAI LA	arestovosetiit	vaelsigvi	03604_12-07.		Chl-a Model			1.00	JO 0.2€	5
Globa	l Variables	Mean	CV		M	ndel Ontion			Code	Description				Secchi Model			1.00	JO 0.10	)
Avera	ting Pariod (vrc)	1	0.0		<u></u>	ncorvotivo	<u>ia</u> Substance		0	NOT COMPLET	FD			Organic N Mo	del		1.00	JO 0.12	2
Precin	itation (m)	0.79	0.0		Ph	osphorus B	alanzo		8	CANE & BACH				TP-OP Model			1.00	JO 0.15	5
Evano	ration (m)	0.75	0.2		NI	trogen Bala	ince		0	NOT COMPLIE	FD			HODv Model			1.00	0.15	5
Storog	ration (m)	0.7	0.5		ch in	lorophyll o	ince		1	R N LIGHT T				MODv Model			1.00	0.22	2
Storag	e niciease (ni)	0	0.0		50	ochi Donth			1	VS CHIAR TI				Secchi/ChlaS	lope (m²/mg	)	0.0:	15 0.00	)
Atmo	s Loads (kalkm <sup>2</sup> -vr)	Moon	cv		3e	-norsion			1	EISCHED NITM				Minimum Qs	(m/yr)		0.10	0.00	)
Conco	su Substance		0.00		Dis	acabarus C	olibration		1		LNIC			Chl-a Flushing	; Term		1.00	0.00	)
Tatel	v. Substance	20	0.00		E LI NE	tragen Colik	anuration		1	DECAY DATES				Chl-a Tempor	al CV		0.62	20 0	)
Tatal		1000	0.50		Гл.	u ogen can.			1	MODEL & DAT	- a			Avail. Factor -	Total P		0.33	30 C	)
Outlo		1000	0.50		Err	ror Analysis	) <b>.</b>		1		А			Avail. Factor -	Ortho P		1.93	30 O	)
Urtho	r 	13	0.50		AV	анаршту на	Tables		1	IGNORE				Avail. Factor -	Total N		0.59	эо с	)
Inorga	nic N	500	0.50			ass-balance	e lables		1					Avail. Factor -	Inorganic N		0.79	30 C	)
					UL	riput Destir	ation		2	EACEL WORKS	NECI								
Saam	ont Mornhomotry													Intornal Load	c (malm?)	day)			
Segin	encimorphometry		Dutflaw		Area	Donth	Longth N	lived Dent	h (m )	Hypel Donth	N	Jon-Algal Tu	rh (m <sup>.1</sup> )	Concoru		al D	т	otal Ni	
6	Nama				km <sup>2</sup>	Depui	Lengun w	Maan	n (iii) Or	Мост		Maan	C) (	Maan	01	Maam		Maan	01
<u>seg</u>	<u>iname</u>	3	<u>segment</u>	<u>sroup</u>	4.95	<u>m</u>	<u>K</u> m	<u>iviean</u>	<u>UV</u>	<u>iviean</u>		<u>iviean</u>		<u>iviean</u>		<u>iviean</u>	<u></u>	<u>iviean</u>	
<u>Seg</u> 1	Conserv <u>Mean</u> 0	ا 2 <u>دv</u> 0	Fotal P (ppb) <u>Mean</u> 134	<u>د۷</u> ٥	Total N (ppb) <u>Mean</u> 2200	сі <u>сv</u> 0	hl-a (ppb) <u>Mean</u> 53	<u>د د م</u>	Secchi (m) <u>Mean</u> 0.4	) Or <u>CV</u> 0	<b>ganic N (</b> <u>Mean</u> 0	ppb) TP <u>CV</u> 0	- Ortho I <u>Mean</u> 0	Р (ррb) НС <u>CV</u> 0	D (ppb/day <u>Mean</u> 0	) N <u>CV</u> 0	MOD (ppb/d <u>Mean</u> 0	<b>ay)</b> <u>CV</u> 0	
~																			
Segm	ent Calibration Factor	5																	
<b>C</b>	Dispersion Rate		otal P (ppb)	~	i otal N (ppb)		ni-a (ppb)		seccni (m	) Ur	ganic N (	ррв) IP	- Urtho	Р (ррв) НС	D (ppb/day	) r	VIOD (ppb/d	ay)	
<u>seg</u>	<u>Iviean</u>		<u>Iviean</u>		<u>iviean</u>		<u>iviean</u>		<u>iviean</u>		<u>iviean</u>		<u>iviean</u>		<u>ivieari</u>		<u>iviean</u>		
1	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	
Tribut	any Data																		
mba	ary Ducu				Dr Area Flo	ow (hm <sup>3</sup> /vr	) (	onserv.		Total P (ppb)	-	Fotal N (ppb)		Ortho P (ppb)	Ino	roanic N	(ppb)		
Trib	Trib Name	ę	Seament	Type	km <sup>2</sup>	Mean	, cv	Mean	cv	Mean	cv	Mean	cv	Mean	cv	Mean	CV		
1	G1	2	1	1	4.45	0.62	0.1	0	0	320.3	0.2	0	<u></u>	0	0	0			
2	inlet 2		- 1	- 1	0.42	0.06	0.1	-	- 0	3375	0.2	-	-	- 0	- 0	0	-		
3	Inlet 3		1	1	0.5	0.08	0.1	ů N	0	254.9	0.2	0	ň	0	n	ů N	ñ		
4	Rutz		1	1	1.13	0.21	0	ň	0 0	300.3	0	ŏ	n	ő	õ	ň	ŏ		
5	Donders		- 1	1	0.89	0.11	0 0	ň	0 0	516.8	ņ	ñ	0	0 0	ň	ň	ň		
6	Direct		1 1	1	0.05	0.37	0	n n	0 n	3493	n n	n	0	0	0	0	0		
7	Inlet 2 Sentic		⊥ 1	2	0.05	0.01	0	0	0 0	76	0 0	ň	0	0	n	0	о О		
, s	Inlet 3 Septic		± 1	3	0	0.01	0	0 0	0	25	0	0	0	0	0	0	0		
q	Direct Sentic		1	3	0	0.01	0	о л	0 0	554	n	0	0	0	0	0	n n		
10	Swan		- 1	1	1 51	0.17	n n	ň	0 0	379.8	ň	Ň	0	0 0	ň	ň	ň		
						NY 8 18 17	- 4	· · · · · · · · · · · · · · · · · · ·	· · · · · · · · · · · · · · · · · · ·		- 4								

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#### Goose Lake 2004

File: S:\Water\Water Monitoring\TMDL\TMDL\Lake TMDLs\Draft TMDL to MPCA\Five Lake TMDL\Individual Lakes\Goose\Models\goose04\_12-07.btb

Over	all Wat	er Bal	lance		Averagi	ng Period =	1.00	years
				Area	Flow	Variance	cv	Runoff
<u>Trb</u>	Туре	Seg	Name	<u>km²</u>	<u>hm³/vr</u>	<u>(hm3/yr)<sup>2</sup></u>	-	m/yr
1	1	1	G1	4.4	0.6	3.84E-03	0.10	0.14
2	1	1	inlet 2	0.4	0.1	3.60E-05	0.10	0.14
3	1	1	Inlet 3	0.5	0.1	6.40E-05	0.10	0.16
4	1	1	Rutz	1.1	0.2	0.00E+00	0.00	0.19
5	1	1	Donders	0.9	0.1	0.00E+00	0.00	0.12
6	1	1	Direct	0.9	0.4	0.00E+00	0.00	0.42
7	3	1	Inlet 2 Septic		0.0	0.00E+00	0.00	
8	3	1	Inlet 3 Septic		0.0	0.00E+00	0.00	
9	3	1	Direct Septic		0.0	0.00E+00	0.00	
10	1	1	Swan	1.5	0.2	0.00E+00	0.00	0.11
PREC	IPITATI	ON		1.4	1.1	4.55E-02	0.20	0.79
TRIB	JTARY I	NFLO	W	9.8	1.6	3.94E-03	0.04	0.17
POIN	T-SOUF	RCE IN	FLOW		0.0	0.00E+00	0.00	
***T	OTALIN	IFLOV	V	11.1	2.7	4.94E-02	0.08	0.24
ADVE	ECTIVE (	DUTFL	_OW	11.1	1.8	1.30E-01	0.20	0.16
***TOTAL OUTFLOW				11.1	1.8	1.30E-01	0.20	0.16
***E	VAPOR	ATION	l		0.9	8.04E-02	0.30	

Over	all Mas	s Bal	ance Based Upon	Predicted	licted Outflow & Reservoir Concentrations							
Com	ponent	:		TOTAL P								
				Load	L	.oad Varianc	e		Conc	Export		
<u>Trb</u>	Туре	Seg	Name	<u>kg/yr</u>	<u>%Total</u>	<u>(ka/vr)</u> 2	<u>%Total</u>	<u>cv</u>	<u>ma/m³</u>	<u>kq/km²/vr</u>		
1	1	1	G1	198.6	21.3%	1.97E+03	89.8%	0.22	320.3	44.6		
2	1	1	inlet 2	20.3	2.2%	2.05E+01	0.9%	0.22	337.5	48.2		
3	1	1	Inlet 3	20.4	2.2%	2.08E+01	0.9%	0.22	254.9	40.8		
4	1	1	Rutz	63.1	6.8%	0.00E+00		0.00	300.3	55.8		
5	1	1	Donders	56.8	6.1%	0.00E+00		0.00	516.8	63.9		
6	1	1	Direct	129.2	13.9%	0.00E+00		0.00	349.3	145.2		
7	3	1	Inlet 2 Septic	0.8	0.1%	0.00E+00		0.00	76.0			
8	3	1	Inlet 3 Septic	0.3	0.0%	0.00E+00		0.00	25.0			
9	3	1	Direct Septic	5.5	0.6%	0.00E+00		0.00	554.0			
10	1	1	Swan	64.6	6.9%	0.00E+00		0.00	379.8	42.8		
PREC	IPITATI	ON		27.0	2.9%	1.82E+02	8.3%	0.50	25.3	20.0		
INTE	RNAL LO	DAD		345.2	37.0%	0.00E+00		0.00				
TRIB	UTARY	INFLO	W	552.9	59.4%	2.01E+03	91.7%	0.08	341.3	56.5		
POIN	IT-SOUF	RCE IN	IFLOW	6.5	0.7%	0.00E+00		0.00	218.3			
***T	OTAL IN	IFLOV	V	931.7	100.0%	2.20E+03	100.0%	0.05	343.0	83.6		
ADV	ECTIVE	DUTFI	LOW	228.9	24.6%	7.10E+03		0.37	129.2	20.5		
***T	OTALO	UTFL	OW	228.9	24.6%	7.10E+03		0.37	129.2	20.5		
***RETENTION				702.8	75.4%	8.35E+03		0.13				
Overflow Rate (m/yr)			te (m/yr)	1.3	Nutrient Resid. Time (yrs				s) 0.2808			
Hydraulic Resid. Time (yrs)			sid. Time (yrs)	1.1431	1	urnover Rati	0		3.6			
	Reserv	oir Co	onc (mg/m3)	129	29 Retention Coef. 0.754							

# **B.1.6 2004 Predicted vs. Observed**

### Goose Lake 2004

File: S:\Water\Water Monitoring\TMDL\TMDL\Lake TMDLs\Draft TMDL to MPCA\

Segment:	1 G	oose La	ke			
	Predicted Va	lues>		Observed Va	lues>	
<u>Variable</u>	<u>Mean</u>	<u>cv</u>	<u>Rank</u>	<u>Mean</u>	<u>cv</u>	<u>Rank</u>
TOTAL P MG/M3	129.2	0.34	86.5%	134.0		87.3%
TOTAL N MG/M3	2200.0		89.0%	2200.0		89.0%
C.NUTRIENT MG/M3	103.1	0.22	90.7%	105.4		91.2%
CHL-A MG/M3	59.5	0.35	99.2%	53.0		98.8%
SECCHI M	0.4	0.19	8.7%	0.4		9.6%
ORGANIC N MG/M3	1642.4	0.31	99.3%			
TP-ORTHO-P MG/M3	142.3	0.30	94.9%			
ANTILOG PC-1	3220.8	0.44	97.5%	3028.9		97.3%
ANTILOG PC-2	11.2	0.22	85.5%	9.6		77.9%
(N - 150) / P	15.9	0.34	46.0%	15.3		43.8%
INORGANIC N / P	557.6	0.91	99.8%			
TURBIDITY 1/M	1.7	0.20	88.0%	1.7	0.20	88.0%
ZMIX * TURBIDITY	2.6	0.23	39.6%	2.6	0.23	39.6%
ZMIX / SECCHI	3.9	0.21	36.5%	3.8	0.12	34.0%
CHL-A * SECCHI	22.9	0.29	87.3%	21.2		84.9%
CHL-A / TOTAL P	0.5	0.30	91.0%	0.4		86.5%
FREQ(CHL-a>10) %	99.5	0.01	99.2%	99.1		98.8%
FREQ(CHL-a>20) %	92.6	0.08	99.2%	89.7		98.8%
FREQ(CHL-a>30) %	78.7	0.20	99.2%	72.8		98.8%
FREQ(CHL-a>40) %	63.0	0.33	99.2%	55.7		98.8%
FREQ(CHL-a>50) %	48.8	0.46	99.2%	41.4		98.8%
FREQ(CHL-a>60) %	37.3	0.57	99.2%	30.5		98.8%
CARLSON TSI-P	74.3	0.07	86.5%	74.8		87.3%
CARLSON TSI-CHLA	70.7	0.05	99.2%	69.5		98.8%
CARLSON TSI-SEC	73.8	0.04	91.3%	73.2		90.4%

R )	Hydog I ol	70																	
D.4	a fryues Lar	VC													ents		Mean		
<b>B.2</b>	.1 2002 Input	S											Lisp T-+-	ersion Kate	• • • -		1.000	0.70	
Hvdes	s Lake 2002												Tota Tota	I Phosphor	us		0.500	0.45	
File:	S:\Water\Water Mon	itorina\T\		ake TMDL	s\Draft TMDL	to MPC	A\Five Lake 1	[MDL\Indiv	idual La	kes∖Hvdes\Mo	dels\hvde	s02new.btb	IOTE	a Nitrogen			1.000	0.55	
Descr	iption:												Cni-	a iviodei			1.000	0.26	
Globa	l Variables	Mean	cv		M	del Opti	ons		Code	Description			Seco	ni iviodei	-1		1.000	0.10	
Avera	zing Period (vrs)	1	0.0		 Cc	nservativ	re Substance		0		FD		Urga	anicinivioa No Maria	ei		1.000	0.12	
Precip	itation (m)	0.92	0.2		Ph	osphorus	Balance		ŝ	CANE & BACH	LAKES		IP-C	JP IViodei			1.000	0.15	
Evano	ration (m)	0.7	0.3		Ni	trogen Ba	alance		0		FD		HUL				1.000	0.15	
Storag	re Increase (m)	0.7	0.0		Ch.	loronhvil	-a		1	P N LIGHT T			NO	JV Model	(2/)		1.000	0.22	
000.06	in a case (m)	v	0.0		Sa Sa	cchi Dent	th th		1	VS CHIA & TI			Seco	ni/unia sio	pe (m. /mg)		0.015	0.00	
Atmos	s Loads (ko/km <sup>2</sup> -vr)	Mean	CV		JC Di	enersion			1	EISCHER-NUM			IVIIn	imum Qs (n - Eliselatera a	n/yr) 		0.100	0.00	
Conse	ny Substance		0.00		Dh	osnhorus	Calibration		1	DECAV RATES	i cinic		chi-	a Hushing I - T	erm		1.000	0.00	
Total	D	20	0.00		PT Ni	trogen Ca	libration		1	DECAY RATES			Chl-i	a iemporal I Fastar 7	UV Setel D		0.620	0	
Total	N	1000	0.50		En	or Analy	ส่ง		⊥ 1	MODEL & DAT	ТА		AVa	I. Factor - I			0.330	Ű	
Ortho	D	1000	0.50		ΕΠ Λ1	or Andry ailability	ala Factore		- 0	IGNORE	17		Avai	I. ⊢actor - C	urtno P		1.930	0	
Inorga	r pic N	500	0.50		A0 N4	anabinty Dec Polon	og Toblag		1	LISE ESTIMAT			Ava	I. Factor - I			0.590	0	
noiga	and in	300	0.50			itaut Daa	tinction		2				Avai	I. Factor - Ir	norganic N		0.790	U	
					0.	itput Des	unauon		2	LACEL WORK.									
Seam	ent Morphometry												Ir	ternal I oa	ids (maim2-i	dav)			
ovgin	enemorphenious		Outflow		Area	Depth	Length M	ixed Depth	(m)	Hypol Depth	Ν	lon-Algal Tu	 rb (m <sup>-1</sup> ) (	Conserv	Tot	al P	Т	otal N	
Sea	Name		Seament	Group	km <sup>2</sup>	m	km	Mean	CV	/ Mean	CV	Mean	CV	Mean	CV CV	Mean	CV .	Mean	C)
1	Hydes Lake		<u>ooginionii</u>	1	0.87	2 53	1	2.5	0.12		<u>o</u>	1.22	0.2	<u>nivan</u>	<u>.</u>	0.01	<u>.</u>	<u>nivan</u>	<u>.</u>
-				-			-							÷	-				
Segm	ent Observed Water Q	uality																	
-	Conserv	-	Total P (ppb	) ·	Total N (ppb)		Chl-a (ppb)	S	ecchi (m	i) Oi	rganic N (p	opb) TF	- Ortho P	(ppb) H	IOD (ppb/day	/) N	AOD (ppb/d	ay)	
Seg	Mean	CV	Mean	CV	Mean	CV	Mean	CV	Mean	CV	Mean	CV	Mean	CV	Mean	CV	Mean	CV	
1	0	0	129	0	2425	0	42	0	0.54	+ 0	0	0	0	0	0	0	0	0	
Segm	ent Calibration Factor	s																	
	Dispersion Rate		Total P (ppb	) ·	Total N (ppb)		Chl-a (ppb)	S	ecchi (m	i) Oi	rganic N (p	opb) TF	- Ortho P	(ppb) H	IOD (ppb/day	/) N	10D (ppb/d	ay)	
Seg	Mean	<u>cv</u>	<u>Mean</u>	<u>cv</u>	<u>Mean</u>	<u>cv</u>	<u>Mean</u>	<u>cv</u>	<u>Mean</u>	<u> </u>	<u>Mean</u>	<u>cv</u>	<u>Mean</u>	<u>cv</u>	<u>Mean</u>	<u>cv</u>	<u>Mean</u>	<u>cv</u>	
1	1	0	1	0	1	0	1	0	1	. 0	1	0	1	0	1	0	1	0	
Tribut	ary Data									Tatal D (mult)	-		~	uthe a D form	h)		(		
T	Tuik Naw -		O	True -	Ur Area Fli km²	M	yi) Ui AV	Me	~	10tal P (ppb)	~ ~ ~	otal N (ppb)	~ 0	тито н (pp	u) ino	Marie N	(add)		
			Segment	Type	<u>NII</u>	<u>iviean</u>		<u>ivie an</u>	<u></u>	<u>iviean</u>		Mean		<u>iviean</u>		wean			
1	HZ (INIET 1)		1	1	2.1	0.35	0.1	U	U	273.3	0.2	U	U	0	U	U	U		
2	Direct		1	1	2.2	0.26	0.1	U	0	415.5	0.2	U	U	U	U	U	U		
3	Septic H2		1	3	2.06	0.1	U	U	0	/5.1	U	U	U	0	U	U	U		
4	Direct Septic		1	3	2.21	0.1	0	0	0	275	0	0	0	0	0	0	0		
5	Patterson		1	1	9.5	1.45	0	0	0	263.3	0	U	0	0	U	0	0		

### **B.2.2 2002 Mass Balance**

#### Hydes Lake 2002

File: S:\Water\Water Monitoring\TMDL\TMDL\Lake TMDLs\Draft TMDL to MPCA\Five Lake TMDL\Individual Lakes\Hydes\Models\hydes02new.btb

Averaging Period = 1.00 years

#### **Overall Water & Nutrient Balances**

Overall	Water	Balance
---------	-------	---------

				Area	Flow	Variance	cv	Runoff
<u>Trb</u>	<u>Type</u>	<u>Seg</u>	<u>Name</u>	<u>km</u> *	<u>hm°/yr</u>	<u>(hm3/yr)²</u>	-	<u>m/yr</u>
1	1	1	H2 (inlet 1)	2.1	0.3	1.23E-03	0.10	0.17
2	1	1	Direct	2.2	0.3	6.76E-04	0.10	0.12
3	3	1	Septic H2	2.1	0.1	0.00E+00	0.00	0.05
4	3	1	Direct Septic	2.2	0.1	0.00E+00	0.00	0.05
5	1	1	Patterson	9.5	1.5	0.00E+00	0.00	0.15
PREC	IPITATIO	DΝ		0.9	0.8	2.56E-02	0.20	0.92
TRIBU	JTARY I	NFLO\	N	13.8	2.1	1.90E-03	0.02	0.15
POIN	T-SOUR	CE INF	LOW	4.3	0.2	0.00E+00	0.00	0.05
***T	OTAL IN	IFLOW	1	18.9	3.1	2.75E-02	0.05	0.16
ADVE	CTIVE C	DUTFL	ow	18.9	2.5	6.09E-02	0.10	0.13
***T	OTAL O	UTFLC	W	18.9	2.5	6.09E-02	0.10	0.13
***E	VAPORA	ATION			0.6	3.34E-02	0.30	

Over Com	all Mas ponent	s Bala :	ance Based Upon	Predicted TOTAL P		Outflow & R	eservoir Cor	ncentra	tions	
				Load	L	.oad Varianc	e		Conc	Export
<u>Trb</u>	<u>Type</u>	<u>Seg</u>	<u>Name</u>	<u>kg/yr</u>	<u>% Total</u>	<u>(kg/yr)<sup>2</sup></u>	<u>% Total</u>	<u>cv</u>	<u>mg/m<sup>3</sup></u>	kg/km²/yr
1	1	1	H2 (inlet 1)	95.7	14.9%	4.57E+02	41.0%	0.22	273.3	45.5
2	1	1	Direct	108.0	16.9%	5.84E+02	52.3%	0.22	415.5	49.1
3	3	1	Septic H2	7.5	1.2%	0.00E+00		0.00	75.1	3.6
4	3	1	Direct Septic	27.5	4.3%	0.00E+00		0.00	275.0	12.4
5	1	1	Patterson	381.8	59.6%	0.00E+00		0.00	263.3	40.2
PREC	IPITATI	ON		17.4	2.7%	7.57E+01	6.8%	0.50	21.7	20.0
INTE	RNAL LO	DAD		3.2	0.5%	0.00E+00		0.00		
TRIB	UTARY I	NFLO	W	585.5	91.3%	1.04E+03	93.2%	0.06	284.2	42.4
POIN	IT-SOUR	CE IN	FLOW	35.0	5.5%	0.00E+00		0.00	175.0	8.2
***T	OTAL IN	IFLOW	V	641.1	100.0%	1.12E+03	100.0%	0.05	209.5	33.8
ADV	ECTIVE (	DUTFL	.ow	324.1	50.6%	5.51E+03		0.23	132.2	17.1
***T	OTAL O	UTFLC	W	324.1	50.6%	5.51E+03		0.23	132.2	17.1
***R	ETENTI	ON		317.0	49.4%	5.67E+03		0.24		
	Overflo	w Rat	e (m/yr)	2.8	٩	Jutrient Resic	l. Time (yrs)		0.4539	
Hydraulic Resid. Time (yrs)			sid. Time (yrs)	0.8979	9 Turnover Ratio			2.2		
Reservoir Conc (mg/m3)			nc (mg/m3)	132	2 Retention Coef.					

# **B.2.3 2002 Predicted vs. Observed**

### Hydes Lake 2002

File: S:\Water\Water Monitoring\TMDL\TMDL\Lake TMDLs\Draft TMDI

Segment:	1 H	ydes Lal	(e			
	Predicted Va	lues>		Observed Va	lues>	
<u>Variable</u>	<u>Mean</u>	<u>cv</u>	<u>Rank</u>	<u>Mean</u>	<u>cv</u>	<u>Rank</u>
TOTAL P MG/M3	132.2	0.23	87.0%	129.0		86.5%
TOTAL N MG/M3	2425.0		91.6%	2425.0		91.6%
C.NUTRIENT MG/M3	108.4	0.15	91.8%	106.7		91.4%
CHL-A MG/M3	50.0	0.31	98.5%	42.0		97.4%
SECCHI M	0.5	0.18	16.0%	0.5		18.1%
ORGANIC N MG/M3	1389.5	0.28	98.3%			
TP-ORTHO-P MG/M3	113.9	0.28	92.0%			
ANTILOG PC-1	2487.7	0.36	96.2%	1836.3		93.8%
ANTILOG PC-2	11.6	0.21	86.8%	10.4		82.0%
(N - 150) / P	17.2	0.23	50.7%	17.6		52.1%
INORGANIC N / P	56.5	2.07	74.1%			
TURBIDITY 1/M	1.2	0.20	78.5%	1.2	0.20	78.5%
ZMIX * TURBIDITY	3.1	0.23	48.3%	3.1	0.23	48.3%
ZMIX / SECCHI	4.9	0.20	52.2%	4.6	0.12	48.0%
CHL-A * SECCHI	25.4	0.26	90.1%	22.7		87.0%
CHL-A / TOTAL P	0.4	0.30	85.0%	0.3		78.8%
FREQ(CHL-a>10) %	98.9	0.01	98.5%	97.7		97.4%
FREQ(CHL-a>20) %	87.9	0.11	98.5%	81.2		97.4%
FREQ(CHL-a>30) %	69.7	0.24	98.5%	59.2		97.4%
FREQ(CHL-a>40) %	52.0	0.37	98.5%	40.8		97.4%
FREQ(CHL-a>50) %	37.9	0.49	98.5%	27.7		97.4%
FREQ(CHL-a>60) %	27.3	0.60	98.5%	18.8		97.4%
CARLSON TSI-P	74.6	0.04	87.0%	74.2		86.5%
CARLSON TSI-CHLA	69.0	0.04	98.5%	67.3		97.4%
CARLSON TSI-SEC	69.8	0.04	84.0%	68.9		81.9%

# **B.2.4 2004 Inputs**

												<u>Moc</u>	lel Coeffi	<u>cients</u>		<u>Mean</u>	<u> </u>	: <u>V</u>
												Disp	ersion Ra	te		1.000	0.7	70
												Tota	l Phospho	orus		0.500	0.4	15
Hydes Lake high												Tota	l Nitrogei	n		1.000	0.5	55
File: S:\Water\Water Mon	itoring\TM	DL\TMDL\La	ake TMDLs	NDraft TMDL	to MPCA	\Five Lake 1	[MDL\Indivi	idual Lak	kes\Hydes\Moo	dels\Hydes0	4TBB.btb	Chl-	a Model			1.000	0.2	26
Description:												Seco	hi Model			1.000	0.1	10
<u>Global Variables</u>	<u>Mean</u>	<u>cv</u>		<u>Mo</u>	del Optic	ons		<u>Code</u>	<u>Description</u>			Orga	anic N Mo	del		1.000	0.1	2
Averaging Period (yrs)	1	0.0		Cor	nservative	e Substance		0	NOT COMPUT	ED		TP-C	)P Model			1.000	0.1	15
Precipitation (m)	0.79	0.2		Pho	osphorus	Balance		8	CANF & BACH,	LAKES		HOD	v Model			1.000	0.1	15
Evaporation (m)	0.7	0.3		Niti	rogen Bal	ance		0	NOT COMPUT	ED		MO	Dv Model			1.000	0.2	22
Storage Increase (m)	0	0.0		Chl	orophyll-	а		1	P, N, LIGHT, T			Seco	:hi/Chla Sl	lope ( $m^2/mg$ )		0.015	0.0	00
2				Sec	chi Depth	٦		1	VS. CHLA & TU	RBIDITY		Min	imum Qs	(m/yr)		0.100	0.0	00
<u>Atmos. Loads (kg/km²-yr)</u>	<u>Mean</u>	<u>cv</u>		Dis	persion			1	FISCHER-NUM	eric		Chl-	a Flushing	Term		1.000	0.0	00
Conserv. Substance	0	0.00		Pho	osphorus	Calibration		1	DECAY RATES			Chl-	a Tempor	, al C <b>V</b>		0.620	l	0
Total P	20	0.50		Niti	rogen Cal	ibration		1	DECAY RATES			Ava	I. Factor -	Total P		0.330	l	0
Total N	1000	0.50		Err	or Analysi	is		1	MODEL & DAT	A		Ava	l. Factor -	Ortho P		1.930	I	0
Ortho P	15	0.50		Ava	ailabilit <b>y</b> F	actors		0	IGNORE			Avai	l. Factor -	Total N		0.590	I	0
Inorganic N	500	0.50		Ma	iss-Balanc	e Tables		1	USE ESTIMATE	D CONCS		Avai	L Factor -	Inorganic N		0.790	I	0
				Ou	tput Dest	ination		2	EXCEL WORKS	HEEI								
												ا سا		ala ( mandua ) a				
Segment worphometry				0	Danth	l a martin M	ived Denth	(ma )	Lium al Danith	Non	Algal Tu	rh (m <sup>-1</sup> ) o	ernai Loa	us (mg/mz-o T-t/	iay)	Tat	J NI	
Sea Name		eament	Group	km <sup>2</sup>	Depui	Lengur M km	Mean	(III) CV	Мезр	CV/	Mean	CY	Mean	CV 100	Mean	C)(	Mean	C)/
1 Hydes Jake	¥	<u>ognieni</u> 0	1	0.87	2 53	1	2.5	0.12	<u></u>	0	0.26	0.2	<u>nic an</u>	<u></u>	0.01	0	0	<u>0</u>
1 Hydes Lake		Ŭ	-	0.07	2.55	Ŧ	2.5	0.12	Ŭ	Ŭ	0.20	0.2	Ŭ	Ŭ	0.01	Ŭ	Ŭ	Ŭ
Segment Observed Water Q	uality																	
Conserv																		
Con Moon	т	otal P (ppb)	) Т	otal N (ppb)	c	Chl-a (ppb)	Se	ecchi (m)	) Or	ganic N (ppt	5) TP	- Ortho P (	ppb) H	IOD (ppb/day)	)	MOD (ppb/day	)	
Seg iviean	т сv	otal P (ppb) Mean	т ( cv	otal N (ppb) Mean	cv	Chl-a (ppb) Mean	Se CV	ecchi (m) Mean	) Ori CV	ganic N (ppt Mean	o) TP 	- Ortho P ( Mean	ppb) H CV	IOD (ppb/day) Mean	cv	MOD (ppb/day Mean	) CV	
<u>seg</u> <u>Mean</u> 1 0	т <u>сv</u> 0	otal P (ppb) <u>Mean</u> 146	т ( <u>сv</u>	otal N (ppb) <u>Mean</u> 2189	م <u>در</u> 0	Chl-a (ppb) <u>Mean</u> 57.78	<b>Se</b> <u>CV</u> 0	ecchi (m) <u>Mean</u> 0.89	) Or; <u>CV</u> 0	ganic N (ppk <u>Mean</u> 0	<b>) TP</b> <u>CV</u> 0	- Ortho P ( <u>Mean</u> 0	( <b>ppb) ⊢</b> <u>CV</u> 0	IOD (ppb/day) <u>Mean</u> 0	<u>cv</u>	MOD (ppb/day <u>Mean</u> 0	) <u>cv</u> 0	
<u>seg Mean</u> 1 0	т <u>сv</u> 0	<b>otal P (ppb)</b> <u>Mean</u> 146	) т <u>сv</u> 0	<b>otal N (ppb)</b> <u>Mean</u> 2189	م 2 <u>در</u> 0	Chl-a (ppb) <u>Mean</u> 57.78	<b>Se</b> <u>CV</u> 0	ecchi (m) <u>Mean</u> 0.89	) Or <u>i</u> <u>CV</u> 0	ganic N (ppt <u>Mean</u> 0	<b>o) TP</b> <u>CV</u> 0	- Ortho P ( <u>Mean</u> 0	<b>ррb) Н</b> <u>CV</u> 0	IOD (ppb/day) <u>Mean</u> 0	<u>cv</u> 0	MOD (ppb/day <u>Mean</u> 0	) <u>cv</u> 0	
1 0 Segment Calibration Factor	т <u>СV</u> о	<b>otal P (ppb)</b> <u>Mean</u> 146	0 T <u>CV</u> 0	<b>otal N (ppb)</b> <u>Mean</u> 2189	م 2 <u>در</u> 0	<b>Chi-a (ppb)</b> <u>Mean</u> 57.78	Se <u>CV</u> 0	ecchi (m) <u>Mean</u> 0.89	) Or, <u>CV</u> 0	ganic N (ppt <u>Mean</u> 0	o) TP <u>CV</u> 0	r - Ortho P ( <u>Mean</u> 0	( <b>ppb) ⊢</b> <u>CV</u> 0	IOD (ppb/day) <u>Mean</u> 0	<u>cv</u> 0	MOD (ppb/day <u>Mean</u> 0	) <u>CV</u> 0	
1 0 Segment Calibration Factor Dispersion Rate	т <u>СV</u> о s	otal P (ppb) <u>Mean</u> 146 otal P (ppb)	ד ו <u>כע</u> ס	otal N (ppb) <u>Mean</u> 2189 otal N (ppb)	م <u>در</u> 0	Chi-a (ppb) <u>Mean</u> 57.78 Chi-a (ppb)	Se <u>CV</u> 0 Se	ecchi (m) <u>Mean</u> 0.89 ecchi (m)	) Or <u>i</u> <u>CV</u> 0	ganic N (ppt <u>Mean</u> 0 ganic N (ppt	o) TP <u>CV</u> 0	• - Ortho P ( <u>Mean</u> 0 • - Ortho P (	ррb) Н <u>CV</u> 0 ррb) Н	IOD (ppb/day) <u>Mean</u> 0 IOD (ppb/day)	<u>cv</u> 0	MOD (ppb/day <u>Mean</u> 0 40D (ppb/day	) <u>cv</u> 0	
Seg         Mean           1         0           Segment Calibration Factor         Dispersion Rate           Seg         Mean	т <u>сv</u> ° s <u>сv</u>	otal P (ppb) <u>Mean</u> 146 otal P (ppb) <u>Mean</u>	T ( <u>CV</u> 0 <u>CV</u>	otal N (ppb) <u>Mean</u> 2189 Otal N (ppb) <u>Mean</u>	<u>ev</u>	Chl-a (ppb) <u>Mean</u> 57.78 Chl-a (ppb) <u>Mean</u>	Se <u>CV</u> 0 Se <u>CV</u>	ecchi (m) <u>Mean</u> 0.89 ecchi (m) <u>Mean</u>	) Or; <u>CV</u> 0	ganic N (ppb <u>Mean</u> 0 ganic N (ppb <u>Mean</u>	) TP <u>CV</u> 0 ) TP <u>CV</u>	- Ortho P ( <u>Mean</u> 0 - Ortho P ( <u>Mean</u>	(ppb) + <u>CV</u> 0 (ppb) + <u>CV</u>	IOD (ppb/day) <u>Mean</u> 0 IOD (ppb/day) <u>Mean</u>	<u>cv</u> 0 <u>cv</u>	MOD (ppb/day <u>Mean</u> 0 MOD (ppb/day <u>Mean</u>	) 	
Seg     Internation       1     0       Segment Calibration Factor       Dispersion Rate       Seg     Mean       1     1	T <u>CV</u> 0 s T <u>CV</u> 0	otal P (ppb) <u>Mean</u> 146 otal P (ppb) <u>Mean</u> 1		rotal N (ppb) <u>Mean</u> 2189 rotal N (ppb) <u>Mean</u> 1		Chi-a (ppb) <u>Mean</u> 57.78 Chi-a (ppb) <u>Mean</u> 1	Se <u>CV</u> 0 Se <u>CV</u> 0	ecchi (m) <u>Mean</u> 0.89 ecchi (m) <u>Mean</u> 1	) Or; <u>CV</u> 0 ) Or; 0	ganic N (ppb <u>Mean</u> 0 ganic N (ppb <u>Mean</u> 1	) TP <u>CV</u> 0 ) TP <u>CV</u> 0	- Ortho P ( <u>Mean</u> 0 - Ortho P ( <u>Mean</u> 1	ppb) + <u>CV</u> 0 ppb) + <u>CV</u> 0	IOD (ppb/day) <u>Mean</u> 0 IOD (ppb/day) <u>Mean</u> 1	<u>cv</u> 0 <u>cv</u> 0	MOD (ppb/day <u>Mean</u> 0 MOD (ppb/day <u>Mean</u> 1	) <u> cv</u> 0 <u> cv</u> 0	
Seg     Internation       1     0       Segment Calibration Factor       Dispersion Rate       Seg     Mean       1     1	T <u>CV</u> 0 s <u>CV</u> 0	otal P (ppb) <u>Mean</u> 146 otal P (ppb) <u>Mean</u> 1		iotal N (ppb) <u>Mean</u> 2189 iotal N (ppb) <u>Mean</u> 1		Chi-a (ppb) <u>Mean</u> 57.78 Chi-a (ppb) <u>Mean</u> 1	Se <u>CV</u> 0 Se <u>CV</u> 0	ecchi (m) <u>Mean</u> 0.89 ecchi (m) <u>Mean</u> 1	) Or; <u>CV</u> 0 ) Or; 0	ganic N (ppt <u>Mean</u> 0 ganic N (ppt <u>Mean</u> 1	) TP <u>CV</u> 0 ) TP <u>CV</u> 0	- Ortho P ( <u>Mean</u> 0 - Ortho P ( <u>Mean</u> 1	(ppb) + <u>CV</u> 0 ppb) + <u>CV</u> 0	IOD (ppb/day) <u>Mean</u> 0 IOD (ppb/day) <u>Mean</u> 1	<u>cv</u> 0 <u>cv</u> 0	MOD (ppb/day <u>Mean</u> 0 MOD (ppb/day <u>Mean</u> 1	) <u>cv</u> ) <u>cv</u>	
Seg     Internation       1     0       Segment Calibration Factor       Dispersion Rate       Seg     Mean       1     1       Tributary Data	T <u>CV</u> 0 s T <u>CV</u> 0	otal P (ppb) <u>Mean</u> 146 Total P (ppb) <u>Mean</u> 1		otal N (ppb) <u>Mean</u> 2189 otal N (ppb) <u>Mean</u> 1		Chi-a (ppb) <u>Mean</u> 57.78 Chi-a (ppb) <u>Mean</u> 1	Se <u>CV</u> 0 Se <u>CV</u> 0	ecchi (m) <u>Mean</u> 0.89 ecchi (m) <u>Mean</u> 1	) Or; <u>CV</u> 0 ) Or; 0	ganic N (ppt <u>Mean</u> 0 ganic N (ppt <u>Mean</u> 1	) TP <u>CV</u> 0 ) TP <u>CV</u> 0	- Ortho P ( <u>Mean</u> 0 - Ortho P ( <u>Mean</u> 1	(ppb) F <u>CV</u> 0 (ppb) F <u>CV</u> 0	IOD (ppb/day) <u>Mean</u> 0 IOD (ppb/day) <u>Mean</u> 1	<u>cv</u> 0 <u>cv</u> 0	MOD (ppb/day <u>Mean</u> 0 MOD (ppb/day <u>Mean</u> 1	) <u>cv</u> 0 <u>cv</u> 0	
Seg     Internation       1     0       Segment Calibration Factor       Dispersion Rate       Seg     Mean       1     1       Tributary Data	т <u>сv</u> s т <u>сv</u> 0	otal P (ppb) <u>Mean</u> 146 otal P (ppb) <u>Mean</u> 1		otal N (ppb) <u>Mean</u> 2189 Otal N (ppb) <u>Mean</u> 1 Pr Area <sub>2</sub> Flo	( <u>cv</u> <u>cv</u> <u>cv</u> w (hm³/y	Chi-a (ppb) <u>Mean</u> 57.78 Chi-a (ppb) <u>Mean</u> 1 r) Co	Se <u>CV</u> 0 Se <u>CV</u> 0	ecchi (m) <u>Mean</u> 0.89 ecchi (m) <u>Mean</u> 1	) Or; <u>CV</u> ) Or; <u>CV</u> 0	ganic N (ppt <u>Mean</u> 0 ganic N (ppt <u>Mean</u> 1 Tota	<ul> <li>p) TP</li> <li><u>CV</u></li> <li>0</li> <li>TP</li> <li><u>CV</u></li> <li>0</li> </ul>	- Ortho P <u>Mean</u> 0 - Ortho P <u>Mean</u> 1	ppb) F <u>CV</u> ppb) F <u>CV</u> 0	HOD (ppb/day) <u>Mean</u> O HOD (ppb/day) <u>Mean</u> 1	CV 0 <u>CV</u> 0	MOD (ppb/day <u>Mean</u> 0 MOD (ppb/day <u>Mean</u> 1	) <u>cv</u> ) <u>cv</u>	
Seg     Internation       1     0       Segment Calibration Factor       Dispersion Rate       Seg     Mean       1     1       Tributary Data       Trib     Trib Name	T <u>CV</u> S T <u>CV</u> 0	otal P (ppb) <u>Mean</u> 146 otal P (ppb) <u>Mean</u> 1		iotal N (ppb) <u>Mean</u> 2189 iotal N (ppb) <u>Mean</u> 1 Pr Area Flo <u>km<sup>2</sup></u>	CCV CV CV 0 ww (hm³/y <u>Mean</u>	Chi-a (ppb) <u>Mean</u> 57.78 Chi-a (ppb) <u>Mean</u> 1 r) Co	Se <u>CV</u> 0 Se <u>CV</u> 0 onserv. <u>Mean</u>	ecchi (m) <u>Mean</u> 0.89 ecchi (m) <u>Mean</u> 1	) Or; <u>CV</u> 0 ) Or; <u>CV</u> 0 Total P (ppb) <u>Mean</u>	ganic N (ppt <u>Mean</u> 0 ganic N (ppt <u>Mean</u> 1 Tota <u>CV</u>	5) TP <u>CV</u> 0 TP <u>CV</u> 0 al N (ppb) <u>Mean</u>	- Ortho P ( <u>Mean</u> 0 - Ortho P ( <u>Mean</u> 1 0 CV	ppb) F <u>CV</u> 0 ppb) F <u>CV</u> 0 tho P (ppl <u>Mean</u>	HOD (ppb/day) <u>Mean</u> O HOD (ppb/day) <u>Mean</u> 1 b) Inor <u>CV</u>	<u>CV</u> 0 <u>CV</u> 0 rganic N <u>Mean</u>	MOD (ppb/day <u>Mean</u> 0 MOD (ppb/day <u>Mean</u> 1 ! (ppb) <u>CV</u>	) <u> cv</u> 0 <u> cv</u> 0	
Seg     Internation       1     0       Segment Calibration Factor       Dispersion Rate       Seg     Mean       1     1       Tributary Data       Trib     Trib Name       1     H2	T <u>CV</u> S T <u>CV</u> 0	otal P (ppb) <u>Mean</u> 146 otal P (ppb) <u>Mean</u> 1 : : : : : :		iotal N (ppb) <u>Mean</u> 2189 iotal N (ppb) <u>Mean</u> 1 r Area Flo <u>km<sup>2</sup></u> 2.1	CV 0 CV 0 ww (hm³/y <u>Mean</u> 0.3	Chi-a (ppb) <u>Mean</u> 57.78 Chi-a (ppb) <u>Mean</u> 1 rr) Co <u>CV</u> 0.1	Se <u>CV</u> 0 Se <u>CV</u> 0 onserv. <u>Mean</u> 0	ecchi (m) <u>Mean</u> 0.89 ecchi (m) <u>Mean</u> 1 <u>CV</u> 0	) Or; <u>CV</u> 0 ) Or; <u>CV</u> 0 Total P (ppb) <u>Mean</u> 321.5	ganic N (ppt <u>Mean</u> 0 ganic N (ppt <u>Mean</u> 1 Tota <u>CV</u> 0.2	<ul> <li>p) TP</li> <li><u>CV</u></li> <li>0</li> <li>TP</li> <li><u>CV</u></li> <li>0</li> <li>al N (ppb)</li> <li><u>Mean</u></li> <li>0</li> </ul>	- Ortho P ( <u>Mean</u> 0 - Ortho P ( <u>Mean</u> 1 0 Or <u>CV</u> 0	ppb) F <u>CV</u> 0 ppb) F <u>CV</u> 0 tho P (ppl <u>Mean</u> 0	HOD (ppb/day) <u>Mean</u> O HOD (ppb/day) <u>Mean</u> 1 b) Inot <u>CV</u> 0	CV 0 CV 0 rganic N <u>Mean</u> 0	MOD (ppb/day <u>Mean</u> 0 MOD (ppb/day <u>Mean</u> 1 I (ppb) <u>CV</u> 0	) 0 0 0 0	
Seg     Internet       1     0       Segment Calibration Factor       Dispersion Rate       Seg     Mean       1     1       Tributary Data       Trib     Trib Name       1     H2       2     Direct       2     Direct	T <u>CV</u> S T <u>CV</u> 0	otal P (ppb) <u>Mean</u> 146 otal P (ppb) <u>Mean</u> 1 : egment 1 1		rotal N (ppb) <u>Mean</u> 2189 rotal N (ppb) <u>Mean</u> 1 r Area Flo <u>km<sup>2</sup></u> 2.1 2.2 2.2	CV 0 CV 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Chi-a (ppb) <u>Mean</u> 57.78 Chi-a (ppb) <u>Mean</u> 1 rr) Ca <u>CV</u> 0.1 0.1	Se <u>CV</u> 0 Se <u>CV</u> 0 onserv. <u>Mean</u> 0 0	ecchi (m) <u>Mean</u> 0.89 ecchi (m) <u>Mean</u> 1 <u>CV</u> 0 0	) Or; <u>CV</u> 0 ) Or; <u>CV</u> 0 Total P (ppb) <u>Mean</u> 321.5 488.6	ganic N (ppt <u>Mean</u> 0 ganic N (ppt <u>Mean</u> 1 Tota <u>CV</u> 0.2 0.2	<ul> <li>p) TP</li> <li>CV</li> <li>0</li> <li>TP</li> <li>CV</li> <li>0</li> </ul>	- Ortho P ( <u>Mean</u> 0 - Ortho P ( <u>Mean</u> 1 0 Or <u>CV</u> 0	ppb) F <u>CV</u> 0 ppb) F <u>CV</u> 0 tho P (ppl <u>Mean</u> 0 0	HOD (ppb/day) <u>Mean</u> O HOD (ppb/day) <u>Mean</u> 1 b) Inou <u>CV</u> 0 0	CV 0 CV 0 rganic N <u>Mean</u> 0 0	MOD (ppb/day <u>Mean</u> 0 MOD (ppb/day <u>Mean</u> 1 I (ppb) <u>CV</u> 0 0	) 0 0 0 0	
Seg     Internet       1     0       Segment Calibration Factor       Dispersion Rate       Seg     Mean       1     1       Tributary Data       Trib     Trib Name       1     H2       2     Direct       3     Septic H2       3     Septic H2	T <u>CV</u> 0 3 5 7 7 0 8 8	otal P (ppb) <u>Mean</u> 146 otal P (ppb) <u>Mean</u> 1 : segment 1 1 1		total N (ppb) <u>Mean</u> 2189 total N (ppb) <u>Mean</u> 1 1 Pr Area Flo <u>km<sup>2</sup></u> 2.1 2.2 2.06	CV 0 CV 0 ww (hm <sup>3</sup> /y <u>Mean</u> 0.3 0.22 0.01	Chi-a (ppb) <u>Mean</u> 57.78 Chi-a (ppb) <u>Mean</u> 1 r) Cri <u>CV</u> 0.1 0.1 0 0	Se <u>CV</u> 0 Se <u>CV</u> 0 0 0 0 0 0 0 0	ecchi (m) <u>Mean</u> 0.89 ecchi (m) <u>Mean</u> 1 <u>CV</u> 0 0 0 0	) Or; <u>CV</u> 0 ( <u>CV</u> 0 Total P (ppb) <u>Mean</u> 321.5 488.6 75	ganic N (ppt <u>Mean</u> 0 ganic N (ppt <u>Mean</u> 1 Tota <u>CV</u> 0.2 0.2 0	<ul> <li>p) TP</li> <li>CV</li> <li>0</li> <li>TP</li> <li>CV</li> <li>0</li> <li>0</li></ul>	- Ortho P ( <u>Mean</u> 0 - Ortho P ( <u>Mean</u> 1 0 0 0 0 0	ppb) F <u>CV</u> 0 ppb) F <u>CV</u> 0 tho P (ppi <u>Mean</u> 0 0	HOD (ppb/day) Mean 0 HOD (ppb/day) Mean 1 5) Inor CV 0 0 0	CV 0 CV 0 rganic N <u>Mean</u> 0 0	MOD (ppb/day <u>Mean</u> 0 MOD (ppb/day <u>Mean</u> 1 I (ppb) 0 0 0	) <u> <u> </u> </u>	
Seg     Mean       1     0       Segment Calibration Factor       Dispersion Rate       Seg     Mean       1     1       Tributary Data       Trib     Trib Name       1     H2       2     Direct       3     Septic H2       4     Direct Septic	T <u>CV</u> 0 3 5 <u>CV</u> 0 8	otal P (ppb) <u>Mean</u> 146 otal P (ppb) <u>Mean</u> 1 1 segment 1 1 1	<b>CV</b> 0 <b>TVDe</b> 1 3 3	total N (ppb) <u>Mean</u> 2189 total N (ppb) <u>Mean</u> 1 tor Area Flo <u>km<sup>2</sup></u> 2.1 2.2 2.06 2.21	CV 0 CV 0 ww (hm³/y Mean 0.3 0.22 0.01 0.01	Chi-a (ppb) <u>Mean</u> 57.78 Chi-a (ppb) <u>Mean</u> 1 rr) Cu 0.1 0.1 0 0 0	Se <u>CV</u> 0 <u>CV</u> 0 0 0 0 0 0 0 0 0 0 0 0 0 0	ecchi (m) <u>Mean</u> 0.89 ecchi (m) <u>Mean</u> 1 0 0 0 0 0	) Or, <u>CV</u> 0 ) Or, <u>CV</u> 0 <b>Total P (ppb)</b> <u>Mean</u> 321.5 488.6 75 275	ganic N (ppt <u>Mean</u> 0 ganic N (ppt <u>Mean</u> 1 Tota <u>CV</u> 0.2 0.2 0 0 0	b) TP CV 0 CV 0 b) TP CV 0 Mean 0 0	- Ortho P ( <u>Mean</u> 0 - Ortho P ( <u>Mean</u> 1 0 0 0 0 0 0 0	ppb) F <u>CV</u> 0 (ppb) F <u>CV</u> 0 (mean 0 0 0 0	HOD (ppb/day) Mean 0 HOD (ppb/day) <u>Mean</u> 1 b) Inol CV 0 0 0 0 0	CV 0 CV 0 rganic N <u>Mean</u> 0 0 0 0	MOD (ppb/day <u>Mean</u> 0 MOD (ppb/day <u>Mean</u> 1 1 (ppb) 0 0 0 0 0		

### **B.2.5 2004 Mass Balance**

#### Hydes Lake high

File: S:\Water\Water Monitoring\TMDL\TMDL\Lake TMDLs\Draft TMDL to MPCA\Five Lake TMDL\Individual Lakes\Hydes\Models\Hydes04TBB.btb

Averaging Period = 1.00 years

#### **Overall Water & Nutrient Balances**

#### Overall Water Balance

Trh	Tuna	S	Nome	Area km <sup>2</sup>	Flow	Variance (bm3/wr) <sup>2</sup>	cv	Runoff
<u> 110</u>	Type	Sey	Name	<u>KIII</u>	<u>       / y </u>	(IIIII)/yr)	-	<u>III/yi</u>
1	1	1	H2	2.1	0.3	9.00E-04	0.10	0.14
2	1	1	Direct	2.2	0.2	4.84E-04	0.10	0.10
3	3	1	Septic H2	2.1	0.0	0.00E+00	0.00	0.00
4	3	1	Direct Septic	2.2	0.0	0.00E+00	0.00	0.00
5	1	1	Patterson	9.5	1.2	0.00E+00	0.00	0.13
PREC	ΙΡΙΤΑΤΙΟ	DN		0.9	0.7	1.89E-02	0.20	0.79
TRIBU	JTARY I	NFLO\	N	13.8	1.8	1.38E-03	0.02	0.13
POIN	T-SOUR	CE INI	LOW	4.3	0.0	0.00E+00	0.00	0.00
***T(	OTAL IN	FLOW	1	18.9	2.5	2.03E-02	0.06	0.13
ADVE	CTIVE C	DUTFL	OW	18.9	1.8	5.37E-02	0.13	0.10
***T(	OTAL O	UTFLC	W	18.9	1.8	5.37E-02	0.13	0.10
***E'	VAPORA	TION			0.6	3.34E-02	0.30	

Overall Mass Balance Based Upon Predicted Outflow & Reservoir								ncentra	tions			
Com	ponent	:		TOTAL P								
				Load	L	oad Varianc	e		Conc	Export		
<u>Trb</u>	<u>Type</u>	<u>Seg</u>	<u>Name</u>	<u>kg/yr</u>	<u>% Total</u>	<u>(kg/yr)<sup>2</sup></u>	<u>% Total</u>	<u>cv</u>	<u>mg/m³</u>	<u>kg/km²/yr</u>		
1	1	1	H2	96.5	15.8%	4.65E+02	41.6%	0.22	321.5	45.9		
2	1	1	Direct	107.5	17.7%	5.78E+02	51.6%	0.22	488.6	48.9		
3	3	1	Septic H2	0.8		0.00	75.0	0.4				
4	3	1	Direct Septic	2.8	0.5%		0.00	275.0	1.2			
5	1	1	Patterson	380.8	62.5%	0.00E+00		0.00	309.6	40.1		
PREC	IPITATI	ON		17.4	2.9%	7.57E+01	6.8%	0.50	25.3	20.0		
INTE	RNAL LO	DAD		3.2	0.5%	0.00E+00		0.00				
TRIB	UTARY I	NFLO	W	584.8	96.0% 1.04E+03 93.2%		0.06	334.1	42.4			
POIN	IT-SOUR	CE IN	FLOW	3.5	0.6% 0.00E+00		0.00	175.0	0.8			
***T	OTAL IN	IFLOW	V	608.8	100.0%	1.12E+03	100.0%	0.05	247.8	32.1		
ADVE	ECTIVE (	DUTFL	.ow	268.6	44.1%	4.92E+03		0.26	145.3	14.2		
***T	OTAL O	UTFLC	W	268.6	44.1%	4.92E+03		0.26	145.3	14.2		
***R	ETENTI	ON		340.2	55.9%	5.22E+03		0.21				
	Overflo	w Rat	e (m/yr)	2.1	N	lutrient Resid	l. Time (yrs)	) 0.5253				
	Hydrau	lic Re	sid. Time (yrs)	1.1909	909 Turnover Ratio					1.9		
	Reserve	oir Co	nc (mg/m3)	145	R	etention Coe	:f.	0.559				

### **B.2.6 2004 Predicted vs. Observed**

Hydes Lake high

File: S:\Water\Water Monitoring\TMDL\TMDL\Lake TMDLs\Draft TMDI

Segment:						
	Predicted Va	lues>		Observed Va	lues>	
<u>Variable</u>	<u>Mean</u>	<u>cv</u>	<u>Rank</u>	<u>Mean</u>	<u>cv</u>	<u>Rank</u>
TOTAL P MG/M3	145.3	0.26	89.1%	146.0		89.2%
TOTAL N MG/M3	2189.0		88.9%	2189.0		88.9%
C.NUTRIENT MG/M3	110.4	0.15	92.1%	110.7		92.1%
CHL-A MG/M3	67.1	0.29	99.5%	57.8		99.1%
SECCHI M	0.8	0.25	34.0%	0.9		40.0%
ORGANIC N MG/M3	1706.2	0.29	99.4%			
TP-ORTHO-P MG/M3	121.5	0.32	93.0%			
ANTILOG PC-1	2582.2	0.42	96.4%	1560.1		92.1%
ANTILOG PC-2	19.7	0.11	98.3%	19.0		98.1%
(N - 150) / P	14.0	0.26	38.9%	14.0		38.6%
INORGANIC N / P	20.3	1.83	35.0%			
TURBIDITY 1/M	0.3	0.20	16.7%	0.3	0.20	16.7%
ZMIX * TURBIDITY	0.6	0.23	2.1%	0.6	0.23	2.1%
ZMIX / SECCHI	3.2	0.26	24.1%	2.8	0.12	18.1%
CHL-A * SECCHI	53.0	0.12	99.0%	51.4		98.9%
CHL-A / TOTAL P	0.5	0.30	91.1%	0.4		86.5%
FREQ(CHL-a>10) %	99.7	0.00	99.5%	99.4		99.1%
FREQ(CHL-a>20) %	95.0	0.05	99.5%	91.9		99.1%
FREQ(CHL-a>30) %	83.8	0.13	99.5%	77.3		99.1%
FREQ(CHL-a>40) %	70.0	0.23	99.5%	61.2		99.1%
FREQ(CHL-a>50) %	56.5	0.32	99.5%	46.9		99.1%
FREQ(CHL-a>60) %	44.8	0.41	99.5%	35.5		99.1%
CARLSON TSI-P	75.9	0.05	89.1%	76.0		89.2%
CARLSON TSI-CHLA	71.9	0.04	99.5%	70.4		99.1%
CARLSON TSI-SEC	63.4	0.06	66.0%	61.7		60.0%

#### **B.3 Miller Lake** Model Coefficients Mean CV **B.3.1 2002 Inputs Dispersion Rate** 1.000 0.70 0.45 Total Phosphorus 1.000 Miller Lake Total Nitrogen 1.000 0.55 File: S:\Water\Water Monitoring\TMDL\TMDL\Lake TMDLs\Draft TMDL to MPCA\Five Lake TMDL\Individual Lakes\Miller\Models\miller2002.btb Chl-a Model 1.000 0.26 Description: Secchi Model 1.000 0.10 **Global Variables** <u>Mean</u> <u>cv</u> Model Options Code Description Organic N Model 1.000 0.12 0.0 Conservative Substance 0 NOT COMPUTED Averaging Period (yrs) 1 TP-OP Model 1.000 0.15 Precipitation (m) 0.9 0.2 Phosphorus Balance 8 CANE & BACH, LAKES HODy Model 1.000 0.15 Evaporation (m) 0.7 0.3 Nitrogen Balance 0 NOT COMPUTED MODv Model 1.000 0.22 Storage Increase (m) 0 0.0 Chlorophyll-a 1 P, N, LIGHT, T Secchi/Chla Slope (m<sup>2</sup>/mg) 0.015 0.00 Secchi Depth VS. CHLA & TURBIDITY 1 Minimum Qs (m/yr) 0.100 0.00 Atmos. Loads (kg/km<sup>2</sup>-yr) <u>cv</u> Dispersion FISCHER-NUMERIC <u>Mean</u> 1 Chl-a Flushing Term 1.000 0.00 Conserv. Substance 0 0.00 DECAY RATES Phosphorus Calibration 1 Chl-a Temporal CV 0.620 0 Total P 20 0.50 Nitrogen Calibration 1 DECAY RATES Avail, Factor - Total P 0.330 0 Total N 1000 0.50 Error Analysis 1 MODEL & DATA Avail, Factor - Ortho P 1.930 Ω Ortho P 15 0.50 Availability Factors 0 IGNORE Avail. Factor - Total N 0.590 0 Inorganic N 500 0.50 Mass-Balance Tables 1 USE ESTIMATED CONCS Avail. Factor - Inorganic N 0.790 0 EXCEL WORKSHEET Output Destination 2 Internal Loads (mg/m2-day) Segment Morphometry Non-Algal Turb (m<sup>-1</sup>) Outflow Area Depth Length Mixed Depth (m) Hypol Depth Conserv. Total P Total N <u>Seg</u> <u>Name</u> <u>km<sup>2</sup></u> <u>Mean</u> <u>CV</u> CV <u>cv</u> <u>cv</u> CV <u>cv</u> Segment Group m <u>k m</u> <u>Mean</u> <u>Mean</u> Mean <u>Mean</u> <u>Mean</u> Miller lake 0.57 2.24 0.12 0.5 2.2 0 0 0.64 0.2 0 0 32.5 0 0 0 1 0 1 Segment Observed Water Quality MOD (ppb/day) Conserv Total P (ppb) Total N (ppb) Chl-a (ppb) Secchi (m) Organic N (ppb) TP - Ortho P (ppb) HOD (ppb/day) <u>cv</u> <u>cv</u> <u>cv</u> <u>cv</u> <u>cv</u> <u>Mean</u> Seg <u>Mean</u> <u>cv</u> <u>Mean</u> Mean Mean <u>cv</u> <u>Mean</u> <u>Mean</u> Mean <u>Mean</u> <u>cv</u> <u>cv</u> 0 343 0 1700 0 23.7 0 0 0 0 0 0 1 0 1 0 0 0 0 Segment Calibration Factors Total N (ppb) MOD (ppb/day) **Dispersion Rate** Total P (ppb) Chl-a (ppb) Secchi (m) Organic N (ppb) TP - Ortho P (ppb) HOD (ppb/day) <u>cv</u> <u>cv</u> Seg <u>Mean</u> <u>CV</u> <u>Mean</u> CV <u>Mean</u> <u>cv</u> <u>Mean</u> <u>cv</u> <u>Mean</u> <u>Mean</u> <u>Mean</u> <u>cv</u> <u>Mean</u> <u>CV</u> <u>Mean</u> <u>cv</u> 0 1 0 0 1 1 0 1 0 1 0 1 0 1 0 1 0 1 0 Tributary Data Dr Area Flow (hm<sup>3</sup>/yr) Ortho P (ppb) Conserv. Total P (ppb) Total N (ppb) Inorganic N (ppb) <u>Trib</u> Trib Name Segment <u>Type</u> $km^2$ Mean <u>cv</u> Mean <u>cv</u> Mean <u>cv</u> <u>Mean</u> <u>cv</u> <u>Mean</u> <u>cv</u> <u>Mean</u> <u>cv</u> 1 Inlet 1 CA 10.4 57.71 10.09 0.1 0 0 262.3 0.2 0 0 0 0 0 0 1 1 2 Inlet 2 (D1) 1 1 1.2 0.21 0.1 0 Ω 245 0.2 Ω 0 Ο Ω n 0 3 Direct (D2) 1 1 0.39 0.05 0.1 0 0 665.4 0.2 0 0 0 0 O 0 4 CA 10.4 septic 1 3 0.01 0.1 0 0 0 4093 0 Ω 0 Ω Ω Ω 0 5 3 0.01 0.1 0 0 0 37.5 0 0 0 0 0 0 0 D1 Septic 1 6 D2 Septic 1 1 0.01 0.1 0 0 0 50.1 0 0 0 0 0 0 0 322.8 0 7 Burandt, Waconia, Goose Sub 1 1 43.633 4.787 0 0 0 0 0 0 0 0 0 8 Winkler, Hydes, Patterson, Ric 1 1 49.633 8.406 0 0 0 249.2 0 0 0 0 0 0 0 9 Reitz Sub 4.204 2.258 0 278.4 0 0 0 0 0 1 1 0 0 0 0

242.6

0

0

0

0

0

Δ

0

0

1.504

1

1

3.126

10

Benton Sub

0

0

# **B.3.2 2002 Mass Balance**

#### Miller Lake

File: S:\Water\Water Monitoring\TMDL\TMDL\Lake TMDLs\Draft TMDL to MPCA\Five Lake TMDL\Individual Lakes\Miller\Models\miller2002.btb

Over	all Wat	er Ba	lance	Averaging Period			1.00 years		
				Area	Flow	Variance	cv	Runoff	
<u>Trb</u>	Туре	Seg	Name	<u>km<sup>2</sup></u>	<u>hm³/yr</u>	<u>(hm3/yr)<sup>2</sup></u>	2	<u>m/yr</u>	
1	1	1	Inlet 1 CA 10.4	57.7	10.1	1.02E+00	0.10	0.17	
2	1	1	Inlet 2 (D1)	1.2	0.2	4.41E-04	0.10	0.17	
3	1	1	Direct (D2)	0.4	0.1	2.50E-05	0.10	0.13	
4	3	1	CA 10.4 septic	0.0	0.1	0.00E+00	0.00	10.00	
5	3	1	D1 Septic	0.0	0.1	0.00E+00	0.00	10.00	
6	1	1	D2 Septic	0.0	0.1	0.00E+00	0.00	10.00	
7	1	1	Burandt, Waconia, Goose Si	43.6	4.8	0.00E+00	0.00	0.11	
8	1	1	Winkler, Hydes, Patterson, I	49.6	8.4	0.00E+00	0.00	0.17	
9	1	1	Reitz Sub	4.2	2.3	0.00E+00	0.00	0.54	
10	1	1	Benton Sub	3.1	1.5	0.00E+00	0.00	0.48	
PREC	IPITATIO	ON		0.6	0.5	1.05E-02	0.20	0.90	
TRIBU	JTARY I	NFLO	N	159.9	27.4	1.02E+00	0.04	0.17	
POIN	T-SOUR	RCE IN	FLOW	0.0	0.2	0.00E+00	0.00	10.00	
***T(	OTAL IN	IFLOW	1	160.5	28.1	1.03E+00	0.04	0.18	
ADVE	CTIVE C	DUTFL	.OW	160.5	27.7	1.04E+00	0.04	0.17	
***T(	OTAL O	UTFLC	W	160.5	27.7	1.04E+00	0.04	0.17	
***E <sup>v</sup>	VAPOR	ATION			0.4	1.43E-02	0.30		

Overall Mass Balance Based Upon Component:				Predicted TOTAL P	eservoir Co	Concentrations							
				Load	L	oad Varianc.	е		Conc	Export			
<u>Trb</u>	<u>Type</u>	<u>Seq</u>	Name	<u>kq/vr</u>	<u>%Total</u>	<u>(kg/yr)<sup>2</sup></u>	<u>%Total</u>	<u>cv</u>	mg/m <sup>3</sup>	<u>kg/km²/yr</u>			
1	1	1	Inlet 1 CA 10.4	2646.6	18.2%	3.50E+05	99.9%	0.22	262.3	45.9			
2	1	1	Inlet 2 (D1)	51.4	0.4%	1.32E+02	0.0%	0.22	245.0	42.9			
3	1	1	Direct (D2)	33.3	0.2%	5.53E+01	0.0%	0.22	665.4	85.3			
4	3	1	CA 10.4 septic	409.3	2.8%	0.00E+00		0.00	0 4093.0 40930				
5	3	1	D1 Septic	3.8	0.0%	0.00E+00		0.00	37.5	375.0			
6	1	1	D2 Septic	5.0	0.0%	0.00E+00		0.00	50.1	501.0			
7	1	1	Burandt, Waconia, Goose S	1545.2	10.6%	0.00E+00		0.00	322.8	35.4			
8	1	1	Winkler, Hydes, Patterson,	2094.8	14.4%	0.00E+00		0.00	249.2	42.2			
9	1	1	Reitz Sub	628.6	4.3%	0.00E+00		0.00	278.4	149.5			
10	1	1	Benton Sub	364.9	2.5%	0.00E+00		0.00	242.6	116.7			
PREC	IPITATI	ON		11.4	0.1% 3.25E+01 0.0%		0.50	22.2	20.0				
INTE	RNAL LO	DAD		6766.3	46.5%	0.00E+00		0.00					
TRIB	UTARY I	NFLO	W	7369.9	50.6%	3.50E+05	100.0%	0.08	268.9	46.1			
POIN	T-SOUF	RCE IN	FLOW	413.1	2.8%	0.00E+00		0.00	2065.3	20652.5			
***T	OTAL IN	IFLOW	/	14560.6	100.0%	3.50E+05	100.0%	0.04	517.8	90.7			
ADVI	ECTIVE (	OUTFL	-OW	9465.6	65.0%	2.33E+06		0.16	341.5	59.0			
***T	OTAL O	UTFLC	W	9465.6	65.0%	2.33E+06		0.16	341.5	59.0			
***R	ETENTI	ON		5095.0	35.0%	2.23E+06		0.29					
	Overflow Rate (m/yr)			48.6	P	Nutrient Resid	0.0299						
	Hydraulic Resid. Time (yrs)			0.0461	51 Turnover Ratio 33.4								
	Reserv	oir Co	nc (mg/m3)	341	F	Retention Coe	ef.		0.350				

# **B.3.3 2002 Predicted vs. Observed**

### Miller Lake

File: S:\Water\Water Monitoring\TMDL\TMDL\Lake TMDLs\Draft TMDI

Segment:	1 M	liller lake	!			
	Predicted Va	lues>		Observed Va	lues>	
<u>Variable</u>	<u>Mean</u>	<u>cv</u>	<u>Rank</u>	<u>Mean</u>	<u>cv</u>	<u>Rank</u>
TOTAL P MG/M3	341.5	0.16	98.5%	343.0		98.6%
TOTAL N MG/M3	1700.0		79.6%	1700.0		79.6%
C.NUTRIENT MG/M3	120.8	0.02	93.6%	120.9		93.6%
CHL-A MG/M3	51.5	0.28	98.6%	23.7		88.5%
SECCHI M	0.7	0.19	28.9%	1.0		46.0%
ORGANIC N MG/M3	1379.7	0.27	98.2%			
TP-ORTHO-P MG/M3	102.8	0.29	90.3%			
ANTILOG PC-1	2294.0	0.32	95.6%	600.8		75.3%
ANTILOG PC-2	14.5	0.16	93.8%	11.4		86.4%
(N - 150) / P	4.5	0.16	2.6%	4.5		2.6%
INORGANIC N / P	1.3	1.09	0.1%			
TURBIDITY 1/M	0.6	0.20	52.2%	0.6	0.20	52.2%
ZMIX * TURBIDITY	1.4	0.23	15.0%	1.4	0.23	15.0%
ZMIX / SECCHI	3.1	0.20	23.1%	2.2	0.12	9.2%
CHL-A * SECCHI	36.5	0.19	96.4%	23.7		88.3%
CHL-A / TOTAL P	0.2	0.31	34.0%	0.1		5.1%
FREQ(CHL-a>10) %	99.0	0.01	98.6%	86.0		88.5%
FREQ(CHL-a>20) %	88.8	0.09	98.6%	48.5		88.5%
FREQ(CHL-a>30) %	71.3	0.21	98.6%	24.5		88.5%
FREQ(CHL-a>40) %	53.9	0.33	98.6%	12.4		88.5%
FREQ(CHL-a>50) %	39.7	0.43	98.6%	6.5		88.5%
FREQ(CHL-a>60) %	28.9	0.53	98.6%	3.5		88.5%
CARLSON TSI-P	88.3	0.03	98.5%	88.3		98.6%
CARLSON TSI-CHLA	69.3	0.04	98.6%	61.7		88.5%
CARLSON TSI-SEC	65.0	0.04	71.1%	60.0		54.0%

В.З	.4 2004 Inputs	S											Mod	lel Coefficier	<u>nts</u>		<u>Mean</u>	<u>cv</u>
Miller	Lake												Uisp	ersion Rate	_		1.000	0.70
File:	S:\\Alater\\Alater Monif	toring\TM		ake TMDI	s\Draft TMDI	to MPC A	Five Lake	TMDI \Indi	vidual I a	kes\Miller\Me	dels\mill	or2004 hth	Tota	al Phosphorus	5		1.000	0.45
Descri	infion:	y. i N											Chl_	a Model			1.000	0.33
Global	Variables	Mean	cv		Mo	del Ontio	ne		Code	Description			Seco	hiModel			1.000	0.20
Avera	ring Pariod (vrs)	<u>mean</u> 1	0.0		<u></u>	ncorvativo	Substanco		0000	NOT COMPLIE	FD		Orea	anic N Model			1.000	0.12
Procini	itation (m)	0.6	0.0		Pho	osphorus P	alanco		8	CANE & BACH	LAKES		TP-C	OP Model			1.000	0.15
Evanor	ration (m)	0.0	0.2		Ni+	vogon Pala			0		, DARES		HOE	Dv Model			1.000	0.15
Evapor	ation (m)	0.7	0.5		INIL Chi	loronhull a	lice		1		ED		MO	Dv Model			1.000	0.22
Storage	e increase (m)	U	0.0		Cini Soci	orophyn-a ochi Donth			1		עדוחוססו		Seco	chi/Chla Slope	e (m²/mg)		0.015	0.00
Atmos	l oade (ka/km <sup>2</sup> -vr)	Maan	01/		Die	.cm Depti			1	V3. CHEA & TO			Min	imum Qs (m/	yr)		0.100	0.00
Canada	Cubatanaa		0.00		Dis	persion 	- 1:1		1	FISCHER-INUIV	IERIC		Chl-	a Flushing Ter	rm		1.000	0.00
Conser	v. Substance	20	0.00		Pho	ospnorus C	allbration		1	DECAY RATES			Chl-	a Temporal C	v		0.620	0
Total P		20	0.50		NIT.	rogen Call	pration		1	DECAY RATES			Avai	1. Factor - Tot	tal P		0.330	0
I otal N	1	1000	0.50		Err	or Analysis			1	WODEL & DAI	A		Avai	1. Factor - Ort	tho P		1.930	0
Urtho I	 Ч	15	0.50		Ava	ailability Fa	actors		0	IGNORE			Avai	1. Factor - Tot	tal N		0.590	0
Inorgai	nic N	500	0.50		Ma	iss-Balance	lables		1	USE ESTIMATI	ED CONCS		Avai	1. Factor - Ino	organic N		0.790	0
					Ou	tput Destii	nation		2	EXCEL WORKS	SHEET							
Segme	ent Morphometry												lr	nternal Load	ls ( mg/m2-c	lay)		
		c	Dutflow		Area	Depth	Length Mi	xed Depth	(m)	Hypol Depth	N	ion-Algal Tu	ırb (m <sup>-</sup> ') (	Conserv.	Tota	al P	т	otal N
<u>Seg</u> 1	<u>Name</u> Miller lake	5	<b>Segment</b> 0	<u>Group</u> 1	<u>km²</u> 0.57	<u>m</u> 2.24	<u>km</u> 0.5	<u>Mean</u> 2.2	<u>CV</u> 0.12	<u>Mean</u> 0	<u>cv</u> 0	<u>Mean</u> 1.15	<u>cv</u> 0.2	<u>Mean</u> 0	<u>cv</u> 0	<u>Mean</u> 0.5	<u>cv</u> 0	<u>Mean</u> 0
Segme	ent Observed Water Qu Conserv	uality T	otal D (nnh)	_	Fatal N (nuh)													
• • •			UI 41 E IUUU			C	hl-a (nnh)	Se	ecchi (m)	) Or	ganic N (	nnhì Ti	- Ortho P	(nnh) H(	OD (nnh/dav)	i N	10D (nnh/c	davi
200	Mean	cv	Mean	i i cv	Mean	CV	hi-a (ppb) Mean	Se CV	ecchi (m) Mean	) Or CV	ganic N () Mean	ppb) TI CV	P - Ortho P Mean	(ppb) HC CV	OD (ppb/day) Mean	CV	MOD (ppb/c Mean	day) CV
<u>5eq</u> 1	<u>Mean</u> 0	<u>כע</u> 0	<u>Mean</u> 197	י <u>כע</u> 0	<u>Mean</u> 1856	כו <u>כע</u> 0	hl-a (ppb) <u>Mean</u> 56	56 <u>CV</u> 0	<b>ecchi (m)</b> <u>Mean</u> 0.68	) Or <u>CV</u> 0	<b>ganic N (</b> <u>Mean</u> 0	ррb) Ті <u>СV</u> 0	P - Ortho P <u>Mean</u> 0	<b>су</b> (ррb) Но <u>СV</u> 0	OD (ppb/day) <u>Mean</u> 0	0 0	MOD (ppb/c <u>Mean</u> 0	day) <u>CV</u> 0
<u>seq</u> 1 Segme	<u>Mean</u> 0 ent Calibration Factors	<u>cv</u> 0	<u>Mean</u> 197	י <u>כע</u> 0	<b>Mean</b> 1856	<del>در</del> 0	hl-a (ppb) <u>Mean</u> 56	Se <u>CV</u> 0	ecchi (m) <u>Mean</u> 0.68	) Or <u>CV</u> 0	<b>ganic N (</b> ) <u>Mean</u> 0	<b>ррb) Ті</b> <u>СV</u> 0	P - Ortho P <u>Mean</u> 0	<b>р (ррb) Но</b> <u>CV</u> 0	OD (ppb/day) <u>Mean</u> 0	0 0	MOD (ppb/s <u>Mean</u> 0	day) <u>CV</u> 0
<u>seq</u> 1 Segme	<u>Mean</u> 0 ent Calibration Factors Dispersion Rate	<u>د v</u> 0 ۲	otal P (ppb) <u>Mean</u> 197 otal P (ppb)	י <u>כע</u> 0	Mean 1856 Total N (ppb)	сі <u>сv</u> 0 сі	hl-a (ppb) <u>Mean</u> 56 hl-a (ppb)	Se <u>CV</u> 0 Se	ecchi (m) <u>Mean</u> 0.68 ecchi (m)	) Or <u>CV</u> 0	ganic N (j <u>Mean</u> 0 ganic N (j	ppb) Ti <u>CV</u> 0 ppb) Ti	P - Ortho P <u>Mean</u> 0 - Ortho P	* (ppb) HC <u>CV</u> 0	OD (ppb/day) <u>Mean</u> 0 OD (ppb/day)	0 0	MOD (ppb/c <u>Mean</u> 0 1OD (ppb/c	day) <u>CV</u> 0 day)
<u>seq</u> 1 Segme Sea	<u>Mean</u> 0 ent Calibration Factors Dispersion Rate Mean	CV 0 s cV	otal P (ppb) <u>Mean</u> 197 Otal P (ppb) Mean	, <u>cv</u> 0 0	Mean 1856 Total N (ppb) Mean	ci <u>cv</u> 0 ci cv	hl-a (ppb) <u>Mean</u> 56 hl-a (ppb) Mean	Se <u>CV</u> 0 Se CV	ecchi (m) <u>Mean</u> 0.68 ecchi (m) Mean	) Or <u>CV</u> 0 ) Or CV	ganic N () <u>Mean</u> 0 ganic N () Mean	ррb) ТІ <u>СV</u> 0 ррb) ТІ СV	P - Ortho P <u>Mean</u> 0 P - Ortho P Mean	* (ppb) HC <u>CV</u> 0 * (ppb) HC CV	OD (ppb/day) <u>Mean</u> 0 OD (ppb/day) Mean		MOD (ppb/r <u>Mean</u> 0 MOD (ppb/c Mean	day) <u>CV</u> 0 day) CV
<u>seq</u> 1 Segme <u>Seq</u> 1	<u>Mean</u> 0 ent Calibration Factors Dispersion Rate <u>Mean</u> 1	<u>cv</u> 0 5 <u>cv</u> 0	otal P (ppb) <u>Mean</u> 197 Otal P (ppb) <u>Mean</u> 1	<u>cv</u> 0 <u>cv</u> 0	Mean 1856 Fotal N (ppb) <u>Mean</u> 1	<u>cv</u> 0 <u>cv</u> 0 <u>cv</u>	hl-a (ppb) <u>Mean</u> 56 hl-a (ppb) <u>Mean</u> 1	56 <u>CV</u> 0 56 <u>CV</u> 0	ecchi (m) <u>Mean</u> 0.68 ecchi (m) <u>Mean</u> 1	) or <u>CV</u> 0 or <u>CV</u> 0	rganic N (j <u>Mean</u> 0 rganic N (j <u>Mean</u> 1	ррb) ТІ <u>CV</u> 0 ррb) ТІ <u>CV</u> 0	P - Ortho P <u>Mean</u> 0 P - Ortho P <u>Mean</u> 1	<sup>•</sup> (ррb) Но <u>CV</u> • (ррb) Но <u>CV</u> 0	OD (ppb/day) <u>Mean</u> 0 OD (ppb/day) <u>Mean</u> 1		MOD (ppb/i <u>Mean</u> 0 MOD (ppb/c <u>Mean</u> 1	day) <u>CV</u> 0 day) <u>CV</u> 0
<u>seq</u> 1 Segma <u>Seq</u> 1 Tributa	<u>Mean</u> 0 Dispersion Rate <u>Mean</u> 1	<u>cv</u> ₀ <u>cv</u> ₀	<u>Mean</u> 197 Total P (ppb) <u>Mean</u> 1	<u>cv</u> 0 <u>cv</u> 0	Mean 1856 Fotal N (ppb) <u>Mean</u> 1	<u>cv</u> 0 <u>cv</u> 0	hi-a (ppb) <u>Mean</u> 56 hi-a (ppb) <u>Mean</u> 1	56 <u>CV</u> 0 56 <u>CV</u> 0	ecchi (m) <u>Mean</u> 0.68 ecchi (m) <u>Mean</u> 1	) or <u>CV</u> 0 0 0	rganic N (( <u>Mean</u> 0 rganic N (( <u>Mean</u> 1	ррв) ТІ <u>CV</u> 0 ррв) ТІ <u>CV</u> 0	P - Ortho P <u>Mean</u> 0 P - Ortho P <u>Mean</u> 1	2 (ppb) HG <u>CV</u> 0 2 (ppb) HG <u>CV</u> 0	OD (ppb/day) <u>Mean</u> 0 OD (ppb/day) <u>Mean</u> 1	<u>cv</u> 0 <u>cv</u> 0	MOD (ppb/i <u>Mean</u> 0 MOD (ppb/c <u>Mean</u> 1	day) <u>CV</u> 0 day) <u>CV</u> 0
<u>&gt;eq</u> 1 Segme <u>Seq</u> 1 Tributa	<u>Mean</u> 0 Dispersion Rate <u>Mean</u> 1	<u>cv</u> 0 5 7 <u>cv</u> 0	<u>Mean</u> 197 Total P (ppb) <u>Mean</u> 1		Mean 1856 Total N (ppb) <u>Mean</u> 1 Dr Area Flo	Cl <u>CV</u> 0 cl <u>CV</u> 0 ww (hm <sup>3</sup> /yr	hl-a (ppb) <u>Mean</u> 56 hl-a (ppb) <u>Mean</u> 1	Se <u>CV</u> 0 Se <u>CV</u> 0	ecchi (m) <u>Mean</u> 0.68 ecchi (m) <u>Mean</u> 1	) Or <u>CV</u> 0 ) Or <u>CV</u> 0 Total P (ppb)	rganic N (j <u>Mean</u> 0 rganic N (j <u>Mean</u> 1	ppb) Ti <u>CV</u> 0 ppb) Ti <u>CV</u> 0	P - Ortho P <u>Mean</u> 0 P - Ortho P <u>Mean</u> 1	rtho P (ppb)	OD (ppb/day) <u>Mean</u> 0 OD (ppb/day) <u>Mean</u> 1	() N <u>CV</u> 0 () N <u>CV</u> 0	MOD (ppb/ <u>Mean</u> 0 MOD (ppb/c <u>Mean</u> 1 (ppb)	day) <u>CV</u> 0 day) <u>CV</u> 0
<u>seg</u> 1 Segme <u>Seg</u> 1 Tributa <u>Trib</u>	<u>Mean</u> 0 ent Calibration Factors Dispersion Rate <u>Mean</u> 1 ary Data <u>Trib Name</u>	<u>cv</u> 0 1 <u>cv</u> 0	Mean 197 Total P (ppb) <u>Mean</u> 1	, <u>cv</u> 0 τ <u>cv</u> 0 <u>τγρε</u>	Mean 1856 Fotal N (ppb) <u>Mean</u> 1 Dr Area Flo <u>km<sup>2</sup></u>	CI <u>CV</u> 0 <u>CV</u> 0 ww (hm <sup>3</sup> /yr <u>Mean</u>	hl-a (ppb) <u>Mean</u> 56 hl-a (ppb) <u>Mean</u> 1 ) Co	Se <u>CV</u> 0 Se <u>CV</u> 0 mserv. <u>Mean</u>	ecchi (m) <u>Mean</u> 0.68 ecchi (m) <u>Mean</u> 1 <u>CV</u>	) Or <u>CV</u> 0 Or <u>CV</u> 0 Total P (ppb) <u>Mean</u>	rganic N (j <u>Mean</u> 0 rganic N (j <u>Mean</u> 1 T <u>CV</u>	ррв) ТІ <u>СУ</u> 0 ррв) ТІ <u>СУ</u> 0	<ul> <li>P - Ortho P</li> <li>Mean</li> <li>Ortho P</li> <li>Mean</li> <li>1</li> <li>O</li> <li>CV</li> </ul>	P (ppb) H( <u>CV</u> 0 P (ppb) H( <u>CV</u> 0 Prtho P (ppb <u>Mean</u>	OD (ppb/day) <u>Mean</u> 0 OD (ppb/day) <u>Mean</u> 1 ) Inor <u>CV</u>	ا ۸ ۸ <u>CV</u> 0 <u>CV</u> 0 rganic N <u>Mean</u>	MOD (ppb/i <u>Mean</u> 0 MOD (ppb/i <u>Mean</u> 1 '(ppb) <u>CV</u>	day) <u>CV</u> 0 day) <u>CV</u> 0
<u>≥eq</u> 1 Segme <u>Seg</u> 1 Tributa <u>Trib</u> 1	<u>Mean</u> 0 ent Calibration Factors Dispersion Rate <u>Mean</u> 1 ary Data <u>Trib Name</u> Inlet 1 CA 10.4	<u>cv</u> 0 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3	Mean 197 Total P (ppb) <u>Mean</u> 1 Segment	<u>cv</u> 0 <u>cv</u> 0	Mean 1856 Fotal N (ppb) <u>Mean</u> 1 Dr Area Flo <u>km<sup>2</sup></u> 57.7	Cl <u>CV</u> 0 <u>CV</u> 0 9 ww (hm <sup>3</sup> /yr <u>Mean</u> 8.58	hl-a (ppb) <u>Mean</u> 56 hl-a (ppb) <u>Mean</u> 1 ) Co <u>CV</u> 0.1	56 <u>CV</u> 0 <u>CV</u> 0 0 0 0 0 0 0 0	ecchi (m) <u>Mean</u> 0.68 ecchi (m) <u>Mean</u> 1 <u>CV</u> 0	) Or <u>CV</u> 0 Or <u>CV</u> 0 Total P (ppb) <u>Mean</u> 287.1	ganic N (( <u>Mean</u> 0 ganic N () <u>Mean</u> 1 T <u>CV</u> 0.2	ppb) Ti <u>CV</u> 0 ppb) Ti <u>CV</u> 0 - - - - - - - - - - - - - - - - - -	<ul> <li>P - Ortho P</li> <li>Mean</li> <li>0</li> <li>Ortho P</li> <li>Mean</li> <li>1</li> <li>0</li> <li>0</li> <li>0</li> <li>0</li> <li>0</li> <li>0</li> <li>0</li> </ul>	P (ppb) HC CV 0 P (ppb) HC CV 0 Prtho P (ppb <u>Mean</u> 0	OD (ppb/day) <u>Mean</u> 0 OD (ppb/day) <u>Mean</u> 1 .) Inor <u>CV</u> 0	rganic N <u>Mean</u> 0	MOD (ppb/c <u>Mean</u> 0 MOD (ppb/c <u>Mean</u> 1 (ppb) <u>CV</u> 0	day) <u>CV</u> 0 day) <u>CV</u> 0
<u>≥eq</u> 1 Segme 1 Tributa <u>Trib</u> 1 2	Mean 0 ent Calibration Factors Dispersion Rate <u>Mean</u> 1 ary Data <u>Trib Name</u> Inlet 1 CA 10.4 Inlet 2 (D1)	<u>v2</u> 0 7 <u>2</u> 0 2	otal P (ppb) <u>Mean</u> 197 'otal P (ppb) <u>Mean</u> 1 Segment 1	, <u>cv</u> 0 1 <u>cv</u> 0 <u>type</u> 1 1	Mean 1856 Fotal N (ppb) <u>Mean</u> 1 Dr Area Flo <u>km<sup>2</sup></u> 57.7 1.2	Cl <u>CV</u> 0 <u>CV</u> 0 ww (hm <sup>3</sup> /yr <u>Mean</u> 8.58 0.18	hl-a (ppb) <u>Mean</u> 56 hl-a (ppb) <u>Mean</u> 1 ) Co <u>CV</u> 0.1 0.1	Se <u>CV</u> 0 Se <u>CV</u> 0 mserv. <u>Mean</u> 0 0	ecchi (m) <u>Mean</u> 0.68 ecchi (m) <u>Mean</u> 1 <u>CV</u> 0 0	) Or <u>CV</u> 0 Or <u>CV</u> 0 Total P (ppb) <u>Mean</u> 287.1 292.6	ganic N (( <u>Mean</u> 0 ganic N (( <u>Mean</u> 1 1 T <u>CV</u> 0.2 0.2	ppb) Ti <u>CV</u> 0 ppb) Ti <u>CV</u> 0 0 <u>CV</u> 0 0 0 0	<ul> <li>P - Ortho P</li> <li>Mean</li> <li>0</li> <li>Ortho P</li> <li>Mean</li> <li>1</li> <li>0</li> <li>0</li> <li>0</li> <li>0</li> <li>0</li> <li>0</li> <li>0</li> <li>0</li> </ul>	P (ppb) H( <u>CV</u> 0 P (ppb) H( <u>CV</u> 0 Prtho P (ppb <u>Mean</u> 0 0	DD (ppb/day) <u>Mean</u> 0 DD (ppb/day) <u>Mean</u> 1 1 1 0 0 0 0	CV 0 0 0 0 0 0 0 0 0	MOD (ppb/ <u>Mean</u> 0 MOD (ppb/c <u>Mean</u> 1 (ppb) <u>CV</u> 0 0	day) <u>CV</u> 0 day) <u>CV</u> 0
<u>seq</u> 1 Segme 1 Tributa <u>Trib</u> 1 2 3	Mean 0 ent Calibration Factors Dispersion Rate <u>Mean</u> 1 ary Data <u>Trib Name</u> Inlet 1 CA 10.4 Inlet 2 (D1) Direct (D2)	<u>22</u> 0 7 <u>22</u> 0	otal P (ppb) <u>Mean</u> 197 •otal P (ppb) <u>Mean</u> 1 Segment 1 1	, <u>cv</u> 0 1 <u>cv</u> 0 <u>Type</u> 1 1 1	Mean 1856 Fotal N (ppb) <u>Mean</u> 1 Dr Area Flo <u>km<sup>2</sup></u> 57.7 1.2 0.39	CI <u>CV</u> 0 CI <u>CV</u> 0 ww (hm <sup>3</sup> /yr <u>Mean</u> 8.58 0.18 0.04	hl-a (ppb) <u>Mean</u> 56 hl-a (ppb) <u>Mean</u> 1 ) Cc <u>CV</u> 0.1 0.1 0.1	Se <u>CV</u> 0 Se <u>CV</u> 0 0 0 0 0 0 0 0	ecchi (m) <u>Mean</u> 0.68 ecchi (m) <u>Mean</u> 1 0 0 0 0 0 0	) Or <u>CV</u> 0 ) Or <u>CV</u> 0 Total P (ppb) <u>Mean</u> 287.1 292.6 323.9	ganic N (( <u>Mean</u> 0 ganic N (( <u>Mean</u> 1 1 T <u>CV</u> 0.2 0.2 0.2	ppb) Ti <u>CV</u> 0 ppb) Ti <u>CV</u> 0 <u>otal N (ppb)</u> 0 0 0	<ul> <li>P - Ortho P</li> <li>Mean</li> <li>0</li> <li>P - Ortho P</li> <li>Mean</li> <li>1</li> <li>1</li> <li>0</li> <li>0</li> <li>0</li> <li>0</li> <li>0</li> <li>0</li> <li>0</li> <li>0</li> </ul>	P (ppb) H( <u>CV</u> 0 P (ppb) H( <u>CV</u> 0 Prtho P (ppb <u>Mean</u> 0 0 0	DD (ppb/day) Mean 0 DD (ppb/day) <u>Mean</u> 1 1 0 0 0 0 0 0	CV 0 0 0 0 0 0 0 0 0 0 0 0 0 0	MOD (ppb/( <u>Mean</u> 0 MOD (ppb/( <u>Mean</u> 1 (ppb) <u>CV</u> 0 0 0 0	day) <u>CV</u> 0 day) <u>CV</u> 0
<u>seq</u> 1 Segme 1 Tributa <u>Trib</u> 1 2 3 4	Mean 0 ent Calibration Factors Dispersion Rate <u>Mean</u> 1 ary Data <u>Trib Name</u> Inlet 1 CA 10.4 Inlet 2 (D1) Direct (D2) Burandt Subwatershee	<u>cv</u> 0 <u>cv</u> 0 5	otal P (ppb) <u>Mean</u> 197 Total P (ppb) <u>Mean</u> 1 Segment 1 1 1	CV 0 1 <u>CV</u> 0 1 1 1 1	Mean 1856 Fotal N (ppb) <u>Mean</u> 1 Dr Area Flo <u>km<sup>2</sup></u> 57.7 1.2 0.39 43.6	Cl <u>CV</u> 0 Cl <u>CV</u> 0 0 0 0 0 0 0 0 0 0 0 0 0	hl-a (ppb) <u>Mean</u> 56 hl-a (ppb) <u>Mean</u> 1 ) Co <u>CV</u> 0.1 0.1 0.1 0.1 0.1	Se <u>CV</u> 0 Se <u>CV</u> 0 0 0 0 0 0 0 0 0 0 0 0 0	ecchi (m) <u>Mean</u> 0.68 ecchi (m) <u>Mean</u> 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	) Or <u>CV</u> 0 Or <u>CV</u> 0 Total P (ppb) <u>Mean</u> 287.1 292.6 323.9 239.3	ganic N (( <u>Mean</u> 0 ganic N (( <u>Mean</u> 1 1 T <u>CV</u> 0.2 0.2 0.2 0.2 0.2	ppb) Ti <u>CV</u> 0 ppb) Ti <u>CV</u> 0 <u>CV</u> 0 0 0 0 0 0 0 0 0	<ul> <li>P - Ortho P</li> <li>Mean</li> <li>0</li> <li>O CO</li> <li>CV</li> <li>0</li> </ul>	P (ppb) HC <u>CV</u> 0 P (ppb) HC <u>CV</u> 0 Prtho P (ppb <u>Mean</u> 0 0 0 0 0	DD (ppb/day) Mean 0 DD (ppb/day) <u>Mean</u> 1 1 0 0 0 0 0 0 0 0 0	<b><u>CV</u></b> 0 <b><u>CV</u> 0 <u><u>CV</u> 0 <u><u>Mean</u> 0 0 0 0 0</u></u></b>	MOD (ppb/ <u>Mean</u> 0 MOD (ppb/ <u>Mean</u> 1 (ppb) <u>CV</u> 0 0 0 0 0 0	day) <u>CV</u> 0 day) <u>CV</u> 0
≥eq 1 Segme 1 Tributa <u>Trib</u> 1 2 3 4 5	Mean 0 ent Calibration Factors Dispersion Rate <u>Mean</u> 1 ary Data Trib Name Inlet 1 CA 10.4 Inlet 2 (D1) Direct (D2) Burandt Subwatershee Winkler Subwatershee	2 0 7 2 0 5 3 0 5 0 5 0 5	otal P (ppb) <u>Mean</u> 197 Otal P (ppb) <u>Mean</u> 1 1 1 1 1 1 1	CV 0 0 <u>CV</u> 0 0 <u>Type</u> 1 1 1 1	Mean         1856           Total N (ppb)         Mean           1         1           Dr Area         Flo           km²         57.7           1.2         0.39           43.6         49.2	Cl <u>CV</u> 0 Cl <u>CV</u> 0 0 0 0 0 0 0 0 0 0 0 0 0	hl-a (ppb) <u>Mean</u> 56 hl-a (ppb) <u>Mean</u> 1 0.1 0.1 0.1 0 0 0	Se <u>CV</u> 0 Se <u>CV</u> 0 0 0 0 0 0 0 0 0 0 0 0 0	ecchi (m) <u>Mean</u> 0.68 ecchi (m) <u>Mean</u> 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	) Or <u>CV</u> 0 <b>Or</b> <u>CV</u> 0 <b>Total P (ppb)</b> <u>Mean</u> 287.1 292.6 323.9 239.3 256.7	ganic N (( <u>Mean</u> 0 ganic N (( <u>Mean</u> 1 1 T <u>CV</u> 0.2 0.2 0.2 0,0 0 0	ppb) Ti <u>CV</u> 0 ppb) Ti <u>CV</u> 0 o 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	<ul> <li>P - Ortho P</li> <li>Mean</li> <li>0</li> <li>O CV</li> <li>0</li> </ul>	P (ppb) HC CV 0 P (ppb) HC CV 0 Prtho P (ppb Mean 0 0 0 0 0 0 0 0 0	DD (ppb/day) Mean 0 DD (ppb/day) Mean 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	<b><u>CV</u></b> 0 <b><u>CV</u> 0 <u><b>Sganic N</b> <u><b>Mean</b></u> 0 0 0 0 0 0 0 0 0 0</u></b>	MOD (ppb/ MOD (ppb/ MOD (ppb/ Mean 1 (ppb) CV 0 0 0 0 0 0 0 0 0 0	day) <u>CV</u> 0 day) <u>CV</u> 0
<u>&gt;eq</u> 1 Segme 1 Tributa <u>Trib</u> 1 2 3 4 5 6	Mean 0 ent Calibration Factors Dispersion Rate <u>Mean</u> 1 ary Data Trib Name Inlet 1 CA 10.4 Inlet 2 (D1) Direct (D2) Burandt Subwatershed Winkler Subwatershed	<u>cv</u> 0 <u>cv</u> 0 <u>s</u>	otal P (ppb) <u>Mean</u> 197 Otal P (ppb) <u>Mean</u> 1 1 5 5 6 9 1 1 1 1 1 1 1 1 1	CV 0 CV 0 CV 0 Type 1 1 1 1 1 1	Mean         1856           Fotal N (ppb)         Mean           1         1           Dr Area         Flo           km²         57.7           1.2         0.39           43.6         49.2           14.7	Cl <u>CV</u> 0 Cl <u>CV</u> 0 0 0 0 0 0 0 0 0 0 0 0 0	hl-a (ppb) <u>Mean</u> 56 hl-a (ppb) <u>Mean</u> 1 0.1 0.1 0.1 0 0 0 0 0	Se <u>CV</u> 0 Se <u>CV</u> 0 0 0 0 0 0 0 0 0 0 0 0 0	ecchi (m) <u>Mean</u> 0.68 ecchi (m) <u>Mean</u> 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	) or <u>CV</u> 0 <b>Or</b> <u>CV</u> 0 <b>Total P (ppb)</b> <u>Mean</u> 287.1 292.6 323.9 239.3 256.7 294.5	ganic N (( <u>Mean</u> 0 ganic N (( <u>Mean</u> 1 1 <u>CV</u> 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2	ppb) Ti <u>CV</u> 0 ppb) Ti <u>CV</u> 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	<ul> <li>P - Ortho P</li> <li>Mean</li> <li>0</li> <li>Ortho P</li> <li>Mean</li> <li>1</li> <li>0</li> </ul>	P (ppb) HC CV 0 P (ppb) HC CV 0 Prtho P (ppb Mean 0 0 0 0 0 0 0 0 0 0 0 0 0	DD (ppb/day) Mean 0 DD (ppb/day) <u>Mean</u> 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	rganic N Mean 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	MOD (ppb/ Mean 0 MOD (ppb/ <u>Mean</u> 1 1 (ppb) <u>CV</u> 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	day) <u>CV</u> 0 day) <u>CV</u> 0
<u>≥eq</u> 1 Segme 1 Tributa <u>Trib</u> 1 2 3 4 5 6 7	Mean 0 ent Calibration Factors Dispersion Rate <u>Mean</u> 1 ary Data <u>Trib Name</u> Inlet 1 CA 10.4 Inlet 2 (D1) Direct (D2) Burandt Subwatershed Reitz Subwatershed Benton Subwatershed	<u>CV</u> 0 5 7 <u>CV</u> 0 8	otal P (ppb) <u>Mean</u> 197 Otal P (ppb) <u>Mean</u> 1 1 5 5 6 6 7 1 1 1 1 1 1 1 1 1	CV 0 CV 0 CV 0 Type 1 1 1 1 1 1 1 1	Mean         1856           Total N (ppb)         Mean           1856         1           Dr Area         Flo <u>km²</u> 57.7           1.2         0.39           43.6         49.2           14.7         9.1	Cl <u>CV</u> 0 Cl <u>CV</u> 0 0 0 0 0 0 0 0 0 0 0 0 0	hl-a (ppb) <u>Mean</u> 56 hl-a (ppb) <u>Mean</u> 1 0.1 0.1 0.1 0 0 0 0 0 0 0 0 0 0 0 0 0	56 <u>CV</u> 0 56 <u>CV</u> 0 0 0 0 0 0 0 0 0 0 0 0 0	ecchi (m) <u>Mean</u> 0.68 ecchi (m) <u>Mean</u> 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	) or <u>CV</u> 0 <b>Or</b> <u>CV</u> 0 <b>Total P (ppb)</b> <u>Mean</u> 287.1 292.6 323.9 239.3 256.7 294.5 244.1	ganic N (( <u>Mean</u> 0 ganic N (( <u>Mean</u> 1 1 <u>CV</u> 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2	ppb) Ti <u>CV</u> 0 ppb) Ti <u>CV</u> 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	<ul> <li>P - Ortho P</li> <li>Mean</li> <li>0</li> <li>Ortho P</li> <li>Mean</li> <li>1</li> <li>0</li> </ul>	2 (ppb) HC <u>CV</u> 0 0 0 0 0 0 0 0 0 0 0 0 0	DD (ppb/day) <u>Mean</u> 0 DD (ppb/day) <u>Mean</u> 1 0 0 0 0 0 0 0 0 0 0 0 0 0	rganic N Mean 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	MOD (ppb/ Mean 0 MOD (ppb/ <u>Mean</u> 1 1 (ppb) <u>CV</u> 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	day) <u>CV</u> 0 day) <u>CV</u> 0
<u>seq</u> 1 Segme 1 Tribut; <u>Trib</u> 1 2 3 4 5 6 7 8	Mean 0 ent Calibration Factors Dispersion Rate <u>Mean</u> 1 ary Data <u>Trib Name</u> Inlet 1 CA 10.4 Inlet 2 (D1) Direct (D2) Burandt Subwatershee Reitz Subwatershed Benton Subwatershed Inlet CA 10.4 Septirs	<u>CV</u> 0 5 7 <u>CV</u> 0 5 8	otal P (ppb) <u>Mean</u> 197 <u>Mean</u> 1 1 <u>Segment</u> 1 1 1 1 1 1 1 1 1	CV 0 CV 0 CV 0 Type 1 1 1 1 1 1 3	Mean         1856           Total N (ppb)         Mean           1856         1           Dr Area         Flo <u>km²</u> 57.7           1.2         0.39           43.6         49.2           14.7         9.1           0         0	Cl <u>CV</u> 0 Cl <u>CV</u> 0 0 0 0 0 0 0 0 0 0 0 0 0	hl-a (ppb) <u>Mean</u> 56 hl-a (ppb) <u>Mean</u> 1 0.1 0.1 0.1 0 0 0 0 0 0 0 0 0 0 0 0	56 <u>CV</u> 0 56 <u>CV</u> 0 0 0 0 0 0 0 0 0 0 0 0 0	ecchi (m) <u>Mean</u> 0.68 ecchi (m) <u>Mean</u> 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	) Or <u>CV</u> 0 <b>Or</b> <u>CV</u> 0 <b>Total P (ppb)</b> <u>Mean</u> 287.1 292.6 323.9 239.3 256.7 294.5 244.1 4093	ganic N (( Mean 0 ganic N (( <u>Mean</u> 1 1 <u>CV</u> 0.2 0.2 0.2 0.2 0.2 0.0 0 0 0 0 0 0 0 0	ppb) Ti <u>CV</u> 0 ppb) Ti <u>CV</u> 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	<ul> <li>P - Ortho P</li> <li>Mean</li> <li>O</li> <li>O</li> <li>Mean</li> <li>1</li> <li>O</li> <li>O</li></ul>	P (ppb) HC <u>CV</u> 0 P (ppb) HC <u>CV</u> 0 0 0 0 0 0 0 0 0 0 0 0 0	DD (ppb/day) <u>Mean</u> 0 DD (ppb/day) <u>Mean</u> 1 0 0 0 0 0 0 0 0 0 0 0 0 0	rganic N Mean 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	MOD (ppb/ <u>Mean</u> 0 MOD (ppb/ <u>Mean</u> 1 1 (ppb) <u>CV</u> 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	day) <u>CV</u> 0 day) <u>CV</u> 0
<u>∍eq</u> 1 Segma 1 Tributa 1 2 3 4 5 6 7 8 9	Mean 0 ent Calibration Factors Dispersion Rate <u>Mean</u> 1 ary Data <u>Trib Name</u> Inlet 1 CA 10.4 Inlet 2 (D1) Direct (D2) Burandt Subwatershed Winkler Subwatershed Benton Subwatershed Benton Subwatershed Inlet CA 10.4 Septics Inlet D1	<u>cv</u> 0 <u>cv</u> 0 <u>s</u>	iotal P (ppb) <u>Mean</u> 197 <u>Mean</u> 1 <u>Segment</u> 1 1 1 1 1 1 1 1 1 1	CV 0 CV 0 CV 0 TVPe 1 1 1 1 1 1 1 3 3	Mean         1856           Fotal N (ppb)         Mean           1856         1           Dr Area         Floo <u>km²</u> 57.7           1.2         0.39           43.6         49.2           14.7         9.1           0         0	Cl <u>CV</u> 0 Cl <u>CV</u> 0 0 0 0 0 0 0 0 0 0 0 0 0	hl-a (ppb) <u>Mean</u> 56 hl-a (ppb) <u>Mean</u> 1 0.1 0.1 0.1 0 0 0 0 0 0 0 0 0 0 0 0 0	56 <u>CV</u> 0 50 50 50 50 50 50 50 50 50	ecchi (m) <u>Mean</u> 0.68 ecchi (m) <u>Mean</u> 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	) or <u>CV</u> 0 <b>O</b> <b>CV</b> 0 <b>Total P (ppb)</b> <u>Mean</u> 287.1 292.6 323.9 239.3 256.7 294.5 244.1 4093 37.5	ganic N (( Mean 0 ganic N (( <u>Mean</u> 1 1 7 <u>CV</u> 0.2 0.2 0.2 0.2 0 0 0 0 0 0 0 0 0 0 0 0	ppb) Ti <u>CV</u> 0 ppb) Ti <u>CV</u> 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	<ul> <li>P - Ortho P</li> <li>Mean</li> <li>O</li> <li>O</li> <li>Mean</li> <li>1</li> <li>O</li> <li>O</li></ul>	P (ppb) HC CV 0 P (ppb) HC CV 0 Prtho P (ppb Mean 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	DD (ppb/day) <u>Mean</u> 0 DD (ppb/day) <u>Mean</u> 1 0 0 0 0 0 0 0 0 0 0 0 0 0	rganic N <u>CV</u> 0 <u>CV</u> 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	MOD (ppb/i <u>Mean</u> 0 MOD (ppb/i <u>Mean</u> 1 1 (ppb) <u>CV</u> 0 0 0 0 0 0 0 0 0 0 0 0 0	day) cv 0 day) <u>cv</u> 0

### **B.3.5 2004 Mass Balance**

#### Miller Lake

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0 ver	all Wat	er Bal	lance		Averagir	ng Period =	1.00 years		
				Area	Flow	Variance	cv	Runoff	
<u>Trb</u>	Туре	Seg	Name	<u>km<sup>2</sup></u>	<u>hm³/yr</u>	<u>(hm3/yr)<sup>2</sup></u>	2	m/yr	
1	1	1	Inlet 1 CA 10.4	57.7	8.6	7.36E-01	0.10	0.15	
2	1	1	Inlet 2 (D1)	1.2	0.2	3.24E-04	0.10	0.15	
3	1	1	Direct (D2)	0.4	0.0	1.60E-05	0.10	0.10	
4	1	1	Burandt Subwatershed	43.6	4.1	0.00E+00	0.00	0.09	
5	1	1	Winkler Subwatershed	49.2	7.2	0.00E+00	0.00	0.15	
6	1	1	Reitz Subwatershed	14.7	1.9	0.00E+00	0.00	0.13	
7	1	1	Benton Subwatershed	9.1	1.3	0.00E+00	0.00	0.14	
8	3	1	Inlet CA 10.4 Septics		0.1	0.00E+00	0.00		
9	3	1	Inlet D1		0.1	0.00E+00	0.00		
10	3	1	Direct Septics		0.1	0.00E+00	0.00		
PREC	IPITATI	ЛC		0.6	0.3	4.68E-03	0.20	0.60	
TRIBU	JTARY I	NFLO	W	175.9	23.2	7.36E-01	0.04	0.13	
POIN	T-SOUF	CE IN	FLOW		0.3	0.00E+00	0.00		
***T(	OTAL IN	IFLOW	1	176.5	23.9	7.41E-01	0.04	0.14	
ADVE	CTIVE (	DUTFL	.ow	176.5	23.5	7.56E-01	0.04	0.13	
***T(	OTAL O	UTFLC	W	176.5	23.5	7.56E-01	0.04	0.13	
***E'	VAPOR	ATION	l		0.4	1.43E-02	0.30		

Overall Mass Balance Based Upon Predicted Outflow & Reservoir Conc							nc entra	tions				
Com	ponent	:		TOTAL P								
				Load	L	oad Varianc.	e		Conc	Export		
<u>Trb</u>	<u>Type</u>	Seq	<u>Name</u>	<u>kq/vr</u>	<u>%Total</u>	<u>(kg/yr)<sup>2</sup></u>	<u>%Total</u>	<u>cv</u>	mg/m <sup>3</sup>	kg/km²/yr		
1	1	1	Inlet 1 CA 10.4	2463.3	36.5%	3.03E+05	99.9%	0.22	287.1	42.7		
2	1	1	Inlet 2 (D1)	52.7	0.8%	1.39E+02	0.0%	0.22	292.6	43.9		
3	1	1	Direct (D2)	13.0	0.2%	8.39E+00	0.0%	0.22	323.9	33.2		
4	1	1	Burandt Subwatershed	974.0	14.4%	0.00E+00		0.00	239.3	22.3		
5	1	1	Winkler Subwatershed	1835.4	27.2%	0.00E+00		0.00	256.7	37.3		
6	1	1	Reitz Subwatershed	565.4	8.4%	0.00E+00		0.00	294.5	38.5		
7	1	1	Benton Subwatershed	312.4	4.6%	0.00E+00		0.00	244.1	34.3		
8	3	1	Inlet CA 10.4 Septics	409.3	6.1%	0.00E+00		0.00	4093.0			
9	3	1	Inlet D1	3.8	0.1%	0.00E+00		0.00	37.5			
10	3	1	Direct Septics	5.0	0.1%	0.00E+00		0.00	50.1			
PREC	IPITATI	ON		11.4	0.2%	3.25E+01	0.0%	0.50	33.3	20.0		
INTE	RNAL LO	DAD		104.1	1.5%	0.00E+00		0.00				
TRIB	UTARY I	NFLO	W	6216.2	92.1%	3.04E+05	100.0%	0.09	267.7	35.3		
POIN	T-SOUF	RCE IN	FLOW	418.1	6.2%	0.00E+00		0.00	1393.5			
***T	OTAL IN	IFLOW	1	6749.7	100.0%	3.04E+05	100.0%	0.08	282.9	38.3		
ADVI	ECTIVE (	DUTFL	.OW	4664.1	69.1%	5.38E+05		0.16	198.8	26.4		
***T	OTAL O	UTFLC	W	4664.1	69.1%	5.38E+05		0.16	198.8	26.4		
***R	ETENTI	ON		2085.6	30.9%	4.56E+05		0.32				
Overflow Rate (m/sr)			e (m/vr)	41.2	Nutrient Resid Time (vrs				0.0376			
Overflow Rate (m/yr) Hydraulic Rosid, Timo (yrs)			sid Time (vrs)	0.0544	2 Nuthent Resid. Time (yr 4 Turnover Batio				26.6			
Hydraulic Resid. Time (yrs) Reservoir Conc (mg/m3)			nc (mg/m3)	199	199 Retention Coef. 0.309							
				200								

# **B.3.6 2004 Predicted vs. Observed**

Miller Lake

File: S:\Water\Water Monitoring\TMDL\TMDL\Lake TMDLs\Draft TMDL

Segment:	1 M	iller lake				
	Predicted Va	lues>		Observed Val	ues>	
<u>Variable</u>	<u>Mean</u>	<u>cv</u>	<u>Rank</u>	<u>Mean</u>	<u>cv</u>	<u>Rank</u>
TOTAL P MG/M3	198.8	0.15	94.3%	197.0		94.2%
TOTALN MG/M3	1856.0		83.2%	1856.0		83.2%
C.NUTRIENT MG/M3	115.6	0.05	92.9%	115.3		92.9%
CHL-A MG/M3	44.1	0.29	97.8%	56.0		99.0%
SECCHI M	0.6	0.17	18.9%	0.7		27.1%
ORGANIC N MG/M3	1249.8	0.26	97.1%			
TP-ORTHO-P MG/M3	101.7	0.26	90.1%			
ANTILOG PC-1	2228.9	0.30	95.4%	1946.3		94.3%
ANTILOG PC-2	10.9	0.21	84.2%	15.1		94.8%
(N - 150) / P	8.6	0.15	15.8%	8.7		16.1%
INORGANIC N / P	6.2	0.52	5.8%			
TURBIDITY 1/M	1.1	0.20	76.5%	1.1	0.20	76.5%
ZMIX * TURBIDITY	2.5	0.23	38.9%	2.5	0.23	38.9%
ZMIX / SECCHI	4.0	0.19	37.9%	3.2	0.12	25.2%
CHL-A * SECCHI	24.4	0.26	89.1%	38.1		96.9%
CHL-A / TOTAL P	0.2	0.31	57.8%	0.3		72.1%
FREQ(CHL-a>10) %	98.1	0.02	97.8%	99.3		99.0%
FREQ(CHL-a>20) %	83.3	0.14	97.8%	91.2		99.0%
FREQ(CHL-a>30) %	62.3	0.28	97.8%	75.7		99.0%
FREQ(CHL-a>40) %	44.0	0.41	97.8%	59.2		99.0%
FREQ(CHL-a>50) %	30.4	0.53	97.8%	44.9		99.0%
FREQ(CHL-a>60) %	21.0	0.64	97.8%	33.7		99.0%
CARLSON TSI-P	80.5	0.03	94.3%	80.3		94.2%
CARLSON TSI-CHLA	67.8	0.04	97.8%	70.1		99.0%
CARLSON TSI-SEC	68.6	0.04	81.1%	65.6		72.9%

	<b>B.4 Winkle</b>	r Lal	<b>ce</b>														1			
	D 4 1 2001 I.															ael Coemc	ients		<u>ivieari</u>	0.70
	B.4.1 2001 In	puts													Disp	persion Kati	e		1.000	0.70
winkle	B.4.2.2001.M	ass Ba	alance												1018	al Phosphol	rus		1.000	0.45
File	S:))A(ater))A(ater Moni	itorina)TM		ake TMDI	s)Draft TMD	to MPCA	Five Lake	TMDI Undi	Licubiyi	akes)MinkleriN	lodels)i in	dated winkl	erî)1 mon	itored data l	th del	a Madal			1.000	0.55
Descr	intion	conng ini			Sibrare mib				i i i u u u i u	ares armirier ar	loacistop	Matea Willing	eror_mon	ntor eu_uutu.	Series	shi Madal			1.000	0.20
Globa	l Variables	Mean	CV		M	ndel Ontio	ns		Code	Description					Orm	onin N Maa			1.000	0.10
Avera	aing Period (vrs)	1	0.0		<u></u>	ncorvativo	Substance		0		FD					OD Model	161		1.000	0.12
Precin	itation (m)	0.74	0.0		Ph	inschorus F	Balance		8	CANE & BACH	LAKES				HOD	Dr Model			1.000	0.15
Evano	ration (m)	0.7	0.3		Ni	trogen Bal:	ance		0	NOT COMPUT	FD				MO	Dy Model			1.000	0.15
Storag	re Increase (m)	0	0.0		Ch	lorophyll-a	1		1	P. N. LIGHT, T					Sec	chi/ChlaSle	ne (m²/mơ)		0.015	0.22
	,,	-			Se	cchi Depth	-		1	VS. CHLA & TU	IRBIDITY				Min	imum Os fr	m /vr)		0.100	0.00
Atmo	s. Loads (kg/km <sup>2</sup> -yr)	Mean	cv		Di	spersion			1	FISCHER-NUM	ERIC				chl-	a Flushing	Term		1 0 0 0	0.00
Conse	rv. Substance	0	0.00		Ph	osphorus (	Calibration		1	DECAY RATES					Chl-	a Tempora	I CV		0.620	0
To tal F	2	20	0.50		Nī	trogen Cali	bration		1	DECAY RATES					Ava	il. Factor - T	Total P		0.330	- 0
To tal I	N	1000	0.50		En	ror Analysi	5		1	MODEL & DAT	A				Ava	il. Factor - 0	Ortho P		1.930	0
Ortho	Р	15	0.50		Av	ailability F	actors		0	IGNORE					Ava	il. Factor - T	Total N		0.590	0
Inorga	anicN	500	0.50		M	ass-Balanci	e Tables		1	USE ESTIMATE	D CONCS				Ava	il. Factor - I	norganic N		0.790	0
					Ou	utput Desti	nation		2	EXCEL WORKS	HEET						-			
Soam	ent Membersetry													nternal Leade	(maim?	(veb-				
Jegin	encinorphonieuy		utflow		Area	Denth	Lonath N	lived Dent	n (m)	Hynal Denth	N	lon-Algal Tu	urb (m <sup>·1</sup> )	Concerv	, (ingrinz Tr	ntal P	Те	tal N		
Sed	Name	5	ieament	Group	km <sup>2</sup>	m	km	Mean	с\ С\	/ Mean	CV	Mean	CV	Mean	cv .	Mean	CV .	Mean	cv	
1	Winkler	-	0	1	0.29	0.6	0.5	0.6	0.12	2 0	0	1.07	0.2	0	0	5	0	0	0	
Seam	ent Observed Water Q	uality																		
o ogini	Conserv	T	otal P (ppb	) T	Fotal N (ppb)	c	hl-a (ppb)	s	ecchi (m	n) Or	aanic N (i	TT (daa	- Ortho F	OH (daa)	D (ppb/da	ιν) Μ	IOD (ppb/da	av)		
Sea	Mean	cv	Mean	, cv	Mean	cv	Mean	CV	Mear	n CV	Mean	CV	Mean	CV	Mean	CV	Mean	°″ cv		
1	0	0	297	0	2000	0	57	0	0.52	2 0	0	0	0	0	0	0	0	0		
Seam	ent Calibration Factors																			
oegiii	Dispersion Rate	- т	otal P (ppb	.) 1	Fotal N (ppb)	c	hl-a (ppb)	s	iecchi (m	ı) Or	aanic N (i	TF (daa	- Ortho F	OH (dag)	D (ppb/da	.v) M	10D (ppb/da	av)		
Seg	Mean	cv	Mean	, cv	Mean	cv	Mean	cv	Mear	n CV	Mean	CV CV	Mean	CV	Mean	τς CV	Mean	°, cv		
1	1	0	1	0	1	0	0.6	0	:	L 0	1	0	1	0	1	0	1	0		
Tribut	tary Data																			
				[	Dr Area 🛛 Fl	ow (hm³/yı	r) (	onserv.		Total P (ppb)	т	'otal N (ppb)	· C	Ortho P (ppb)	In	organic N	(ppb)			
<u>Trib</u>	<u>Trib Name</u>	<u>s</u>	egment	Туре	<u>km²</u>	<u>Mean</u>	<u>cv</u>	<u>Mean</u>	<u>C\</u>	<u>Mean</u>	<u>cv</u>	<u>Mean</u>	<u>cv</u>	<u>Mean</u>	<u>cv</u>	<u>Mean</u>	<u>CV</u>			
1	CC9 (Inlet 2)		1	1	9.3	1.49	0.1	0	(	) 313	0.2	0	0	0	0	0	0			
2	CO8 (Inlet 3)		1	1	2	0.27	0.1	0	(	) 355.8	0.2	0	0	0	0	0	0			
3	Direct		1	1	1.1	0.12	0.1	0	(	) 410	0.2	0	0	0	0	0	0			
4	Inlet 1		1	1	0.5	0.09	0	0	(	) 294.3	0	0	0	0	0	0	0			
5	Inlet 1 Septic		1	3	0.01	0.1	0	0	(	) 12.5	0	0	0	0	0	0	0			
6	Inlet 2 Septic		1	3	0.01	0.1	0	0	(	) 613.3	0	0	0	0	0	0	0			
7	Inlet 3 Septic		1	3	0.01	0.1	0	0	(	) 863.6	0	0	0	0	0	0	0			
8	Direct Septic		1	3	0.01	0.1	0	0	(	) 25	0	0	0	0	0	0	0			
9	Rice Subwatershed		1	1	18.5	2.56	0	0	(	321	0	0	0	0	0	0	0			
10	Barlous Subwatershee	d	1	1	3.8	0.48	0	0	(	) 300.3	0	0	0	0	0	0	0			
11	Hydes Subwatershed		1	1	12.8	1.63	0	0	(	321.2	0	0	0	0	0	0	0			

#### winkler\_monitored\_data

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Over	all Wat	er Ba	lance		Averagir	ng Period =	1.00 y	/ears
				Area	Flow	Variance	cv	Runoff
<u>Trb</u>	Туре	Seg	Name	<u>km<sup>2</sup></u>	hm <sup>3</sup> /vr	<u>(hm3/yr)<sup>2</sup></u>	-	<u>m/yr</u>
1	1	1	CC9 (Inlet 2)	9.3	1.5	2.22E-02	0.10	0.16
2	1	1	CC8 (Inlet 3)	2.0	0.3	7.29E-04	0.10	0.14
3	1	1	Direct	1.1	0.1	1.44E-04	0.10	0.11
4	1	1	Inlet 1	0.5	0.1	0.00E+00	0.00	0.18
5	3	1	Inlet 1 Septic	0.0	0.1	0.00E+00	0.00	10.00
6	3	1	Inlet 2 Septic	0.0	0.1	0.00E+00	0.00	10.00
7	3	1	Inlet 3 Septic	0.0	0.1	0.00E+00	0.00	10.00
8	3	1	Direct Septic	0.0	0.1	0.00E+00	0.00	10.00
9	1	1	Rice Subwatershed	18.5	2.6	0.00E+00	0.00	0.14
10	1	1	Barlous Subwatershed	3.8	0.5	0.00E+00	0.00	0.13
11	1	1	Hydes Subwater shed	12.8	1.6	0.00E+00	0.00	0.13
PREC	ΙΡΠΑΤΙ	ON		0.3	0.2	1.84E-03	0.20	0.74
TRIBU	JTARY I	NFLO	W	48.0	6.6	2.31E-02	0.02	0.14
POIN	T-SOUR	CE IN	FLOW	0.0	0.4	0.00E+00	0.00	10.00
***TOTAL INFLOW				48.3	7.3	2.49E-02	0.02	0.15
ADVECTIVE OUTFLOW				48.3	7.1	2.86E-02	0.02	0.15
***TOTAL OUTFLOW				48.3	7.1	2.86E-02	0.02	0.15
***E	VAPOR	ATION	I		0.2	3.71E-03	0.30	

Over Com	Overall Mass Balance Based Upon Component:			Predicted TOTAL P		Outflow & R	teservoir Co	ncentra	tions			
				Load	L	.oad Variand	e		Conc	Export		
<u>Trb</u>	Туре	<u>Seg</u>	<u>Name</u>	<u>kg/yr</u>	<u>%Total</u>	<u>(ka/vr)<sup>2</sup></u>	<u>%Total</u>	<u>cv</u>	<u>ma/m<sup>3</sup></u>	<u>ka/km²/yr</u>		
1	1	1	CC9 (Inlet 2)	466.4	16.6%	1.09E+04	94.8%	0.22	313.0	50.1		
2	1	1	CC8 (Inlet 3)	96.1	3.4%	4.61E+02	4.0%	0.22	355.8	48.0		
3	1	1	Direct	49.2	1.7%	1.21E+02	1.1%	0.22	410.0	44.7		
4	1	1	Inlet 1	26.5	0.9%	0.00E+00		0.00	294.3	53.0		
5	3	1	Inlet 1 Septic	1.3	0.0%	0.00E+00		0.00	12.5	125.0		
6	3	1	Inlet 2 Septic	61.3	2.2%	0.00E+00		0.00	613.3	6133.0		
7	3	1	Inlet 3 Septic	86.4	3.1%	0.00E+00		0.00	863.6	8636.0		
8	3	1	Direct Septic	2.5	0.1%	0.00E+00		0.00	25.0	250.0		
9	1	1	Rice Subwatershed	821.8	29.2%	0.00E+00		0.00	321.0	44.4		
10	1	1	Barlous Subwatershed	144.1	5.1%	0.00E+00		0.00	300.3	37.9		
11	1	1	Hydes Subwater shed	523.6	18.6%		0.00	321.2	40.9			
PREC	IP ITATI	ON		5.8	0.2%	8.41E+00	0.1%	0.50	27.0	20.0		
INTE	RNAL LO	DAD		529.6	18.8%	0.00E+00		0.00				
TRIB	UTARY I	NFLO	W	2127.6	75.6%	1.15E+04	99.9%	0.05	320.4	44.3		
POIN	IT-SOUR	CE IN	FLOW	151.4	5.4%	0.00E+00		0.00	378.6	3786.0		
***T	OTAL IN	IFLOV	V	2814.4	100.0%	1.15E+04	100.0%	0.04	388.0	58.2		
ADVI	ECTIVE (	OUTFI	LOW	2102.8	74.7%	6.23E+04		0.12	298.2	43.5		
***T	OTAL O	UTFL	WC	2102.8	74.7%	6.23E+04		0.12	298.2	43.5		
***R	ETENTI	ON		711.6	25.3%	5.75E+04		0.34				
Overflow Rate (m/yr)		24.3	1	l. Time (yrs)	s) 0.0184							
Hydraulic Resid. Time (yrs)			sid. Time (yrs)	0.0247	T	urnover Rati	0		54.2			
Reservoir Conc (mg/m3)			nc (mg/m3)	298	298 Retention Coef. 0.253							

### **B.4.3 2001 Predicted vs. Observed**

winkler\_monitored\_data

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Segment:	1 W	finkler				
	Predicted Va	lues>		Observed Va	lues>	
<u>Variable</u>	<u>Mean</u>	<u>cv</u>	<u>Rank</u>	<u>Mean</u>	<u>cv</u>	<u>Rank</u>
TOTAL P MG/M3	298.2	0.12	97.9%	297.0		97.9%
TOTAL N MG/M3	2000.0		86.0%	2000.0		86.0%
C.NUTRIENT MG/M3	136.9	0.02	95.4%	136.8		95.3%
CHL-A MG/M3	56.7	0.27	99.0%	57.0		99.0%
SECCHI M	0.5	0.18	16.9%	0.5		16.8%
ORGANIC N MG/M3	1529.3	0.26	98.9%			
TP-ORTHO-P MG/M3	122.1	0.27	93.0%			
ANTILOG PC-1	3121.9	0.29	97.4%	2541.4		96.3%
ANTILOG PC-2	12.4	0.18	89.5%	12.4		89.5%
(N - 150) / P	6.2	0.12	6.9%	6.2		7.0%
INORGANIC N / P	2.7	0.76	0.8%			
TURBIDITY 1/M	1.1	0.20	73.9%	1.1	0.20	73.9%
ZMIX * TURBIDITY	0.6	0.23	2.0%	0.6	0.23	2.0%
ZMIX / SECCHI	1.2	0.20	0.7%	1.2	0.12	0.7%
CHL-A * SECCHI	29.5	0.22	93.3%	29.6		93.4%
CHL-A / TOTAL P	0.2	0.28	48.0%	0.2		48.7%
FREQ(CHL-a>10) %	99.4	0.01	99.0%	99.4		99.0%
FREQ(CHL-a>20) %	91.5	0.07	99.0%	91.6		99.0%
FREQ(CHL-a>30) %	76.3	0.17	99.0%	76.6		99.0%
FREQ(CHL-a>40) %	59.9	0.27	99.0%	60.3		99.0%
FREQ(CHL-a>50) %	45.7	0.37	99.0%	46.1		99.0%
FREQ(CHL-a>60) %	34.4	0.46	99.0%	34.7		99.0%
CARLSON TSI-P	86.3	0.02	97.9%	86.3		97.9%
CARLSON TSI-CHLA	70.2	0.04	99.0%	70.3		99.0%
CARLSON TSI-SEC	69.4	0.04	83.1%	69.4		83.2%

# **B.4.4 2005 Inputs**

Intel         Status         Status </th <th>winkle</th> <th>er monitored data</th> <th></th> <th><u>M</u> D</th> <th>lodel Coeffi ispersion Ra</th> <th>icients ate</th> <th></th> <th><u>Mean</u> 1.000</th> <th><u>CV</u> 0.70</th>	winkle	er monitored data														<u>M</u> D	lodel Coeffi ispersion Ra	icients ate		<u>Mean</u> 1.000	<u>CV</u> 0.70												
Description:	File:	S:\Water\Water Mon	itorina\TM		ake TMDL	.s\Draft TMD	L to MPCA	Five Lake	TMDL\Ind	lividual L	akes\Winkler\N	/lodels\up	ated winkle	er05 mon	itored data	.btb	otal Phosph	orus		1.000	0.45												
Sighal/Catalities         Main         CV         Model Options         Cate         Description         Descript	Descri	iption:													-	T	otal Nitroge	n		1.000	0.55												
Americange Previod (yn)         1         0.0         Conservative Substance         0         NOT COMPUTED         Security Substance         0.00         0.03           Verophation (m)         0.7         0.3         NYTragen Datance         0         NOT COMPUTED         Tragen American         1000         0.03           Strage Increase (m)         0.7         0.3         NYTragen Datance         0         NOT COMPUTED         Tragen American         1000         0.03           Strage Increase (m)         0.0         0.0         Christershyll-3         1         NYT COMPUTED         MCDN Medel         1000         0.03           Strage Increase (m)         0         0.00         Phosphore (Calibration         1         DCCAY ARTS         MCDN Medel         1.000         0.00           Grane X. State Schem" American         0         0.5.0         NTragen Charafies         1         MCDX ARTS         McDI Schem" Trait N         0.030         0.030         0.030         0.030         0.030         0.00         0.030         0.00         0.030         0.00         0.030         0.00         0.030         0.00         0.03         0.00         0.00         0.01         0.030         0.00         0.01         0.02         0.01         0.01	Globa	l Variables	Mean	cv		м	lodel Option	ıs		Code	Description					C C	hi-a Model			1.000	0.26												
Production (m)         1.1         0.2         Prospheruse Barrise         8         CALE & BAGU, LAKES         The program (m)         1.1         0.20         1.1         0.00	Avera	zing Period (vrs)	1	0.0		<u></u>	onservative	 Substance		0	NOT COMPUT	FD				5	ecchi Model	   -		1.000	0.10												
Decomposition (m)         0.7         0.3         Ntragen Balance         0         NDT COMPUTED         HCD TOMPUTED         HCD	Predo	itation (m)	1.1	0.2		P	hosphorus B	alanœ		8	CANE & BACH.	. LAKES				т т	rganic N Model	bael		1.000	0.12												
Starge liver.exe (n)         0.0         Othersphyles         1         P, M, UHT, T         MOD, Marail         1.000         0.00 <td>Evanor</td> <td>ration (m)</td> <td>0.7</td> <td>0.3</td> <td></td> <td>N</td> <td>itrogen Bala</td> <td>nce</td> <td></td> <td>0</td> <td>NOT COMPUT</td> <td>FD</td> <td></td> <td></td> <td></td> <td>н</td> <td>ODv Model</td> <td></td> <td></td> <td>1.000</td> <td>0.15</td>	Evanor	ration (m)	0.7	0.3		N	itrogen Bala	nce		0	NOT COMPUT	FD				н	ODv Model			1.000	0.15												
Second Depth         1         VS_GUL6 Xites (MiRQ) TY         Second Depth         1         VS_GUL6 Xites (MiRQ) TY         Second Depth         0.013         0.00           Conserv-Substance         0         0.00         Phorphorus Gillbration         1         PSCH28 Xites (MiRQ) TY         Mirphane         0.013         0.00           Conserv-Substance         0         0.00         Phorphorus Gillbration         1         DECAY ARTS         Other Housing IV         0.03         0.00           Conserv-Substance         Conserv-Substance         Conserv-Substance         Other Housing IV         0.03         0.00           Total N         100         0.50         Kranz Analysis         1         MODE: SONA         Avail Factor - Total P         0.33         0           Ontho P         100         0.50         Avail Factor - Total P         0.33         0         Avail Factor - Total P         0.33         0           Segment Morphonetry         Segment Sona         Segment S	Storag	e Increase (m)	0	0.0		d	hlorophyll-a	c		1	P. N. LIGHT, T					N	10Dv Model	I.		1.000	0.15												
Atmos Loads Kathm <sup>2</sup> vn         Mean         CV         Depersion         1         FSOLER AURSLOW         Methods         Methods         Out         Methods         Out         Methods         Out         Methods         Out         Out         Out         Out         Methods         Out	0.01.06	e morease (m)	-			Se	ecchi Denth			1	VS. CHIA& TU	IRBIDITY				Si	ecchi/ChlaS	Slope (m²/mg	6	0.015	0.00												
Conserve Substance         M         O         O         Phospherus Calibration         1         DECK         Name         OHA         Fluid P         Mole         Mole <th< td=""><td>Atmos</td><td>s. Loads (kɑ/km²-vr)</td><td>Mean</td><td>CV</td><td></td><td>а П</td><td>isnersion</td><td></td><td></td><td>1</td><td>EISCHER-NUM</td><td>IFRIC</td><td></td><td></td><td></td><td>N</td><td>linimum Qs</td><td>(m/vr)</td><td>,,</td><td>0.100</td><td>0.00</td></th<>	Atmos	s. Loads (kɑ/km²-vr)	Mean	CV		а П	isnersion			1	EISCHER-NUM	IFRIC				N	linimum Qs	(m/vr)	,,	0.100	0.00												
Tayal P         20         0.50         Mitragen Calimation         1         DECM Parts / Construct         OH Tayal N / Construct         OH Construct	Conser	ry Substance	<u>nieun</u>	0.00		PI	hosphorus (	alibration		1	DECAY RATES	Ente				d	hl-a Flushing	g Term		1.000	0.00												
Image         Image <th< td=""><td>Total P</td><td>)</td><td>20</td><td>0.00</td><td></td><td>N</td><td>itrogen Celik</td><td>vision</td><td></td><td>1</td><td>DECAY RATES</td><td></td><td></td><td></td><td></td><td>d</td><td>hl-a Tempoi</td><td>ral CV</td><td></td><td>0.620</td><td>0</td></th<>	Total P	)	20	0.00		N	itrogen Celik	vision		1	DECAY RATES					d	hl-a Tempoi	ral CV		0.620	0												
Logan         Loga         Logan         Logan <thl< td=""><td>Total</td><td></td><td>1000</td><td>0.50</td><td></td><td></td><td>ru ogen can. rar Anolycia</td><td>Jacon</td><td></td><td>1</td><td></td><td>- A</td><td></td><td></td><td></td><td>A</td><td>vail. Factor</td><td>- Total P</td><td></td><td>0.330</td><td>0</td></thl<>	Total		1000	0.50			ru ogen can. rar Anolycia	Jacon		1		- A				A	vail. Factor	- Total P		0.330	0												
Onlog         Dia         Dia         Dia         Dia         Output Packadas         Dia         Normalia         Aueli, Factor - Total N         Output Destination         Dia	Ortho	D	1000	0.50			uoilobility Eo	store		0		~				A	vail. Factor	- Ortho P		1.930	0												
Miningenicity         Sol         Outsol         Mises balances         1         Ougset Destination         2         EXCEL WORKSHEET         Avail. Factor - Integrant N         0.790         0           Segment Morphometry	lange	r 	10	0.50			Valiau III Ly Fa Jose Delense	Tobles		1	LISE ESTIMATE					A	vail. Factor	-Total N		0.590	0												
Segment Morphometry         Duttlow         Area 0         Depth Length Mixed Depth (m)         Hypol Depth         Non-Algal Turb (m')         Conserv.         Total P         Total N           Sea         Numke         Seament         Group         Mm         M         Mean         CV         Mea	morga	ITICIN	300	0.50		IV IV	utaut Destin	tables		2		U CUNCS				A	vail. Factor	- Inorganic N		0.790	0												
Segure to protect with the protocol of the protect with the protocol of the protocol occl of the protocol occl occl occl occl occl occl						0	utput Destir	ation		2	EACEL WORKS																						
Outfow         Area Seament         Oppth Winder         Length Mixed Depth (m) Mixed         Wean         CV         Mean         CV         Mea	Segm	ent Morphometry												1	nternal Loa	ds (mg/mź	2-day)																
Sea         Name         Seament         Group         Km <sup>2</sup> m         km         Mean         CV         Mean			c	Dutflow		Area	Depth	Length M	lixed Dept	h (m)	Hypol Depth	N	on-Algal Tu	rb (m <sup>-1</sup> )	Conserv.	T	otal P	٦	'otal N														
1       Winkler       0       1       0.29       0.6       0.5       0.6       0.12       0       0.01       0.2       0       0       13       0       0       0         Segment Conserved Water Quality       Conserved Water Quality       Total P (ppb)       Total P (ppb)       Total P (ppb)       Chi-a (ppb)       Secchi (m)       Organic N (ppb)       TP - Ortho P (pb)       HOD (ppb/day)       Most       CV       Mean       <	Seg	<u>Name</u>	5	Segment	Group	<u>km<sup>2</sup></u>	<u>m</u>	<u>km</u>	<u>Mean</u>	<u>cv</u>	<u>Mean</u>	<u>cv</u>	<u>Mean</u>	<u>cv</u>	<u>Mean</u>	<u>cv</u>	<u>Mean</u>	<u>cv</u>	<u>Mean</u>	<u>cv</u>													
Sement Observed Water Quality         Conserv         Total P (ppb)         Total N (pp)         Chi-a (ppb)         Secchi (m)         Organic N (ppb)         Total N (ppb)         HOD (ppb/day)         MOD (ppb/day)         MO	1	Winkler		0	1	0.29	0.6	0.5	0.6	0.12	2 0	0	0.01	0.2	0	0	13	0	0	0													
Organic Node Value         Total P (ppb)         Total N (ppb)         Chi-a (ppb)         Secchi (m)         Organic N (ppb)         TP - Ortho P (ppb)         HOD (ppb/day)         MOD (ppb/day)           Seg         Mean         CV         Mean	Seam	ent Observed Mater C	wality																														
Sea         Mean         CV         Mean         CV <td>Segin</td> <td>Conserv</td> <td>ruanty T</td> <td>otal P (ppb)</td> <td>· ·</td> <td>Total N (ppb</td> <td>) CF</td> <td>ıl-a (ppb)</td> <td></td> <td>Secchi (m</td> <td>i) On</td> <td>aanic N fo</td> <td>ob) TP</td> <td>- Ortho I</td> <td>P(pob) H</td> <td>OD (ppb/dz</td> <td>1 (ve</td> <td>MOD (ppb/</td> <td>davì</td> <td></td> <td></td>	Segin	Conserv	ruanty T	otal P (ppb)	· ·	Total N (ppb	) CF	ıl-a (ppb)		Secchi (m	i) On	aanic N fo	ob) TP	- Ortho I	P(pob) H	OD (ppb/dz	1 (ve	MOD (ppb/	davì														
Intent         Or         Intent         Intent         Intent         Intent	Sea	Mean	CV.	Mean	, cv	Mean	, cv .	Mean	CV.	Mean	сv СV	Mean	сv	Mean	CV (04	Mean	~,, сv	Mean	, CV														
Seguent Calibration Factors           Dispersion Rato         Total P (ppb)         Total N (ppb)         Chl-a (ppb)         Seechi (m)         Organic N (ppb)         TP - Ortho P (ppb)         HOD (ppb/dav)         MOD (ppb/dav)           Seg         Mean         CV         Mean         CV <td><u>) eg</u> 1</td> <td>0</td> <td>0</td> <td>283</td> <td>0</td> <td>3230</td> <td>0</td> <td><u>101eann</u> 71</td> <td>0</td> <td>0.525</td> <td><u> </u></td> <td>0</td> <td>0</td> <td><u>niean</u> 0</td> <td>0</td> <td>0</td> <td>0</td> <td><u>inean</u> 0</td> <td>0</td> <td></td> <td></td>	<u>) eg</u> 1	0	0	283	0	3230	0	<u>101eann</u> 71	0	0.525	<u> </u>	0	0	<u>niean</u> 0	0	0	0	<u>inean</u> 0	0														
Segment Calibration Factors           Dispersion Rate         Total P (ppb)         Total N (ppb)         Chi-a (ppb)         Segment N (ppb)         Total P (ppb)         Mean         CV         Mean <th c<="" colspan="12" td=""><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></th>	<td></td>																																
Dispersion Rate         Total P (ppb)         Total N (ppb)         CM-a (ppb)         Seach (m)         Organic N (ppb)         TP - Ortho P (ppb)         HOD (ppb)day)         MOD (ppb)day)           Seg         Mean         CV         Mean	Segmo	ent Calibration Factor	s -				, a												1														
Seg         Mean         CV         Mean         CV <td>•</td> <td>Dispersion Rate</td> <td>~ 1</td> <td>otal P (ppb)</td> <td>)</td> <td>I otal N (ppb</td> <td>) (1</td> <td>ni-a (ppb)</td> <td>~</td> <td>Secchi (m</td> <td>i) Un</td> <td>ganic N (p</td> <td>(10) (11) (11)</td> <td>· - Ortno i</td> <td>- (ppp) H</td> <td></td> <td>ay) r</td> <td></td> <td>day) OV</td> <td></td> <td></td>	•	Dispersion Rate	~ 1	otal P (ppb)	)	I otal N (ppb	) (1	ni-a (ppb)	~	Secchi (m	i) Un	ganic N (p	(10) (11) (11)	· - Ortno i	- (ppp) H		ay) r		day) OV														
1       1       0       1 <th1< th=""> <th1< th=""> <th1< th=""></th1<></th1<></th1<>	Seg	Mean	<u>UV</u>	Mean		Mean		Mean	<u>CV</u>	Mean		Mean		Mean		Mean	<u>UV</u>	Mean	<u>UV</u>														
Tribut         Tribut<	1	1	U	1	U	1	U	U.6	U	1	L U	1	U	1	U	1	U	1	U														
Irib NameSegmentTypeFlow (m²)Conserv.Total P (pp)Total N (pp)Ortho P (pp)Inorganic N (pp)1Irib NameSegmentTypeManCVMeanCVMeanCVMeanCVMeanCV1CC9 (Inle 2)119.32.160.102160.20000002CC8 (Inle 3)110.30.100245.50.20000003Direct septic11.10.170.10025.50.200000004Direct septic11.010.07000203.10000000005Inlet 110.050.1300203.100 <td>Tribut</td> <td>ary Data</td> <td></td>	Tribut	ary Data																															
Trib NameSegmentTypeMm²MeanCVMeanCVMeanCVMeanCVMeanCVMeanCV1CC9 (inlet 2)119.32.160.102160.20000002CC8 (inlet 3)1120.390.10245.50.200000003Direct110.170.1002830.200000004Direct septic130.010.0100255000000005Inlet 110.50.13000203.1000000006Inlet 1 Septic130.010.100215.5000000007Inlet 2 Septic130.010.100137.7000000008Inlet 3 Septic1118.53.7200137.7000000000000000000000000000000000 </td <td></td> <td></td> <td></td> <td></td> <td>I</td> <td>Dr Area 🍦 Fl</td> <td>low (hm³/yr)</td> <td>) с</td> <td>onserv.</td> <td></td> <td>Total P (ppb)</td> <td>T</td> <td>otal N (ppb)</td> <td>C C</td> <td>Ortho P (ppł</td> <td>o) Ir</td> <td>organic N</td> <td>l (ppb)</td> <td></td> <td></td> <td></td>					I	Dr Area 🍦 Fl	low (hm³/yr)	) с	onserv.		Total P (ppb)	T	otal N (ppb)	C C	Ortho P (ppł	o) Ir	organic N	l (ppb)															
1       CC9 (Inlet 2)       1       1       9.3       2.16       0.1       0       0216       0.2       0       0       0       0       0       0         2       CC8 (Inlet 3)       1       1       2       0.39       0.1       0       0245.5       0.2       0       0       0       0       0       0         3       Direct       1       1       0.17       0.1       0       0283       0.2       0       0       0       0       0         4       Direct septic       1       3       0.01       0.0       0       023.1       0 <td><u>Trib</u></td> <td><u>Trib Name</u></td> <td>5</td> <td><u>Segment</u></td> <td>Түре</td> <td><u>km<sup>2</sup></u></td> <td><u>Mean</u></td> <td><u>cv</u></td> <td><u>Mean</u></td> <td><u>cv</u></td> <td><u>Mean</u></td> <td><u>CV</u></td> <td><u>Mean</u></td> <td><u>cv</u></td> <td><u>Mean</u></td> <td><u>cv</u></td> <td><u>Mean</u></td> <td><u>cv</u></td> <td></td> <td></td> <td></td>	<u>Trib</u>	<u>Trib Name</u>	5	<u>Segment</u>	Түре	<u>km<sup>2</sup></u>	<u>Mean</u>	<u>cv</u>	<u>Mean</u>	<u>cv</u>	<u>Mean</u>	<u>CV</u>	<u>Mean</u>	<u>cv</u>	<u>Mean</u>	<u>cv</u>	<u>Mean</u>	<u>cv</u>															
2       CC8 (Inlet 3)       1       1       2       0.39       0.1       0       0245.5       0.2       0       0       0       0       0         3       Direct       1       1       1.1       0.17       0.1       0       283       0.2       0       0       0       0       0         4       Direct septic       1       3       0.01       0.01       0 <t< td=""><td>1</td><td>CC9 (Inlet 2)</td><td></td><td>1</td><td>1</td><td>9.3</td><td>2.16</td><td>0.1</td><td>0</td><td>C</td><td>) 216</td><td>0.2</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td></td><td></td><td></td></t<>	1	CC9 (Inlet 2)		1	1	9.3	2.16	0.1	0	C	) 216	0.2	0	0	0	0	0	0															
3       Direct       1       1       1.1       0.17       0.1       0       283       0.2       0       0       0       0       0       0         4       Direct septic       1       3       0.01       0.01       0	2	CC8 (Inlet 3)		1	1	2	0.39	0.1	0	C	) 245.5	0.2	0	0	0	0	0	0															
4       Direct septic       1       3       0.01       0.01       0       0       25       0	3	Direct		1	1	1.1	0.17	0.1	0	C	) 283	0.2	0	0	0	0	0	0															
5       Inlet 1       1       1       0.5       0.13       0       0       203.1       0	4	Direct septic		1	3	0.01	0.01	0	0	C	) 25	0	0	0	0	0	0	0															
6       Inlet 1 Septic       1       3       0.01       0.1       0       0       12.5       0       0       0       0       0       0         7       Inlet 2 Septic       1       3       0.01       0.1       0       0       613.3       0       0       0       0       0       0       0         8       Inlet 3 Septic       1       3       0.01       0.1       0       0       137.7       0       0       0       0       0       0         9       Rice Subwatershed       1       1       18.5       3.72       0       0       02       0	5	Inlet 1		1	1	0.5	0.13	0	0	C	) 203.1	0	0	0	0	0	0	0															
7       Inlet 2 Septic       1       3       0.01       0.1       0       0       613.3       0       0       0       0       0       0         8       Inlet 3 Septic       1       3       0.01       0.1       0       0       137.7       0       <	6	Inlet 1 Septic		1	3	0.01	0.1	0	0	C	) 12.5	0	0	0	0	0	0	0															
8       Inlet 3 Septic       1       3       0.01       0.1       0       0       137.7       0 <td>7</td> <td>Inlet 2 Septic</td> <td></td> <td>1</td> <td>3</td> <td>0.01</td> <td>0.1</td> <td>0</td> <td>0</td> <td>C</td> <td>) 613.3</td> <td>0</td> <td>0</td> <td>0</td> <td>0</td> <td>0</td> <td>0</td> <td>0</td> <td></td> <td></td> <td></td>	7	Inlet 2 Septic		1	3	0.01	0.1	0	0	C	) 613.3	0	0	0	0	0	0	0															
9         Rice Subwatershed         1         1         18.5         3.72         0         0         221.5         0<	8	Inlet 3 Septic		1	3	0.01	0.1	0	0	C	) 13 <b>7.7</b>	0	0	0	0	0	0	0															
10       Hydes Subwatershed       1       1       12.8       2.36       0       0       221.6       0       0       0       0       0       0         11       Barlous Subwatershed       1       1       3.8       0.7       0       0       207.2       0       0       0       0       0       0	9	Rice Subwatershed		1	1	18.5	3.72	0	0	C	) 221.5	0	0	0	0	0	0	0															
11 Barlous Subwatershed 1 1 3.8 0.7 0 0 0 207.2 0 0 0 0 0 0 0	10	Hydes Subwatershed		1	1	12.8	2.36	0	0	C	) 221.6	0	0	0	0	0	0	0															
	11	Barlous Subwatershe	d	1	1	3.8	0.7	0	0	C	207.2	0	0	0	0	0	0	0															

# **B.4.5 2005 Mass Balance**

#### winkler\_monitored\_data

File: S:\Water\Water Monitoring\TMDL\TMDL\Lake TMDLs\Draft TMDL to MPCA\Five Lake TMDL\Individual Lakes\Winkler\Models\updated winkler05\_monitored\_data.btb

Over	all Wat	er Ba	lance		Averagir	ng Period =	1.00	years
				Area	Flow	Variance	cv	Runoff
<u>Trb</u>	Туре	<u>Seg</u>	<u>Name</u>	<u>km<sup>2</sup></u>	<u>hm³/vr</u>	<u>(hm3/yr)<sup>2</sup></u>	-	<u>m/yr</u>
1	1	1	CC9 (Inlet 2)	9.3	2.2	4.67E-02	0.10	0.23
2	1	1	CC8 (Inlet 3)	2.0	0.4	1.52E-03	0.10	0.19
3	1	1	Direct	1.1	0.2	2.89E-04	0.10	0.15
4	3	1	Direct septic	0.0	0.0	0.00E+00	0.00	1.00
5	1	1	inlet 1	0.5	0.1	0.00E+00	0.00	0.26
6	3	1	Inlet 1 Septic	0.0	0.1	0.00E+00	0.00	10.00
7	3	1	Inlet 2 Septic	0.0	0.1	0.00E+00	0.00	10.00
8	3	1	Inlet 3 Septic	0.0	0.1	0.00E+00	0.00	10.00
9	1	1	Rice Subwatershed	18.5	3.7	0.00E+00	0.00	0.20
10	1	1	Hydes Subwatershed	12.8	2.4	0.00E+00	0.00	0.18
11	1	1	Barlous Subwatershed	3.8	0.7	0.00E+00	0.00	0.18
PREC	ΙΡΠΑΤΙ	ON		0.3	0.3	4.07E-03	0.20	1.10
TRIBU	JTARY I	NFLO	W	48.0	9.6	4.85E-02	0.02	0.20
POIN	T-SOUR	CE IN	FLOW	0.0	0.3	0.00E+00	0.00	7.75
***TOTAL INFLOW				48.3	10.3	5.25E-02	0.02	0.21
ADVECTIVE OUTFLOW				48.3	10.1	5.62E-02	0.02	0.21
***T(	***TOTAL OUTFLOW				10.1	5.62E-02	0.02	0.21
***E'	VAPOR	ATION	l		0.2	3.71E-03	0.30	

Over	rall Mas	s Bal	ance Based Upon	Predicted		Outflow & R	eservoir Co	ncentra	ations	
Corr	ponent	:		TOTAL P						
				Load	L	.oad Variand	e		Conc	Export
Trb	Туре	Seg	Name	kg/yr	<u>%Total</u>	<u>(kq/yr)<sup>2</sup></u>	<u>%Total</u>	<u>cv</u>	ma/m <sup>3</sup>	<u>ka/km²/vr</u>
1	1	1	CC9 (Inlet 2)	466.6	13.0%	1.09E+04	94.9%	0.22	216.0	50.2
2	1	1	CC8 (Inlet 3)	95.7	2.7%	4.58E+02	4.0%	0.22	245.5	47.9
3	1	1	Direct	48.1	1.3%	1.16E+02	1.0%	0.22	283.0	43.7
4	3	1	Direct septic	0.3	0.0%	0.00E+00		0.00	25.0	
5	1	1	Inlet 1	26.4	0.7%	0.00E+00		0.00	203.1	52.8
6	3	1	Inlet 1 Septic	1.3	0.0%	0.00	12.5	125.0		
7	3	1	Inlet 2 Septic	61.3	1.7%	0.00E+00		0.00	613.3	6133.0
8	3	1	Inlet 3 Septic	13.8	0.4%	0.00E+00		0.00	137.7	1377.0
9	1	1	Rice Subwatershed	824.0	23.0%	0.00E+00		0.00	221.5	44.5
10	1	1	Hydes Subwater shed	523.0	14.6%	0.00E+00		0.00	221.6	40.9
11	1	1	Barlous Subwater shed	145.0	4.0%	0.00E+00		0.00	207.2	38.2
PREC	ΙΡΠΑΤΙ	ON		5.8 0.2% 8.41E+00 0.1%				0.50	18.2	20.0
INTE	RNAL LO	DAD		1377.0	38.4%	0.00E+00		0.00		
TRIB	UTARY I	NFLO	W	2128.8	59.3%	1.15E+04	99.9%	0.05	221.1	44.4
POIN	IT-SOUF	CE IN	FLOW	76.6	2.1%	0.00E+00		0.00	247.1	1915.0
***T	OTAL IN	IFLOV	V	3588.2	100.0%	1.15E+04	100.0%	0.03	349.8	74.2
ADV	ECTIVE (	DUTFI	OW	2836.0	79.0%	7.76E+04		0.10	282.0	58.7
***T	OTAL O	UTFLO	WC	2836.0	79.0%	7.76E+04		0.10	282.0	58.7
***R	ETENTI	ON		752.2	21.0%	7.15E+04		0.36		
	Overflo	w Rat	te (m/yr)	34.7	n	lutrient Resid	l. Time (yrs)		0.0137	
Hydraulic Resid. Time (yrs)			0.0173	73 Turnover Ratio				73.1		
Reservoir Conc (mg/m3)			282	F	Retention Coe	ef.		0.210		
	Reservoir conc (marmo)									

# **B.4.6 2005 Predicted vs. Observed**

# winkler\_monitored\_data

File: S:\Water\Water Monitoring\TMDL\TMDL\Lake TMDLs\Draft TMDI

Segment:	1	Winkler			
	Predicted \	/alues>		Observed Valu	les>
<u>Variable</u>	<u>Mean</u>	<u>cv</u>	<u>Rank</u>	<u>Mean</u>	<u>CV Rank</u>
TOTAL P MG/M3	282.0	0.10	97.6%	283.0	97.6%
TOTAL N MG/M3	3230.0		96.6%	3230.0	96.6%
C.NUTRIENT MG/M3	189.8	0.04	98.2%	190.1	98.2%
CHL-A MG/M3	81.9	0.27	99.8%	71.0	99.6%
SECCHI M	0.8	0.28	35.1%	0.5	17.1%
ORGANIC N MG/M3	2025.3	0.27	99.8%		
TP-ORTHO-P MG/M3	141.9	0.31	94.9%		
ANTILOG PC-1	4162.6	0.37	98.5%	3102.6	97.4%
ANTILOG PC-2	21.1	0.08	98.8%	14.5	93.9%
(N - 150) / P	10.9	0.10	25.8%	10.9	25.6%
INORGANIC N / P	8.6	0.36	10.6%		
TURBIDITY 1/M	0.0	0.20	0.0%	0.0	0.20 0.0%
ZMIX * TURBIDITY	0.0	0.23	0.0%	0.0	0.23 0.0%
ZMIX / SECCHI	0.7	0.29	0.1%	1.1	0.12 0.7%
CHL-A * SECCHI	66.1	0.10	99.6%	37.3	96.6%
CHL-A / TOTAL P	0.3	0.27	73.2%	0.3	65.1%
FREQ(CHL-a>10) %	99.9	0.00	99.8%	99.8	99.6%
FREQ(CHL-a>20) %	97.5	0.02	99.8%	95.8	99.6%
FREQ(CHL-a>30) %	90.5	0.08	99.8%	86.0	99.6%
FREQ(CHL-a>40) %	80.1	0.15	99.8%	73.1	99.6%
FREQ(CHL-a>50) %	68.7	0.22	99.8%	60.1	99.6%
FREQ(CHL-a>60) %	57.6	0.29	99.8%	48.5	99.6%
CARLSON TSI-P	85.5	0.02	97.6%	85.6	97.6%
CARLSON TSI-CHLA	73.8	0.04	99.8%	72.4	99.6%
CARLSON TSI-SEC	63.1	0.06	64.9%	69.3	82.9%

# Appendix C BATHTUB TMDL Load Response Models

# C.1 Goose Lake C.1.1 TMDL Inputs

												Model Coef	ficients		Mean	<u>cv</u>		
Goos	a lako TMDI											Dispersion F	late		1.000	0.70		
File	C:Documents and	Softings\t	sundhvåDos	kton\4_6_	10 work\Eiv	o Lako TMI	DI Model Ru	ns\Goose Lake T				Total Phosp	horu s		1.000	0.45		
Pile.	intion	Jeungau	sunubyides	Ktop (4-0-			DE MOUA RU	IIS GOUSE LAKE I				Total Nitrog	en		1.000	0.55		
Descr	ipuon:					Indal Onti		0.4.	Description	_		Chl-a Model			1.000	0.26		
GIODA	<u>i variadies</u>	<u>inean</u>			<u>N</u>	<u>loael Opti</u>	ons	Code	Description			Secchi Mode	el • • •		1.000	0.10		
Avera	ging Period (yrs)	1	0.0		L L	on servativ	e Substance	U	NULUMP			Organic N N	lodel		1.000	0.12		
Precip	itation (m)	0	0.0		P	'hosphoru s	Balance	8	CANF & BAG	CH, LAKES		TP-OP Mode	31		1.000	0.15		
Evapo	ration (m)	0	0.0		N	litrogen Ba	lance	0	NOTCOMP	UTED		HODV Mode	-1		1.000	0.15		
Storag	e Increase (m)	0	0.0		C	hlorophyll-	-a	2	P, LIGHT, T			MUDV Mod	el Classa (m. <sup>2</sup> /m.	-1	1.000	0.22		
					5	ecchi Dept	h	1	VS. CHLA &	TURBIDITY		Seccni/Chia	stope (m /m)	8)	0.015	0.00		
<u>Atmos</u>	s. Loads (kg/km²-yr)	<u>Mean</u>	<u>cv</u>		C	Dispersion		1	FISCHER-NU	JMERIC		Chi a Fluchi	s (m/yr) ng Torm		0.100	0.00		
Conse	rv. Sub stance	0	0.00		P	'ho sphoru s	Calibration	1	DECAY RATI	ES		Chi a Tamp	ng Termi Aval CV		1.000	0.00		
Total I	>	0	0.50		N	litrogen Ca	libration	1	DECAY RATI	ES		Avail Factor	Totol D		0.620	0		
Total I	N	1000	0.50		E	rror Analys	sis	1	MODEL & D	ATA		Avail Factor	- Tutal r Ortho P		1 930	0		
Ortho	Р	0	0.50		Д	wailability I	Factors	0	IGNORE			Avail Factor	- Total N		0.590	0		
Inorga	nic N	500	0.50		N	/ ass-Baland	ce Table s	1	USE ESTIMA	ATED CONCS		Avail Factor	- Inorganic I		0.550	ů N		
Ů					C	Output Dest	tination	2	EXCEL WOR	KSHEET		Avan. racco	morpanie i	•	0.750	Ū		
C	ont Mornhomotry																	
Segm	en morphonieu y												iternai Loa	as (mg/mz-a	ayj			
Segm	ent Morphometry	i	Outflow		Area	Depth	Length Mi	xed Depth (m)	Hypol Dept	th N	ion-Algai 1	urb (m <sup>-1</sup> )	Conserv.	as (mg/mz-a Tota	iayj Il P	т	otal N	
Segri Seg	<u>Name</u>		Outflow Segment	Group	Area <u>km²</u>	Depth <u>m</u>	Length Mi <u>km</u>	xed Depth (m) <u>Mean C</u>	Hypol Dept <u>V Mean</u>	th N <u>CV</u>	lon-Algal 1 <u>Mean</u>	" "urb (m <sup>-1</sup> ) <u>CV</u>	Conserv. <u>Mean</u>	os (mg/m2-o Tota <u>CV</u>	iayj il P <u>Mean</u>	т <u>сv</u>	otal N <u>Mean</u>	<u>cv</u>
Segm Seg 1	<u>Name</u> Goose Lake	:	Outflow Segment 0	<u>Group</u> 1	<b>Area</b> <u>km<sup>2</sup></u> 1.34865	<b>Depth</b> <u>m</u> 1.324842	Length Mi <u>km</u> 0.5	xed Depth (m) <u>Mean</u> <u>C</u> 1.3	Hypol Dept V <u>Mean</u> 0 0	th N <u>CV</u> 0	lon-Algal T <u>Mean</u> 0.08	" "urb (m <sup>-1</sup> ) <u>CV</u> 0	Conserv. <u>Mean</u> 0	as (mg/m2-a Tota <u>CV</u> 0	iay) Il P <u>Mean</u> 0	т <u>сv</u> 0	otal N <u>Mean</u> 0	<u>cv</u> 0
Segm 1 Segm	<u>Name</u> Goose Lake	Duolity	Outflow <u>Segment</u> 0	<u>Group</u> 1	<b>Area</b> <u>km²</u> 1.34865	<b>Depth</b> <u>m</u> 1.324842	Length Mi <u>km</u> 0.5	xed Depth (m) <u>Mean C</u> 1.3	Hypol Dept V <u>Mean</u> 0 0	th N <u>CV</u> 0	<b>lon-Algal 1</b> <u>Mean</u> 0.08	<b>"urb (m<sup>-1</sup>)</b> <u>CV</u> 0	iternai Loa Conserv. <u>Mean</u> 0	os (mg/m2-o Tota <u>CV</u> 0	ayj Il P <u>Mean</u> 0	т <u>сv</u> 0	otal N <u>Mean</u> 0	<u>cv</u> 0
Segn <u>Seg</u> 1 Segm	<u>Name</u> Goose Lake ent Observed Water C	Quality	Outflow <u>Segment</u> 0 Total B (ppb	<u>Group</u> 1	Area <u>km²</u> 1.34865 Total N (ppl	Depth <u>m</u> 1.324842	Length Mi <u>km</u> 0.5 Chl.a (ppb)	xed Depth (m) <u>Mean C</u> 1.3 Socchi (	Hypol Dept <u>V Mean</u> 0 0	th N <u>CV</u> Organic N (/	ion-Algai 1 <u>Mean</u> 0.08	"urb (m <sup>-1</sup> ) <u>CV</u> 0	Conserv. <u>Mean</u> 0	as (mg/mz-a Tota <u>CV</u> 0	ayj Il P <u>Mean</u> 0	Tr <u>CV</u> 0	otal N <u>Mean</u> 0	<u>cv</u> 0
Segn 1 Segm	<u>Name</u> Goose Lake ent Observed Water ( Conserv	Quality	Outflow Segment 0 Total P (ppb	<u>Group</u> 1	Area <u>km²</u> 1.34865 Total N (ppl	Depth <u>m</u> 1.324842	Length Mi <u>km</u> 0.5 Chl-a (ppb)	xed Depth (m) <u>Mean C</u> 1.3 Secchi (i	Hypol Dept <u>V Mean</u> 0 0 m) 0	th N <u>CV</u> 0 Organic N (j	lon-Algal T <u>Mean</u> 0.08 ppb) 7	"urb (m <sup>-1</sup> ) <u>CV</u> 0 TP - Ortho F	rternai Loa Conserv. <u>Mean</u> 0 ? (ppb) H	os (mg/m2-o Tota <u>CV</u> 0 OD (ppb/day)	ayj I P <u>Mean</u> 0 M	Tr <u>CV</u> 0 OD (ppb/d	otal N <u>Mean</u> 0 ay)	<u>cv</u> 0
Segm 1 Segm <u>Seg</u>	<u>Name</u> Goose Lake ent Observed Water O Conserv <u>Mean</u> o	Quality	Outflow Segment 0 Total P (ppb <u>Mean</u>	<u>Group</u> 1 ) <u>CV</u> 0	Area <u>km</u> 1.34865 Total N (ppl <u>Mean</u>	Depth <u>m</u> 1.324842 b) <u>CV</u>	Length Mi <u>km</u> 0.5 Chl-a (ppb) <u>Mean</u>	xed Deptin (m) <u>Mean C</u> 1.3 Secchi (i <u>CV Mea</u>	Hypol Dept <u>V Mean</u> 0 0 m) 0 <u>n CV</u> 0 0	th N <u>CV</u> 0 Organic N (( <u>Mean</u>	lon-Algal 1 <u>Mean</u> 0.08 ppb) 1 <u>CV</u>	•urb (m <sup>-1</sup> ) <u>CV</u> 0 □ P - Ortho F <u>Mean</u>	rternal Loa Conserv. <u>Mean</u> 0 ' (ppb) H <u>CV</u>	os (mg/m2-o Tota <u>CV</u> 0 OD (ppb/day) <u>Mean</u>	iayj Ni P <u>Mean</u> 0 M <u>CV</u>	T( <u>CV</u> 0 OD (ppb/d <u>Mean</u>	otal N <u>Mean</u> 0 ay) <u>CV</u> 0	<u>cv</u> 0
Seg 1 Segm <u>Seg</u> 1	<u>Name</u> Goose Lake ent Observed Water O Conserv <u>Mean</u> 0	Quality <u>CV</u> 0	Outflow Segment 0 Total P (ppb <u>Mean</u> 0	<u>Group</u> 1 ) <u>CV</u> 0	Area <u>km</u> 1.34865 Total N (ppl <u>Mean</u> 0	Depth <u>m</u> 1.324842 b) 0 <u>CV</u> 0	Length Mi <u>km</u> 0.5 Chl-a (ppb) <u>Mean</u> 0	xed Deptin (m) <u>Mean C</u> 1.3 Secchi (i <u>CV Mea</u> 0	Hypol Dept <u>V Mean</u> 0 0 m) 0 <u>n CV</u> 0 0	th N <u>CV</u> 0 Organic N (( <u>Mean</u> 0	lon-Algal T <u>Mean</u> 0.08 ppb) 7 <u>CV</u> 0	<b><sup>™</sup>urb (m<sup>-1</sup>)</b> <u>CV</u> 0 <b>™ - Ortho F</b> <u>Mean</u> 0	rternal Loa Conserv. <u>Mean</u> 0 <b>(ppb) H</b> <u>CV</u> 0	os (mg/m2-o Tota <u>CV</u> 0 OD (ppb/day) <u>Mean</u> 0	ayj Il P <u>Mean</u> 0 0 <u>CV</u> 0	Ti <u>CV</u> 0 OD (ppb/d <u>Mean</u> 0	<b>btal N</b> <u>Mean</u> 0 ay) <u>CV</u> 0	<u>cv</u> 0
Segn 1 Segm <u>Seq</u> 1 Segm	<u>Name</u> Goose Lake ent Observed Water O Conserv <u>Mean</u> 0 ent Calibration Factor	Quality <u>CV</u> 0	Outflow Segment 0 Total P (ppb <u>Mean</u> 0	<u>Group</u> 1 ) <u>CV</u> 0	Area <u>km²</u> 1.34865 Total N (ppl <u>Mean</u> 0	Depth <u>m</u> 1.324842 o) <u>CV</u> 0	Length Mi <u>km</u> 0.5 Chl-a (ppb) <u>Mean</u> 0	xed Deptin (m) <u>Mean C</u> 1.3 Secchi (i <u>CV Mea</u> 0	Hypol Dept <u>V</u> <u>Mean</u> 0 0 m) <u>n</u> <u>CV</u> 0 0	th N <u>CV</u> Organic N (j <u>Mean</u> 0	ion-Algal T <u>Mean</u> 0.08 0.08 0.08	Turb (m <sup>-1</sup> ) <u>CV</u> 0 TP - Ortho F <u>Mean</u> 0	rternal Loa Conserv. <u>Mean</u> 0 (ppb) H <u>CV</u> 0	os (mg/m2-o Tota <u>CV</u> 0 OD (ppb/day) <u>Mean</u> 0	ayj IP <u>Mean</u> 0 <u>0</u> M	T( <u>CV</u> 0 OD (ppb/d <u>Mean</u> 0	<b>btal N</b> <u>Mean</u> 0 ay) <u>CV</u> 0	<u>cv</u> 0
Segm 1 Segm <u>Seg</u> 1 Segm	<u>Name</u> Goose Lake ent Observed Water O Conserv <u>Mean</u> 0 ent Calibration Factor Dispersion Rate	Quality <u>CV</u> 0	Outflow Segment 0 Total P (ppb <u>Mean</u> 0 Total P (ppb	<u>Group</u> 1 ) <u>CV</u> 0	Area <u>km²</u> 1.34865 Total N (ppt <u>Mean</u> 0 Total N (ppt	Depth <u>m</u> 1.324842 b) ( <u>CV</u> 0	Length Mi <u>km</u> 0.5 Chi-a (ppb) <u>Mean</u> 0 Chi-a (ppb)	xed Deptin (m) <u>Mean C</u> 1.3 Secchi (i <u>CV Mea</u> 0 Secchi (i	Hypol Depti ⊻ <u>Mean</u> 0 0 m) <u>n</u> <u>CV</u> 0 0 m)	th N <u>CV</u> Organic N (j <u>Mean</u> 0 Organic N (j	ion-Algal T <u>Mean</u> 0.08 ppb) 7 <u>CV</u> 0	Turb (m <sup>-1</sup> ) <u>CV</u> 0 TP - Ortho F <u>Mean</u> 0 TP - Ortho F	rternal Loa Conserv. <u>Mean</u> 0 (ppb) H <u>CV</u> 0	os (mg/m2-o Tota <u>CV</u> 0 OD (ppb/day) <u>Mean</u> 0 OD (ppb/day)	ay) I P <u>Mean</u> 0 <u>CV</u> 0	CV 0 OD (ppb/d <u>Mean</u> 0 OD (ppb/d	otal N <u>Mean</u> 0 ay) <u>CV</u> 0	<u>cv</u> 0
Seg 1 Segm <u>Seg</u> 1 Segm Seg	<u>Name</u> Goose Lake ent Observed Water C Conserv <u>Mean</u> 0 ent Calibration Factor Dispersion Rate Mean	Quality CV 0 rs	Outflow Segment 0 Total P (ppb <u>Mean</u> 0 Total P (ppb Mean	<u>Group</u> 1 ) <u>CV</u> 0	Area <u>km²</u> 1.34865 Total N (ppl <u>Mean</u> 0 Total N (ppl Mean	Depth <u>m</u> 1.324842 b) ( <u>CV</u> c) (	Length Mi <u>km</u> 0.5 Chi-a (ppb) <u>Mean</u> 0 Chi-a (ppb) Mean	xed Depth (m) <u>Mean</u> <u>C</u> 1.3 Secchi (i <u>CV</u> <u>Mea</u> 0 Secchi (i CV Mea	Hypol Depti <u>V</u> <u>Mean</u> 0 0 m) 0 <u>n</u> <u>CV</u> 0 0 m) 0 n <u>CV</u>	th N <u>CV</u> Organic N (j <u>Mean</u> O Organic N (j Mean	lon-Algal 1 <u>Mean</u> 0.08 ppb) 1 <u>CV</u> 0	Turb (m <sup>-1</sup> ) <u>CV</u> 0 TP - Ortho F <u>Mean</u> 0 TP - Ortho F Mean	rternal Loar Conserv. <u>Mean</u> (ppb) H <u>CV</u> 0 (ppb) H	os ( mg/m2-o Tota <u>CV</u> 0 OD (ppb/day) <u>Mean</u> 0 OD (ppb/day) Mean	iay) IP <u>Mean</u> 0 <u>CV</u> 0 M CV	CV 0 OD (ppb/d <u>Mean</u> 0 OD (ppb/d Mean	otal N <u>Mean</u> 0 ay) <u>CV</u> 0 ay)	<u>cv</u> 0
Seg 1 Segm <u>Seq</u> 1 Segm <u>Seq</u> 1	<u>Name</u> Goose Lake ent Observed Water C Conserv <u>Mean</u> 0 ent Calibration Factor Dispersion Rate <u>Mean</u> 1	Quality <u>CV</u> o rs <u>CV</u> 0	Outflow Segment 0 Total P (ppb <u>Mean</u> 0 Total P (ppb <u>Mean</u> 1	<u>Group</u> 1 ) <u>CV</u> 0 ) <u>CV</u> 0	Area <u>km²</u> 1.34865 Total N (ppl <u>Mean</u> 0 Total N (ppl <u>Mean</u> 1	$\begin{array}{c} \text{Depth} \\ \underline{m} \\ 1.324842 \\ \text{o} \\ \underline{CV} \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ $	Length Mi <u>km</u> 0.5 Chi-a (ppb) <u>Mean</u> 0 Chi-a (ppb) <u>Mean</u> 1	xed Depth (m) <u>Mean</u> <u>C</u> 1.3 Secchi (i <u>CV</u> <u>Mea</u> 0 Secchi (i <u>CV Mea</u> 0	Hypol Depti <u>V</u> <u>Mean</u> 0 0 m) 0 m) 0 m) 0 m) 0 m) 0 1 00	th N <u>CV</u> Organic N (j <u>Mean</u> O Organic N (j <u>Mean</u> 1	Ion-Algal T <u>Mean</u> 0.08 PPPb) T <u>CV</u> 0 PPPb) T <u>CV</u> 0	Turb (m <sup>-1</sup> ) <u>CV</u> 0 TP - Ortho F <u>Mean</u> 0 TP - Ortho F <u>Mean</u> 1	rternal Loa Conserv. <u>Mean</u> 0 <b>(ppb) H</b> <u>CV</u> 0 <b>(ppb) H</b> <u>CV</u> 0	os (mg/m2-o Tota <u>CV</u> 0 OD (ppb/day) <u>Mean</u> 0 OD (ppb/day) <u>Mean</u> 1	ay) IP <u>Mean</u> 0 <u>CV</u> 0 <u>CV</u> 0	Tr <u>CV</u> 0 OD (ppb/d <u>Mean</u> 0 OD (ppb/d <u>Mean</u> 1	ntal N <u>Mean</u> 0 ay) <u>CV</u> 0 ay) <u>CV</u> 0	<u>cv</u> 0
Segm 1 Segm <u>Seg</u> 1 Segm <u>Seg</u> 1	<u>Name</u> Goo se Lake ent Observed Water O Conserv <u>Mean</u> 0 ent Calibration Factor Dispersion Rate <u>Mean</u> 1	Quality <u>CV</u> 0 rs <u>CV</u> 0	Outflow Segment 0 Total P (ppb <u>Mean</u> 0 Total P (ppb <u>Mean</u> 1	<u>Group</u> 1 ) <u>CV</u> 0 ) <u>CV</u> 0	Area <u>km²</u> 1.34865 Total N (ppl <u>Mean</u> 0 Total N (ppl <u>Mean</u> 1	Depth <u>m</u> 1.324842 a) <u>CV</u> 0 a) <u>CV</u> 0	Length Mi <u>km</u> 0.5 Chi-a (ppb) <u>Mean</u> 0 Chi-a (ppb) <u>Mean</u> 1	xed Depth (m) <u>Mean</u> <u>C</u> 1.3 Secchi (i <u>CV</u> <u>Mea</u> 0 Secchi (i <u>CV Mea</u> 0	Hypol Depti <u>V</u> <u>Mean</u> 0 0 m) <u>n</u> <u>CV</u> 0 0 m) <u>n</u> <u>CV</u> 1 0	th N <u>CV</u> Organic N (j <u>Mean</u> 0 Organic N (j <u>Mean</u> 1	Ion-Algal T <u>Mean</u> 0.08 PPPb) T <u>CV</u> 0 PPPb) T <u>CV</u> 0	"urb (m <sup>-1</sup> ) <u>CV</u> 0 P - Ortho F <u>Mean</u> 0 P - Ortho F <u>Mean</u> 1	rternal Loa Conserv. <u>Mean</u> 0 <b>(ppb) H</b> <u>CV</u> 0 <b>(ppb) H</b> <u>CV</u> 0	os (mg/m2-o Tota <u>CV</u> 0 OD (ppb/day) <u>Mean</u> 1	IN 19 <u>Mean</u> 0 <u>CV</u> 0 <u>CV</u> 0 <u>M</u> <u>CV</u> 0	Tr <u>CV</u> 0 OD (ppb/d <u>Mean</u> 0 OD (ppb/d <u>Mean</u> 1	ntal N <u>Mean</u> 0 ay) <u>CV</u> 0 ay) <u>CV</u> 0	<u>cv</u> 0
Segm 1 Segm <u>Seg</u> 1 Segm <u>Seg</u> 1 Tribut	<u>Name</u> Goo se Lake ent Observed Water O Conserv <u>Mean</u> 0 ent Calibration Factor Dispersion Rate <u>Mean</u> 1	Quality <u>CV</u> 0 rs <u>CV</u> 0	Outflow Segment 0 Total P (ppb <u>Mean</u> 0 Total P (ppb <u>Mean</u> 1	<u>Group</u> 1 ) <u>CV</u> 0 ) <u>CV</u> 0	Area <u>km²</u> 1.34865 Total N (ppl <u>Mean</u> 0 Total N (ppl <u>Mean</u> 1	Depth <u>m</u> 1.324842 b) <u>CV</u> 0 c) <u>CV</u> 0	Length Mi <u>km</u> 0.5 Chi-a (ppb) <u>Mean</u> 0 Chi-a (ppb) <u>Mean</u> 1	xed Depth (m) <u>Mean</u> <u>C</u> 1.3 Secchi (i <u>CV</u> <u>Mea</u> 0 Secchi (i <u>CV</u> <u>Mea</u> 0	Hypol Depti <u>Mean</u> 0 0 m) 0 0 0 m) 0 m) 0 n <u>CV</u> 1 0	th N <u>CV</u> Organic N (j <u>Mean</u> 0 Organic N (j <u>Mean</u> 1	Ion-Algal T <u>Mean</u> 0.08 Ppb) 7 <u>CV</u> 0 Ppb) 7 <u>CV</u> 0	Turb (m <sup>-1</sup> ) <u>CV</u> 0 P - Ortho F <u>Mean</u> 0 P - Ortho F <u>Mean</u> 1	Conserv. <u>Mean</u> 0 (ppb) H <u>CV</u> 0 (ppb) H <u>CV</u> 0 0	os (mg/m2-o Tota <u>CV</u> 0 OD (ppb/day) <u>Mean</u> 1	iayj M <u>ean</u> 0 <u>CV</u> 0 <u>CV</u> 0	Tri <u>CV</u> 0 OD (ppb/d <u>Mean</u> 0 OD (ppb/d <u>Mean</u> 1	ay) ay) ay) <u>CV</u> 0 ay) <u>CV</u> 0	<u>cv</u> 0
Segn Segn Segm Segm Segm 1 Tribut	<u>Name</u> Goo se Lake ent Observed Water O Conserv <u>Mean</u> 0 ent Calibration Factor Dispersion Rate <u>Mean</u> 1	Quality <u>CV</u> 0 rs <u>CV</u> 0	Outflow Segment 0 Total P (ppb <u>Mean</u> 1	<u>Group</u> 1 ) <u>CV</u> 0 ) <u>CV</u> 0	Area <u>km²</u> 1.34865 Total N (ppl <u>Mean</u> 1 Dr Area F	Depth <u>m</u> 1.324842 a) <u>CV</u> 0 a) <u>CV</u> 0	Length Mi <u>km</u> 0.5 Chi-a (ppb) <u>Mean</u> 0 Chi-a (ppb) <u>Mean</u> 1	xed Depth (m) <u>Mean</u> <u>C</u> 1.3 Secchi (i <u>CV</u> <u>Mea</u> 0 Secchi (i <u>CV</u> <u>Mea</u> 0	Hypol Depti           V         Mean           0         0           m)         0           n         CV           0         0           m)         0           n         CV           1         0           Total P (pp	th N <u>CV</u> Organic N (j <u>Mean</u> 0 Organic N (j <u>Mean</u> 1	ion-Algal T <u>Mean</u> 0.08 (0.08 (0.08 (0.08 (0.09 (0.09 (0.09 (0.09 (0.09 (0.09 (0.09) (	Turb (m <sup>-1</sup> ) <u>CV</u> 0 <b>IP - Ortho F</b> <u>Mean</u> 1 0 0 0 0 0 0 0 0 0 0 0 0 0	r (ppb) H Conserv. <u>Mean</u> 0 (ppb) H <u>CV</u> 0 (ppb) H <u>CV</u> 0 0 0 0 0 0 0 0 0 0 0 0 0	os ( mg/m2-o Tota <u>CV</u> 0 OD (ppb/day) <u>Mean</u> 1	iayj U P <u>Mean</u> 0 <u>CV</u> 0 <u>CV</u> 0 ganic N	Tri <u>CV</u> 0 OD (ppb/d <u>Mean</u> 0 OD (ppb/d <u>Mean</u> 1	otal N <u>Mean</u> 0 <b>ay)</b> 0 ay) <u>CV</u> 0 <u>CV</u> 0	<u>cv</u> 0
Segm Segm Segm Segm Segm 1 Tribut Tribut	<u>Name</u> Goo se Lake ent Observed Water C Conserv <u>Mean</u> 0 ent Calibration Factor Dispersion Rate <u>Mean</u> 1 ary Data <u>Trib Name</u>	Quality <u>CV</u> 0 rs <u>CV</u> 0	Outflow Segment 0 Total P (ppb <u>Mean</u> 1 Segment	<u>Group</u> 1 ) <u>CV</u> 0 ) <u>CV</u> 0	Area <u>km²</u> 1.34865 Total N (ppl <u>Mean</u> 0 Total N (ppl <u>Mean</u> 1 Dr Area F <u>km²</u>	Depth <u>m</u> 1.324842 b) <u>CV</u> 0 c) <u>CV</u> 0	Length Mi <u>km</u> 0.5 Chi-a (ppb) <u>Mean</u> 0 Chi-a (ppb) <u>Mean</u> 1 yr) Co	xed Depth (m) <u>Mean</u> <u>C</u> 1.3 Secchi (l <u>CV</u> <u>Mea</u> 0 Secchi (l <u>CV</u> <u>Mea</u> 0 onserv. <u><u>Mean</u> <u>C</u></u>	Hypol Depting           ⊻         Mean           0         0           m)         0           n         CV           0         0           m)         0           m         CV           1         0           Total P (pp           ⊻         Mean	th N <u>CV</u> Organic N (  <u>Mean</u> 0 Organic N (  <u>Mean</u> 1 b) T <u>CV</u>	ion-Algal T <u>Mean</u> 0.08 (opb) T <u>CV</u> 0 (otal N (ppl <u>Mean</u>	Furb (m <sup>-1</sup> ) <u>CV</u> 0 FP - Ortho F <u>Mean</u> 1 0 0 CV CV	rternal Loa Conserv. <u>Mean</u> 0 (ppb) H <u>CV</u> 0 (ppb) H <u>CV</u> 0 Prtho P (ppl <u>Mean</u>	op (ppb/day) <u>Mean</u> 0 OD (ppb/day) <u>Mean</u> 1 0 OD (ppb/day) <u>Mean</u> 1	iayj Mean 0 <u>CV</u> 0 <u>CV</u> 0 ganic N <u>Mean</u>	Tri <u>CV</u> 0 OD (ppb/d <u>Mean</u> 0 OD (ppb/d <u>Mean</u> 1 (ppb) <u>CV</u>	ntal N <u>Mean</u> 0 ay) <u>CV</u> 0 ay) <u>CV</u> 0	<u>cv</u> 0

# C.1.2 TMDL Mass Balance

Goose Lake TMDL

File: C:\Documents and Settings\tsundby\Desktop\4-6-10 work\Five Lake TMDL Model Runs\Goose Lake TMDL.btb

Overall Water Balance		1.00	years		
<u>Trb Type Seg Name</u>	Area <u>km²</u>	Flow <u>hm³/yr</u>	Variance <u>(hm3/yr)<sup>2</sup></u>	cv 	Runoff <u>m/yr</u>
1 1 1 Total P load	1.0	1.6	0.00E+00	0.00	1.61
TRIBUTARY INFLOW	1.0	1.6	0.00E+00	0.00	1.61
***TOTAL INFLOW	2.3	1.6	0.00E+00	0.00	0.69
ADVECTIVE OUTFLOW	2.3	1.6	0.00E+00	0.00	0.69
***TOTAL OUTFLOW	2.3	1.6	0.00E+00	0.00	0.69

Overall Mass Balance Based Upon Component:	Predicted TOTAL P	Outflow & Reservoir Concentrations								
	Load		Load Variance	<u>!</u>		Conc	Export			
<u>Trb Type Seg Name</u>	<u>kg/yr</u>	<u>%Total</u>	<u>(kq/yr)<sup>2</sup></u>	<u>%Total</u>	<u>cv</u>	<u>mg/m<sup>3</sup></u>	<u>kg/km²/yr</u>			
1 1 1 Total P load	269.9	100.0%	0.00E+00		0.00	167.6	269.9			
TRIBUTARY INFLOW	269.9	100.0%	0.00E+00		0.00	167.6	269.9			
***TOTAL INFLOW	269.9	100.0%	0.00E+00		0.00	167.6	114.9			
ADVECTIVE OUTFLOW	96.7	35.8%	7.51E+02		0.28	60.1	41.2			
***TOTAL OUTFLOW	96.7	35.8%	7.51E+02		0.28	60.1	41.2			
***RETENTION	173.1	64.2%	7.51E+02		0.16					
Overflow Rate (m/yr)	1.2		Nutrient Resid.	Time (yrs)		0.3978				
Hydraulic Resid. Time (yrs)	1.1098		Turnover Ratio			2.5				
Reservoir Conc (mg/m3)	60		Retention Coef			0.642				

# C.1.3 TMDL Predicted

Goose Lake TMDL

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Segment:	1 G	oose Lal	ke
	Predicted Va	lues>	
Variable	<u>Mean</u>	<u>cv</u>	<u>Rank</u>
TOTAL P MG/M3	60.1	0.28	59.9%
CHL-A MG/M3	45.3	0.41	98.0%
SECCHI M	1.3	0.38	60.3%
ORGANIC N MG/M3	1196.6	0.38	96.5%
TP-ORTHO-P MG/M3	78.5	0.45	84.4%
ANTILOG PC-1	860.8	0.74	83.1%
ANTILOG PC-2	21.9	0.08	99.0%
TURBIDITY 1/M	0.1		1.1%
ZMIX * TURBIDITY	0.1		0.0%
ZMIX / SECCHI	1.0	0.38	0.3%
CHL-A * SECCHI	59.6	0.11	99.4%
CHL-A / TOTAL P	0.8	0.26	98.3%
FREQ(CHL-a>10) %	98.3	0.03	98.0%
FREQ(CHL-a>20) %	84.4	0.19	98.0%
FREQ(CHL-a>30) %	63.9	0.39	98.0%
FREQ(CHL-a>40) %	45.7	0.58	98.0%
FREQ(CHL-a>50) %	32.0	0.74	98.0%
FREQ(CHL-a>60) %	22.3	0.89	98.0%
CARLSON TSI-P	63.2	0.07	59.9%
CARLSON TSI-CHLA	68.0	0.06	98.0%
CARLSON TSI-SEC	56.0	0.10	39.7%

C.2 C.2.1 Hydes	Hydes Lake TMDL Inpu Lake TMDL	e its	dhu à D	1de	40	- 1 - 1/- 744	Di Madal Du					<u> </u>   -	Model Coe Dispersion Total Phosp Total Nitrog	<b>fficients</b> Rate bhoru s gen		<u>Mea</u> 1.00 1.00 1.00	n 0 0 0 0 0 0	<u>CV</u> .70 .45 .55	
File:	Cabocuments and a	secongsu	sunabyvbes	ктор ч4-о-		е цаке ни	DL Model Ru	Instruges		DL.DD		(	Chl-a Mode			1.00	0 0	.26	
Global	puon: Wariables	Moan	<b>C</b> 1/			Andol Onti	000		Codo	Docorintion		,	Secchi Mod	lel		1.00	0 0	.10	
Averag	ing Pariod (urs)	<u>mean</u> 1			<u>n</u>	on corvativ	a Substanca			NOTCOMPU		(	Organic N M	vlodel		1.00	00	.12	
Procini	tation (m)	1	0.0			bosphoru	Balance		0	CANE & RAC			IP-OP Mod	el		1.00	00	.15	
Evapor	ration (m)	0	0.0		r	litrogen Ba	lance		0		ITED		HODv Mode	el		1.00	0 0	.15	
Evapor	ation (iii)	0	0.0		1	ilu Ugeri Da Shlaranhull	ance		0 2			I	MODv Mod	lel		1.00	0 0	.22	
Storage	e increase (iii)	U	0.0			лиогорнун 	-d		2				Secchi/Chla	i Slope (m²∕r	ng)	0.01	50	.00	
Atmos	l oade (ka/km <sup>2</sup> ve)	Maan	011		3	ecchi Depi	n		1	VS. CHEA & I		I	Minimum C	Qs (m/γr)		0.10	0 0	.00	
Autios	. Ludus (Ky/Kill -yi				L	Jispersion	Calib and an		1	FISCHER-NU	IVIE KIU C	(	Chl-a Flushi	ing Term		1.00	0 0	.00	
T- t- L D	v. Substance	0	0.00		r N	nosphoru s	Calibration		1		5	(	Chl-a Temp	oral CV		0.62	0	0	
		1000	0.50		r r	attrogen Ca	libration		1		5	,	Avail. Facto	or - Total P		0.33	0	0	
Total N	l R	1000	0.50		t	rror Analy	51 S		1	MODEL & D#	AIA	1	Avail. Facto	or - Ortho P		1.93	0	0	
Urtho	r nie N	- ГОО	0.50		4	wanabiiity As as Balam	Factors		1	IGNORE			Avail. Facto	or - Total N		0.59	0	0	
morga		500	0.50		ľ	via ss-baiari	ce rabies		1		TED CONCS	· ,	Avail. Facto	or - Inorganic	: N	0.79	0	0	
					,	Julput Des	unation		Z		SHEET								
Soam	nt Mornhometry													internal Lea	de (ma/m?_d	21/1			
Jegina	ant morphometry		Outflow		Area	Denth	Lenath Mi	ixed Denth	(m)	Hynol Denth	n 1	Non-Algal 1	Turb (m <sup>-1</sup> )	Conserv	us (mg/mz-u Tota	ay) IP	То	ital N	
Sea	Name		Seament	Group	km <sup>2</sup>	m	km	Mean	, CV	Mean	cv.	Mean	сv	Mean	CV	Mean	cv .	Mean	cv
<u>009</u> 1	Hydes Lake	2	0	1	0.87/29/	3 160/91	0.5	3 1	<u></u>	0	0	0.08	0	<u>mean</u>	<u></u>	0	0	<u>mean</u>	<u></u>
Т	HYUE'S Lake		0	Т	0.0/4294	5.100451	0.5	5.1	0	0	0	0.08	0	0	0	0	0	0	0
Seam	ent Observed Water G	ality																	
	Conserv		Fotal P (ppb	1	Total N (ppl	b)	Chl-a (ppb)	Se	ecchi (m	) C	Drganic N (	ppb) -	TP - Ortho	P(ppb) H	OD (ppb/dav)	мо	) (ppb/da	av)	
Seq	Mean	cv	Mean	cv	Mean	cv	Mean	cv	Mean	cv	Mean	cv	Mean	cν	Mean	cv	Mean	cv	
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Segme	ent Calibration Factor	s																	
-	Dispersion Rate	-	Fotal P (ppb	)	Total N (ppl	b)	Chl-a (ppb)	Se	ecchi (m	) C	Drganic N (	ppb) -	TP - Ortho	P(ppb) H	OD (ppb/day)	мог	) (ppb/da	ay)	
Seq	Mean	cv	Mean	cv	Mean	CV	Mean	CV	Mean	cv	Mean	cv	Mean	CV	Mean	CV	Mean	CV	
1	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	
Tribut	ary Data					_													
					Dr Area F	low (hm³/	yr) Co	onserv.		Total P (ppb	ר (כ	Fotal N (pp	b) (	Ortho P (ppl	b) Inor	ganic N (pj	ob)		
<u>Trib</u>	<u>Trib Name</u>	5	Segment	Туре	<u>km</u>	<u>Mean</u>	<u>cv</u>	<u>Mean</u>	<u>cv</u>	Mean	<u>cv</u>	<u>Mean</u>	<u>cv</u>	<u>Mean</u>	<u>cv</u>	<u>Mean</u>	<u>cv</u>		
	T-I-I BII		1	1	1	1 7 6 1	0	0	~	113 30	0	0	0	0	0	0	~		

### C.2.2 TMDL Mass Balance C.2.3 TMDL Predicted Hydes Eake TMDL

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Overall Water Balance		Averagin	g Period =	1.00	years
	Area	Flow	Variance	cv	Runoff
<u>Trb Type Seg Name</u>	<u>km</u> ²	<u>hm³/yr</u>	<u>(hm3/yr)²</u>	_	<u>m/yr</u>
1 1 1 Total P load	1.0	1.8	0.00E+00	0.00	1.75
TRIBUTARY INFLOW	1.0	1.8	0.00E+00	0.00	1.75
***TOTAL INFLOW	1.9	1.8	0.00E+00	0.00	0.93
ADVECTIVE OUTFLOW	1.9	1.8	0.00E+00	0.00	0.93
***TOTAL OUTFLOW	1.9	1.8	0.00E+00	0.00	0.93

Overall Mass Balance Based Upon Component:	Predicted TOTAL P	Outflow & Reservoir Concentrations							
	Load	I	!		Conc	Export			
<u>Trb Type Seg Name</u>	<u>kg/yr</u>	<u>%Total</u>	<u>(kg/yr)<sup>2</sup></u>	<u>%Total</u>	<u>cv</u>	<u>mg/m³</u>	<u>kg/km²/yr</u>		
1 1 1 Total P load	196.6	100.0%	0.00E+00		0.00	112.3	196.6		
TRIBUTARY INFLOW	196.6	100.0%	0.00E+00		0.00	112.3	196.6		
***TOTAL INFLOW	196.6	100.0%	0.00E+00		0.00	112.3	104.9		
ADVECTIVE OUTFLOW	70.1	35.7%	3.97E+02		0.28	40.1	37.4		
***TOTAL OUTFLOW	70.1	35.7%	3.97E+02		0.28	40.1	37.4		
***RETENTION	126.5	64.3%	3.97E+02		0.16				
Overflow Rate (m/yr)	2.0	I	Nutrient Resid.	Time (yrs)		0.5630			
Hydraulic Resid. Time (yrs)	1.5781	-	Turnover Ratio			1.8			
Reservoir Conc (mg/m3)	40	l	Retention Coef.			0.643			

# Hydes Lake TMDL

File: C:\Documents and Settings\tsundby\Desktop\4-6-10 w

Segment:	1 H	ydes Lal	ke					
	Predicted Va	Predicted Values>						
<u>Variable</u>	<u>Mean</u>	<u>cv</u>	<u>Rank</u>					
TOTAL P MG/M3	40.1	0.28	42.1%					
CHL-A MG/M3	23.8	0.40	88.7%					
SECCHI M	2.3	0.34	83.8%					
ORGANIC N MG/M3	706.3	0.33	78.3%					
TP-ORTHO-P MG/M3	40.2	0.45	62.1%					
ANTILOG PC-1	279.4	0.69	54.0%					
ANTILOG PC-2	21.9	0.08	99.0%					
TURBIDITY 1/M	0.1		1.1%					
ZMIX * TURBIDITY	0.2		0.1%					
ZMIX / SECCHI	1.4	0.34	1.5%					
CHL-A * SECCHI	54.5	0.12	99.1%					
CHL-A / TOTAL P	0.6	0.26	96.0%					
FREQ(CHL-a>10) %	86.2	0.16	88.7%					
FREQ(CHL-a>20) %	48.9	0.53	88.7%					
FREQ(CHL-a>30) %	24.8	0.82	88.7%					
FREQ(CHL-a>40) %	12.6	1.06	88.7%					
FREQ(CHL-a>50) %	6.6	1.25	88.7%					
FREQ(CHL-a>60) %	3.6	1.42	88.7%					
CARLSON TSI-P	57.4	0.07	42.1%					
CARLSON TSI-CHLA	61.7	0.06	88.7%					
CARLSON TSI-SEC	48.1	0.10	16.2%					

# C.3 Miller Lake C.3.1 TMDL Inputs

#### Miller Lake TMDL

File: C:\Documents and Settings\tsundby\Desktop\4-6-10 work\Five Lake TMDL Model Runs\Miller Lake TMDL.btb

Description:												Chl-a N	1odel		1	.000	0.26
<u>Global Variables</u>	<u>Mean</u>	<u>cv</u>		<u>I</u>	<u>Model Optio</u>	ns		<u>Code</u>	Description			Secchi	Model		1	.000	0.10
Averaging Period (yrs)	1	0.0		(	Con servative	Substance		0	NOT COMPUT	ED		Organi	c N Model		1	.000	0.12
Precipitation (m)	0	0.0		F	Phosphoru s E	Balance		8	CANF & BACH	, LAKES		TP-OP	Model		1	.000	0.15
Evaporation (m)	0	0.0		I	Vitrogen Bala	ince		0	<b>NOT COMPUT</b>	ED		HODVI	Vlodel		1	.000	0.15
Storage Increase (m)	0	0.0		C	Chlorophyll-a			2	P, LIGHT, T			MODV	Model (chia chana (		1		0.22
				9	Secchi Depth			1	VS. CHLA & TU	JRBIDITY		Seccni/	unia siope (i	m /mg)	l l	0.015	0.00
Atmos. Loads (kg/km <sup>2</sup> -yr)	<u>Mean</u>	<u>cv</u>		Ι	Dispersion			1	FISCHER-NUM	IE RIC		Chlar	im Qs(m/yr luching Torr	)	1	000	0.00
Conserv. Sub stance	0	0.00		F	phosphoru s (	alibration		1	DECAY RATES			Chilla T	amporal CV	1	1		0.00
Total P	0	0.50		ſ	Vitrogen Cali	bration		1	DECAY RATES			Avail E	actor - Total	D	(	1 330	0
Total N	1000	0.50		E	Error Analysi:	S		1	MODEL & DA <sup>-</sup>	ΓA		Avail F	actor - Orth	n P	1	930	0
Ortho P	0	0.50		4	Availability Fa	actors		0	IGNORE			Avail. F	actor - Total	N	-	0.590	ů 0
Inorganic N	500	0.50		г	Mass-Balance	e Table s		1	USE ESTIMATI	ED CONCS		Avail. F	actor - Inorg	anic N	(	0.790	0
-				(	Dutput Destii	nation		2	EXCEL WORKS	HEET							
Segment Morphometry													Internal Lo	ads (mg/m2	-day)		
	(	Outflow		Area	Depth	Length Mi	ixed Depth	(m)	Hypol Depth	N	on-Algal Tu	ırb (m <sup>-1</sup> )	Conserv.	То	tal P	٦	íotal N
			-	·2				AL 1	Maam	<b>AV</b>	Maam	<b>M</b> (	Maam	011	<b>B B a a a a</b>	<b>AV</b>	Moon
<u>Seg Name</u>	-	<u>Segment</u>	<u>Group</u>	<u>кт</u>	m	<u>кm</u>	<u>mean</u>	<u>UV</u>	ivieari	<u> </u>	<u>iviean</u>	<u> </u>	<u>ivieari</u>	<u> </u>	<u>mean</u>	<u> </u>	<u>iviean</u>
<u>Seg Name</u> 1 Miller Lake	<u>-</u>	<u>Segment</u> 0	<u>Group</u> 1	<u>кт</u> 0.572654	<u>ш</u> 2.244576	<u>кт</u> 0.5	<u>mean</u> 2.2	<u>CV</u> 0	<u>iviean</u> 0	<u>0</u>	<u>iviean</u> 0.08	<u>UV</u> 0	<u>imean</u> 0	0	<u>mean</u> 0	0	<u>wean</u> 0
<u>Seg Name</u> 1 Miller Lake	<u>:</u>	<u>Segment</u> 0	<u>Group</u> 1	<u>кт</u> 0.572654	<u>m</u> 2.244576	<u>кт</u> 0.5	<u>mean</u> 2.2	0 0	<u>iiiean</u> 0	0	<u>iviean</u> 0.08	0	<u>imean</u> 0	0	<u>mean</u> 0	0	<u>199211</u> 0
<u>Seg Name</u> 1 Miller Lake Segment Observed Water (	Quality	<u>Segment</u> 0	<u>Group</u> 1	<u>кт</u> 0.572654	<u>m</u> 2.244576	<u>кт</u> 0.5	<u>mean</u> 2.2	0	<u>imean</u> 0	0	0.08	0	<u>inean</u> 0	0 0	<u>mean</u> 0	0	<u>inean</u> 0
Seg <u>Name</u> 1 Miller Lake Segment Observed Water ( Conserv	Quality	<u>Segment</u> 0 Total P (ppb	<u>Group</u> 1 ) 1	<u>km</u> 0.572654 Fotal N (pp	<u>m</u> 2.244576 <b>b) C</b>	<u>km</u> 0.5 hl <b>-a (ppb)</b>	<u>Mean</u> 2.2 Se	<u>CV</u> 0 ecchi (m)	<u>intean</u> 0 Or	0 ganic N (p	0.08 ( <b>pb) TF</b>	<u>C v</u> 0 • - Ortho	0 P (ppb)	UV 0 HOD (ppb/da	<u>mean</u> 0 y) M	0 0 10D (ppb/	0 day)
Seg     Name       1     Miller Lake       Segment Observed Water of Conserv       Seg     Mean	Quality <u>CV</u>	<u>Segment</u> 0 Total P (ppb <u>Mean</u>	<u>Group</u> 1 ) 1 <u>CV</u>	<u>km</u> 0.572654 Fotal N (pp) <u>Mean</u>	<u>m</u> 2.244576 b) C <u>CV</u>	<u>km</u> 0.5 hi-a (ppb) <u>Mean</u>	<u>меап</u> 2.2 СV	<u>CV</u> 0 ecchi (m) <u>Mean</u>	0 Or <u>CV</u>	0 ganic N (p <u>Mean</u>	0.08 0.08 Ppb) TF <u>CV</u>	0 • - Ortho <u>Mean</u>	0 0 P (ppb) <u>CV</u>	UD (ppb/da) Mean	y) Mean 0 y) M	0 //OD (ppb/ <u>Mean</u>	0 day) <u>CV</u>
Seg     Name       1     Miller Lake       Segment Observed Water of Conserv       Seg     Mean       1     0	Quality - <u>CV</u> 0	Segment 0 Total P (ppb <u>Mean</u> 0	<u>Group</u> 1 ) 7 <u>CV</u> 0	<u>km</u> 0.572654 Fotal N (pp <u>Mean</u> 0	<u>m</u> 2.244576 b) Cl <u>CV</u> 0	<u>km</u> 0.5 hl-a (ppb) <u>Mean</u> 0	<u>Mean</u> 2.2 Se <u>CV</u> 0	0 0 ecchi (m) <u>Mean</u> 0	0 0 <u>CV</u> 0	0 ganic N (p <u>Mean</u> 0	0.08 0.08 0 0 0	0 • - Ortho <u>Mean</u> 0	0 P (ppb) <u>CV</u> 0	<u>CV</u> 0 HOD (ppb/da) <u>Mean</u> 0	<u>Mean</u> 0 y) M <u>CV</u> 0	0 10D (ppb/ <u>Mean</u> 0	0 day) <u>CV</u> 0
Seg     Name       1     Miller Lake       Segment Observed Water     Conserv       Seg     Mean       1     0	Quality <u>CV</u> 0	Segment 0 Total P (ppb <u>Mean</u> 0	(Group 1 () 1 () 1 () 1 () 1 () 1 () 1 () 1 ()	<u>km</u> 0.572654 Fotal N (ppl <u>Mean</u> 0	2.244576 b) C <u>CV</u> 0	<u>km</u> 0.5 hl-a (ppb) <u>Mean</u> 0	<u>mean</u> 2.2 <b>Se</b> <u>CV</u> 0	0 ecchi (m) <u>Mean</u> 0	or <u>CV</u> 0	o ganic N (p <u>Mean</u> 0	0.08 0.08 0 0 0	0 • - Ortho <u>Mean</u> 0	0 P (ppb) <u>CV</u> 0	<u>U</u> 0 HOD (ppb/da) <u>Mean</u> 0	y) Mean 0 y) M <u>CV</u> 0	0 10D (ppb/ <u>Mean</u> 0	0 day) <u>CV</u> 0
Seg         Name           1         Miller Lake           Segment Observed Water of Conserv           Seq         Mean           1         0           Segment Calibration Facto         Dispersion Rate	Quality <u>CV</u> 0	Segment 0 Total P (ppb <u>Mean</u> 0 Total P (ppb	(Group 1 () 1 <u>CV</u> 0	<u>km</u> 0.572654 Fotal N (ppi <u>Mean</u> 0	<u>m</u> 2.244576 b) C <u>CV</u> 0	<u>km</u> 0.5 hil-a (ppb) <u>Mean</u> 0	<u>mean</u> 2.2 Se <u>CV</u> 0	<u>CV</u> 0 ecchi (m) <u>Mean</u> 0 ecchi (m)	or <u>CV</u> 0	<u>ev</u> ganic N (p <u>Mean</u> 0	<u>wean</u> 0.08 (pb) TF <u>CV</u> 0	0 • - Ortho <u>Mean</u> 0	<u>mean</u> 0 P (ppb) <u>CV</u> 0 P (npb)	<u>UV</u> 0 HOD (ppb/da) <u>Mean</u> 0 HOD (ppb/da)	y) N <u>cv</u> 0	<u>Cv</u> 0 10D (ppb/ <u>Mean</u> 0	day) <u>CV</u> 0
Seg     Name       1     Miller Lake       Segment Observed Water of Conserv       Seg     Mean       1     0       Segment Calibration Facto       Dispersion Rate       Seg     Mean	Quality <u>CV</u> ors CV	Segment 0 Total P (ppb <u>Mean</u> 0 Total P (ppb Mean	( <u>Group</u> 1 ) 1 <u>CV</u> 0	<u>km</u> 0.572654 Fotal N (ppi <u>Mean</u> 0 Fotal N (ppi Mean	2.244576 b) Ci <u>CV</u> 0 b) Ci	<u>km</u> 0.5 hi-a (ppb) <u>Mean</u> 0 hi-a (ppb) Mean	<u>Mean</u> 2.2 Se <u>CV</u> 0 Se	<u>CV</u> 0 ecchi (m) <u>Mean</u> 0 ecchi (m) Mean	or CV Or CV	<u>cv</u> 0 ganic N (p <u>Mean</u> 0 rganic N (p Mean	<u>ичеан</u> 0.08 рр <b>b) ТР <u>СV</u> 0 ррb) ТР СV</b>	• - Ortho <u>Mean</u> 0 • - Ortho Mean	0 P (ppb) <u>CV</u> 0 P (ppb) CV	<u>UV</u> 0 HOD (ppb/da) 0 HOD (ppb/da) Mean	y) N <u>CV</u> y) N CV	<u>Cv</u> 0 10D (ppb/ <u>Mean</u> 0 10D (ppb/ Mean	day) <u>CV</u> 0 day)
Seg     Name       1     Miller Lake       Segment Observed Water of Conserv       Seq     Mean       1     0       Segment Calibration Facto       Dispersion Rate       Seg     Mean       1     1	Guality <u>CV</u> ors <u>CV</u>	Segment 0 Total P (ppb <u>Mean</u> 0 Total P (ppb <u>Mean</u> 1	$\begin{array}{c} \underline{\text{Group}} \\ 1 \\ 0 \\ \underline{CV} \\ 0 \\ 0 \\ 0 \\ \underline{CV} \\ 0 \\ 0 \\ \end{array}$	<u>km</u> 0.572654 Fotal N (ppi <u>Mean</u> 0 Fotal N (ppi <u>Mean</u> 1	2.244576 b) Ci <u>CV</u> 0 b) Ci <u>CV</u> 0	<u>km</u> 0.5 hi-a (ppb) <u>Mean</u> 0 hi-a (ppb) <u>Mean</u> 1	<u>Mean</u> 2.2 Se <u>CV</u> 0 Se <u>CV</u> 0	<u>CV</u> 0 ecchi (m) <u>Mean</u> 0 ecchi (m) <u>Mean</u> 1	or CV O CV O O	<u>ev</u> ganic N (p <u>Mean</u> 0 rganic N (p <u>Mean</u> 1	<u>о.08</u> о.08 орр) тр <u>СV</u> о трр) тр <u>СV</u> 0	• - Ortho <u>Mean</u> 0 • - Ortho <u>Mean</u> 1	<u>ичеан</u> 0 Р (ррb) <u>CV</u> 0 Р (ррb) <u>CV</u> 0	<u>Cv</u> 0 HOD (ppb/da) 0 HOD (ppb/da) <u>Mean</u> 1	y) y) <u> cv</u> y) <u> cv</u>	<u>o</u> 10D (ppb/ <u>Mean</u> 0 10D (ppb/ <u>Mean</u> 1	day) <u>CV</u> 0 day) <u>CV</u>
Seg     Name       1     Miller Lake       Segment Observed Water of Conserv       Seq     Mean       1     0       Segment Calibration Facto       Dispersion Rate       Seg     Mean       1     1	Quality <u>CV</u> ors <u>CV</u>	Segment 0 Total P (ppb <u>Mean</u> 0 Total P (ppb <u>Mean</u> 1	Group     1       1     1       0     7       0     7       0     7       0     7       0     7	<u>km</u> 0.572654 Fotal N (ppi <u>Mean</u> 0 Fotal N (ppi <u>Mean</u> 1	2.244576 b) Ci <u>CV</u> 0 b) Ci <u>CV</u> 0	<u>km</u> 0.5 hi-a (ppb) <u>Mean</u> 0 hi-a (ppb) <u>Mean</u> 1	<u>Mean</u> 2.2 <u>CV</u> 0 <u>Se</u> <u>CV</u> 0	<u>CV</u> 0 <u>Mean</u> 0 ecchi (m) <u>Mean</u> 1	0 0 <u>CV</u> 0 0 0 0	ganic N (p Mean 0 ganic N (p <u>Mean</u> 1	<u>о.08</u> о.08 орр) тр <u>СV</u> о тр <u>СV</u> о	• - Ortho <u>Mean</u> 0 • - Ortho <u>Mean</u> 1	<u>ивал</u> 0 Р (ррb) <u>CV</u> 0 Р (ррb) <u>CV</u> 0	<u>Cv</u> 0 HOD (ppb/da) 0 HOD (ppb/da) <u>Mean</u> 1	<u>mean</u> 0 y) <u>cv</u> 0 y) <u>cv</u> 0	0 10D (ppb/ <u>Mean</u> 0 10D (ppb/ <u>Mean</u> 1	day) <u>CV</u> 0 day) <u>CV</u>
Seg     Name       1     Miller Lake       Segment Observed Water of Conserv       Seg     Mean       1     0       Segment Calibration Factor       Dispersion Rate       Seg     Mean       1     1       1     1	Quality <u>CV</u> ors <u>CV</u> 0	Segment 0 Total P (ppb <u>Mean</u> 0 Total P (ppb <u>Mean</u> 1	Group     1       1     1       0     7       0     0       0     7       0     0	<u>km</u> 0.572654 Fotal N (ppi <u>Mean</u> 0 Fotal N (ppi <u>Mean</u> 1	2.244576 b) C <u>CV</u> 0 b) C <u>CV</u> 0	<u>km</u> 0.5 hi-a (ppb) <u>Mean</u> 0 hi-a (ppb) <u>Mean</u> 1	<u>Mean</u> 2.2 Se <u>CV</u> 0 Se <u>CV</u> 0	<u>CV</u> 0 <u>Mean</u> 0 ecchi (m) <u>Mean</u> 1	0 0 <u>CV</u> 0 0 <u>CV</u> 0	ganic N (p Mean 0 rganic N (p <u>Mean</u> 1	<u>о.08</u> о.08 орр) ТР <u>СV</u> 0 орр) ТР <u>СV</u> 0	• - Ortho <u>Mean</u> 0 • - Ortho <u>Mean</u> 1	<u>ивал</u> 0 Р (ррb) <u>CV</u> 0 Р (ррb) <u>CV</u> 0	<u>Uv</u> 0 HOD (ppb/da) 0 HOD (ppb/da) <u>Mean</u> 1	v) (v) (v) (v) (v) (v) (v) (v) (v) (v) (	(OD (ppb/ <u>Mean</u> 0 (OD (ppb/ <u>Mean</u> 1	day) <u>CV</u> 0 day) <u>CV</u> 0
Seg     Name       1     Miller Lake       Segment Observed Water of Conserv       Seq     Mean       1     0       Segment Calibration Factor       Dispersion Rate       Seg     Mean       1     1       Tributary Data	Quality <u>CV</u> ors <u>CV</u> 0	Segment 0 Total P (ppb <u>Mean</u> 0 Total P (ppb <u>Mean</u> 1	(Croup 1 () 1 CV 0 () 1 () 1 () 1 () 1 () 1 () 1 () () () () () () () () () ()	Km 0.572654 Fotal N (pp) <u>Mean</u> 0 Fotal N (pp) <u>Mean</u> 1 Dr Area	2.244576 b) Ci <u>CV</u> b) Ci <u>CV</u> 0 =low (hm <sup>3</sup> /yi	<u>km</u> 0.5 hi-a (ppb) <u>Mean</u> 1 1	<u>Mean</u> 2.2 Se <u>CV</u> 0 Se <u>CV</u> 0	<u>CV</u> 0 <u>Mean</u> 0 ecchi (m) <u>Mean</u> 1	Or CV O CV O CV O Total P (ppb)	ganic N (p Mean 0 ganic N (p <u>Mean</u> 1	<u>(viean</u> 0.08 рр <b>b) ТР <u>СV</u> 0 ррb) ТР <u>СV</u> 0</b>	• - Ortho <u>Mean</u> 0 • - Ortho <u>Mean</u> 1	0 P (ppb) <u>CV</u> 0 P (ppb) <u>CV</u> 0 Ortho P (p)	UV 0 HOD (ppb/da) 0 HOD (ppb/da) <u>Mean</u> 1	y) N <u>CV</u> y) N <u>CV</u> 0 vy N	(ppb)	day) <u>CV</u> 0 day) <u>CV</u>
Seg       Name         1       Miller Lake         Segment Observed Water of Conserv         Seq       Mean         1       0         Segment Calibration Facto         Dispersion Rate         Seq       Mean         1       1         Tributary Data         Trib       Trib Name	Quality <u>CV</u> ors <u>CV</u> 0	Segment 0 Total P (ppb <u>Mean</u> 0 Total P (ppb <u>Mean</u> 1 Segment	<u>Group</u> 1 ) 1 <u>CV</u> 0 ) 1 <u>CV</u> 0 <u>Type</u>	Km 0.572654 Fotal N (ppi <u>Mean</u> 0 Fotal N (ppi <u>Mean</u> 1 Dr Area	<u>m</u> 2.244576 b) Ci <u>CV</u> 0 b) Ci <u>CV</u> 0 =low (hm³/yr <u>Mean</u>	<u>km</u> 0.5 hi-a (ppb) <u>Mean</u> 1 1 () Co	<u>Mean</u> 2.2 Se <u>CV</u> 0 Se <u>CV</u> 0 nserv. <u>Mean</u>	<u>CV</u> 0 <u>Mean</u> 0 <u>Mean</u> 1 <u>CV</u>	Or CV O CV O CV O Total P (ppb) <u>Mean</u>	ganic N (p Mean 0 ganic N (p <u>Mean</u> 1 To <u>CV</u>	<u>(меан</u> 0.08 рр <b>b) ТР <u>СV</u> 0 ррb) ТР <u>СV</u> 0 otal N (ppb) <u>Mean</u></b>	• - Ortho <u>Mean</u> 0 • - Ortho <u>Mean</u> 1	0 P (ppb) <u>CV</u> 0 P (ppb) <u>CV</u> 0 Ortho P (pj <u>Mean</u>	UV 0 HOD (ppb/da) 0 HOD (ppb/da) <u>Mean</u> 1 1 pb) Inc	y) N <u>CV</u> y) N <u>CV</u> 0 prganic N <u>Mean</u>	(PPb) (Ppb) (Ppb) (Ppb)	day) <u>CV</u> 0 day) <u>CV</u> 0

Model Coefficients

Dispersion Rate

Total Nitrogen

Total Phosphorus

<u>Mean</u>

1.000

1.000

1.000

<u>cv</u>

0.70

0.45

0.55

<u>ע:</u> 0

# C.3.2 TMDL Mass Balance Miller Lake TMDL File: C:\Documents and Settings\tsundby\Desktop\4-6-10 work\Five Lake TMDL Model Runs\Miller Lake TMDL.btb

Overall Water Balance		Averagir	ng Period =	1.00	years	
<u>Trb Type Seg Name</u>	Area <u>km²</u>	Flow <u>hm³/yr</u>	Variance <u>(hm3/yr)<sup>2</sup></u>	cv _	Runoff <u>m/yr</u>	
1 1 1 Total P load	1.0	23.2	0.00E+00	0.00	23.21	
TRIBUTARY INFLOW	1.0	23.2	0.00E+00	0.00	23.21	
***TOTAL INFLOW	1.6	23.2	0.00E+00	0.00	14.76	
ADVECTIVE OUTFLOW	1.6	23.2	0.00E+00	0.00	14.76	
***TOTAL OUTFLOW	1.6	23.2	0.00E+00	0.00	14.76	

Predicted	oir Concentra	tions			
TOTAL P					
Load	I	Load Variance		Conc	Export
<u>kg/yr</u>	<u>%Total</u>	<u>(kg/yr)<sup>2</sup> %Tot</u>	<u>al CV</u>	<u>mg/m³</u>	<u>kg/km²/yr</u>
1737.7	100.0%	0.00E+00	0.00	74.9	1737.7
1737.7	100.0%	0.00E+00	0.00	74.9	1737.7
1737.7	100.0%	0.00E+00	0.00	74.9	1104.9
1397.2	80.4%	1.50E+04	0.09	60.2	888.4
1397.2	80.4%	1.50E+04	0.09	60.2	888.4
340.5	19.6%	1.50E+04	0.36		
40.5	I	Nutrient Resid. Time	(yrs)	0.0445	
0.0554	-	Furnover Ratio		22.5	
60	I	Retention Coef.		0.196	
	Predicted TOTAL P Load <u>kg/vr</u> 1737.7 1737.7 1737.7 1397.2 1397.2 340.5 40.5 0.0554 60	Predicted         TOTAL P         Load       I         kg/yr       %Total         1737.7       100.0%         1737.7       100.0%         1737.7       100.0%         1397.2       80.4%         340.5       19.6%         40.5       1         60       1	Predicted         Outflow & Reserve           TOTAL P         Load         Load Variance           kg/yr         %Total         (kg/yr) <sup>2</sup> %Total           1737.7         100.0%         0.00E+00         1           1737.7         100.0%         0.00E+00         1           1737.7         100.0%         0.00E+00         1           1397.2         80.4%         1.50E+04         1           1397.2         80.4%         1.50E+04         1           340.5         19.6%         1.50E+04         1           40.5         Nutrient Resid. Time         1           0.0554         Turnover Ratio         1           60         Retention Coef.         1	Predicted TOTAL P         Outflow & Reservoir Concentration           Load         Load Variance           kg/yr         % Total         (kg/yr) <sup>2</sup> % Total         CV           1737.7         100.0%         0.00E+00         0.00           1737.7         100.0%         0.00E+00         0.00           1737.7         100.0%         0.00E+00         0.00           1737.7         100.0%         0.00E+00         0.00           1397.2         80.4%         1.50E+04         0.09           1397.2         80.4%         1.50E+04         0.09           340.5         19.6%         1.50E+04         0.36           40.5         Nutrient Resid. Time (yrs)         0.0554           60         Retention Coef.         10000	Predicted TOTAL P         Outflow & Reservoir Concentrations           Load         Load Variance         Conc           kg/yr         %Total         (kg/yr) <sup>2</sup> %Total         CV         mg/m <sup>3</sup> 1737.7         100.0%         0.00E+00         0.00         74.9           1397.2         80.4%         1.50E+04         0.09         60.2           1397.2         80.4%         1.50E+04         0.09         60.2           340.5         19.6%         1.50E+04         0.36            40.5         Nutrient Resid. Time (yrs)         0.0445           0.0554         Turnover Ratio         22.5         22.5           60         Retention Coef.         0.196         0.196

# C.3.3 TMDL Predicted

Miller Lake TMDL

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Segment:	1 Miller Lake						
	Predicted Va	lues>					
<u>Variable</u>	<u>Mean</u>	<u>cv</u>	<u>Rank</u>				
TOTAL P MG/M3	60.2	0.09	60.0%				
CHL-A MG/M3	36.0	0.27	95.9%				
SECCHI M	1.6	0.25	70.2%				
ORGANIC N MG/M3	982.8	0.26	92.4%				
TP-ORTHO-P MG/M3	61.8	0.32	77.7%				
ANTILOG PC-1	570.8	0.49	74.1%				
ANTILOG PC-2	22.0	0.08	99.0%				
TURBIDITY 1/M	0.1		1.1%				
ZMIX * TURBIDITY	0.2		0.0%				
ZMIX / SECCHI	1.4	0.26	1.6%				
CHL-A * SECCHI	58.1	0.11	99.3%				
CHL-A / TOTAL P	0.6	0.26	96.0%				
FREQ(CHL-a>10) %	96.0	0.04	95.9%				
FREQ(CHL-a>20) %	73.8	0.19	95.9%				
FREQ(CHL-a>30) %	49.3	0.35	95.9%				
FREQ(CHL-a>40) %	31.5	0.49	95.9%				
FREQ(CHL-a>50) %	20.0	0.62	95.9%				
FREQ(CHL-a>60) %	12.8	0.73	95.9%				
CARLSON TSI-P	63.2	0.02	60.0%				
CARLSON TSI-CHLA	65.7	0.04	95.9%				
CARLSON TSI-SEC	53.1	0.07	29.8%				

# C.4 Winkler Lake C.4.1 TMDL Inputs

C.4.1	TMDL Inpu	ts										M	lodel Coefi	ficients		Mean	<u>cv</u>	
Winkle	er Lake TMDL											U T	Ispersion K	ate		1.000	0.70	
File:	C:)Documents and !	Settinas	tsundbv/Des	:kton\4-6-	10 work\Five	Lake TMD	)L Model Ri	uns\Winkler La	ike TN	/DL.btb		т. Т.	otal Priospr otal Nitrogy	iorus		1.000	0.45	
Descr	ription:	<b>-</b> 3-	·····, ····										bl-a Model			1.000	0.55	
Globa	l Variables	Mean	cv		M	odel Optic	ons	Co	de l	Description		S	erchi Mode	1		1 000	0.20	
Avera	ging Period (vrs)	1	0.0		Co	onservative	Substance	0	, ,	NOT COMPUTE	D	0	rganic N M	odel		1 000	0.12	
Precip	itation (m)	0	0.0		Ph	no sphoru s	Balance	8	3 (	CANF & BACH	LAKES	T	P-OP Mode	l		1.000	0.15	
Evapor	ration (m)	0	0.0		Ni	trogen Bal	ance	0	)	NOTCOMPUT	D	Н	ODv Mode			1.000	0.15	
Storag	e Increase (m)	0	0.0		Ch	lorophyll-a	a	2	2	P, LIGHT, T		N	10Dv Mode	el		1.000	0.22	
-					Se	cchi Depth	ı	1	. ,	VS. CHLA & TU	RBIDITY	S	ecchi/Chla !	Slope (m²/m	ig)	0.015	0.00	
Atmos	s. Loads (kg/km²-yr)	Mean	cv		Di	spersion		1	. 1	FISCHER-NUM	ERIC	N	linimum Q	s (m/yr)		0.100	0.00	
Consei	rv. Substance	0	0.00		Ph	no sphoru s	Calibration	1	. 1	DECAY RATES		C	hl-a Flushin	g Term		1.000	0.00	
Total F	Р	0	0.50		Ni	trogen Cal	ibration	1	. 1	DECAY RATES		C	hl-a Tempo	ral CV		0.620	0	
Total N	N	1000	0.50		Er	ror Analysi	is	1	. 1	MODEL & DAT	д	A	vail. Factor	- Total P		0.330	0	
Ortho	Р	0	0.50		Av	ailability F	actors	0	) (	IGNORE		A	vail. Factor	- Ortho P		1.930	0	
Inorga	nic N	500	0.50		М	a ss-Balanc	e Tables	1	. 1	USE ESTIMATE	D CONCS	A	vail. Factor	- Total N		0.590	0	
					Οι	utput Desti	ination	2	!	EXCEL WORKS	HEET	A	vail. Factor	- Inorganic	N	0.790	0	
Segm	ent Morphometry												Ir	nternal Loa	ds (mg/m2-d	ay)		
			Outflow		Area	Depth	Lenath M	ived Death (m)	۱ I	Hynol Denth	No	on-Algal Ti	urb (m <sup>-1</sup> ) (	Conserv	Tota	10	Tot	al N
							g	iven nehni (iii)	, .	nyper sopar		•		ovnaci i.	TULA	1 F		
Seg	<u>Name</u>		<u>Segment</u>	<u>Group</u>	<u>km<sup>2</sup></u>	<u>m</u>	<u>km</u>	<u>Mean</u>	<u>_cv</u>	Mean	<u>cv</u>	<u>Mean</u>	<u>cv</u>	<u>Mean</u>	<u>cv</u>	Mean	<u>cv</u>	<u>Mean</u>
<u>Seq</u> 1	<u>Name</u> Winkler Lake		Segment 0	<u>Group</u> 1	<u>km</u> 0.293625 0	<u>m</u> 0.576573	<u>km</u> 0.5	Mean 0.57	<u>cv</u> 0	Mean 0	0 0	<u>Mean</u> 0.08	<u>cv</u> 0	<u>Mean</u> 0	<u>cv</u> 0	Mean 0	<u>cv</u> 0	<u>Mean</u> 0
<u>Seq</u> 1 Segm	<u>Name</u> Winkler Lake Ient Observed Water G	ality	<u>Segment</u> 0	<u>Group</u> 1	<u>km²</u> 0.293625 0	<u>m</u> 0.576573	<u>km</u> 0.5	<u>Mean</u> 0.57	′ <u>cv</u> 0	<u>Mean</u> 0	0 0	<u>Mean</u> 0.08	<u>cv</u> 0	<u>Mean</u> 0	<u>cv</u> 0	Mean 0	<u>cv</u> 0	<u>Mean</u> 0
<u>Seg</u> 1 Segm	<u>Name</u> Winkler Lake Nent Observed Water G Conserv	ality	Segment 0 Total P (ppt	<u>Group</u> 1	<u>km²</u> 0.293625 0 Total N (ppb)	<u>m</u> 0.576573	<u>km</u> 0.5	<u>Mean</u> 0.57 Secci	, <u>cv</u> 0 hi (m)	<u>Mean</u> 0 Org	CV 0 ganic N (pj	<u>Mean</u> 0.08 р <b>b) П</b>	<u>CV</u> 0 P - Ortho F	<u>Mean</u> 0 9 (ppb) H	0 <u>CV</u> 0 OD (ppb/day)	Mean 0 MOI	0 0 0 0 (ppb/da	<u>Mean</u> 0
<u>Seq</u> 1 Segm <u>Seq</u>	<u>Name</u> Winkler Lake Ient Observed Water G Conserv <u>Mean</u>	uality <u>CV</u>	Segment 0 Total P (ppb	<u>Group</u> 1 ) <u>CV</u>	<u>km²</u> 0.293625 0 Total N (ppb) <u>Mean</u>	) <u>m</u> 0.576573	<u>km</u> 0.5 Chl-a (ppb) <u>Mean</u>	<u>Mean</u> 0.57 Secci	, <u>cv</u> 0 hi (m) <u>1ean</u>	<u>Mean</u> 0 Org <u>CV</u>	<u>CV</u> 0 ganic N (p) <u>Mean</u>	<u>Mean</u> 0.08 рb) П <u>CV</u>	<u>CV</u> 0 P - Ortho F <u>Mean</u>	<u>Mean</u> 0 (ppb) H <u>CV</u>	OD (ppb/day) <u>Mean</u>	<u>Mean</u> 0 MOI <u>CV</u>	0 <u>CV</u> 0 (ppb/day <u>Mean</u>	<u>Mean</u> 0 () () <u>CV</u>
Seg 1 Segm Seg 1	<u>Name</u> Winkler Lake Ient Observed Water G Conserv <u>Mean</u> 0	Nuality <u>CV</u> 0	Segment 0 Total P (pp: <u>Mean</u> 0	<u>Group</u> 1 ) <u>CV</u> 0	<u>km²</u> 0.293625 0 Total N (ppb) <u>Mean</u> 0	<u>m</u> 0.576573 ) c <u>cv</u> 0	<b><u>km</u></b> 0.5 <b>chl-a (ppb)</b> <u><b>Mean</b></u> 0	Mean 0.57 Secci <u>CV</u> <u>N</u> 0	, <u>CV</u> 0 hi (m) <u>Alean</u> 0	<u>Mean</u> 0 Org <u>CV</u> 0	<u>CV</u> 0 ganic N (p) <u>Mean</u> 0	<u>Mean</u> 0.08 рb) П <u>CV</u> 0	<u>CV</u> 0 P - Ortho F <u>Mean</u> 0	<u>Mean</u> 0 (ppb) H <u>CV</u> 0	OD (ppb/day)	Mean 0 MOI <u>CV</u> 0	<u>CV</u> 0 0 (ppb/da <u>)</u> <u>Mean</u> 0	Mean 0 (/) (/) 0
<u>Seq</u> 1 Segm <u>Seq</u> 1 Segm	<u>Name</u> Winkler Lake Conserv <u>Mean</u> 0 eent Calibration Factor	Nuality <u>CV</u> 0	Segment 0 Total P (ppb Mean 0	<u>Group</u> 1 ) <u>CV</u> 0	km <sup>2</sup> 0.293625 0 Total N (ppb) <u>Mean</u> 0	<u>m</u> ).576573 ) <b>c</b> <u>cv</u> 0	<u>km</u> 0.5 Chl-a (ppb) <u>Mean</u> 0	Mean 0.57 Secci <u>CV</u> M 0	, <u>CV</u> 0 hi (m) <u>1ean</u> 0	<u>Mean</u> 0 0 <u>0</u> 0 0	<u>CV</u> 0 ganic N (p) <u>Mean</u> 0	<u>Mean</u> 0.08 р <b>b) П</b> <u>CV</u> 0	<u>CV</u> 0 P - Ortho F <u>Mean</u> 0	<u>Mean</u> 0 <b>(ppb) H</b> <u>CV</u> 0	OD (ppb/day) <u>Mean</u> 0	Mean 0 MOI <u>CV</u> 0	<u>CV</u> 0 0 (ppb/day <u>Mean</u> 0	Mean 0 (/) (/) 0
<u>Seq</u> 1 Segm <u>Seq</u> 1 Segm	<u>Name</u> Winkler Lake Conserv <u>Mean</u> 0 ent Calibration Factor Dispersion Rate	Quality <u>CV</u> 0 s	Total P (ppt: <u>Mean</u> 0 Total P (ppt:	Group 1 ) <u>CV</u> 0	<u>kmř</u> 0.293625 0 Total N (ppb) <u>Mean</u> 0 Total N (ppb)	) c	<u>km</u> 0.5 Chi-a (ppb) <u>Mean</u> 0 Chi-a (ppb)	Mean 0.57 Secci <u>CV</u> M 0 Secci	, <u>CV</u> 0 hi (m) <u>1ean</u> 0 hi (m)	<u>Mean</u> 0 0 <u>CV</u> 0	<u>CV</u> 0 ganic N (p) <u>Mean</u> 0 ganic N (p)	<u>Mean</u> 0.08 рb) П <u>CV</u> 0 рb) П	<u>CV</u> 0 • - Ortho F <u>Mean</u> 0 • - Ortho F	<u>Mean</u> 0 (ppb) H <u>CV</u> 0	OD (ppb/day) <u>Mean</u> 0	Mean 0 MOI <u>CV</u> 0	<u>CV</u> 0 0 (ppb/day <u>Mean</u> 0 0 (ppb/day	Mean 0 () () () () () () () () () () () () ()
<u>Seq</u> 1 Segm 1 Segm Segm	<u>Name</u> Winkler Lake Conserv <u>Mean</u> 0 eent Calibration Factor Dispersion Rate <u>Mean</u>	Nuality <u>CV</u> 0 s	Segment 0 Total P (ppt <u>Mean</u> 0 Total P (ppt	Group 1 ) () () () () () () () () () () () () (	<u>kmř</u> 0.293625 0 Total N (ppb) <u>Mean</u> Total N (ppb) <u>Mean</u>	) c	<u>km</u> 0.5 Chi-a (ppb) <u>Mean</u> 0 Chi-a (ppb) <u>Mean</u>	Mean 0.57 Secci <u>CV M</u> 0 Secci	, <u>CV</u> 0 hi (m) <u>Alean</u> 0 hi (m) <u>Alean</u>	Mean 0 <u>CV</u> 0 0 0 0 0	<u>CV</u> 0 ganic N (p) <u>Mean</u> 0 ganic N (p) <u>Mean</u>	<u>Mean</u> 0.08 рb) П <u>CV</u> 0 рb) П <u>CV</u>	CV 0 • - Ortho F <u>Mean</u> 0 • - Ortho F <u>Mean</u>	Mean           0           (ppb)           CV           0           (ppb)           EV           0	OD (ppb/day) <u>Mean</u> 0 OD (ppb/day) <u>Mean</u>	Mean 0 <u>CV</u> 0 MOI <u>CV</u>	<u>CV</u> 0 0 (ppb/day <u>Mean</u> 0 0 (ppb/day <u>Mean</u>	Mean 0 (1) (1) (1) (1) (1) (1) (1) (1) (1) (1)
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# C.4.2 TMDL Mass Balance

Winkler Lake TMDL

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Overall Water Balance		Averagin	g Period =	1.00	years	
<u>Trb Type Seg Name</u>	Area <u>km²</u>	Flow <u>hm³/yr</u>	Variance <u>(hm3/yr)<sup>2</sup></u>	cv _	Runoff <u>m/yr</u>	
1 1 1 Total P load	1.0	9.5	0.00E+00	0.00	9.48	
TRIBUTARY INFLOW	1.0	9.5	0.00E+00	0.00	9.48	
***TOTAL INFLOW	1.3	9.5	0.00E+00	0.00	7.33	
ADVECTIVE OUTFLOW	1.3	9.5	0.00E+00	0.00	7.33	
***TOTAL OUTFLOW	1.3	9.5	0.00E+00	0.00	7.33	

Overall Mass Balance Based Upon Component:	Predicted TOTAL P	ncentra	tions				
	Load		Load Varianc	e		Conc	Export
<u>Trb Type Seg Name</u>	<u>kg/yr</u>	<u>%Total</u>	<u>(kg/yr)<sup>2</sup></u>	<u>%Total</u>	<u>cv</u>	<u>mg/m<sup>3</sup></u>	<u>kg/km²/yr</u>
1 1 1 Total P load	643.1	100.0%	0.00E+00		0.00	67.8	643.1
TRIBUTARY INFLOW	643.1	100.0%	0.00E+00		0.00	67.8	643.1
***TOTAL INFLOW	643.1	100.0%	0.00E+00		0.00	67.8	497.1
ADVECTIVE OUTFLOW	571.1	88.8%	8.22E+02		0.05	60.2	441.5
***TOTAL OUTFLOW	571.1	88.8%	8.22E+02		0.05	60.2	441.5
***RETENTION	72.0	11.2%	8.22E+02		0.40		
Overflow Rate (m/yr)	32.3		Nutrient Resid	. Time (yrs)		0.0159	
Hydraulic Resid. Time (yrs)	0.0179		Turnover Ratio	þ		63.1	
Reservoir Conc (mg/m3)	60		Retention Coe	f.		0.112	

# C.4.3 TMDL Predicted

Winkler Lake TMDL

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Segment:	1 W	/inkler La	ake
	Predicted Va	lues>	
<u>Variable</u>	<u>Mean</u>	<u>cv</u>	<u>Rank</u>
TOTAL P MG/M3	60.2	0.05	60.0%
CHL-A MG/M3	45.8	0.27	98.0%
SECCHI M	1.3	0.25	59.8%
ORGANIC N MG/M3	1206.9	0.26	96.7%
TP-ORTHO-P MG/M3	79.3	0.31	84.7%
ANTILOG PC-1	876.1	0.49	83.5%
ANTILOG PC-2	21.9	0.08	99.0%
TURBIDITY 1/M	0.1		1.1%
ZMIX * TURBIDITY	0.0		0.0%
ZMIX / SECCHI	0.4	0.26	0.0%
CHL-A * SECCHI	59.7	0.10	99.4%
CHL-A / TOTAL P	0.8	0.26	98.3%
FREQ(CHL-a>10) %	98.4	0.02	98.0%
FREQ(CHL-a>20) %	84.8	0.12	98.0%
FREQ(CHL-a>30) %	64.5	0.24	98.0%
FREQ(CHL-a>40) %	46.3	0.36	98.0%
FREQ(CHL-a>50) %	32.6	0.47	98.0%
FREQ(CHL-a>60) %	22.8	0.57	98.0%
CARLSON TSI-P	63.2	0.01	60.0%
CARLSON TSI-CHLA	68.1	0.04	98.0%
CARLSON TSI-SEC	56.2	0.07	40.2%