Illinois
Environmental
Protection Agency

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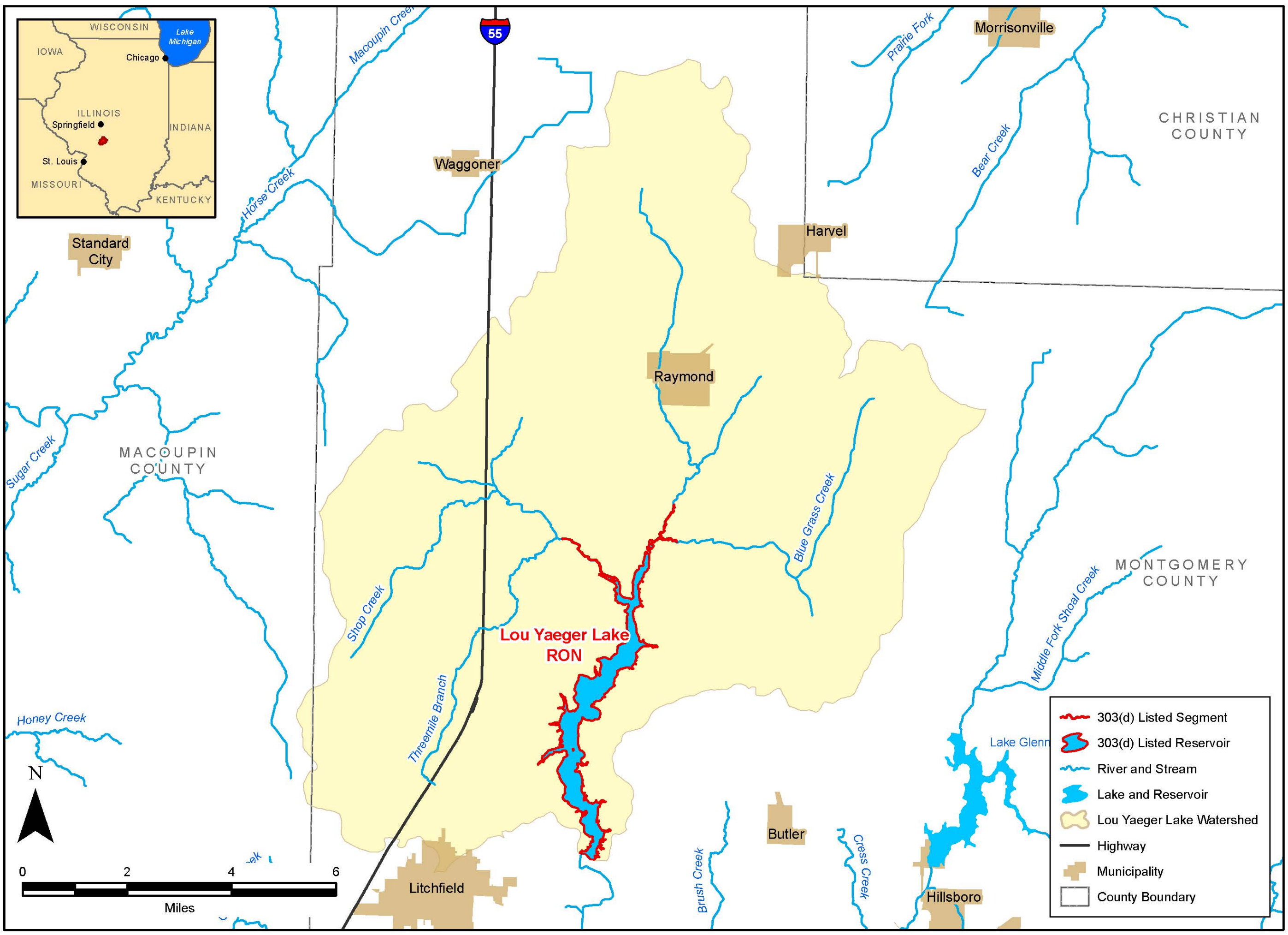
February 2021

IEPA/BOW/IL-2021-002

Lake Lou Yaeger Watershed TMDL Report



Lou Yaeger Lake TMDL Watershed

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TMDL Development for the Lake Lou Yaeger Watershed, Illinois

This file contains the following documents:

1) U.S. EPA Approval Letter and Decision Document for the Final TMDL Report
2) TMDL Report

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 5
77 WEST JACKSON BOULEVARD
CHICAGO, IL 60604-3590

February 11, 2021

REPLY TO THE ATTENTION OF:
WW-16J

Sanjay Sofat, Chief
Bureau of Water
Illinois Environmental Protection Agency
P.O. Box 19276
Springfield, Illinois 62794-9276

Dear Mr. Sofat:

The U.S. Environmental Protection Agency has conducted a complete review of the final Total Maximum Daily Load (TMDL) for phosphorus for Lake Lou Yaeger, including supporting documentation and follow up information. The lake is located in southern Illinois. The TMDL submitted by the Illinois Environmental Protection Agency address the impaired Aesthetic Quality Use for the lake.

The TMDL meets the requirements of Section 303(d) of the Clean Water Act and EPA's implementing regulations at 40 C.F.R. Part 130. Therefore, EPA hereby approves Illinois's one TMDL for phosphorus as noted in the enclosed decision document. The statutory and regulatory requirements, and EPA's review of Illinois's compliance with each requirement, are described in the enclosed decision document.

We wish to acknowledge Illinois's effort in submitting this TMDL and look forward to future TMDL submissions by the State of Illinois. If you have any questions, please contact Mr. David Werbach, at 312-886-4242 or werbach.david@epa,gov .

Sincerely,

Tera L. Fong
Divison Director, Water Division

cc: Abel Haile, IEPA

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TMDL: Lake Lou Yaeger TMDL; Montgomery, Macoupin, and Edwards Counties, IL
Date: 2/11/2021

DECISION DOCUMENT FOR THE APPROVAL OF THE LAKE LOU YAEGER, ILLINOIS TMDL

Section 303(d) of the Clean Water Act (CWA) and EPA's implementing regulations at 40 C.F.R. Part 130 describe the statutory and regulatory requirements for approvable TMDLs. Additional information is generally necessary for EPA to determine if a submitted TMDL fulfills the legal requirements for approval under Section 303(d) and EPA regulations, and should be included in the submittal package. Use of the verb "must" below denotes information that is required to be submitted because it relates to elements of the TMDL required by the CWA and by regulation. Use of the term "should" below denotes information that is generally necessary for EPA to determine if a submitted TMDL is approvable. These TMDL review guidelines are not themselves regulations. They are an attempt to summarize and provide guidance regarding currently effective statutory and regulatory requirements relating to TMDLs. Any differences between these guidelines and EPA's TMDL regulations should be resolved in favor of the regulations themselves.

1. Identification of Waterbody, Pollutant of Concern, Pollutant Sources, and Priority Ranking

The TMDL submittal should identify the waterbody as it appears on the State's/Tribe's 303(d) list. The waterbody should be identified/georeferenced using the National Hydrography Dataset (NHD), and the TMDL should clearly identify the pollutant for which the TMDL is being established. In addition, the TMDL should identify the priority ranking of the waterbody and specify the link between the pollutant of concern and the water quality standard (see Section 2 below).

The TMDL submittal should include an identification of the point and nonpoint sources of the pollutant of concern, including location of the source(s) and the quantity of the loading, e.g., lbs/per day. The TMDL should provide the identification numbers of the NPDES permits within the waterbody. Where it is possible to separate natural background from nonpoint sources, the TMDL should include a description of the natural background. This information is necessary for EPA's review of the load and wasteload allocations, which are required by regulation.

The TMDL submittal should also contain a description of any important assumptions made in developing the TMDL, such as:

(1) the spatial extent of the watershed in which the impaired waterbody is located;
(2) the assumed distribution of land use in the watershed (e.g., urban, forested, agriculture);
(3) Population characteristics, wildlife resources, and other relevant information affecting the characterization of the pollutant of concern and its allocation to sources;
(4) present and future growth trends, if taken into consideration in preparing the TMDL (e.g., the TMDL could include the design capacity of a wastewater treatment facility); and

(5) an explanation and analytical basis for expressing the TMDL through *surrogate measures*, if applicable. *Surrogate measures* are parameters such as percent fines and turbidity for sediment impairments; chlorophyll *a* and phosphorus loadings for excess algae; length of riparian buffer; or number of acres of best management practices.

Comment:
Location Description: Section 5.2 of the TMDL states that Lake Lou Yaeger was built in 1966 in south-central Illinois, approximately 45 miles south of the City of Springfield (Figure 1-1 of the TMDL). The lake is a reservoir on the West Branch of Shoal Creek, and several small tributaries feed into the lake. Most of the watershed lies within Montgomery County (approximately 69,300 acres), with a very small acreage in Macoupin and Christian Counties (229 acres and 13 acres, respectively). Lake Lou Yaeger has a surface area of 1,268 acres with an average depth of 10 feet and a maximum depth of 32 feet. The lake provides flood control on Shoal Creek and is a municipal water supply for the City of Litchfield, Illinois serving approximately 13,000 customers. The lake is used for recreational activities such as boating, fishing, swimming, etc.

The Illinois Environmental Protection Agency (IEPA) has developed a TMDL for phosphorus for Lake Lou Yaeger (Table 1 of this Decision Document). Illinois also submitted a Load Reduction Strategy (LRS) which establishes a watershed-specific target value to address total suspended solids (TSS), which does not have a numeric criterion (Section 1.2 of the TMDL). The LRS provides guidance for voluntary nonpoint source reduction efforts by implementing agricultural and urban stormwater best management practices (BMPs), until numeric criteria are adopted by IEPA. The LRS portion of the submittal is not included in EPA's approval decision.

Table1: Lake Lou Yaeger TMDL List Information

Segment Name	Segment ID	Pollutant	Impaired Designated Use	Potential Sources*
Lake Lou Yaeger	RON	Phosphorus	Aesthetic Quality	Agriculture, Internal Nutrient Recycling, Runoff from forest/ grassland/parkland

* As identified on the Illinois 2016 303(d) list

Land use: Section 2.3 of the TMDL discusses land use in the contributing watershed. Approximately 75% of the land use in the watershed is row crop agriculture, with the remaining land uses being forest 9%, grassland/pasture 6%, and the remaining a mixture of low intensity developed land use and open space. The Village of Raymond is located withing the watershed, with a population of approximately 1,000. A portion of the City of Litchfield is also located in the watershed. IEPA estimates the total population in the watershed at approximately 4,100 (Section 2.5 of the TMDL).

Problem Identification: Section 5.1 of the TMDL discusses the available data used in determining the water quality of Lake Lou Yaeger. Three sampling locations have been utilized by IEPA in 2003, 2008, and 2012 to gather phosphorus data in the lake. As noted in Table 5-2 and Figure 5-2 of the TMDL, phosphorus levels have exceeded the criterion during all sampling events.

Pollutant of Concern: Phosphorus is the pollutant of concern for the TMDL.

Sources: The sources of phosphorus in the watershed are predominantly nonpoint sources, but there are some contributions from point sources.

Point Sources: IEPA noted that there are two point sources that discharge phosphorus in the Lake Lou Yaeger watershed (Section 5.2 of the TMDL). There is one Municipal Wastewater Treatment Facility (WWTF), for the Village of Raymond, and a commercial discharge system for the Magnus Grand Hotel and Conference Center. IEPA did not identify any other permitted dischargers in the watershed.

Nonpoint Sources: The nonpoint sources of phosphorus are described in Section 5.4 of the TMDL.

Stormwater runoff from agricultural land use practices: Runoff from agricultural lands may contain significant amounts of nutrients, organic material and organic-rich sediment which contribute to the impairments in the Lake Lou Yaeger watershed. Stormwater runoff may contribute nutrients and organic-rich sediment to surface waters from livestock manure, fertilizers, vegetation and erodible soils. Manure spread onto fields is often a source of phosphorus, and can be exacerbated by tile drainage lines, which channelize the stormwater. Tile lined fields and channelized ditches enable particles to move more efficiently into surface waters.

Internal loading: The release of phosphorus from lake sediments via physical disturbance from benthic fish (i.e., rough fish, e.g., carp) and the release of phosphorus from wind mixing the water column may contribute internal phosphorus loading to the lake. Phosphorus may build up in the bottom waters of the lake and may be resuspended or mixed into the water column when the thermocline decreases, and the lake water mixes.

Discharges from septic systems or unsewered communities: Failing septic systems are a potential source of nutrients within the Lake Lou Yaeger watershed. Septic systems generally do not discharge directly into a waterbody, but effluents from failing septic systems may leach into groundwater or pond at the surface where they can be washed into surface waters via stormwater runoff events. Age, construction and use of septic systems can vary throughout a watershed and influence the nutrient contribution from these systems. IEPA noted that while there is no specific information on the presence of failing septic systems in the watershed, discussions with the local county health departments indicated that many of the systems are aerated systems, which treat effluent more effectively and require more frequent maintenance.

Wildlife: Wildlife is a known source of nutrient inputs to waterbodies as many animals spend time in or around waterbodies. Deer, geese, ducks, raccoons, and other animals all create potential sources of nutrients via contaminated runoff from animal habitats, such as urban park areas, forest, and rural areas.

Future growth: IEPA did not set aside a portion of the load capacity for future growth. IEPA determined that the population in the watershed is not expected to increase in the near future (Section 8.3.1.5 of the TMDL).

Priority ranking: The watershed was given priority for TMDL development due to the impairment impacts on the public value of the impaired water resource, and the timing of Illinois' basin monitoring process.

EPA finds that the TMDL document submitted by IEPA satisfies all requirements concerning this first element.

2. Description of the Applicable Water Quality Standards and Numeric Water Quality Target

The TMDL submittal must include a description of the applicable State/Tribal water quality standard, including the designated use(s) of the waterbody, the applicable numeric or narrative water quality criterion, and the antidegradation policy. (40 C.F.R. §130.7(c)(1)). EPA needs this information to review the loading capacity determination, and load and wasteload allocations, which are required by regulation.

The TMDL submittal must identify a numeric water quality target(s) – a quantitative value used to measure whether or not the applicable water quality standard is attained. Generally, the pollutant of concern and the numeric water quality target are, respectively, the chemical causing the impairment and the numeric criteria for that chemical (e.g., chromium) contained in the water quality standard. The TMDL expresses the relationship between any necessary reduction of the pollutant of concern and the attainment of the numeric water quality target. Occasionally, the pollutant of concern is different from the pollutant that is the subject of the numeric water quality target (e.g., when the pollutant of concern is phosphorus and the numeric water quality target is expressed as Dissolved Oxygen (DO) criteria). In such cases, the TMDL submittal should explain the linkage between the pollutant of concern and the chosen numeric water quality target.

Comment:
Section 4.2 of the TMDL identifies the designated uses for the impaired lake as General Use and Public and Food Processing Water Supply. General Use is defined as a standard that "will protect the state's water for aquatic life, wildlife, agricultural use, secondary contact use and most industrial uses, and ensure the aesthetic quality of the state's aquatic environment." Public and Food Processing Water Supply is defined as a standard that is "cumulative with the general use standards of Subpart B and must be met in all waters designated in Part 303 at any point at which water is withdrawn for treatment and distribution as a potable supply or for food processing." Lake Lou Yaeger is listed as impaired for the General Use standard, but is not listed as impaired for the Public and Food Processing Water Supply Use.

The applicable water quality standards (WQS) for the lake is established in Illinois Administrative Rules Title 35, Environmental Protection; Subtitle C, Water Pollution; Chapter I, Pollution Control Board; Part 302, Water Quality Standards, Subpart B for General Use Water Quality Standards. The portions of the WQS that apply to the lake is General Use, specifically the Aesthetic Quality Use (Section 4.3 of the TMDL).

Criteria: The applicable criterion is **0.05 mg/L** of phosphorus, and is the target for this TMDL.

Other impairments: IEPA also noted that the lake is impaired due to TSS. IEPA explained that TMDLs for this impairment will be developed after numeric criteria are developed for this pollutant. However, IEPA did develop a LRS that contain BMPs designed to reduce sediment (and related nutrient) loads entering the impaired waterbody (Section 4.4 of the TMDL).

EPA finds that the TMDL document submitted by IEPA satisfies all requirements concerning this second element.

3. Loading Capacity - Linking Water Quality and Pollutant Sources

A TMDL must identify the loading capacity of a waterbody for the applicable pollutant. EPA regulations define loading capacity as the greatest amount of a pollutant that a water can receive without violating water quality standards (40 C.F.R. §130.2(f)).

The pollutant loadings may be expressed as either mass-per-time, toxicity or other appropriate measure (40 C.F.R. §130.2(i)). If the TMDL is expressed in terms other than a daily load, e.g., an annual load, the submittal should explain why it is appropriate to express the TMDL in the unit of measurement chosen. The TMDL submittal should describe the method used to establish the cause-and-effect relationship between the numeric target and the identified pollutant sources. In many instances, this method will be a water quality model.

The TMDL submittal should contain documentation supporting the TMDL analysis, including the basis for any assumptions; a discussion of strengths and weaknesses in the analytical process; and results from any water quality modeling. EPA needs this information to review the loading capacity determination, and load and wasteload allocations, which are required by regulation.

TMDLs must take into account *critical conditions* for stream flow, loading, and water quality parameters as part of the analysis of loading capacity. (40 C.F.R. §130.7(c)(1)). TMDLs should define applicable *critical conditions* and describe their approach to estimating both point and nonpoint source loadings under such *critical conditions*. In particular, the TMDL should discuss the approach used to compute and allocate nonpoint source loadings, e.g., meteorological conditions and land use distribution.

Comment:

Loading Capacity: The loading capacity is found in Section 8 of the TMDL submittal. Table 2 of this Decision Document summarizes the phosphorus TMDL for Lake Lou Yaeger.

Table 2: Summary for the Lake Lou Yaeger (RON) Phosphorus TMDL

Segment	Loading Source	LC (lbs/day)	WLA-Facilities (lbs/day)	LA (lbs/day)	MOS (10% of LC)	Current Load (lbs/day)	Reduction Needed (lbs/day)	Reduction Needed (Percent)
RON	Internal	8.63	-	7.77	0.86	34.5	25.87	75%
	External	17.0	5.25	10.0	1.70	149	132	89%
	Total	**25.6**	**5.25**	**17.8**	**2.56**	**184**	**158.4**	**86%**

Methodology: IEPA used the Simplified Lake Analysis Model (SLAM) to determine allocations for phosphorus (Section 7 of the TMDL).

SLAM – This model uses a simple loading analysis for lakes, described in Section 7.2.1 of the TMDL. A more traditional method for lake analysis, such as BATHTUB, was not used because IEPA determined that SLAM could also integrate the sediment dynamics and characteristics within the lake to determine phosphorus loading by using lake and sediment interactions. Parameter inputs considered in the calculations include: lake morphology, hydraulics, and thermal stratification; segmentation and flow direction; watershed inflows via runoff and point source discharge into the reservoir watershed; in-lake nutrients, settling velocity and nutrient uptake and burial; and sediment layer dynamics. Confirmatory analysis was also completed to document that the observed and simulated values supported the methodology. Comparison of observed and predicted calculations yielded a range of 2.2% – 7.3% difference amongst the three zones of the lake (Table 7-4 of the TMDL).

Modeling results: Loading of phosphorus from the surrounding watershed was calculated using estimated runoff values and export coefficients based upon land use (Appendix A of the TMDL). Runoff from the surrounding watershed, along with flow records from a nearby USGS gage, were used to determine the current loading. Then, IEPA reduced phosphorus loads from the sources until the in-lake criterion of 0.05 mg/L was attained. Further details on the modeling efforts are found in Section 7 and Appendix E of the TMDL.

Critical Conditions - Section 8.3.1.2 of the TMDL states that the critical condition for phosphorus in the lake is primarily during the growing season. The critical conditions were taken into account during the development of the TMDL via data collection at these critical times, as well as times with different runoff characteristics and flow regimes.

EPA finds IEPA's approach for calculating the loading capacity to be reasonable and consistent with EPA guidance. EPA finds that the TMDL document submitted by IEPA satisfies all requirements concerning this third element.

4. Load Allocations (LAs)

EPA regulations require that a TMDL include LAs, which identify the portion of the loading capacity attributed to existing and future nonpoint sources and to natural background. Load allocations may range from reasonably accurate estimates to gross allotments (40 C.F.R. §130.2(g)). Where possible, load allocations should be described separately for natural background and nonpoint sources.

<u>Comment</u>:
IEPA identified several nonpoint sources which contribute nutrient loading to the Lake Lou Yaeger (Table 2 of this Decision Document). These nonpoint sources included: stormwater runoff from agricultural land use practices, internal loading, contributions from septic systems or unsewered communities and wildlife. IEPA did identify the internal load portion of the LA for phosphorus (Table 2 of this Decision Document).

EPA finds IEPA's approach for calculating the LA to be reasonable and consistent with EPA guidance. EPA finds that the TMDL document submitted by IEPA satisfies all requirements concerning this fourth element.

5. Wasteload Allocations (WLAs)

EPA regulations require that a TMDL include WLAs, which identify the portion of the loading capacity allocated to individual existing and future point source(s) (40 C.F.R. §130.2(h), 40 C.F.R. §130.2(i)). In some cases, WLAs may cover more than one discharger, e.g., if the source is contained within a general permit.

The individual WLAs may take the form of uniform percentage reductions or individual mass based limitations for dischargers where it can be shown that this solution meets WQSs and does not result in localized impairments. These individual WLAs may be adjusted during the NPDES permitting process. If the WLAs are adjusted, the individual effluent limits for each permit issued to a discharger on the impaired water must be consistent with the assumptions and requirements of the adjusted WLAs in the TMDL. If the WLAs are not adjusted, effluent limits contained in the permit must be consistent with the individual WLAs specified in the TMDL. If a draft permit provides for a higher load for a discharger than the corresponding individual WLA in the TMDL, the State/Tribe must demonstrate that the total WLA in the TMDL will be achieved through reductions in the remaining individual WLAs and that localized impairments will not result. All permittees should be notified of any deviations from the initial individual WLAs contained in the TMDL. EPA does not require the establishment of a new TMDL to reflect these revised allocations as long as the total WLA, as expressed in the TMDL, remains the same or decreases, and there is no reallocation between the total WLA and the total LA.

Comment:
WLA for Phosphorus for Individually Permitted NPDES sources: IEPA determined loads for phosphorus for the two dischargers in the Lake Lou Yaeger watershed (Table 3 of this Decision Document). To determine the WLAs, IEPA reviewed discharge data for flow and estimated an effluent concentration of 5 mg/L (Section 8.3.1.4 of the TMDL). IEPA noted that neither facility has phosphorus monitoring as part of their permit requirements. The WLAs for each facility were applied to the SLAM model as impacting the nearest downstream section of the lake.

Table 3: WLAs for the Lake Lou Yaeger Phosphorus TMDL

Permit Number	Facility Name	Estimated Effluent Concentration (mg/L of P)	Design Average Flow (DAF) (MGD)	WLA (lbs/day)
IL0025381	Village of Raymond STP	5.0	0.1	**4.17**
IL0063525	Magnus Grand Hotel and Conference Center	5.0	0.026	**1.08**
			Total	**5.25**

EPA finds IEPA's approach for calculating the WLA to be reasonable and consistent with EPA guidance. EPA finds that the TMDL document submitted by IEPA satisfies all requirements concerning this fifth element.

6. Margin of Safety (MOS)

The statute and regulations require that a TMDL include a margin of safety (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 C.F.R. §130.7(c)(1)). EPA's 1991 TMDL Guidance explains that the MOS may be implicit, i.e., incorporated into the TMDL through conservative assumptions in the analysis, or explicit, i.e., expressed in the TMDL as loadings set aside for the MOS. If the MOS is implicit, the conservative assumptions in the analysis that account for the MOS must be described. If the MOS is explicit, the loading set aside for the MOS must be identified.

Comment:
IEPA determined that the MOS for phosphorus for Lake Lou Yaeger is both implicit and explicit (Table 2 of this Decision Document and Section 8.3.1.3 of the TMDL). An explicit MOS of 10% was used because of the lack of some site-specific data and uncertainty in the data due to flow, bathymetry, temperature variation, and well as uncertainty in chemical data. IEPA also noted that the SLAM modeling is implicitly conservative in utilizing using the default coefficients and conservative calculations, which are developed in that manner to account to be inherently conservative. Default model values, such as dispersion rates, are based on scientific data accumulated from literature and represent a broad-reaching survey of lakes.

EPA finds IEPA's approach for calculating the MOS to be reasonable and consistent with EPA guidance. EPA finds that the TMDL document submitted by IEPA satisfies all requirements concerning this sixth element.

7. Seasonal Variation

The statute and regulations require that a TMDL be established with consideration of seasonal variations. The TMDL must describe the method chosen for including seasonal variations. (CWA §303(d)(1)(C), 40 C.F.R. §130.7(c)(1)).

Comment:
Section 7.3.1.2 of the TMDL states that for phosphorus, seasonal variation was included because the calculations were performed on an annual basis using flow and runoff data under various climatic conditions of the calendar year. Both seasonal variation and critical conditions were considered in the development of the Lake Lou Yaeger phosphorus TMDL because the data calculations were performed on an average annual basis using all time periods of the calendar year. and then the values were recalculated to a daily basis. IEPA analyzed lake level data and determined that seasonal changes in lake level are small, as the lake level is controlled via the outlet dam (Section 7.2.1.1.2 of the TMDL). The model was also adjusted to account for potential lake stratification in the summer.

EPA finds that the TMDL document submitted by IEPA satisfies all requirements concerning this seventh element.

8. Reasonable Assurances

When a TMDL is developed for waters impaired by point sources only, the issuance of a National Pollutant Discharge Elimination System (NPDES) permit(s) provides the reasonable assurance that the wasteload allocations contained in the TMDL will be achieved. This is because 40 C.F.R. 122.44(d)(1)(vii)(B) requires that effluent limits in permits be consistent with "the assumptions and requirements of any available wasteload allocation" in an approved TMDL.

When a TMDL is developed for waters impaired by both point and nonpoint sources, and the WLA is based on an assumption that nonpoint source load reductions will occur, EPA's 1991 TMDL Guidance states that the TMDL should provide reasonable assurances that nonpoint source control measures will achieve expected load reductions in order for the TMDL to be approvable. This information is necessary for EPA to determine that the TMDL, including the load and wasteload allocations, has been established at a level necessary to implement water quality standards.

EPA's August 1997 TMDL Guidance also directs Regions to work with States to achieve TMDL load allocations in waters impaired only by nonpoint sources. However, EPA cannot disapprove a TMDL for nonpoint source-only impaired waters, which do not have a demonstration of reasonable assurance that LAs will be achieved, because such a showing is not required by current regulations.

Comment:
Discussion regarding reasonable assurance that the reductions can occur is found in Section 9 and Appendix E of the TMDL. IEPA noted that Lake Lou Yaeger is a highly-prized recreational asset in the area, and the City of Litchfield has implemented several projects over time to improve and protect the lake.

Litchfield has submitted a request for a Clean Water Act Section 319 grant to address sediment and nutrient loading in the lake (Attachment E of the TMDL). As noted in the TMDL, the sediment in the watershed is enriched in phosphorus, and therefore attempts to reduce nutrients will necessitate reductions in sediment. The proposal is to develop two settling ponds to restrict sediment migration into the lake. As noted in the proposal, the ponds would have a significant impact on sediment loading into the lake.

In addition to the sediment ponds, Litchfield is also looking to develop rock berms parallel to the shoreline in several locations in the lake. These locations are sites where significant shoreline erosion is occuring and large amounts of phosphorus-rich sediment are entering the lake, likely a significant source of internal loading. These berms would trap slumping sediment and provide a more stable slope along the shoreline. The berms would also protect the shoreline from storm and winter impacts. The City is also looking at renovating a previous sediment pond located nearby (Five Mile Lake) providing additional sediment removal.

The US Army Corps of Engineers (USACE) developed a draft feasibility report "Lake Lou Yaeger Aquatic Ecosystem Restoration Project, Continuing Authorities Program, Section 206" dated September 2016. This report investigates several options for providing larger, more expensive sediment ponds located along the mouths of two of the larger tributaries to Lake Lou Yaeger. These recommendations were deemed too expensive by the City, but resulted in the current 319 proposal, and remain possible should funding become available (Appendix F of the TMDL).

To reduce nutrients and sediments from entering the ponds or lake, IEPA investigated several BMPs including buffer strips along the edges of fields and small tributaries. Section 9.3 of the TMDL discusses the development and impacts that buffer strips could have in reducing pollutant loads into the lake. Figure 9-1 of the TMDL identifies locations where buffer strips could be emplaced to reduce pollutant loads.

EPA finds that the TMDL document submitted by IEPA satisfies all requirements concerning this eighth element.

9. Monitoring Plan to Track TMDL Effectiveness

EPA's 1991 document, *Guidance for Water Quality-Based Decisions: The TMDL Process* (EPA 440/4-91-001), recommends a monitoring plan to track the effectiveness of a TMDL, particularly when a TMDL involves both point and nonpoint sources, and the WLA is based on an assumption that nonpoint source load reductions will occur. Such a TMDL should provide assurances that nonpoint source controls will achieve expected load reductions and, such TMDL should include a monitoring plan that describes 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.

Comment:

Monitoring will be an essential part of going forward, as IEPA plans to use an adaptive management (Section 9.2 of the TMDL) or phased approach in implementation, and will need to monitor key response indicators to track effectiveness of nonpoint source BMPs. Section 9.9.2 of the TMDL states that monitoring to track BMP emplacement and effectiveness of BMPs will be critical in restoring Lake Lou Yaeger.

EPA finds that the TMDL document submitted by IEPA satisfies all requirements concerning this ninth element.

10. Implementation

EPA policy encourages Regions to work in partnership with States/Tribes to achieve nonpoint source load allocations established for 303(d)-listed waters impaired by nonpoint sources. Regions may assist States/Tribes in developing implementation plans that include reasonable assurances that nonpoint source LAs established in TMDLs for waters impaired solely or primarily by nonpoint sources will in fact be achieved. In addition, EPA policy recognizes that other relevant watershed management processes may be used in the TMDL process. EPA is not required to and does not approve TMDL implementation plans.

Comment:
Section 9 of the TMDL includes many aspects of implementation that would improve water quality in the watershed. These include actions such as identifying causes and sources of pollution, estimating reductions, describing the NPS management measures, estimating the technical assistance and costs, including public information, developing a schedule, developing the interim and measurable milestones, identifying indicators to determining the achievement of reductions, and developing a monitoring component for the project.

The siltation and sediment controls that are discussed at length as part of the LRS are also applicable to effective phosphorus reduction. Section 9.3 of the TMDL has a lengthy list of possible actions, including filter strips, field borders, conservation tillage, contour farming, conservation crop rotation, conservation cover, critical area planting, urban reforestation/riparian buffer restoration, wetland buffers, stormwater retention basins, vegetated swales, grassed waterways, pervious and porous pavement, stormwater reduction, bio-retention cells (rain gardens), and streambank stabilization.

Sections 9.3 and 9.4 of the TMDL recognize the internal and external sources of phosphorus in the lake in relation to BMPs, and reiterates that both point and nonpoint sources should be addressed. The internal loading may be addressed by more aeration, addition of aluminum to inactivate phosphorus, and dredging. Septic system management or upgrades to a municipal system, or agricultural nutrient management may decrease the phosphorus that can enter the lake.

Section 9.5 of the TMDL includes BMP cost estimates to control nonpoint sources in great detail, including the pricing of filter strips/ riparian buffer, nutrient management plans, wetland functions, bank stabilization/erosion controls, conservation cover, vegetated swales, green roofs, bio-retention cells, and septic maintenance.

Education and funding mechanisms are discussed in Sections 9.6 - 9.8 of the TMDL. The funding mechanisms include Illinois Section 319(h) of the Clean Water Act funding, whereby IEPA receives federal funds, contributing to as much as 60% of the total cost. There are also wetland program development grants, National Park Service financial assistance, the Conservation Reserve Program, the Conservation Stewardship Program, the Agricultural Conservation Easement Program and the Environmental Quality Incentive Program. Many of these programs provide cost-share funds to encourage implementation. Illinois has provided timeline milestones in Section 9.9.1 of the TMDL for acquiring funds, implementing short- and long-term projects, monitoring, holding stakeholder meetings, and providing education and outreach.

EPA reviews, but does not approve, implementation plans. EPA finds that all elements have been adequately addressed.

11. Public Participation

EPA policy is that there should be full and meaningful public participation in the TMDL development process. The TMDL regulations require that each State/Tribe must subject calculations to establish TMDLs to public review consistent with its own continuing planning process (40 C.F.R. §130.7(c)(1)(ii)). In guidance, EPA has explained that final TMDLs submitted to EPA for review and approval should describe the State's/Tribe's public participation process, including a summary of significant comments and the State's/Tribe's responses to those comments. When EPA establishes a TMDL, EPA regulations require EPA to publish a notice seeking public comment (40 C.F.R. §130.7(d)(2)). Provision of inadequate public participation may be a basis for disapproving a TMDL. If EPA determines that a State/Tribe has not provided adequate public participation, EPA may defer its approval action until adequate public participation has been provided for, either by the State/Tribe or by EPA.

Comment:
IEPA held a meeting for the Stage 1 TMDL Report at the Litchfield Community Center in Litchfield, Illinois on March 7, 2017. This meeting was an opportunity for the public to be informed of the proposed project and invite the public to provide information to the State for TMDL development efforts.

The TMDL was public noticed from August 6, 2020 to September 7, 2020. Copies of the draft TMDL were made available upon request, at the Illinois EPA and on IEPA's Internet web site at https://www2.illinois.gov/epa/public-notices/Pages/general-notices.aspx. IEPA held a virtual public meeting on August 6, 2020. The draft TMDL report was available for review in hard copy at the City of Litchfield City Hall.

Comments were received from the public. A summary of the issues raised is set forth below.

One comment requested clarification on how the phosphorus criterion of 0.05 mg/L was determined. IEPA explained the criteria value is based upon the USEPA Water Quality Handbook from 1976, and adopted by the Illinois Pollution Control Board in 1979 and revised in 1983. Another comment concerned the impaired uses in the lake, and noted that the public water supply use was not impaired. The commenter suggested that the Aesthetic Quality Use is not a serious consequence. IEPA noted that both uses are equally important under state regulations, and that while the Public Water Supply use is not technically impaired, the elevated levels of nutrients and sediments will negatively affect aquatic life and drinking water costs for the City of Litchfield.

Detailed comments were also submitted regarding the implementation plan and the various actions and activities that the City of Litchfield is implementing or has implemented. The Section 319 Grant Proposal was updated with new information regarding BMPs planned for the lake.

EPA reviewed the comments and the IEPA responses, as well as changes made to the TMDL as a result of the comments. EPA determined that IEPA adequately responded to the comments. EPA finds that the TMDL document submitted by IEPA satisfies all requirements concerning this eleventh element.

12. Submittal Letter

A submittal letter should be included with the TMDL submittal, and should specify whether the TMDL is being submitted for a technical review or final review and approval. Each final TMDL submitted to EPA should be accompanied by a submittal letter that explicitly states that the submittal is a final TMDL submitted under Section 303(d) of the Clean Water Act for EPA review and approval. This clearly establishes the State's/Tribe's intent to submit, and EPA's duty to review, the TMDL under the statute. The submittal letter, whether for technical review or final review and approval, should contain such identifying information as the name and location of the waterbody, and the pollutant(s) of concern.

Comment:
EPA received the Lake Lou Yaeger TMDL on January 26, 2021, accompanied by a submittal letter dated January 26, 2021. In the submittal letter, IEPA stated "Illinois is submitting the Lake Lou Yaeger TMDL …. for USEPA's final approval." The letter states that Lake Lou Yaeger is impaired on Illinois' 2016 303(d) list. The waterbody is impaired for Aesthetic Quality Use due to phosphorus.

EPA finds that the TMDL document submitted by IEPA satisfies all requirements concerning this twelfth element.

13. Conclusion

After a full and complete review, EPA finds that the phosphorus TMDL for Lake Lou Yaeger satisfies all the elements of a TMDL, for a total of **one TMDL** (Table 1 of this Decision Document).

The EPA's approval of these TMDLs extends to the water bodies which are identified in Table 1 of this Decision Document with the exception of any portions of the water bodies that are within Indian Country, as defined in 18 U.S.C. Section 1151. The EPA is taking no action to approve or disapprove TMDLs for those waters at this time. The EPA, or eligible Indian Tribes, as appropriate, will retain responsibilities under the CWA Section 303(d) for those waters.

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Lake Lou Yaeger Watershed Final TMDL Report

Prepared for Illinois EPA

February 2021

CDM Smith

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Table of Contents

Appendices

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Acronyms

BMPs	best management practices
C-BMP	Council on best management practices
CDL	Cropland Data Layer
cfs	cubic feet per second
CSTR	Constinuously stirred tank reactor
CWA	Clean Water Act
DMR	Discharge monitoring report
EQIP	Environmental Quality Incentives Program
GIS	geographic information system
IDA	Illinois Department of Agriculture
Illinois EPA	Illinois Environmental Protection Agency
IPCB	Illinois Pollution Control Board
ISWS	Illinois State Water Survey
LA	Load Allocation
LC	Loading Capacity
mg/L	milligrams per liter
µg/L	micrograms per liter
MCL	Maximum contaminant level
MGD	Million gallons per day
MOS	Margin of Safety
NA	not applicable
NASS	National Agricultural Statistics Service
NCDC	National Climatic Data Center
NED	National Elevation Dataset
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Service
RC	Reserve Capacity
SLAM	Simplified Lake Analysis Model
SSURGO	Soil Survey Geographic
SWCDs	Soil and Water Conservation Districts
TMDL	total maximum daily load
TSS	total suspended solids
USDA	United States Department of Agriculture
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
USLE	Universal Soil Loss Equation
WLA	Waste Load Allocation

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Section 1

Goals and Objectives for the Lake Lou Yaeger Watershed

1.1 Total Maximum Daily Load Overview

A total maximum daily load, or TMDL, is a calculation of the maximum amount of a pollutant that a water body can receive and still meet water quality standards. TMDLs are a requirement of Section 303(d) of the Clean Water Act (CWA). To meet this requirement, the Illinois Environmental Protection Agency (Illinois EPA) must identify water bodies not meeting water quality standards and then establish TMDLs for restoration of water quality. Illinois EPA develops a list known as the "303(d) list" of water bodies not meeting water quality standards every 2 years, and it is included in the Integrated Water Quality Report. Water bodies on the 303(d) list are then targeted for TMDL development. The Illinois EPA's most recent Integrated Water Quality Report was submitted to the United States Environmental Protection Agency (USEPA) in July 2016. In accordance with USEPA's guidance, the report assigns all waters of the state to one of five categories; 303(d) listed water bodies make up category five in the integrated report (Appendix A of the Integrated Report).

In general, a TMDL is a quantitative assessment of water quality impairments, contributing potential sources, and pollutant reductions needed to attain water quality standards. The TMDL specifies the amount of pollutant or other stressor that needs to be reduced to meet water quality standards, allocates pollutant control or management responsibilities among sources in a watershed, and provides a scientific and policy basis for taking actions needed to restore a water body.

Water quality standards are laws or regulations that states authorize to enhance water quality and protect public health and welfare. Water quality standards provide the foundation for accomplishing two of the principal goals of the CWA. These goals are:

- Restore and maintain the chemical, physical, and biological integrity of the nation's waters; and
- Where attainable, to achieve water quality that promotes protection and propagation of fish, shellfish, and wildlife, and provides for recreation in and on the water.

Water quality standards consist of three elements:

- The designated beneficial use or uses of a water body or segment of a water body;
- The water quality criteria necessary to protect the use or uses of that particular water body; and
- An antidegradation policy.

Examples of designated uses are primary contact (swimming), protection of aquatic life, and public and food processing water supply. Water quality criteria describe the quality of water that will support a designated use. Water quality criteria can be expressed as numeric limits or as a narrative statement. Additional discussion of designated uses and water quality standards is provided in Section 4. Antidegradation policies are adopted so that water quality improvements are conserved, maintained, and protected.

1.2 TMDL Goals and Objectives for the Lake Lou Yaeger Watershed

The Illinois EPA has a three-stage approach to TMDL development. The stages are:

Stage 1 – Watershed Characterization, Data Analysis, Methodology Selection

Stage 2 – Data Collection (optional – as needed for TMDL development)

Stage 3 – Model Calibration, TMDL Scenarios, Implementation Plan

This report addresses all stages of TMDL development. The Stage 1 TMDL report for the Lake Lou Yaeger watershed was finalized in 2017. Stage 2 (data collection) was not needed for Lake Lou Yaeger as existing data were sufficient for TMDL development. This document combines the reports for Stages 1 and 3.

The TMDL goals and objectives for the Lake Lou Yaeger watershed included developing TMDLs for all impaired water bodies within the watershed, describing all the necessary elements of the TMDL, developing an implementation plan for each TMDL, and gaining public acceptance of the process. Following is the impaired water body segment in the Lake Lou Yaeger watershed:

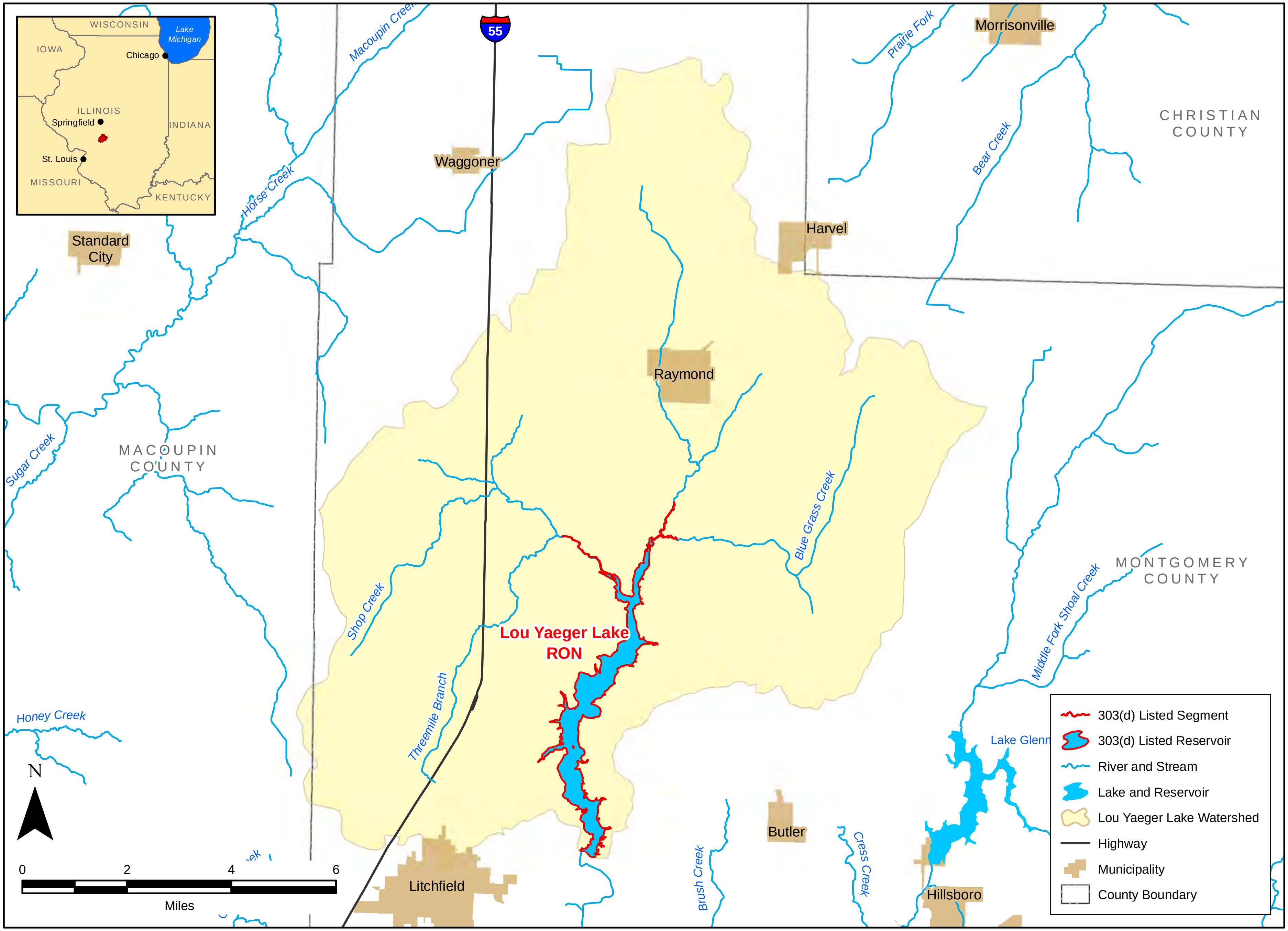
- Lake Lou Yaeger (RON)

The impaired water body segment is shown on **Figure 1-1**. There is one water body segment within the Lake Lou Yaeger watershed for which a TMDL and a load reduction strategy (LRS) were developed. **Table 1-1** lists the water body segment, potential causes of impairment, use description and potential sources of impairment.

Table 1-1 Impaired Water Bodies in Lake Lou Yaeger Watershed

Segment ID	Segment Name	Potential Causes of Impairment	Use Description	Potential Sources (as identified by the 2016 303(d) list)
RON	Lake Lou Yaeger	**Phosphorus (Total)**	Aesthetic Quality	Agriculture, Internal Nutrient Recycling, Runoff from forest/grassland/parkland
		Total Suspended Solids (TSS)	Aesthetic Quality	Agriculture, Littoral/shore area modifications (non-riverine), other recreational pollution sources, Runoff from forest/grassland/parkland

Bold Causes of Impairment have numeric water quality standards and a TMDL was developed. *Italicized* Causes of Impairment do not have numeric water quality standards and a LRS was developed.



Lou Yaeger Lake
TMDL Watershed

FIGURE 1-1

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Illinois EPA is currently only developing TMDLs for parameters that have numeric water quality standards. For potential causes that do not have numeric water quality standards as noted in **Table 1-1**, TMDLs will be deferred until those criteria are developed. However, until numeric criteria are adopted, a LRS was developed using a watershed-specific target value that was established by Illinois EPA.

The TMDL for Lake Lou Yaeger specifies the following elements:

- Loading Capacity (LC) or the maximum amount of pollutant loading a water body can receive without violating water quality standards
- Waste Load Allocation (WLA) or the portion of the TMDL allocated to existing or future point sources
- Load Allocation (LA) or the portion of the TMDL allocated to existing or future nonpoint sources and natural background
- Margin of Safety (MOS) or an accounting of uncertainty about the relationship between pollutant loads and receiving water quality
- Reserve Capacity (RC) or a portion of the load explicitly set aside to account for growth in the watershed as appropriate

These elements are combined into the following equation:

$$\mathbf{TMDL = LC = \Sigma WLA + \Sigma LA + MOS + RC}$$

As part of the TMDL development process, Illinois EPA started to include LRSs in TMDL watershed projects in 2012 for those pollutants that do not currently have numeric water quality standards. Developing a LRS involves determining the LC and load reduction that is needed in order for the waterbody to meet “Full Use Support” for its designated uses. In an LRS, the LC is not divided into WLA, LA, or MOS. These TMDL components are represented by one number as a target concentration for load reduction within each unique watershed. The LRS provides guidance (with no regulatory requirements) for voluntary nonpoint source reduction efforts by implementing agricultural and urban stormwater best management practices (BMPs). TMDL development also considers the seasonal variability of pollutant loads so that water quality standards are met during all seasons of the year. Also, reasonable assurance that the TMDL and LRS targets will be achieved is described in the implementation plan. The implementation plan for the Lake Lou Yaeger watershed describes how water quality standards and targets will be met and attained. This implementation plan includes recommendations for implementing BMPs, cost estimates, institutional needs to implement BMPs and controls throughout the watershed, and a timeframe for completion of implementation activities.

1.3 Report Overview

The remaining sections of this report contain:

- **Section 2 Lake Lou Yaeger Watershed Description** provides a description of the watershed's location, topography, geology, land use, soils, population, and hydrology.

- **Section 3 Public Participation and Involvement** discusses public participation activities that will occur throughout TMDL development.
- **Section 4 Lake Lou Yaeger Watershed Water Quality Standards** defines the water quality standards and guidelines/targets for the impaired water body.
- **Section 5 Lake Lou Yaeger Watershed Characteristics** presents the available water quality data needed to develop TMDLs and LRSs, discusses the characteristics of the impaired water body in the watershed, and also describes the point and nonpoint sources with potential to contribute to the watershed load.
- **Section 6 Approach to Developing TMDL and Identification of Data Needs** makes recommendations for the models and analysis that are needed for TMDL and LRS development.
- **Section 7 Methodology Development for the Lake Lou Yaeger Watershed** details the development of the TMDL and LRS for the impaired lake.
- **Section 8 Total Maximum Daily Load for the Lake Lou Yaeger Watershed** provides the results of the TMDL and LRS analyses for Lake Lou Yaeger.
- **Section 9 Implementation Plan for the Lake Lou Yaeger Watershed** makes recommendations for implementation actions, point source controls, management measures, and BMPs that can be used to address water quality issues in the watershed.

Section 2

Lake Lou Yaeger Watershed Description

2.1 Lake Lou Yaeger Watershed Location

The Lake Lou Yaeger watershed is located in south-central Illinois (refer to **Figure 1-1**). The watershed is 69,604 acres and is located 45 miles south of Springfield, Illinois. The majority of the watershed (approximately 69,300 acres) lies within Montgomery County. The additional acreage lies within Macoupin and Christian Counties (229 and 13 acres, respectively). Lake Lou Yaeger is located on the West Fork of Shoal Creek and has a surface area of approximately 1,268 acres. [1]

2.2 Topography

Topography is an important factor in watershed management because stream types, precipitation, and soil types can vary dramatically by elevation. National Elevation Dataset (NED) coverages containing 30-meter grid resolution elevation data are available from the U.S. Geological Survey (USGS) for each 1:24,000-topographic quadrangle in the United States. Elevation data for the Lake Lou Yaeger watershed were obtained by overlaying the NED grid onto the geographic information system (GIS)-delineated watershed. **Figure 2-1** shows the elevations found within the watershed. Elevation in the Lake Lou Yaeger watershed ranges from 591 feet above sea level along the waterways in the watershed to 730 feet in the southwestern portion of the watershed.

Lake Lou Yaeger

Photo taken from the City of Litchfield (http://www.cityoflitchfieldil.com/)

2.3 Land Use

Land use data for the Lake Lou Yaeger watershed were extracted from the U.S. Department of Agriculture's (USDA) National Agriculture Statistics Service (NASS) 2014 Cropland Data Layer (CDL), The CDL is a raster based, geo-referenced, crop-specific land cover data layer created to provide acreage estimates to the Agricultural Statistics Board for the state's major commodities and to produce digital, crop-specific, categorized geo-referenced output products. This information is made available to all agencies and to the public free of charge and represents the most accurate and up-to-date land cover datasets available at a national scale. The most recent available CDL dataset was produced in 2014 and includes 34 separate land use classes applicable to the watershed. The available resolution of the land cover dataset is 30 square meters. The 2014 CDL and extensive metadata are available at http://www.nass.usda.gov/Research_and_Science/Cropland/SARS1a.php.

[1] Lake Lou Yaeger Master Plan. 2015. http://www.cityoflitchfieldil.com/news/images/FinalReport6-8-15.pdf

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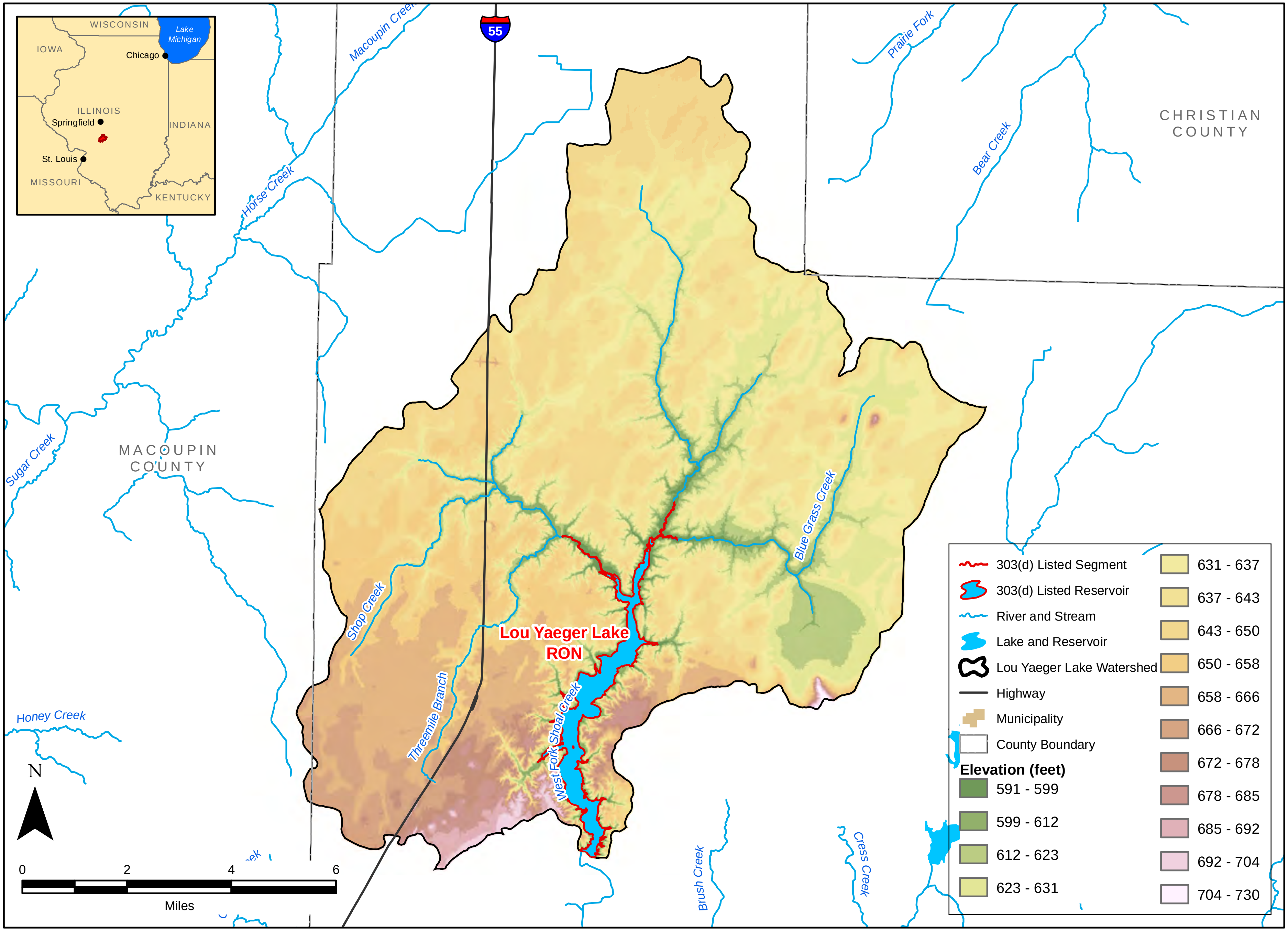

CDM Smith

Lou Yaeger Lake
Watershed Elevation

FIGURE 2-1

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Land use characteristics of the watershed were determined by overlaying the Illinois Statewide 2014 CDL data layers onto the GIS-delineated watershed. **Table 2-1** contains the land uses contributing to the Lake Lou Yaeger watershed and also includes the area of each land cover category and percentage of the watershed area. **Figure 2-2** illustrates the land uses of the watershed. Appendix A contains future detail of the land uses in the watershed.

Table 2-1 Land Cover and Land Use in the Lake Lou Yaeger Watershed

USDA/NASS Land Use Cropland Category	Acres	Percentage
Corn	28,924	42%
Soybeans	22,497	32%
Deciduous Forest	6,394	9%
Grass/Pasture	3,935	6%
Developed/Open Space	2,404	4%
Developed/Low Intensity	2,402	4%
Open Water	1,481	2%
Double Crop (Winter Wheat/Soybeans)	735	1%
Winter Wheat	410	<1%
Developed/Med Intensity	314	<1%
Developed/High Intensity	38	<1%
Other	68	<1%
Total	69,602	

The land cover data reveal that 52,620 acres, representing 76 percent of the total watershed area, are devoted to agricultural activities. Deciduous forests, grass/pasture, and barren land cover 15 percent of the watershed (10,338 acres). Approximately 7 percent of the watershed area (5,159 acres) is developed, urbanized land. The remaining watershed (2 percent of land area) is wetland and open water.

2.4 Soils

Soils data are available through the Soil Survey Geographic (SSURGO) database[2]. For SSURGO data, field mapping methods using national standards are used to construct the soil maps. Mapping scales generally range from 1:12,000 to 1:63,360 making SSURGO the most detailed level of soil mapping done by the Natural Resources Conservation Service (NRCS).

Attributes of the spatial coverage can be linked to the SSURGO databases, which provide information on various chemical and physical soil characteristics for each map unit and soil series. Of particular interest for TMDL development are the hydrologic soil groups as well as the K-factor of the Universal Soil Loss Equation (USLE). The following sections describe and summarize the specified soil characteristics for the Lake Lou Yaeger watershed.

[2] https://www.nrcs.usda.gov/wps/portal/nrcs/surveylist/soils/survey/state/?stateId=IL

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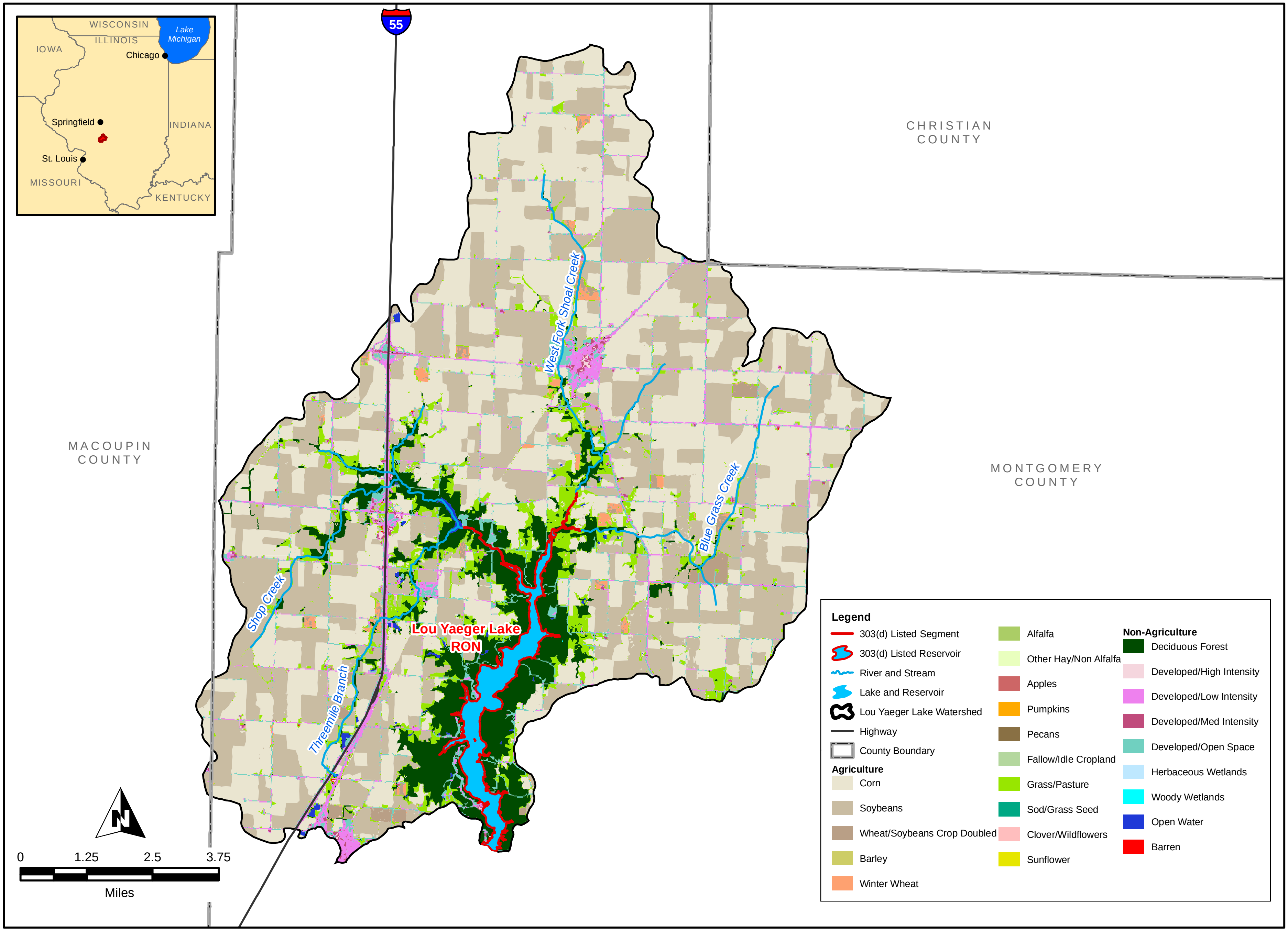

CDM Smith

Lou Yaeger Lake
Watershed Land Use

FIGURE 2-2

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2.4.1 Lake Lou Yaeger Watershed Soil Characteristics

Appendix B contains a table of the SSURGO soil series for the Lake Lou Yaeger watershed. A total of 58 soil types exist in the watershed. The three most common soil types—Virden silty clay loam (0 to 2 percent slopes), Herrick-Biddle-Piasa silt loams (0 to 2 percent slopes), and Herrick silt loam (0 to 2 percent slopes) — cover over 54 percent of the watershed (21, 18, and 15 percent, respectively). All remaining soil types within the watershed each represent less than 4 percent of the total watershed area. The table in Appendix B also contains the area, dominant hydrologic soil group, and K-factor range. Each of these characteristics is described in more detail in the following paragraphs.

Figure 2-3 shows the hydrologic soils groups found within the Lake Lou Yaeger watershed. Hydrologic soil groups are used to estimate runoff from precipitation. Soils are assigned to one of four groups according to the infiltration of water when the soils are thoroughly wet and receive precipitation from long-duration storms:

- Group A: Soils in this group have low runoff potential when thoroughly wet. Water is transmitted freely through the soil.
- Group B: Soils in this group have moderately low runoff potential when thoroughly wet. Water transmission through the soil is unimpeded.
- Group C: Soils in this group have moderately high runoff potential when thoroughly wet. Water transmission through the soil is somewhat restricted.
- Group D: Soils in this group have high runoff potential when thoroughly wet. Water movement through the soil is restricted or very restricted.

While hydrologic soil groups B, C, D, B/D, and C/D are all found within the Lake Lou Yaeger watershed, group C/D soils are the most common type representing 76 percent of the watershed. Group B, C, D, and B/D soils cover a relatively smaller portion of the watershed at 6.5, 7.0, 3.4, and 3.5 percent, respectively. The most common type, group C/D is a dual hydrologic soil group because these soils can be adequately drained. The first letter applies to the drained condition and the second to the undrained condition. For the purpose of hydrologic soil group, adequately drained means that the seasonal high water table is kept at 24 inches below the surface (NRCS 2007). **Figure 2-3** shows that while the majority of the watershed is Group C/D soils, Group B and C soils are located along tributaries and streams that drain to the impaired Lake Lou Yaeger Lake, as well as along the perimeter of the lake. Group B soils "have moderately low runoff potential when thoroughly wet". These soils have a moderate rate of water transmission. Group C soils "have moderately high runoff potential when thoroughly wet". These soils have a slow rate of water transmission.

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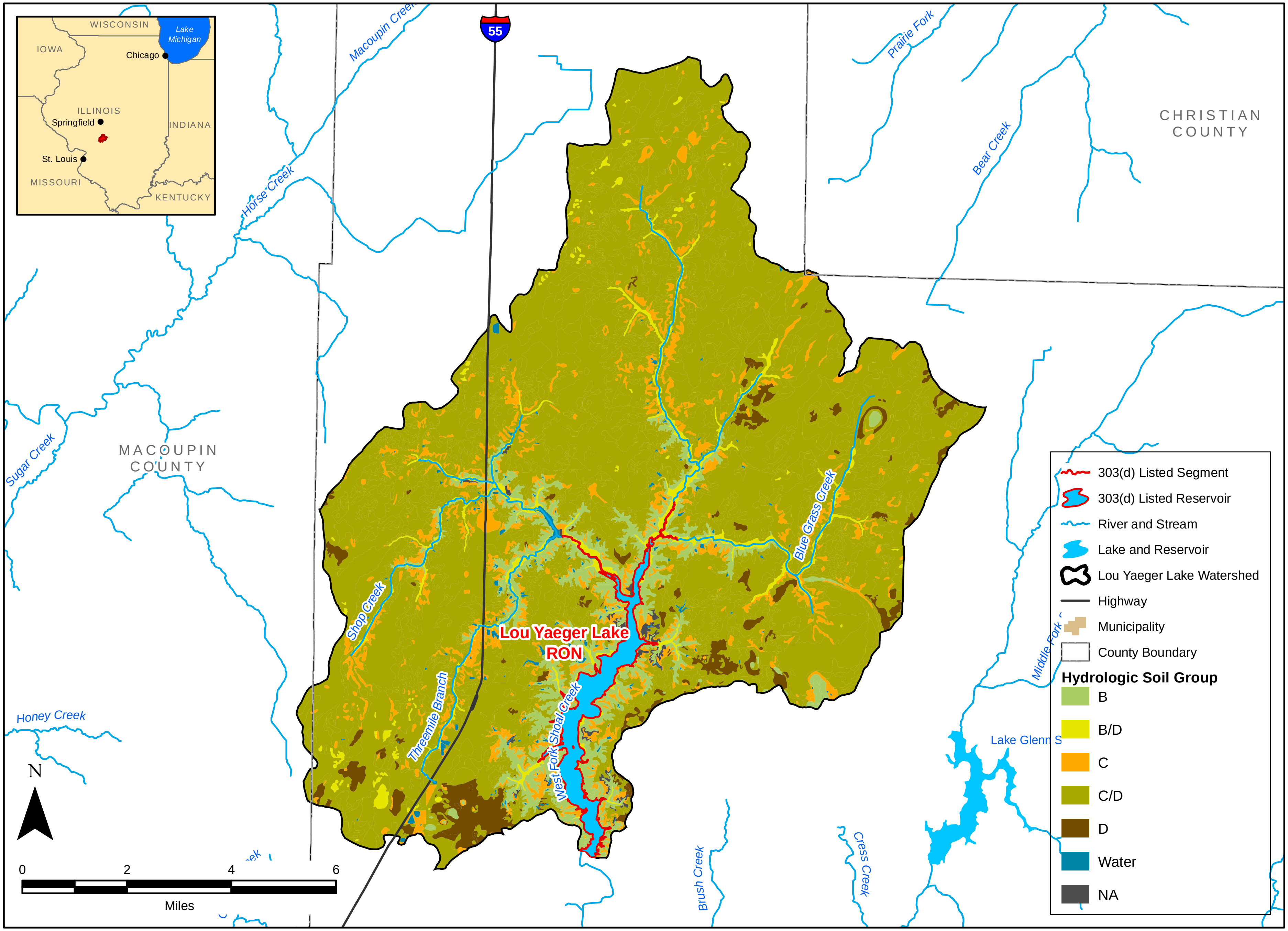

CDM Smith

Lou Yaeger Lake Watershed Soils

FIGURE 2-3

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A commonly used soil attribute is the K-factor. The K-factor:

> *Indicates the susceptibility of a soil to sheet and rill erosion by water. (The K-factor) is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average annual rate of soil loss by sheet and rill erosion. Losses are expressed in tons per acre per year. These estimates are based primarily on percentage of silt, sand, and organic matter (up to 4 percent) and on soil structure and permeability. Values of K range from 0.02 to 0.69. The higher the value, the more susceptible the soil is to sheet and rill erosion by water (NRCS 2005).*

The distribution of K-factor values in the Lake Lou Yaeger watershed range from 0.24 to 0.49 **Figure 2-4**.

2.5 Population

The Census 2010 TIGER/Line data from the U.S. Census Bureau were reviewed along with shapefiles of census blocks that are available for the entire state of Illinois. All census blocks that have geographic center points (centroids) within the watershed were selected and tallied in order to provide an estimate of populations in all census blocks both completely and partially contained by the watershed boundary. Approximately 4,100 people reside in the Lake Lou Yaeger watershed. The main municipalities in the watershed were shown in **Figure 1-1**. The largest urban development in the watershed is the city of Litchfield. A small portion of the city of Litchfield lies within the watershed, while the majority of the city limits are located outside of the watershed. The total population of Litchfield (including portions of the city not located within the Lake Lou Yaeger watershed) is approximately 6,900 people. Population estimates from 2015 show a slight reduction (-3%) in the population of Litchfield since 2010 (www.census.gov).

2.6 Climate, Pan Evaporation, and Streamflow

2.6.1 Climate

Central Illinois has a temperate climate with hot summers and cold, moderately snowy winters. A National Climatic Data Center (NCDC) climate station is located within the watershed in Honey Bend, IL; however, temperature data are not available prior to 2011 and an alternative station was selected to lengthen the historical record. Monthly temperature and precipitation data from a station in Hillsboro, Illinois (station id. USC00114108) were extracted from the NCDC database for the years 1915 through 2015. This station was selected due to its proximity to the watershed (approximately 10 miles west) and completeness of its dataset.

Table 2-2 contains the average monthly precipitation along with average high and low temperatures for the period of record. The average annual precipitation is 39 inches. May and June are historically the wettest months while January and February are the driest.

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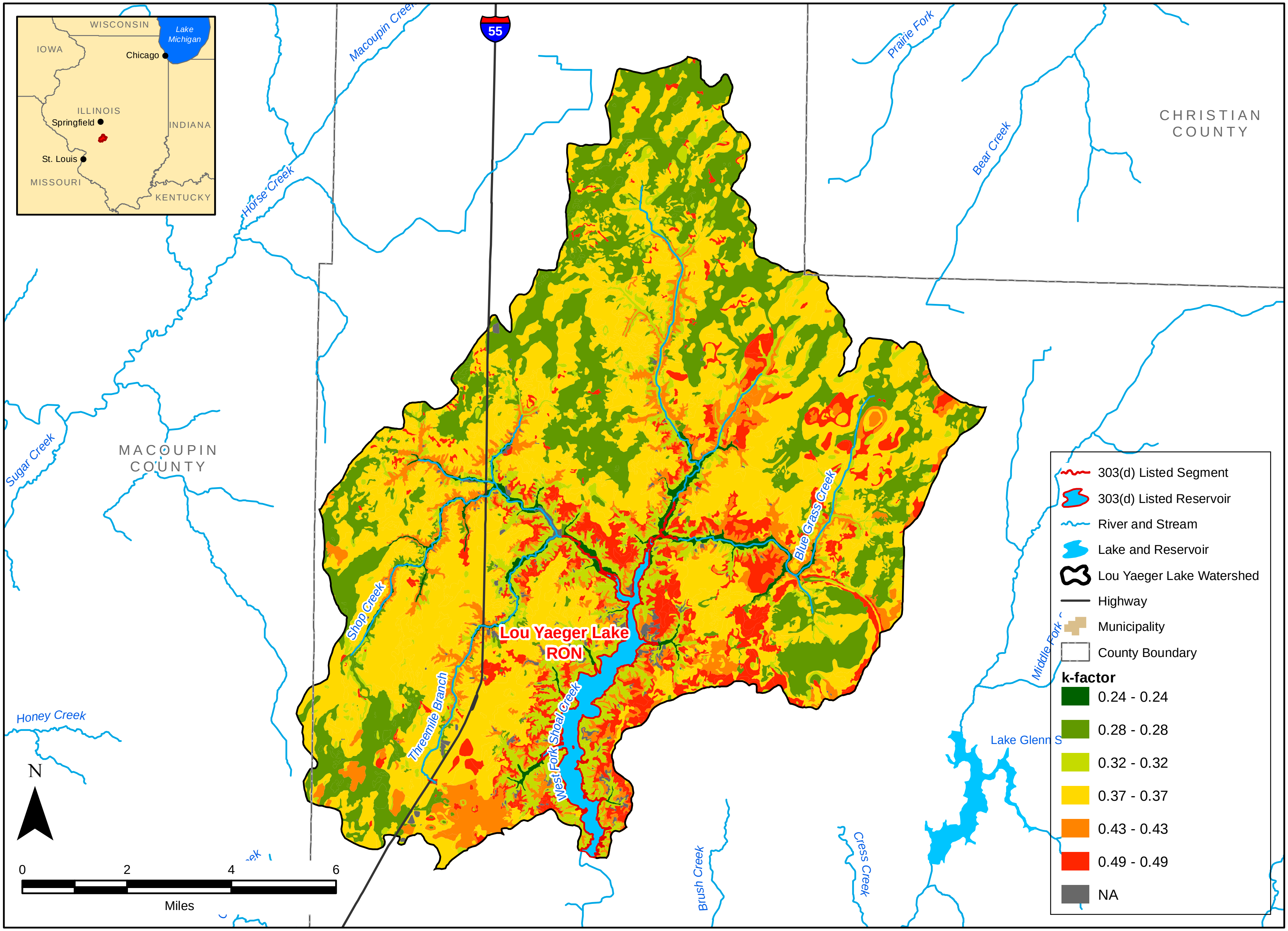

CDM Smith

Lou Yaeger Lake
Watershed k-factor Ranges

FIGURE 2-4

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Table 2-2 Average Monthly Climate Data for Hillsboro, Illinois (1915-2015)

Month	Average Total Precipitation (inches)	Average Daily Maximum Temperature (degrees F)	Average Daily Minimum Temperature (degrees F)
January	2.19	37.9	20.6
February	2.03	43.0	24.2
March	3.28	54.2	33.2
April	4.17	66.6	43.7
May	4.56	76.1	53.2
June	4.32	85.0	62.3
July	3.38	89.2	65.9
August	3.29	87.5	63.9
September	3.35	80.9	56.1
October	3.15	69.4	45.3
November	3.14	54.0	34.7
December	2.62	41.5	24.9
Total	39.22		

2.6.2 Pan Evaporation

Through the Illinois State Water Survey (ISWS) website, pan evaporation data are available from nine locations across Illinois (ISWS 2009). The Springfield, Illinois station was chosen to be representative of pan evaporation conditions for the Lake Lou Yaeger watershed. The Springfield station is located approximately 30 miles north of the Lake Lou Yaeger watershed. This station was chosen as it is the closest pan evaporation station to the Lake Lou Yaeger watershed. The average annual pan evaporation at the Springfield station for the years 1980 to 1990 is 49.2 inches. Actual evaporation is typically less than pan evaporation, so the average annual pan evaporation was multiplied by 0.75 to calculate an average annual evaporation of 36.9 inches[3].

2.6.3 Streamflow

Analysis of the Lake Lou Yaeger watershed requires an understanding of flow throughout the drainage area. There are no active USGS gages located within the boundaries of the watershed. Note that local stakeholders suggested that the surrogate gage (near Coffen, IL), used in the Stage 1 report, was not the most representative gage due to differences in watershed soils and suggested Sugar Creek data as surrogate measures for flows in the Lake Lou Yaeger watershed. The gage located on Sugar Creek near Springfield, IL is located below Lake Springfield which means that flows recorded at the gage are regulated by reservoir releases and could not be used to estimate natural flows in the Lake Lou Yaeger drainage area. Further investigation into alternative gages during Stage 3 TMDL development resulted in the selection of the USGS gage

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[3] Data provided by the Illinois State Climatologist's Office, a part of the Illinois State Water Survey (ISWS) located in Champaign and Peoria, Illinois, and on the web at https://www.isws.illinois.edu/statecli/Pan-Evap/Panevap.htm.

near Shelbyville, IL as a more appropriate surrogate. Robinson Creek near Shelbyville was used to estimate flow conditions in the area (**Figure 2-5**). **Table 2-3** summarizes the station information.

Table 2-3 USGS Stream Gages

Gage Number	Name	POR
USGS 05592050	Robinson Creek Near Shelbyville, IL	2000-2018

Based on data collected from this gage (USGS 05592050 Robinson Creek near Shelbyville, IL), the lowest flows are historically seen in August while highest flows have occurred in April (see **Figure 2-6**). The gage drains an area of 55.5 square miles.

Because flows for the Lake Lou Yaeger watershed needed to be estimated using surrogate data from a site located outside of the watershed, flow values were adjusted during Stage 3 (see additional discussion in **Section 7**) using the drainage area ratio method, represented by the following equation:

$$Q_{gaged}\left(\frac{Area_{ungaged}}{Area_{gaged}}\right) = Q_{ungaged}$$

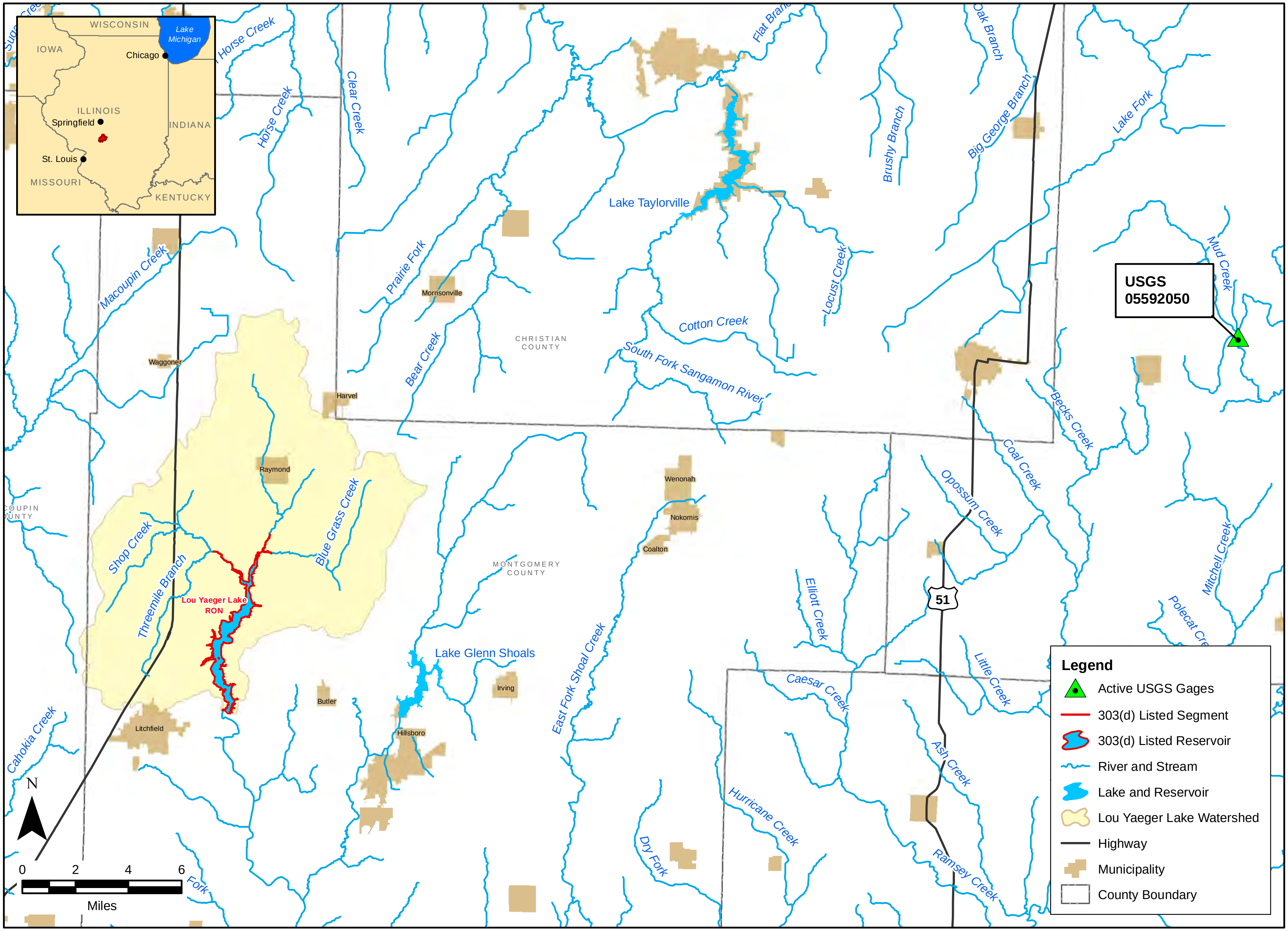
where Q_{gaged} = Streamflow of the gaged basin

$Q_{ungaged}$ = Streamflow of the ungaged basin

$Area_{gaged}$ = Area of the gaged basin

$Area_{ungaged}$ = Area of the ungaged basin

The assumption behind the equation is that the flow per unit area is equivalent in watersheds with similar characteristics. Therefore, the flow per unit area in the gaged watershed multiplied by the area of the ungaged watershed, and adjusted for point source influences, estimates the flow for the ungaged watershed.



CDM Smith

Lou Yaeger Lake
Active USGS Gages

FIGURE 2-5

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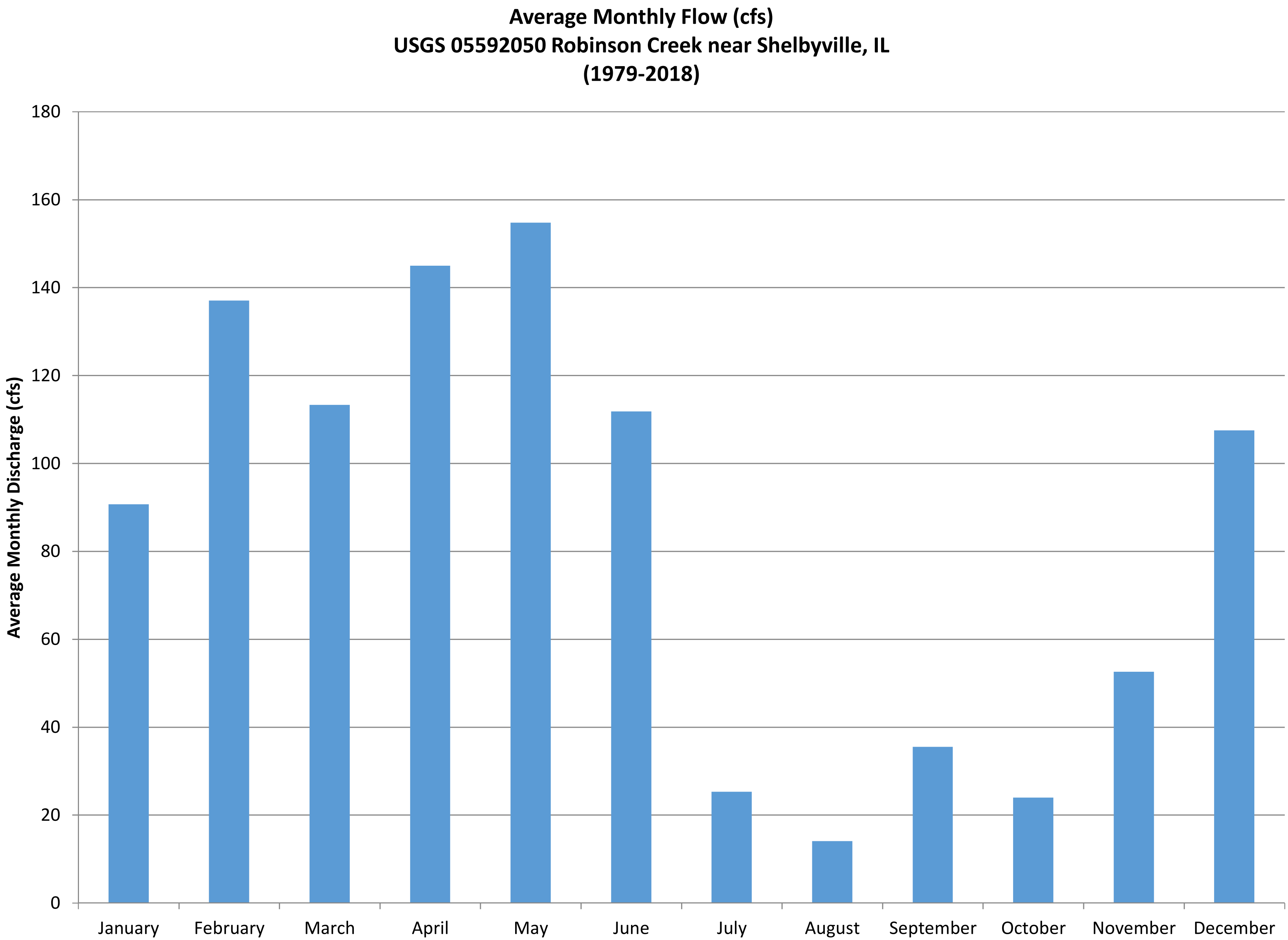

Figure 2-6
Average Daily Streamflow by Month at USGS Gage 05592050
Lou Yaeger Lake Watershed

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Section 3

Lake Lou Yaeger Watershed Public Participation

3.1 Lake Lou Yaeger Watershed Public Participation

Public knowledge, acceptance, and follow-through are necessary to implement a plan to meet recommended TMDLs and LRSs. It is important to involve the public as early in the process as possible to achieve maximum cooperation and counter concerns as to the purpose of the process and the regulatory authority to implement any recommendations.

Illinois EPA, along with CDM Smith, held a Stage 1 public meeting in the Lake Lou Yaeger watershed at the Litchfield Community Center on March 7, 2017. A virtual Stage 3 public meeting was held on August 6, 2020. Comments received through the public meeting process are included in Appendix C.

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Section 4

Lake Lou Yaeger Water Quality Standards and Guidelines

4.1 Illinois Water Quality Standards

Water quality standards are developed and enforced by the state to protect the "designated uses" of the state's waterways. In the state of Illinois, water quality standards are established by the Illinois Pollution Control Board (IPCB). Illinois is required to update water quality standards every 3 years in accordance with the CWA. The standards requiring modifications are identified and prioritized by Illinois EPA, in conjunction with USEPA. New standards are then developed or revised during the 3-year period.

Illinois EPA is also responsible for developing scientifically based water quality criteria and proposing them to the IPCB for adoption into state rules and regulations. The Illinois water quality standards are established in the Illinois Administrative Rules Title 35, Environmental Protection; Subtitle C, Water Pollution; Chapter I, Pollution Control Board; Part 302, Water Quality Standards (IPCB, 2015).

4.2 Designated Uses

The waters of Illinois are classified by designated uses, which include: General Use, Public and Food Processing Water Supply, Lake Michigan Basin, and Secondary Contact and Indigenous Aquatic Life Use[1]. The designated uses applicable to the Lake Lou Yaeger watershed are the General Use and Public and Food Processing Water Supplies Use.

4.2.1 General Use

The General Use classification is defined by IPCB as standards that "will protect the state's water for aquatic life, wildlife, agricultural use, secondary contact use and most industrial uses, and ensure the aesthetic quality of the state's aquatic environment." Primary contact uses are protected for all General Use waters whose physical configuration permits such use.

4.2.2 Public and Food Processing Water Supplies

The Public and Food Processing Water Supplies Use is defined by IPCB as standards that are "cumulative with the general use standards of Subpart B and must be met in all waters designated in Part 303 at any point at which water is withdrawn for treatment and distribution as a potable supply or for food processing."

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[1] Illinois EPA, 2016. Illinois Integrated Water Quality Report and Section 303(d) List. https://www2.illinois.gov/epa/topics/water-quality/watershed-management/tmdls/Pages/303d-list.aspx

4.3 Illinois Water Quality Criteria

To make 303(d) listing determinations for general use waters, Illinois EPA compares available data with water quality standards to make impairment determinations. To make 303(d) listing determinations for public and food processing water supplies, data are reviewed for both the raw water intake and the finished/treated water. Although both uses are applicable within the watershed, it should be noted that the lake is 303(d) listed for impairment of aesthetic quality under General Use and the public water supply use is currently not listed as impaired. **Table 4-1** presents the numeric water quality standard for the listed cause of impairment for Lake Lou Yaeger.

Table 4-1 Summary of Numeric Water Quality Standards for Potential Causes of Impairments in Lake Lou Yaeger Watershed

Parameter	Units	General Use Water Quality Standard	Regulatory Reference	Public and Food Processing Water Supplies	Regulatory Reference
Phosphorus (Total)	mg/L	0.05(1)	302.205	No numeric standard	N/A

mg/L = milligrams per liter
NA = Not Applicable
(1) Standard applies in particular to inland lakes and reservoirs (greater than 20 acres) and in any stream at the point where it enters any such lake or reservoir.

4.4 Water Quality Guidelines

In addition to the water quality standard provided above, the Illinois EPA has also established watershed-specific water quality guidelines for a number of parameters. As part of the TMDL development process, Illinois EPA started to include LRSs in TMDL watershed projects in 2012 for those pollutants that do not currently have a numeric water quality standards. Developing a LRS involves determining the loading capacity and load reduction necessary that is needed in order for the water body to meet "Full Use Support" for its designated uses. The load capacity is not divided into WLA, LA, or MOS; these are represented by one number as a target concentration for load reduction within each unique watershed. The LRS provides guidance (with no regulatory requirements) for voluntary nonpoint source reduction efforts by implementing agricultural and urban stormwater BMPs.

The LRS targets are based on data from all stream segments within the HUC-10 basins of the watershed, as well as stream segments or lakes which closely border the watershed in neighboring HUC-10 basins, in order to best represent the land use, hydrologic, and geologic conditions unique to the watershed. Load reduction targets were calculated by Illinois EPA using data from stream segments whose most current assessment shows full use support and data that have passed quality assurance and quality checks within Illinois EPA and are in accordance with state and federal laws. The applicable LRS target value developed by Illinois EPA for the Lake Lou Yaeger watershed is provided in **Table 4-2**.

Table 4-2 LRS Target Values for the Lake Lou Yaeger Watershed

Segment Name	Segment ID	Potential Causes of Impairment	LRS Target Value
Lake Lou Yaeger	RON	Total Suspended Solids (TSS)	21.9 mg/L

4.5 Potential Pollutant Sources

In order to properly address the conditions within the Lake Lou Yaeger watershed, potential pollutant sources must be investigated for the pollutants where TMDLs and LRSs will be developed. The following is a summary of the potential sources identified by Illinois EPA on the 2016 303(d) list.

Table 4-3 Impaired Water Bodies

Segment ID	Segment Name	Potential Causes of Impairment	Use Description	Potential Sources (as identified by the 2016 303(d) list)
RON	Lake Lou Yaeger	**Phosphorus (Total)**	Aesthetic Quality	Agriculture, Internal Nutrient Recycling, Runoff from forest/grassland/parkland
		Total Suspended Solids (TSS)	Aesthetic Quality	Agriculture, Littoral/shore area modifications (non-riverine), other recreational pollution sources, Runoff from forest/grassland/parkland

Bold Causes of Impairment have numeric water quality standards and a TMDL was developed. Italicized Causes of Impairment do not have numeric water quality standards and a LRS was developed.

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Section 5

Lake Lou Yaeger Watershed Characterization

In order to further characterize the Lake Lou Yaeger watershed, a wide range of pertinent data were collected and reviewed. Lake water quality data, as well as information on potential point and nonpoint sources within the watershed, were compiled from a variety of data sources. This information is presented and discussed in further detail in the remainder of this section.

5.1 Water Quality Data

Data from a total of three historical water quality stations within the Lake Lou Yaeger watershed were located and reviewed for this report (**Figure 5-1**). The water quality data were primarily provided by Illinois EPA. Stations RON-01, RON-02 and RON-03, located on Lake Lou Yaeger, are part of the Illinois EPA Ambient Water Program and were sampled approximately four times a year in 2003, 2008 and 2012.

Lake Lou Yaeger is listed for impairment of aesthetic quality due to total phosphorus and TSS. Data presented below relate to the constituents of concern that currently have numeric criteria as well as those with water quality targets. These values (presented in Section 4) will be used to confirm impairment listings in the following sections.

There are three active water quality monitoring locations on Lake Lou Yaeger used for the following data discussion (**Figure 5-1**). All historical water quality data for the impaired waterbody are available in Appendix D. An inventory of all available data associated with the impairments in the Lake Lou Yaeger watershed is presented in **Table 5-1**.

Table 5-1 Data Inventory for Impairments in Lake Lou Yaeger Watershed

Lake Lou Yaeger Segment RON; Sample locations RON-01, RON-02, RON-03		
RON-01	**Period of Record**	**Number of Samples**
Phosphorus, Total	2003,2008,2012	14
Phosphorus, Dissolved	2003,2008,2012	13
Phosphorus in Bottom Deposits	2003, 2008	2
Total Suspended Solids[1]	2003,2008,2012	42
RON-02		
Phosphorus, Total	2003,2008,2012	14
Phosphorus, Dissolved	2003,2008,2012	14
Phosphorus in Bottom Deposits	-	0
Total Suspended Solids[1]	2003,2008,2012	15
RON-03		
Phosphorus, Total	2003,2008,2012	14
Phosphorus, Dissolved	2003,2008,2012	14
Phosphorus in Bottom Deposits	-	0
Total Suspended Solids[1]	2003,2008,2012	15

(1) Number of TSS samples at all depths

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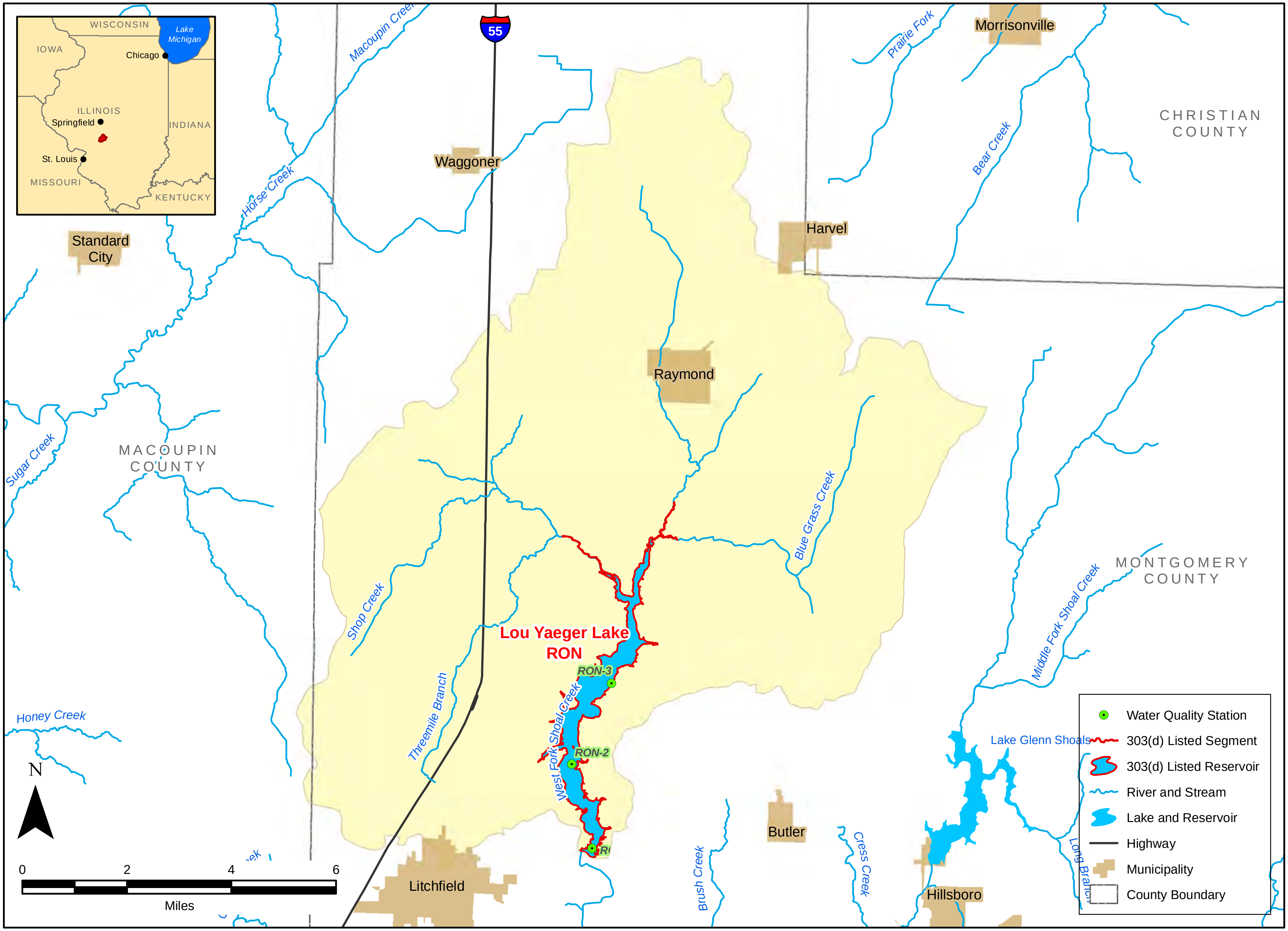

CDM Smith

Lou Yaeger Lake
Water Quality Stations

FIGURE 5-1

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5.1.1 Total Phosphorus in Lake Lou Yaeger

The applicable water quality standard for total phosphorus in Lake Lou Yaeger is 0.05 mg/L. Compliance with the total phosphorus standard is assessed using samples collected at a 1-foot depth from the lake surface. The number of samples, a count of exceedances, and the average total phosphorus concentrations at 1-foot depth for each year of available data at each monitoring station in Lake Lou Yaeger are presented in **Table 5-2** and shown on **Figure 5-2**. Based on the available dataset, total phosphorus concentrations in Lake Lou Yaeger are consistently higher than the water quality standard. No significant seasonal or annual trends in total phosphorus concentrations were observed based on the available dataset.

Table 5-2 Sample Counts, Exceedances of WQ Standard (0.05 mg/L, and Average Total Phosphorus Concentrations (mg/L) at One-Foot Depth in Lake Lou Yaeger Watershed

Station	RON-01		RON-02		RON-03	
Year	Data Count; Number of Exceedances	Average	Data Count; Number of Exceedances	Average	Data Count; Number of Exceedances	Average
2003	4; 4	0.10	4;4	0.09	4;3	0.10
2008	5; 5	0.20	5;5	0.21	5;5	0.25
2012	5;5	0.16	5;5	0.19	5;5	0.25

5.1.2 Total Suspended Solids in Lake Lou Yaeger

The LRS target value for TSS in Lake Lou Yaeger is 21.9 mg/L. The average TSS concentrations for each year of available data at each monitoring site in Lake Lou Yaeger are presented in **Table 5-3.** TSS concentrations in excess of the LRS target value occur at each sampling location with the highest levels recorded at RON-3 (**Figure 5-3**). TSS values have also increased over time at all locations.

Table 5-3 Sample Counts, Exceedances of LRS Target Value (21.9 mg/L), and Average TSS Concentrations (mg/L) in Lake Lou Yaeger Watershed

Year	RON-1		RON-2		RON-3		Lake Average	
	Data Count; Number of Exceedances	Average	Data Count; Number of Exceedances	Average	Data Count; Number of Exceedances	Average	Data Count; Number of Exceedances	Average
2003	15; 0	11.0	5; 1	13.0	5; 3	23.8	25; 4	15.9
2008	14; 3	16.1	5; 2	16.2	5; 3	27.2	24; 8	19.8
2012	13; 3	16.8	5; 2	18.8	5; 3	31.8	23; 8	22.5

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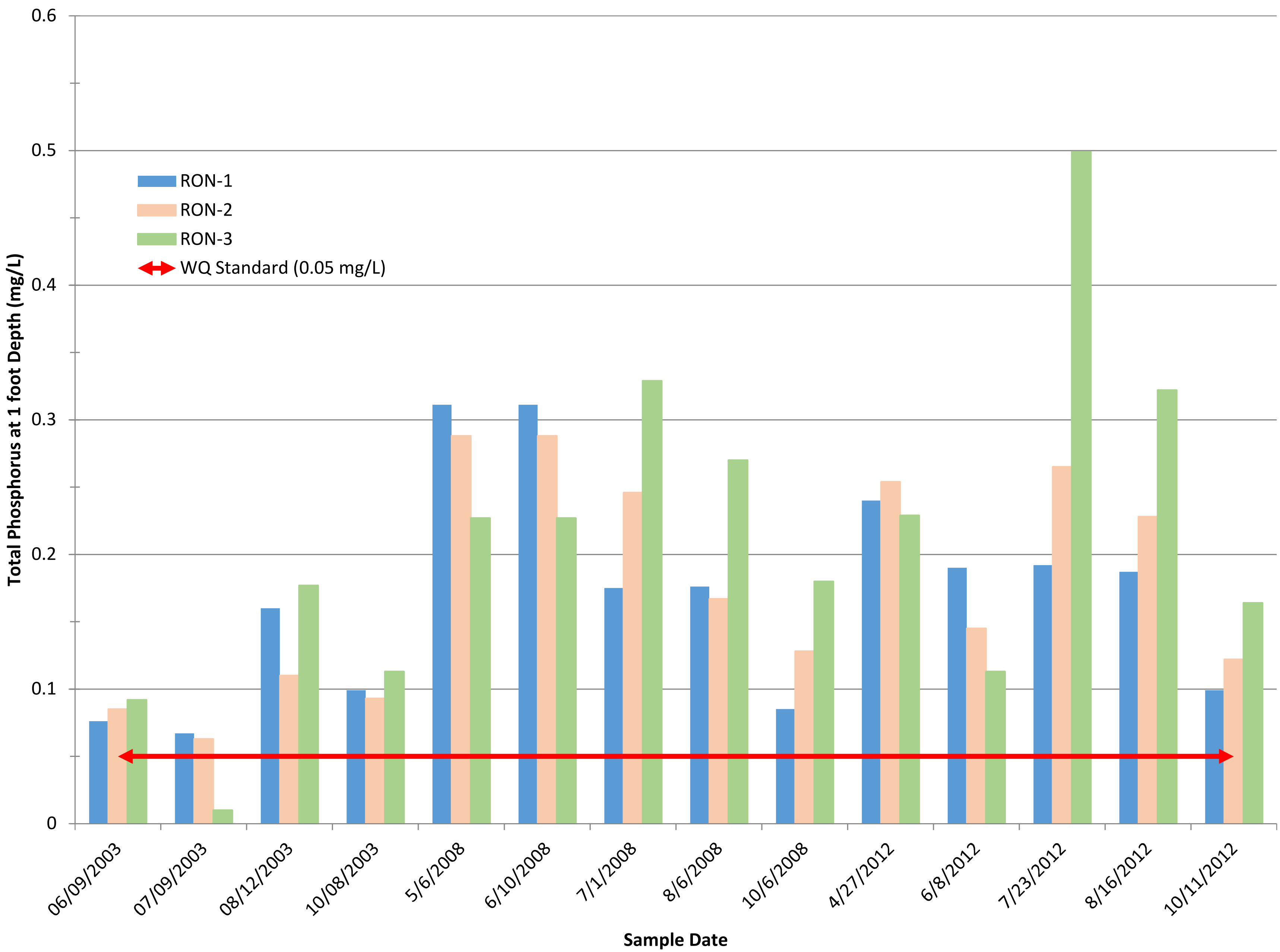

Figure 5-2
Total Phoshporus at 1-ft Depth
Lou Yaeger Lake (RON)

CDM Smith

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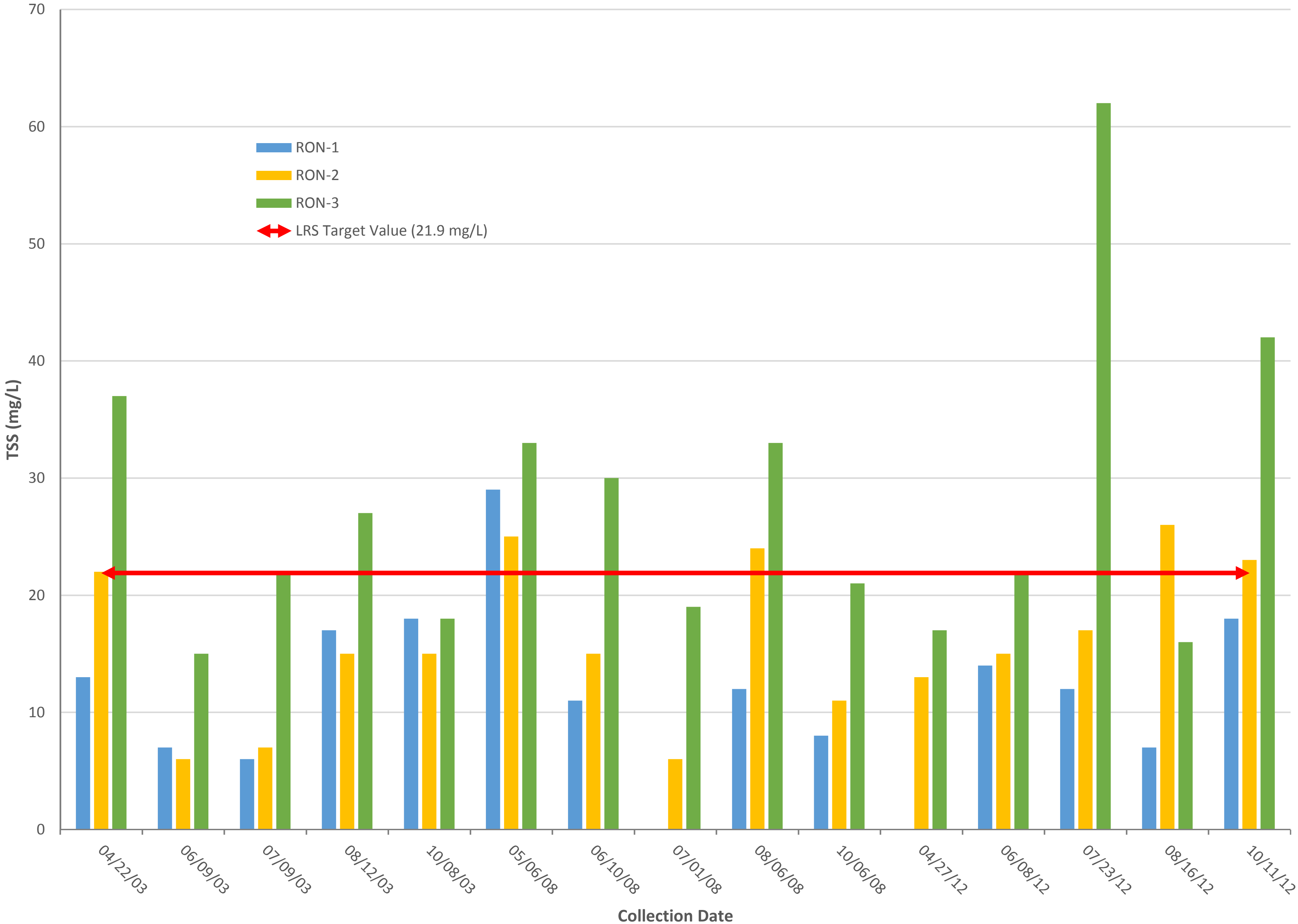

Figure 5-3
TSS
Lou Yaeger Lake (RON)

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5.2 Lake Characteristics

Lake Lou Yaeger was built in 1966 and is located within Montgomery County, approximately 45 miles south of the City of Springfield, Illinois. The lake provides flood control on Shoal Creek and is a municipal water supply for the City of Litchfield, serving approximately 13,000 customers. Additionally, it offers a number of recreational activities including boating, fishing, and camping. It is fed by the West Fork of Shoal Creek, Blue Grass Creek, Shop Creek and Threemile Branch. Lake Lou Yaeger has a surface area of 1,200 acres with an average depth of 10 feet and a reported maximum depth of 32 feet. The lake is used for recreational activities such as boating, fishing, swimming, camping, hiking, equestrian trails, picnic pavilions and the Shoal Creek Nature Conservation Area[1].

5.3 Point Sources

There are two active point sources that are located within the Lake Lou Yaeger watershed. Both facilities treat municipal waste; one for a commercial facility (the Magnus Grand Hotel) and the other for the Village of Raymond. **Table 5-4** contains permit information for both facilities. Facility locations are shown on **Figure 5-4**.

Wastewater can contain nutrients from human waste, food and certain soaps and detergents. Treated municipal wastewater can be a source of phosphorus to receiving waters. The amount of phosphorus in treated effluent varies by the type of treatment used at each facility. Treatment processes, permits and associated discharge monitoring reports (DMRs) were reviewed and relevant data have been included in TMDL development.

Table 5-4 Permitted Facilities Discharging to or Upstream of Impaired Segments in the Lake Lou Yaeger Watershed

Facility ID	Facility Name	Flow (MGD)	Permit Program/ Facility Type	Effluent Limits	Receiving Water
IL0025381	Raymond STP	0.25	NPDES/ Municipal Wastewater	BOD, Chlorine (total residual), Fecal Coliform, DO, TSS, pH	Unnamed Tributary to West Fork of Shoal Creek
IL0063525	Magnus Grand Hotel and Conference Center	0.033	NPDES/ Municipal Wastewater	BOD, Chlorine (total residual), Fecal Coliform, DO, TSS, Nitrogen, Ammonia-N, pH	Shop Creek, Tributary to Shoal Creek

[1] June, 2015. Lake Lou Yaeger Master Plan Facility use Evaluation with Recommendations. Prepared by M.E. Badash & Associates, LLC.

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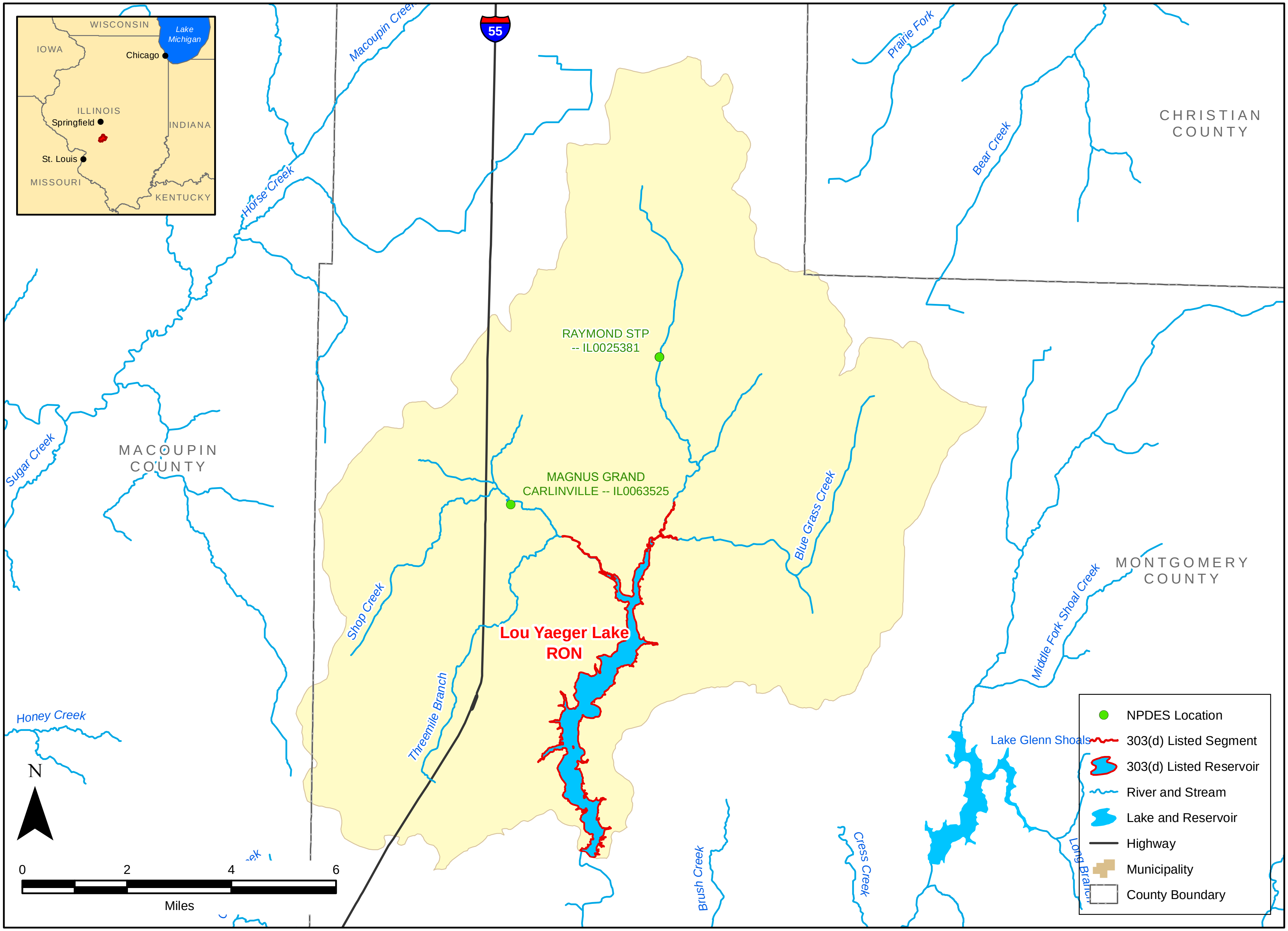

CDM Smith

Lou Yaeger Lake
NPDES Locations

FIGURE 5-7

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5.4 Nonpoint Sources

There are many potential nonpoint sources of phosphorus and TSS to Lake Lou Yaeger. The following section presents information on watershed cropping practices, animal operations, and area septic systems. Data were collected where available through communications with the local NRCS, Illinois Soil and Water Conservation Districts (SWCDs), and public health departments.

5.4.1 Crop Information

Approximately 76 percent of the land within the Lake Lou Yaeger watershed is devoted to row crop agriculture. Because most the watershed is under cultivation, soil loss from fields is likely the primary source of sediment and phosphorus (attached to the sediment) to Lake Lou Yaeger. Tillage practices for crops such as corn, soybeans, and grains can be categorized as conventional till, reduced till, mulch till, and no till. The percentage of each tillage practice for corn, soybeans, and small grains by county are generated from County Transect Surveys by the Illinois Department of Agriculture (IDA)[2]. Data from the 2015 survey are presented in **Tables 5-5** through **5-7** for Montgomery, Macoupin, and Christian Counties, respectively.

According to the County Transect Survey summary report, fields planted conventionally leave less than 15% of the soil surfaced covered with crop residue after planting while mulch-till leaves at least 30% of the residue from the previous crop remaining on the soil surface after being tilled and planted. Reduced-till falls between conventional and mulch (greater than 15% but less than 30%) and no-till practices leave the soil virtually undisturbed from harvest through planting. Residue is important because it shields the ground from the eroding effects of rain and helps retain moisture for crops.

Table 5-5 Tillage Practices in Montgomery County, Illinois – 2015

Tillage System	Corn	Soybean	Small Grain
Conventional	62%	0.5%	0%
Reduced - Till	15%	5%	0%
Mulch - Till	19%	66%	0%
No - Till	4%	29%	100%

Table 5-6 Tillage Practices in Macoupin County, Illinois – 2015

Tillage System	Corn	Soybean	Small Grain
Conventional	62%	21%	60%
Reduced - Till	18%	16%	40%
Mulch - Till	17%	37%	0%
No - Till	3%	26%	0%

[2] https://www2.illinois.gov/sites/agr/Resources/LandWater/Pages/Illinois-Soil-Conservation-Transect-Survey-Reports.aspx

Table 5-7 Tillage Practices in Christian County, Illinois – 2015

Tillage System	Corn	Soybean	Small Grain
Conventional	41%	3%	0%
Reduced - Till	58%	84%	20%
Mulch - Till	0%	4%	0%
No - Till	1%	8%	80%

Tillage practices from the 2004 County Transect Survey for Montgomery County were also reviewed to gain an understanding of how cropping practices have changed over time (**Table 5-8**). The data indicate that since 2004, both corn and soybean conventional tillage has decreased.

Table 5-8 Historical and Current Tillage Practices in Montgomery County, Illinois – 2004 and 2015

Tillage System	Corn		Soybean		Small Grain	
	2004	2015	2004	2015	2004	2015
Conventional	76%	62%	6%	0.5%	0%	0%
Reduced - Till	9%	15%	23%	5%	0%	0%
Mulch - Till	8%	19%	38%	66%	0%	0%
No - Till	7%	4%	33%	29%	100%	100%

Information on field tiling practices was also sought as field drains can influence the timing and amounts of water delivered to the lake as well as deliver dissolved nutrients from fields to receiving waters. Local NRCS offices reported that they currently do not keep records on which farms use tile drainage. The NRCS office in Montgomery County said the use of drain tile is common but they did not have exact numbers. As a rule of thumb, tile drainage is more common north of Route 16 and less common south of Route 16. The dividing line was said to be due to clay soil in the southern part of the county, in which tile drainage does not work as well.

5.4.2 Animal Operations

Information on commercial animal operations is available from the NASS. Although watershed-specific data are not available, county-wide data for Montgomery County, Macoupin County, and Christian County, are presented in the following **Tables 5-9** through **5-11**. No concentrated animal feeding operations (an intensive animal feeding operation in which over 1000 animal units are confined for over 45 days a year – referred to as CAFOs) are located within the watershed. Data from 2007 and 2012 have been published on the USDA website.

Table 5-9 Montgomery County Animal Population (2007 and 2012 Census of Agriculture)

Livestock Type	2007	2012	Percent Change
Cattle and Calves	9,644	8,035	-17%
Beef	4,662	2,907	-38%
Dairy	548	590	8%
Hogs and Pigs	70,689	126,949	80%
Poultry(1)	1,069	1,482	39%
Sheep and Lambs	698	791	13%
Horses and Ponies	736	550	-25%

(1) Poultry census data inclusive of broilers, layers, pullets, roosters and turkeys

Table 5-10 Macoupin County Animal Population (2007 and 2012 Census of Agriculture)

Livestock Type	2007	2012	Percent Change
Cattle and Calves	22,314	23,721	6%
Beef	7,408	7,645	3%
Dairy	997	1,109	11%
Hogs and Pigs	81,456	34,373	-58%
Poultry(1)	1,144	1,092	-5%
Sheep and Lambs	704	702	0%
Horses and Ponies	810	323	-60%

(1) Poultry census data inclusive of broilers, layers, pullets, roosters and turkeys

Table 5-11 Christian County Animal Population (2007 and 2012 Census of Agriculture)

Livestock Type	2007	2012	Percent Change
Cattle and Calves	8,610	7,164	-17%
Beef	4,771	1,974	-59%
Dairy	ND	10	-
Hogs and Pigs	35,096	46,581	33%
Poultry(1)	881	529	-40%
Sheep and Lambs	537	388	-28%
Horses and Ponies	517	337	-35%

(1) Poultry census data inclusive of broilers, layers, pullets, roosters and turkeys
ND= No data

Specific information on animal operations within the watershed was not available. It should be noted that local stakeholders indicated that the numbers reported in the agricultural census seemed very high for the watershed counties.

5.4.3 Septic Systems

Many households in rural areas of Illinois that are not connected to municipal sewers make use of onsite sewage disposal systems, or septic systems. Across the U.S., septic systems have been found to be a significant source of phosphorus pollution. There are many types of septic systems, but the most common septic system is composed of a septic tank draining to a septic field, where nutrient removal occurs. However, the degree of nutrient removal is limited by soils and system upkeep and maintenance.

Information on the extent of sewered and non-sewered municipalities in the Lake Lou Yaeger watershed was obtained from the county health departments. Health department officials in Montgomery County stated that the towns are served by sewer systems, but most county residents within the watershed rely on private septic systems. It was said that most, if not all homes around Lake Lou Yaeger have septic systems. Note that residential lots around lakes are often not large enough to have a septic field. They are often aerated chlorine systems without a field which generally require more frequent maintenance than typical septic systems. It was also noted during the Stage 1 public meeting that there are several campsites near the lakeshore that are potential sources of nutrients to the lake.

5.5 Watershed Studies and Other Watershed Information

A number of efforts have been performed in Lake Lou Yaeger and the Lake Lou Yaeger watershed, as described in the following timeline:

1964 – Construction of Lake Lou Yaeger, financed under Federal Public Law 566 for flood control. The lake serves as the public drinking water supply for the City of Litchfield. Construction was completed in 1966.

1995 – USEPA Clean Lakes Program Phase 1 Diagnostic/Feasibility Study and Illinois Division of Water Pollution Control Restoration plan for Lake Lou Yaeger (by Crawford Murphy and Tilley)

1999 –In order to help farmers in adopting sound agricultural practices the Illinois Council on Best Management Practices (C-BMP) was formed. The Council is a coalition of agribusiness and agricultural producer organizations, with the support of the University of Illinois Extension, and serves as a clearinghouse on current research to protect water quality in Illinois. The council also provides information and support to local watershed groups to help implement sound water quality initiatives, and can offer educational assistance to help facilitate the technical and financial resources needed to carry out water quality objectives.

1999 – Lake Lou Yaeger Resource Planning Committee formed.

2000 – City of Litchfield received a grant in the amount of $3,438 from the Illinois Conservation 2000 program in support of local private-public partnerships for natural resource protection project. Cypress tree seedlings were planted in critical locations in an effort to protect and stabilize 600 feet of shoreline at Lake Lou Yeager.

2001 – Lake Lou Yaeger Resource plan, a report providing ways to reduce sedimentation and water quality impairments to Lake Lou Yaeger, presented to City of Litchfield council members by the Lake Lou Yaeger Resource Planning Committee.

2011 – Environmental Quality Incentives Program (EQIP), administered by NRCS, provided funding for sediment trapping in the upper portion of the Lake Lou Yaeger watershed. EQIP is a voluntary based conservation program providing technical and financial assistance to individual or groups facing natural resource problems.

2013 – Federal Interest and Determination was completed and approved by USACE. The FID identified potential wetland restoration that could only be created by essentially eliminating motorized boat access to the northernmost portion of the lake.

2015 – Lake Lou Yaeger Master Plan Facility Use Evaluation with Recommendations released. The report provides recommended upgrades to Lake Lou Yaeger, such as construction of an equestrian campground, renovating the existing beach house, implementing a master signage plan and redesign of the website.

2015 – USACE presented the results of the Aquatic Ecosystem Restoration study to the City of Litchfield. The Plan addresses key problems including loss of lake depth due to sedimentation, reduced water quality, degraded fisheries, and shoreline erosion. Constructing a rock berm at the northern end of the lake was proposed, in addition to other possible measures such as dredging, in-lake and tributary detention structures, lake draw-down, artificial underwater reefs and lake destratifiers. USACE presented the results of sediment sampling and analysis, sediment yield calculations for two primary tributaries and lake bottom depth-change analysis. Stakeholder noted that the Aquatic Ecosystem Restoration project is currently on hold. The City decided not to proceed further. Issues arose with agricultural land owners upstream of the lake who are concerned with the lake and impact on field tiles.

An active local stakeholder group was present for the Stage 1 public meeting in March 2017. They indicated that several projects for improved water quality have been identified for grant applications and future implementation. Any local information that is gained through the public meeting process will be included in the final report and implementation plan, as applicable.

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Section 6

Approach to Developing TMDL and Identification of Data Needs

Illinois EPA is currently developing TMDLs for pollutants that have numeric water quality standards. Of the pollutants listed in the 2016 Integrated Report as causing impairment in Lake Lou Yaeger, total phosphorus has a numeric water quality standard. In addition, a LRS was developed for TSS. Recommended technical approaches for developing the total phosphorus TMDL and a LRS for TSS in Lake Lou Yaeger are presented in this section. No additional data were needed for TMDL or LRS development.

6.1 Simple and Detailed Approaches for Developing TMDLs

The range of analyses used for developing TMDLs varies from simple to complex. Examples of a simple approach include mass-balance, load-duration, and simple watershed and receiving water models. Detailed approaches incorporate the use of complex watershed and receiving water models. Simplistic approaches typically require less data than detailed approaches and therefore these are the analyses recommended for the Lou Yaeger watershed. Adequate data exists from Lake Lou Yaeger to develop a simple modeling approach for both total phosphorus and TSS. Total phosphorus and TSS data from lake tributaries would be useful information and could have been used for calibration purposes, however, tributary data were not essential to proceeding with TMDL and LRS calculations.

Establishing a link between pollutant loads and resulting water quality is one of the most important steps in developing a TMDL. As discussed above, this link can be established through a variety of techniques. The objective of the remainder of this section is to document the recommended approaches for establishing these links for the constituents of concern in Lake Lou Yaeger.

6.2 Approaches for Developing TMDLs and LRSs for Lake Lou Yaeger

6.2.1 Recommended Approach for Total Phosphorus TMDL

Lake Lou Yaeger is listed for impairment of the aesthetic quality use, caused by elevated total phosphorus. The BATHTUB model (Walker, 1996) is typically recommended for TMDL development for lake and reservoir impairments such as those in Lake Lou Yaeger. The BATHTUB model performs steady-state water and nutrient balance calculations in a spatially segmented hydraulic network that account for advective and diffusive transport, and nutrient sedimentation[1]. The model relies on empirical relationships to predict lake trophic conditions as functions of total phosphorus and nitrogen loads, residence time, and mean depth. Watershed

[1] EPA, 2000. Nutrient Criteria Technical Guidance Manual. Lakes and Reservoirs.

loadings to the lake are estimated using event mean concentration data, precipitation data, and estimated daily tributary flows within the watershed.

Another option for the total phosphorus TMDL for Lake Lou Yaeger is CDM Smith's Simplified Lake Analysis Model (SLAM). SLAM was developed specifically to address an identified need for a practical and low cost water quality model focused on lake eutrophication that could be easily and simply applied in planning studies by a wide range of end-users. The model was originally developed as an enhanced version of the BATHTUB model and retains many of the core algorithms of that model.

SLAM calculates lake mass and flow balances on a daily time step assuming one or more well-mixed lake zones. Each zone follows the conceptual model often referred to as a "continuously stirred tank reactor" (CSTR), whereby complete and immediate mixing is assumed for each zone in both the vertical and horizontal directions. This assumption makes the model particularly well suited for Lake Lou Yaeger, which is generally well-mixed and can justifiably be divided into a limited number of small and/or shallow zones. The model targets the key parameters important for eutrophic lakes: phytoplankton (as chl-a), phosphorus (P), and nitrogen (N), and can be easily modified to aid in assessment of unrelated conservative parameters such as TSS.

SLAM also includes a state-of-the-art dynamic sediment nutrient flux module. This module calculates internal nutrient loads from the sediments to the water column as a function of shallow sediment nutrient dynamics and diffusive exchanges between sediment pore water and the overlying water column. Internal nutrient loads are a key component of many eutrophic lakes, particularly small and/or shallow lakes with large catchment areas. The inclusion of dynamic and rigorous sediment nutrient calculations within a practical planning level water quality model distinguishes SLAM from the majority of other published lake water quality models and is a particularly appealing feature for this application.

6.2.2 Recommended Approach for TSS LRS

A simple spreadsheet approach was recommended to calculate the reduction in TSS loading into Lake Lou Yaeger required to meet the target value established by Illinois EPA. The calculations utilize the following information:

- Watershed flow estimates developed as part of the BATHTUB or SLAM model,
- The relative proportion of the lake watershed made up by each subbasin,
- Measured in-lake TSS concentrations, and
- The target value developed by Illinois EPA.

The information is used to calculate the current daily load of TSS into the lake (lbs/day), the target load (lbs/day), and the percent reduction needed in order to meet the LRS target. This simplified approach is appropriate for LRS development as it does not require the explicit assessment of WLA and LA.

Section 7

Methodology Development for the Lake Lou Yaeger Watershed

7.1 Methodology Overview

Table 7-1 contains information on the methodologies selected and used to develop the total phosphorus TMDL and TSS LRS for Lake Lou Yaeger.

Table 7-1 Methodologies Used to Develop TMDL and LRS in the Lake Lou Yaeger Watershed

Segment Name/ID	Causes of Impairment	Assessment Type	Methodology
Lou Yaeger (RON)	Total Phosphorous	TMDL	SLAM
	TSS	LRS	Spreadsheet model for target reductions

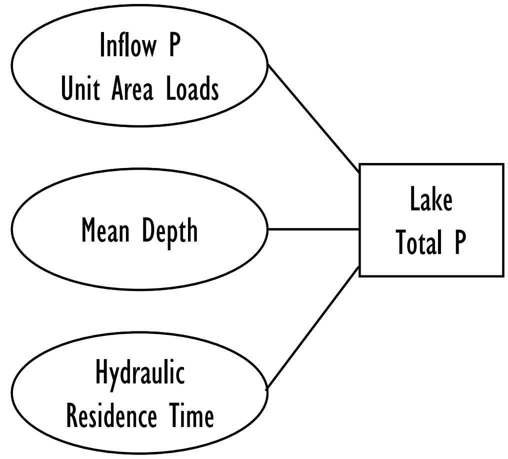
7.1.1 Simplified Lake Assessment Model (SLAM) Overview

CDM Smith's SLAM was used to develop the TMDL for total phosphorous in Lake Lou Yaeger. SLAM was originally developed as an enhanced version of the USEPA's BATHTUB model that provides more explicit modeling of lake/sediment interactions than is available in the BATHTUB model and has streamlined functionality and data requirements while still providing for a robust simulation of small lake nutrient and phytoplankton dynamics. SLAM requires inputs from several data sources including online databases and GIS-compatible data.

SLAM calculates lake mass and flow balances on a daily time step assuming one or more well-mixed lake zones. Each zone follows the conceptual model often referred to as a "continuously stirred tank reactor", whereby complete and immediate mixing is assumed for each zone in both the vertical and horizontal directions. This assumption makes the model well suited for Lake Lou Yaeger, which is generally well-mixed and can justifiably be divided into a limited number of small and/or shallow zones. The model targets the key parameters important for eutrophic lakes, including phytoplankton (as chl-*a*), phosphorus (P), and nitrogen (N), and can be easily modified to aid in assessment of unrelated conservative parameters such as TSS.

SLAM also includes a state-of-the-art dynamic sediment nutrient flux module. This module calculates internal nutrient loads from the sediments to the water column as a function of shallow sediment nutrient dynamics and diffusive exchanges between sediment pore water and the overlying water column. Internal nutrient loads are a key component of many eutrophic lakes, particularly small and/or shallow lakes with large catchment areas, as is the case with Lake Lou Yaeger.

Oxygen conditions in the model are simulated as meta- and hypolimnetic depletion rates, rather than explicit concentrations. Watershed loadings to the lakes were estimated using event mean concentration data, precipitation data, and estimated runoff flows within the watershed. **Schematic 1** outlines the basic data inputs for SLAM used to calculate the TMDL. Subbasin flows were estimated using the area ratio method, and phosphorus loadings to the lake from the surrounding watershed was estimated using the unit area load method, also known as the "export coefficient" method (USEPA 2001). This method is based on the assumption that, on an annual basis and normalized to area, a roughly constant runoff pollutant loading can be expected for a given land use type. This method also requires that unit area loads are not applied to watersheds that differ greatly in climate, hydrology, soils, or ecology from those from which the parameters were derived (USGS 1997).



Schematic 1

7.1.2 Load Reduction Strategy Overview for TSS in Lake Lou Yaeger

A simple spreadsheet approach was used to calculate the reductions in TSS loading into Lake Lou Yaeger required to meet the watershed-specific target value established by Illinois EPA. LRS targets are based on data from all stream segments or lakes within the HUC-10 basins of the watershed, as well as stream segments or lakes which closely border the watershed in neighboring HUC-10 basins, in order to best represent the land use, hydrologic, and geologic conditions unique to the watershed. Load reduction targets were calculated by Illinois EPA using data from stream/lake segments whose most current assessment shows full support for aquatic life and data that has passed quality assurance and quality checks within Illinois EPA and are in accordance with state and federal laws.

The calculations for TSS reduction utilize the target value, watershed flow estimates, relative lake watershed proportion, and measured in-lake TSS concentration to calculate the current daily load of TSS into the lake (lbs/day), the target load (lbs/day), and the percent reductions needed in order to meet the LRS target. This simplified approach is appropriate for LRS development as it does not require the explicit assessment of waste load allocation (WLA) and load allocation (LA).

7.2 Methodology Development

The following sections further discuss and describe the methodologies utilized to examine total phosphorus and TSS in Lake Lou Yaeger.

7.2.1 SLAM Development for Total Phosphorus

Historically, the U.S. Army Corps of Engineers (USACE) BATHTUB model (Walker 1996) has been the primary model used for assessment of nutrient (total phosphorus, ammonia) and nutrient-related impairments (chlorophyll a, pH, DO). However, the BATHTUB model may not be the most efficient approach to developing this type of TMDL as it does not provide explicit modeling of the major lake and sediment interactions that are important drivers of nutrient issues in Lake Lou

Yaeger. The BATHTUB model also relies on a dated platform that is less user friendly than other options and is primarily setup to model nutrient fate and transport on an annual basis. Modeling on an annual basis can lead to additional error and uncertainty when calibrating than one may typically see in models focusing on daily or even monthly time-steps.

As an alternative to BATHTUB, CDM Smith's SLAM was used to develop the TMDL for total phosphorus impairment in Lake Lou Yaeger. The SLAM relies on the following primary inputs:

- Model segmentation: number of geographically distinct segments of a reservoir to be modeled, flow direction, and an estimate of longitudinal dispersion between segments
- Lake morphology and hydraulics: surface area, average and maximum depth, volume, inflows, mixing lengths, thermal stratification
- Watershed inflows: estimated runoff and point source discharges into the reservoir's watershed, average annual phosphorus load to each segment as a function of land use using runoff coefficients and point source data
- In-lake nutrients: initial nutrient concentrations in the lake; estimates of settling velocity nutrient uptake; and burial fractions. Seasonality factors may be included to account for expected variations in settling velocity and nutrient uptake over time.
- Sediment layer dynamics: sediment characteristics used for calculating nutrient fluxes, or seasonally prescribed nutrient fluxes can be used.

The individual values input into each of the above portions of the model interface are described in the following sections along with watershed information for the impaired lake.

Up to five distinct lake segments or model zones can be defined in SLAM. Each zone is treated as a well-mixed module within the model and zones are connected via advection and/or diffusion. Concentration outputs are generated for each zone. Lake hydraulic parameter inputs are required for each zone. In addition to defining the number of lake segments, or zones, to be modeled, the model segmentation screen is used to specify the lateral or longitudinal diffusion coefficient used to provide an estimate of mixing between zones. A recommended range of longitudinal dispersion coefficients for mixing between zones is 1,000 – 1,000,000 square feet per day, based on literature values. Model segmentation, or zones, are discussed for each model in the following sections.

7.2.1.1 SLAM Development for Lake Lou Yaeger

The TMDL target for total phosphorus in Lake Lou Yaeger is 0.05 mg/L.

7.2.1.1.1 Model Segmentation

Given the available data and the general morphology of Lake Lou Yaeger, three model zones were defined for this waterbody in SLAM. The sampling locations and watershed segmentation boundaries are shown on **Figure 7-1.**

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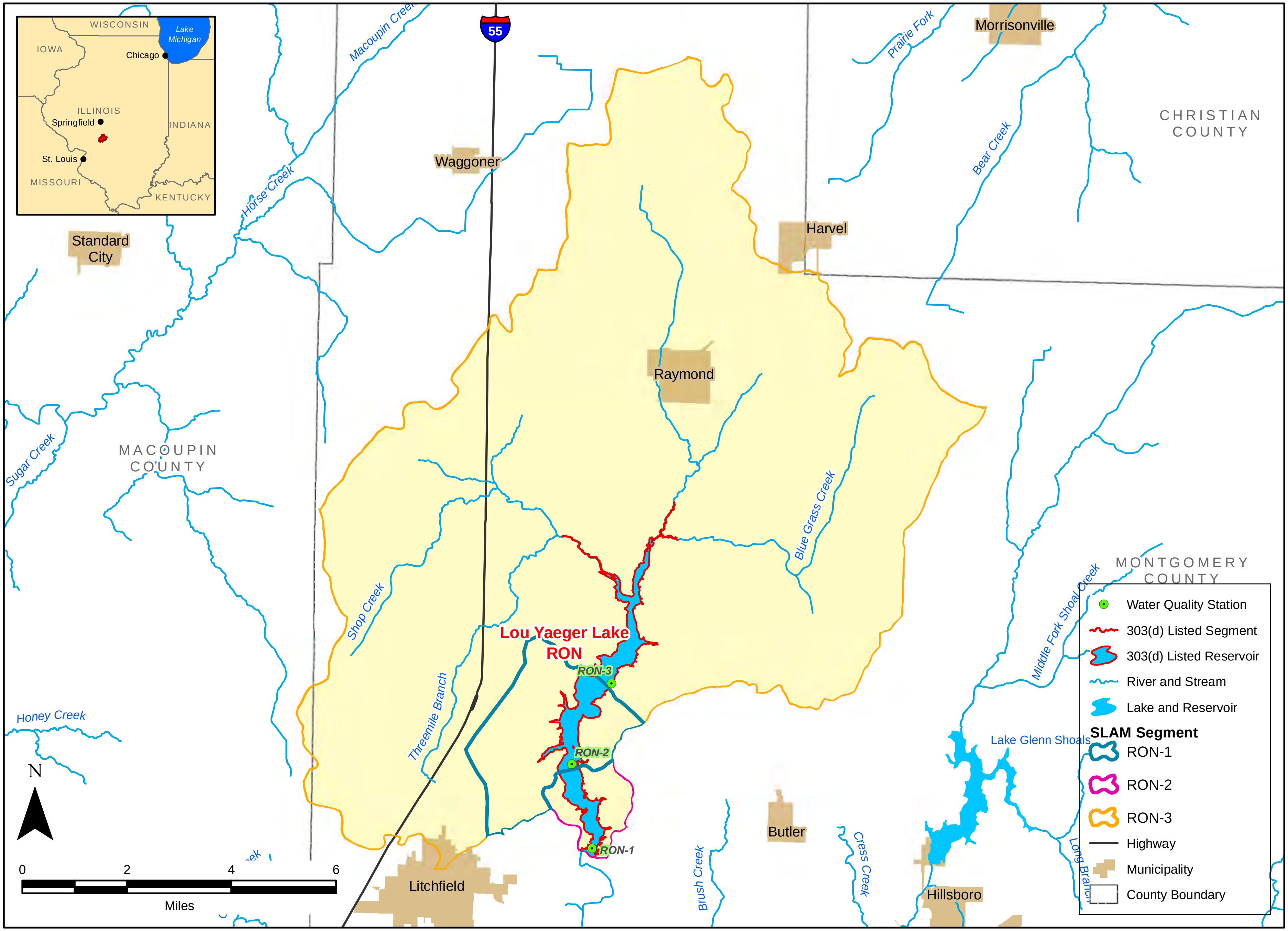

CDM Smith

Lou Yaeger Lake
SLAM Segmentation Boundaries

FIGURE 7-1

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7.2.1.1.2 Lake Hydraulics

Lake hydraulics are defined in SLAM via either internal calculation or user prescription. Data needs for internal calculations of lake hydraulics are somewhat greater as the model performs dynamic water balance calculations of lake volumes at each time-step based on user-defined or calculated inflows, outflows, and evaporative losses. Corresponding lake depths, surface areas, and releases are calculated as a function of user-defined bathymetry tables. For the prescribed hydraulics option, users specify monthly-variable lake volumes, areas, and depths. Hydraulics are assumed static within a month and lake outflows are set equal to total lake inflows at each time-step. Evaporative losses are not explicitly included in the calculations but rather should be implicitly reflected in the prescribed volumes.

Due to data availability and the limited fluctuation of water levels Lake Lou Yaeger in a typical year, prescribed lake hydraulics were used in this model setup, and included total lake volumes by month. The surface area and volume estimates were derived using GIS and available total depth data for each sampling station. These values were input into the model as static measures without seasonal variation as there is little evidence of significant and consistent water surface elevation fluctuation over the course of a year in Lake Lou Yaeger. Surface areas were verified using GIS. A summary of these inputs is shown below in **Table 7-2**.

Table 7-2 Lake Lou Yaeger (RON) Lake Hydraulics Data

Segment	Downstream Zone Within Model	Surface Area (acres)	Surface Area (% of total)	Volume (acre-ft)	Average Depth (ft)	Segment Mixing Length (ft)	Interface Width (ft)
RON-01	1	345	25%	7,717	22	16,064	1,964
RON-02	2	534	39%	8,013	15	10,137	1,715
RON-03	3	491	36%	2,947	6	9,951	n/a

7.2.1.1.3 Watershed Parameters

Watershed parameters input into SLAM are associated with flows and pollutant loads entering the lake from the watershed. Watershed sources simulated in the model include storm runoff events, dry weather baseflow, and, if applicable, supplemental water. Flows and loads can either be internally calculated or prescribed by the user. Internally calculated flows and loads are calculated in the model as a combination of wet weather runoff and dry weather baseflow. Runoff is calculated as a function of user defined daily precipitation, runoff coefficients, and total drainage area. Alternatively, monthly flows and nutrient loads entering the lake from the watershed can be prescribed by the user as a daily time-series. For lake models with multiple zones, zone distribution percentages must be specified by the user. These percentages define how much of the total lake nutrient load (calculated or prescribed) enters the lake at a given zone. Estimates of the particulate fractions associated with prescribed total phosphorus concentrations are also required inputs into the model and are derived from site specific total and dissolved phosphorus data, as available.

Watershed inputs to SLAM for the Lake Lou Yaeger model were developed using prescribed flows and loads. Daily flows into the reservoir were estimated using available gage data from USGS gage

05592050 Robinson Creek Near Shelbyville, IL using the watershed area ratio method as described in **Section 2.6.3**.

Phosphorus loads from the contributing watershed were estimated based on land use data and the median annual export coefficients for each land use. Export coefficients for each land use category found in the Lake Lou Yaeger watershed were extracted from the USEPA's PLOAD version 3.0 user's manual (USEPA 2001). The export coefficients for each land use were multiplied by the number of acres of each land use type in the lake's subbasin to provide a median annual phosphorus load into the lake (**Appendix A**). The total phosphorus load from runoff into Lake Lou Yaeger is estimated to be approximately 52,598 lbs/year based on flow and land use characteristics. The annual total phosphorus load from overland runoff was then scaled to the daily flow estimates to estimate the daily phosphorus load into the reservoir as a function of flow. The subbasin area and estimated phosphorus load as a function of land use characteristics is provided in **Table 7-3.**

Table 7-3 Lake Lou Yaeger (RON) Subbasin Areas and Phosphorus Loads

Lake Segment	Subbasin Area (acres)	Annual External Phosphorus Load (lbs)
RON-1	4,079	1,653
RON-2	1,291	215
RON-3	64,200	50,730
Lake Total	**69,570**	**52,598**

Phosphorus loads from point source discharges can be explicitly included as supplemental water in the watershed inputs to the SLAM. The supplemental water input allows the user to input average monthly discharge and monthly average phosphorus concentrations in the discharge along with the fraction of the load as particulate phosphorus. In the case of Lake Lou Yaeger, there are two point sources discharging to the watershed upstream of the lake (point sources were also previously presented/discussed in Section 5.3). The Village of Raymond Sewage Treatment Plant (IL0025381) has a measured daily average flow of 0.25 million gallons per day (mgd) versus a permitted design average flow (DAF) of 0.1 mgd. The STP is not required by its permit to monitor phosphorus in its effluent. The Raymond STP treats effluent through bar screens, an Imhoff tank, a trickling filter, and a three-cell aerated lagoon followed by disinfection. Based on this treatment process and best professional knowledge, an effluent concentration of 5 mg/L was estimated for total phosphorus. In addition, the Magnus Grand Hotel Sanitary Treatment Plant (IL0063525) discharges in the watershed and has a measured daily average flow of 0.033 mgd and a permitted DAF of 0.026 mgd. The hotel is also not required to monitor phosphorus in its effluent. The facility treats effluent through a 2-cell aerated lagoon with rock filter and chlorine contact chamber. An effluent concentration of 5 mg/L was also assumed for this facility. Measured flow values were input into SLAM in order to reflect actual conditions during the model calibration process, while permitted flow values were used for model runs developed to calculate TMDLs and WLAs. These inputs and resulting WLAs are described further in **Section 8.3.1**

7.2.1.1.4 Lake Nutrient Parameters

Lake nutrient parameters support the simulation of lake water column nutrient dynamics and include nutrient uptake kinetic and settling rates and lake water quality initial conditions. Uptake kinetics are defined by first order rate constants, applied to dissolved nutrients only. These rate constants represent the transformation of dissolved nutrient into organic particulate fraction via phytoplankton uptake.

Uptake kinetics and settling rates can be specified as steady annual rates or as monthly-variable rates. Seasonality in rates might represent, for example, changes in phytoplankton uptake with growing season or differences between particulate nutrient composition in summer (phytoplankton-based organic nutrients) vs. winter (sediment-bound runoff load). Due to limited availability of site specific data, the nutrient uptake and settling rates were set to model-default values derived from literature for the SLAM developed for Lake Lou Yaeger. The initial lake water quality condition was entered into the model as the average total phosphorus concentration for all available data collected from Lake Lou Yaeger (0.182 mg/L).

7.2.1.1.5 Sediment Layer Parameters

SLAM allows for user inputs of monthly sediment nutrient fluxes, quantifying the movement of phosphorus from the shallow sediments to the water column or vice versa. Areal flux rates ($mg/m^2/day$) can be entered as positive values for fluxes from sediments to the water column and negative values for exchanges in the opposite direction. Due to lack of site-specific sediment flux data, sediment nutrient flux rates were initially set to zero during the development of the SLAM for Lake Lou Yaeger. These rates were later adjusted during model calibration to reflect seasonal lake stratification and mixing on a monthly average basis.

7.2.1.1.6 SLAM Confirmatory Analysis

Historical water quality data for Lake Lou Yaeger were used to help calibrate the model and confirm model calculations. As the data inventory for Lake Lou Yaeger included measurements only between the months of May and October on any given year, the model calibration period was limited to those months. Although the analyses presented below do lend confidence to the modeling, additional lake and tributary water quality data, site-specific sediment characterization, and more precise land use and flow data could potentially contribute to a more thorough calibration of the model.

The Lake Lou Yaeger SLAM was initially simulated assuming default phosphorus kinetic parameters (assimilation and decay) and no internal phosphorus loading. When using these loadings, the SLAM consistently under-predicted the concentrations when compared to actual water quality data, as in-lake loads from sediment resuspension and cycling are not accounted for. To achieve a better match with actual water quality data, the internal loading rates were increased. Internal loading rates reflect nutrient recycling and resuspension from bottom sediments. Because much of the lake is relatively shallow and has relatively high concentrations of suspended sediment; wind, precipitation, and waterbody uses likely result in increased resuspension of sediment year-round. Furthermore, a review of historical DO data recorded at depths in the lake suggests the potential for sediment loading of phosphorus as a result of anoxic conditions near the lake bottom. This lends confidence to the potential for internal loading at rates well within the range of expected flux as defined in the available literature. As can be seen in **Table 7-4**, a reasonably good match between observed and predicted in-lake phosphorus values was achieved, lending significant support to the predictive ability of this simple model. A printout of the SLAM files is provided in **Appendix E** of this report.

Table 7-4 Summary of Model Confirmatory Analysis – Lake Lou Yaeger Annual Total Phosphorus Concentrations (mg/L) During Model Calibration Period

Segment/Station	Observed Concentration (mg/L)	Predicted Concentration (mg/L)	Percent Difference (%)
RON-1	0.171	0.176	3.1%
RON-2	0.186	0.190	2.2%
RON-3	0.216	0.233	7.3%

7.2.2 LRS Development for TSS in Lake Lou Yaeger

Spreadsheet calculations were performed for Lake Lou Yaeger to determine the reduction in TSS loading required to meet the watershed-specific LRS target value established by Illinois EPA of 21.9 mg/L. Spreadsheet inputs included the target value, watershed flow estimates based on watershed areas and surrogate gage calculations similar to those developed as part of the SLAM, the relative proportion of the lake watershed made up by each subbasin, and measured in-lake TSS concentrations to calculate the current daily load of TSS into the lake (lbs/day), the target load (lbs/day), and the percent reduction needed in order to meet the LRS target. WLAs are not calculated for impairments associated with narrative water quality standards for which this LRS was developed.

Section 8

Total Maximum Daily Loads for the Lake Lou Yaeger Watershed

8.1 TMDL Endpoints for the Lake Lou Yaeger Watershed

The TMDL endpoint and LRS target value for impairments in the Lake Lou Yaeger watershed are summarized in **Table 8-1**. For both total phosphorus and TSS, the concentrations must be less than the TMDL endpoint or LRS target value. The endpoint for TSS in the Lake Lou Yaeger is watershed-specific. The endpoint for total phosphorus in the lake is based on protection of the aesthetic quality designated use.

The total phosphorus endpoint reflects the lowest applicable numeric water quality standard. Parameters without numeric water quality standards, such as TSS in lakes, are assigned a watershed-specific LRS target value by Illinois EPA. LRS targets are based on data from all stream segments or lakes within the HUC-10 basins of the watershed, as well as stream segments or lakes which closely border the watershed in neighboring HUC-10 basins, in order to best represent the land use, hydrologic, and geologic conditions unique to the watershed. Load reduction targets were calculated by Illinois EPA using data from waterbodies in which the most current assessment shows full use support. Only data that have passed quality assurance and quality checks within Illinois EPA and are in accordance with state and federal laws are used in the LRS target value calculations. The LRS target value is a voluntary measure and is intended to serve as a planning tool for overall water quality improvement strategies in the watershed.

Table 8-1 TMDL Endpoints for Impaired Constituents in the Lake Lou Yaeger Watershed

Segment Name/ID	Causes of Impairment	Assessment Type	TMDL/Modeling Endpoint or LRS Target Value
Lake Lou Yaeger (RON)	Total Phosphorous	TMDL, SLAM	0.05 mg/L of Total Phosphorus
	Total Suspended Solids (TSS)	LRS, spreadsheet	21.9 mg/L of TSS

8.2 Pollutant Sources and Linkages

Potential pollutant sources for impaired segments in the Lake Lou Yaeger watershed include both point and nonpoint sources as described in Section 5 of this report. The sources identified for each parameter of concern, based on data gathered and documented during Stage 1 and modeling completed in Stage 3, are presented in **Table 8-2**.

Table 8-2 Sources of Pollutants in the Lake Lou Yaeger Watershed

Segment ID	Segment Name	Causes of Impairment	Sources of Pollutants in the Lake Lou Yaeger Watershed
RON	Lake Lou Yaeger	Total Phosphorus	Agriculture, internal nutrient recycling, runoff from forest/grassland/parkland, domestic wastewater
		TSS	Agriculture, littoral/shore area modifications (non-riverine), other recreational pollution sources, runoff from forest/grassland/parkland

Pollutant sources and their linkages to Lake Lou Yaeger were established through the modeling as discussed in Section 7. Lake modeling indicated that loads of total phosphorus may originate from internal loading and external sources such as municipal point sources, septic systems, and watershed-wide agricultural practices. Nutrients bound in eroded soils and plant materials are introduced to the waterbodies through runoff from precipitation events. Once in the waterbodies, nutrients are introduced to the water column and/or nutrient rich soils and plant materials settle to the bottom perpetuating the internal cycling of nutrients.

Sources of Suspended Sediment

None of the NPDES permitted facilities in this watershed currently have discharge monitoring requirements for TSS that would suggest they are a significant source of this pollutant. Note that both TSS and sedimentation/siltation impairments are based on narrative (i.e. non-numeric) standards and are addressed through the LRS process which does not include development of WLAs.

Non-point and stormwater-related inputs of sediments into the impacted waterbodies in the watershed include limited urban runoff; runoff from agricultural and undeveloped lands; runoff from temporarily disturbed areas during construction processes; and stream bank erosion during high flow conditions. Further pollutant source discussion related to TSS and impairment in this watershed is provided below.

Sources of Phosphorus

Point sources of phosphorus in the watershed include two individually NPDES-permitted facilities. **Table 8-3** contains permit information on the treatment facilities, as well as model input parameters used in the lake modeling discussed throughout this section. Septic systems throughout the watershed and on properties surrounding the lake are also likely sources of excess nutrients.

Potential stormwater-related inputs of phosphorus and other nutrients to the lake in the watershed include limited urban runoff, and runoff from agricultural and undeveloped lands. Inputs are often caused by nutrient applications on agricultural lands, lawns, golf courses, and other maintained landscapes. Nutrients adsorb to soils and enter waterways with runoff and erosion, resulting in excessive growth of algae and other aquatic plants, which impairs aesthetics, water quality, and recreational potential.

Further pollutant source discussion is provided throughout this section, and implementation activities to reduce loading from the potential sources are outlined in Section 9.

8.3 TMDL Allocation

As explained in Section 1 of this report, the TMDL for Lake Lou Yaeger watershed addresses the following equation:

$$\textbf{TMDL} = \textbf{LC} = \Sigma\textbf{WLA} + \Sigma\textbf{LA} + \textbf{MOS} + \textbf{RC}$$

where:	LC	=	Loading capacity - the maximum amount of pollutant loading a water body can receive without violating water quality standards
	WLA	=	Waste load allocation - the portion of the TMDL allocated to existing or future point sources
	LA	=	Load allocation – the portion of the TMDL allocated to existing or future nonpoint sources and natural background
	MOS	=	Margin of safety - an accounting of uncertainty about the relationship between pollutant loads and receiving water quality
	RC	=	Reserve capacity – the portion of the load explicitly set aside for future population growth and additional development in the watershed

Each element will be discussed in this section as well as consideration of seasonal variation in the TMDL calculation.

8.3.1 Total Phosphorus TMDL for Lake Lou Yaeger

8.3.1.1 Loading Capacity

The LC of Lake Lou Yaeger is the mass of total phosphorus that can be allowed as input into the lake per day while still meeting the applicable water quality standard concentration of 0.05 mg/L total phosphorus. The allowable loads of total phosphorus that can be generated in the watershed and still maintain water quality standards were determined with the lake model that was developed using SLAM as discussed in Section 7. To calculate the LC, the current total phosphorus load into the lake was first calculated in the model using average concentration values from the available historical data. The current calculated loads from internal and external sources were then iteratively reduced in the model until the water quality standards were met. The resulting load at the point of concentration compliance represents the LC.

The total allowable load of total phosphorus into Lake Lou Yaeger through SLAM is shown in **Section 8.3.1.6** in **Table 8-4**.

8.3.1.2 Seasonal Variation

Seasonal variation is accounted for in the total phosphorus TMDL by developing the model and performing all calculations of load on an annual basis. Modeling on an annual basis takes into account the seasonal effects the lake will undergo during a given year. Since the pollutant source can be expected to contribute loadings in different quantities during different time periods (e.g., various agricultural processes occurring at different times of year, combined with seasonal changes in precipitation, result in different runoff characteristics at different times of year), the loadings for this TMDL are focused on average annual loadings converted to daily loads rather than specifying different loadings by season. Lake Lou Yaeger will experience critical conditions pertaining to phosphorus concentrations every year based on the growing season. Because an average annual basis was used for TMDL development, the critical condition is accounted for within the analysis.

8.3.1.3 Margin of Safety

The MOS can be implicit (incorporated into the TMDL analysis through conservative assumptions), explicit (expressed in the TMDL as a portion of the loadings), or a combination of both. The MOS for the Lake Lou Yaeger TMDL is both implicit and explicit. An explicit MOS of 10% was included to account for the lack of site-specific data available within the watershed.

In addition to the explicit MOS of 10%, the analyses completed for the lake was conservative as a result of the default coefficients and values used in the SLAM model, which were developed to be conservative in nature in the absence of site-specific information. Default model values, such as dispersion rates, are based on scientific data accumulated from a large survey of lakes. Wherever site-specific data are not available, default model rates are used which are based on error analysis calculations. The SLAM model and the default values incorporated within the model provide a conservative range of where the predictions could fall and provide confidence in the predicted values.

As discussed in the SLAM technical documentation, if the model is re-calibrated to site-specific data and the default input values for model error coefficients are used, the procedure will over-estimate prediction uncertainty (CV's of predicted values). In this case, all available data were used to perform a limited site-specific calibration, while default error coefficients were maintained in the model. Therefore, the uncertainty presented in the final results is likely an over-estimation of the actual model uncertainty, and thus conservative. In other words, the range of potential outcomes is likely smaller than the range presented. Or, put another way, the high ends of the ranges of predicted phosphorus concentrations (worst case concentrations) are likely higher than the actual expected outcomes.

8.3.1.4 Waste Load Allocation

A total of two NPDES-permitted facilities discharge to tributaries of Lake Lou Yaeger (**Table 8-3**). Although each of these dischargers contribute only a small proportion of the total flow into the lake, the cumulative effect of the point sources on total phosphorus loading can be significant and warrants the development of WLAs in the TMDL calculations for Lake Lou Yaeger.

Total phosphorus data for dischargers in the watershed are extremely limited and neither of the facilities currently have effluent limits or monitoring requirements for total phosphorus in their discharge. In order to estimate total phosphorus loading for each facility, a review of effluent data and permit language for similar facilities in the region was performed and coupled with best professional knowledge of effluent concentrations expected for each type of treatment facility. Using a value near the upper limit of the expected range serves as a conservative measure for the overall modeling process.

Based on a review of similar permits and using best professional judgement, facilities that are described as using domestic lagoon or Imhoff tank and sand filtration treatment in their NPDES permit were assigned an estimated average total phosphorus concentration of 5.0 mg/L. As stated above, this value was at the upper range of estimated concentrations for these types of facilities and were used in calculations with the intent that current permits will not require nutrient removal technologies to be implemented at this time. However, future plant expansions and new facilities may be subject to applicable Water Quality Standards (WQS) or technologically achievable Water Quality Based Effluent Limits (WQBELs).

Flow estimates for both facilities discharging to tributaries of Lake Lou Yaeger were based on each facility's DAF for model calibration and WLA calculation purposes. The DAF for the point sources in the Lake Lou Yaeger watershed (Raymond STP, IL0025381 and Magnus Hotel, IL0063525) were listed as 0.1 and 0.026 MGD in the current NPDES permits, respectively. The TMDL allocations were calculated using the facility's DAF as this is most representative of average discharge on an annual basis.

The estimated flow and total phosphorus concentrations for each point source were used to calculate WLAs for each facility in the Lake Lou Yaeger watershed. These values are summed to provide an estimate of the total WLA for total phosphorus in the watershed. Calculations are based on DAFs which often exceed actual discharge rates shown on DMRs and estimated phosphorus concentrations set to the high end of best professional estimates of treatment capabilities. However, the inclusion of total phosphorus monitoring requirements in future permits is recommended and will help inform future modeling efforts and would provide greater certainty to relative impact of point sources on total phosphorus concentrations in Lake Lou Yaeger.

Table 8-3 WLAs for Total Phosphorus Loads to Lake Lou Yaeger

NPDES Permit Number	Permit Name	Estimated Total Phosphorus Concentration (mg/L)	Design Average Flow (MGD)	WLA[1] (lbs/Day)
IL0025381	RAYMOND STP	5.0	0.1	4.17
IL0063525	MAGNUS GRAND HOTEL AND CONFERENCE CENTER	5.0	0.026	1.08
			Total WLA	**5.25**

[1] WLAs are equivalent to estimates of current allowable waste loads. TMDL assumes no changes in current treatment plant process and NPDES permit limits in the watershed

WLAs may also include loads originating from NPDES permitted municipal separate storm sewers (MS4s) in the watershed. However, no NPDES permitted MS4 areas exist in the Lake Lou Yaeger watershed.

8.3.1.5 Reserve Capacity

A portion of a TMDL's loading capacity may be set as a RC to allow for future population growth and development potentially leading to increased pollutant loads in the future. In the case of this TMDL for total phosphorus, an explicit RC was not included in the TMDL calculations due to the lack of projected population growth in the area and available capacity in existing treatment facilities. Flow estimates used to develop the WLAs for each point source and for estimating non-point source runoff concentrations were conservative and allow for implicit reserve capacity should population growth become a factor in the future.

8.3.1.6 Load Allocation and TMDL Summary

Summaries of the total phosphorus TMDL developed for Lake Lou Yaeger are provided in **Table 8-4**. A total reduction of approximately 86 percent of total phosphorus loads will result in compliance with the applicable water quality standard of 0.05 mg/L total phosphorus in the Lake Lou Yaeger watershed.

Percent reductions presented under this scenario assume no imminent change in current NPDES permit limits or other factors that would impact current waste loads in the watershed. All necessary reductions are limited to reductions of internal loads and non-permitted non-point source loads.

Table 8-4 TMDL Summary for Lake Lou Yaeger

Segment	Loading Source	LC (lbs/day)	WLA-MS4s (lbs/day)[1]	WLA-Facilities (lbs/day)	LA (lbs/day)	MOS (10% ofLC)	Current Load (lbs/day)	Reduction Needed (Percent)
RON-1	Internal	3.33	-	-	3.00	0.33	8.77	62%
	External	1.81	-	-	1.63	0.18	4.53	60%
	Total	5.15	-	-	4.63	0.51	13.3	61%
RON-2	Internal	4.08	-	-	3.67	0.41	13.6	70%
	External	0.18	-	-	0.16	0.02	0.59	70%
	Total	4.26	-	-	3.83	0.43	14.2	70%
RON-3	Internal	1.21	-	-	1.09	0.12	12.1	90%
	External	15.0	-	5.25	8.23	1.50	144	90%
	Total	16.2	-	5.25	9.32	1.62	156	90%
Total	Internal	8.63	-	-	7.77	0.86	34.5	75%
	External	17.0	-	5.25	10.0	1.70	149	89%
	Total	25.6	-	5.25	17.8	2.56	184	86%

[1] No NPDES permitted MS4s exist within the Lake Lou Yeager watershed.

8.4 LRS Allocations

LRS impairments are determined through comparison of site conditions to narrative water quality standards. A watershed-specific numeric target was developed by Illinois EPA for TSS in the Lake Lou Yaeger watershed. The target value was used to develop a target loading capacity for the lake. The target loading capacity was then compared to the current existing load to develop a percent reduction needed to meet the target value, as discussed in the following sections.

8.4.1 LRS for TSS in Lake Lou Yaeger

Lake Lou Yaeger is listed for impairment of the aesthetic quality use caused by TSS. No numeric water quality standard exists for TSS in lakes or reservoirs in Illinois, so a watershed-specific numeric target of 21.9 mg/L of TSS was developed by Illinois EPA to aid in assessment of this impairment. Determination of the reduction in TSS load needed to meet the water quality target was performed using a simplified spreadsheet calculation approach.

The spreadsheet approach incorporated the available TSS data for each segment of the impaired lake and estimates of the average daily overland and tributary flow from the watershed to produce an estimate of the current average daily TSS load into the lake. The current load was then compared to the maximum daily load possible without exceeding the watershed-specific TSS target concentration value to calculate the overall percent reduction in daily TSS load into the lake that is necessary to meet the target concentration. The percent reduction in TSS necessary to meet the target value in Lake Lou Yaeger is presented in **Table 8-5**. An overall reduction in TSS loads of approximately 32 percent is necessary to meet the target value in Lake Lou Yaeger.

Table 8-5 LRS Summary for TSS in Lake Lou Yaeger (RON)

Site	Target Concentration (mg/L)	Existing Concentration (mg/L)	Average Overland and Tributary Flow (cfs)	Target Loading Capacity (lbs/day)	Actual Load (lbs/day)	Percent Reduction Needed (%)
RON	21.9	32.4	93.8	11,068	16,375	32%

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Section 9

Implementation Plan for the Lake Lou Yaeger Watershed

9.1 Implementation Overview

The goal of this watershed plan is to identify BMPs to be implemented in the Lake Lou Yaeger watershed. The BMPs will provide reasonable assurance that impaired waters in the watershed will meet water quality criteria developed to ensure waterbodies are able to support their designated uses.

The USEPA has identified nine minimum elements that a watershed plan for impaired waters is expected to include. A watershed plan is expected to:

1. Identify causes and sources of pollution that will need to be controlled to achieve pollutant load reduction requirements estimated within the watershed plan.
2. Estimate pollutant load reductions expected as a result of implementation of management measures described in #3 below.
3. Describe the nonpoint source management measures that will need to be implemented to achieve load reductions estimates and identify the critical areas where measures need to be implemented.
4. Estimate the level of technical assistance, associated costs, potential funding sources and parties that will be relied upon to implement the prescribed measures.
5. Include a public information/education component designed to change social behavior.
6. Develop an implementation schedule for the plan.
7. Develop a description of interim, measurable milestones.
8. Identify indicators that can be used to determine whether pollutant loading reductions are being achieved over time.
9. Develop a monitoring component to evaluate the effectiveness of the implementation efforts over time.

9.2 Adaptive Management

An adaptive management or phased approach is recommended for the implementation of management practices designed to meet the TMDLs and LRSs developed for the Lake Lou Yaeger watershed. Adaptive management conforms to the USEPA guidelines outlined above as it is a systematic process for continually improving management policies and practices through learning from the outcomes of operational programs. Some of the defining characteristics of adaptive management include:

- Acknowledgement of uncertainty about what policy or practice is "best" for the particular management issue
- Thoughtful selection of the policies or practices to be applied (the assessment and design stages of the cycle)
- Careful implementation of a plan of action designed to reveal the critical knowledge that is currently lacking
- Monitoring of key response indicators
- Analysis of the management outcomes in consideration of the original objectives and incorporation of the results into future decisions (British Columbia Ministry of Forests 2000)

Implementation actions, point source controls, management measures, and/or BMPs are used to control the generation or distribution of pollutants within a watershed. BMPs are either structural; such as wetlands, sediment basins, fencing, or filter strips; or managerial, such as conservation tillage practices, nutrient management plans, or crop rotation. Both structural and managerial BMPs require effective management to be successful in reducing pollutant loading to water resources (Osmond et al. 1995).

It is typically most effective to install a combination of point source controls and BMPs or a BMP system. A BMP system is a combination of two or more individual BMPs that are used to control pollutants from a single critical source. If the watershed has more than one identified pollutant, but the transport mechanism is the same, then a BMP system that establishes controls for the transport mechanism can be employed (Osmond et al. 1995).

To assist in development of an adaptive management program; implementation actions, management measures, available assistance programs, and recommended continued monitoring are all discussed throughout the remainder of this section. The point source BMPs described below are generally required and typically already being implemented although some modifications may be appropriate. The nonpoint source BMPs are entirely voluntary based on the landowner’s preference.

9.3 BMP Recommendations for Reducing TSS in Lake Lou Yaeger

Soil erosion is the process of moving soil particles or sediment by flowing water or wind. Additionally, eroding soil transports pollutants that can potentially degrade water quality. TSS and/or sedimentation/siltation load reductions are needed for Lake Lou Yaeger (RON) in order to meet the watershed-specific LRS target value of 21.9 mg/L. Existing loads of TSS need to be reduced by 32% to meet the target concentration in the lake, as discussed in Section 8.4.

Nonpoint source runoff from agricultural areas and unstable streambanks and shorelines are likely the main contributors to high sediment loads in the impaired waterbody. Therefore, nonpoint source controls designed to reduce erosion are expected to reduce sediment as well as provide a secondary benefit of reducing other contaminants such as total phosphorus that may be entering waterways via erosive processes.

The City of Litchfield has concurrently developed a "Lake Lou Yaeger Implementation Plan" that details planned efforts to mitigate sediment and nutrient loading to the lake (**Appendix F**). The City is proposing to construct three BMPs, including the construction of two sediment ponds and approximately 1,800 linear feet of shoreline erosion remediation. Stakeholders also noted that a siltation basin (Five Mile Lake) exists at the confluence of Threemile Branch and Shop Creek at the northwest arm of the lake. Maintenance and development of these BMPs, as well as other applicable practices discussed below will help to reduce TSS levels within the watershed.

Filter Strips: Filter strips are strips or areas of permanent herbaceous vegetation situated between cropland, grazing land, or disturbed land and environmentally sensitive areas, such as waterways. Filter strips serve as controls to reduce, sediment, particulate organic matter, and sediment-absorbed contaminant and pollutant loading in runoff. The filter strips are permanently designated plantings to treat runoff and are not part of an adjacent cropland's rotation. Grass filter strips have been shown to remove as much as 65 percent of sediment and 75 percent of total phosphorus loads from runoff (USEPA 2003).

The filter strip vegetation may consist of a single species or a mixture of grasses, legumes, and/or other forbs that are appropriately adapted to the soil and climate, as well as to the farm chemicals used in the adjacent land. Approved seed listings are provided in the Illinois NRCS Conservation Practice Standard (CPS) 393 (NRCS 2017). Applicable maintenance shall be performed as needed to ensure the strips continue to function properly, including removal of state-listed noxious weeds, gully repair, removal of excess sediment, and re-seeding. Overland flow entering the filter strip should be primarily sheet flow; areas of concentrated flow should be dispersed as part of the maintenance activities so as not to circumvent the filter strip. Harvesting of the filter strip vegetation, where appropriate, will help to encourage dense growth, maintain an upright growth habit, and remove contaminants and unwanted nutrients contained in the plant tissue. Prescribed burning may be used to manage and maintain the filter strip when an approved burn plan has been developed.

The installation of filter strips adjacent to the impaired lake segment, as well as any contributing tributaries, can result in considerable reduction of overland contributions of sediments and suspended solids to an impaired waterbody. Filter strips implemented along lakes and their tributaries slow and filter runoff and provide bank stabilization thereby decreasing erosion and re-sedimentation; however, they should not be installed on unstable channel banks already eroding due to undercutting of the bank toe. In some cases, riparian vegetation also provides bank stability that further reduces sediment loading to the lake. When used in support of a riparian forest buffer, filter strips can also restore or maintain sheet flow.

The Illinois NRCS CPS 393 describes filter strip requirements based on land slope; the requirements are designed to achieve a minimum flow through time of 15 to 30 minutes at a one-half inch depth. **Table 9-1** provides a summary of the guidance for filter strip width, or flow length, as a function of slope (NRCS 2017).

Table 9-1 Filter Strip Flow Lengths Based on Land Slope

Percent Slope	0.5%	1.0%	2.0%	3.0%	4.0%	5.0% or greater
Minimum (feet)	36	54	72	90	108	117
Maximum (feet)	72	108	144	180	216	234

GIS land use and topographic data, described in Section 2 of this report, were used in conjunction with soil slope data to provide an estimate of acreage where filter strips could be installed. As discussed in Section 2.4.1 of this report, a total of 58 soil types exist within the watershed. The three most common soil types—Virden silty clay loam (0 to 2 percent slopes), Herrick-Biddle-Piasa silt loams (0 to 2 percent slopes), and Herrick silt loam (0 to 2 percent slopes) — cover over 54 percent of the watershed (21, 18, and 15 percent, respectively). All other soil types each represent less than 4 percent of the total watershed area. There is therefore a wide diversity of soil types in the watershed.

In conjunction with the available land use, topography, and soil information discussed in Section 2, mapping software was used to buffer impaired segments and their major tributaries to an appropriate and reasonable width to determine the total area found in the subbasin. Due to the wide range of soil types and slopes found throughout the watershed, the appropriate buffer widths estimated in GIS were based on the average slope of land within the maximum buffer areas of the impaired segment's major tributaries. These average slopes were then used to calculate approximate buffer distances based on the NRCS guidance using a best-fit equation to interpolate between the slope percentages to buffer width relationships provided in the NRCS guidance.

Not all land use types within the buffer areas are candidates for conversion to buffer strips. Existing forests and undisturbed grasslands already function as filter strips and conversion of developed residential or commercial lands is often infeasible. In general, agricultural lands are the land use type most conducive to conversion to buffer strips and will likely provide the greatest benefit to water quality once converted. Therefore, GIS software was used to extract the approximate acreage of agricultural lands surrounding potential tributaries and shoreline buffer areas of the impaired lake segment. The calculated overall buffer areas and acreage of agricultural land within the buffer distances for the impaired segment and its tributaries are provided in **Table 9-2**. These data represent an approximation of the maximum acreage of land potentially available for conversion to filter strips. More detailed assessment of a given property is necessary to determine the exact size and extent of convertible lands likely to provide the greatest benefit to surface water quality following conversion to filter strips.

There are approximately 2,997 total acres within the various buffer distances of the lake and its tributaries, an estimated 1,219 acres of which are agricultural land where filter strips could potentially be installed. Landowners should be encouraged to evaluate their land adjacent to impaired lakes and their tributaries to determine the practicality of installing or extending filter strips to achieve effective flow lengths as described in the NRCS guidance provided in **Table 9-1**.

Figure 9-1 shows the buffered areas and agricultural lands suitable for conversion to filter strips within the watershed.

Table 9-2 Average Slopes, Filter Strip Flow Length, Total Buffer Area, and Area of Agricultural Land Within Buffers Potentially Suitable for Conversion to Filter Strips for Lake Lou Yaeger

Waterbody Name	Segment ID	Average Slope Adjacent to Lake (%)	Filter Strip Flow Length (feet)	Total Area in Buffer (Acres)	Agricultural Land in Buffer (Acres)
Lake Lou Yaeger	RON	11	234	2,197	60

If this BMP is selected for use by a landowner, a separate plan should be prepared for each area which will use this practice. Additional guidance and minimum plan elements are discussed in Illinois NRCS CPS 393, including site preparation; seed, seeding rates, and mixtures; lime and fertilizer; seedbed preparation and seeding; and operation and maintenance.

Field Borders: A field border is a strip of permanent vegetation established at the edge or around the perimeter of a field to reduce erosion from wind and water and protect soil and water quality. This practice applies to cropland and grazing lands which are often farmed to the maximum extent possible, sometimes even into adjacent road ditches and to creek banks. Leaving a field border will reduce erosion and transportation of sediment, including contaminant-impacted materials, to nearby environmentally sensitive areas.

As a minimum, field borders should be located along the edge(s) of fields where runoff enters or leaves the field. The minimum width shall be 30 feet; wider if needed to meet the resource needs. When determining the border width, consideration should be given to factors such as equipment turning, parking, loading/unloading, grain harvest operations, and other related activities. For example, field borders planned to be used for turn strips shall be at least twice as wide as the widest equipment to be used. Border widths should also comply with all applicable state and local manure and chemical application setbacks. The field border shall not be used as a hay yard or machinery parking lot for any extended period of time, especially if doing so will damage or impair the function of the field border. When crossing the border, sprayers should be shut off and tillage equipment raised to avoid damage to the borders.

The field border shall be established using permanent stiff-stemmed, upright grasses; grass/legumes; forbs; and/or shrubs to trap wind- or water-borne soil particles. These plants should be appropriately adapted to the soil and climate, have the physical characteristics necessary to control wind and water erosion to tolerable levels in the field border area, be tolerant to sediment deposition and the chemicals planned for application in the crop field, be tolerant to equipment traffic, and shall not include any state-listed noxious plant. For water quality purposes in particular (adsorbed, dissolved and suspended contaminants), the field border should have a vegetation stem density/retardance of moderate to high (e.g., equivalent to a good stand of wheat). Field border establishment shall be timed so that the soil will be adequately protected during the critical erosion period(s). Seedbed preparation, seeding rates, dates, depths, fertility requirements, and planting methods will be consistent with approved local criteria and site conditions.

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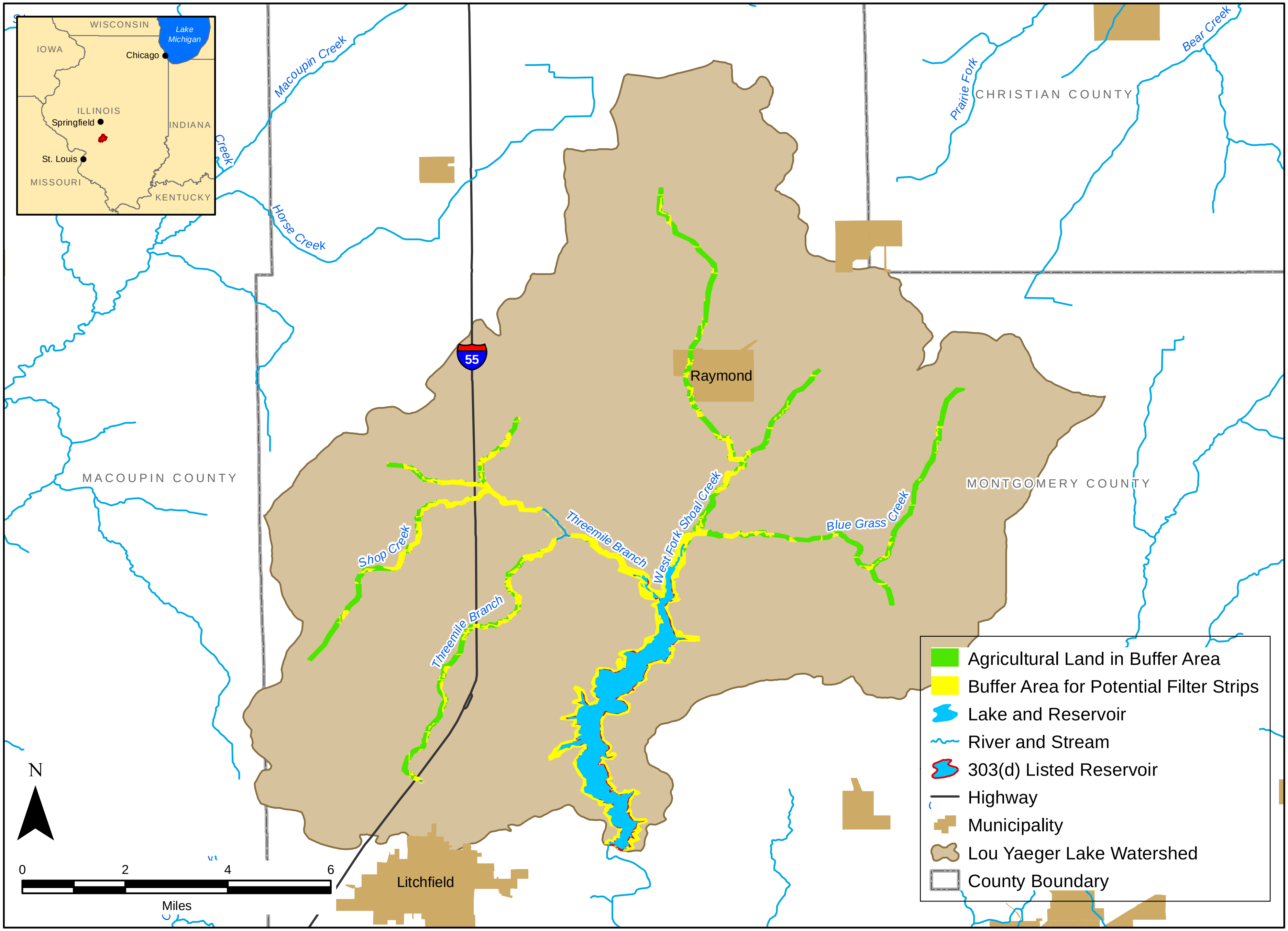

CDM Smith

Lou Yaeger Lake

Buffer Areas and Agricultural Lands Potentially Suitable for Conversion to Filter Strips

FIGURE 9-1

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Applicable maintenance shall be performed as needed to ensure the borders continue to function properly, including removal of state-listed noxious weeds and excess accumulated sediment. Overland flow entering the border should be primarily sheet flow; areas of concentrated flow should be dispersed as part of the maintenance activities so as not to circumvent the border. Any area damaged by animals, chemicals, tillage, or equipment traffic should be repaired as soon as possible. Use of contour buffer, no-till, or other conservation practices on adjacent upland areas will help to reduce surface runoff and excessive sedimentation of field borders.

If this BMP is selected for use by a landowner, a separate plan shall be prepared for each area which will use this practice. Additional guidance and minimum plan elements are discussed in Illinois NRCS CPS 386 (NRCS 2010a).

Conservation Tillage Practices: Conservation tillage practices could help reduce nutrient and sediment loads into the impaired segment by reducing erosion of soils. **Table 9-3** shows the areas (acres) in the watershed that are under cultivation, along with the percent of the corresponding watershed area which is cultivated. Crop residuals or living vegetation cover on the soil surface protects against soil detachment from water and wind erosion.

Table 9-3 Cultivated Areas for the Lake Lou Yaeger Subbasin[1]

Waterbody Name	Segment ID	Land Cover Area (Acres)	Cultivated Area (Acres)	Percent Cultivated
Lake Lou Yaeger	RON	69,602	51,421	74%

1 = Areas are compiled from Table 2-1 of this report

Conservation tillage practices are no-till and reduced-till. No-till is the practice of limiting soil disturbance in order to manage the amount, orientation, and distribution of crop and plant residue on the soil surface year around (NRCS 2016c). Reduced-till is managing the amount, orientation, and distribution of crop and other plant residue on the soil surface year round while limiting the soil-disturbing activities used to grow and harvest crops in systems where the field surface is tilled prior to planting (NRCS 2016d).

The no-till practice consists only of an in-row soil tillage operation during the planting activities and a seed row/furrow closing device. No full-width tillage is performed from the time of harvest or termination of one cash crop to the time of harvest/termination of the next cash crop in the rotation regardless of the depth of the tillage operation. Limited tillage is allowed to close or level ruts from harvesting equipment; however, no more than 25 percent of the field may be tilled for this purpose.

As noted above, the reduced-till practice consists of managing plant residue on the soil surface while limiting soil-disturbing activities. The practice includes tillage methods commonly referred to as mulch tillage or conservation tillage where the entire soil surface is disturbed by tillage operations such as chisel plowing, field cultivating, tandem disking, or vertical tillage. It also includes tillage/planting systems with few tillage operations (e.g. ridge till) but which do not meet the criteria for the no-till practice as described above and in Illinois NRCS CPS 329 (NRCS 2016c).

In both the no-till and reduced-till practices, removal of residue from the row area prior to or as part of the planting operation is acceptable. In the no-till practice, however, the disturbed portion of the row width should not exceed one third of the crop row width. In either practice, none of the residue should be burned. To reduce erosion to the targeted level, the current approved water and/or wind erosion prediction technology should be used to determine the amount of randomly distributed surface residue needed, the period of the year the residue needs to be present in the field, and the amount of surface soil disturbance allowed. All residues shall be uniformly distributed over the entire field. Residue should not be shredded after harvest because shredding makes it susceptible to movement by wind or water, and areas where the shredded residue accumulates may interfere with planting of the next crop.

If the no-till BMP is selected for use by a landowner, a separate plan shall be prepared for each area which will use this practice. Additional guidance and minimum plan elements are discussed in Illinois NRCS CPS 329. If the reduced-till BMP is selected for use by a landowner, a separate plan shall be prepared for each area which will use this practice. Additional guidance and minimum plan elements are discussed in Illinois NRCS CPS 345 (NRCS 2016d).

Conservation tillage practices can remove up to 45 percent of the phosphorus from runoff and approximately 75 percent of the sediment. Additionally, studies have found around 93 percent less erosion occurred from no-till acreage compared to acreage subject to moldboard plowing (USEPA 2003). The 2013 Illinois Department of Agriculture's Soil Transect Survey estimates indicate that conventional till currently accounts for the vast majority of tillage practices in Montgomery County.

Contour Farming – Contour farming is the practice of aligning ridges, furrows, and roughness formed by tillage, planting, and other operations to alter the velocity and/or direction of water flow to or around the hillslope. Use of this practice results in reduced erosion; reduced transport of sediment, other solids, and the contaminants attached to them; and reduced transport of contaminants found in solution runoff (e.g. excess nutrients and pesticides) by increasing water infiltration. Contour farming applies on sloping land where crops are grown.

Criteria which apply to this practice are minimum and maximum row grades, minimum ridge heights, and stable outlets to receive surface flow. The practice standard (Illinois NRCS CPS 330 [NRCS 2017a]) provides more information; however, in general, crop rows shall have sufficient grade to ensure that runoff water does not pond and cause unacceptable crop damage. The maximum row grade shall typically not exceed one-half of the up-and-down hill slope percent used for conservation planning or 2 percent; see the standard for exceptions. During the period of the rotation that soil is most vulnerable to erosion, the minimum ridge height is 2 inches when row spacing is greater than 10 inches and 1 inch for close-grown crops such as small grains (row spacing less than 10 inches). Additionally, for close-grown crops, the spacing between plants within the row shall not be greater than 2 inches. The minimum ridge height criteria are not required when the no-till practice (Illinois NRCS CPS 329 [NRCS 2016c]) is employed and at least 50 percent surface residue cover is present between the rows after planting.

Farming operations should begin on the contour baselines/markers and proceed both up and down the slope in a pattern parallel to any contour baselines/markers or terraces, diversions, or contour buffer strip boundaries where these practices are also present, until the patterns meet, and provided the applicable row grade criteria are met. Where field operations begin to converge between two non-parallel contour baselines, a correction area should be established that is permanently in sod or established to an annual close-grown crop. Sod turn strips should also be established where contour row curvature becomes too sharp to keep machinery aligned with rows during field operations, on sharp ridge points, or other odd areas as needed. Where terraces, diversions, or contour buffer strips are not present, contour markers shall be retained on grades that, when followed during establishment of each crop, will maintain crop rows at designed grades. Contour markers may be field boundaries, a crop row left untilled near or on an original contour baseline or other readily identifiable, continuous, lasting marker. If a marker is lost, a contour baseline shall be re-established within the applicable criteria set forth in Illinois NRCS CPS 330 (NRCS 2017a) prior to seedbed preparation for the next crop.

When using contour farming, a separate plan shall be prepared for each field which will use this practice. Additional guidance and minimum plan elements are discussed in Illinois NRCS CPS 330 (NRCS 2017a).

Conservation Crop Rotation – Conservation crop rotation is a planned sequence of at least two different crops grown on the same ground over a period of time (i.e. the rotation cycle), and applies to all cropland where at least one annually-planted crop is included in the crop rotation. This practice can reduce sheet, rill, and wind erosion as well as reduce water quality degradation due to excess nutrients. For the purposes of the practice, a cover crop is considered a different crop. Where applicable, suitable crop substitutions may be planted when the planned crop cannot be planted due to weather, soil conditions, or other local situations. Acceptable substitutes are crops having similar properties that will accomplish the purpose of the original crop.

For reducing sheet, rill, and wind erosion, the crops, a tillage system, and cropping sequences should be selected that will produce sufficient and timely quantities of biomass or crop residue which will reduce erosion to the planned soil loss objective, as calculated using current approved erosion prediction technology. Selection of high-residue producing crops and varieties, use of cover crops, and adjustment of plant density and row spacing can enhance production of the kind, amount, and distribution of residue needed, especially when used in combination with Illinois NRCS CPSs for Residue and Tillage Management (Codes 329 and 345 NRCS 2016c and 2016d, respectively, discussed above under "Conservation Tillage"). Crop damage by wind erosion can be reduced by selecting crops tolerant to abrasion from windblown soil or high wind velocity. Alternatively, if crops sensitive to wind erosion damage are grown, the potential for plant damage can be reduced by crop residue management, field windbreaks, herbaceous wind barriers, intercropping, or other methods of wind erosion control.

To recover excess nutrients from the soil profile in order to reduce water quality degradation, crops with the following qualities should be used: quick germination and root system formation, a rooting depth sufficient to reach the nutrients not removed by the previous crop, and nutrient requirements that readily utilize the excess nutrients. In addition, including perennial or annual legume crops in the rotation can help provide nitrogen for the non-legume crops, especially in fields where manure applications are restricted by high or excessive soil phosphorus or potassium levels.

When using conservation crop rotation, a separate plan shall be prepared for each field or treatment unit which will use this practice. Additional guidance and minimum plan elements are discussed in Illinois NRCS CPS 328 (NRCS 2014a).

Stripcropping: Stripcropping is the practice of growing planned rotations of erosion-resistant and erosion-susceptible crops or fallow in a systematic arrangement of approximately equal strips (two or more) across a field. This practice reduces sheet, rill, and wind erosion as well as the transport of sediment and other water- and wind-borne contaminants. Stripcropping can be applicable on steeper slopes but is less effective on slopes exceeding 12 percent. The practice has the greatest impact where cropped or fallow strips having less than 10 percent cover are alternated with close grown and/or grass/legume strips or crop strips with 75 percent or greater surface cover. Stripcropping is not well suited to rolling topography and does not apply to situations where the widths of alternating strips cannot be made generally equal.

Vegetation in a stripcropping arrangement consists of crops and/or forages grown in a planned rotation. No two adjacent strips should be in an erosion-susceptible condition at the same time during the year although two adjacent strips may be in erosion-resistant cover at the same time. Erosion-resistant strips should be crops or crop residues that provide the needed protective cover during those periods when erosion is expected to occur. Acceptable protective cover is tolerant of the anticipated depth of sediment deposition and includes a growing crop, including grasses, legumes, or grass-legume mixtures, standing stubble, residue with enough surface cover to provide protection, or surface roughness sufficient to provide protection. When the erosion-resistant strip is in permanent vegetation, the species established shall either be tolerant to herbicides used on the cropped strips or protected from damage by herbicides used on the cropped strips.

All tillage and planting operations will follow an established strip line. Strip boundaries shall run parallel to each other and follow as close to the contour as practical. Strips widths shall be determined using currently approved erosion prediction technologies but shall not exceed 50 percent of the slope length used for erosion prediction or 150 feet, whichever is less. Strips susceptible to erosion shall be alternated down the slope with strips of erosion-resistant cover.

When using stripcropping, a separate plan shall be prepared for each field which will use this practice. Additional guidance and minimum plan elements are discussed in Illinois NRCS CPS 585 (NRCS 2017b), including arrangement and vegetative condition of strips, minimum and maximum row grades, minimum ridge height, critical slope length, headlands and end rows, and establishment of stable outlets to control runoff. Sediment accumulations along strip edges should be smoothed or removed and re-distributed over the field as necessary to maintain practice effectiveness. When headlands are in permanent cover, they should be renovated as needed to keep ground cover above 65 percent. No-till renovation of headlands is recommended, but in any case should only include the immediate seedbed preparation and reseeding to a sod-forming crop with or without a nurse crop. Full headland width should be maintained to allow turning of farm implements at the end of a tilled strip to double back on the same strip.

Conservation Cover: Conservation cover is the practice of establishing and maintaining permanent vegetative cover in order to: reduce sheet, rill, and wind erosion and sedimentation; and reduce ground and surface water quality degradation by nutrients and surface water quality degradation by sediment. This practice applies on all lands needing permanent herbaceous vegetative cover and can be applied on only a portion of a field; however, it does not apply to plantings for forage production or to critical area plantings.

When using conservation cover, the amount of plant biomass and cover needed to reduce wind and water erosion to the planned soil loss objective should be calculated using the current approved wind and/or water erosion prediction technology. The selected plant species should be suitable for the planned purpose as well as adapted to the soil, ecological, and climatic conditions of the area. Planting dates, planting methods, and care in handling and planting of the seed or planting stock shall ensure that planted materials have an acceptable rate of survival. No-till seeding methods are preferred where erosion concerns are present. Periodic removal of some products such as high value trees, medicinal herbs, nuts, and fruits is permitted provided the conservation purpose is not compromised by the loss of vegetation or harvesting disturbance.

When using conservation cover, a separate plan shall be prepared for each field which will use this practice. Additional guidance and minimum plan elements are discussed in Illinois NRCS CPS 327 (NRCS 2011a), including seeding periods; seed quality; seedbed preparation and seeding; use of temporary and/or nurse crops (if necessary); native species; seed mixtures; soil testing; fertilizer, lime, and pesticide requirements; weed and companion crop control; and maintenance of the vegetative cover. Mowing after the establishment period (except for noxious weed control) shall be done prior to April 15 or after August 1 to protect nesting wildlife. Exceptions can be made to allow mowing, burning, and/or chemical treatments when necessary to maintain the health and diversity of the plant community.

Cover Crop: A cover crop consists of grasses, legumes, and forbs planted for seasonal vegetative cover. This practice can help reduce wind and water erosion as well as reduce water quality degradation by utilizing excessive soil nutrients. Cover crops may either be established between successive production crops, or companion-planted or relay-planted into production crops. Species and planting dates should be selected that will not compete with the production crop yield or harvest. Cover crops should not be harvested for seed, nor should the residue be burned.

As discussed in Illinois NRCS CPS 340 (NRCS 2011b), plant species, seeding rates, seeding dates, and seeding depths should be determined using the Illinois Cover Crop Selection Tool (http://mccc.msu.edu/selector-tool/). Cover crops should be selected based on having the physical characteristics necessary to provide adequate erosion protection, their ability to effectively utilize the nutrients of concern, and their ability to produce higher volumes of organic material and root mass in order to maintain or increase soil organic matter. Use of deep-rooted species will help maximize nutrient recovery. The cover crop should be established as soon as practical prior to or after harvest of the production crop and terminated as late as practical to maximize plant biomass production and nutrient uptake, while allowing time to prepare the field for the next production crop.

When using a cover crop, a separate plan shall be prepared for each field which will use this practice. Additional guidance and minimum plan elements are discussed in Illinois NRCS CPS 340 (NRCS 2011b). The cover crop should be evaluated periodically to determine if the cover crop is meeting the planned purpose. If not, changes to the crop species, management, or technology should be implemented.

Terracing: Terracing is a soil conservation practice that can prevent runoff of precipitation falling on high gradient lands from causing serious erosion. Terraces may consist of an earthen embankment, a channel, or a combination of ridges and channels constructed across the slope. They can be narrow based (grass on both sides), grass backed, or farmable (no grass), and have an outlet to convey runoff water to a point where it will not cause damage. Terraces reduce both the volume and velocity of water moving across the soil surface, which greatly reduces soil erosion. Terracing reduces peak discharge rates by temporarily storing runoff and allowing the associated sediment and other contaminants to settle out behind the terrace ridge rather than directly entering a receiving waterbody. Terrace systems have been shown to remove as much as 85 percent of sediment and 70 percent of total phosphorus from runoff (USEPA 2003). See Illinois NRCS CPS 600 (NRCS 2010c) for additional guidance, including information on spacing, alignment, capacity, cross-sections, channel grades, and outlets.

If this BMP is selected for use by a landowner, a separate plan shall be prepared for each area which will use this practice. Minimum elements for each plan are discussed in Illinois NRCS CPS 600 (NRCS 2010c). The terraces should be inspected periodically and repaired as needed, including maintaining terrace ridge heights, channel profiles, terrace cross-sections, and outlet elevations. Accumulated sediment should be removed regularly to maintain terrace capacity and grade. For terraces where vegetation is specified, seasonal mowing, control of trees and brush, reseeding, and fertilizing should be competed as needed.

Critical area planting: Critical area planting is the establishment of permanent vegetation on sites that have or are expected to have high erosion rates, and/or on sites that have physical, chemical, or biological conditions that prevent the establishment of vegetation using normal practices. This practice can be used to stabilize a variety of areas, including: areas with existing or expected high rates of soil erosion by wind or water; riparian areas; sand dunes; tributary stream and channel banks; and pond, lake, and other shorelines. In addition, critical area planting applies to highly disturbed areas such as active or abandoned mined lands; urban restoration sites; construction areas; conservation practice construction sites; areas needing stabilization before or after natural disasters such as floods, hurricanes, tornados and wildfires; and other areas degraded by human activities or natural events. Use of the area should be managed as long as necessary to stabilize the site and achieve the intended purpose.

To use this practice, a site investigation should be conducted to identify any physical, chemical, or biological conditions that could affect the successful establishment of vegetation. Plant species should then be selected based on any identified factors and should have the capacity to achieve adequate density and vigor within an appropriate period to stabilize the site sufficiently to permit suited uses with ordinary management activities. The amount of plant biomass and cover needed to reduce wind and water erosion to the planned soil loss objective shall be determined using the current approved wind and/or water erosion prediction technology. Seeding or planting shall be done at a time and in a manner that best ensures establishment and growth of the selected species. See Illinois NRCS CPS 342 (NRCS 2016a) for additional guidance on this and other considerations.

When using a critical area planting, a separate plan shall be prepared for each treatment unit which will use this practice. Additional guidance and minimum plan elements are discussed in

Illinois NRCS CPS 342 (NRCS 2016a), including species selection, seeding, restoring degraded areas such as gullies and deep rills, amending the soil if needed to ameliorate or eliminate physical or chemical conditions that inhibit plant establishment and growth, and shaping stream/channel banks and pond/lake shorelines so they are stable and allow for the establishment and maintenance of desired vegetation. Planted areas should be protected from damage by farm equipment, vehicular traffic, and livestock. Inspections should be performed on a regular basis, and reseeding or replanting, fertilization, pest control, and repair of damaged or scoured areas performed as needed to ensure that this practice continues to function as intended throughout its expected life.

Grassed Waterways: A grassed waterway is a shaped or graded channel, established with suitable vegetation, used to convey surface water at a non-erosive velocity by way of a broad and shallow cross-section to a stable outlet. The vegetative cover within the waterway reduces peak discharge and protects the channel surface from rill and gully erosion. Waterways are often constructed in naturally-occurring depressions where the water collects and flows to an outlet but can be constructed in any area where added water conveyance capacity and vegetative protection are needed to prevent erosion resulting from concentrated surface flow. In addition to reducing erosion, grassed waterways can positively affect water quality through uptake of other pollutants attached to soils such as nutrients. Criteria for constructing grassed waterways are discussed in Illinois NRCS CPS 412 (NRCS 2015), including capacity, stability, width, depth, side slopes, drainage and outlets, and establishment of vegetation.

When using a grassed waterway, a separate plan shall be prepared for each treatment unit which will use this practice and which describes how the practice requirements will be applied to that particular area. Additional guidance and minimum plan elements are discussed in Illinois NRCS CPS 342 (NRCS 2016a). The NRCS recommends these maintenance measures for grassed waterways:

- Plant a good quality NRCS-approved seed mixture. Fertilization of the vegetation should not be necessary unless the waterway is proven to lack proper nutrients. Avoid spraying herbicides in or adjacent to the waterway. Mowing or periodic grazing of the vegetation may be appropriate to maintain waterway capacity and reduce sediment deposition. Noxious weeds should be controlled.

- Inspect the area frequently for eroding areas, places needing reseeding, and damaged areas caused by machinery, herbicides, or livestock. Repair all areas as needed; e.g., minor rills or gullies may be repaired by reshaping and reseeding. Outlets should also be maintained to prevent gullies from forming. This may include reshaping and reseeding the outlet or repairing components of structural outlets.

- Maintain the width of the grass area when tilling and planting adjacent fields. If possible, bring row crop patterns up to (but not into) the waterway nearly on the contour. Do not plant end rows along the side of the waterway. Do not use the waterway as a turn area because this can result in damage to the vegetation.

- Avoid driving up and down, or crossing, grassed waterways, especially during wet conditions. This can damage the vegetation and the ruts caused by tire tracks can lead to gullies.
- When crossing grassed waterways, lift tillage equipment off of the waterway and turn off chemical application equipment.

Restrict Livestock Access to Streams and Tributaries: As discussed in Section 5 of this report, livestock are present within the Lake Lou Yaeger watershed. It is unknown to what extent livestock have access to streams in the watershed. Reduction of livestock access to streams, however, is recommended to limit damage to streambanks. Access of livestock and other animals to streams can increase bank erosion, trample filter strips and riparian buffers causing short circuiting of pollutant treatment. Exclusion or restricting pet, livestock, and wildlife access to streams with fencing helps reduce pollutant loads. Fencing and alternate watering systems are effective ways to restrict livestock from streams; however, fencing emplacement is not always feasible from either a cost or animal management viewpoint. If used, fencing should be placed outside of the filter strips/riparian areas.

Diversion: A diversion is a channel generally constructed across a slope with a supporting ridge on the lower side. This practice applies to all land uses where surface runoff water control and/or management are needed, where soils and topography are such that the diversion can be constructed, and where a suitable outlet is available or can be provided. Diversions can be used to support a variety of purposes, including the following:

- Break up concentrations of water on long slopes, on undulating land surfaces, and on land that is generally considered too flat or irregular for terracing.
- Protect terrace systems by diverting water from the top terrace where topography, land use, or land ownership prevents terracing the land above.
- Intercept surface and shallow subsurface flow.
- Reduce runoff damages from upland runoff.
- Reduce erosion and runoff on urban or developing areas and at construction or mining sites.
- Divert water away from active gullies or critically eroding areas.
- Supplement water management on conservation cropping or stripcropping systems.

A diversion in a cultivated field should be aligned and spaced from other structures or practices to permit use of modern farming equipment. The side slope lengths should be sized to fit equipment widths when cropped. For vegetated diversions, areas of unsuitable subsurface, subsoil, or substratum material that limits plant growth should be avoided. Limiters include salts, acidity, root restrictions, etc., which may be exposed during implementation of the practice. Where these areas cannot be avoided, a soil scientist can provide recommendations for ameliorating the condition or, if that is not feasible, stock piling the topsoil, over-cutting the diversion, and replacing the topsoil over the cut area may be used to facilitate vegetative establishment. Wetland functions and values can be maximized with the diversion design while minimizing adverse effects. For example, diversion of upland water to prevent entry into a wetland may convert a wetland by changing the hydrology.

When using a diversion, a separate plan shall be prepared for each unit. Additional guidance and minimum plan elements are discussed in Illinois NRCS CPS 362 (NRCS 2016b), including capacity, cross-section, stability, protection against sedimentation, outlets for diverted water, and establishment of vegetation, where appropriate. As with other practices, regular maintenance should be performed to ensure the diversion is operating as intended. Maintenance activities include the following.

- Perform periodic inspections, especially immediately following significant storms. Promptly repair or replace damaged components of the diversion as necessary.
- Maintain diversion capacity, ridge height, and outlet elevations especially if high sediment yielding areas are in the drainage area above the diversion. Establish necessary clean-out requirements. Redistribute sediment as necessary to maintain the capacity of the diversion.
- Keep each inlet for underground outlets clean and redistribute sediment buildup so that the inlet is at the lowest point. Inlets damaged by farm machinery must be replaced or repaired immediately.
- Maintain vegetation and trees and control brush by hand, chemical, and/or mechanical means. Maintenance of vegetation will be scheduled outside of the primary nesting season for grassland birds.
- Control pests that will interfere with the timely establishment of vegetation.

Water and Sediment Control Basins (WASCOBs): WASCOBs are earth embankments or combination ridge and channel systems constructed across the slopes of minor watercourses to reduce watercourse and gully erosion. These basins act as water detention basins and trap sediments (and the pollutants bound to the sediment) prior to them reaching a receiving water. The WASCOB reduces gully erosion by controlling flow within the drainage area, and the basins may be installed singly or in series as part of a system. The practice applies to sites where the topography is generally irregular, runoff and sediment damage land and improvements, and watercourse or gully erosion is a problem. Adequate and stable outlets from the basin are required to convey runoff water to a point where it will not cause damage. Additionally, sheet and rill erosion should be controlled by other conservation practices; i.e. the WASCOB would be part of another conservation system that adequately addresses resource concerns both above and below the basin. However, if land ownership or physical conditions preclude treatment of the upper portion of a slope, a WASCOB may be used to separate the upper area from and permit treatment of the lower slope.

WASCOBS should, at a minimum, be designed to be large enough to control runoff from at least a 10-year, 24-hour storm using a combination of flood storage and discharge through the outlet. Additionally, the WASCOB must be designed to have the capacity to store at least the anticipated 10-year sediment accumulation. Otherwise, periodic sediment removal is required as part of the maintenance activities in order to maintain the required capacity. Locations are determined based on slopes, erosion areas, crop management, and soil survey data.

When using a WASCOB, a separate plan shall be prepared for each treatment unit which will use this practice. Local NRCS personnel can often provide information and advice for design and installation. Illinois NRCS CPS 638 (NRCS 2017c) also provides additional information on the design and maintenance requirements for WASCOBs, as well as information on cropping activity recommendations and requirements around the basin. Maintenance includes reseeding or planting the basins in order to maintain vegetation, where specified, and periodically checking them, especially after large storms, to determine the need for embankment repairs or mechanical removal of excess sediment. Inlets and outlets should be cleaned regularly. Damaged components should be replaced promptly.

Sediment Control Basins: A sediment control basin is a basin formed by an embankment or excavation, or combination of these, and constructed with an engineered outlet. These basins are used to capture and detain sediment-laden runoff, or other debris, for a sufficient length of time to allow it to settle out in the basin. They differ from WASCOBs in that the sediment control basins are the last line of defense for capturing sediment when erosion has already occurred, and these basins act more like ponds; sediment control basins also differ in where they can be used.

The sediment control basin practice applies to urban land, construction sites, agricultural land, and other disturbed lands where a sediment basin offers the most practical solution. This includes areas where physical conditions or land ownership preclude treatment of a sediment source by the installation of erosion-control measures, and where failure of the basin will not result in loss of life, damage to homes, commercial or industrial buildings, main highways or railroads; or in the use of public utilities. A sediment basin should be located so that it intercepts as much of the runoff as possible from the disturbed area while minimizing the number of entry points for runoff into the basin. These basins should also be located to minimize interference with construction or farming activities but should not be located in perennial streams.

The sediment basin must have sediment storage capacity, detention storage, and temporary flood storage capacities. Flood storage capacity is based on the design storms for the principal and auxiliary spillways. Sediment storage should be for a minimum of 900 ft^3/acre of disturbed area, and the detention storage for a minimum of 3,600 ft^3/acre of drainage area. For maximum sediment retention, the basin should be designed so that the detention storage remains full of water between storm events. However, if site conditions, safety concerns, or local laws preclude a permanent pool of water, all or a portion of the detention and sediment storages may be designed to be dewatered between storm events.

A large sediment basin may have an effect on the peak discharge rate from a watershed and this should be taken into account during placement of the basin. In these cases, steps should be taken to mitigate any potential negative effects on riparian habitat downstream of the structure. In many cases, the use of a sediment basin alone may not provide sufficient protection against offsite sedimentation. To work most effectively, the sediment basin should be the last practice in a series of erosion control and sediment capturing practices installed in the disturbed area. This incremental approach will reduce the load on the basin and improve the effectiveness of the overall effort to prevent offsite sedimentation problems. Additionally, because the sediment basin must be designed to handle all of the contributing drainage whether it is from disturbed areas or not, diverting runoff from undisturbed areas away from the basin will improve the function of the basin.

When using a sediment control basin, a separate plan shall be prepared for each treatment unit which will use this practice. Local NRCS personnel can often provide information and advice for design and installation. Illinois NRCS CPS 350 (NRCS 2016e) also provides additional information on the design and maintenance requirements for sediment control basins. Maintenance includes periodic inspections and maintenance of the embankment, principal and auxiliary spillways, and dewatering device especially following significant runoff events. Damaged components should be replaced promptly and accumulated sediment should be removed when it reaches the pre-determined storage elevation for the basin. Where applicable, planting, reseeding, and mowing of the basin should be performed in order to maintain vegetation and to control trees, brush, and invasive species.

Note that the City of Litchfield had proposed to install two sediment ponds to capture a portion of the sediment and nutrients that flow into the lake from two tributaries. The proposed locations were at Bishop's Cove and Pete's Cove (see detailed maps in Appendix F). The proposed ponds would increase the detention time of the tributary inflows, helping to settle additional sediment out of the water column prior to Lake Lou Yaeger. The two sediment basin BMPs were not implemented because of the high cost to mitigate impacts to wetlands and streams that were learned after the grant was awarded.

Following the Stage 3 public meeting, a stakeholder noted that an existing sediment basin (Five Mile Lake) exists at the confluence of Threemile Branch and Shop Creek (northwest branch of Lake Lou Yaeger). The existing basin can be evaluated for effectiveness as part of ongoing monitoring and enhanced as needed.

Streambank Protection: Treatments used to stabilize and protect banks of streams or constructed channels are discussed in Illinois NRCS CPS 580 (NRCS 2010b). This practice can be used to help maintain the flow capacity of streams or channels, and to reduce the offsite or downstream effects of sediment resulting from bank erosion.

Prior to implementation of the practice, an assessment of the unstable streambank sites should be conducted in sufficient detail to identify the causes contributing to the instability (e.g. livestock access, watershed alterations resulting in significant modifications of discharge or sediment production, and in channel modifications such as water level fluctuations and boat-generated waves). Protective treatments need to be compatible with the bank materials, water chemistry, channel hydraulics, and slope characteristics above and below the water line.

Treatment area designs should provide for protection of installed treatments from overbank flows resulting from upslope runoff and flood return flows, and from bank seepage. The designs should also account for any anticipated ice action, wave action, and fluctuating water levels. End sections of treatment areas shall be adequately anchored to existing treatments, terminate in stable areas, or be otherwise stabilized to prevent flanking of the treatment. Livestock traffic along treated streambanks shall be limited to stable access points. All disturbed areas around protective treatments shall be protected from erosion through cultivation or selected vegetation suitable for the site conditions and intended purposes.

Streambanks should be assessed to determine if the causes of instability are local (e.g. poor soils, high water table in banks, alignment, obstructions deflecting flows into the bank, etc.) or systemic (e.g. aggradation due to increased sediment from the watershed, increased runoff due to urban development in the watershed, degradation due to channel modifications, etc.). Bank protection treatment should not be installed in channel systems undergoing rapid and extensive changes in bottom grade and/or alignment unless the treatment is designed to control or accommodate the changes. Bank treatment shall be constructed to a depth at or below the anticipated lowest depth of streambed scour. When appropriate, a buffer strip and/or diversion may be established at the top of the bank protection zone to help maintain and protect installed treatments; improve their function; and filter out sediments, nutrients, and pollutants from runoff.

Some available approaches to potentially decrease nonpoint TSS and/or pollutant source loads, as well as help stabilize eroding banks include the following:

- Stone Toe Protection: Non-erodible materials are used to protect the eroding banks of tributary streams that discharge into the lake. Meandering bends found in the watershed could potentially be stabilized by placing the hard armor only on the toe of the bank. Stone toe protection is most commonly implemented using stone quarry stone that is sized to resist movement and is placed on the lower one third of the bank in a windrow fashion.

- Rock Riffle Grade Control: Naturally stable stream systems typically have an alternating riffle-pool sequence that helps to dissipate stream energy. Riffle rock grade control places loose rock grade control structures at locations where natural riffles would occur to create and enhance the riffle-pool flow sequence of stable streams. By installing riffle rock in an incised channel, the riffles will raise the water surface elevation resulting in lower effective bank heights, which increases the bank stability by reducing the tractive force on the banks.

- Floodplain Excavation: Rather than raising the water level, Floodplain Excavation lowers the floodplain to create a more stable stream. Floodplain Excavation uses mechanical means to restore the floodplain by excavating and utilizing the soil that would eventually be eroded away and deposited in the stream.

- Rock chutes: Rock chutes are riprap lined water conveyance structures used to move water down a slope in a non-erosive manner. The main purpose of a rock chute is to reduce channel flow velocity by dissipating energy and to provide a stable grade at the outlet to prevent erosion.

The extent of streambank erosion within upstream tributaries of Lake Lou Yaeger (RON) is unknown but stakeholders have noted that the streams adjacent to Lake Yaeger have relatively steep gradients because of the substantial elevation difference between the West Fork of Shoal Creek and the surrounding land. There are substantial lengths of stream near the lake which are aggressively eroding and would benefit from stream bank protection.

Shoreline Protection: Treatments used to stabilize and protect shorelines of lakes, reservoirs, or estuaries, are also discussed in Illinois NRCS CPS 580 (NRCS 2010b). Refer to the discussion provided above in Streambank Protection for additional details that are also applicable to Shoreline Protection. Stakeholders note that a major part of Lake Lou Yaeger shoreline erosion is due to the steep slope of the original ground at the shoreline and that contributing factors include saturation of the soil; wind-induced and boat induced waves; and erosive soil types.

Riprap is human-placed rock or other material used to armor shoreline and/or shoreline structures against scour and water, wave, or ice erosion. The City has previously installed riprap through two methods to successfully reduce erosion to portions of the Lake Lou Yaeger Shoreline:

- The City has used conventional placement of riprap blanket on the existing shoreline from a few feet above water level to a few feet below water level.
- The City of Litchfield has installed a line of peaked stone riprap at a water depth of 1.5 feet (the edge of the riprap is about 5 to 10 feet from the edge of water). This method was used in the 1990s and local officials noted that is has proven very effective. The method breaks the waves which would collide with the eroded bank. The riprap also accumulates soil which erodes from the bank which in turn allows vegetation to establish in the quiescent zones between the riprap and the eroded shoreline. Another benefit of this method is that boats and barges construct the riprap from the water and the steep eroded shorelines are not disturbed by construction equipment. Note that it can take years for the area between the riprap and edge of water to accumulate soil and to become fully vegetated.

The City of Litchfield originally proposed to install riprap along 1,800 linear feet of shoreline to address a portion of the shore identified with the most severe erosion. This proposal has been expanded to 2,270 linear feet of shoreline at Bishop's Cove and Pete's Cove. Maps showing the original identified section of shoreline can be found in Appendix F along with photographs of the previously installed riprap described above and a more detailed description of the expanded shoreline improvements planned for Bishop's and Pete's Cove.

Grade Stabilization Structure: A grade stabilization structure used to control the grade in either natural or constructed channels to reduce erosion and improve water quality. This practice does not apply to structures designed to control the rate of flow or to regulate the water level in channels, or to structures designed to stabilize the bed or bottom of a perennial (non-intermittent) stream channel. Grade stabilization structures may be open flow or closed flow. Open flow structures, such as toe walls or chutes, are used where there is downstream stability. Closed structures are required where the downstream is unstable but can also be used where it is stable. In this case, topography, cost, or landowner preference can sometimes dictate what type of structure is used.

Regardless of the type of structure used, sufficient discharge should be provided to minimize crop damaging water detention. Fences may be needed to protect structures, earth embankments, and vegetated spillways from livestock, or, near urban areas, to control access and exclude traffic. When designing, and implementing each structure, consideration should be given to the effect of the structure on fluvial geomorphic conditions (especially in natural channels), aquatic habitat, and landscape resources and forms; i.e. select sites to reduce adverse impacts or create desirable focal points.

The following general considerations apply to either open or closed flow structures. The crest of the inlet should be set at an elevation that will stabilize the channel and prevent upstream head cutting. Runoff should be able to safely pass through a principal spillway or a combination of principal and auxiliary spillways. Soil material proposed for use as fill and for foundation must be verified as suitable for the purpose, using soil borings, review of existing data, or other suitable means. A foundation cutoff may be needed if the structure will impound permanent water and the total embankment height is greater than 4 feet. See Illinois NRCS CPS 410 (NRCS 2014b) for more information. Seepage control is needed for all embankments over 25 feet high. For embankments less than 25 feet high, seepage control is to be included if pervious layers are not intercepted by the cutoff, seepage could create swamping downstream, or such control is needed to ensure a stable embankment. Seepage may be controlled by foundation, abutment, or embankment drains and/or reservoir blanketing.

The grade stabilization structure must include an embankment or berm to direct flow to the entrance of the principal spillway. See Illinois NRCS CPS 410 (NCRS 2014b) for more information on sizing of the embankment depending on concurrent use; e.g. public road. The upstream and downstream side slopes of the settled embankment must each be no steeper than two horizontal to one vertical unit of measure. For all embankments with effective height greater than 4 feet, the sum of the upstream and downstream side slope of the settled embankment must be at least 5 horizontal to one vertical. All slopes must be designed to be stable, even if flatter side slopes are required. Downstream or upstream berms can be used to help achieve stable embankment sections. An auxiliary spillway must be provided for each grade stabilization structure unless the principal spillway is large enough to pass the peak discharge from the design event while still meeting the freeboard requirements. See Illinois NRCS CPS 410 (NRCS 2014b) for more information on settlement allowance requirements, freeboard requirements, and auxiliary spillways. The exposed surfaces of earthen embankments, earth spillways, non-cropped borrow areas, and other disturbed areas should be seeded or sodded following construction, or covered by an inorganic cover such as gravel.

When using a grade stabilization structure, a separate plan shall be prepared for each structure. Additional information on the types of structures and their design requirements may be found in Illinois NRCS CPS 410 (NRCS 2014b). As with other practices, regular maintenance should be performed to ensure the structure is operating as intended. Maintenance activities include the following: periodic inspection of the structure and prompt repair of any identified concerns; prompt removal of sediment once the accumulation reaches the pre-determined storage elevation; periodic removal of trees, brush, and invasive species; and maintenance of vegetative cover and immediate seeding of bare areas as needed.

Stream Crossing: A stream crossing is a stabilized area or structure constructed across a stream to provide a travel way for people, livestock, equipment, or vehicles. Tributaries upstream of the lake should be assessed to determine if stream crossings are needed to reduce sediment loads in Lake Lou Yaeger. Use of established stream crossings in lake tributaries can reduce streambank and streambed erosion, as well as improve water quality by reducing sediment, nutrient, organic, and inorganic loading downstream. This practice applies to all land uses where an intermittent or perennial watercourse exists and a ford, bridge, or culvert type crossing is needed.

Stream crossings should be located in areas where the streambed is stable or can be stabilized, and preferably where the crossing can be installed perpendicular to the direction of stream flow. Each proposed crossing site should be evaluated for variations in stage and discharge, hydraulics, aquatic organism life stages, fluvial geomorphic impacts, sediment transport and flow continuity, groundwater conditions, and movement of woody and organic material. The crossing should then be designed to account for the know range of factors. Crossings should not be placed where the channel grade or alignment changes abruptly, excessive seepage or instability is evident, overfalls exist (evidence of incision and bed instability), where large tributaries enter the stream, within 300 feet of know spawning areas for listed species, or in wetland areas. The width of the crossing will depend upon its intended purpose. Side slope cuts and fills will depend on the channel materials involved; e.g., soil vs. rock. Surface runoff should be diverted around the approaches to prevent erosion. All areas around the crossing to be vegetated should be planted as soon as practical after construction to minimize erosion.

When using a stream crossing, a plan shall be prepared for each crossing as discussed in Illinois NRCS CPS 578 (NRCS 2018). The CPS also provides additional guidance for each type of crossing. Maintenance activities should continue throughout the life of the practice, and at a minimum, include regular inspections and repairs of the crossing's components. Accumulated organic material, woody material, and excess sediment should be removed periodically.

Urban Soil/Erosion BMPs: Section 2.3 of this report indicates that less than one percent of the watershed is developed or urban. Because the developed/urban percentage of the watershed is small compared to the agricultural and natural percentages, this implementation plan will not focus on urban BMPs. The developed/urban areas, as shown in Figure 2-2, appear to mainly occur in the Village of Raymond and the City of Litchfield. A small portion of the City of Litchfield lies within the Lake Lou Yaeger watershed, while the majority of the city limits are located outside of the watershed.

In the developed/urban areas, runoff from urban areas, decreased infiltration associated with the prevalence of impervious surfaces, and increased overland flow can contribute to high sediment loads in the impaired stream segment. Most modern developments route runoff from impervious surfaces directly into storm sewers or paved channels which effectively convey the pollutants, including sediments and suspended solids, into receiving water bodies with little to no opportunity for infiltration or filtering. The storm sewers and lined channels then convey the runoff water downstream at a much faster rate than would normally occur in a natural, non-urbanized, setting. The increased flow rate leads to several issues including stream channel erosion and/or downcutting of the channel, both of which contribute to suspended solid loads. Alterations to natural storage and conveyance functions (e.g. stream channel modification) can also result in increased flow velocities and volumes subsequently causing stream channel erosion and increased flooding.

In addition to flow and conveyance concerns, building and road construction activity in and adjacent to water bodies and wetlands create both short-term and long-term effects on water quality. Although erosion on construction sites often affects only a relatively small acreage of land in a watershed, it is a major source of sediment because the potential for erosion on highly disturbed land is commonly 100 times greater than on agricultural land (Brady and Weil 1999).

The primary short-term effect is erosion in the denuded areas, those lacking vegetation, with potential deposition of sediment in nearby waterbodies. The long-term effects of urban development upon waterbodies and wetlands primarily results in the elimination of vegetation and other natural materials. The typical consequences of these alterations include reduced shading and a resultant increase in water temperature, reduced capacity for pollutant filtering, and increased stream instability and erosion.

The Association of Illinois Soil and Water Conservation Districts maintains and updates the Illinois Urban Manual (https://illinoisurbanmanual.org/) which is "intended for use as a technical reference by developers, planners, engineers, government officials and others involved in land use planning, building site development, and natural resource conservation in rural and urban communities and developing areas." Below is information on urban stormwater BMPs that Jefferson County SWCD staff noted as being used within the watershed:

Detention basins, rock check dams and/or manufactured tri-dikes, and silt fences are BMPs employed to reduce surface runoff, particularly addressing the reduction of sediments and other suspended solids.

- Detention Basins: A dry detention basin is a vegetated basin designed to hold stormwater runoff, thus reducing peak stormwater flows and reducing flooding. Drainage areas for these basins are typically between 5 and 50 acres and plans and specifications require the signature of a licensed professional engineer. Design components include a basin inflow and outflow control structures, an emergency spillway, and basin planting. Refer to practice standard 809 in the Urban Manual for additional information.

- Rock Check Dam: A rock check dam is a small dam built across a grass swale or road ditch to slow stormwater flows, reduce erosion, trap sediment, and increase infiltration. The practice is limited to small grassed swales or open channels that drain 10 acres or less. Refer to practice standard 905 in the Urban Manual for additional information on criteria, plans/specifications, operations and maintenance.

- Manufactured tri-dikes: Also known as manufactured ditch checks (reference practice 814 in the Urban Manual), this practice involves the installation of a pre-fabricated temporary dam or flow through device (10-15 inches in height) across a swale or road ditch to slow water flow. Similar to a rock check dam, the purpose of manufactured ditch checks is to trap sediment, promote settling of suspended solids, reduce erosion, and promote infiltration. The practice is used where grading activity occurs in areas of concentrated flows with slopes less than 8% and flow velocities are less than 8 cfs.

- Silt fence: A silt fence is a temporary barrier of filter fabric stretched between posts to cause sediment deposition from sheet flows from disturbed sites. Maximum drainage areas for overland flow to a silt fence shall not exceed ½ acre per 100 feet of fence. Refer to practice standard 920 of the Urban Manual for additional information.

9.4 BMP Recommendations for Reducing Total Phosphorus in the Lake Lou Yaeger Watershed

Phosphorus is a nutrient critical to healthy ecosystems at low concentrations; however, over enrichment of phosphorus can result in aquatic ecosystem degradation when nitrogen is also available in sufficient quantities. Nutrient enrichment can result in rapid algal growth as available nutrients and carbon dioxide are consumed. This response can alter pH, decrease DO (which is critical to other aquatic biota), alter the diurnal DO pattern, and even create anoxic conditions. In addition, nutrient enrichment can reduce water clarity and light penetration and is aesthetically displeasing.

Inputs of phosphorus originate from both point and nonpoint sources. Internal cycling of phosphorus from lake sediments is also a significant contributor to the lake impairment. Most of the phosphorus discharged by point sources is soluble. Phosphorus from point sources also typically has a continuous impact and is human in origin; for example, effluents from municipal sewage treatment plants. The contribution from failed onsite waste water treatment (septic) systems can also be significant (nonpoint sources), especially if they are concentrated in a small area. Phosphorus from nonpoint sources is generally insoluble or particulate. Most of this phosphorus is bound tightly to soil particles and enters streams from erosion although some may come from sources such as tile drainage in the dissolved form. The impact from phosphorus discharged by nonpoint sources is typically intermittent and is most often associated with stormwater runoff. Sedimentation can impact the physical attributes of the stream and act as a transport mechanism for phosphorus.

Phosphorus loads in the Lake Lou Yaeger watershed originate from internal and external sources. As presented in previous sections, possible external sources of total phosphorus include agricultural activity, runoff from natural areas (forest, grassland, and parkland), municipal point sources, failing septic systems, or other recreational pollution sources. To achieve a reduction of total phosphorus for the lake, management measures must address loading through sediment and surface runoff controls. Reduction of phosphorus loads from internal cycling can also contribute to future compliance with the established water quality criteria.

9.4.1 Point Sources of Phosphorus

Table 9-4 lists two wastewater treatment facilities found within the Lake Lou Yaeger watershed. Both facilities discharge into upstream tributaries of Lake Lou Yaeger. WLAs were calculated using each facility's DAF and estimated discharge concentrations based on existing treatment systems. The overall contribution of phosphorus to the lakes from point sources is relatively low at approximately 3% of the total current phosphorus load. These facilities may be advised to monitor for total phosphorus and submit the data along with their NPDES permit renewal application in the future. Illinois EPA will evaluate the monitoring data and decide whether the WLA is being met or if additional treatment may be necessary.

Table 9-4 WLAs for Total Phosphorus Loads in the Lake Lou Yaeger Watershed

NPDES Permit Number	Permit Name	Subbasin	Estimated Total Phosphorus Concentration (mg/L)	Flow (MGD)	WLA (lbs/Day)
IL0025381	Raymond STP	Lake Lou Yaeger	5.0	0.1	4.17
IL0063525	Magnus Grand Hotel and Conference Center	Lake Lou Yaeger	5.0	0.026	1.08

9.4.2 Nonpoint Sources of Phosphorus

There are many potential nonpoint sources of phosphorus to Lake Lou Yaeger. The following section presents information on watershed cropping practices, animal operations, and area septic systems. Data were collected where available through communications with the local NRCS, Illinois Soil and Water Conservation Districts (SWCDs), and public health departments.

BMPs that could be used for treatment of these nonpoint sources include:

- Nutrient management;
- Conservation Tillage Practices;
- Filter Strips and Riparian Buffers;
- Any farming/soil retention methods such as those discussed in Section 9.3, including field borders, conservation tillage, contour farming, conservation crop rotation, stripcropping, conservation cover, cover cropping, terracing, critical area planting, WASCOBs, and sediment basins;
- Wetlands;
- Phosphorus-based lawn fertilizer restrictions; and
- In-lake management measures.

Soil retention practices could help reduce nutrient and sediment loads into the impaired stream segment by reducing erosion of soils. As indicated in **Table 2-1**, approximately 51,421 acres in the Lake Lou Yaeger watershed are under cultivation, which accounts for 74 percent of the watershed area. Farming practices in the watershed should be assessed to determine methods being used, where they can be improved upon, and what additional practices might be appropriate to help reduce sediment loads.

Nutrient Management: Nutrient management programs could result in reduced nutrient loads to the impaired stream segments in the Lake Lou Yaeger watershed. Crop management of nitrogen and phosphorus originating in the agricultural portions of the watershed can be accomplished through Nutrient Management Plans (NMPs) that focus on increasing the efficiency with which applied nutrients are used by crops, thereby reducing the amount available to be transported to both surface water and groundwater.

The overall goal of nutrient reduction from agriculture should be to increase the efficiency of nutrient use by balancing nutrient inputs in feed and fertilizer with outputs in crops and animal produce as well as to manage the concentration of nutrients in the soil. The four "Rs" of nutrient management are applying the right fertilizer source at the right rate at the right time and in the right place. It is not unusual for crops in fields or portions of fields to show nutrient deficiencies during periods of the growing season, even where an adequate NMP is followed. The fact that nutrients are applied does not necessarily mean they are available. Plants obtain most of their nutrients and water from the soil through their root system. Any factor that restricts root growth and activity has the potential to restrict nutrient availability and result in increased nutrient runoff.

Reducing nutrient loss in agricultural runoff may be brought about by source and transport control measures, such as filter strips or grassed waterways. The NMPs account for all inputs and outputs of nutrients to determine reductions. NMPs typically include the following measures:

- A review of aerial photography and soil maps.
- Recommendation for regular soil testing – Traditionally, soil testing has been used to decide how much lime and fertilizer to apply to a field. With increased emphasis on precision agriculture, economics, and the environment, soil tests have become a logical tool to determine areas where adequate or excessive fertilization has taken place. Additionally, they can be used to monitor nutrient buildup in soils due to past fertility practices and aid in determining maintenance fertilization requirements. Appropriate soil sampling and analysis techniques are described in the Illinois Agronomy Handbook (http://extension.cropsciences.illinois.edu/handbook/).
- A review of current and/or planned crop rotation practices.
- Establishment of yield goals and associated nutrient application rates – Matching nutrient applications to crop needs will minimize the potential for excessive buildup of phosphorus soil tests and reallocate phosphorus sources to fields or areas where they can produce agronomic benefits.
- Development of nutrient budgets with planned application rates (which may be variable), application methods, and timing and form of nutrient application.
- Identification of sensitive areas and restrictions on application when land is snow covered, frozen or saturated.

Regional differences in phosphorus-supplying power are shown in Figure 8-4 of the Illinois Agronomy Handbook. The differences were broadly defined primarily based on variability in parent material, degree of weathering, native vegetation, and natural drainages. For example, soils developed under forest cover appear to have more available subsoil phosphorus than those developed under grass. Soil test values are used to determine when buildup and maintenance of soil phosphorus is needed to supplement soils with low phosphorus-supplying power. Specific application amounts should be determined by periodic soil testing. Subsoil levels of phosphorus in the southern Illinois region may be rather high by soil test in some soils, but this is partially offset by conditions that restrict rooting.

It should be noted, however, that excessively high-phosphorus soil test levels should not be maintained. While soil test procedures were designed to predict where phosphorus was needed, not to predict environmental problems, the likelihood of phosphorus loss increases with high-phosphorus test levels. Environmental decisions regarding phosphorus applications should include such factors as distance from a significant lake or stream, infiltration rate, slope, and residue cover. One possible problem with using soil test values to predict environmental problems is in sample depth. Normally samples are collected to a 7-inch depth for predicting nutritional needs. For environmental purposes, it would often be better to collect the samples from a 1- or 2-inch depth, which is the depth that will influence phosphorus runoff. Another potential problem is variability in soil test levels within fields in relation to the dominant runoff and sediment-producing zones. Several fertilizer placement recommendations are described in the Illinois Agronomy Handbook. However, given the propensity of phosphorus to bind tightly to soil particles and subsequently enter streams through erosion, the deep fertilizer placement technique may be most appropriate in phosphorus impaired areas. Under the deep placement technique, the fertilizer is placed 4 to 8 inches deep into the soil rather than being spread near the surface.

Conservation Tillage Practices: Conservation tillage was described in Section 9.3. As indicated above, agricultural land accounts for approximately 81 percent of land use within the Lake Lou Yaeger watershed. These areas can utilize conservation tillage practices in order to reduce runoff and subsequent nutrient impairments to nearby waterbodies.

The 2013 Illinois Department of Agriculture's Soil Transect Survey estimated that conventional till currently accounts for 79 percent of corn, 36 percent of soybeans, and 7 percent of small grain tillage practices in Montgomery County. To achieve TMDL load reductions, tillage practices already in place should be continued, and practices should be assessed and improved upon for all agricultural areas in the reservoirs' watersheds. Additional soil retention practices should also be assessed, such as field borders, contour farming, conservation crop rotation, stripcropping, conservation cover, cover cropping, terracing, and critical area planting.

Filter Strips: As discussed in Section 9.3, filter strips can be used as a control to reduce both pollutant loads from runoff, such as phosphorus, and sedimentation to impaired waterbodies. Filter strip areas for nutrient control are calculated as described in Section 9.3. Based on those calculations, and as noted in **Table 9-2**, there are approximately 1,219 acres of agricultural land within the buffer delineated for Lake Lou Yaeger and its tributaries (see **Figure 9-1**).

Riparian Buffers: Riparian vegetation in a buffer enhances infiltration of runoff and subsequent trapping of nonpoint source pollutants such as phosphorus. The vegetation also serves to reinforce streambank soils, which helps minimize erosion. These buffers are described in more detail in Section 9.7. Grassland, forest, and agricultural areas within the 25-foot buffer zone for the Lake Lou Yaeger watershed are shown in **Table 9-2**. There are 2,197 acres within 234 feet of the segment. Approximately 750 of these acres are existing grassland or forest while 60 acres are currently classified as agricultural. Landowners should assess parcels adjacent to the stream channels and maintain or improve existing riparian areas or potentially convert cultivated lands.

Wetlands: The use of wetlands as a structural control is applicable to nutrient reduction. To treat loads from agricultural runoff, such as phosphorus, wetlands could potentially be constructed at select locations where more focused runoff from fields occurs; e.g., downstream of a tile drainage system. Wetlands are effective BMPs for phosphorus and sediment control because they:

- Prevent floods by temporarily storing water, allowing the water to evaporate or percolate into the ground
- Improve water quality through natural pollution control such as plant nutrient uptake
- Filter sediment
- Slow overland flow of water thereby reducing soil erosion

A properly designed and functioning wetland can provide very efficient treatment of pollutants, such as phosphorus. Design of wetland systems is critical to the sustainable functionality of the system and should consider soils in the proposed location, hydraulic retention time, and space requirements. In general, soils classified as hydric are most suitable for wetland construction. The current extent of soils classified as hydric by the NRCS as well the current extent of existing USFWS classified wetlands in the Lake Lou Yaeger watershed are shown in **Figure 9-2**. Areas near waterways that are not currently classified as wetlands but have hydric soils present are typically strong candidates for potential wetland construction. Existing wetland areas may also be candidates for reconstruction or enhancement to improve their nutrient uptake capacity. These data layers are developed on a large-scale and onsite soil investigation and wetland delineation is typically necessary for verification of the suitability of a given area for wetland construction.

Constructed wetlands, which comprise the second or third stage of a nonpoint source treatment system, can be very effective at improving water quality. Studies have shown that artificial wetlands designed and constructed specifically to remove pollutants from surface water runoff have removal rates of greater than 90 percent for suspended solids, up to 90 percent for total phosphorus, 20 to 80 percent of orthophosphate, and 10 to 75 percent for nitrogen species (Johnson, Evans, and Bass 1996; Moore 1993; USEPA 2003; Kovosic et al. 2000). Although the removal rate for phosphorus is low in long-term studies, the rate can be improved if sheet flow is maintained to the wetland and vegetation and substrate are monitored to ensure the wetland is operation optimally. Sediment or vegetation removal may be necessary if the wetland removal efficiency is lessened over time (USEPA 2003). Guidelines for wetland design suggest a wetland to watershed ratio of 0.6 percent for nutrient and sediment removal from agricultural runoff.

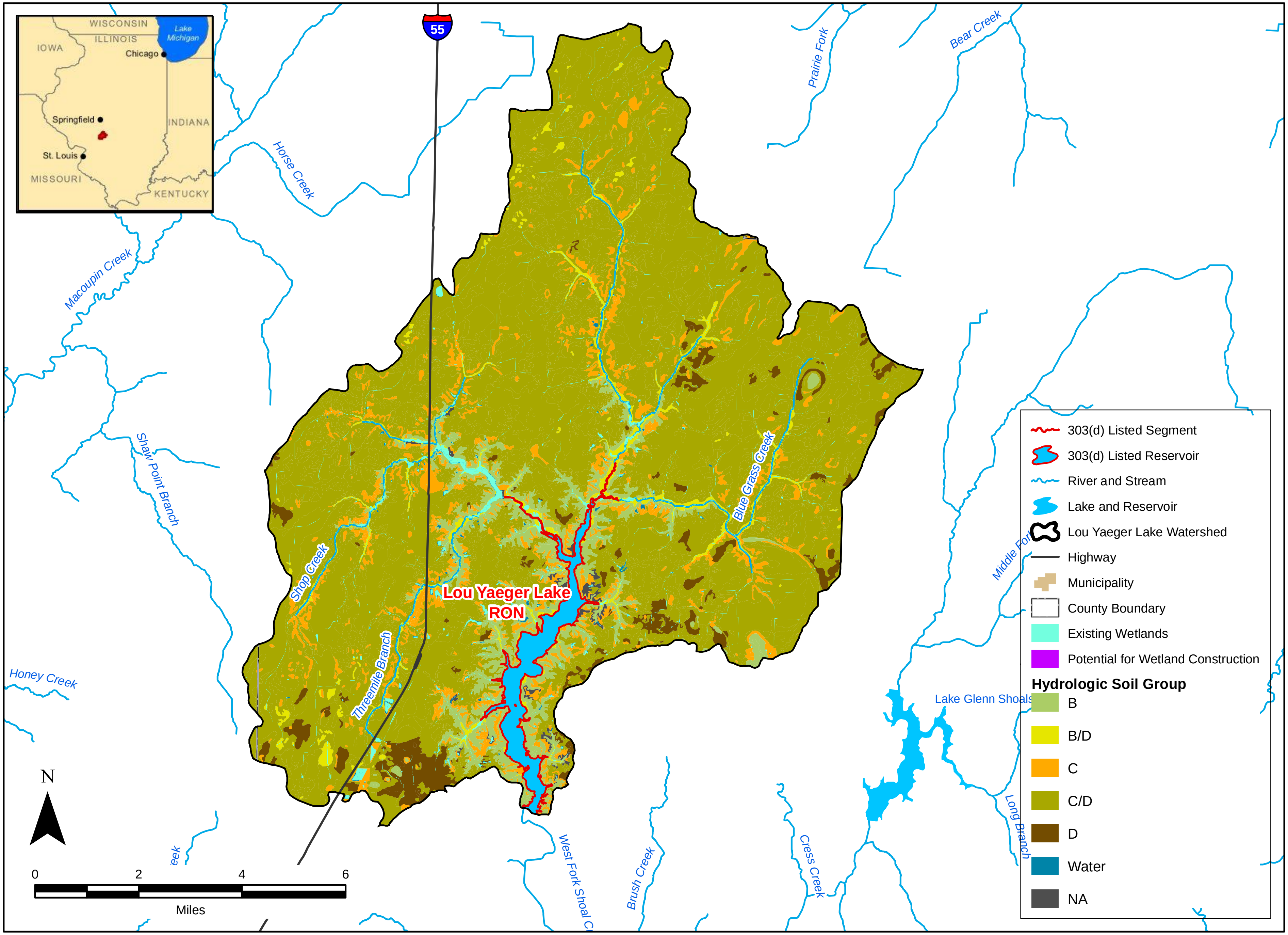
In-Lake Phosphorus Loading: Modeling described in Section 8 determined that internal loading of phosphorus is likely a significant contributor to overall watershed loads. A reduction of phosphorus from in-lake cycling through in-lake management strategies may be necessary for attainment of the TMDL load allocations. Internal phosphorus loading can occur when the water above the sediments becomes anoxic causing the release of phosphorus from the sediment in a form which is available for plant uptake. The addition of bioavailable phosphorus in the water column stimulates more plant growth and die-off, which may perpetuate or create anoxic conditions and enhance the subsequent release of phosphorus into the water. Internal phosphorus loading can also occur in shallow lakes through release from sediments by the physical mixing and reintroduction of sediments into the water column as a result of wave action, winds, boating activity, and other means.

For lakes experiencing high rates of phosphorus input from bottom sediments, several management measures are available to control internal loading. Three BMP options for the control of internal loading include the installation of an aerator, the addition of aluminum, and dredging.

- **Hypolimnetic (bottom water) aeration** involves an aerator air-release that can be positioned at a selected depth or at multiple depths to increase oxygen transfer efficiencies in the water column and reduce internal loading by establishing aerobic conditions at the sediment-water interface.

- **Phosphorus inactivation by aluminum addition** (specifically aluminum sulfate or alum) to lakes is the most widely-used technique to control internal phosphorus loading. Alum forms a polymer that binds phosphorus and organic matter. The aluminum hydroxide-phosphate complex (commonly called alum floc) is insoluble and settles to the bottom, carrying suspended and colloidal particles with it. Once on the sediment surface, alum floc inhibits phosphate diffusion from the sediment to the water (Cooke et al.1993).

- Phosphorus release from the sediment is greatest from recently deposited layers. **Dredging** approximately one meter of recently deposited phosphorus–rich sediment can remove approximately 80 to 90 percent of the internally loaded phosphorus without the addition of potentially toxic compounds to the reservoir. Dredging may also contribute to reductions in internal phosphorus loading by increasing the depth of large portions of the waterbody, reducing the degree of reintroduction of sediments into the water column through physical mixing. However, dredging is typically more costly than other management options.



Lou Yaeger Lake

Hydric Soils, Existing Wetlands, and Potential for Wetland Construction

FIGURE 9-2

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Phosphorus-Based Lawn Fertilizer Restrictions: Runoff from urban areas may include phosphorus-based fertilizers applied to residential lawns, golf courses, and other surfaces. If used too close to a receiving waterbody, phosphorus present in stormwater runoff will enter the waterbody. Illinois has a statute in place which governs the use of phosphorus-based fertilizers in urban areas: Lawn Care Products Application and Notice Act (415 ILCS 65). This act includes the following prohibitions for phosphorus-based fertilizers (see act for limited exceptions):

- They shall not be applied to lawns unless it can be demonstrated by soil test that the lawn is lacking in phosphorus when compared against the standard established by the University of Illinois; see the act for exceptions
- They shall not be applied to impervious surfaces
- They shall not be applied within 3 feet of any waterbody if a spray, drop, or rotary spreader is used. If other equipment is used, the fertilizer may not be applied within 15 feet of a water body.
- They shall not be applied when the ground is frozen or saturated
- Appropriate lawn markers for the application event and notifications to potentially affected adjacent properties are required

9.5 Cost Estimates of BMPs

Cost estimates for a number of suggested BMPs are available through the SWCD (**Table 9-5**). Cost information for additional BMPs not included in the table are discussed below.

Table 9-5 Fiscal Year 2017 SWCD BMP Cost Data

Practice	Component	Unit	Average Cost
329A	No-till	acre	$33.33
329C	Strip-till	acre	$33.33
340A	Cover Crops	acre	$66.67
340B	Temporary Cover	acre	$266.66
342	Critical Area Planting	acre	$350
345	Mulch-till	acre	N/A
362	Diversions	foot	$3.80
410	Block Lined Chute (Includes earthwork)	block	$7.00
410	Metal Toewall (including aluminum) - (weir length x overfall = sq.ft.) (Includes earthwork)	square foot	$140
410	Modular Block Structure (Includes earthwork)	block	$85
410	Rock Lined Chute (Includes earthwork)	ton	$40
412	Grassed Waterway Earthwork	acre	$2,900

Practice	Component	Unit	Average Cost
512	Pasture+Hayland Planting (Applys to land not in pasture or hayland within the past 5 years)	acre	$300
590A	Nutrient Management Plan	acre	$4
590B	Nutrient Management Plan Implementation	acre	$12
600	Terrace, < 3 feet (Earthwork for narrow base or grass ridge)	foot	$3.30
600	Terrace, > 3 feet (Earthwork for narrow base or grass ridge)	foot	$3.80
638	Water & Sediment Control Basin, < 3 feet (Earthwork for narrow base)	foot	$3.30
638	Water & Sediment Control Basin, > 3 feet (Earthwork for narrow base)	foot	$3.80

9.5.1 Filter Strips and Riparian Buffers

Several types of filter strip practices are available, including areas for native herbaceous vegetation with or without fertility measures required and areas of introduced species, also with or without fertility measures required. Filter strip implementation that includes seedbed preparation and native seed application ranges from $520/acre to $639/acre depending on the type used, with an average cost of approximately $594/acre.

Riparian buffers consisting of bare-root shrubs cost approximately $1.10 to $1.65 each while direct seeding of trees and/or shrubs costs approximately $741/acre. The direct seeding scenario includes a planting rate of approximately 3,000 to 4,800 seeds per acre as well as the foregone income for the land taken out of crop production. Land preparation, including removing undesirable vegetation and improving site conditions, is estimated at $38/acre. For cases where an herbaceous cover is preferable, such as native grass or certain species of forbs and/or shrubs, costs average $642/acre.

9.5.2 Livestock and Wildlife Exclusion

Costs for livestock and/or wildlife exclusion depend on the type of fencing used. For example, permanent high tensile electric fencing is approximately $0.79/foot for a single strand, $1.16/foot for 2 to 3 strands, $1.42/foot for 4 to 6 strands (with fence post centers no more than 30 feet apart), and $1.78/foot for 7 or more strands (with double H bracing and fence post centers no more than 30 feet apart). A permanent, multi-strand barbed wire fence averages $1.62/foot, and a permanent woven wire fence averages $1.96/foot.

The cost for providing an alternate water supply will vary depending on the supply system used. For example, in areas frequently used by livestock for limited access to drinking water from a pond or stream, an access ramp may be constructed to provide a stable, non-eroding surface and is approximately $1.44/square foot. This includes earthwork, geotextile, gravel, and other surfacing materials that might be part of the design, as well as a small diversion berm to protect the ramp from concentrated overland flow. If vegetation should be established near the access ramp, costs for a dozer for grading and shaping of small gullies, seedbed preparation with typical tillage implements, grass/legume seed, companion crop, and fertilizer and lime with application are $716.03/acre. Straw mulch or other approved natural material may be applied where needed to facilitate establishment of vegetative cover. The cost for mulching averages $238/acre.

Several tank types may be used in areas where lower capacity water supplies are needed and only a backup supply is required for peak demand periods. Above ground tanks vary from $2,220 for a 1,000- to 3,000-gallon tank and $3,717 for a tank greater than 3,000 gallons. A large, permanent water tank (500 to 1,000 gallons) or fountain averages $975, a small permanent tank (less than 500 gallons) is approximately $400, a frost-free waterer is approximately $1,011, and a portable tank is $153. Heavy use protection should be established around these tanks and costs range from $0.86 to $4.91/square foot for gravel beds up to a 12-foot width. An underground storage tank may also be used, $3,600 each, with a livestock pipeline for overflow. A plastic, buried pipeline, less than 2 inches diameter, averages $1.94/foot. If a bedded pipeline is needed due to special considerations, such as rocky soil, the cost is $3.38/foot. A non-electric livestock pump is approximately $961.

9.5.3 Wetlands

The price to establish a wetland is very site specific and depends on factors such as size and type of vegetation used. Examples of costs associated with constructed wetlands include excavation costs, vegetation removal, and revegetation costs. Costs for wetlands created on a flat-mineral uplands where surface runoff may be intercepted and ponded by excavation range from $3,186 (no embankment) to $3,680 (with embankment). Some areas may favor a wetlands setting, which just needs to be enhanced or restored. In an area of natural depression fed by surface runoff, enhancement/restoration is approximately $2,557/acre. Enhancing or restoring a wetland on a floodplain site that has existing levees and/or ditches may consist of regrading or shaping the land, potentially including levee removal, for $1,167/acre. Constructed wetlands to reduce the pollution potential of runoff and wastewater average $7,725/acre where natural regeneration of wetland plants will be a major contributor to the working vegetation and $10,286/acre where wetland vegetation in the pool area is planted at a denser grid (3-foot by 3-foot or closer). As needed, embankments, water control and grade stabilization structures, and filter strips should be added.

9.5.4 Septic System Maintenance

Septic tanks are designed to accumulate sludge in the bottom portion of the tank while allowing water to pass into the drain field. If the tank is not pumped out regularly, the sludge can accumulate and eventually become deep enough to allow for flow into the drain field. Pumping the tank every three to five years prolongs the life of the system by protecting the drain field from solid material that may cause clogs and system back-ups. In addition, septic systems should not be connected to field tile lines.

The cost to pump a typical septic tank ranges from $250 to $350 depending on how many gallons are pumped out and the disposal fee for the area. If a system is pumped once every three to five years, this expense averages out to less than $100 per year.

The cost of developing and maintaining a watershed-wide database of the onsite wastewater treatment systems in the Lake Lou Yaeger watershed depends on the number of systems that need to be inspected and the means by which the systems are inventoried. Education of home and business owners that use onsite wastewater treatment systems should occur periodically. Public meetings; mass mailings; and radio, newspaper, and TV announcements can all be used to remind and inform owners of their responsibility to maintain their systems. The costs associated with education and inspection programs will vary depending on the level of effort required to communicate the importance of proper maintenance and the number of systems in the area.

Information on the extent of sewered and non-sewered municipalities in the Lake Lou Yaeger watershed was obtained from the county health departments. Health department officials in Montgomery County stated that the towns are served by sewer systems, but most county residents within the watershed rely on private septic systems. It was said that most, if not all homes around Lake Lou Yaeger have septic systems. It was also noted during the Stage 1 public meeting that there are several campsites near the lakeshore that are potential sources of nutrients to the lake.

Section 2.5 indicates that approximately 4,078 people reside in the Lake Lou Yaeger watershed. The largest urban development served by municipal sewer systems in the watershed is the City of Litchfield, with a total population of approximately 6,934 people. A small portion of the City of Litchfield lies within the Lake Lou Yaeger watershed, while the majority of the city limits are located outside of the watershed. Assuming equal population distribution in Litchfield, approximately 690 Litchfield residents reside within the Lake Lou Yaeger watershed area. Additionally, the Village of Raymond, a small community served by municipal sewer systems located north of Lake Lou Yaeger, has an estimated population of 1,006 (Census, 2010). Based on these assumptions, up to 2,300 people reside in rural areas and may be served by private septic systems. If a typical household is assumed to consist of four people, there may be around 600 households which have septic systems in the watershed.

9.5.5 Cost Estimates for City Implementation of Planned BMPs

The City developed a Lake Lou Yaeger BMP Implementation Plan for two sediment ponds and shoreline stabilization (see Appendix F). The City provided cost estimates for the projects as shown in **Table 9-6**. Information gained during the Stage 3 virtual public meeting in 2020 indicated that the City did not move forward with the proposed Sediment Ponds but are moving forward with expanded bank stabilization implementation.

Table 9-6 Cost Estimates from Lake Lou Yaeger BMP Implementation Plan

BMP	Estimated BMP Efficiency	Estimated Sediment Load (ton/yr)		Estimated Load Reduction (ton/yr)	Cost/BMP	Cost ton/yr reduction
		Without BMP	With BMP			
Sediment Pond A	40%	581	349	232	$358,675	$1,543
Sediment Pond B	40%	465	279	186	$275,075	$1,479
Bank Stabilization	100%	342	0	342	$183,000	$535

9.6 Information and Education

As discussed in Section 3, public education and participation is a key factor for TMDL and watershed plan implementation. Increased public awareness can increase implementation of BMPs. Small incremental improvements and individual adoption of BMPs can be achieved at a much lower cost compared to the large-scale BMPs identified above. Outreach and education efforts should focus on activities that support the watershed plan goals, including:

- Continued regular meeting of local stakeholder group with intent of broadening audience/attendance
- Field visit days with demonstrations of agricultural conservation practices
- Continued outreach and messaging to landowners to encourage implementation of edge of field BMPs, nutrient management, conservation tillage, cover crops, and livestock/pasture management.
- Soil testing
- Reducing the use of lawn chemicals (pesticides and phosphorus fertilizers)
- Education/outreach for rural residence on proper septic system maintenance
- Periodic updates on watershed health/monitoring results

Illinois EPA staff have met with the local stakeholder group, including county SWCD staff, to discuss BMPs used throughout the watershed and continued future collaboration. Public meetings were held within the watershed in March 2017 and virtually in August 2020 to present Stages 1 and 3 of TMDL development. Feedback received from stakeholders and the county SWCD staff in attendance was incorporated throughout this plan to include local information and discuss BMPs that are thought to be most effective and implementable in this watershed. Additional recommended activities to support public outreach and education include:

- Websites and social media to publicize meetings, upcoming events and links to resources
- E-mail updates
- Brochures with information on household pollutant reduction, fertilizer use, and septic tanks
- Educational signs to educate viewers on water quality issues, purpose of BMPs, and environmental stewardship
- Public service announcements
- Informational meetings on State and Federal cost share programs

9.7 Project Funding

Cost-share and incentive programs at the state and federal level are available to landowners, homeowners, and farmers in the watershed to help offset costs of implementing many of the BMPs recommended in this report. Some of these programs are discussed below. When reviewing the programs, it should be noted that some of the programs are only meant to provide incentives to encourage operators or landowners to try the practice. These incentive programs are not intended to cover the entire cost associated with implementing a practice. Additionally, some practices have many variables to consider that will affect both the cost of the program and the incentive or cost-share amount to be received; e.g. NMPs.

9.7.1 Available State-Level Programs for Nonpoint Sources

State-level programs to encourage landowners to implement resource-conserving practices for water quality and erosion control purposes are discussed in the following paragraphs.

9.7.1.1 Illinois Department of Agriculture and Illinois EPA Nutrient Management Plan Project

The IDA and Illinois EPA co-sponsor a cropland Nutrient Management Plan project in watersheds that have developed or are developing TMDLs. This voluntary project supplies incentive payments to producers to have NMPs developed and implemented. Additionally, watersheds that have sediment or phosphorus identified as a cause for impairment (as is the case in this watershed), are eligible for cost-share assistance in implementing traditional erosion control practices through the Nutrient Management Plan project.

9.7.1.2 Partners for Conservation Program

The Partners for Conservation Program (PFC) provides cost sharing on a variety of practices such as no-till systems, WASCOBs, pasture/hayland establishment, critical area planting, cover crops, temporary cover (if added to another practice in order to extend the construction season), filter strips, rain gardens, terrace systems, diversions, well decommissioning, NMPs, and grade stabilization structures. The PFC is funded through the IDA and administered by the local SWCDs. Life/maintenance contracts can be 1 to 10 years depending on the practice and costs per acre vary significantly from project to project.

9.7.1.3 Streambank Stabilization and Restoration Program

The SSRP was established to address problems associated with streambank erosion, such as loss or damage to valuable farmland, wildlife habitat, and roads; stream capacity reduction through sediment deposition; and degraded water quality, fish, and wildlife habitat. The primary goals of the SSRP are to develop and demonstrate vegetative, stone structure, and other low cost bio-engineering techniques for stabilizing streambanks and to encourage the adoption of low-cost streambank stabilization practices by making available financial incentives, technical assistance, and educational information to landowners with critically eroding streambanks. A cost share of 75 percent is available for approved project components such as willow post installation, bendway weirs, rock riffles, stream barbs/rock, vanes, lunker structures, gabion baskets, and stone toe protection techniques. There is no limit on the total program payment for cost-share projects that a landowner can receive in a fiscal year. However, maximum cost per foot of bank treated is used to cap the payment assistance on a per foot basis and maintain the program's objectives of funding low-cost techniques (IDA 2000). All project proposals must be sponsored and submitted by the local SWCD.

9.7.2 Available Federal-Level Programs for Nonpoint Sources

There are several voluntary conservation programs established by various federal agencies that encourage landowners to implement resource-conserving practices for water quality and erosion control purposes. These programs apply to crop fields as well as rural grasslands that are presently used for livestock grazing. Federal-level programs are discussed in the following paragraphs. The USEPA manages the Clean Water Act Section 319 Grants. The Farm Service Agency (FSA) oversees the Conservation Reserve Program (CRP) and the Grasslands Reserve Program (GRP). Voluntary conservation programs established through the 2014 U.S. Farm Bill, and managed by the NRCS, include the Agricultural Conservation Easement Program (ACEP), the Conservation Stewardship Program (CSP), and the Environmental Quality Incentives Program (EQIP).

9.7.2.1 Clean Water Act Section 319 Grants

Section 319 was added to the CWA to establish a national program to address nonpoint sources of water pollution. Through this program, each state is allocated Section 319 funds on an annual basis according to a national allocation formula based on the total annual appropriation for the section 319 grant program. The total award consists of two categories of funding: incremental funds and base funds. A state is eligible to receive USEPA 319(b) grants upon the USEPA's approval of the state's Nonpoint Source Assessment Report and Nonpoint Source Management Program. States may reallocate funds through sub-awards (e.g., contracts, sub-grants) to both public and private entities, including local governments, tribal authorities, cities, counties, regional development centers, local school systems, colleges and universities, local nonprofit organizations, state agencies, federal agencies, watershed groups, for-profit groups, and individuals.

USEPA designates incremental funds, a $163-million award in 2016, for the restoration of impaired water through the development and implementation of watershed-based plans and TMDLs for impaired waters. Base funds, funds other than incremental funds, are used to provide staffing and support to manage and implement the state Nonpoint Source Management Program. Section 319 funding can be used to implement activities which improve water quality, such as filter strips, streambank stabilization, etc. (USEPA 2003).

Illinois EPA receives federal funds through Section 319(h) of the CWA to help implement Illinois' Nonpoint Source Pollution Management Program. The purpose of the program is to work cooperatively with local units of government and other organizations toward the mutual goal of protecting the quality of water in Illinois by controlling nonpoint source pollution. The program emphasizes funding for implementing cost-effective corrective and preventative BMPs on a watershed scale; funding is also available for BMPs on a non-watershed scale and the development of information/education nonpoint source pollution control programs.

The maximum Federal funding available is 60 percent of the total cost, with the remaining 40 percent coming from local match. The program period is two years unless otherwise approved. This is a reimbursement program.

Section 319(h) funds are awarded for the purpose of implementing approved nonpoint source management projects. The funding will be directed toward activities that result in the implementation of appropriate BMPs for the control of nonpoint source pollution or to enhance the public's awareness of nonpoint source pollution. Applications are accepted June 1 through August 1. Note that the City is seeking a 60% cost share for the Lake Lou Yaeger BMP Implementation Plan through 319 funding (Appendix F).

9.7.2.2 Conservation Reserve Program

The CRP is a voluntary program, administered through the FSA, which encourages landowners to agree to remove environmentally sensitive land from agricultural production and plant long-term resource-conserving cover to improve water quality, prevent soil erosion, and reduce loss of wildlife habitat. The program was initially established in the Food & Security Act of 1985 and is the largest private-lands conservation program in the United States.

Participants can enroll in CRP in two ways and the duration of the contracts under CRP range from 10 to 15 years. The first enrollment method is through a competitive process known as the CRP General Sign-up. These are announced on a periodic basis by the Secretary of Agriculture but do not occur on any fixed schedule. The second enrollment method is through CRP Continuous Sign-up, which is offered on a continuous basis. Continuous sign-up provides management flexibility to farmers and ranchers to implement certain high-priority conservation practices on eligible land. All enrollment offers are processed through the local FSA office.

Certain conditions must be met in order for land to be eligible for CRP enrollment. These conditions include the following:

1. The farmer applying for enrollment must have owned or operated the land for at least 12 months prior to the previous CRP sign-up period (except in cases of a change in ownership due to the previous owner's death, foreclosure, or land purchase by the new owner without the sole intention of placing it in the CRP).
2. Cropland that is planted or considered planted to an agricultural commodity for four of the six most recent crop years (including field margins) and must be physically and legally capable of being planted in a normal manner to an agricultural commodity.
3. Certain marginal pastureland suitable for use as any of the following conservation practices: buffer for wildlife habitat, wetlands buffer or restoration, filter strips, riparian buffer, grass waterway, shelter belt, living snow fence, contour grass strip, salt tolerant vegetation, or shallow water area for wildlife.

In addition to the eligible land requirements, cropland must meet one of the following criteria:

- Have a weighted average erosion index of 8 or higher
- Be expiring CRP acreage
- Be located in a national or state CRP conservation priority area.

The FSA bases rental rates on the relative productivity of soils within each county and the average dryland cash rent or cash-rent equivalent. The maximum rental rate for each offer is calculated in advance of enrollment. Producers may offer land at the maximum rate or at a lower rental rate to increase likelihood of offer acceptance. In addition, the FSA provides cost-share assistance for up to 50 percent of the participant's costs in establishing approved conservation practices (USDA 2016: https://www.fsa.usda.gov/programs-and-services/conservation-programs/prospective-participants/index). CRP annual rental payments may include an additional amount up to $2 per acre per year as an incentive to perform certain maintenance obligations (up to $7 for certain continuous sign-up practice).

Finally, the FSA offers additional financial incentives for certain continuous sign-up practices. Signing Incentive Payment is a one-time incentive payment of $10/acre for each acre enrolled for each full year of the contract. Eligible practices include field windbreaks; grassed waterways; shelter belts; living snow fences; filter strips; riparian buffers; marginal pastureland wildlife and wetland buffers; bottom timber establishment; field borders; longleaf pine establishment; duck nesting habitat; SAFE buffers, wetlands, trees, longleaf pine, and grass; pollinator habitat; and several wetlands practices. The Performance Incentive Payment is a one-time incentive payment made to participants who enroll land in CRP to be devoted to all continuous sign up practices except establishment of permanent vegetative cover on terraces, wetland restoration (including non-floodplain), bottomland timber establishment, and duck nesting habitat.

The maximum annual non-cost share payment that an eligible "person" can receive under the CRP is $50,000 per fiscal year. This is a separate payment limitation applying only to CRP non-cost share payment.

The current extent of land enrolled in CRP within the Lake Lou Yaeger watershed is unknown.

9.7.2.3 Grassland Reserve Program

The purpose of the GRP, administered by the FSA, is to prevent grazing and pasture land from being converted into cropland, used for urban development, or developed for other non-grazing uses. Participants in the program voluntarily limit future development of the land while still being able to use the land for livestock grazing and activities related to forage and seed production. Some restrictions on activities may apply during the nesting season of certain bird species that are in decline or protected under federal or state law.

The GRP has several enrollment options, including a rental contract for 10, 15, or 20 years, or enrollment of the land in a conservation easement for an indefinite period of time. Applications are accepted any time and are processed through the local FSA office.

To be eligible for a rental agreement, the applicant must own or have control of the land for the length of the contract. To enroll in a conservation easement, the applicant must own and be willing to restrict use of the land either in perpetuity or under the maximum length of time under state law. Persons enrolled in GRP receive an annual rental payment for their enrolled acres. Rental payments were not available on the USDA website as of June 2016 (https://www.fsa.usda.gov/programs-and-services/conservation-programs/grassland-reserve/index); however, further information about the program, including payment amounts, eligibility and maintenance criteria, and land requirements may be obtained from the local FSA office.

9.7.2.4 Agricultural Conservation Easement Program

ACEP provides financial and technical assistance to help conserve agricultural lands and wetlands and their related benefits. Under the Agricultural Land Easements component, NRCS helps American Indian tribes, state and local governments, and non-governmental organizations protect working agricultural lands and limit non-agricultural uses of the land. Land protected by agricultural land easements provides additional public benefits, including environmental quality, historic preservation, wildlife habitat, and protection of open space. Under the Wetlands Reserve Easements component, NRCS helps to restore, protect, and enhance enrolled wetlands. Wetland Reserve Easements provide habitat for fish and wildlife, including threatened and endangered species, improve water quality by filtering sediments and chemicals, reduce flooding, recharge groundwater, protect biological diversity and provide opportunities for educational, scientific and limited recreational activities.

Agricultural Land Easements: NRCS provides financial assistance to eligible partners purchase Agricultural Land Easements that protect the agricultural use and conservation values of eligible land. In the case of working farms, the program helps farmers and ranchers keep their land in agriculture. The program also protects grazing uses and related conservation values by conserving grassland, including rangeland, pastureland and shrubland. Land eligible for agricultural easements includes cropland, rangeland, grassland, pastureland and non-industrial private forest land. NRCS will prioritize applications that protect agricultural uses and related conservation values of the land and those that maximize the protection of contiguous acres devoted to agricultural use.

To enroll land through agricultural land easements, NRCS enters into cooperative agreements with eligible partners. Each easement is required to have an agricultural land easement plan that promotes the long-term viability of the land. Under the Agricultural Land component, NRCS may contribute up to 50 percent of the fair market value of the agricultural land easement. Where NRCS determines that grasslands of special environmental significance will be protected, NRCS may contribute up to 75 percent of the fair market value of the agricultural land easement.

Wetland Reserve Easements: NRCS also provides technical and financial assistance to restore, protect, and enhance wetlands through the purchase of a wetland reserve easement. These agreements include the right for NRCS to develop and implement a wetland reserve restoration easement plan to restore, protect, and enhance the wetland's functions and values. Land eligible for wetland reserve easements includes farmed or converted wetland that can be successfully and cost-effectively restored. NRCS will prioritize applications based the easement's potential for protecting and enhancing habitat for migratory birds and other wildlife. For acreage owned by an Indian tribe, there is an additional enrollment option of a 30-year contract. Through the wetland reserve enrollment options, NRCS may enroll eligible land through one of the following:

- Permanent Easements – These are conservation easements in perpetuity. NRCS pays 100 percent of the easement value for the purchase of the easement. Additionally, NRCS pays between 75 to 100 percent of the restoration costs.

- 30-year Easements – These expire after 30 years. Under 30-year easements, NRCS pays 50 to 75 percent of the easement value for the purchase of the easement. Additionally, NRCS pays between 50 to 75 percent of the restoration costs.

- Term Easements – Term easements are easements made for the maximum duration allowed under applicable State laws. NRCS pays 50 to 75 percent of the easement value for the purchase of the term easement. Additionally, NRCS pays between 50 to 75 percent of the restoration costs.

- 30-year Contracts – 30-year contracts are only available to enroll acreage owned by Indian tribes, and program payment rates are commensurate with 30-year easements.

For wetland reserve easements, NRCS pays all costs associated with recording the easement in the local land records office, including recording fees, charges for abstracts, survey and appraisal fees, and title insurance.

Wetland Reserve Enhancement Partnership – The 2014 Farm Bill replaced the Wetland Reserve Enhancement Program with the Wetland Reserve Enhancement Partnership (WREP) as an enrollment option under ACEP. WREP continues to be a voluntary program through which NRCS signs agreements with eligible partners to leverage resources to carry out high priority wetland protection, restoration, and enhancement and to improve wildlife habitat.

- Partner benefits through WREP agreements include:
  - Wetland restoration and protection in critical areas
  - Ability to cost-share restoration or enhancement beyond NRCS requirements through leveraging
  - Able to participate in the management or monitoring of selected project locations
  - Ability to use innovative restoration methods and practices

In 2016, NRCS made $15 million in financial and technical assistance available to help eligible conservation partners leverage local resources to voluntarily protect, restore, and enhance critical wetlands on private and tribal agricultural land nationwide. The funding is provided through the WREP, a special enrollment option under the Agricultural Conservation Easement Program. Proposals were due to the local NRCS offices by May 16, 2016; however, landowners should check with the NRCS to see about applying in future years. To enroll land eligible partners may submit proposals to the local NRCS office.

9.7.2.5 Conservation Stewardship Program

The CSP helps agricultural producers maintain and improve their existing conservation systems and adopt additional conservation activities to address priority resources concerns. Participants earn CSP payments for conservation performance—the higher the performance, the higher the payment.

Through CSP, participants take additional steps to improve resource conditions including soil quality, water quality and quantity, air quality, habitat quality, and energy. CSP provides two types of payments through 5-year contracts: annual payments for installing new conservation activities and maintaining existing practices; and supplemental payments for adopting a resource-conserving crop rotation. Producers may be able to renew a contract if they have successfully fulfilled the initial contract and agree to achieve additional conservation objectives. Payments are made soon as practical after October 1 of each fiscal year for contract activities installed and maintained in the previous year. In fiscal year 2016, NRCS made $150 million available for producers through the CSP.

Eligible lands include private and Tribal agricultural lands, cropland, grassland, pastureland, rangeland and non-industrial private forest land. CSP is available to all producers, regardless of operation size or type of crops produced, in all 50 states, the District of Columbia, and the Caribbean and Pacific Island areas. Applicants may include individuals, legal entities, joint operations, or Indian tribes that meet the stewardship threshold for at least two priority resource concerns when they apply. They must also agree to meet or exceed the stewardship threshold for at least one additional priority resource concern by the end of the contract. Producers must have effective control of the land for the term of the proposed contract, which include all eligible land in the agricultural operation. Some additional restrictions and program requirements may apply and interested applicants should contact the local NRCS office for more information.

9.7.2.6 Environmental Quality Incentive Program

EQIP is a voluntary program that provides financial and technical assistance to agricultural producers to plan and implement conservation practices that improve soil, water, plant, animal, sir, and related natural resources on agricultural land and non-industrial private forestland. Through EQIP, the NRCS develops contracts with agricultural producers to implement conservation practices to address environmental natural resource problems. Persons engaged in livestock or agricultural production and owners of non-industrial private forestland are eligible for the program. Eligible land includes cropland, rangeland, pastureland, private non-industrial forestland, and other farm or ranch lands. Eligible applicants must, at a minimum, meet the following criteria; additional program requirements may apply:

- Be agricultural producer (person, legal entity, or joint operation who has an interest in the agricultural operation, or who is engaged in agricultural production or forestry management).
- Control or own eligible land.
- Comply with adjusted gross income for less than $900,000. Note: Federally recognized Native American Indian Tribes or Alaska Native corporations are exempt from the adjusted gross income payment limitations.
- Be in compliance with the highly erodible land and wetland conservation requirements.
- Develop an NRCS EQIP plan of operations that addresses at least one natural resource concern

Persons interested in entering into a cost-share agreement with the NRCS for EQIP assistance may file an application at any time; however, each state may establish deadlines for one or more application periods in which to consider eligible applications for funding. Applications submitted after the deadlines will be evaluated and considered for funding during later funding opportunities.

As part of the program, a Conservation Activity Plan (can be developed for producers to address a specific natural resource concern on their agricultural operation. Each plan is developed by a certified Technical Service Provider, who is selected by the EQIP participant. Technical assistance payments for Technical Service Providers do not count against the financial assistance aggregate payment limitation or the contract financial assistance payment limitation. The plan becomes the basis of the EQIP contract between NRCS and the participant, and the contracts can be up to 10 years in duration. Financial assistance payments are made to eligible producers once conservation practices are completed according to NRCS requirements. Payment rates are set for each fiscal year and are attached to the EQIP contract when it is approved.

Historically underserved producers (limited resource farmers/ranchers, beginning farmers/ranchers, socially disadvantaged producers, Indian Tribes, and veteran farmer or ranchers) who self-certify on Form NRCS-CPA-1200, Conservation Program Application are eligible for a higher practice payment rate to support implementation of contracted conservation practices and activities. Historically underserved producers may also be issued advance payments up to 50 percent of the established payment rate to go toward purchasing materials or contracting services to begin installation of approved conservation practices. Self-certified socially disadvantaged farmer/rancher, beginning farmer/rancher, and veteran farmer/rancher producers may elect to be evaluated in special EQIP funding pools. More information can be obtained from the local NRCS office.

EQIP provides payments up to 75 percent of the incurred costs and 100 percent estimated income foregone of certain conservation practices and activities. Payments received by producers through EQIP contracts after February 7, 2014 may not exceed $450,000 for all EQIP contracts entered into during the period from 2014 to 2018. Payment limitations for organic production may not exceed an aggregate $20,000 per fiscal year or $80,000 during any 6-year period for installing conservation practices.

Conservation practices eligible for EQIP funding which are recommended BMPs for this watershed TMDL include filter strips, conservation tillage, grade stabilization structures, grass waterways, riparian buffers, streambank/shoreline protection, terraces, and wetland restoration. More information regarding state and local EQIP implementation can be found at http://www.nrcs.usda.gov/wps/portal/nrcs/main/il/programs/financial/eqip/.

9.7.2.7 Farmer to Farmer Program

Farmer to Farmer is a potential funding source from USEPA depending upon future funding. Available funds to improve water quality, habitat, resilience, and environmental education through the demonstration of innovative practices on working 'agricultural' lands. The project supports farmer-led or farm focused organizations in the Gulf of Mexico Watershed. Additional information can be found at: https://www.epa.gov/gulfofmexico/farmer-farmer-rfa-and-supporting-documents.

9.7.2.8 Regional Conservation Partnership Program

The Regional Conservation Partnership Program (RCPP) is a stand-alone USDA program funded at $300 million annually. The RCPP website states that the program "promotes coordination of NRCS conservation activities with partners that offer value-added contributions to expand our collective ability to address on-farm, watershed, and regional natural resource concerns. Through RCPP, NRCS seeks to co-invest with partners to implement projects that demonstrate innovative solutions to conservation challenges and provide measurable improvements and outcomes tied to the resource concerns they seek to address." Information on eligibility, project types, funding, and how to apply can be found at https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/financial/rcpp/.

9.7.3 Local Program Contact Information

The FSA administers the CRP and GRP. NRCS administers the ACEP, CSP, and EQIP. Local contact information for the Lake Lou Yaeger watershed is listed in the **Table 9-7** below.

Table 9-7 Local SWCD, NRCS, and FSA Contact Information

County	Address	Phone
Montgomery County	1621 Vandalia Road Hillsboro, IL 62049	(217) 532-3361

9.8 Planning Level Cost Estimates for Implementation Measures

Cost estimates for different implementation measures are presented in **Table 9-8**. The column labeled "Program" or "Sponsor" lists the financial assistance program or sponsor available for various BMPs (as discussed in Section 9.13). Illinois EPA 319 Grants are applicable to all of the practices.

Table 9-8 Cost Estimates of Various BMP Measures

BMP	Units	Installation Cost	Program	Sponsor(s)
Filter strip (seeded)	per ac	$520 - $639, avg $594	CRP	NRCS, IDA
Riparian buffer – bare-root shrubs	each	$1.10 - $1.65	CRP	NRCS, IDA
– forested	per ac	$741		
– herbaceous cover	per ac	$642		
– land preparation	per ac	$38		
Nutrient management – development and implementation	per ac	$16	EQIP	NRCS, IDA, Illinois EPA
Livestock exclusion	per ac		EQIP	NRCS
Fencing – permanent high-tensile, 1 strand	per ft	$0.79		
– permanent high-tensile, 2-3 strands	per ft	$1.16		
– permanent high-tensile, 4-6 strands	per ft	$1.42		
– permanent high-tensile, 7 or more strands	per ft	$1.78		

BMP	Units	Installation Cost	Program	Sponsor(s)
– barbed wire, multi-strand	per ft	$1.62		
– woven wire	per ft	$1.96		
Alternate water			EQIP	NRCS
– access ramp	per SF	$1.44		
– tanks, at or above ground	each	$153 - $3,717;		
– tanks, at or above ground, heavy use protection	per SF	$0.86 - $4.91		
– tanks, frost-free waterer	each	$1,011		
– tank, below ground	each	$3,600		
– tank, below ground, pipeline and pump	per ft each	$1.94 - $3.38/ft for pipeline, $961/pump		
Water and sediment control basin, <3 ft	per ft	$3.30	CPP	IDA
– >3ft	per ft	$3.80		
Terraces, <3 feet	per ft	$3.30	CPP	IDA
– >3ft	per ft	$3.80		
Bank stabilization	per ac	$27 - $52/ft	SSRP	IDA
– weirs/rock riffles	each	$2,448 - $6,305		
– stream barb/bendway weir with longitudinal peaked stone toe	per ft	$27.27 - $52.50		
– bank armor	per CY	$37.55		
Grade stabilization			CPP, SSRP	IDA
– concrete block chutes	per block	$7.00		
– rip rap-lined (rock) chute	per ton	$40.00		
– metal toe wall	per SF	$140		
– modular block structure	perblock	$85		
Grassed waterway	per ac	$2,900	CPP CRP	IDA NRCS
Conservation tillage			EQIP	NRCS, IDA
– no-till/strip-till	per ac	$133.33		
Contour farming	per ac	$6.06	EQIP	NRCS
Cover Crops	per ac	$66.67	EQIP	NRCS
Wetland – enhancement/restoration	per ac	$1,167 - $3,680	ACEP	NRCS
– constructed	per ac	$7,725 - $10,286		
Mulch as needed for various BMPs, such as alternate water access ramp and WASCOBs	per ac	$440 for mulch	See corresponding program and sponsor listed above	
Septic system maintenance	per event	$250 - $350	Private system owner	

ac = acre
ft = foot
CY = cubic yard
SF = square foot

9.9 Milestones and Monitoring

Successful plan implementation relies on establishing and tracking milestones to measure progress. **Table 9-9** below identifies an implementation schedule for meeting milestones also listed in the table. Stakeholders should evaluate schedule/milestone progress on an annual basis and implement adaptive management to modify management measures, milestones, and schedule as necessary.

9.9.1 Implementation Schedule

Implementation of the management actions outlined in this section should occur in phases, often over the course of several years, with effectiveness assessments made as improvements are completed. The process of obtaining funding and developing and implementing projects designed to improve water quality, can take months or years to complete and once in place, improvements in water quality, as a result of BMPs, may not be detectable for several years. Continued monitoring and reevaluation of the implementation measures during this time will allow for more expedient adjustment to BMP implementation measures that may result in earlier attainment of water quality targets.

Table 9-9 Implementation Schedule

Schedule Category	Detailed Description	Recommended Schedule
Funding	Develop grant applications	Short term: 2-5 years
Implement Short-term Projects and Assess Existing BMPs	Identify and implement short-term pilot projects that can be completed (i.e. willing landowners and available funding) Assess existing BMPs in the watershed for effectiveness	Mid-term: 2-5 years
Monitoring	Implement monitoring plan	Continuous: 1-20 years
Annual Stakeholder meetings	Stakeholders will convene at once a year to gauge progress and discuss evolving needs and planned activities	Annually
Implement Larger Projects	Identify and implement larger projects. These projects are more likely to have multiple funding sources and stakeholders.	Mid- Term: 5-10 years
Education and outreach	Prepare and implement and education and outreach plan. Conduct at least two public meetings annually.	Immediate: 1-2 years
Schedule Category – Critical Areas	**Detailed Description**	**Recommended Schedule**
Implement Identified Projects	Work with local SWCD to use TMDL priority to secure funding and implement “ready-to-go” projects.	Process began in 2018
Erosion Control Measures	Identify willing landowners in upstream areas of the watershed to participate in pilot studies to implement edge of field BMPs and/or in-field cover BMPs	Process began in 2018

Schedule Category	Detailed Description	Recommended Schedule
	Monitor results of pilot studies to measure success and adapt/adjust wider-scale implementation	Throughout 2019 under varying flow scenarios
	Secure funding and begin implementation of BMPs detailed in Lake Lou Yaeger BMP Implementation Plan (Appendix F)	2020
	Continue to identify key farmland and work with landowners to implement erosion control BMPs along impaired segments and tributaries.	Begin by 2020
	Work with SWCD to identify areas throughout the watershed where livestock regularly enter the streams	2019-2020
	Work with landowners to secure funding for fencing/alternate watering source implementation	2020-2022
Reduce Septic System Loading	Perform community outreach with septic system management educational information to non-sewered areas (particularly those surrounding the lake).	2019-2020
Reduce In-Lake Phosphorus	Perform cost-benefit study to understand options of dredging, alum addition, and/or reaeration in Lake Lou Yaeger	By the end of 2025
	Implement in-lake management measures to reduce TP (if above study shows cost-effectiveness)	By 2030

9.9.2 Monitoring Plan

The purpose of the monitoring plan for the Lake Lou Yaeger watershed is to assess the overall implementation of management actions outlined above. This can be accomplished by conducting the monitoring programs designed to:

- Track implementation of BMPs in the watershed
- Estimate effectiveness of BMPs
- Further monitor point source discharges in the watershed
- Continued monitoring of impaired stream segments and tributaries
- Monitoring of lake sediments to refine internal loading estimates
- Monitor storm-based high flow events
- Low flow monitoring of total phosphorus and TSS throughout the watershed.

Tracking the implementation of management measures can be used to:

- Determine the extent to which management measures and practices have been implemented compared to action needed to meet the TMDL endpoints
- Establish a baseline from which decisions can be made regarding the need for additional incentives for implementation efforts
- Measure the extent of voluntary implementation efforts
- Support work-load and costing analysis for assistance or regulatory programs
- Determine the extent to which management measures are properly maintained and operated

Estimating the effectiveness of the BMPs implemented in the watershed could be completed by monitoring before and after the BMP is incorporated into the watershed. Additional monitoring could be conducted on specific structural systems such as a sediment control basin. Inflow and outflow measurements could be conducted to determine site-specific removal efficiency.

Illinois EPA conducts Intensive Basin Surveys every five years. Additionally, select ambient sites are monitored nine times a year. Continuation of this state monitoring program will assess lake and stream water quality as improvements in the watershed are completed. This data will also be used to assess whether water quality standards in the impaired segments are being attained.

9.9.3 Success Criteria

Measuring the plan's success depends largely on tracking milestones. Implementing BMPs should equate to improved water quality and attainment of designated uses and water quality standards. Monitoring pollutant-load reductions will be the primary success criteria. General components include:

- Securing funding for priority projects within 5 years
- Meeting the identified milestones
- Meeting 25-50% of target reductions within 10 years
- Meeting 100% of target reductions within 20 years
- Utilizing adaptive management to ensure best practices
- Delisting of the impaired waterbodies

Table 9-10 Implementation Milestones

Milestone	Detailed Description	Milestone Date
Stakeholder Engagement	Continue work that has been completed to date through Lake Lou Yaeger watershed stakeholder group and continue attempts to engage additional landowners, municipalities, environmental groups, and others.	Minimum of annual stakeholder meeting

Milestone	Detailed Description	Milestone Date
TSS Reduction (and associated reductions in nutrients)	10% of target reductions through implementation of "ready-to-go" projects	End of 2020
	25% of target reductions through beginning implementation of filter strips and other key farmland erosion control in the watershed and shoreline stability BMPs around Lake Lou Yaeger	End of 2023
	50% of target reductions through continued implementation of erosion control BMPs and adaptive management	End of 2027
	100% or target reductions achieved through implementation of most successful BMPs continuously identified through regular monitoring and adaptive management	2030
Nutrient Reduction	10% of target reductions through implementation of "ready-to-go" projects	End of 2020
	25% of target reductions through implementation of erosion control measures, septic system maintenance outreach, and expanded nutrient management planning	End of 2023
	50% of target reductions through continued implementation of erosion control BMPs and adaptive management	End of 2027
	100% or target reductions achieved through implementation of most successful BMPs continuously identified through regular monitoring and adaptive management and cost-effective in-lake management measures	2030

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Section 10

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Appendix A

Land Use Categories

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Table A1: Lake Lou Yaeger Land Use Data

Land Cover Code	Land Cover Class	Acres	Percent Watershed
1	Corn	28,923.77	41.556
5	Soybeans	22,497.17	32.322
6	Sunflower	0.44	0.001
21	Barley	0.22	0.000
24	Winter Wheat	409.87	0.589
26	Dbl Crop WinWht/Soybeans	735.42	1.057
36	Alfalfa	31.41	0.045
37	Other Hay/Non Alfalfa	10.67	0.015
58	Clover/Wildflowers	0.76	0.001
59	Sod/Grass Seed	1.07	0.002
61	Fallow/Idle Cropland	3.44	0.005
68	Apples	0.44	0.001
74	Pecans	0.22	0.0003
111	Open Water	1,481.15	2.128
121	Developed/Open Space	2,404.12	3.454
122	Developed/Low Intensity	2,402.39	3.452
123	Developed/Med Intensity	314.00	0.451
124	Developed/High Intensity	38.31	0.055
131	Barren	9.26	0.013
141	Deciduous Forest	6,394.07	9.187
176	Grass/Pasture	3,934.58	5.653
190	Woody Wetlands	0.97	0.001
195	Herbaceous Wetlands	2.88	0.004
229	Pumpkins	5.67	0.008
Total		**69,602.30**	**100**

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Appendix B

SSURGO Soil Series

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Table B-1: Lake Lou Yaeger SSURGO Soil Data

SSURGO Soil Series Code	SSURGO Soil Series Code Definition	Dominant Hydrologic Soil Group	Acres	Percent of Watershed	ksat_l	ksat_r	ksat_h	kwfact	kffact
128B	Douglas silt loam, 2 to 5 percent slopes	B	39.25	0.06	4.23	9.170	14.11	0.32	0.32
128C2	Douglas silt loam, 5 to 10 percent slopes, eroded	B	69.33	0.10	4.23	23.290	42.34	0.43	0.43
256C2	Pana loam, 5 to 10 percent slopes, eroded	B	45.39	0.07	4.23	9.170	14.11	0.28	0.28
583B	Pike silt loam, 2 to 5 percent slopes	B	16.55	0.02	4.23	9.170	14.11	0.49	0.49
583C2	Pike silt loam, 5 to 10 percent slopes, eroded	B	27.36	0.04	4.23	9.170	14.11	0.43	0.43
583D2	Pike silt loam, 10 to 18 percent slopes, eroded	B	61.65	0.09	4.23	9.170	14.11	0.37	0.37
8D2	Hickory silt loam, 10 to 18 percent slopes, eroded	B	1,676.65	2.41	4.23	9.170	14.11	0.32	0.32
8D3	Hickory clay loam, 10 to 18 percent slopes, severely eroded	B	247.18	0.36	4.23	9.170	14.11	0.32	0.32
8F	Hickory silt loam, 18 to 35 percent slopes	B	2,195.57	3.15	4.23	9.170	14.11	0.32	0.32
8G	Hickory silt loam, 35 to 60 percent slopes	B	152.64	0.22	4.23	9.170	14.11	0.32	0.32
3074A	Radford silt loam, 0 to 2 percent slopes, frequently flooded	B/D	687.20	0.99	4.23	9.170	14.11	0.32	0.32
3451A	Lawson silt loam, 0 to 2 percent slopes, frequently flooded	B/D	1,322.68	1.90	4.23	9.170	14.11	0.24	0.24
385A	Mascoutah silty clay loam, 0 to 2 percent slopes	B/D	342.40	0.49	4.23	9.170	14.11	0.28	0.28
7788B	Shoals and Terril loams, 1 to 4 percent slopes, rarely flooded	B/D	112.30	0.16	4.23	9.170	14.11	0.32	0.32
127A	Harrison silt loam, 0 to 2 percent slopes	C	129.95	0.19	4.23	9.170	14.11	0.32	0.32
127B	Harrison silt loam, 2 to 5 percent slopes	C	1,821.28	2.62	4.23	9.170	14.11	0.32	0.32
127B2	Harrison silt loam, 2 to 5 percent slopes, eroded	C	1,011.75	1.45	4.23	9.170	14.11	0.37	0.37
259C2	Assumption silt loam, 5 to 10 percent slopes, eroded	C	462.92	0.67	0.42	2.330	4.23	0.28	0.28

SSURGO Soil Series Code	SSURGO Soil Series Code Definition	Dominant Hydrologic Soil Group	Acres	Percent of Watershed	ksat_l	ksat_r	ksat_h	kwfact	kffact
582B	Homen silt loam, 2 to 5 percent slopes	C	610.18	0.88	4.23	9.170	14.11	0.43	0.43
582C	Homen silt loam, 5 to 10 percent slopes	C	91.65	0.13	4.23	9.170	14.11	0.43	0.43
582C2	Homen silt loam, 5 to 10 percent slopes, eroded	C	346.50	0.50	4.23	9.170	14.11	0.43	0.43
5C3	Blair silty clay loam, 5 to 10 percent slopes, severely eroded	C	4.24	0.01	4.23	9.170	14.11	0.43	0.43
680B	Campton silt loam, 2 to 5 percent slopes	C	5.09	0.01	4.23	9.170	14.11	0.43	0.43
7C2	Atlas silt loam, 5 to 10 percent slopes, eroded	C	74.06	0.11	4.23	9.170	14.11	0.43	0.43
7D2	Atlas silt loam, 10 to 18 percent slopes, eroded	C	130.27	0.19	4.23	9.170	14.11	0.43	0.43
802B	Orthents, loamy, undulating	C	199.83	0.29	1.41	2.820	4.23	0.37	0.37
802E	Orthents, loamy, hilly	C	10.09	0.01	1.41	2.820	4.23	0.28	0.28
112A	Cowden silt loam, 0 to 2 percent slopes	C/D	1,244.66	1.79	4.23	9.170	14.11	0.49	0.49
113A	Oconee silt loam, 0 to 2 percent slopes	C/D	1,397.81	2.01	4.23	9.170	14.11	0.37	0.37
113B	Oconee silt loam, 2 to 5 percent slopes	C/D	677.23	0.97	4.23	9.170	14.11	0.37	0.37
113B2	Oconee silt loam, 2 to 5 percent slopes, eroded	C/D	59.36	0.09	4.23	9.170	14.11	0.49	0.49
127C2	Harrison silt loam, 5 to 10 percent slopes, eroded	C/D	82.80	0.12	1.41	2.820	4.23	0.37	0.37
287A	Chauncey silt loam, 0 to 2 percent slopes	C/D	93.64	0.13	4.23	9.170	14.11	0.37	0.37
46A	Herrick silt loam, 0 to 2 percent slopes	C/D	10,775.09	15.48	4.23	9.170	14.11	0.37	0.37
470B2	Keller silt loam, 2 to 5 percent slopes, eroded	C/D	2,365.42	3.40	4.23	9.170	14.11	0.37	0.37
48A	Ebbert silt loam, 0 to 2 percent slopes	C/D	983.11	1.41	1.41	2.820	4.23	0.37	0.37
50A	Virden silty clay loam, 0 to 2 percent slopes	C/D	14,667.38	21.07	4.23	9.170	14.11	0.28	0.28
515C2	Bunkum silt loam, 5 to 10 percent slopes, eroded	C/D	265.10	0.38	1.41	2.820	4.23	0.43	0.43
515C3	Bunkum silty clay loam, 5 to 10 percent slopes, severely eroded	C/D	15.24	0.02	1.41	2.820	4.23	0.43	0.43
517A	Marine silt loam, 0 to 2 percent slopes	C/D	511.26	0.73	4.23	9.170	14.11	0.49	0.49
517B	Marine silt loam, 2 to 5 percent slopes	C/D	1,613.08	2.32	1.41	2.820	4.23	0.49	0.49
6B2	Fishhook silt loam, 2 to 5 percent slopes, eroded	C/D	119.97	0.17	4.23	9.170	14.11	0.37	0.37
6C2	Fishhook silt loam, 5 to 10 percent slopes, eroded	C/D	39.73	0.06	0.42	0.920	1.41	0.32	0.32
790A	Herrick-Biddle silt loams, 0 to 2 percent slopes	C/D	357.68	0.51	4.23	9.170	14.11	0.37	0.37
882B2	Oconee-Darmstadt-Coulterville silt loams, 2 to 5 percent slopes, eroded	C/D	2,120.50	3.05	4.23	9.170	14.11	0.49	0.49
885A	Virden-Fosterburg silt loams, 0 to 2 percent slopes	C/D	713.53	1.03	4.23	9.170	14.11	0.37	0.37

SSURGO Soil Series Code	SSURGO Soil Series Code Definition	Dominant Hydrologic Soil Group	Acres	Percent of Watershed	ksat_l	ksat_r	ksat_h	kwfact	kffact
894A	Herrick-Biddle-Piasa silt loams, 0 to 2 percent slopes	C/D	12,550.88	18.03	4.23	9.170	14.11	0.37	0.37
897C2	Bunkum-Atlas silt loams, 5 to 10 percent slopes, eroded	C/D	2,741.09	3.94	4	9.000	14.00	0.43	0.43
31A	Pierron silt loam, 0 to 2 percent slopes	D	118.16	0.17	4.23	9.170	14.11	0.49	0.49
581B	Tamalco silt loam, 2 to 5 percent slopes	D	81.51	0.12	4.23	9.170	14.11	0.49	0.49
581B2	Tamalco silt loam, 2 to 5 percent slopes, eroded	D	211.94	0.30	4.23	9.170	14.11	0.49	0.49
5C2	Blair silt loam, 5 to 10 percent slopes, eroded	D	49.17	0.07	0.141	0.776	1.41	0.49	0.49
882A	Oconee-Darmstadt-Coulterville silt loams, 0 to 2 percent slopes	D	348.30	0.50	0.42	0.920	1.41	0.43	0.43
882A	Oconee-Darmstadt-Coulterville silt loams, 0 to 2 percent slopes	D	5.39	0.01	1.41	2.820	4.23	0.43	0.43
882B	Oconee-Darmstadt-Coulterville silt loams, 2 to 5 percent slopes	D	6.58	0.01	0.42	0.920	1.41	0.43	0.43
993A	Cowden-Piasa silt loams, 0 to 2 percent slopes	D	1,564.82	2.25	0.423	2.330	4.23	0.43	0.43
835G	Earthen dam		5.16	0.01	0	0.000	0.00		
8D	Hickory silt loam, 10 to 18 percent slopes		257.05	0.37	0	0.000	0.00		
M-W	Miscellaneous water		3.39	0.00	0	0.000	0.00		
W	Water		1,662.51	2.39	0	0.000	0.00		
	Total		69,602.53	100.00					

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Appendix C

Responsiveness Summary and Public Comments

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Responsiveness Summary

Lake Lou Yaeger Watershed

Total Maximum Daily Load

The responsiveness summary responds to questions and comments received during the public comment period from August 6, 2020, through September 7, 2020.

What is a TMDL?

A Total Maximum Daily Load (TMDL) is the sum of the allowable amount of a pollutant that a waterbody can receive from all contributing sources and still meet water quality standards or designated uses. **The Lake Lou Yaeger Watershed** TMDL report contains a plan detailing the actions necessary to reduce pollutant loads to the impaired water bodies and ensure compliance with applicable water quality standards. The Illinois EPA implements the TMDL program in accordance with Section 303(d) of the federal Clean Water Act and regulations thereunder.

Background

The Lake Lou Yaeger watershed is located in south-central Illinois. The watershed is 69,542 acres and is located 45 miles south of Springfield, Illinois. The majority of the watershed (approximately 69,300 acres) lies within Montgomery County. The additional acreage lies within Macoupin and Christian Counties (229 and 13 acres, respectively). Lake Lou Yaeger is located on the West Fork of Shoal Creek and has a surface area of approximately 1,268 acres.

The Clean Water Act and USEPA regulations require that states develop TMDLs for waters on the Section 303(d) List. Illinois EPA is currently developing TMDLs for pollutants that have numeric water quality standards. Therefore, a Phosphorus (Total) TMDL was developed for Lake Lou Yaeger (waterbody segment – IL_RON) listed as impaired for Aesthetic Quality per the *Draft Illinois Integrated Water Quality Report and Section 303(d) List-2016*.

In addition, a Load Reduction Strategy (LRS) was developed for pollutant(s) that do not have numeric water quality standard. This includes the total suspended Solids for Lake Lou Yaeger.

Illinois EPA contracted with CDM Smith (TMDL Consultant) to prepare the TMDL report for the Lake Lou Yaeger Watershed TMDL project.

Public Meetings

The draft Stage 1 public meeting was held on March 7, 2017 (6:00 pm) at the Litchfield Community Center-Senior Room, Litchfield, Illinois, and the draft Stage 3 public meeting was conducted virtually on August 6, 2020. Illinois EPA provided public notice for both meetings by placing display-ad in the Litchfield News Herald (the local newspaper). In addition, a direct mailing was sent to several NPDES Permittees\stakeholders in the watershed. The notice gave the date, time, and purpose of the public meeting. The notice also provided references on how to obtain additional information about this specific site, the TMDL program, and other related information. The draft TMDL report was available for review at the City of Litchfield – City Hall/City Clerk's Office, and on the Agency's webpage: https://www2.illinois.gov/epa/public-notices/Documents/Lake%20Lou%20Yaeger%20Watershed%20TMDL%20-%20FINAL%20Stage%203%20Public%20Notice%20%28August%206%202020%29_070620.pdf

The draft Stage 3 virtual public meeting started at 10:00 a.m. (CDT) on Thursday, August 6, 2020. It was attended by approximately 20 people and the meeting concluded at 12:00 pm. (CDT), with the meeting record remaining open until midnight on September 7, 2020.

Questions & Comments

1. <u>Editorial Comments on Report</u>

a. Page 8-4: Section 8.3.1.3. Second paragraph. Should the word “conservation” be “conservative”?

Response:

The Section has been updated to read as conservative rather than conservation.

b. Five Mile Lake, an existing silt basin, could be added to the maps of the Lake Yaeger watershed. Five Mile Lake is located at the confluence of Threemile Branch and Shop Creek.

Response:

The Section has been updated in multiple locations throughout the Implementation Section (Section 9) to acknowledge the existing sedimentation basin.

c. Page 9-18 fourth paragraph: A major part of Lake Yaeger shoreline erosion is due to the steep slope of the original ground at the shoreline. Contributing factors are saturation of the soil; wind induced, and boat induced waves; and erosive soil types.

Response:

This information has been added to the paragraph.

d. On Pages 9-18 and 9-19, we suggest separating streambank and shoreline protection into separate sections because the methods are different. We also suggest adding language to the section regarding two methods of lake shoreline protection used by the City. One method is conventional placement of riprap blanket on the existing shoreline from a few above water levels to a few feet below water level. The second method is to install a line of peaked stone riprap at a water depth of 1.5 feet (the edge of the riprap is about 5 to 10 feet from the edge of water). The City of Litchfield has installed the second method in the 1990’s and it has proven very effective. (See attached photo.) The top of the peak is about 1.5 feet above normal pool. The quantity of riprap is about 1.3 tons per lineal foot of shoreline. The method breaks the waves which would collide with the eroded bank. The riprap also accumulates soil which erodes from the bank which in turn allows vegetation to establish in the quiescent zones between the riprap and eroded shoreline. Another benefit is that the method is that boats and barges construct the riprap from the water and the steep eroded shorelines are not disturbed by construction equipment. It takes years for the area between the riprap and edge of water to accumulate soil and to become fully vegetated. (Three photos attached for eroded bank examples, one photo of conventional riprap and one photo of peaked riprap from 1990's)

Response:

These Sections have been separated and the information provided about riprap installation in Lake Lou Yaeger has been included in the report.

e. General comment: Regarding stream bank protection, the streams adjacent to Lake Yaeger have relatively steep gradients because of the substantial elevation difference between the West Fork of Shoal Creek and the surrounding land. There are substantial lengths of stream near the lake which are aggressively eroding and would benefit from stream bank protection.

Response:

This information has been added to the Streambank Protection Section in the implementation plan.

<u>Questions</u>

2. Is the inflow of phosphorus in the computer model based on computer generated values from Lake Shelbyville or was any field data used? I noticed that the report mentions only 5 phosphorus samples for the three Lake Yaeger stations in 2003, 2008 and 2012.

Response:

Please refer to Section 7.2.1.1.3 in the report. Phosphorus loads to Lake Lou Yaeger were estimated based on land use data and the median annual export coefficients for each land use.

3. Was there any calibration of the computer model for Lake Yaeger?

   Response:

   A confirmatory analysis was performed and is described in Section 7.2.1.1.6. Historical water quality data for Lake Lou Yaeger were used to help calibrate the model and confirm model calculations.

4. Do you know the physical rationale of the 0.05 mg/l value for the phosphorus? I understand that it is the state standard. The value of 0.05 mg/l does not seem realistic for a reservoir in Illinois that drains farm ground and naturally vegetated areas. You mentioned following the Public Hearing that the standard originated with US EPA. We suggest adding an explanation of the rationale for a phosphorus standard of 0.05 mg/l.

   Response:

   USEPA's phosphorus water quality criteria for lakes came from USEPA's Water Quality Standards Handbook – the QUALITY CRITERIA FOR WATER (a.k.a, the Red Book), which was published in July of 1976. In the Red Book, it states that, "To prevent the development of biological nuisances and to control accelerated or cultural eutrophication, total phosphates as phosphorus (P) should not exceed 50 ug/L (0.05 mg/L) in any stream at the point where it enters any lake or reservoir, nor 25 ug/L (0.025 mg/L) within the lake or reservoir." Here is the link to the report: https://www.epa.gov/sites/production/files/2018-10/documents/qual teria-ater-1976.pdf

   The phosphorus water quality standard for Illinois lakes (Section 302.205) was adopted by the Illinois Pollution Control Board (IPCB) on May 17, 1979, and later updated in 1983.

   Additional information on the subject can be found at: https://www.epa.gov/nutrient-policy-data (USEPA), and https://www2.illinois.gov/epa/topics/water-quality/watershed-management/excess-nutrients/Pages/default.aspx (Illinois EPA).

   The TMDL report has been updated to reflect the origin of the phosphorus water quality standard for Illinois lakes.

5. The TMDL Report sets goals for phosphorus and TSS reductions in Lake Yaeger. The City of Litchfield owns Lake Yaeger and the adjacent property with an area of about 3700 acres which is about 5% of the total watershed area. The report states on Page 1-5 that the report provides guidance with no regulatory requirements for Load Reduction Strategies. The City may implement LRS within its property over a long period of time. Please comment on whether the City will or will not be required in the future to implement the LRS on its own property or on properties in the watershed outside of its ownership.

   Response:

   The City of Litchfield is not required to implement the Load Reduction Strategy (LRS). However, the LRS provides guidance (with no regulatory requirements) for voluntary nonpoint source reduction efforts by implementing agricultural and urban stormwater best management practices (BMPs).

6. On Page 4-1, the Designated Use of Lake Yaeger is General Use and Food Processing Water Supplies use. However, on Page 4-2 the lake is 303(d) listed for impairment of aesthetic quality under General Use. The public water supply use is currently not listed as impaired. Impairment of Lake Yaeger just for aesthetic reasons does not seem to be a very serious consequence. This seems to be stating that phosphorus and TSS make the water look dirty and have algae in it, but it is not causing any serious consequences. Is this a correct interpretation?

   Response:

   According to the 2016 Illinois Integrated Water Quality Report, Lake Lou Yaeger has been placed on the 303(d) list impaired for aesthetic quality, and a phosphorus TMDL development is required. The Pubic Water Supply use is fully supporting. Note that increased Total suspended Solids (TSS) and Total Phosphorus (TP) affects aquatic life and drinking water treatment costs.

7. On Page 5-19, the Aquatic Ecosystem Restoration project is on hold. The City made a decision 2 to 3 years ago to not proceed further. Issues arose with agricultural landowners upstream of the lake who are concerned with the construction at the upstream end of the lake and impact on field tiles.

   Response:

   This information has been added to the report.

8. In Section 9.4 BMP Recommendations for Reducing Phosphorus: The agricultural watershed for Lake Yaeger has many miles of field tiles which drain groundwater. Field tiles are not identified as a phosphorus source in Section 5 of the report. Are field tiles a source of dissolved phosphorus into the surface water? Also, it seems that a field tile outlet could be considered a point source. Forms of nitrogen nutrients are transported by field tiles. The Wetlands section on Page 9-27 suggests constructing wetlands downstream of a field tile outlet which implies that nutrients are being discharged from the field tiles.

   Response:

   Field tiles were identified as a potential nonpoint source of nutrients as well as having potential impacts on stream erosion. Field tiles are considered a nonpoint source. The final paragraph of Section 5.4.1 states: Information on field tiling practices was also sought as field drains can influence the timing and amounts of water delivered to the lake as well as deliver dissolved nutrients from fields to receiving waters. Local NRCS offices reported that they currently do not keep records on which farms use tile drainage. According to the Natural Resources Conservation Service (NRCS) office in Montgomery County, the use of drain tile is common practice, but they do not have exact numbers. As a rule of thumb, tile drainage is more common north of Illinois Route 16 and less common south of Illinois Route 16. The dividing line was said to be due to clay soil in the southern part of the county, in which tile drainage does not work as well.

<u>Comments on Implementation Plan and Funding</u>

9. Page 9-18 mentions two sediment ponds were proposed by City of Litchfield in the 2017 application for Section 319(h) funds (Appendix F). However, the two-sediment basin BMP’s were not implemented because of the high cost to mitigate impacts to wetlands and streams that were learned after the grant was awarded. The lake shoreline protection did remain in the project and was increased from 1800 feet to 2270 feet in length. The two-sediment basin BMP’s were deleted and the following BMP’s proposed:

   a. Bishop’s Cove location
      - An in-lake sediment basin 300’ by 250’ will be excavated 2 to 5 feet in Bishop’s Cove.
      - Three sediment trapping cells will be constructed in the floodplain on dry land upstream of Bishop’s Cove.

b. Pete's Cove location

- An in-lake sediment basin 175' by 175' will be excavated 1 to 4 feet deep in Bishop's Cove.
- A permanent pool sediment basin will be constructed on the north side of 16th Avenue.

The in-lake basins will be effective for trapping future sediment because they are located where sediment has been depositing for the past 55 years as the flow enters the lake.

Response:

The report has been updated using the information stated above. General information is included in the Implementation Plan and detailed information provided by the commenter has been added to Appendix F.

10. The sediment trapping cells are a unique concept based on the natural shape of the floodplain being very wide and nearly level ground. Three impermeable low height dams (earth and riprap) will detain water during significant runoff events. The flow be directed to meander across the floodplain at a slow velocity to allow sediment to settle. The cells will trap sediment from the larger runoff events which tend to transport the greater share of sediment. The water from 2-year frequency storms and larger will be detained between 24 and 48 hours after the rainfall ends. The area will drain dry after the event similar to a dry bottom stormwater detention pond. It is anticipated that existing vegetation will survive without impact. New sediment is expected to accumulate at a depth of approximately 0.01" per year if the sediment were spread evenly over the 10-acre area of the three cells (Sediment will not be deposited uniformly). A benefit of the BMP is that no sediment removal by the City is anticipated in the future. The vegetation should adapt to the slowly rising ground level similar to vegetation in the floodplain of a major river (like the Illinois River).

Response:

The Implementation Plan has been updated, and detailed information provided by the commenter has been added to Appendix F.

11. The 16th Avenue sediment basin will utilize an existing road embankment. The new construction will consist of an outlet water control structure, shoreline riprap on the upstream face, earth fill to flatten the downstream slope and the extension of the existing culvert. The permanent impoundment will be a 3.4-acre pond with a maximum depth of 11 feet. The outlet control structure will have dewatering

outlets which when opened will allow the sediment to dry and be removed. Sediment removal would be required at a frequency of 10 to 30 years.

Response:

The Implementation Plan has been updated, and detailed information provided by the commenter has been added to Appendix F.

12. The 16th Avenue dam has been submitted for a Section 319 grant in 2020. The other BMP's are under construction and scheduled for completion in 2020.

    Response:

    The Implementation Plan has been updated, and detailed information provided by the commenter has been added to Appendix F.

13. In Section 9.7, two other funding opportunities could be added. The Farmer to Farmer program is a funding source. Chris Davis at Illinois EPA emailed us about this opportunity through the US Department of Agriculture. Also, there is the Regional Conservation Partnership Program (RCPP) through the USDA.

    Response:

    Farmer to Farmer is a potential funding source from USEPA depending upon future funding. Available funds to improve water quality, habitat, resilience, and environmental education through the demonstration of innovative practices on working 'agricultural' lands. The project supports farmer-led or farm focused organizations in the Gulf of Mexico Watershed. Information about Farmer to Farmer Assistance Program (a funding source from USEPA) has been added to Section 9.7 of the report. See link below: https://www.epa.gov/gulfofmexico/farmer-farmer-rfa-and-supporting-documents

    The RCPP program has also been added in Section 9-Implementation Plan, as a potential funding source for implementing BMPs.

Other Public Comment on Lake Lou Yaeger (LLY):

LLY is a valuable resource for the community, but has impairments related to total phosphorus (TP) and total suspended solids (TSS) that have existed for decades. There have been very thorough reports published on potential management of these problems.

In 1995, Crawford, Murphy, and Tilly, Inc. (CMT) published, "Lake Lou Yaeger Restoration Plan" for the City of Litchfield. A Lake Lou Yeager Resource Plan was published in 2001 written by a volunteer planning committee in cooperation with the Montgomery County Soil and Water Conversation District and the USDA Natural Resource Conservation Service. CDM Smith prepared the "Lake Lou Yaeger Watershed Draft TMDL Report for Public Review" for the Illinois Environmental Protection Agency (IEPA) in 2020. This report also includes the City of Litchfield's Lake Lou Yaeger Best Management Plan (BMP) from the 319 Grant they received.

IEPA developed a TMDL and LRSs for LLY based on CDM Smith's Simplified Lake Analysis Model (SLAM). SLAM was developed as a practical and low-cost water quality model focused on lake eutrophication. The TMDL target for total phosphorus in LLY is 0.05 mg/L with 3 sampling locations and watershed segmentations. The infiltration of phosphorus into the lake is associated with sedimentation from erosion. The LRS target value of 21.9 mg/L for TSS establishes that the existing loads of TSS must be reduced by 32% to meet the target concentration in the lake. The less suspended solids in the lake will result in lower phosphorus in the lake. These target values will provide LLY the mechanism to achieve the water quality standards in accordance with Section 303(d) of the federal Clean Water Act.

The City of Litchfield is proposing to construct 3 BMPs, including the construction of 2 sediment ponds and approximately 1,800 linear feet of shoreline erosion remediation. The areas of severe shoreline erosion as shown in the report were recognized in the 1995 CMT Restoration Plan. One of the areas is directly across from our home and we are very pleased to see the erosion being address with a riprap barrier.

The proposed locations for the 2 sediment ponds are at Bishop's Cove and Pete's Cove. These sedimentation ponds will increase the detention time of the tributary inflows of sediment and nutrients. These sediment ponds were described in the CMT report as an alternate D3 and D4 approach to lowering TP and TSS. Hopefully in the future, there will also be sediment ponds D1 and D2 established in the northern areas of the lake where the major infiltration of TP and TSS exists. Data supports the need to address these areas as soon as possible.

The watershed for the 2 sediment ponds D3 (Pete's Cove) and D4 (Bishop's Cove) is 2400 acres. Addressing BMPs in the 74,000-acre watershed is a challenge with hundreds of agricultural property owners. It seems that the BMPs for the City of Litchfield would be to pursue the D1 and D2 areas for future work.

Documentation of the primary infiltration of TP and TSS points to the northern tributaries that are fed by several water resources. West Fork Shoal Creek, Blue Grass Creek, Three mile Branch, and Shop Creek all contribute to the siltation and nutrient problem in LLY. The management of LLY's water quality is certainly challenging, but the City is up to the challenge.

Looking to the future, some issues that must be evaluated. Considering the internal phosphorus in the lake, the BMP would be to install hypolimnetic (bottom water) aeration to increase oxygen transfer efficiencies. Phosphorus inactivation with aluminum sulfate (alum) is not protective of the lake's ecological system and should not be considered. This is not the time to do the cheapest or least protective of LLY.

With the Eagle Ridge Subdivision, very careful planning must include "do no harm." In the Lake Lou Yaeger Resource Plan (page 54), it was recommended to have a buffer zone for home lease sites. The recommended set back from the lake is 1000 to 1500 feet as seen in Federal Lakes. Illinois Lake Shelbyville homes have setbacks of 1000-1500 feet. Such a setback has not been enforced in prior construction but should be strongly considered for future homes on the lake as sited in the Resource Plan.

Septic systems were considered another potential source of nutrients if not designed and maintained properly. Public health and quality of our lake must be considered a mandate to carefully monitor and regulate this potential threat.

Thanks to IEPA and the City of Litchfield for their due diligence in addressing the impairments of LLY and its watershed. Our beautiful lake needs our help and support to survive the ongoing exposure to TP and TSS.

Response:

Thank you, the comment has been noted and added to Appendix F.

Notes from Lake Lou Yaeger Public Stage 1 Meeting

- One stakeholder took issue with the assertion that tile drainage can increase nutrient delivery to surface waters and can increase runoff. RESPONSE: *Text has been updated in Section 5*.
- Several stakeholders disagreed with the presented ag statistics (such as number of cattle in the county). RESPONSE: *Census data were reviewed and confirmed. A statement was added to document that the local stakeholders disagreed with the values*.
- For the slide with the breakdown of tillage practices from the county transect surveys, a stakeholder asked if there was documentation of the ranges of percentage residue for each category. RESPONSE: *Additional information has been added to Section 5.*
- A stakeholder noted that the USGS flow gage that we propose to use to calculate flows for the Lake Lou Yaeger watershed is not necessarily representative of the Lake Lou Yaeger watershed because the tributary area has very different soils. RESPONSE: *Gages with available data were reviewed and flows from a different gage will be evaluated prior to Stage 3 modeling.*
- A stakeholder mentioned that there are likely wastewater loadings coming from camp sites and trailers. RESPONSE: *Text was added to the septic system discussion and information will be included in the implementation plan.*
- The Mayor mentioned that they have compiled a list of projects/improvements. These should get included in the implementation plan so that they may be eligible for 319 funding. RESPONSE: *CDM Smith will work with stakeholders to include projects that have already been identified in the implementation plan.*

Abel A. Haile
Manager, Planning (TMDL) Unit
Illinois Environmental Protection Agency
Watershed Management Section
Bureau of Water
1021 North Grand Ave. East
P.O. Box 19276
Springfield, IL 62794-9276

April 7, 2017

Via email: Abel.Haile@illinois.gov

Dear Mr. Haile:

Thank you for conducting the public meeting on the Total Maximum Daily Load and Load Reduction Strategy for Lake Lou Yaeger Watershed in Litchfield on March 7, 2017. The management and protection of lake quality are of primary concern to us as homeowners on Lake Lou Yaeger, residents who are supplied drinking water from Lake Lou Yaeger, and advocates for clean water.

As discussed at the meeting, erosion of shorelines, farmland, hillsides, etc resulting in high total suspended solids is an ongoing problem since the lake was developed. The extensive watershed has numerous areas that can provide siltation to the lake and will be a challenge to address.

The land surrounding the water in LLY is owned by the City of Litchfield and leased to homeowners and campers at designated sites. Although erosion prevention measures are recommended in leases, there is no enforcement or assistance to stabilize shorelines and property. It is encouraging that the city has applied for a grant that can facilitate homeowners and landowners with the costs of stabilizing land in their area.

Litchfield considers the lake to be a valuable resource and revenue generator for the city. A new subdivision of 60 homes on the lake has been mapped out and there are plans to increase recreational attractions. There are coves that are so full of silt that many residents cannot use their docks or navigate their shoreline. Many studies of Lake Lou Yaeger have been done in the past with potential solutions, but the city has never invested in any recommended siltation management program.

The drainage into LLY is extensive as shown by a recent observation. There was approximately 4 inches of rain in the last 3 weeks that raised the water level 4 feet from the winter drawdown of 4 feet. Is the location of where drainage tiles empty into LLY known or the ditches and gullies that carry the tile water to the lake? RESPONSE: *This information is currently unknown.* Are there streambank stabilization areas at critical points? RESPONSE: *If critical areas have been identified locally, the information will be included in the Stage 3 report/implementation plan.* Have there been turbidity studies after rains on the feeder creeks like West Fork Shoal Creek, Blue Grass Creek, Shop Creek, and Threemile Branch? RESPONSE: *Currently unknown.*

Is there a record of where there are best management practices in place? Filter strips, terracing, and grassed waterways were addressed as potential deterrents to erosion. Is no till crop production utilized in the LLY watershed? Are there any sediment control basins in LLY that are functional? RESPONSE: *We will work with County SWCD reps and local stakeholders to document this information in the Stage 3 report.*

LLY also has chemical impairment with excessive phosphorus. What is your best estimate of the source? RESPONSE: *In general, elevated levels of phosphorus in streams can result from fertilizer use, animal wastes and wastewater, and the use of phosphate detergents. Sources identified by Illinois EPA on the 303(d) list include Agriculture, Internal Nutrient Recycling, Runoff from forest/grassland/parkland. Septic systems and municipal treatment plant effluent also contribute phosphorus loading to Lake Lou Yaeger.* Is phosphate in automatic dishwashing soap like Cascade and Finish outlawed in Illinois? RESPONSE: *Yes, since 2010.* There is a golf course in Raymond that could be one sources of extra phosphorus. RESPONSE: *The implementation plan will include lawn fertilization recommendations to reduce nutrient runoff.* What are the specific phosphate compounds that farmers might apply to their fields?

Were any biological studies performed on LLY like a survey of fish, invertebrates, and aquatic plants? Are there any records of dissolved oxygen in the 3 areas that were examined? RESPONSE: *Lake Lou Yaeger is sampled ever 5 years by Illinois EPA through the Intensive Basin Survey program. The Illinois EPA website describes data collected during Intensive Basin Surveys: "Water chemistry and biological (fish and macroinvertebrate) data along with qualitative and quantitative instream habitat information including stream discharge are collected to characterize stream segments within the basin, identify water quality conditions, and evaluate aquatic life use impairment. Fish tissue contaminant and sediment chemistry sampling are also conducted to screen for the accumulation of toxic substances." It should be noted that in the most recent assessment, the lake itself is shown to be in full use support for public water supply and was not listed for impairment caused by low dissolved oxygen.* Your help and efforts are appreciated and very important for LLY improvement. Looking forward to hearing from you in the future.

Sincerely,

Jim and Mary Ellen DeClue
366 Westlake Trail
Litchfield, IL 62056
jwdmed@consolidated.net

cc: Steve Dougherty, Mayor of Litchfield
Ray Kellenberger, Alderman Ward 4
Dave Hollo, Alderman-Lake

Appendix D

Historical Water Quality Data

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Table D1 - Lake Lou Yaeger Watershed TMDL Water Quality Data

Segment	Date	Time	Analyte	Fraction	Result	Units	Depth
RON-1	2012-06-08	09:41	2,4-D	Total	0.12	ug/l	17 ft
RON-1	2012-10-11	11:47	2,4-D	Total	0.18	ug/l	17 ft
RON-1	2012-08-16	08:51	2,4-D	Total	0.22	ug/l	17 ft
RON-1	2012-04-27	09:11	2,4-D	Total	0.32	ug/l	17 ft
RON-1	2008-10-06	00-Jan-00	Acetochlor	Total	0.01	ug/l	17 ft
RON-1	2012-10-11	11:47	Acetochlor	Total	0.027	ug/l	17 ft
RON-1	2012-08-16	08:51	Acetochlor	Total	0.091	ug/l	17 ft
RON-1	2012-07-23	09:20	Acetochlor	Total	0.13	ug/l	17 ft
RON-1	2012-04-27	09:11	Acetochlor	Total	0.62	ug/l	17 ft
RON-1	2008-08-06	00-Jan-00	Acetochlor	Total	0.76	ug/l	17 ft
RON-1	2012-06-08	09:41	Acetochlor	Total	0.84	ug/l	17 ft
RON-1	2008-06-10	00-Jan-00	Acetochlor	Total	1.9	ug/l	17 ft
RON-1	2008-07-01	00-Jan-00	Acetochlor	Total	2.5	ug/l	17 ft
RON-3	2008-08-06	00-Jan-00	Acetochlor	Total	21	ug/kg	7 ft
RON-1	2008-07-01	00-Jan-00	Alachlor	Total	0.017	ug/l	17 ft
RON-1	2008-06-10	00-Jan-00	Alachlor	Total	0.032	ug/l	17 ft
RON-1	2012-06-08	09:41	Alachlor	Total	0.056	ug/l	17 ft
RON-3	2008-08-06	00-Jan-00	Alachlor	Total	3.2	ug/kg	7 ft
RON-1	2008-10-06	00-Jan-00	Alkalinity, total		40	mg/l	1 ft
RON-1	2008-10-06	00-Jan-00	Alkalinity, total		43	mg/l	17 ft
RON-2	2008-10-06	00-Jan-00	Alkalinity, total		43	mg/l	1 ft
RON-1	2008-10-06	00-Jan-00	Alkalinity, total		47	mg/l	21 ft
RON-3	2008-10-06	00-Jan-00	Alkalinity, total		54	mg/l	1 ft
RON-1	2008-05-06	00-Jan-00	Alkalinity, total		70	mg/l	20 ft
RON-1	2008-05-06	00-Jan-00	Alkalinity, total		70	mg/l	17 ft
RON-2	2008-05-06	00-Jan-00	Alkalinity, total		75	mg/l	1 ft
RON-1	2008-05-06	00-Jan-00	Alkalinity, total		75	mg/l	1 ft
RON-1	2012-06-08	09:38	Alkalinity, total		80	mg/l	1 ft
RON-2	2012-06-08	09:43	Alkalinity, total		80	mg/l	1 ft
RON-1	2012-06-08	09:41	Alkalinity, total		82	mg/l	17 ft
RON-3	2008-05-06	00-Jan-00	Alkalinity, total		85	mg/l	1 ft
RON-3	2008-07-01	00-Jan-00	Alkalinity, total		85	mg/l	1 ft
RON-1	2012-06-08	09:43	Alkalinity, total		88	mg/l	19 ft

Segment	Date	Time	Analyte	Fraction	Result	Units	Depth
RON-3	2012-06-08	10:46	Alkalinity, total		90	mg/l	1 ft
RON-3	2008-06-10	00-Jan-00	Alkalinity, total		90	mg/l	1 ft
RON-2	2008-06-10	00-Jan-00	Alkalinity, total		90	mg/l	1 ft
RON-1	2008-06-10	00-Jan-00	Alkalinity, total		90	mg/l	17 ft
RON-1	2008-06-10	00-Jan-00	Alkalinity, total		95	mg/l	1 ft
RON-1	2008-07-01	00-Jan-00	Alkalinity, total		95	mg/l	1 ft
RON-1	2008-07-01	00-Jan-00	Alkalinity, total		95	mg/l	19 ft
RON-2	2008-08-06	00-Jan-00	Alkalinity, total		95	mg/l	1 ft
RON-2	2012-07-23	09:21	Alkalinity, total		100	mg/l	1 ft
RON-1	2012-10-11	11:47	Alkalinity, total		100	mg/l	17 ft
RON-1	2008-07-01	00-Jan-00	Alkalinity, total		100	mg/l	17 ft
RON-2	2008-07-01	00-Jan-00	Alkalinity, total		100	mg/l	1 ft
RON-1	2008-08-06	00-Jan-00	Alkalinity, total		100	mg/l	19 ft
RON-1	2008-08-06	00-Jan-00	Alkalinity, total		100	mg/l	17 ft
RON-1	2012-07-23	09:18	Alkalinity, total		105	mg/l	1 ft
RON-1	2012-08-16	08:51	Alkalinity, total		105	mg/l	17 ft
RON-1	2012-08-16	08:51	Alkalinity, total		105	mg/l	20 ft
RON-1	2012-10-11	11:47	Alkalinity, total		105	mg/l	20 ft
RON-2	2012-10-11	12:14	Alkalinity, total		105	mg/l	1 ft
RON-1	2008-08-06	00-Jan-00	Alkalinity, total		105	mg/l	1 ft
RON-3	2012-04-27	10:07	Alkalinity, total		110	mg/l	1 ft
RON-1	2012-07-23	09:20	Alkalinity, total		110	mg/l	17 ft
RON-3	2012-07-23	09:51	Alkalinity, total		110	mg/l	1 ft
RON-1	2012-08-16	08:49	Alkalinity, total		110	mg/l	1 ft
RON-2	2012-08-16	08:52	Alkalinity, total		110	mg/l	1 ft
RON-3	2008-08-06	00-Jan-00	Alkalinity, total		110	mg/l	1 ft
RON-1	2012-04-27	09:10	Alkalinity, total		115	mg/l	1 ft
RON-2	2012-04-27	09:11	Alkalinity, total		115	mg/l	1 ft
RON-3	2012-08-16	09:21	Alkalinity, total		115	mg/l	1 ft
RON-1	2012-10-11	11:47	Alkalinity, total		115	mg/l	1 ft
RON-3	2012-10-11	12:27	Alkalinity, total		115	mg/l	1 ft
RON-1	2012-04-27	09:11	Alkalinity, total		120	mg/l	17 ft
RON-1	2012-04-27	09:11	Alkalinity, total		120	mg/l	21 ft

Segment	Date	Time	Analyte	Fraction	Result	Units	Depth
RON-1	2012-07-23	09:21	Alkalinity, total		130	mg/l	20 ft
RON-1	2012-04-27	09:11	Aluminum	Total	67.9	ug/l	17 ft
RON-1	2012-06-08	09:41	Aluminum	Total	174	ug/l	17 ft
RON-1	2008-08-06	00-Jan-00	Aluminum	Total	198	ug/l	17 ft
RON-1	2012-07-23	09:20	Aluminum	Total	212	ug/l	17 ft
RON-1	2012-10-11	11:47	Aluminum	Total	301	ug/l	17 ft
RON-1	2012-08-16	08:51	Aluminum	Total	311	ug/l	17 ft
RON-1	2008-10-06	00-Jan-00	Aluminum	Total	632	ug/l	17 ft
RON-1	2008-06-10	00-Jan-00	Aluminum	Total	776	ug/l	17 ft
RON-1	2008-05-06	00-Jan-00	Aluminum	Total	4270	ug/l	17 ft
RON-3	2012-08-16	09:21	Ammonia-nitrogen	Total	0.02	mg/l	1 ft
RON-1	2012-06-08	09:38	Ammonia-nitrogen	Total	0.03	mg/l	1 ft
RON-1	2012-10-11	11:47	Ammonia-nitrogen	Total	0.11	mg/l	1 ft
RON-1	2012-10-11	11:47	Ammonia-nitrogen	Total	0.13	mg/l	17 ft
RON-1	2012-10-11	11:47	Ammonia-nitrogen	Total	0.15	mg/l	20 ft
RON-1	2012-06-08	09:41	Ammonia-nitrogen	Total	0.27	mg/l	17 ft
RON-1	2012-06-08	09:43	Ammonia-nitrogen	Total	0.36	mg/l	19 ft
RON-1	2012-07-23	09:20	Ammonia-nitrogen	Total	0.4	mg/l	17 ft
RON-1	2012-08-16	08:51	Ammonia-nitrogen	Total	0.62	mg/l	17 ft
RON-2	2012-08-16	08:52	Ammonia-nitrogen	Total	0.68	mg/l	1 ft
RON-1	2012-08-16	08:49	Ammonia-nitrogen	Total	0.73	mg/l	1 ft
RON-1	2012-08-16	08:51	Ammonia-nitrogen	Total	0.74	mg/l	20 ft
RON-1	2012-07-23	09:21	Ammonia-nitrogen	Total	2.34	mg/l	20 ft
RON-1	2012-04-27	09:11	Arsenic	Total	1.85	ug/l	17 ft
RON-1	2012-10-11	11:47	Arsenic	Total	2.87	ug/l	17 ft
RON-1	2012-07-23	09:20	Arsenic	Total	5.6	ug/l	17 ft
RON-1	2012-08-16	08:51	Arsenic	Total	6.66	ug/l	17 ft
RON-1	2008-05-06	00-Jan-00	Arsenic	Total	8.92	ug/l	17 ft
RON-3	2008-08-06	00-Jan-00	Arsenic	Total	10.9	mg/kg	7 ft
RON-1	2008-08-06	00-Jan-00	Arsenic	Total	12.6	mg/kg	21 ft
RON-1	2008-07-01	00-Jan-00	Atrazine	Total	0.11	ug/l	17 ft
RON-1	2008-10-06	00-Jan-00	Atrazine	Total	0.27	ug/l	17 ft
RON-1	2012-10-11	11:47	Atrazine	Total	0.72	ug/l	17 ft

Segment	Date	Time	Analyte	Fraction	Result	Units	Depth
RON-1	2012-06-08	09:41	Atrazine	Total	0.9	ug/l	17 ft
RON-1	2008-08-06	00-Jan-00	Atrazine	Total	0.98	ug/l	17 ft
RON-1	2012-08-16	08:51	Atrazine	Total	1	ug/l	17 ft
RON-1	2012-07-23	09:20	Atrazine	Total	1.1	ug/l	17 ft
RON-1	2012-04-27	09:11	Atrazine	Total	5.4	ug/l	17 ft
RON-1	2008-06-10	00-Jan-00	Atrazine	Total	8.9	ug/l	17 ft
RON-1	2008-10-06	00-Jan-00	Barium	Total	34	ug/l	17 ft
RON-1	2008-08-06	00-Jan-00	Barium	Total	54.9	ug/l	17 ft
RON-1	2012-04-27	09:11	Barium	Total	66.2	ug/l	17 ft
RON-1	2012-07-23	09:20	Barium	Total	69.7	ug/l	17 ft
RON-1	2008-07-01	00-Jan-00	Barium	Total	73	ug/l	17 ft
RON-1	2012-06-08	09:41	Barium	Total	76.3	ug/l	17 ft
RON-1	2008-06-10	00-Jan-00	Barium	Total	76.3	ug/l	17 ft
RON-1	2012-10-11	11:47	Barium	Total	83.1	ug/l	17 ft
RON-1	2008-05-06	00-Jan-00	Barium	Total	97.8	ug/l	17 ft
RON-1	2012-08-16	08:51	Barium	Total	123	ug/l	17 ft
RON-3	2008-08-06	00-Jan-00	Barium	Total	123	mg/kg	7 ft
RON-1	2008-08-06	00-Jan-00	Barium	Total	177	mg/kg	21 ft
RON-1	2012-07-23	09:20	Beryllium	Total	0.16	ug/l	17 ft
RON-1	2012-04-27	09:11	Beryllium	Total	0.81	ug/l	17 ft
RON-1	2008-06-10	00-Jan-00	Boron	Total	4.07	ug/l	17 ft
RON-1	2008-10-06	00-Jan-00	Boron	Total	15.1	ug/l	17 ft
RON-1	2008-08-06	00-Jan-00	Boron	Total	21.9	ug/l	17 ft
RON-1	2012-08-16	08:51	Boron	Total	22.7	ug/l	17 ft
RON-1	2012-07-23	09:20	Boron	Total	22.8	ug/l	17 ft
RON-1	2012-06-08	09:41	Boron	Total	23	ug/l	17 ft
RON-1	2012-04-27	09:11	Boron	Total	26.2	ug/l	17 ft
RON-1	2012-10-11	11:47	Boron	Total	31	ug/l	17 ft
RON-1	2008-07-01	00-Jan-00	Boron	Total	40.6	ug/l	17 ft
RON-1	2012-06-08	09:41	Cadmium	Total	0.5	ug/l	17 ft
RON-1	2008-06-10	00-Jan-00	Cadmium	Total	0.54	ug/l	17 ft
RON-1	2012-04-27	09:11	Cadmium	Total	0.68	ug/l	17 ft
RON-1	2008-07-01	00-Jan-00	Cadmium	Total	0.88	ug/l	17 ft

Segment	Date	Time	Analyte	Fraction	Result	Units	Depth
RON-1	2008-05-06	00-Jan-00	Cadmium	Total	1.49	ug/l	17 ft
RON-1	2008-10-06	00-Jan-00	Calcium	Total	11300	ug/l	17 ft
RON-1	2012-06-08	09:41	Calcium	Total	25300	ug/l	17 ft
RON-1	2012-07-23	09:20	Calcium	Total	26700	ug/l	17 ft
RON-1	2012-08-16	08:51	Calcium	Total	29000	ug/l	17 ft
RON-1	2012-10-11	11:47	Calcium	Total	31900	ug/l	17 ft
RON-1	2008-05-06	00-Jan-00	Calcium	Total	32200	ug/l	17 ft
RON-1	2008-08-06	00-Jan-00	Calcium	Total	32900	ug/l	17 ft
RON-1	2008-07-01	00-Jan-00	Calcium	Total	35500	ug/l	17 ft
RON-1	2012-04-27	09:11	Calcium	Total	38300	ug/l	17 ft
RON-3	2008-08-06	00-Jan-00	Carbon, organic	Total	2.37	%	7 ft
RON-1	2008-08-06	00-Jan-00	Carbon, organic	Total	3.49	%	21 ft
RON-3	2008-08-06	00-Jan-00	Chlordane, cis	Total	0.27	ug/kg	7 ft
RON-1	2008-08-06	00-Jan-00	Chlordane, cis	Total	0.31	ug/kg	21 ft
RON-1	2008-10-06	00-Jan-00	Chloride	Total	3.34	mg/l	21 ft
RON-2	2008-10-06	00-Jan-00	Chloride	Total	3.38	mg/l	1 ft
RON-1	2008-10-06	00-Jan-00	Chloride	Total	3.5	mg/l	1 ft
RON-1	2008-10-06	00-Jan-00	Chloride	Total	3.58	mg/l	17 ft
RON-3	2008-10-06	00-Jan-00	Chloride	Total	4.58	mg/l	1 ft
RON-1	2012-06-08	09:41	Chloride	Total	16.5	mg/l	17 ft
RON-1	2012-07-23	09:20	Chloride	Total	17	mg/l	17 ft
RON-2	2012-10-11	12:14	Chloride	Total	18.6	mg/l	1 ft
RON-1	2012-08-16	08:51	Chloride	Total	19	mg/l	17 ft
RON-1	2012-10-11	11:47	Chloride	Total	19.9	mg/l	20 ft
RON-3	2008-07-01	00-Jan-00	Chloride	Total	20.8	mg/l	1 ft
RON-1	2008-08-06	00-Jan-00	Chloride	Total	21	mg/l	19 ft
RON-1	2008-08-06	00-Jan-00	Chloride	Total	21.2	mg/l	17 ft
RON-3	2008-08-06	00-Jan-00	Chloride	Total	21.5	mg/l	1 ft
RON-1	2008-08-06	00-Jan-00	Chloride	Total	21.6	mg/l	1 ft
RON-2	2008-08-06	00-Jan-00	Chloride	Total	21.8	mg/l	1 ft
RON-1	2008-07-01	00-Jan-00	Chloride	Total	23	mg/l	17 ft
RON-2	2008-07-01	00-Jan-00	Chloride	Total	23	mg/l	1 ft
RON-1	2008-05-06	00-Jan-00	Chloride	Total	23.1	mg/l	17 ft

Segment	Date	Time	Analyte	Fraction	Result	Units	Depth
RON-1	2008-05-06	00-Jan-00	Chloride	Total	23.2	mg/l	1 ft
RON-1	2008-05-06	00-Jan-00	Chloride	Total	23.4	mg/l	20 ft
RON-1	2008-07-01	00-Jan-00	Chloride	Total	23.6	mg/l	19 ft
RON-1	2008-07-01	00-Jan-00	Chloride	Total	23.9	mg/l	1 ft
RON-2	2008-05-06	00-Jan-00	Chloride	Total	24.3	mg/l	1 ft
RON-1	2008-06-10	00-Jan-00	Chloride	Total	24.6	mg/l	17 ft
RON-1	2008-06-10	00-Jan-00	Chloride	Total	24.7	mg/l	1 ft
RON-3	2008-06-10	00-Jan-00	Chloride	Total	25.6	mg/l	1 ft
RON-2	2008-06-10	00-Jan-00	Chloride	Total	25.6	mg/l	1 ft
RON-3	2008-05-06	00-Jan-00	Chloride	Total	25.7	mg/l	1 ft
RON-1	2012-04-27	09:11	Chloride	Total	26.2	mg/l	17 ft
RON-1	2008-05-06	00-Jan-00	Chlorophyll a, corrected for pheophytin	Total	2.91	ug/l	1 ft
RON-2	2008-05-06	00-Jan-00	Chlorophyll a, corrected for pheophytin	Total	5.89	ug/l	1 ft
RON-1	2008-07-01	00-Jan-00	Chlorophyll a, corrected for pheophytin	Total	6.95	ug/l	5 ft
RON-2	2008-06-10	00-Jan-00	Chlorophyll a, corrected for pheophytin	Total	9.09	ug/l	1 ft
RON-2	2008-07-01	00-Jan-00	Chlorophyll a, corrected for pheophytin	Total	9.5	ug/l	3 ft
RON-3	2008-06-10	00-Jan-00	Chlorophyll a, corrected for pheophytin	Total	11.3	ug/l	1 ft
RON-1	2008-06-10	00-Jan-00	Chlorophyll a, corrected for pheophytin	Total	13.3	ug/l	2 ft
RON-1	2008-10-06	00-Jan-00	Chlorophyll a, corrected for pheophytin	Total	17.1	ug/l	4 ft
RON-3	2008-07-01	00-Jan-00	Chlorophyll a, corrected for pheophytin	Total	20.6	ug/l	2 ft
RON-1	2012-08-16	08:49	Chlorophyll a, corrected for pheophytin	Total	25.4	ug/l	4 ft
RON-2	2008-10-06	00-Jan-00	Chlorophyll a, corrected for pheophytin	Total	35.6	ug/l	4 ft
RON-1	2012-10-11	11:47	Chlorophyll a, corrected for pheophytin	Total	38.3	ug/l	3 ft
RON-1	2012-07-23	09:18	Chlorophyll a, corrected for pheophytin	Total	39.2	ug/l	4 ft
RON-3	2008-10-06	00-Jan-00	Chlorophyll a, corrected for pheophytin	Total	42.7	ug/l	3 ft
RON-3	2012-10-11	12:27	Chlorophyll a, corrected for pheophytin	Total	48.1	ug/l	2 ft
RON-2	2012-10-11	12:14	Chlorophyll a, corrected for pheophytin	Total	53.4	ug/l	3 ft
RON-2	2012-07-23	09:21	Chlorophyll a, corrected for pheophytin	Total	55.2	ug/l	3 ft
RON-3	2008-05-06	00-Jan-00	Chlorophyll a, corrected for pheophytin	Total	61.3	ug/l	1 ft
RON-1	2008-08-06	00-Jan-00	Chlorophyll a, corrected for pheophytin	Total	80.7	ug/l	4 ft
RON-1	2012-04-27	09:10	Chlorophyll a, corrected for pheophytin	Total	87.2	ug/l	3 ft
RON-3	2012-04-27	10:07	Chlorophyll a, corrected for pheophytin	Total	87.6	ug/l	2 ft
RON-3	2012-08-16	09:21	Chlorophyll a, corrected for pheophytin	Total	89.4	ug/l	1 ft

Segment	Date	Time	Analyte	Fraction	Result	Units	Depth
RON-2	2012-08-16	08:52	Chlorophyll a, corrected for pheophytin	Total	91.7	ug/l	2 ft
RON-3	2012-07-23	09:51	Chlorophyll a, corrected for pheophytin	Total	92.1	ug/l	2 ft
RON-2	2012-04-27	09:11	Chlorophyll a, corrected for pheophytin	Total	110	ug/l	2 ft
RON-3	2008-08-06	00-Jan-00	Chlorophyll a, corrected for pheophytin	Total	113	ug/l	2 ft
RON-2	2008-08-06	00-Jan-00	Chlorophyll a, corrected for pheophytin	Total	139	ug/l	3 ft
RON-1	2008-05-06	00-Jan-00	Chlorophyll a, uncorrected for pheophytin	Total	7.12	ug/l	1 ft
RON-1	2008-07-01	00-Jan-00	Chlorophyll a, uncorrected for pheophytin	Total	7.18	ug/l	5 ft
RON-2	2008-07-01	00-Jan-00	Chlorophyll a, uncorrected for pheophytin	Total	8.07	ug/l	3 ft
RON-2	2008-05-06	00-Jan-00	Chlorophyll a, uncorrected for pheophytin	Total	9.16	ug/l	1 ft
RON-2	2008-06-10	00-Jan-00	Chlorophyll a, uncorrected for pheophytin	Total	12.2	ug/l	1 ft
RON-3	2008-06-10	00-Jan-00	Chlorophyll a, uncorrected for pheophytin	Total	14.9	ug/l	1 ft
RON-1	2008-06-10	00-Jan-00	Chlorophyll a, uncorrected for pheophytin	Total	15.1	ug/l	2 ft
RON-1	2008-10-06	00-Jan-00	Chlorophyll a, uncorrected for pheophytin	Total	18.5	ug/l	4 ft
RON-3	2008-07-01	00-Jan-00	Chlorophyll a, uncorrected for pheophytin	Total	21	ug/l	2 ft
RON-1	2012-08-16	08:49	Chlorophyll a, uncorrected for pheophytin	Total	32.8	ug/l	4 ft
RON-2	2008-10-06	00-Jan-00	Chlorophyll a, uncorrected for pheophytin	Total	38.3	ug/l	4 ft
RON-1	2012-10-11	11:47	Chlorophyll a, uncorrected for pheophytin	Total	42.6	ug/l	3 ft
RON-1	2012-07-23	09:18	Chlorophyll a, uncorrected for pheophytin	Total	47.1	ug/l	4 ft
RON-3	2008-10-06	00-Jan-00	Chlorophyll a, uncorrected for pheophytin	Total	48.6	ug/l	3 ft
RON-3	2012-10-11	12:27	Chlorophyll a, uncorrected for pheophytin	Total	53.1	ug/l	2 ft
RON-2	2012-10-11	12:14	Chlorophyll a, uncorrected for pheophytin	Total	61.7	ug/l	3 ft
RON-3	2008-05-06	00-Jan-00	Chlorophyll a, uncorrected for pheophytin	Total	66.8	ug/l	1 ft
RON-2	2012-07-23	09:21	Chlorophyll a, uncorrected for pheophytin	Total	67	ug/l	3 ft
RON-1	2008-08-06	00-Jan-00	Chlorophyll a, uncorrected for pheophytin	Total	85.3	ug/l	4 ft
RON-1	2012-04-27	09:10	Chlorophyll a, uncorrected for pheophytin	Total	88.8	ug/l	3 ft
RON-3	2012-04-27	10:07	Chlorophyll a, uncorrected for pheophytin	Total	92.4	ug/l	2 ft
RON-3	2012-08-16	09:21	Chlorophyll a, uncorrected for pheophytin	Total	98.7	ug/l	1 ft
RON-2	2012-08-16	08:52	Chlorophyll a, uncorrected for pheophytin	Total	101	ug/l	2 ft
RON-3	2012-07-23	09:51	Chlorophyll a, uncorrected for pheophytin	Total	110	ug/l	2 ft
RON-2	2012-04-27	09:11	Chlorophyll a, uncorrected for pheophytin	Total	111	ug/l	2 ft
RON-3	2008-08-06	00-Jan-00	Chlorophyll a, uncorrected for pheophytin	Total	117	ug/l	2 ft
RON-2	2008-08-06	00-Jan-00	Chlorophyll a, uncorrected for pheophytin	Total	147	ug/l	3 ft
RON-1	2012-04-27	09:10	Chlorophyll b	Total	1.67	ug/l	3 ft

Segment	Date	Time	Analyte	Fraction	Result	Units	Depth
RON-2	2012-04-27	09:11	Chlorophyll b	Total	1.84	ug/l	2 ft
RON-3	2012-04-27	10:07	Chlorophyll b	Total	1.91	ug/l	2 ft
RON-1	2012-08-16	08:49	Chlorophyll c	Total	1.57	ug/l	4 ft
RON-1	2012-07-23	09:18	Chlorophyll c	Total	3.03	ug/l	4 ft
RON-2	2012-07-23	09:21	Chlorophyll c	Total	3.38	ug/l	3 ft
RON-3	2012-08-16	09:21	Chlorophyll c	Total	6.55	ug/l	1 ft
RON-3	2012-07-23	09:51	Chlorophyll c	Total	6.65	ug/l	2 ft
RON-2	2012-08-16	08:52	Chlorophyll c	Total	7.82	ug/l	2 ft
RON-3	2012-04-27	10:07	Chlorophyll c	Total	9.39	ug/l	2 ft
RON-1	2012-04-27	09:10	Chlorophyll c	Total	9.54	ug/l	3 ft
RON-2	2012-04-27	09:11	Chlorophyll c	Total	11.8	ug/l	2 ft
RON-1	2008-06-10	00-Jan-00	Chlorophyll-c	Total	1.38	ug/l	2 ft
RON-2	2008-06-10	00-Jan-00	Chlorophyll-c	Total	1.89	ug/l	1 ft
RON-3	2008-06-10	00-Jan-00	Chlorophyll-c	Total	2.03	ug/l	1 ft
RON-1	2008-10-06	00-Jan-00	Chlorophyll-c	Total	3.58	ug/l	4 ft
RON-3	2008-07-01	00-Jan-00	Chlorophyll-c	Total	3.85	ug/l	2 ft
RON-2	2008-10-06	00-Jan-00	Chlorophyll-c	Total	4.81	ug/l	4 ft
RON-3	2008-10-06	00-Jan-00	Chlorophyll-c	Total	5.58	ug/l	3 ft
RON-1	2008-08-06	00-Jan-00	Chlorophyll-c	Total	6.32	ug/l	4 ft
RON-3	2008-05-06	00-Jan-00	Chlorophyll-c	Total	7.01	ug/l	1 ft
RON-3	2008-08-06	00-Jan-00	Chlorophyll-c	Total	7.98	ug/l	2 ft
RON-2	2008-08-06	00-Jan-00	Chlorophyll-c	Total	13	ug/l	3 ft
RON-1	2012-08-16	08:51	Chromium	Total	0.49	ug/l	17 ft
RON-1	2012-10-11	11:47	Chromium	Total	0.5	ug/l	17 ft
RON-1	2012-06-08	09:41	Chromium	Total	0.82	ug/l	17 ft
RON-1	2008-10-06	00-Jan-00	Chromium	Total	0.93	ug/l	17 ft
RON-1	2008-08-06	00-Jan-00	Chromium	Total	1.23	ug/l	17 ft
RON-1	2008-06-10	00-Jan-00	Chromium	Total	1.31	ug/l	17 ft
RON-1	2008-07-01	00-Jan-00	Chromium	Total	1.4	ug/l	17 ft
RON-1	2008-05-06	00-Jan-00	Chromium	Total	4.78	ug/l	17 ft
RON-3	2008-08-06	00-Jan-00	Chromium	Total	12.3	mg/kg	7 ft
RON-1	2008-08-06	00-Jan-00	Chromium	Total	15.4	mg/kg	21 ft
RON-1	2012-10-11	11:47	Cobalt	Total	0.33	ug/l	17 ft

Segment	Date	Time	Analyte	Fraction	Result	Units	Depth
RON-1	2012-07-23	09:20	Cobalt	Total	0.34	ug/l	17 ft
RON-1	2012-06-08	09:41	Cobalt	Total	0.48	ug/l	17 ft
RON-1	2012-08-16	08:51	Cobalt	Total	0.6	ug/l	17 ft
RON-1	2008-05-06	00-Jan-00	Cobalt	Total	1.24	ug/l	17 ft
RON-1	2012-04-27	09:11	Cobalt	Total	3.65	ug/l	17 ft
RON-1	2008-07-01	00-Jan-00	Copper	Total	1.68	ug/l	17 ft
RON-1	2012-06-08	09:41	Copper	Total	2.53	ug/l	17 ft
RON-1	2008-05-06	00-Jan-00	Copper	Total	2.99	ug/l	17 ft
RON-1	2008-08-06	00-Jan-00	Copper	Total	3.55	ug/l	17 ft
RON-1	2012-04-27	09:11	Copper	Total	3.62	ug/l	17 ft
RON-1	2012-08-16	08:51	Copper	Total	4.98	ug/l	17 ft
RON-3	2008-08-06	00-Jan-00	Copper	Total	8.4	mg/kg	7 ft
RON-1	2008-08-06	00-Jan-00	Copper	Total	13.3	mg/kg	21 ft
RON-3	2008-06-10		Depth, bottom		6	ft	
RON-3	2008-07-01		Depth, bottom		6	ft	
RON-3	2008-05-06		Depth, bottom		7	ft	
RON-3	2008-08-06		Depth, bottom		7	ft	
RON-3	2008-10-06		Depth, bottom		7	ft	
RON-2	2008-07-01		Depth, bottom		13	ft	
RON-2	2008-10-06		Depth, bottom		14	ft	
RON-2	2008-08-06		Depth, bottom		15	ft	
RON-2	2008-06-10		Depth, bottom		16	ft	
RON-2	2008-05-06		Depth, bottom		20	ft	
RON-1	2008-06-10		Depth, bottom		21	ft	
RON-1	2008-07-01		Depth, bottom		21	ft	
RON-1	2008-08-06		Depth, bottom		21	ft	
RON-1	2008-05-06		Depth, bottom		22	ft	
RON-1	2008-10-06		Depth, bottom		23	ft	
RON-2	2008-05-06	00-Jan-00	Depth, Secchi Disk Depth		5	in	
RON-3	2008-06-10	00-Jan-00	Depth, Secchi Disk Depth		5	in	
RON-1	2008-05-06	00-Jan-00	Depth, Secchi Disk Depth		6	in	
RON-1	2008-05-06	00-Jan-00	Depth, Secchi Disk Depth		6	in	
RON-3	2008-05-06	00-Jan-00	Depth, Secchi Disk Depth		6	in	

Segment	Date	Time	Analyte	Fraction	Result	Units	Depth
RON-2	2008-06-10	00-Jan-00	Depth, Secchi Disk Depth		7	in	
RON-3	2008-07-01	00-Jan-00	Depth, Secchi Disk Depth		10	in	
RON-1	2008-06-10	00-Jan-00	Depth, Secchi Disk Depth		12	in	
RON-3	2008-08-06	00-Jan-00	Depth, Secchi Disk Depth		12	in	
RON-2	2008-08-06	00-Jan-00	Depth, Secchi Disk Depth		15	in	
RON-3	2008-10-06	00-Jan-00	Depth, Secchi Disk Depth		15	in	
RON-2	2008-07-01	00-Jan-00	Depth, Secchi Disk Depth		17	in	
RON-1	2008-08-06	00-Jan-00	Depth, Secchi Disk Depth		21	in	
RON-2	2008-10-06	00-Jan-00	Depth, Secchi Disk Depth		23	in	
RON-1	2008-10-06	00-Jan-00	Depth, Secchi Disk Depth		25	in	
RON-1	2008-07-01	00-Jan-00	Depth, Secchi Disk Depth		29	in	
RON-1	2012-06-08	09:41	Dicamba	Total	0.054	ug/l	17 ft
RON-1	2008-06-10	00-Jan-00	Dicamba	Total	0.087	ug/l	17 ft
RON-1	2008-07-01	00-Jan-00	Dicamba	Total	0.11	ug/l	17 ft
RON-1	2012-04-27	09:11	Dieldrin	Total	0.0019	ug/l	17 ft
RON-1	2008-05-06	00-Jan-00	Dieldrin	Total	0.0037	ug/l	17 ft
RON-1	2012-06-08	09:41	Dieldrin	Total	0.0052	ug/l	17 ft
RON-1	2008-06-10	00-Jan-00	Dieldrin	Total	0.0058	ug/l	17 ft
RON-1	2012-07-23	09:20	Dieldrin	Total	0.0061	ug/l	17 ft
RON-1	2008-08-06	00-Jan-00	Dieldrin	Total	0.0063	ug/l	17 ft
RON-1	2008-07-01	00-Jan-00	Dieldrin	Total	0.0092	ug/l	17 ft
RON-3	2008-08-06	00-Jan-00	Dieldrin	Total	0.87	ug/kg	7 ft
RON-1	2008-08-06	00-Jan-00	Dieldrin	Total	0.93	ug/kg	21 ft
RON-1	2012-04-27	09:11	Dinoseb	Total	0.063	ug/l	17 ft
RON-1	2012-06-08	09:41	Dinoseb	Total	0.099	ug/l	17 ft
RON-1	2012-06-08	09:41	Fluoride	Total	0.25	mg/l	17 ft
RON-1	2012-07-23	09:20	Fluoride	Total	0.26	mg/l	17 ft
RON-1	2012-04-27	09:11	Fluoride	Total	0.29	mg/l	17 ft
RON-1	2012-08-16	08:51	Fluoride	Total	0.3	mg/l	17 ft
RON-1	2012-10-11	11:47	Fluoride	Total	0.31	mg/l	17 ft
RON-1	2008-10-06	00-Jan-00	Hardness, Ca + Mg	Total	41500	ug/l	17 ft
RON-1	2008-05-06	00-Jan-00	Hardness, Ca + Mg	Total	125000	ug/l	17 ft
RON-1	2008-08-06	00-Jan-00	Hardness, Ca + Mg	Total	129000	ug/l	17 ft

Segment	Date	Time	Analyte	Fraction	Result	Units	Depth
RON-1	2008-07-01	00-Jan-00	Hardness, Ca + Mg	Total	137000	ug/l	17 ft
RON-1	2012-06-08	09:41	Hardness, Ca, Mg		97000	ug/l	17 ft
RON-1	2012-07-23	09:20	Hardness, Ca, Mg		108000	ug/l	17 ft
RON-1	2012-08-16	08:51	Hardness, Ca, Mg		116000	ug/l	17 ft
RON-1	2012-10-11	11:47	Hardness, Ca, Mg		126000	ug/l	17 ft
RON-1	2012-04-27	09:11	Hardness, Ca, Mg		155000	ug/l	17 ft
RON-1	2012-08-16	08:51	Heptachlor	Total	0.00075	ug/l	17 ft
RON-1	2012-04-27	09:11	Heptachlor	Total	0.0011	ug/l	17 ft
RON-1	2012-08-16	08:51	Inorganic nitrogen (nitrate and nitrite)	Total	0.019	mg/l	20 ft
RON-2	2012-10-11	12:14	Inorganic nitrogen (nitrate and nitrite)	Total	0.047	mg/l	1 ft
RON-1	2012-10-11	11:47	Inorganic nitrogen (nitrate and nitrite)	Total	0.225	mg/l	17 ft
RON-1	2012-10-11	11:47	Inorganic nitrogen (nitrate and nitrite)	Total	0.235	mg/l	20 ft
RON-1	2012-10-11	11:47	Inorganic nitrogen (nitrate and nitrite)	Total	0.249	mg/l	1 ft
RON-1	2012-04-27	09:11	Inorganic nitrogen (nitrate and nitrite)	Total	0.95	mg/l	21 ft
RON-1	2012-04-27	09:11	Inorganic nitrogen (nitrate and nitrite)	Total	0.973	mg/l	17 ft
RON-1	2012-04-27	09:10	Inorganic nitrogen (nitrate and nitrite)	Total	0.974	mg/l	1 ft
RON-3	2012-06-08	10:46	Inorganic nitrogen (nitrate and nitrite)	Total	1.42	mg/l	1 ft
RON-1	2012-06-08	09:38	Inorganic nitrogen (nitrate and nitrite)	Total	1.83	mg/l	1 ft
RON-2	2012-06-08	09:43	Inorganic nitrogen (nitrate and nitrite)	Total	1.85	mg/l	1 ft
RON-1	2012-06-08	09:43	Inorganic nitrogen (nitrate and nitrite)	Total	2.46	mg/l	19 ft
RON-2	2012-04-27	09:11	Inorganic nitrogen (nitrate and nitrite)	Total	2.5	mg/l	1 ft
RON-1	2012-06-08	09:41	Inorganic nitrogen (nitrate and nitrite)	Total	2.62	mg/l	17 ft
RON-3	2012-04-27	10:07	Inorganic nitrogen (nitrate and nitrite)	Total	3.55	mg/l	1 ft
RON-1	2012-07-23	09:20	Iron	Total	242	ug/l	17 ft
RON-1	2008-08-06	00-Jan-00	Iron	Total	263	ug/l	17 ft
RON-1	2012-04-27	09:11	Iron	Total	304	ug/l	17 ft
RON-1	2012-06-08	09:41	Iron	Total	362	ug/l	17 ft
RON-1	2012-10-11	11:47	Iron	Total	508	ug/l	17 ft
RON-1	2012-08-16	08:51	Iron	Total	575	ug/l	17 ft
RON-1	2008-06-10	00-Jan-00	Iron	Total	662	ug/l	17 ft
RON-1	2008-07-01	00-Jan-00	Iron	Total	777	ug/l	17 ft
RON-1	2008-10-06	00-Jan-00	Iron	Total	784	ug/l	17 ft
RON-1	2008-05-06	00-Jan-00	Iron	Total	4600	ug/l	17 ft

Segment	Date	Time	Analyte	Fraction	Result	Units	Depth
RON-3	2008-08-06	00-Jan-00	Iron	Total	13600	mg/kg	7 ft
RON-1	2008-08-06	00-Jan-00	Iron	Total	19100	mg/kg	21 ft
RON-1	2012-06-08	09:41	Kjeldahl nitrogen	Total	0.511	mg/l	17 ft
RON-1	2012-06-08	09:43	Kjeldahl nitrogen	Total	0.514	mg/l	19 ft
RON-3	2012-06-08	10:46	Kjeldahl nitrogen	Total	0.677	mg/l	1 ft
RON-1	2012-07-23	09:18	Kjeldahl nitrogen	Total	0.927	mg/l	1 ft
RON-1	2012-04-27	09:11	Kjeldahl nitrogen	Total	0.937	mg/l	17 ft
RON-1	2012-10-11	11:47	Kjeldahl nitrogen	Total	0.948	mg/l	1 ft
RON-1	2012-10-11	11:47	Kjeldahl nitrogen	Total	1.01	mg/l	17 ft
RON-1	2012-04-27	09:11	Kjeldahl nitrogen	Total	1.05	mg/l	21 ft
RON-2	2012-10-11	12:14	Kjeldahl nitrogen	Total	1.13	mg/l	1 ft
RON-1	2012-04-27	09:10	Kjeldahl nitrogen	Total	1.14	mg/l	1 ft
RON-1	2012-10-11	11:47	Kjeldahl nitrogen	Total	1.14	mg/l	20 ft
RON-3	2012-10-11	12:27	Kjeldahl nitrogen	Total	1.14	mg/l	1 ft
RON-1	2012-08-16	08:49	Kjeldahl nitrogen	Total	1.16	mg/l	1 ft
RON-2	2012-06-08	09:43	Kjeldahl nitrogen	Total	1.18	mg/l	1 ft
RON-3	2012-04-27	10:07	Kjeldahl nitrogen	Total	1.2	mg/l	1 ft
RON-1	2012-07-23	09:20	Kjeldahl nitrogen	Total	1.26	mg/l	17 ft
RON-3	2012-08-16	09:21	Kjeldahl nitrogen	Total	1.26	mg/l	1 ft
RON-1	2012-08-16	08:51	Kjeldahl nitrogen	Total	1.28	mg/l	17 ft
RON-2	2012-08-16	08:52	Kjeldahl nitrogen	Total	1.33	mg/l	1 ft
RON-1	2012-08-16	08:51	Kjeldahl nitrogen	Total	1.45	mg/l	20 ft
RON-2	2012-04-27	09:11	Kjeldahl nitrogen	Total	1.5	mg/l	1 ft
RON-3	2012-07-23	09:51	Kjeldahl nitrogen	Total	1.55	mg/l	1 ft
RON-1	2012-06-08	09:38	Kjeldahl nitrogen	Total	1.6	mg/l	1 ft
RON-1	2012-07-23	09:21	Kjeldahl nitrogen	Total	2.82	mg/l	20 ft
RON-2	2012-07-23	09:21	Kjeldahl nitrogen	Total	2.83	mg/l	1 ft
RON-1	2008-08-06	00-Jan-00	Lead	Total	0.76	ug/l	17 ft
RON-1	2008-06-10	00-Jan-00	Lead	Total	0.89	ug/l	17 ft
RON-1	2012-04-27	09:11	Lead	Total	1	ug/l	17 ft
RON-1	2012-06-08	09:41	Lead	Total	1.04	ug/l	17 ft
RON-1	2008-05-06	00-Jan-00	Lead	Total	3.89	ug/l	17 ft
RON-1	2008-08-06	00-Jan-00	Lead	Total	13.1	mg/kg	21 ft

Segment	Date	Time	Analyte	Fraction	Result	Units	Depth
RON-3	2008-08-06	00-Jan-00	Lead	Total	14.3	mg/kg	7 ft
RON-1	2008-10-06	00-Jan-00	Magnesium	Total	3210	ug/l	17 ft
RON-1	2012-06-08	09:41	Magnesium	Total	8180	ug/l	17 ft
RON-1	2012-07-23	09:20	Magnesium	Total	10100	ug/l	17 ft
RON-1	2012-08-16	08:51	Magnesium	Total	10600	ug/l	17 ft
RON-1	2008-05-06	00-Jan-00	Magnesium	Total	10900	ug/l	17 ft
RON-1	2012-10-11	11:47	Magnesium	Total	11300	ug/l	17 ft
RON-1	2008-08-06	00-Jan-00	Magnesium	Total	11400	ug/l	17 ft
RON-1	2008-07-01	00-Jan-00	Magnesium	Total	11800	ug/l	17 ft
RON-1	2012-04-27	09:11	Magnesium	Total	14300	ug/l	17 ft
RON-1	2008-06-10	00-Jan-00	Manganese	Total	65.4	ug/l	17 ft
RON-1	2008-08-06	00-Jan-00	Manganese	Total	73.5	ug/l	17 ft
RON-1	2008-07-01	00-Jan-00	Manganese	Total	97.8	ug/l	17 ft
RON-1	2008-05-06	00-Jan-00	Manganese	Total	104	ug/l	17 ft
RON-1	2012-04-27	09:11	Manganese	Total	115	ug/l	17 ft
RON-1	2012-06-08	09:41	Manganese	Total	140	ug/l	17 ft
RON-1	2012-10-11	11:47	Manganese	Total	167	ug/l	17 ft
RON-1	2008-10-06	00-Jan-00	Manganese	Total	174	ug/l	17 ft
RON-1	2012-08-16	08:51	Manganese	Total	318	ug/l	17 ft
RON-3	2008-08-06	00-Jan-00	Manganese	Total	379	mg/kg	7 ft
RON-1	2012-07-23	09:20	Manganese	Total	622	ug/l	17 ft
RON-1	2008-08-06	00-Jan-00	Manganese	Total	1080	mg/kg	21 ft
RON-1	2008-08-06	00-Jan-00	Mercury	Total	0.03	mg/kg	21 ft
RON-3	2008-08-06	00-Jan-00	Mercury	Total	0.04	mg/kg	7 ft
RON-1	2008-10-06	00-Jan-00	Methoxychlor	Total	0.0065	ug/l	17 ft
RON-1	2008-05-06	00-Jan-00	Methoxychlor	Total	0.012	ug/l	17 ft
RON-1	2008-08-06	00-Jan-00	Methoxychlor	Total	0.024	ug/l	17 ft
RON-1	2008-05-06	00-Jan-00	Metolachlor	Total	0.095	ug/l	17 ft
RON-1	2008-10-06	00-Jan-00	Metolachlor	Total	0.2	ug/l	17 ft
RON-1	2012-10-11	11:47	Metolachlor	Total	0.23	ug/l	17 ft
RON-1	2012-08-16	08:51	Metolachlor	Total	0.8	ug/l	17 ft
RON-1	2012-07-23	09:20	Metolachlor	Total	1.3	ug/l	17 ft
RON-1	2012-04-27	09:11	Metolachlor	Total	1.7	ug/l	17 ft

Segment	Date	Time	Analyte	Fraction	Result	Units	Depth
RON-1	2008-08-06	00-Jan-00	Metolachlor	Total	2.8	ug/l	17 ft
RON-1	2008-06-10	00-Jan-00	Metolachlor	Total	3.3	ug/l	17 ft
RON-1	2012-06-08	09:41	Metolachlor	Total	4.2	ug/l	17 ft
RON-1	2008-07-01	00-Jan-00	Metolachlor	Total	4.7	ug/l	17 ft
RON-1	2012-07-23	09:20	Metribuzin	Total	0.0082	ug/l	17 ft
RON-1	2012-04-27	09:11	Metribuzin	Total	0.01	ug/l	17 ft
RON-1	2012-10-11	11:47	Metribuzin	Total	0.01	ug/l	17 ft
RON-1	2012-08-16	08:51	Metribuzin	Total	0.012	ug/l	17 ft
RON-1	2012-06-08	09:41	Metribuzin	Total	0.038	ug/l	17 ft
RON-1	2008-08-06	00-Jan-00	Nickel	Total	0.6	ug/l	17 ft
RON-1	2012-07-23	09:20	Nickel	Total	0.68	ug/l	17 ft
RON-1	2008-06-10	00-Jan-00	Nickel	Total	0.79	ug/l	17 ft
RON-1	2012-10-11	11:47	Nickel	Total	1.03	ug/l	17 ft
RON-1	2008-10-06	00-Jan-00	Nickel	Total	1.13	ug/l	17 ft
RON-1	2012-06-08	09:41	Nickel	Total	1.7	ug/l	17 ft
RON-1	2008-07-01	00-Jan-00	Nickel	Total	2.33	ug/l	17 ft
RON-1	2008-05-06	00-Jan-00	Nickel	Total	3.13	ug/l	17 ft
RON-3	2008-08-06	00-Jan-00	Nickel	Total	10.9	mg/kg	7 ft
RON-1	2008-08-06	00-Jan-00	Nickel	Total	15.3	mg/kg	21 ft
RON-2	2008-08-06	00-Jan-00	Nitrogen, ammonia as N	Total	0.0516	mg/l	1 ft
RON-3	2008-08-06	00-Jan-00	Nitrogen, ammonia as N	Total	0.0553	mg/l	1 ft
RON-1	2008-08-06	00-Jan-00	Nitrogen, ammonia as N	Total	0.0604	mg/l	1 ft
RON-1	2008-08-06	00-Jan-00	Nitrogen, ammonia as N	Total	0.0681	mg/l	17 ft
RON-1	2008-08-06	00-Jan-00	Nitrogen, ammonia as N	Total	0.136	mg/l	19 ft
RON-3	2008-10-06	00-Jan-00	Nitrogen, ammonia as N	Total	0.17	mg/l	1 ft
RON-1	2008-06-10	00-Jan-00	Nitrogen, ammonia as N	Total	0.175	mg/l	17 ft
RON-1	2008-07-01	00-Jan-00	Nitrogen, ammonia as N	Total	0.185	mg/l	1 ft
RON-1	2008-06-10	00-Jan-00	Nitrogen, ammonia as N	Total	0.207	mg/l	1 ft
RON-1	2008-06-10	00-Jan-00	Nitrogen, ammonia as N	Total	0.217	mg/l	19 ft
RON-3	2008-07-01	00-Jan-00	Nitrogen, ammonia as N	Total	0.251	mg/l	1 ft
RON-2	2008-06-10	00-Jan-00	Nitrogen, ammonia as N	Total	0.28	mg/l	1 ft
RON-3	2008-06-10	00-Jan-00	Nitrogen, ammonia as N	Total	0.288	mg/l	1 ft
RON-2	2008-10-06	00-Jan-00	Nitrogen, ammonia as N	Total	0.31	mg/l	1 ft

Segment	Date	Time	Analyte	Fraction	Result	Units	Depth
RON-2	2008-07-01	00-Jan-00	Nitrogen, ammonia as N	Total	0.339	mg/l	1 ft
RON-1	2008-07-01	00-Jan-00	Nitrogen, ammonia as N	Total	0.36	mg/l	17 ft
RON-1	2008-10-06	00-Jan-00	Nitrogen, ammonia as N	Total	0.369	mg/l	17 ft
RON-1	2008-10-06	00-Jan-00	Nitrogen, ammonia as N	Total	0.466	mg/l	1 ft
RON-1	2008-07-01	00-Jan-00	Nitrogen, ammonia as N	Total	0.553	mg/l	19 ft
RON-1	2008-10-06	00-Jan-00	Nitrogen, ammonia as N	Total	0.842	mg/l	21 ft
RON-1	2008-07-01	00-Jan-00	Nitrogen, Kjeldahl	Total	0.593	mg/l	1 ft
RON-1	2008-10-06	00-Jan-00	Nitrogen, Kjeldahl	Total	0.757	mg/l	1 ft
RON-2	2008-10-06	00-Jan-00	Nitrogen, Kjeldahl	Total	0.761	mg/l	1 ft
RON-3	2008-10-06	00-Jan-00	Nitrogen, Kjeldahl	Total	0.768	mg/l	1 ft
RON-1	2008-05-06	00-Jan-00	Nitrogen, Kjeldahl	Total	0.822	mg/l	1 ft
RON-1	2008-05-06	00-Jan-00	Nitrogen, Kjeldahl	Total	0.843	mg/l	17 ft
RON-1	2008-05-06	00-Jan-00	Nitrogen, Kjeldahl	Total	0.855	mg/l	20 ft
RON-1	2008-06-10	00-Jan-00	Nitrogen, Kjeldahl	Total	0.872	mg/l	19 ft
RON-2	2008-05-06	00-Jan-00	Nitrogen, Kjeldahl	Total	0.873	mg/l	1 ft
RON-1	2008-10-06	00-Jan-00	Nitrogen, Kjeldahl	Total	0.896	mg/l	17 ft
RON-1	2008-08-06	00-Jan-00	Nitrogen, Kjeldahl	Total	0.966	mg/l	17 ft
RON-1	2008-06-10	00-Jan-00	Nitrogen, Kjeldahl	Total	0.967	mg/l	1 ft
RON-1	2008-08-06	00-Jan-00	Nitrogen, Kjeldahl	Total	0.992	mg/l	19 ft
RON-1	2008-07-01	00-Jan-00	Nitrogen, Kjeldahl	Total	1.04	mg/l	17 ft
RON-2	2008-07-01	00-Jan-00	Nitrogen, Kjeldahl	Total	1.06	mg/l	1 ft
RON-1	2008-08-06	00-Jan-00	Nitrogen, Kjeldahl	Total	1.07	mg/l	1 ft
RON-3	2008-05-06	00-Jan-00	Nitrogen, Kjeldahl	Total	1.08	mg/l	1 ft
RON-1	2008-06-10	00-Jan-00	Nitrogen, Kjeldahl	Total	1.1	mg/l	17 ft
RON-1	2008-10-06	00-Jan-00	Nitrogen, Kjeldahl	Total	1.1	mg/l	21 ft
RON-1	2008-07-01	00-Jan-00	Nitrogen, Kjeldahl	Total	1.12	mg/l	19 ft
RON-2	2008-06-10	00-Jan-00	Nitrogen, Kjeldahl	Total	1.19	mg/l	1 ft
RON-3	2008-07-01	00-Jan-00	Nitrogen, Kjeldahl	Total	1.23	mg/l	1 ft
RON-3	2008-06-10	00-Jan-00	Nitrogen, Kjeldahl	Total	1.33	mg/l	1 ft
RON-2	2008-08-06	00-Jan-00	Nitrogen, Kjeldahl	Total	1.78	mg/l	1 ft
RON-3	2008-08-06	00-Jan-00	Nitrogen, Kjeldahl	Total	1.91	mg/l	1 ft
RON-3	2008-08-06	00-Jan-00	Nitrogen, Kjeldahl	Total	2260	mg/kg	7 ft
RON-1	2008-08-06	00-Jan-00	Nitrogen, Kjeldahl	Total	3890	mg/kg	21 ft

Segment	Date	Time	Analyte	Fraction	Result	Units	Depth
RON-2	2008-10-06	00-Jan-00	Nitrogen, Nitrite (NO2) + Nitrate (NO3) as N	Total	0.029	mg/l	1 ft
RON-1	2008-10-06	00-Jan-00	Nitrogen, Nitrite (NO2) + Nitrate (NO3) as N	Total	0.031	mg/l	17 ft
RON-1	2008-10-06	00-Jan-00	Nitrogen, Nitrite (NO2) + Nitrate (NO3) as N	Total	0.034	mg/l	1 ft
RON-1	2008-10-06	00-Jan-00	Nitrogen, Nitrite (NO2) + Nitrate (NO3) as N	Total	0.044	mg/l	21 ft
RON-3	2008-08-06	00-Jan-00	Nitrogen, Nitrite (NO2) + Nitrate (NO3) as N	Total	0.513	mg/l	1 ft
RON-2	2008-08-06	00-Jan-00	Nitrogen, Nitrite (NO2) + Nitrate (NO3) as N	Total	1.32	mg/l	1 ft
RON-1	2008-08-06	00-Jan-00	Nitrogen, Nitrite (NO2) + Nitrate (NO3) as N	Total	2.12	mg/l	1 ft
RON-1	2008-08-06	00-Jan-00	Nitrogen, Nitrite (NO2) + Nitrate (NO3) as N	Total	2.24	mg/l	17 ft
RON-1	2008-08-06	00-Jan-00	Nitrogen, Nitrite (NO2) + Nitrate (NO3) as N	Total	2.26	mg/l	19 ft
RON-3	2008-07-01	00-Jan-00	Nitrogen, Nitrite (NO2) + Nitrate (NO3) as N	Total	4.16	mg/l	1 ft
RON-1	2008-07-01	00-Jan-00	Nitrogen, Nitrite (NO2) + Nitrate (NO3) as N	Total	4.98	mg/l	19 ft
RON-2	2008-07-01	00-Jan-00	Nitrogen, Nitrite (NO2) + Nitrate (NO3) as N	Total	5.07	mg/l	1 ft
RON-1	2008-07-01	00-Jan-00	Nitrogen, Nitrite (NO2) + Nitrate (NO3) as N	Total	5.15	mg/l	17 ft
RON-1	2008-07-01	00-Jan-00	Nitrogen, Nitrite (NO2) + Nitrate (NO3) as N	Total	5.17	mg/l	1 ft
RON-1	2008-06-10	00-Jan-00	Nitrogen, Nitrite (NO2) + Nitrate (NO3) as N	Total	5.52	mg/l	19 ft
RON-1	2008-06-10	00-Jan-00	Nitrogen, Nitrite (NO2) + Nitrate (NO3) as N	Total	5.56	mg/l	17 ft
RON-1	2008-06-10	00-Jan-00	Nitrogen, Nitrite (NO2) + Nitrate (NO3) as N	Total	5.69	mg/l	1 ft
RON-2	2008-06-10	00-Jan-00	Nitrogen, Nitrite (NO2) + Nitrate (NO3) as N	Total	5.73	mg/l	1 ft
RON-2	2008-05-06	00-Jan-00	Nitrogen, Nitrite (NO2) + Nitrate (NO3) as N	Total	5.81	mg/l	1 ft
RON-1	2008-05-06	00-Jan-00	Nitrogen, Nitrite (NO2) + Nitrate (NO3) as N	Total	5.94	mg/l	20 ft
RON-1	2008-05-06	00-Jan-00	Nitrogen, Nitrite (NO2) + Nitrate (NO3) as N	Total	5.99	mg/l	17 ft
RON-1	2008-05-06	00-Jan-00	Nitrogen, Nitrite (NO2) + Nitrate (NO3) as N	Total	6	mg/l	1 ft
RON-3	2008-06-10	00-Jan-00	Nitrogen, Nitrite (NO2) + Nitrate (NO3) as N	Total	6.13	mg/l	1 ft
RON-3	2008-05-06	00-Jan-00	Nitrogen, Nitrite (NO2) + Nitrate (NO3) as N	Total	6.24	mg/l	1 ft
RON-1	2012-04-27	09:11	Pentachlorophenol	Total	0.019	ug/l	17 ft
RON-1	2012-06-08	09:41	Pentachlorophenol	Total	0.042	ug/l	17 ft
RON-1	2008-10-06	00-Jan-00	pH		7		17 ft
RON-1	2008-10-06	00-Jan-00	pH		7.06		21 ft
RON-1	2008-10-06	00-Jan-00	pH		7.21		1 ft
RON-1	2008-06-10	00-Jan-00	pH		7.25		19 ft
RON-1	2008-06-10	00-Jan-00	pH		7.35		17 ft
RON-1	2008-07-01	00-Jan-00	pH		7.39		19 ft
RON-1	2008-05-06	00-Jan-00	pH		7.4		1 ft

Segment	Date	Time	Analyte	Fraction	Result	Units	Depth
RON-1	2008-07-01	00-Jan-00	pH		7.44		17 ft
RON-2	2008-06-10	00-Jan-00	pH		7.49		1 ft
RON-1	2008-05-06	00-Jan-00	pH		7.5		17 ft
RON-1	2008-05-06	00-Jan-00	pH		7.5		20 ft
RON-2	2008-05-06	00-Jan-00	pH		7.5		1 ft
RON-3	2008-06-10	00-Jan-00	pH		7.53		1 ft
RON-1	2008-07-01	00-Jan-00	pH		7.58		1 ft
RON-1	2008-06-10	00-Jan-00	pH		7.67		1 ft
RON-2	2008-10-06	00-Jan-00	pH		7.68		1 ft
RON-2	2008-07-01	00-Jan-00	pH		7.71		1 ft
RON-3	2008-07-01	00-Jan-00	pH		7.84		1 ft
RON-1	2008-08-06	00-Jan-00	pH		8.4		19 ft
RON-3	2008-05-06	00-Jan-00	pH		8.5		1 ft
RON-1	2008-08-06	00-Jan-00	pH		8.7		17 ft
RON-3	2008-10-06	00-Jan-00	pH		8.8		1 ft
RON-1	2008-08-06	00-Jan-00	pH		9.14		1 ft
RON-2	2008-08-06	00-Jan-00	pH		9.4		1 ft
RON-3	2008-08-06	00-Jan-00	pH		9.5		1 ft
RON-1	2008-10-06	00-Jan-00	Phenol	Total	46	ug/l	17 ft
RON-1	2012-04-27	09:11	Phenols	Total	1.55	ug/l	17 ft
RON-1	2012-10-11	11:47	Phenols	Total	1.59	ug/l	17 ft
RON-3	2012-04-27	10:07	Pheophytin a	Total	2.88	ug/l	2 ft
RON-1	2012-10-11	11:47	Pheophytin a	Total	4.72	ug/l	3 ft
RON-3	2012-10-11	12:27	Pheophytin a	Total	5.21	ug/l	2 ft
RON-3	2012-08-16	09:21	Pheophytin a	Total	9.61	ug/l	1 ft
RON-2	2012-08-16	08:52	Pheophytin a	Total	9.88	ug/l	2 ft
RON-2	2012-10-11	12:14	Pheophytin a	Total	10.1	ug/l	3 ft
RON-1	2012-08-16	08:49	Pheophytin a	Total	10.6	ug/l	4 ft
RON-1	2012-07-23	09:18	Pheophytin a	Total	10.7	ug/l	4 ft
RON-2	2012-07-23	09:21	Pheophytin a	Total	15.8	ug/l	3 ft
RON-3	2012-07-23	09:51	Pheophytin a	Total	23.8	ug/l	2 ft
RON-1	2008-10-06	00-Jan-00	Pheophytin-a	Total	1.35	ug/l	4 ft
RON-1	2008-06-10	00-Jan-00	Pheophytin-a	Total	1.96	ug/l	2 ft

Segment	Date	Time	Analyte	Fraction	Result	Units	Depth
RON-2	2008-10-06	00-Jan-00	Pheophytin-a	Total	2.04	ug/l	4 ft
RON-1	2008-08-06	00-Jan-00	Pheophytin-a	Total	2.19	ug/l	4 ft
RON-2	2008-08-06	00-Jan-00	Pheophytin-a	Total	2.94	ug/l	3 ft
RON-2	2008-06-10	00-Jan-00	Pheophytin-a	Total	4.6	ug/l	1 ft
RON-2	2008-05-06	00-Jan-00	Pheophytin-a	Total	4.97	ug/l	1 ft
RON-3	2008-06-10	00-Jan-00	Pheophytin-a	Total	5.19	ug/l	1 ft
RON-3	2008-05-06	00-Jan-00	Pheophytin-a	Total	5.25	ug/l	1 ft
RON-1	2008-05-06	00-Jan-00	Pheophytin-a	Total	6.67	ug/l	1 ft
RON-3	2008-10-06	00-Jan-00	Pheophytin-a	Total	6.75	ug/l	3 ft
RON-3	2012-06-08	10:46	Phosphorus	Dissolved	0.015	mg/l	1 ft
RON-2	2012-06-08	09:43	Phosphorus	Dissolved	0.027	mg/l	1 ft
RON-1	2012-10-11	11:47	Phosphorus	Dissolved	0.028	mg/l	1 ft
RON-1	2012-04-27	09:10	Phosphorus	Dissolved	0.029	mg/l	1 ft
RON-1	2012-04-27	09:11	Phosphorus	Dissolved	0.031	mg/l	17 ft
RON-2	2012-10-11	12:14	Phosphorus	Dissolved	0.034	mg/l	1 ft
RON-1	2012-04-27	09:11	Phosphorus	Dissolved	0.037	mg/l	21 ft
RON-2	2012-04-27	09:11	Phosphorus	Dissolved	0.041	mg/l	1 ft
RON-3	2012-10-11	12:27	Phosphorus	Dissolved	0.045	mg/l	1 ft
RON-3	2012-04-27	10:07	Phosphorus	Dissolved	0.053	mg/l	1 ft
RON-1	2012-06-08	09:38	Phosphorus	Dissolved	0.066	mg/l	1 ft
RON-1	2012-06-08	09:41	Phosphorus	Dissolved	0.077	mg/l	17 ft
RON-1	2012-06-08	09:43	Phosphorus	Dissolved	0.087	mg/l	19 ft
RON-2	2012-08-16	08:52	Phosphorus	Dissolved	0.096	mg/l	1 ft
RON-1	2012-08-16	08:51	Phosphorus	Dissolved	0.098	mg/l	17 ft
RON-1	2012-08-16	08:51	Phosphorus	Dissolved	0.099	mg/l	20 ft
RON-1	2012-10-11	11:47	Phosphorus	Total	0.099	mg/l	1 ft
RON-1	2012-10-11	11:47	Phosphorus	Total	0.103	mg/l	17 ft
RON-1	2012-08-16	08:49	Phosphorus	Dissolved	0.104	mg/l	1 ft
RON-3	2012-06-08	10:46	Phosphorus	Total	0.113	mg/l	1 ft
RON-1	2012-10-11	11:47	Phosphorus	Total	0.114	mg/l	20 ft
RON-1	2012-07-23	09:18	Phosphorus	Dissolved	0.12	mg/l	1 ft
RON-2	2012-10-11	12:14	Phosphorus	Total	0.122	mg/l	1 ft
RON-1	2012-06-08	09:41	Phosphorus	Total	0.124	mg/l	17 ft

Segment	Date	Time	Analyte	Fraction	Result	Units	Depth
RON-1	2012-04-27	09:11	Phosphorus	Total	0.128	mg/l	21 ft
RON-1	2012-04-27	09:10	Phosphorus	Total	0.135	mg/l	1 ft
RON-1	2012-06-08	09:43	Phosphorus	Total	0.135	mg/l	19 ft
RON-1	2012-04-27	09:11	Phosphorus	Total	0.136	mg/l	17 ft
RON-3	2012-08-16	09:21	Phosphorus	Dissolved	0.138	mg/l	1 ft
RON-2	2012-06-08	09:43	Phosphorus	Total	0.145	mg/l	1 ft
RON-2	2012-07-23	09:21	Phosphorus	Dissolved	0.146	mg/l	1 ft
RON-3	2012-10-11	12:27	Phosphorus	Total	0.164	mg/l	1 ft
RON-3	2012-04-27	10:07	Phosphorus	Total	0.169	mg/l	1 ft
RON-1	2012-07-23	09:20	Phosphorus	Dissolved	0.173	mg/l	17 ft
RON-2	2012-04-27	09:11	Phosphorus	Total	0.181	mg/l	1 ft
RON-1	2012-08-16	08:49	Phosphorus	Total	0.187	mg/l	1 ft
RON-1	2012-06-08	09:38	Phosphorus	Total	0.19	mg/l	1 ft
RON-1	2012-07-23	09:18	Phosphorus	Total	0.192	mg/l	1 ft
RON-1	2012-08-16	08:51	Phosphorus	Total	0.2	mg/l	17 ft
RON-1	2012-08-16	08:51	Phosphorus	Total	0.208	mg/l	20 ft
RON-2	2012-08-16	08:52	Phosphorus	Total	0.228	mg/l	1 ft
RON-1	2012-07-23	09:20	Phosphorus	Total	0.261	mg/l	17 ft
RON-2	2012-07-23	09:21	Phosphorus	Total	0.265	mg/l	1 ft
RON-3	2012-07-23	09:51	Phosphorus	Dissolved	0.27	mg/l	1 ft
RON-3	2012-08-16	09:21	Phosphorus	Total	0.322	mg/l	1 ft
RON-1	2012-07-23	09:21	Phosphorus	Dissolved	0.327	mg/l	20 ft
RON-3	2012-07-23	09:51	Phosphorus	Total	0.499	mg/l	1 ft
RON-1	2012-07-23	09:21	Phosphorus	Total	0.649	mg/l	20 ft
RON-1	2008-08-06	00-Jan-00	Phosphorus as P	Dissolved	0.019	mg/l	1 ft
RON-2	2008-08-06	00-Jan-00	Phosphorus as P	Dissolved	0.02	mg/l	1 ft
RON-1	2008-08-06	00-Jan-00	Phosphorus as P	Dissolved	0.029	mg/l	17 ft
RON-1	2008-08-06	00-Jan-00	Phosphorus as P	Dissolved	0.035	mg/l	19 ft
RON-3	2008-08-06	00-Jan-00	Phosphorus as P	Dissolved	0.04	mg/l	1 ft
RON-1	2008-05-06	00-Jan-00	Phosphorus as P	Dissolved	0.072	mg/l	17 ft
RON-3	2008-05-06	00-Jan-00	Phosphorus as P	Dissolved	0.073	mg/l	1 ft
RON-1	2008-08-06	00-Jan-00	Phosphorus as P	Total	0.085	mg/l	1 ft
RON-1	2008-08-06	00-Jan-00	Phosphorus as P	Total	0.09	mg/l	19 ft

Segment	Date	Time	Analyte	Fraction	Result	Units	Depth
RON-3	2008-10-06	00-Jan-00	Phosphorus as P	Dissolved	0.095	mg/l	1 ft
RON-1	2008-08-06	00-Jan-00	Phosphorus as P	Total	0.096	mg/l	17 ft
RON-1	2008-06-10	00-Jan-00	Phosphorus as P	Dissolved	0.12	mg/l	1 ft
RON-2	2008-07-01	00-Jan-00	Phosphorus as P	Dissolved	0.123	mg/l	1 ft
RON-2	2008-08-06	00-Jan-00	Phosphorus as P	Total	0.128	mg/l	1 ft
RON-1	2008-06-10	00-Jan-00	Phosphorus as P	Dissolved	0.129	mg/l	19 ft
RON-2	2008-05-06	00-Jan-00	Phosphorus as P	Dissolved	0.13	mg/l	1 ft
RON-1	2008-05-06	00-Jan-00	Phosphorus as P	Dissolved	0.13	mg/l	1 ft
RON-1	2008-06-10	00-Jan-00	Phosphorus as P	Dissolved	0.131	mg/l	17 ft
RON-1	2008-05-06	00-Jan-00	Phosphorus as P	Dissolved	0.136	mg/l	20 ft
RON-1	2008-07-01	00-Jan-00	Phosphorus as P	Dissolved	0.139	mg/l	1 ft
RON-2	2008-10-06	00-Jan-00	Phosphorus as P	Dissolved	0.141	mg/l	1 ft
RON-1	2008-10-06	00-Jan-00	Phosphorus as P	Dissolved	0.143	mg/l	21 ft
RON-1	2008-07-01	00-Jan-00	Phosphorus as P	Dissolved	0.146	mg/l	17 ft
RON-1	2008-07-01	00-Jan-00	Phosphorus as P	Dissolved	0.146	mg/l	19 ft
RON-1	2008-10-06	00-Jan-00	Phosphorus as P	Dissolved	0.161	mg/l	17 ft
RON-2	2008-06-10	00-Jan-00	Phosphorus as P	Dissolved	0.162	mg/l	1 ft
RON-2	2008-07-01	00-Jan-00	Phosphorus as P	Total	0.167	mg/l	1 ft
RON-1	2008-06-10	00-Jan-00	Phosphorus as P	Total	0.168	mg/l	19 ft
RON-1	2008-06-10	00-Jan-00	Phosphorus as P	Total	0.173	mg/l	17 ft
RON-1	2008-06-10	00-Jan-00	Phosphorus as P	Total	0.175	mg/l	1 ft
RON-1	2008-07-01	00-Jan-00	Phosphorus as P	Total	0.176	mg/l	1 ft
RON-1	2008-07-01	00-Jan-00	Phosphorus as P	Total	0.176	mg/l	17 ft
RON-3	2008-07-01	00-Jan-00	Phosphorus as P	Dissolved	0.177	mg/l	1 ft
RON-1	2008-07-01	00-Jan-00	Phosphorus as P	Total	0.179	mg/l	19 ft
RON-1	2008-10-06	00-Jan-00	Phosphorus as P	Dissolved	0.179	mg/l	1 ft
RON-3	2008-08-06	00-Jan-00	Phosphorus as P	Total	0.18	mg/l	1 ft
RON-3	2008-06-10	00-Jan-00	Phosphorus as P	Dissolved	0.192	mg/l	1 ft
RON-3	2008-05-06	00-Jan-00	Phosphorus as P	Total	0.227	mg/l	1 ft
RON-3	2008-10-06	00-Jan-00	Phosphorus as P	Total	0.229	mg/l	1 ft
RON-1	2008-10-06	00-Jan-00	Phosphorus as P	Total	0.24	mg/l	1 ft
RON-2	2008-06-10	00-Jan-00	Phosphorus as P	Total	0.246	mg/l	1 ft
RON-2	2008-10-06	00-Jan-00	Phosphorus as P	Total	0.254	mg/l	1 ft

Segment	Date	Time	Analyte	Fraction	Result	Units	Depth
RON-3	2008-07-01	00-Jan-00	Phosphorus as P	Total	0.27	mg/l	1 ft
RON-1	2008-10-06	00-Jan-00	Phosphorus as P	Total	0.273	mg/l	17 ft
RON-2	2008-05-06	00-Jan-00	Phosphorus as P	Total	0.288	mg/l	1 ft
RON-1	2008-05-06	00-Jan-00	Phosphorus as P	Total	0.302	mg/l	17 ft
RON-1	2008-05-06	00-Jan-00	Phosphorus as P	Total	0.311	mg/l	1 ft
RON-1	2008-05-06	00-Jan-00	Phosphorus as P	Total	0.313	mg/l	20 ft
RON-3	2008-06-10	00-Jan-00	Phosphorus as P	Total	0.329	mg/l	1 ft
RON-1	2008-10-06	00-Jan-00	Phosphorus as P	Total	0.367	mg/l	21 ft
RON-3	2008-08-06	00-Jan-00	Phosphorus as P	Total	791	mg/kg	7 ft
RON-1	2008-08-06	00-Jan-00	Phosphorus as P	Total	1130	mg/kg	21 ft
RON-1	2012-06-08	09:41	Picloram	Total	0.049	ug/l	17 ft
RON-1	2012-04-27	09:11	Picloram	Total	0.057	ug/l	17 ft
RON-3	2008-08-06	00-Jan-00	Potassium	Total	1340	mg/kg	7 ft
RON-1	2008-08-06	00-Jan-00	Potassium	Total	1740	mg/kg	21 ft
RON-1	2012-04-27	09:11	Potassium	Total	3130	ug/l	17 ft
RON-1	2012-06-08	09:41	Potassium	Total	3520	ug/l	17 ft
RON-1	2012-07-23	09:20	Potassium	Total	3910	ug/l	17 ft
RON-1	2008-07-01	00-Jan-00	Potassium	Total	4270	ug/l	17 ft
RON-1	2012-08-16	08:51	Potassium	Total	4320	ug/l	17 ft
RON-1	2012-10-11	11:47	Potassium	Total	4400	ug/l	17 ft
RON-1	2008-08-06	00-Jan-00	Potassium	Total	4630	ug/l	17 ft
RON-1	2008-05-06	00-Jan-00	Potassium	Total	4720	ug/l	17 ft
RON-1	2008-10-06	00-Jan-00	Potassium	Total	4920	ug/l	17 ft
RON-1	2008-07-01	00-Jan-00	Simazine	Total	0.037	ug/l	17 ft
RON-1	2012-08-16	08:51	Simazine	Total	0.042	ug/l	17 ft
RON-1	2008-10-06	00-Jan-00	Simazine	Total	0.1	ug/l	17 ft
RON-1	2008-08-06	00-Jan-00	Simazine	Total	0.11	ug/l	17 ft
RON-1	2012-04-27	09:11	Simazine	Total	0.25	ug/l	17 ft
RON-1	2008-06-10	00-Jan-00	Simazine	Total	0.41	ug/l	17 ft
RON-1	2008-05-06	00-Jan-00	Simazine	Total	0.74	ug/l	17 ft
RON-1	2008-10-06	00-Jan-00	Sodium	Total	2120	ug/l	17 ft
RON-1	2012-06-08	09:41	Sodium	Total	9380	ug/l	17 ft
RON-1	2012-07-23	09:20	Sodium	Total	11300	ug/l	17 ft

Segment	Date	Time	Analyte	Fraction	Result	Units	Depth
RON-1	2008-05-06	00-Jan-00	Sodium	Total	11300	ug/l	17 ft
RON-1	2008-08-06	00-Jan-00	Sodium	Total	11900	ug/l	17 ft
RON-1	2012-08-16	08:51	Sodium	Total	12400	ug/l	17 ft
RON-1	2012-10-11	11:47	Sodium	Total	12400	ug/l	17 ft
RON-1	2008-07-01	00-Jan-00	Sodium	Total	12400	ug/l	17 ft
RON-1	2012-04-27	09:11	Sodium	Total	18400	ug/l	17 ft
RON-1	2008-10-06	00-Jan-00	Solids, Dissolved	Dissolved	48	mg/l	17 ft
RON-1	2008-08-06	00-Jan-00	Solids, Dissolved	Dissolved	194	mg/l	17 ft
RON-1	2008-06-10	00-Jan-00	Solids, Dissolved	Dissolved	216	mg/l	1 ft
RON-1	2008-06-10	00-Jan-00	Solids, Dissolved	Dissolved	218	mg/l	17 ft
RON-1	2008-07-01	00-Jan-00	Solids, Dissolved	Dissolved	226	mg/l	17 ft
RON-3	2008-05-06	00-Jan-00	Solids, Dissolved	Dissolved	240	mg/l	1 ft
RON-2	2008-05-06	00-Jan-00	Solids, Dissolved	Dissolved	240	mg/l	1 ft
RON-1	2008-05-06	00-Jan-00	Solids, Dissolved	Dissolved	240	mg/l	20 ft
RON-1	2008-05-06	00-Jan-00	Solids, Dissolved	Dissolved	246	mg/l	17 ft
RON-2	2008-06-10	00-Jan-00	Solids, Dissolved	Dissolved	250	mg/l	1 ft
RON-1	2008-05-06	00-Jan-00	Solids, Dissolved	Dissolved	254	mg/l	1 ft
RON-3	2008-06-10	00-Jan-00	Solids, Dissolved	Dissolved	262	mg/l	1 ft
RON-3	2008-06-10	00-Jan-00	Solids, suspended, volatile		4	mg/l	1 ft
RON-1	2008-06-10	00-Jan-00	Solids, suspended, volatile		4	mg/l	1 ft
RON-1	2008-07-01	00-Jan-00	Solids, suspended, volatile		4	mg/l	19 ft
RON-1	2008-08-06	00-Jan-00	Solids, suspended, volatile		4	mg/l	19 ft
RON-1	2008-06-10	00-Jan-00	Solids, suspended, volatile		5	mg/l	19 ft
RON-1	2008-10-06	00-Jan-00	Solids, suspended, volatile		5	mg/l	1 ft
RON-2	2008-05-06	00-Jan-00	Solids, suspended, volatile		6	mg/l	1 ft
RON-1	2008-05-06	00-Jan-00	Solids, suspended, volatile		6	mg/l	20 ft
RON-1	2008-05-06	00-Jan-00	Solids, suspended, volatile		7	mg/l	17 ft
RON-1	2008-05-06	00-Jan-00	Solids, suspended, volatile		7	mg/l	1 ft
RON-3	2008-07-01	00-Jan-00	Solids, suspended, volatile		7	mg/l	1 ft
RON-1	2008-08-06	00-Jan-00	Solids, suspended, volatile		7	mg/l	17 ft
RON-2	2008-10-06	00-Jan-00	Solids, suspended, volatile		7	mg/l	1 ft
RON-1	2008-10-06	00-Jan-00	Solids, suspended, volatile		8	mg/l	17 ft
RON-3	2008-05-06	00-Jan-00	Solids, suspended, volatile		9	mg/l	1 ft

Segment	Date	Time	Analyte	Fraction	Result	Units	Depth
RON-1	2008-08-06	00-Jan-00	Solids, suspended, volatile		10	mg/l	1 ft
RON-3	2008-10-06	00-Jan-00	Solids, suspended, volatile		11	mg/l	1 ft
RON-1	2008-10-06	00-Jan-00	Solids, suspended, volatile		16	mg/l	21 ft
RON-2	2008-08-06	00-Jan-00	Solids, suspended, volatile		18	mg/l	1 ft
RON-3	2008-08-06	00-Jan-00	Solids, suspended, volatile		20	mg/l	1 ft
RON-1	2008-07-01	00-Jan-00	Solids, Total Suspended (TSS)		4	mg/l	17 ft
RON-2	2008-07-01	00-Jan-00	Solids, Total Suspended (TSS)		6	mg/l	1 ft
RON-1	2008-08-06	00-Jan-00	Solids, Total Suspended (TSS)		8	mg/l	17 ft
RON-1	2008-10-06	00-Jan-00	Solids, Total Suspended (TSS)		8	mg/l	1 ft
RON-1	2008-06-10	00-Jan-00	Solids, Total Suspended (TSS)		9	mg/l	17 ft
RON-1	2008-08-06	00-Jan-00	Solids, Total Suspended (TSS)		9	mg/l	19 ft
RON-1	2008-06-10	00-Jan-00	Solids, Total Suspended (TSS)		11	mg/l	1 ft
RON-2	2008-10-06	00-Jan-00	Solids, Total Suspended (TSS)		11	mg/l	1 ft
RON-1	2008-08-06	00-Jan-00	Solids, Total Suspended (TSS)		12	mg/l	1 ft
RON-1	2008-06-10	00-Jan-00	Solids, Total Suspended (TSS)		14	mg/l	19 ft
RON-2	2008-06-10	00-Jan-00	Solids, Total Suspended (TSS)		15	mg/l	1 ft
RON-1	2008-10-06	00-Jan-00	Solids, Total Suspended (TSS)		18	mg/l	17 ft
RON-3	2008-07-01	00-Jan-00	Solids, Total Suspended (TSS)		19	mg/l	1 ft
RON-3	2008-10-06	00-Jan-00	Solids, Total Suspended (TSS)		21	mg/l	1 ft
RON-2	2008-08-06	00-Jan-00	Solids, Total Suspended (TSS)		24	mg/l	1 ft
RON-2	2008-05-06	00-Jan-00	Solids, Total Suspended (TSS)		25	mg/l	1 ft
RON-1	2008-05-06	00-Jan-00	Solids, Total Suspended (TSS)		29	mg/l	20 ft
RON-1	2008-05-06	00-Jan-00	Solids, Total Suspended (TSS)		29	mg/l	1 ft
RON-1	2008-05-06	00-Jan-00	Solids, Total Suspended (TSS)		30	mg/l	17 ft
RON-3	2008-06-10	00-Jan-00	Solids, Total Suspended (TSS)		30	mg/l	1 ft
RON-3	2008-05-06	00-Jan-00	Solids, Total Suspended (TSS)		33	mg/l	1 ft
RON-3	2008-08-06	00-Jan-00	Solids, Total Suspended (TSS)		33	mg/l	1 ft
RON-1	2008-10-06	00-Jan-00	Solids, Total Suspended (TSS)		75	mg/l	21 ft
RON-1	2008-10-06	00-Jan-00	Specific conductance		95	umho/cm	1 ft
RON-1	2008-10-06	00-Jan-00	Specific conductance		99	umho/cm	17 ft
RON-1	2008-10-06	00-Jan-00	Specific conductance		99	umho/cm	21 ft
RON-2	2008-10-06	00-Jan-00	Specific conductance		103	umho/cm	1 ft
RON-3	2008-10-06	00-Jan-00	Specific conductance		133	umho/cm	1 ft

Segment	Date	Time	Analyte	Fraction	Result	Units	Depth
RON-1	2008-05-06	00-Jan-00	Specific conductance		298	umho/cm	17 ft
RON-1	2008-05-06	00-Jan-00	Specific conductance		299	umho/cm	20 ft
RON-1	2008-05-06	00-Jan-00	Specific conductance		300	umho/cm	1 ft
RON-2	2008-08-06	00-Jan-00	Specific conductance		302	umho/cm	1 ft
RON-3	2008-08-06	00-Jan-00	Specific conductance		303	umho/cm	1 ft
RON-2	2008-05-06	00-Jan-00	Specific conductance		305	umho/cm	1 ft
RON-1	2008-08-06	00-Jan-00	Specific conductance		318	umho/cm	1 ft
RON-1	2008-08-06	00-Jan-00	Specific conductance		326	umho/cm	17 ft
RON-3	2008-07-01	00-Jan-00	Specific conductance		327	umho/cm	1 ft
RON-1	2008-08-06	00-Jan-00	Specific conductance		331	umho/cm	19 ft
RON-2	2008-06-10	00-Jan-00	Specific conductance		355	umho/cm	1 ft
RON-3	2008-05-06	00-Jan-00	Specific conductance		355	umho/cm	1 ft
RON-3	2008-06-10	00-Jan-00	Specific conductance		355	umho/cm	1 ft
RON-1	2008-07-01	00-Jan-00	Specific conductance		368	umho/cm	1 ft
RON-1	2008-06-10	00-Jan-00	Specific conductance		369	umho/cm	1 ft
RON-1	2008-07-01	00-Jan-00	Specific conductance		369	umho/cm	17 ft
RON-1	2008-07-01	00-Jan-00	Specific conductance		371	umho/cm	19 ft
RON-2	2008-07-01	00-Jan-00	Specific conductance		372	umho/cm	1 ft
RON-1	2008-06-10	00-Jan-00	Specific conductance		375	umho/cm	19 ft
RON-1	2008-06-10	00-Jan-00	Specific conductance		376	umho/cm	17 ft
RON-1	2008-10-06	00-Jan-00	Strontium	Total	33.5	ug/l	17 ft
RON-1	2012-06-08	09:41	Strontium	Total	87.9	ug/l	17 ft
RON-1	2012-07-23	09:20	Strontium	Total	91.6	ug/l	17 ft
RON-1	2008-05-06	00-Jan-00	Strontium	Total	95	ug/l	17 ft
RON-1	2012-08-16	08:51	Strontium	Total	106	ug/l	17 ft
RON-1	2012-10-11	11:47	Strontium	Total	106	ug/l	17 ft
RON-1	2008-08-06	00-Jan-00	Strontium	Total	107	ug/l	17 ft
RON-1	2012-04-27	09:11	Strontium	Total	110	ug/l	17 ft
RON-1	2008-07-01	00-Jan-00	Strontium	Total	111	ug/l	17 ft
RON-1	2008-06-10	00-Jan-00	Strontium	Total	115	ug/l	17 ft
RON-1	2012-07-23	09:20	Sulfate	Total	4.35	mg/l	17 ft
RON-1	2012-06-08	09:41	Sulfate	Total	9.44	mg/l	17 ft
RON-1	2008-05-06	00-Jan-00	Sulfate	Total	10.7	mg/l	17 ft

Segment	Date	Time	Analyte	Fraction	Result	Units	Depth
RON-1	2012-08-16	08:51	Sulfate	Total	11.4	mg/l	17 ft
RON-1	2008-07-01	00-Jan-00	Sulfate	Total	17.5	mg/l	17 ft
RON-1	2008-06-10	00-Jan-00	Sulfate	Total	20.5	mg/l	17 ft
RON-1	2012-04-27	09:11	Sulfate	Total	33.3	mg/l	17 ft
RON-1	2008-05-06	00-Jan-00	Temperature, sample		0	deg C	1 ft
RON-2	2008-05-06	00-Jan-00	Temperature, sample		0	deg C	1 ft
RON-3	2008-05-06	00-Jan-00	Temperature, sample		0	deg C	1 ft
RON-1	2008-06-10	00-Jan-00	Temperature, sample		0	deg C	2 ft
RON-2	2008-06-10	00-Jan-00	Temperature, sample		0	deg C	1 ft
RON-3	2008-06-10	00-Jan-00	Temperature, sample		0	deg C	1 ft
RON-1	2008-07-01	00-Jan-00	Temperature, sample		0	deg C	5 ft
RON-2	2008-07-01	00-Jan-00	Temperature, sample		0	deg C	3 ft
RON-3	2008-07-01	00-Jan-00	Temperature, sample		0	deg C	2 ft
RON-1	2008-08-06	00-Jan-00	Temperature, sample		0	deg C	21 ft
RON-3	2008-08-06	00-Jan-00	Temperature, sample		0	deg C	7 ft
RON-1	2008-08-06	00-Jan-00	Temperature, sample		0	deg C	4 ft
RON-2	2008-08-06	00-Jan-00	Temperature, sample		0	deg C	3 ft
RON-3	2008-08-06	00-Jan-00	Temperature, sample		0	deg C	2 ft
RON-1	2008-10-06	00-Jan-00	Temperature, sample		0	deg C	4 ft
RON-2	2008-10-06	00-Jan-00	Temperature, sample		0	deg C	4 ft
RON-3	2008-10-06	00-Jan-00	Temperature, sample		0	deg C	3 ft
RON-1	2012-06-08	09:38	Temperature, sample		2	deg C	
RON-1	2012-06-08	09:41	Temperature, sample		2	deg C	
RON-1	2012-06-08	09:43	Temperature, sample		2	deg C	
RON-2	2012-06-08	09:43	Temperature, sample		2	deg C	
RON-3	2012-06-08	10:46	Temperature, sample		2	deg C	
RON-1	2012-10-11	11:47	Temperature, sample		2	deg C	
RON-1	2012-10-11	11:47	Temperature, sample		2	deg C	
RON-1	2012-10-11	11:47	Temperature, sample		2	deg C	
RON-2	2012-10-11	12:14	Temperature, sample		2	deg C	
RON-3	2012-10-11	12:27	Temperature, sample		2	deg C	
RON-1	2012-04-27	09:11	Temperature, sample		3	deg C	
RON-1	2012-04-27	09:11	Temperature, sample		3	deg C	

Segment	Date	Time	Analyte	Fraction	Result	Units	Depth
RON-1	2012-04-27	09:10	Temperature, sample		3	deg C	
RON-2	2012-04-27	09:11	Temperature, sample		3	deg C	
RON-3	2012-04-27	10:07	Temperature, sample		3	deg C	
RON-1	2008-05-06	00-Jan-00	Temperature, sample		3	deg C	17 ft
RON-3	2008-05-06	00-Jan-00	Temperature, sample		3	deg C	1 ft
RON-2	2008-05-06	00-Jan-00	Temperature, sample		3	deg C	1 ft
RON-1	2008-05-06	00-Jan-00	Temperature, sample		3	deg C	17 ft
RON-1	2008-05-06	00-Jan-00	Temperature, sample		3	deg C	1 ft
RON-3	2008-06-10	00-Jan-00	Temperature, sample		3	deg C	1 ft
RON-2	2008-06-10	00-Jan-00	Temperature, sample		3	deg C	1 ft
RON-1	2008-06-10	00-Jan-00	Temperature, sample		3	deg C	19 ft
RON-1	2008-06-10	00-Jan-00	Temperature, sample		3	deg C	17 ft
RON-1	2008-06-10	00-Jan-00	Temperature, sample		3	deg C	17 ft
RON-1	2008-06-10	00-Jan-00	Temperature, sample		3	deg C	1 ft
RON-1	2008-05-06	00-Jan-00	Temperature, sample		4	deg C	20 ft
RON-1	2008-10-06	00-Jan-00	Temperature, sample		4	deg C	17 ft
RON-1	2008-10-06	00-Jan-00	Temperature, sample		4	deg C	17 ft
RON-1	2008-10-06	00-Jan-00	Temperature, sample		4	deg C	21 ft
RON-1	2008-10-06	00-Jan-00	Temperature, sample		4	deg C	1 ft
RON-2	2008-10-06	00-Jan-00	Temperature, sample		4	deg C	1 ft
RON-3	2008-10-06	00-Jan-00	Temperature, sample		4	deg C	1 ft
RON-1	2012-07-23	09:18	Temperature, sample		5	deg C	
RON-1	2012-07-23	09:20	Temperature, sample		5	deg C	
RON-1	2012-07-23	09:21	Temperature, sample		5	deg C	
RON-2	2012-07-23	09:21	Temperature, sample		5	deg C	
RON-3	2012-07-23	09:51	Temperature, sample		5	deg C	
RON-1	2012-08-16	08:49	Temperature, sample		6	deg C	
RON-1	2012-08-16	08:51	Temperature, sample		6	deg C	
RON-1	2012-08-16	08:51	Temperature, sample		6	deg C	
RON-2	2012-08-16	08:52	Temperature, sample		6	deg C	
RON-3	2012-08-16	09:21	Temperature, sample		6	deg C	
RON-1	2008-07-01	00-Jan-00	Temperature, sample		6	deg C	1 ft
RON-1	2008-07-01	00-Jan-00	Temperature, sample		6	deg C	17 ft

Segment	Date	Time	Analyte	Fraction	Result	Units	Depth
RON-1	2008-07-01	00-Jan-00	Temperature, sample		6	deg C	17 ft
RON-1	2008-07-01	00-Jan-00	Temperature, sample		6	deg C	19 ft
RON-2	2008-07-01	00-Jan-00	Temperature, sample		6	deg C	1 ft
RON-3	2008-07-01	00-Jan-00	Temperature, sample		6	deg C	1 ft
RON-1	2008-08-06	00-Jan-00	Temperature, sample		8	deg C	19 ft
RON-1	2008-08-06	00-Jan-00	Temperature, sample		8	deg C	1 ft
RON-2	2008-08-06	00-Jan-00	Temperature, sample		8	deg C	1 ft
RON-3	2008-08-06	00-Jan-00	Temperature, sample		8	deg C	1 ft
RON-1	2008-08-06	00-Jan-00	Temperature, sample		8	deg C	17 ft
RON-1	2008-08-06	00-Jan-00	Temperature, sample		8	deg C	17 ft
RON-1	2008-10-06	00-Jan-00	Terbufos	Total	0.024	ug/l	17 ft
RON-1	2008-08-06	00-Jan-00	Terbufos	Total	0.032	ug/l	17 ft
RON-1	2008-06-10	00-Jan-00	Terbufos	Total	0.039	ug/l	17 ft
RON-1	2008-07-01	00-Jan-00	Terbufos	Total	0.049	ug/l	17 ft
RON-1	2012-06-08	09:41	Terbufos	Total	0.11	ug/l	17 ft
RON-1	2012-08-16	08:51	Terbufos	Total	0.11	ug/l	17 ft
RON-1	2012-07-23	09:20	Terbufos	Total	0.13	ug/l	17 ft
RON-1	2012-07-23	09:20	Total dissolved solids		134	mg/l	17 ft
RON-1	2012-06-08	09:41	Total dissolved solids		162	mg/l	17 ft
RON-1	2012-08-16	08:51	Total dissolved solids		198	mg/l	17 ft
RON-1	2012-04-27	09:11	Total dissolved solids		206	mg/l	17 ft
RON-1	2008-08-06	00-Jan-00	Total fixed solids		89.5	%	21 ft
RON-3	2008-08-06	00-Jan-00	Total fixed solids		92.2	%	7 ft
RON-1	2008-08-06	00-Jan-00	Total solids		42.7	%	21 ft
RON-3	2008-08-06	00-Jan-00	Total solids		53.4	%	7 ft
RON-1	2012-08-16	08:49	Total suspended solids		7	mg/l	1 ft
RON-1	2012-04-27	09:11	Total suspended solids		10	mg/l	21 ft
RON-1	2012-04-27	09:10	Total suspended solids		10	mg/l	1 ft
RON-1	2012-04-27	09:11	Total suspended solids		12	mg/l	17 ft
RON-1	2012-07-23	09:18	Total suspended solids		12	mg/l	1 ft
RON-2	2012-04-27	09:11	Total suspended solids		13	mg/l	1 ft
RON-1	2012-06-08	09:41	Total suspended solids		13	mg/l	17 ft
RON-1	2012-06-08	09:38	Total suspended solids		14	mg/l	1 ft

Segment	Date	Time	Analyte	Fraction	Result	Units	Depth
RON-2	2012-06-08	09:43	Total suspended solids		15	mg/l	1 ft
RON-1	2012-08-16	08:51	Total suspended solids		15	mg/l	17 ft
RON-1	2012-08-16	08:51	Total suspended solids		16	mg/l	20 ft
RON-3	2012-08-16	09:21	Total suspended solids		16	mg/l	1 ft
RON-3	2012-04-27	10:07	Total suspended solids		17	mg/l	1 ft
RON-1	2012-07-23	09:20	Total suspended solids		17	mg/l	17 ft
RON-2	2012-07-23	09:21	Total suspended solids		17	mg/l	1 ft
RON-1	2012-06-08	09:43	Total suspended solids		18	mg/l	19 ft
RON-1	2012-10-11	11:47	Total suspended solids		18	mg/l	1 ft
RON-3	2012-06-08	10:46	Total suspended solids		22	mg/l	1 ft
RON-1	2012-07-23	09:21	Total suspended solids		23	mg/l	20 ft
RON-2	2012-10-11	12:14	Total suspended solids		23	mg/l	1 ft
RON-1	2012-10-11	11:47	Total suspended solids		24	mg/l	17 ft
RON-2	2012-08-16	08:52	Total suspended solids		26	mg/l	1 ft
RON-1	2012-10-11	11:47	Total suspended solids		32	mg/l	20 ft
RON-3	2012-10-11	12:27	Total suspended solids		42	mg/l	1 ft
RON-3	2012-07-23	09:51	Total suspended solids		62	mg/l	1 ft
RON-3	2008-08-06	00-Jan-00	Total volatile solids		7.79	%	7 ft
RON-1	2008-08-06	00-Jan-00	Total volatile solids		10.5	%	21 ft
RON-1	2008-08-06	00-Jan-00	Trifluralin	Total	0.51	ug/kg	21 ft
RON-1	2008-10-06	00-Jan-00	Turbidity		14	NTU	1 ft
RON-2	2008-10-06	00-Jan-00	Turbidity		15	NTU	1 ft
RON-1	2008-07-01	00-Jan-00	Turbidity		17	NTU	1 ft
RON-1	2008-08-06	00-Jan-00	Turbidity		18	NTU	17 ft
RON-1	2008-08-06	00-Jan-00	Turbidity		19	NTU	1 ft
RON-2	2008-07-01	00-Jan-00	Turbidity		21	NTU	1 ft
RON-1	2008-07-01	00-Jan-00	Turbidity		22	NTU	17 ft
RON-3	2008-10-06	00-Jan-00	Turbidity		22	NTU	1 ft
RON-1	2008-10-06	00-Jan-00	Turbidity		28	NTU	17 ft
RON-1	2008-06-10	00-Jan-00	Turbidity		33	NTU	1 ft
RON-1	2008-06-10	00-Jan-00	Turbidity		33	NTU	17 ft
RON-2	2008-08-06	00-Jan-00	Turbidity		39	NTU	1 ft
RON-3	2008-07-01	00-Jan-00	Turbidity		46	NTU	1 ft

Segment	Date	Time	Analyte	Fraction	Result	Units	Depth
RON-3	2008-08-06	00-Jan-00	Turbidity		56	NTU	1 ft
RON-2	2008-06-10	00-Jan-00	Turbidity		76	NTU	1 ft
RON-3	2008-05-06	00-Jan-00	Turbidity		85	NTU	1 ft
RON-1	2008-05-06	00-Jan-00	Turbidity		126	NTU	1 ft
RON-3	2008-06-10	00-Jan-00	Turbidity		136	NTU	1 ft
RON-2	2008-05-06	00-Jan-00	Turbidity		137	NTU	1 ft
RON-1	2008-05-06	00-Jan-00	Turbidity		148	NTU	17 ft
RON-1	2008-05-06	00-Jan-00	Turbidity		299	NTU	20 ft
RON-1	2012-06-08	09:41	Vanadium	Total	2.49	ug/l	17 ft
RON-1	2012-08-16	08:51	Vanadium	Total	3.6	ug/l	17 ft
RON-1	2012-08-16	08:49	Volatile suspended solids		4	mg/l	1 ft
RON-1	2012-08-16	08:51	Volatile suspended solids		6	mg/l	17 ft
RON-1	2012-08-16	08:51	Volatile suspended solids		8	mg/l	20 ft
RON-1	2012-04-27	09:11	Volatile suspended solids		9	mg/l	21 ft
RON-3	2012-04-27	10:07	Volatile suspended solids		9	mg/l	1 ft
RON-1	2012-07-23	09:18	Volatile suspended solids		9	mg/l	1 ft
RON-3	2012-08-16	09:21	Volatile suspended solids		9	mg/l	1 ft
RON-1	2012-04-27	09:11	Volatile suspended solids		10	mg/l	17 ft
RON-1	2012-06-08	09:41	Volatile suspended solids		10	mg/l	17 ft
RON-1	2012-06-08	09:43	Volatile suspended solids		10	mg/l	19 ft
RON-1	2012-07-23	09:20	Volatile suspended solids		10	mg/l	17 ft
RON-1	2012-10-11	11:47	Volatile suspended solids		10	mg/l	1 ft
RON-1	2012-10-11	11:47	Volatile suspended solids		10	mg/l	17 ft
RON-2	2012-10-11	12:14	Volatile suspended solids		10	mg/l	1 ft
RON-1	2012-07-23	09:21	Volatile suspended solids		11	mg/l	20 ft
RON-2	2012-08-16	08:52	Volatile suspended solids		11	mg/l	1 ft
RON-1	2012-10-11	11:47	Volatile suspended solids		11	mg/l	20 ft
RON-3	2012-06-08	10:46	Volatile suspended solids		13	mg/l	1 ft
RON-2	2012-07-23	09:21	Volatile suspended solids		13	mg/l	1 ft
RON-1	2012-04-27	09:10	Volatile suspended solids		13	mg/l	1 ft
RON-2	2012-04-27	09:11	Volatile suspended solids		14	mg/l	1 ft
RON-1	2012-06-08	09:38	Volatile suspended solids		14	mg/l	1 ft
RON-2	2012-06-08	09:43	Volatile suspended solids		14	mg/l	1 ft

Segment	Date	Time	Analyte	Fraction	Result	Units	Depth
RON-3	2012-10-11	12:27	Volatile suspended solids		15	mg/l	1 ft
RON-3	2012-07-23	09:51	Volatile suspended solids		20	mg/l	1 ft
RON-1	2012-07-23	09:20	Zinc	Total	0.97	ug/l	17 ft
RON-1	2008-08-06	00-Jan-00	Zinc	Total	1.88	ug/l	17 ft
RON-1	2012-08-16	08:51	Zinc	Total	2.16	ug/l	17 ft
RON-1	2012-10-11	11:47	Zinc	Total	3.36	ug/l	17 ft
RON-1	2008-10-06	00-Jan-00	Zinc	Total	3.86	ug/l	17 ft
RON-1	2012-06-08	09:41	Zinc	Total	8.9	ug/l	17 ft
RON-1	2008-05-06	00-Jan-00	Zinc	Total	16.9	ug/l	17 ft
RON-3	2008-08-06	00-Jan-00	Zinc	Total	53.7	mg/kg	7 ft
RON-1	2008-08-06	00-Jan-00	Zinc	Total	64.5	mg/kg	21 ft

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Appendix E

SLAM Documentation

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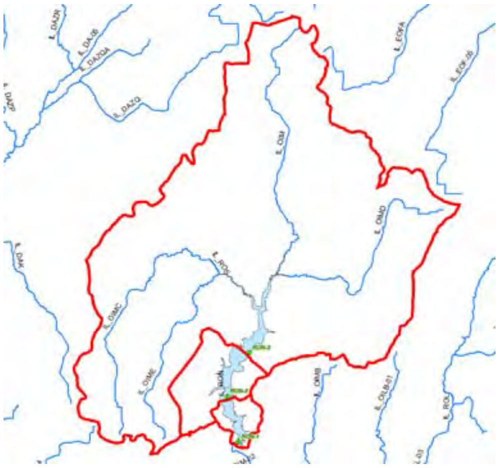
Model Name:	Lake Lou Yaeger NA
Start Date:	1/1/2000
End Date:	1/1/2018

Number of Zones/Segments:	D (ft2/d) used:
3	50,000

longitudinal dispersion coefficient for mixing between zones (recommended range 1,000 – 1,000,000)

Note: this coefficent can be used in calibration process to reflect movement of TP from one zone to another



Station_ID	Zone	Month	Volume (AF)	Depth (ft)
RON-1	1	1	7,717	22.4
RON-1	1	2	7,717	22.4
RON-1	1	3	7,717	22.4
RON-1	1	4	7,717	22.4
RON-1	1	5	7,717	22.4
RON-1	1	6	7,717	22.4
RON-1	1	7	7,717	22.4
RON-1	1	8	7,717	22.4
RON-1	1	9	7,717	22.4
RON-1	1	10	7,717	22.4
RON-1	1	11	7,717	22.4
RON-1	1	12	7,717	22.4
RON-2	2	1	8,013	15
RON-2	2	2	8,013	15
RON-2	2	3	8,013	15
RON-2	2	4	8,013	15
RON-2	2	5	8,013	15
RON-2	2	6	8,013	15
RON-2	2	7	8,013	15
RON-2	2	8	8,013	15
RON-2	2	9	8,013	15
RON-2	2	10	8,013	15
RON-2	2	11	8,013	15
RON-2	2	12	8,013	15
RON-3	3	1	2,947	6
RON-3	3	2	2,947	6
RON-3	3	3	2,947	6
RON-3	3	4	2,947	6
RON-3	3	5	2,947	6
RON-3	3	6	2,947	6
RON-3	3	7	2,947	6
RON-3	3	8	2,947	6
RON-3	3	9	2,947	6
RON-3	3	10	2,947	6
RON-3	3	11	2,947	6
RON-3	3	12	2,947	6

	Prescribed	Calculated
Hydraulics	X	

Based on typical data availability, prescribed hydraulics will likely be used

Interface length and width calculate from google earth.

Length	NA
Width	NA

Note: Total Lake and each individual zone must be entered (zones must add Up to 5 zones can be used

Monthly timestaps of lake volume/area are typically going to be the same for every month due to data limitations

Estimated based on available bathymetry or simple multiplication of area x depth

Average depth from availble bathymetry or vertical profile data

https://nepis.epa.gov/Exe/ZyPDF.cgi/91024J0Q.PDF?Dockey=91024J0Q.PDF

Segment	Mixing_length (ft)	Interface Width (ft)	Surface_area (acres)	Avg Depth (ft)	Volume (AF)	
RON-1	9,951	na	345	22	7,717	25%
RON-2	10,137	1,715	534	15	8,013	39%
RON-3	16,064	1,964	491	6	2,947	36%
			1,370	14.5	18,677	

Segment	OBJECTID *	Value	Count	LAND_COVER	LAND_COVER	Acres
Lou Yaeger	0	11	6571	Open Water	Open Water	1461.35
Lou Yaeger	1	21	12792	Developed, Open Space	Developed, Open Space	2844.87
Lou Yaeger	2	22	11273	Developed, Low Intensity	Developed, Low Intensit	2507.05
Lou Yaeger	3	23	1413	Developed, Medium Intensity	Developed, Medium Inte	314.24
Lou Yaeger	4	24	159	Developed, High Intensity	Developed, High Intensi	35.36
Lou Yaeger	5	31	0	Barren Land	Barren Land	0.00
Lou Yaeger	6	41	27834	Deciduous Forest	Deciduous Forest	6190.13
Lou Yaeger	7	42	51	Evergreen Forest	Evergreen Forest	11.34
Lou Yaeger	8	71	604	Herbaceuous	Herbaceuous	134.33
Lou Yaeger	9	81	15270	Hay/Pasture	Hay/Pasture	3395.96
Lou Yaeger	10	82	236456	Cultivated Crops	Cultivated Crops	52586.51
Lou Yaeger		90	233	Woody Wetlands	Woody Wetlands	51.82
Lou Yaeger	11	95	167	Emergent Herbaceuous Wetlands	Emergent Herbaceuous	37.14
						69570.11

Conversion

Unit	m2
1 cell	900 m2
m2	**acre**
1	0.000247

Conversion

Unit	m2
1 cell	900 m2
m2	**acre**
1	0.000247

Segment	OBJECTID *	Value	Count	LAND_COVER	LAND_COVER	Acres
RON-1	0	11	2533	Open Water	Open Water	563.33
RON-1	1	21	926	Developed, Open Space	Developed, Open Space	205.94
RON-1	2	22	205	Developed, Low Intensity	Developed, Low Intensit	45.59
RON-1	3	23	23	Developed, Medium Intensity	Developed, Medium Inte	5.12
RON-1	4	24	0	Developed, High Intensity	Developed, High Intensi	0.00
RON-1	5	31		Barren Land	Barren Land	0.00
RON-1	6	41	7078	Deciduous Forest	Deciduous Forest	1574.11
RON-1	7	42	44	Evergreen Forest	Evergreen Forest	9.79
RON-1	8	71	61	Herbaceuous	Herbaceuous	13.57
RON-1	9	81	920	Hay/Pasture	Hay/Pasture	204.60
RON-1	10	82	6553	Cultivated Crops	Cultivated Crops	1457.35
RON-1		90	0	Woody Wetlands	Woody Wetlands	0.00
RON-1	11	95	0	Emergent Herbaceuous Wetlands	Emergent Herbaceuous	0.00
						4079.38

Conversion

Unit	m2
1 cell	900 m2
m2	**acre**
1	0.000247

Segment	OBJECTID *	Value	Count	LAND_COVER	LAND_COVER	Acres
RON-2	0	11	1584	Open Water	Open Water	352.27
RON-2	1	21	440	Developed, Open Space	Developed, Open Space	97.85
RON-2	2	22	142	Developed, Low Intensity	Developed, Low Intensit	31.58
RON-2	3	23	54	Developed, Medium Intensity	Developed, Medium Inte	12.01
RON-2	4	24	6	Developed, High Intensity	Developed, High Intensi	1.33
RON-2	5	31		Barren Land	Barren Land	0.00
RON-2	6	41	2832	Deciduous Forest	Deciduous Forest	629.82
RON-2	7	42	0	Evergreen Forest	Evergreen Forest	0.00
RON-2	8	71	124	Herbaceuous	Herbaceuous	27.58
RON-2	9	81	322	Hay/Pasture	Hay/Pasture	71.61
RON-2	10	82	302	Cultivated Crops	Cultivated Crops	67.16
RON-2		90	0	Woody Wetlands	Woody Wetlands	0.00
RON-2	11	95	0	Emergent Herbaceuous Wetlands	Emergent Herbaceuous	0.00
						1291.22

Conversion

Unit	m2
1 cell	900 m2
m2	**acre**
1	0.000247

Segment	OBJECTID *	Value	Count	LAND_COVER	LAND_COVER	Acres
RON-3	0	11	2454	Open Water	Open Water	545.76
RON-3	1	21	11426	Developed, Open Space	Developed, Open Space	2541.08
RON-3	2	22	10926	Developed, Low Intensity	Developed, Low Intensit	2429.88
RON-3	3	23	1336	Developed, Medium Intensity	Developed, Medium Int	297.12
RON-3	4	24	153	Developed, High Intensity	Developed, High Intensi	34.03
RON-3	5	31		Barren Land	Barren Land	0.00
RON-3	6	41	17924	Deciduous Forest	Deciduous Forest	3986.20
RON-3	7	42	7	Evergreen Forest	Evergreen Forest	1.56
RON-3	8	71	419	Herbaceuous	Herbaceuous	93.18
RON-3	9	81	14028	Hay/Pasture	Hay/Pasture	3119.75
RON-3	10	82	229601	Cultivated Crops	Cultivated Crops	51062.00
RON-2		90	233	Woody Wetlands	Woody Wetlands	51.82
RON-3	11	95	167	Emergent Herbaceuous Wetlands	Emergent Herbaceuous	37.14
						64199.51

Watershed Information		Total Phosphorus Export Coefficients			Phosphorus Loads			
Land Use	Area (acres)	Low (lb/ac/yr)	Median (lb/ac/yr)	High (lb/ac/yr)	Low (lbs/yr)	Median (lbs/yr)	High (lbs/yr)	Proportion of whole
Barren Land	-	0.16	0.16	0.16	0.0	0.0	0.0	0
Cultivated Crops	52,587	0.66	0.92	0.94	34707.1	48379.6	49431.3	0.939794717
Deciduous Forest	6,190	0.08	0.105	0.13	495.2	650.0	804.7	0.015299378
Developed, High	35	0.7	1.96	4.77	24.8	69.3	168.7	0.003206788
Developed, Low I	2,507	0.04	0.47	1.43	100.3	1165.8	3585.1	0.068160121
Developed, Medi	314	0.46	1.38	4.77	144.6	433.7	1498.9	0.028498063
Developed, Open	2,845	0.03	0.04	0.16	85.3	113.8	455.2	0.008653927
Emergent Herbac	37	0.22	0.22	0.22	8.2	8.2	8.2	0.000155344
Evergreen Forest	11	0.08	0.105	0.13	0.9	1.2	1.5	2.80329E-05
Herbaceuous	134	0.5	0.5	0.5	67.2	67.2	67.2	0.001276914
Mixed Forest	--	0.08	0.105	0.13	--	--	--	--
Open Water	1,461	0	0	0	0.0	0.0	0.0	0
Hay/Pasture	3,396	0.5	0.5	0.5	1698.0	1698.0	1698.0	0.032282254
Shrub/Scrub	--	0.08	0.105	0.13	--	--	--	--
Woody Wetlands	52	0.22	0.22	0.22	11.4	11.4	11.4	0.000216737
	69,570				Total:	52598.0		

Land Use	Area (acres)	Low (lb/ac/yr)	Median (lb/ac/yr)	High (lb/ac/yr)	Low (lbs/yr)	Median (lbs/yr)	High (lbs/yr)	Proportion of whole
Barren Land	-	0.16	0.16	0.16	0.0	0.0	0.0	0
Cultivated Crops	1,457	0.66	0.92	0.94	961.9	1340.8	1369.9	0.026044908
Deciduous Forest	1,574	0.08	0.105	0.13	125.9	165.3	204.6	0.00389053
Developed, High	-	0.7	1.96	4.77	0.0	0.0	0.0	0
Developed, Low I	46	0.04	0.47	1.43	1.8	21.2	65.2	0.001239495
Developed, Medi	5	0.46	1.38	4.77	2.4	7.1	24.4	0.000463875
Developed, Open	206	0.03	0.04	0.16	6.2	8.2	32.9	0.000626449
Emergent Herbac	-	0.22	0.22	0.22	0.0	0.0	0.0	0
Evergreen Forest	10	0.08	0.105	0.13	0.8	1.0	1.3	2.41853E-05
Herbaceuous	14	0.5	0.5	0.5	6.8	6.8	6.8	0.00012896
Mixed Forest	--	0.08	0.105	0.13	--	--	--	--
Open Water	563	0	0	0	0.0	0.0	0.0	0
Hay/Pasture	205	0.5	0.5	0.5	102.3	102.3	102.3	0.001944969
Shrub/Scrub	--	0.08	0.105	0.13	--	--	--	--
Woody Wetlands	-	0.22	0.22	0.22	0.0	0.0	0.0	0
	4,079				Total:	1652.7		

Land Use	Area (acres)	Low (lb/ac/yr)	Median (lb/ac/yr)	High (lb/ac/yr)	Low (lbs/yr)	Median (lbs/yr)	High (lbs/yr)	Proportion of whole
Barren Land	-	0.16	0.16	0.16	0.0	0.0	0.0	0
Cultivated Crops	67	0.66	0.92	0.94	44.3	61.8	63.1	0.001200299
Deciduous Forest	630	0.08	0.105	0.13	50.4	66.1	81.9	0.001556652
Developed, High	1	0.7	1.96	4.77	0.9	2.6	6.4	0.000121011
Developed, Low I	32	0.04	0.47	1.43	1.3	14.7	45.2	0.000858577
Developed, Medi	12	0.46	1.38	4.77	5.5	16.6	57.3	0.001089098
Developed, Open	98	0.03	0.04	0.16	2.9	3.9	15.7	0.000297665
Emergent Herbac	-	0.22	0.22	0.22	0.0	0.0	0.0	0
Evergreen Forest	-	0.08	0.105	0.13	0.0	0.0	0.0	0
Herbaceuous	28	0.5	0.5	0.5	13.8	13.8	13.8	0.000262148
Mixed Forest	--	0.08	0.105	0.13	--	--	--	--
Open Water	352	0	0	0	0.0	0.0	0.0	0
Hay/Pasture	72	0.5	0.5	0.5	35.8	35.8	35.8	0.000680739
Shrub/Scrub	--	0.08	0.105	0.13	--	--	--	--
Woody Wetlands	-	0.22	0.22	0.22	0.0	0.0	0.0	0
	1,291				Total:	215.3		

Land Use	Area (acres)	**Low (lb/ac/yr)**	**Median (lb/ac/yr)**	**High (lb/ac/yr)**	Low (lbs/yr)	Median (lbs/yr)	High (lbs/yr)	Proportion of whole
Barren Land	-	0.16	0.16	0.16	0.0	0.0	0.0	0
Cultivated Crops	51,062	0.66	0.92	0.94	33700.9	46977.0	47998.3	0.912549509
Deciduous Forest	3,986	0.08	0.105	0.13	318.9	418.6	518.2	0.009852197
Developed, High	34	0.7	1.96	4.77	23.8	66.7	162.3	0.003085778
Developed, Low I	2,430	0.04	0.47	1.43	97.2	1129.9	3474.7	0.066062049
Developed, Medi	297	0.46	1.38	4.77	136.7	410.0	1417.3	0.02694509
Developed, Open	2,541	0.03	0.04	0.16	76.2	101.6	406.6	0.007729813
Emergent Herbac	37	0.22	0.22	0.22	8.2	8.2	8.2	0.000155344
Evergreen Forest	2	0.08	0.105	0.13	0.1	0.2	0.2	3.84766E-06
Herbaceuous	93	0.5	0.5	0.5	46.6	46.6	46.6	0.000885806
Mixed Forest	--	0.08	0.105	0.13	--	--	--	--
Open Water	546	0	0	0	0.0	0.0	0.0	0
Hay/Pasture	3,120	0.5	0.5	0.5	1559.9	1559.9	1559.9	0.029656546
Shrub/Scrub	--	0.08	0.105	0.13	--	--	--	--
Woody Wetlands	52	0.22	0.22	0.22	11.4	11.4	11.4	0.000216737
	64,200				Total:	50730.0		

Calculating Daily Load	
Annual_P_load (lbs/year)	**Daily_avg_P_load (lbs/day)**
52598	144

Number of Days in POR
6576

Fraction of particulate P

Lake fp P	Inflow fp P
0.59	0.72

Lake Zone Loading Factors

Zone	% P Load	% N Load
1	0.031	0.031
2	0.004	0.004
3	0.964	0.964

Initial P Concentration (mg/L)
0.182

Catchment Area Calcs

Name	Catchment_area (mi^2)	Ratio
5592050	93.1	1.00
Lou Yaeger	108.7	1.17

Conversion

Acres	Mi Square
1	0.0015625

Lake Sedimentation Parameters

Calibration Run

Prescribed - Used as calibration factors for sediment nutrient flux where sediment data not available.
Consititutes Internal loading

Zone 1 RON-1

Month	P (mg/m2/d)	N (mg/m2/d)	P load (lbs/day)	Days	P load (lbs/month)
Jan	0	0	0.00	31	0.0
Feb	0	0	0.00	28	0.0
Mar	0	0	0.00	31	0.0
Apr	0	0	0.00	30	0.0
May	7	0	21.51	31	667.0
Jun	10	0	30.74	30	922.1
Jul	10	0	30.74	31	952.8
Aug	5	0	15.37	31	476.4
Sep	2	0	6.15	30	184.4
Oct	0	0	0.00	31	0.0
Nov	0	0	0.00	30	0.0
Dec	0	0	0.00	31	0.0
			Annual TP load (lbs)		**3202.7**

Zone 1 RON-2

Month	P (mg/m2/d)	N (mg/m2/d)	P load (lbs/day)	Days	P load (lbs/month)
Jan	0	0	0.00	31	0.0
Feb	0	0	0.00	28	0.0
Mar	0	0	0.00	31	0.0
Apr	0	0	0.00	30	0.0
May	7	0	33.36	31	1034.2
Jun	10	0	47.66	30	1429.8
Jul	10	0	47.66	31	1477.5
Aug	5	0	23.83	31	738.7
Sep	2	0	9.53	30	286.0
Oct	0	0	0.00	31	0.0
Nov	0	0	0.00	30	0.0
Dec	0	0	0.00	31	0.0
			Annual TP load (lbs)		**4966.2**

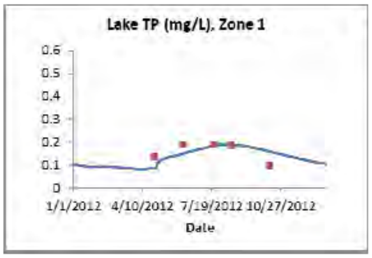
Zone 1 RON-3

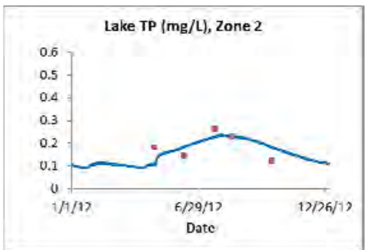
Month	P (mg/m2/d)	N (mg/m2/d)	P load (lbs/day)	Days	P load (lbs/month)
Jan	0	0	0.00	31	0.0
Feb	0	0	0.00	28	0.0
Mar	0	0	0.00	31	0.0
Apr	0	0	0.00	30	0.0
May	7	0	30.68	31	951.0
Jun	10	0	43.82	30	1314.7
Jul	10	0	43.82	31	1358.5
Aug	4	0	17.53	31	543.4
Sep	2	0	8.76	30	262.9
Oct	0	0	0.00	31	0.0
Nov	0	0	0.00	30	0.0
Dec	0	0	0.00	31	0.0
			Annual TP load (lbs)		**4430.6**

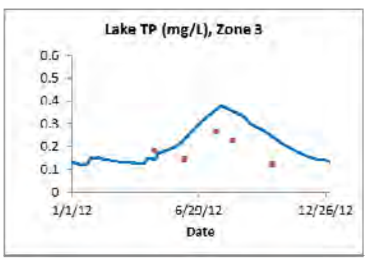
May-Oct Averages

	Predicted			Observed		
	Zone 1	Zone 2	Zone 3	Zone 1	Zone 2	Zone 3
May -Oct	0.176	0.190	0.216	0.171	0.186	0.233

RPD (%)		
Zone 1	Zone 2	Zone 3
3.1	2.2	-7.3







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Appendix F

Section 319 Application: Lake Lou Yaeger BMP Implementation Plan

*Includes 2020 Update at end of Appendix

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CITY OF LITCHFIELD

SECTION 319 GRANT APPLICATION

LAKE LOU YAEGER BMP IMPLEMENTATION PLAN

PROJECT DESCRIPTION

Lake Lou Yaeger, a 1,200-acre lake located in central Illinois, provides flood control, a drinking water supply for the City of Litchfield and three water districts, habitat for wildlife and wetlands and recreational opportunities. The lake has been experiencing an excessive accumulation of sediment caused by migration to the lake throughout the past 50 years. In order to reduce the sediment and nutrient load entering Lake Lou Yaeger, the City is proposing to construct three best management practices (BMPs), including construction of two sediment ponds and approximately 1,800 linear feet of shoreline erosion remediation. The projects will improve the Lake Lou Yaeger ecosystem and reduce the nutrient load into the Gulf of Mexico.

Project Goals and Methods

The two sediment ponds proposed are Sediment Pond Location A (Bishop's Cove) and Sediment Pond Location B (Pete's Cove). The goal of the sediment ponds is to capture a portion of the sediment and nutrients which will flow into the lake from two significant tributaries to Lake Lou Yaeger, as shown on the attachments.

In the two proposed sediment ponds, the detention time of the tributary flow will be increased thereby increasing the portion of sediment which settles out. In the preliminary design phase, the City will evaluate the options for the water level in the sediment pond. The water level could be at the same as the Lake Yaeger or at a higher elevation.

- If the pond water level is the same as Lake Yaeger, the detention time would be increased by restricting the outflow and surcharging the pond during runoff events.
- If the pond water level is higher than Lake Yaeger, there will be a larger volume of water stored behind the dam which increases the detention time. A second benefit is that the amount of resuspension of bottom sediment and nutrients in the ponds will be reduced. A third benefit is that the water level in the ponds can be lowered by gravity flow to allow sediment removal by dry excavation methods.

Proposed shoreline protection will address a portion of the most severe erosion on the lake shore. The shoreline is nearly vertical in these areas as shown in Attachment C. The primary benefit will be to trap sediment from future erosion of the shoreline behind the ridge of riprap. Vegetation will then begin to grow in the sediment. A secondary benefit of shoreline erosion remediation will be improved aesthetics for area residents and the nearly 100,000 tourists who visit the lake annually. The project will include a means of monitoring the future bank lateral recession rates through the installation of monuments.

All three proposed BMP projects are recommended measures in the Lake Lou Yaeger Restoration Plan (Clean Lakes Program 1995). The sediment ponds are identified as Alternative Actions D3 and D4 in the Restoration Plan. The shoreline erosion protection is Alternative Action E in the Restoration Plan. The three BMPs will be included in the TMDL report which is in the final draft stage and is scheduled to be completed in mid-2018.

The City plans to make future Section 319 grant applications which will include both watershed BMP measures and lake measures. The City will cooperate with Montgomery County Soil and Water Conservation District and USDA NRCS personnel for watershed BMP applications.

Completion of the BMPs will demonstrate the City's commitment to reduction of sediment and nutrients release. Furthermore, the projects will demonstrate to other watershed property owners the importance of reducing nutrients in the watershed and encourage participation by all stakeholders to construct other BMP measures. An additional benefit is Sediment Pond Location B (Pete's Cove) will have visibility from a public road (16th Avenue) to showcase the City's efforts to control nutrient loads into the lake.

The two sediment ponds will begin reducing sediment influx to Lake Yaeger upon completion of construction and thus will be an effective use of grant funds. The watershed for the two ponds is 2,400 acres. Watershed BMP's can take many years to complete because of the size of the watershed (74,000 acres) and hundreds of agricultural property owners. Another benefit of Sediment Pond Location A (Bishop's Cove) is that the half of the watershed area is wooded and wooded areas are not typically treated with watershed BMP's as agricultural areas are.

Project Implementation

The City will manage the grant award to complete the projects within two years. The schedule of quarterly milestones is shown on Page 8 of the Section 319 Application. Completion by June 30, 2020 will require that some tasks be performed concurrently. For example, during the first half of the design period, preliminary submittals will be made and meetings scheduled with the IDNR and COE offices to initiate the permit review process. During the permit review process, work will continue on the plan details and the bid documents.

The project is planned to utilize a design-bid-build approach to construction. This will provide the City and IEPA with a competitive bid for the construction work to provide a cost-effective solution for the proposed improvements. The completion date of the construction will be set forth in the construction contract.

The City has obtained LiDAR aerial data collection flights for the project areas. Thus there will be no need to wait for the winter season to complete the flights. Contours are available for Pete's Cove and the contours for Bishop's Cove and shoreline areas can be generated within a month.

The City can move forward with pre-award work if IEPA notifies the City of an award prior to July 1. This will allow the City get underway with the project on July 1, 2018.

Regarding the shoreline protection component, the City has in the past specified Class A quality riprap at its lakes in order to extend the life of the riprap in place. Class A has the highest level of freeze-thaw durability under IDOT specifications. During implementation of the project, a lesser quality could be specified if desired to increase the length of shoreline protection for same funding.

The design water level in the sediment pond will be a significant factor in the issuance of a permit from the Corps of Engineers and IEPA because of the impact on the existing wetlands upstream of the sediment dam sites. Projects that qualify for a nationwide permit will have a much shorter time to issuance than projects which require an individual permit. During the implementation of the project, it is expected that there will be discussions with the COE and IEPA to develop the project scope and the applicable permit requirements. Although existing wetlands will be affected, the project will result in new wetlands created between the riprap and the shoreline, as well as new areas upstream of the sediment pools which will become emergent wetlands.

Previous Accomplishments

The City has carried out numerous public works projects at Lake Lou Yaeger in the past 25 years include:

- Shoreline protection installed in mid-1990's was completed with Priority Lake and Watershed Implementation Program (PLWIP) grant funds from IEPA. (See photo in Attachment C which demonstrates the effectiveness 20 years after installation.)
- Repair of the principal spillway in the mid-1990's.
- Conservation 2000 program grant to plant cypress tree seedlings to stabilize 600 feet of shoreline at Lake Yeager.
- Installation of two new electrically operated lake drawdown gates on the intake structure in 2012.
- New equestrian campground along Yaeger Lake Trail in 2013.
- Remodeling of the City beach house and new playground equipment at the public swimming area.
- Corps of Engineers study of environmental enhancement in the upper end of Lake Yaeger to increase the wetland acreage.

Funding Request

The three BMPs presented are independent improvements on Lake Lou Yaeger. The City will accept a grant toward all three of the BMPs, or toward one or two of the BMPs if the Agency determines that there is insufficient funding for all projects. Currently, the City has 40 percent of the required funds on hand, and seeks to obtain 60 percent of project funding through the Section 319 grant.

All three projects are ready to move forward, and the City has the ability to administer the projects.

- The City owns the property on which all BMPs are located.

- The City will apply for the construction permits required from the Army Corps of Engineers, Illinois Department of Natural Resources, and Illinois EPA.
- Wetlands which will be affected by the two sediment ponds will be delineated and mitigated as required by the agencies. New wetlands will gradually be created between the riprap and shoreline with the proposed shoreline protection measures.
- The City will likely need to acquire flood easements for the two sediment dams depending on the final design elevation of the normal pool of each sediment pond.

Measurable Objectives

A summary of the estimated benefits of the BMP measures and the associated costs are summarized as follows (also refer to Attachment A):

BMP	Estimated BMP Efficiency	Estimated Sediment Load (ton/yr)		Estimated Load Reduction (ton/yr)	Cost / BMP	Cost for each ton/yr reduction
		without BMP	with BMP			
Sediment Pond A - Bishop's Cove	40%	581	349	232	$358,675	$1,543
Sediment Pond B - Pete's Cove	40%	465	279	186	$275,075	$1,479
Bank Stabilization (per 1800 LF shoreline*)	100%	342	0	342	$183,000	$535

** Bank stabilization length does not include all areas in need of stabilization. Assumed 1800 LF of bank stabilization for the scope of the grant application.*

The sediment ponds are intended to accumulate sediment for a period of years and then to be cleaned of sediment to restore storage capacity. If the normal water level of the sediment ponds is 6.5 feet above the normal pool level of Lake Yaeger, the capacity and frequency of cleaning is shown in the table below. If the difference is less than 6.5 feet, then the values in the table would be reduced. If the sediment pond is designed with a water level the same as Lake Yaeger, then the available volume will be based on the volume of surcharging that will occur in each flood event.

BMP - Sediment Pond	Max Storage Volume * (Ac-Ft)	Soil Unit Weight ** (ton/CF)	Max Sediment Storage (Tons)	Estimated Sediment Load (ton/yr) STEPL Worksheet	Sediment Reduction Efficiency	Sediment Capture (ton/yr)	Potential Years of Sediment Storage (at full capacity)	Years between cleaning (half of full sediment storage)
Sediment Pond A - Bishop's Cove	29.6	0.04	51649	581	40%	232	222	111
Sediment Pond B - Pete's Cove	19.4	0.04	33746	465	40%	186	181	91

** Approximate volume calculated from assumed berm elevation using available contour mapping*

*** Unit weights taken from Exhibit 1 DEQ Section 319 Manual (silty clay loam, silty clay)*

The capacity available for sediment storage below the normal pool level of Lake Yaeger upstream of the sediment pond is minimal. The storage of sediment will be above normal pool.

End of Project Description

ATTACHMENT A

BMP / Load Data Summary

Lake Lou Yaeger

Section 319 Grant Application

Attachment A

		Application Title:	Lake Lou Yaeger Watershed Implementation Project					**Table #**	1	
		12-Digit HUC:	71402030104		**AUID:**	IL_RON		**Waterbody:**	Lake Lou Yaeger	
HUC	71402030104									
Table	1	** NOTE					**Pollutant Load Reduction**			
	Landowner	**BMP (Unit Type)**	**Design**	**Units**	**Unit Cost**	**Total Cost**	**P Lbs/yr**	**N Lbs/yr**	**TSS Lbs/yr**	**Sediment Tons/yr**
1	City of Litchfield	Sediment Basin (number) **	Underway	1.0	$ 358,675	$358,675	232	464		232.0
2	City of Litchfield	Sediment Basin (number) **	Underway	1.0	$ 275,075	$275,075	186	372		186.0
3	City of Litchfield	Shoreline Stabilization (linear feet)	Underway	1,800.0	$ 102	$183,000	266	532		266.0
4						$0				
5						$0				
6						$0				
7						$0				
8						$0				
9						$0				
10						$0				
					TABLE TOTAL	**$816,750**	**684**	**1,368**	**-**	**684.0**

Enter WBP or TMDL Pollutant Load Reduction Recommendation for 12-Digit HUC				

HUC	71402030104					
Table	1					
	Landowner	**Latitude**	**Longitude**	**Recommended in Watershed-Based Plan or TMDL Recommendation**	**Report Page Number(s)**	**Comments**
1	City of Litchfield	39.21418	--89.61831	Site/BMP in plan	2.3.1 - 2.4.2	Sediment Basin A - Bishop's Cove
2	City of Litchfield	39.23065	--89.61215	Site/BMP in plan	2.3.1 - 2.4.2	Sediment Basin B - Pete's Cove
3	City of Litchfield	39.23013	--89.59911	Site/BMP in plan	2.3.1 - 2.4.2	Bank stabilization length does not include all areas in need of stabilization. Assumed 1800 LF of bank stabilization for this application.
4						
5						
6						
7						
8						
9						
10						

Attachment A - Supplement

2017

Lake Lou Yaeger - Section 319 Grant Application

BMP / Load Reduction Summary

BMP	Estimated BMP Efficiency	Estimated Sediment Load (ton/yr)		Estimated Load Reduction (ton/yr)	Cost / BMP	Cost for each ton/yr reduction
		without BMP	with BMP			
Sediment Pond A - Bishop's Cove	40%	581	349	232	$358,675	$1,543
Sediment Pond B - Pete's Cove	40%	465	279	186	$275,075	$1,479
Bank Stabilization (per 1800 LF shoreline*)	100%	342	0	342	$183,000	$535

** Bank stabilization length does not include all areas in need of stabilization. Assumed 1800 LF of bank stabilization for the scope of the grant application.*

ATTACHMENT B

Reference Maps

Lake Lou Yaeger

Section 319 Grant Application

Attachment B

IL State Location Map

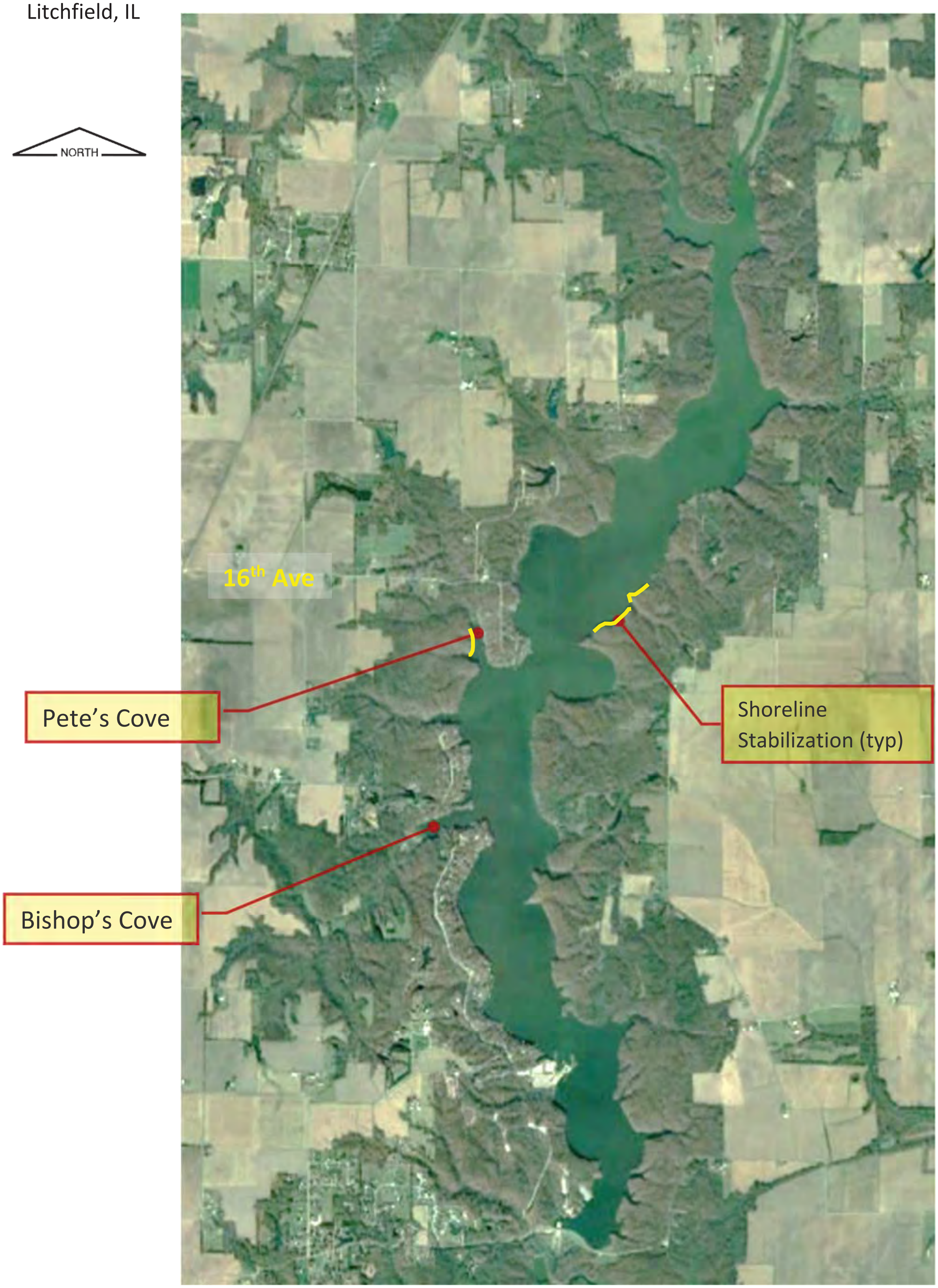
Lake Lou Yaeger 319 Grant Application

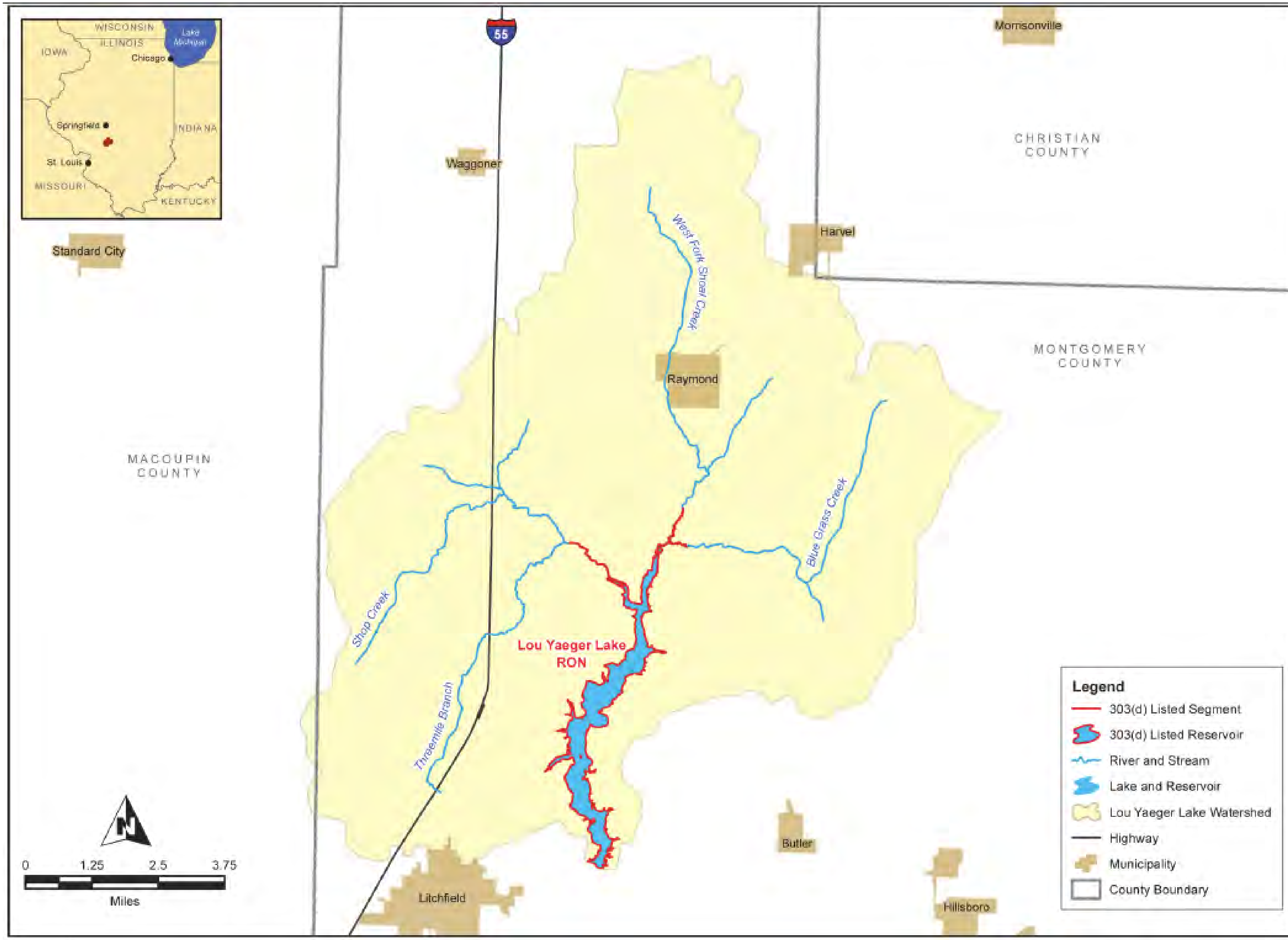
Litchfield, IL

General Lake Map

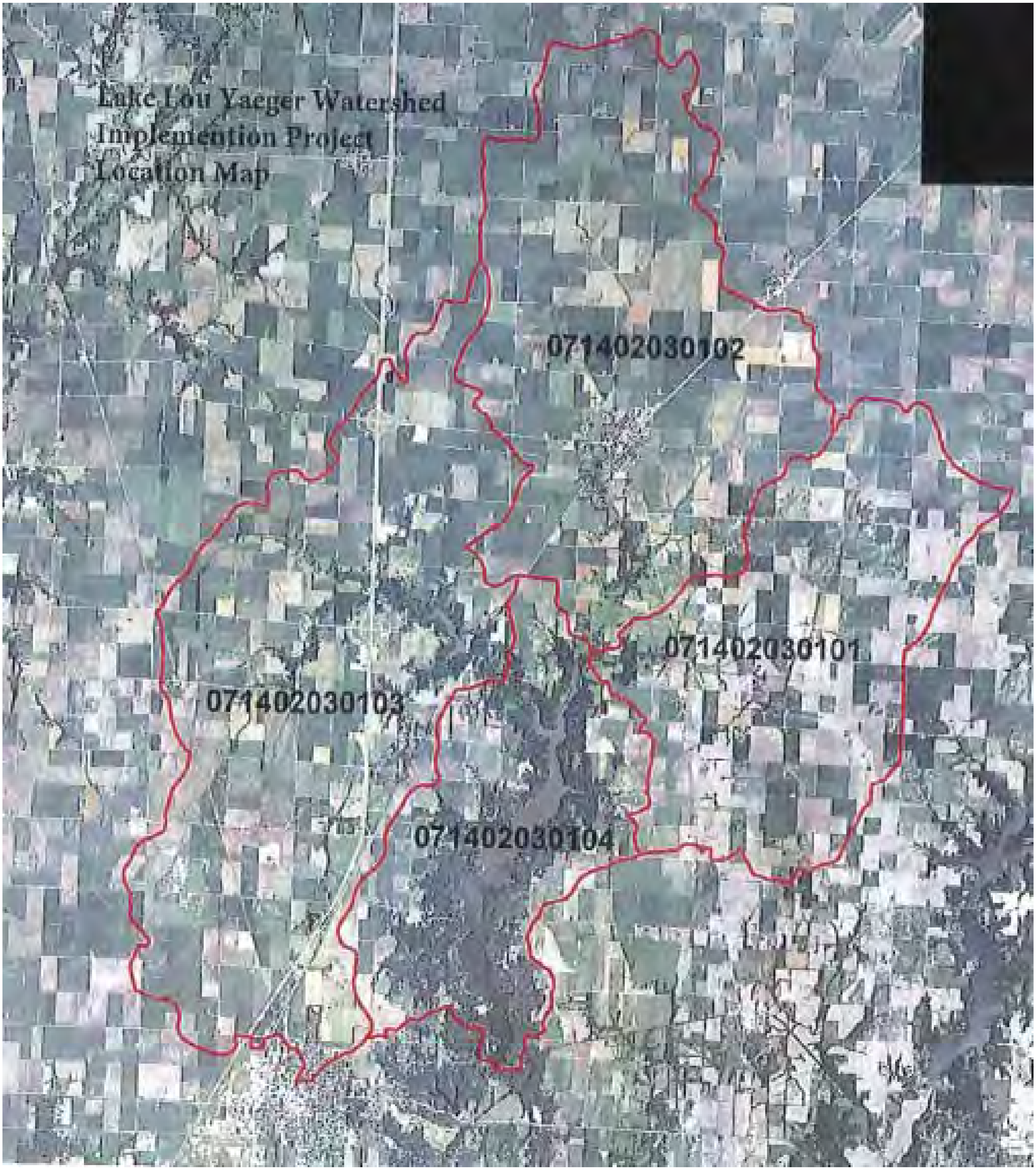
Lake Lou Yaeger 319 Grant Application

Litchfield, IL

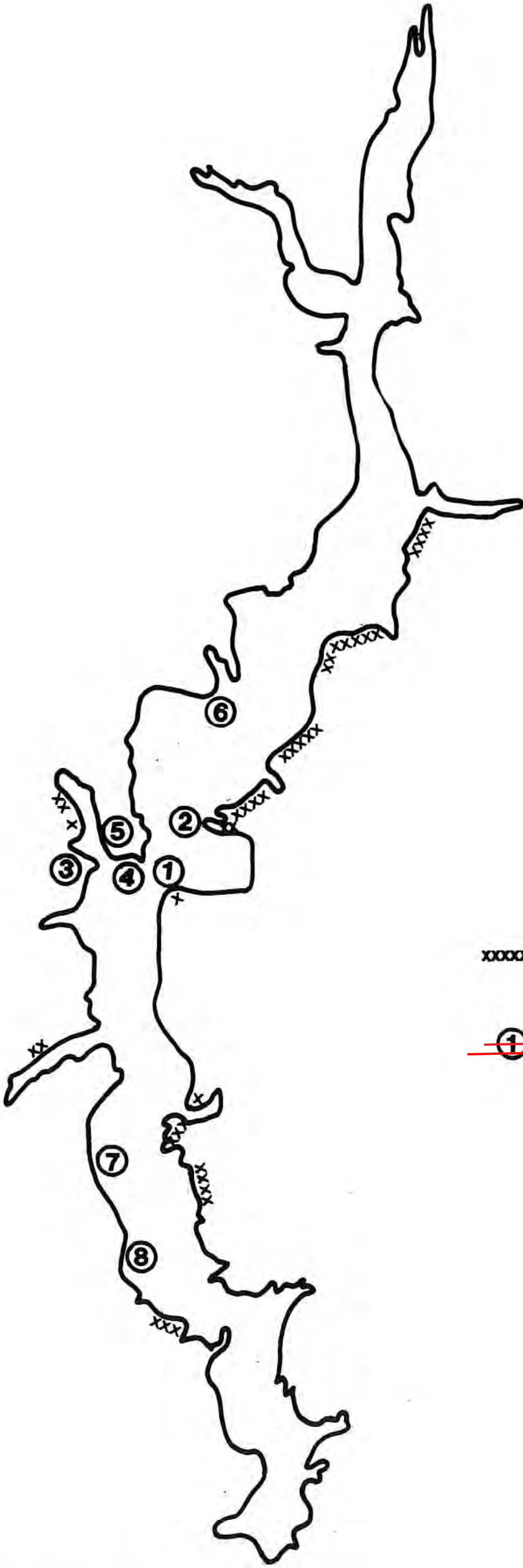




Lake Lou Yaeger - Litchfield, IL
Watershed Map



Watershed 12-Digit HUC



N

APPROX. SCALE
1 INCH=0.63 MILES 1 CM.=0.4 KM.

xxxxxx AREAS OF MOST SEVERE SHORELINE EROSION

① ~~PHOTO NUMBER (CORRESPONDS TO PREVIOUS FIGURES)~~

Exhibit from Lake Lou Yaeger Restoration Plan (1995)

LAKE LOU YAEGER

LOCATION MAP OF SEVERE SHORELINE EROSION

SOURCE, IDOC - FISHERIES

ATTACHMENT C

Existing Conditions

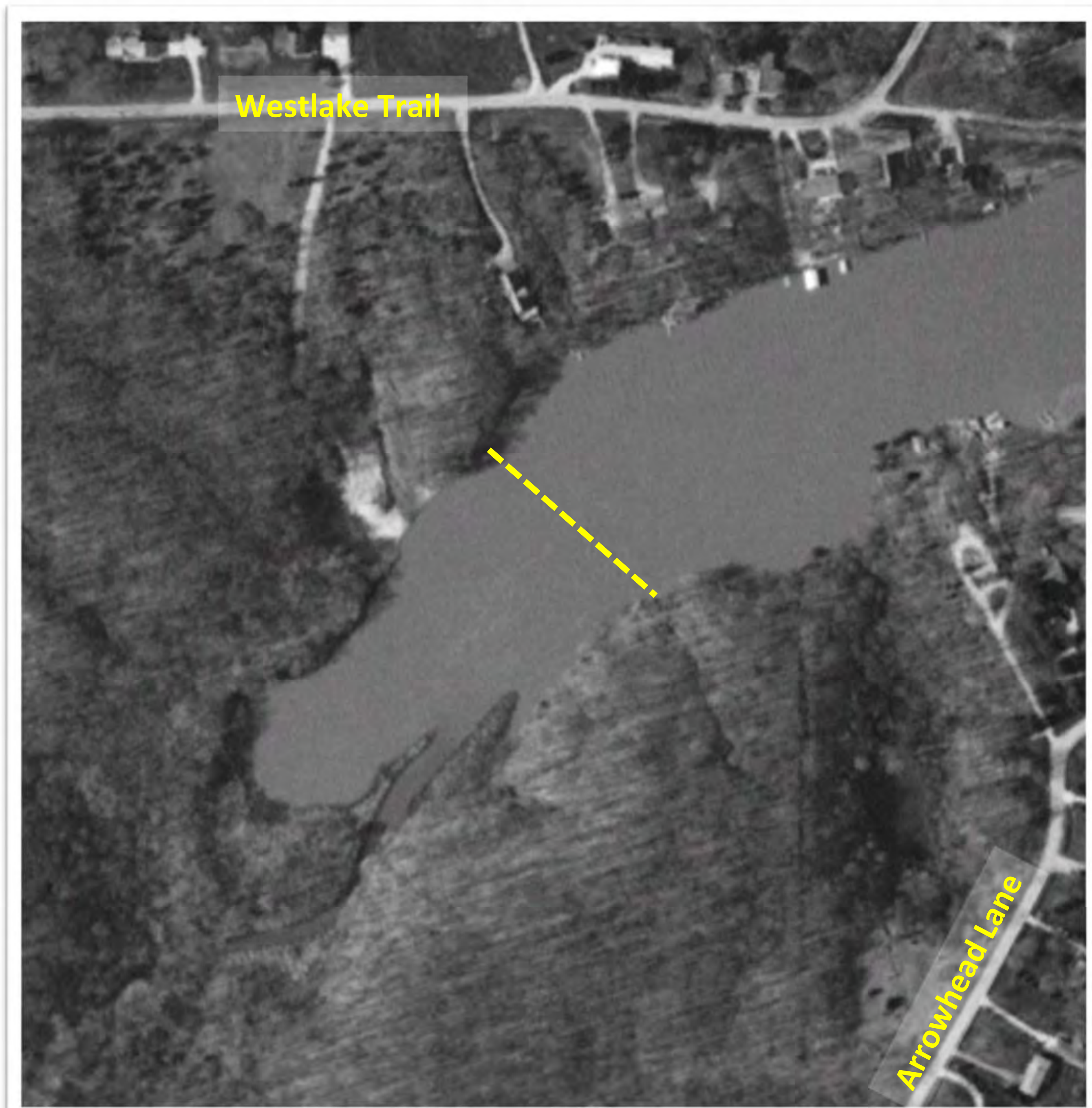
Lake Lou Yaeger

Section 319 Grant Application

Attachment C

AERIAL IMAGE COMPARISON

PROPOSED SEDIMENT POND – LOCATION A : BISHOP'S COVE



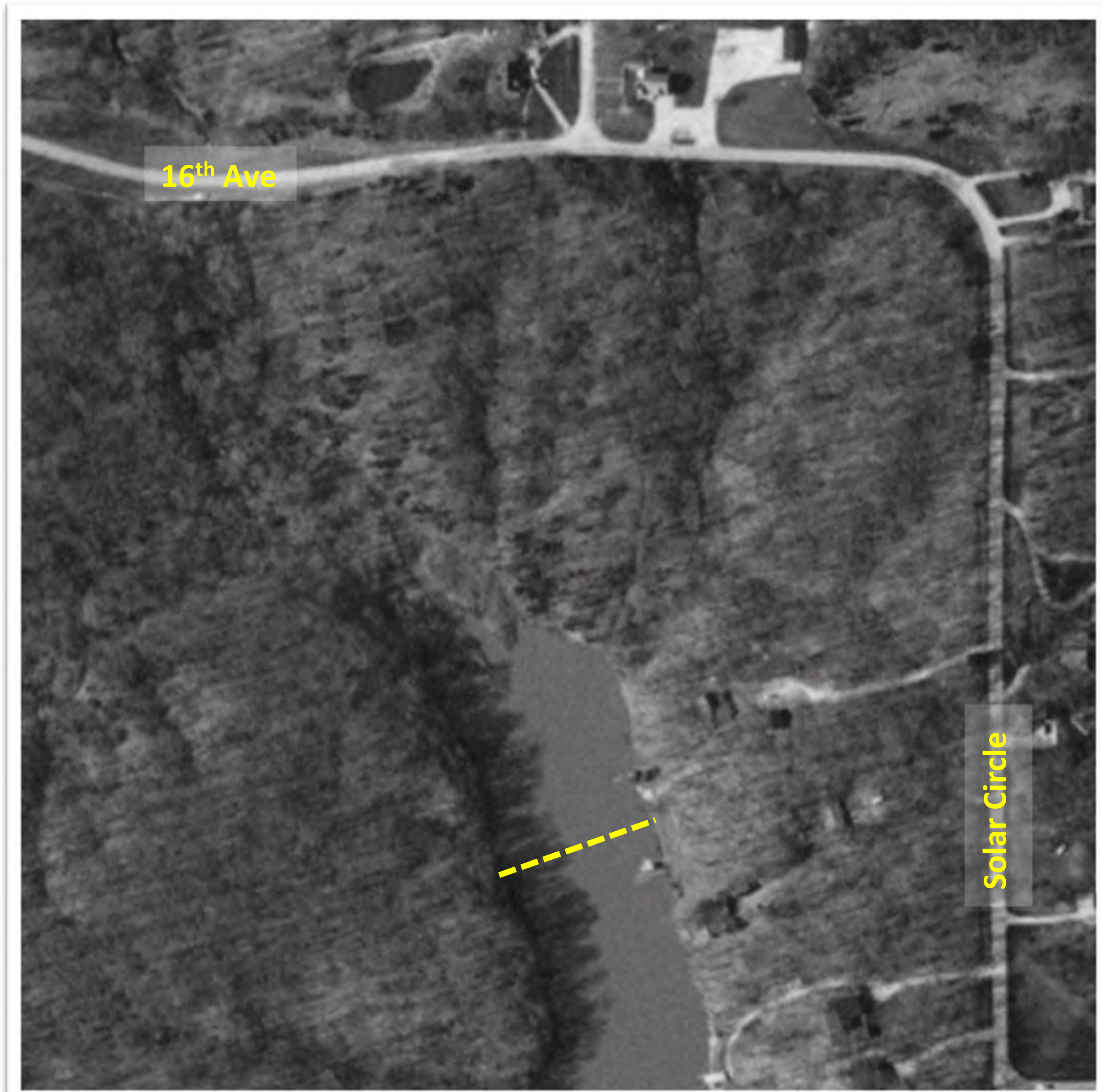
1998 Aerial Image

2015 Aerial Image

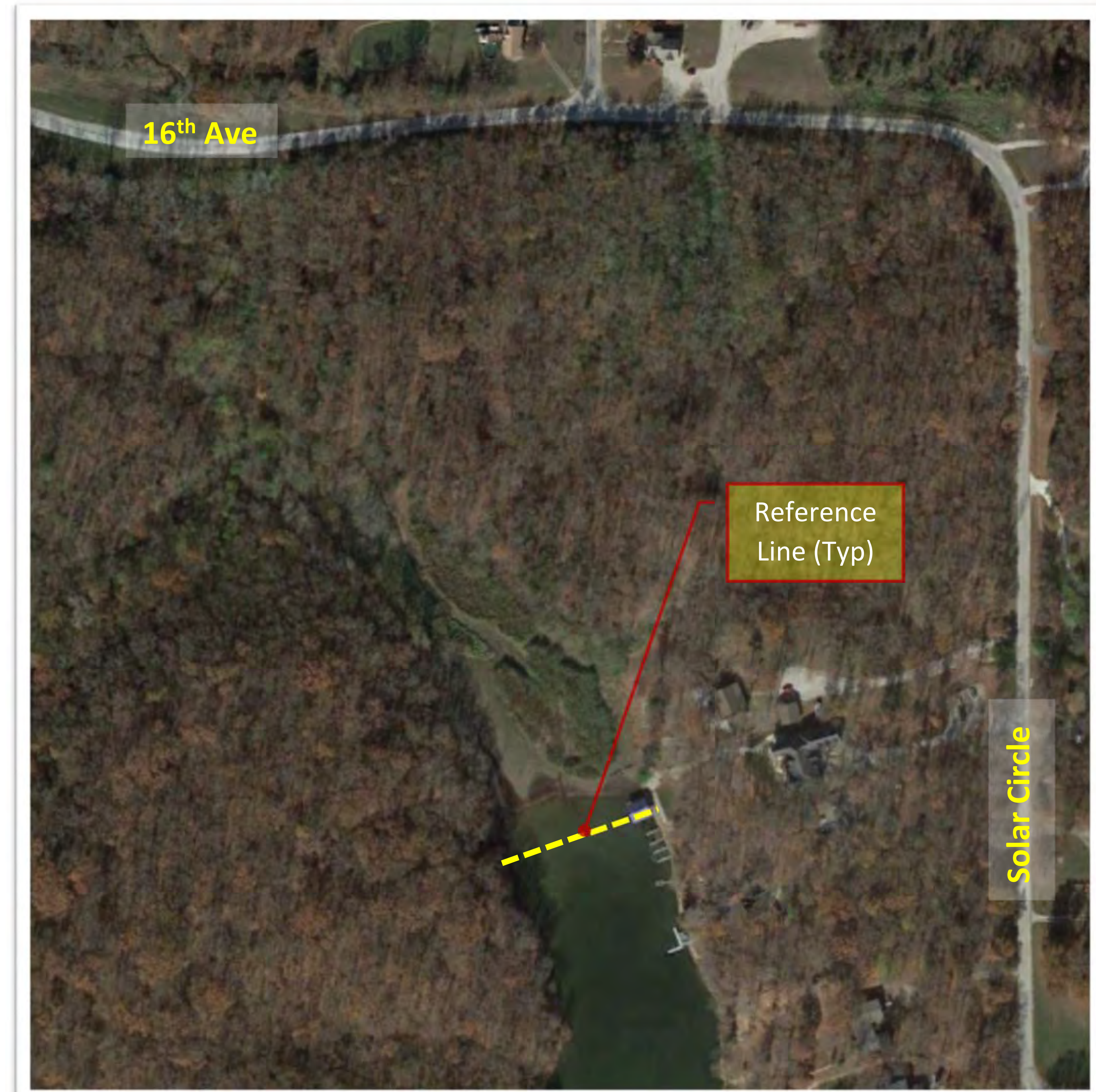
AERIAL IMAGE COMPARISON

PROPOSED SEDIMENT POND – LOCATION B : PETE'S COVE

NORTH



1998 Aerial Image



2015 Aerial Image

<u>Proposed Sediment Pond – Location A</u> :

Bishop's Cove

<u>Proposed Sediment Pond – Location B</u> :

Pete's Cove (West of Solar Circle Drive)

Lake Lou Yaeger Photos :

Taken 6/28/2017

AREA 1 – West Shoreline :

Existing Shoreline Protection (just north of Marina #2) installed in the mid-1990s

Note: Prior Bank Stabilization methods are successful. Existing bank held by riprap berm. Vegetation and soil are filling-in between berm and eroded bank.

AREA 2 – West Shoreline Pete's Cove (West of Solar Circle Drive) :

Severe Shoreline Erosion

AREA 3 – East Shoreline :

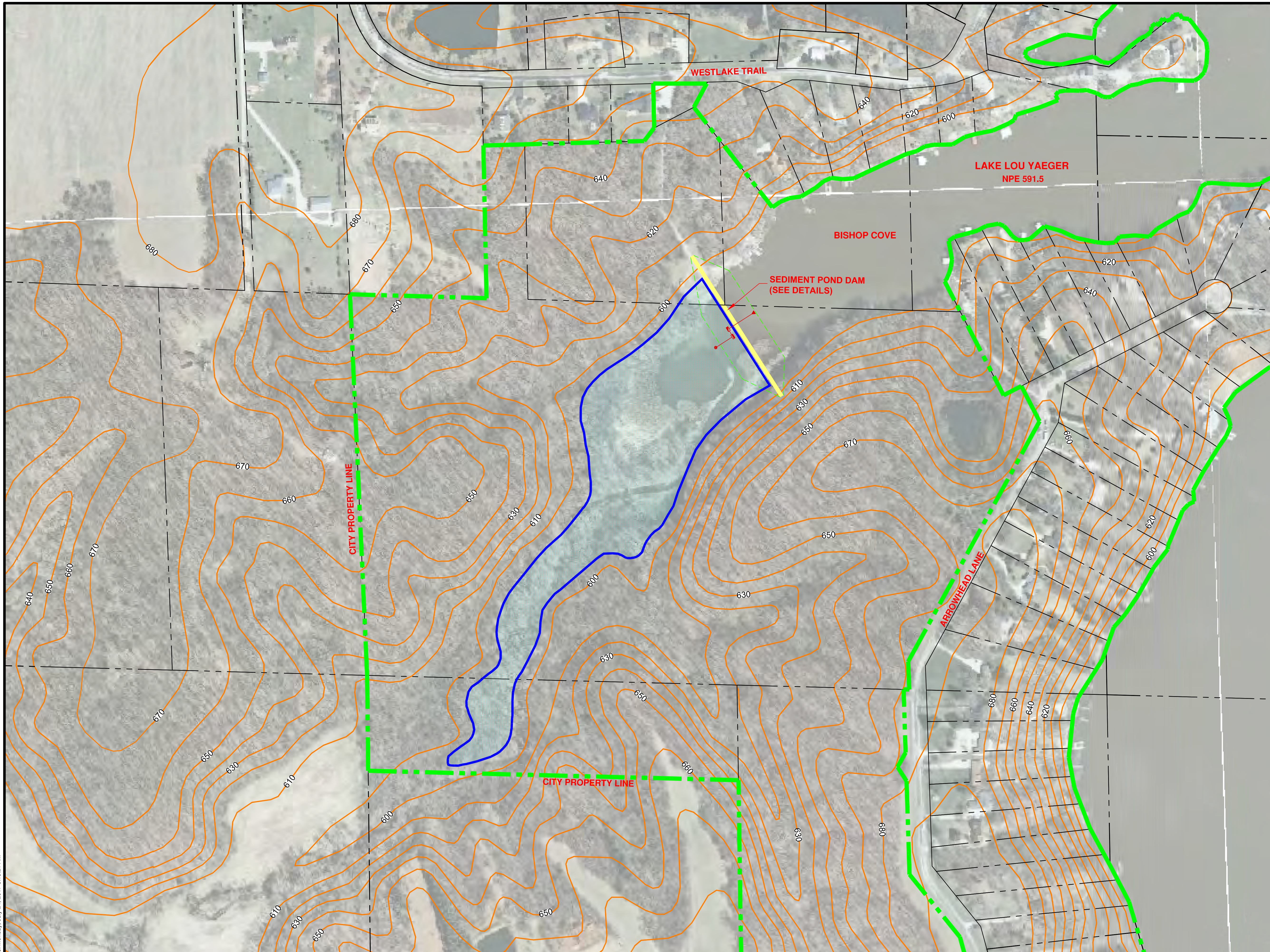
Typical Severe Shoreline Erosion along East Banks

<u>AREA 4 – West Shoreline</u> :

Typical Severe Shoreline Erosion

ATTACHMENT D

Proposed Conditions



CMT
Crawford, Murphy & Tilly

License No. 184-000613

CONSULTANTS

NORTH

0 160 320

SCALE IN FEET

LAKE LOU YAEGER

319 GRANT APPLICATION

City of LITCHFIELD
MORE than a GREAT location!

OWNER :

CITY OF LITCHFIELD

LITCHFIELD, IL

MARK	DATE	DESCRIPTION

PROJECT NO: 16028-04

CAD DWG FILE: EXHIBIT-A-BASIND3.DWG

DESIGNED BY: JFM

DRAWN BY: KN

CHECKED BY:

APPROVED BY:

SHEET TITLE

PROPOSED SEDIMENT POND BASIN A

SHEET OF

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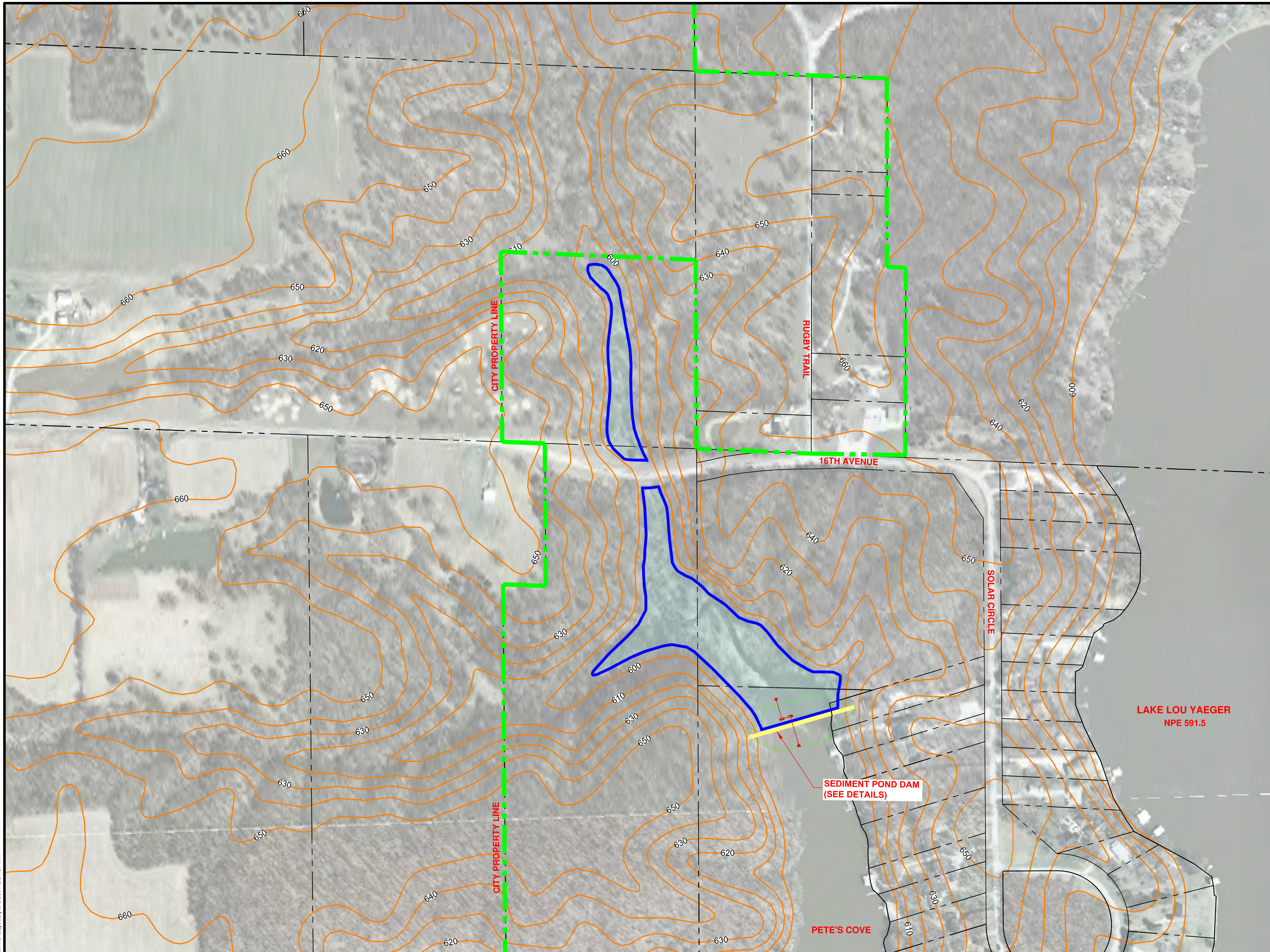

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NORTH

0 160 320

SCALE IN FEET

LAKE LOU YAEGER

319 GRANT APPLICATION

City of LITCHFIELD
MORE than a GREAT location!

OWNER :

CITY OF LITCHFIELD
LITCHFIELD, IL

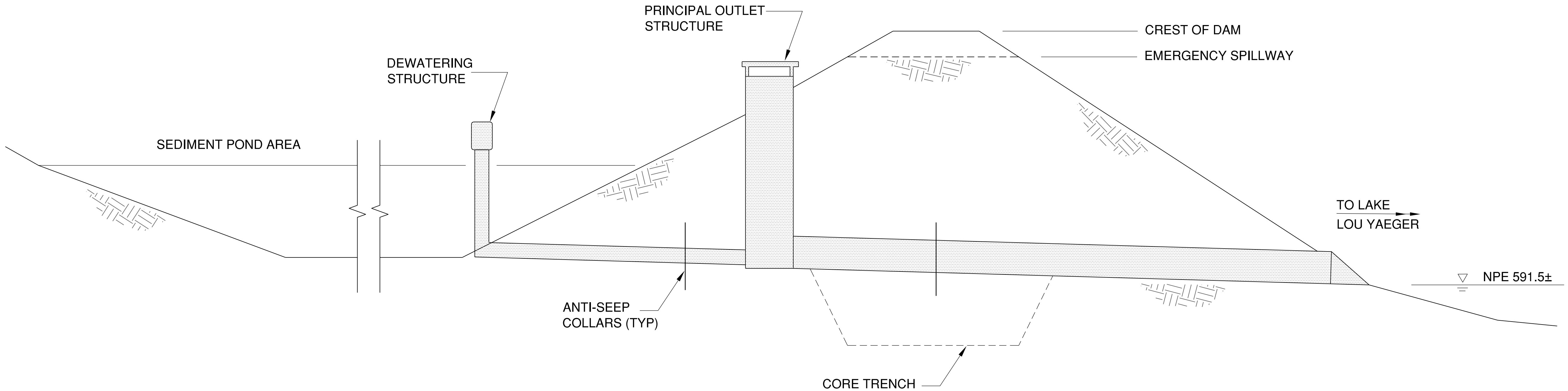
MARK	DATE	DESCRIPTION

PROJECT NO: 16028-04
CAD DWG FILE: ATTACHD1-BASINB.DWG
DESIGNED BY: JFM
DRAWN BY: KN
CHECKED BY:
APPROVED BY:

SHEET TITLE

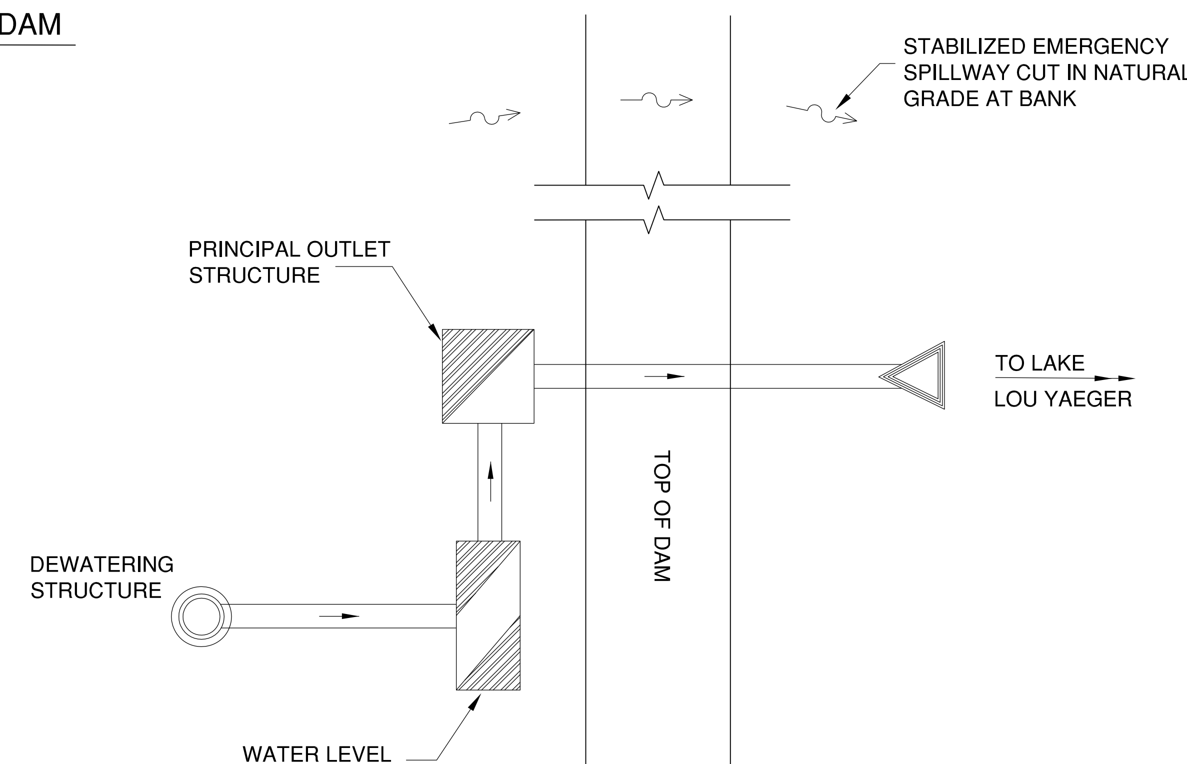
PROPOSED SEDIMENT POND BASIN B

SHEET OF



TYPICAL SECTION OF DAM

NTS



PLAN OF DAM

NTS

Crawford, Murphy & Tilly

License No. 184-000613

CONSULTANTS

LAKE LOU YAEGER

319 GRANT APPLICATION

OWNER :

CITY OF LITCHFIELD

LITCHFIELD, IL

MARK	DATE	DESCRIPTION

PROJECT NO: 16028-04

CAD DWG FILE: ATTACHD2-DAMDETAILS.DWG

DESIGNED BY: JFM

DRAWN BY: KN

CHECKED BY:

APPROVED BY:

SHEET TITLE

SEDIMENT POND
TYPICAL DAM DETAILS

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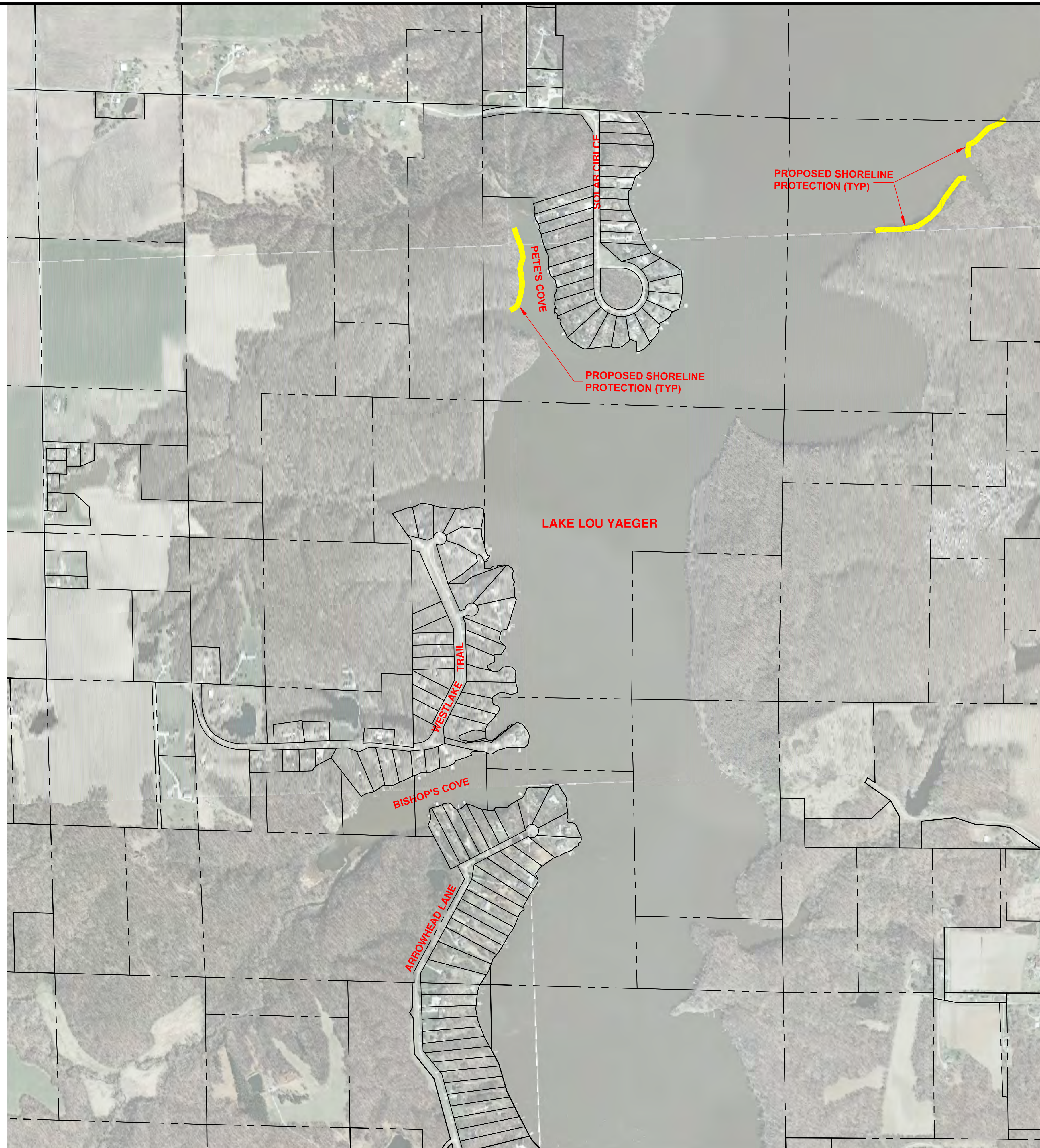

CMT
Crawford, Murphy & Tilly

License No. 184-000613

CONSULTANTS

NORTH

0 500 1000

SCALE IN FEET

LAKE LOU YAEGER

319 GRANT APPLICATION

City of LITCHFIELD
MORE than a GREAT location!

OWNER :

CITY OF LITCHFIELD

LITCHFIELD, IL

MARK	DATE	DESCRIPTION

PROJECT NO: 16028-04

CAD DWG FILE: ATTACHD3-SHORELINE.DWG

DESIGNED BY: JFM

DRAWN BY: KN

CHECKED BY:

APPROVED BY:

SHEET TITLE

PROPOSED SHORELINE PROTECTION AREAS

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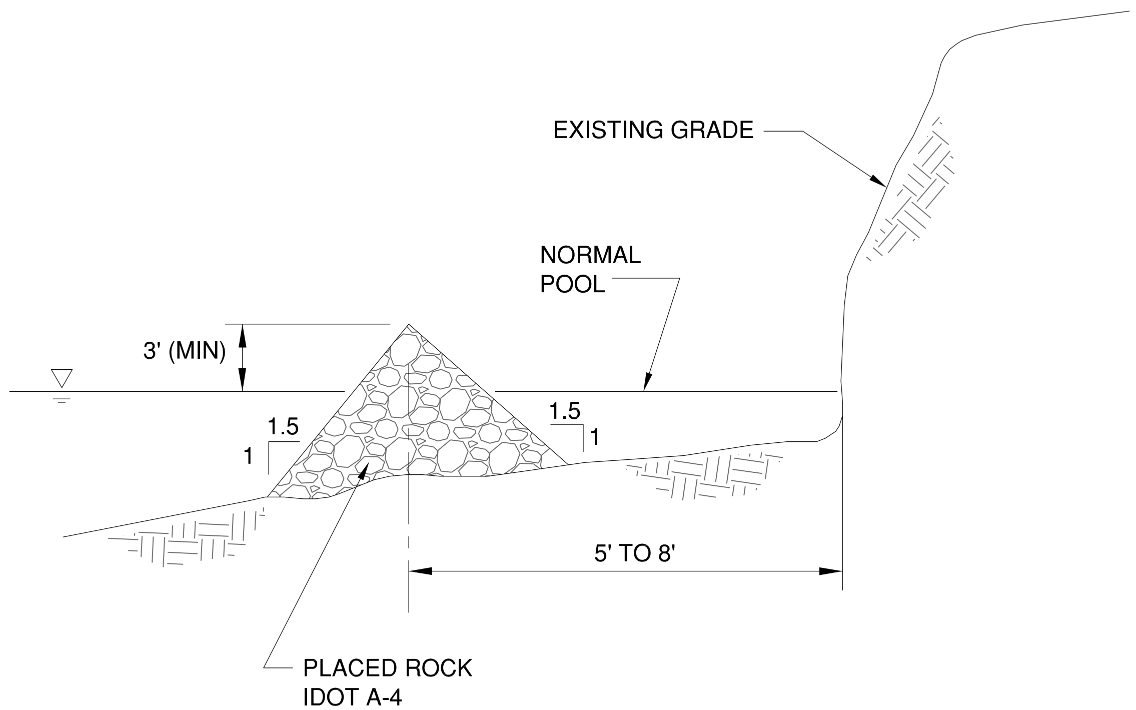

SHORELINE PROTECTION

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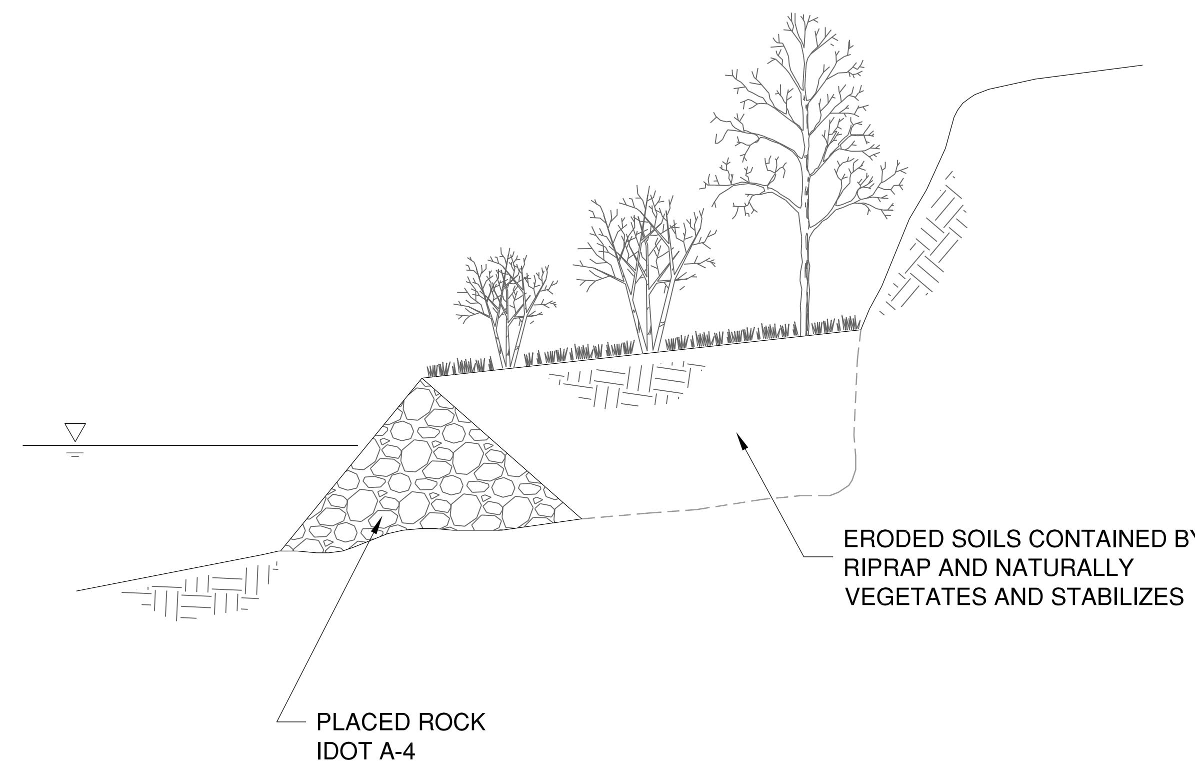

SHORELINE PROTECTION - FUTURE CONDITION

NTS

CMT
Crawford, Murphy & Tilly

License No. 184-000613

CONSULTANTS

LAKE LOU YAEGER

319 GRANT APPLICATION

City of LITCHFIELD
MORE than a GREAT location!

OWNER :

CITY OF LITCHFIELD
LITCHFIELD, IL

MARK	DATE	DESCRIPTION

PROJECT NO: 16028-04
CAD DWG FILE: EXHIBIT-A-BASIND3.DWG
DESIGNED BY: JFM
DRAWN BY: KN
CHECKED BY:
APPROVED BY:

SHEET TITLE

SHORELINE PROTECTION DETAILS

SHEET OF

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ATTACHMENT E

Analysis Data

Proposed Sediment Pond Summary

BASIN A - BISHOP'S COVE

Drainage Area (Watershed) = 2.34 sq mi = **1498 Ac**

Annual Rain = 36" / yr

Annual Inflow Volume = 36" x 12"/ft x 1498 Ac = **4494 Ac-FT**

Volume Estimate : (from existing contour map)
From EL 598 (assumed spill elev) to NPE 591.5

EL	Area (Ac)	Vol	
598	9.00		
		20.6	
595	4.71		
		8.8	
592	1.15		
		0.3	
591.5	0.0		
	Total Volume :	**29.6**	Ac-Ft

Efficiency Estimate: Brunes Curve

Capacity / Inflow = 29.6 / 4494 = **0.007**

From Brunes Curve ---> Efficiency = 35 - 40 %

Estimate Sediment Pond Efficiency = 40%

Proposed Sediment Pond Summary

BASIN B - PETE'S COVE

Drainage Area (Watershed) = 1.37 sq mi = **898 Ac**

Annual Rain = 36" / yr

Annual Inflow Volume = 36" x 12"/ft x 898 Ac = **2695 Ac-FT**

Volume Estimate : (from existing contour map)
From EL 598 (assumed spill elev) to NPE 591.5

EL	Area (Ac)	Vol	
598	5.38		
		13.2	
595	3.41		
		6.0	
592	0.61		
		0.2	
591.5	0.0		
	Total Volume :	**19.4**	Ac-Ft

Efficiency Estimate: Brunes Curve

Capacity / Inflow = 19.4 / 2695 = **0.007**

From Brunes Curve ---> Efficiency = 35 - 40 %

Estimate Sediment Pond Efficiency = 40%

UPDATED SHORELINE STABILIZATION PLANS (submitted through stakeholder comment/response period following the Stage 3 virtual public meeting - 2020):

The two sediment basin BMP's were deleted and the following BMP's proposed:

a. Bishop's Cove location
   - An in-lake sediment basin 300' by 250' will be excavated 2 to 5 feet in Bishop's Cove.
   - Three sediment trapping cells will be constructed in the floodplain on dry land upstream of Bishop's Cove.

b. Pete's Cove location
   - An in-lake sediment basin 175' by 175' will be excavated 1 to 4 feet deep in Bishop's Cove.
   - A permanent pool sediment basin will be constructed on the north side of 16th Avenue.
   -

The in-lake basins will be effective for trapping future sediment because they are located where sediment has been depositing for the past 55 years as the flow enters the lake.

The sediment trapping cells are a unique concept based on the natural shape of the floodplain being very wide and nearly level ground. Three impermeable low height dams (earth and riprap) will detain water during significant runoff events. The flow be directed to meander across the floodplain at a slow velocity to allow sediment to settle. The cells will trap sediment from the larger runoff events which tend to transport the greater share of sediment. The water from 2-year frequency storms and larger will be detained between 24 and 48 hours after the rainfall ends. The area will drain dry after the event similar to a dry bottom stormwater detention pond. It is anticipated that existing vegetation will survive without impact. New sediment is expected to accumulate at a depth of approximately 0.01" per year if the sediment were spread evenly over the 10-acre area of the three cells (Sediment will not be deposited uniformly). A benefit of the BMP is that no sediment removal by the City is anticipated in the future. The vegetation should adapt to the slowly rising ground level similar to vegetation in the floodplain of a major river (like the Illinois River).

The 16th Avenue sediment basin will utilize an existing road embankment. The new construction will consist of an outlet water control structure, shoreline riprap on the upstream face, earth fill to flatten the downstream slope and the extension of the existing culvert. The permanent impoundment will be a 3.4-acre pond with a maximum depth of 11 feet. The outlet control structure will have dewatering outlets which when opened will allow the sediment to dry and be removed. Sediment removal would be required at a frequency of 10 to 30 years.

The 16th Avenue dam has been submitted for a Section 319 grant in 2020. The other BMP's are under construction and scheduled for completion in 2020.

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