



# Lake Dalecarlia Watershed Diagnostic Study Public Meeting

PRESENTER:  
Tom Estrem with Cardno

July 18, 2022

## Topics Discussed

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- Project Review-Goals

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- Review of Watershed Characteristics

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- Assessment Tasks Completed

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- Results of Sampling

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- Management  
Considerations/Recommendations

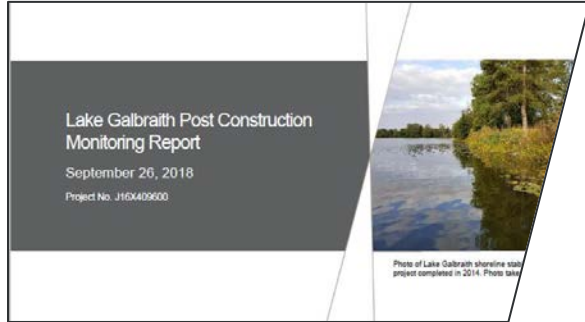
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- Questions

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# Lake Dalecarlia Watershed Diagnostic Study Overview

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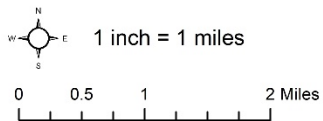
## > Goal of Study

- Document existing water quality conditions within the watershed (Tributaries) and in Lake Dalecarlia
- Develop management recommendations
- Study includes watershed downstream of Cedar Lake

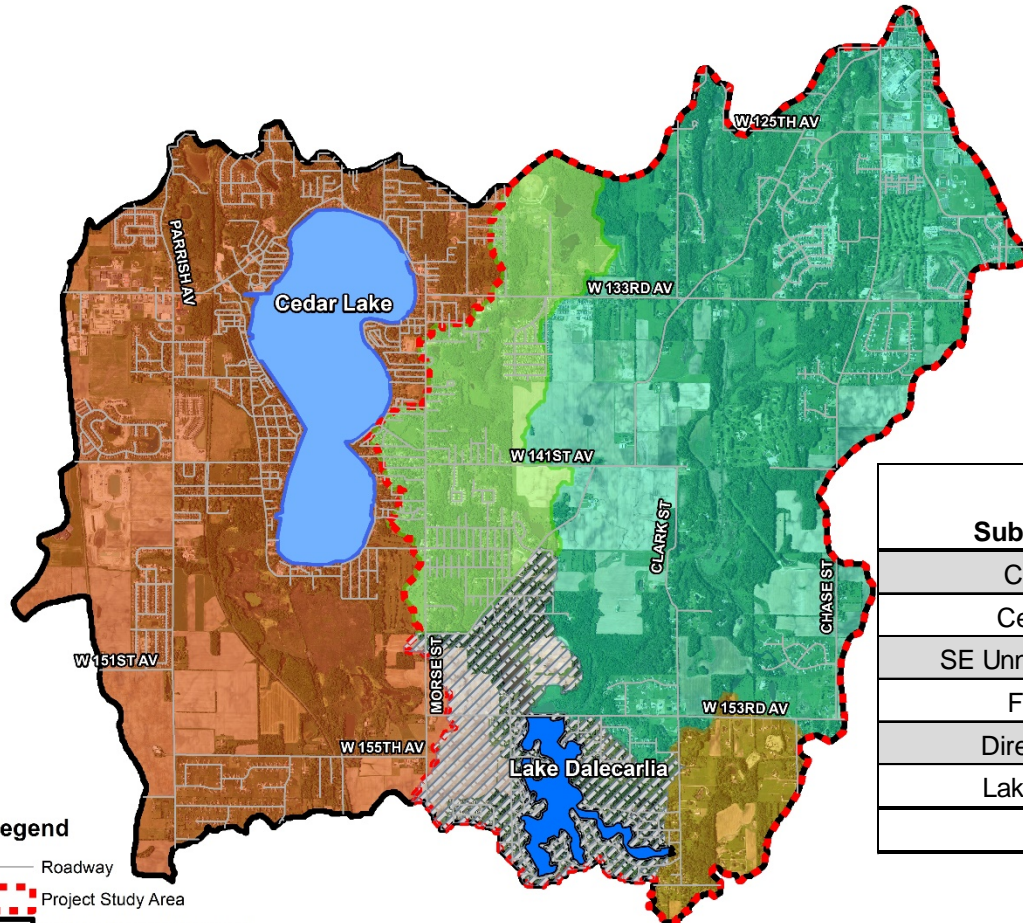
## > Study Tasks

- Watershed tour
- Tributary Sampling – 8 sites – 6 events
- In-lake sampling – 1 event in summer
- Sediment assessment in Lake Dalecarlia and Foss Ditch sediment trap
- Comprehensive project report
- **In-kind service credit provided to LDPOA (\$2,600 utilized)**





## Subwatershed Map

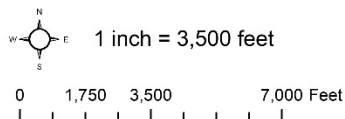


Subwatershed	AREA		DRAINAGES	
	Acres	Hectares	Feet	Miles
Cedar Lake	5233	2118	307194	58.20
Cedar Creek	1249	506	78165	14.82
SE Unnamed Tributary	470	190	26191	4.97
Foss Ditch	4940	1999	307033	58.10
Direct Drainage	883	357	77604	14.69
Lake Dalecarlia	172	70	-	-
<b>TOTAL</b>	<b>12947</b>	<b>5240</b>	<b>796187</b>	<b>150.78</b>

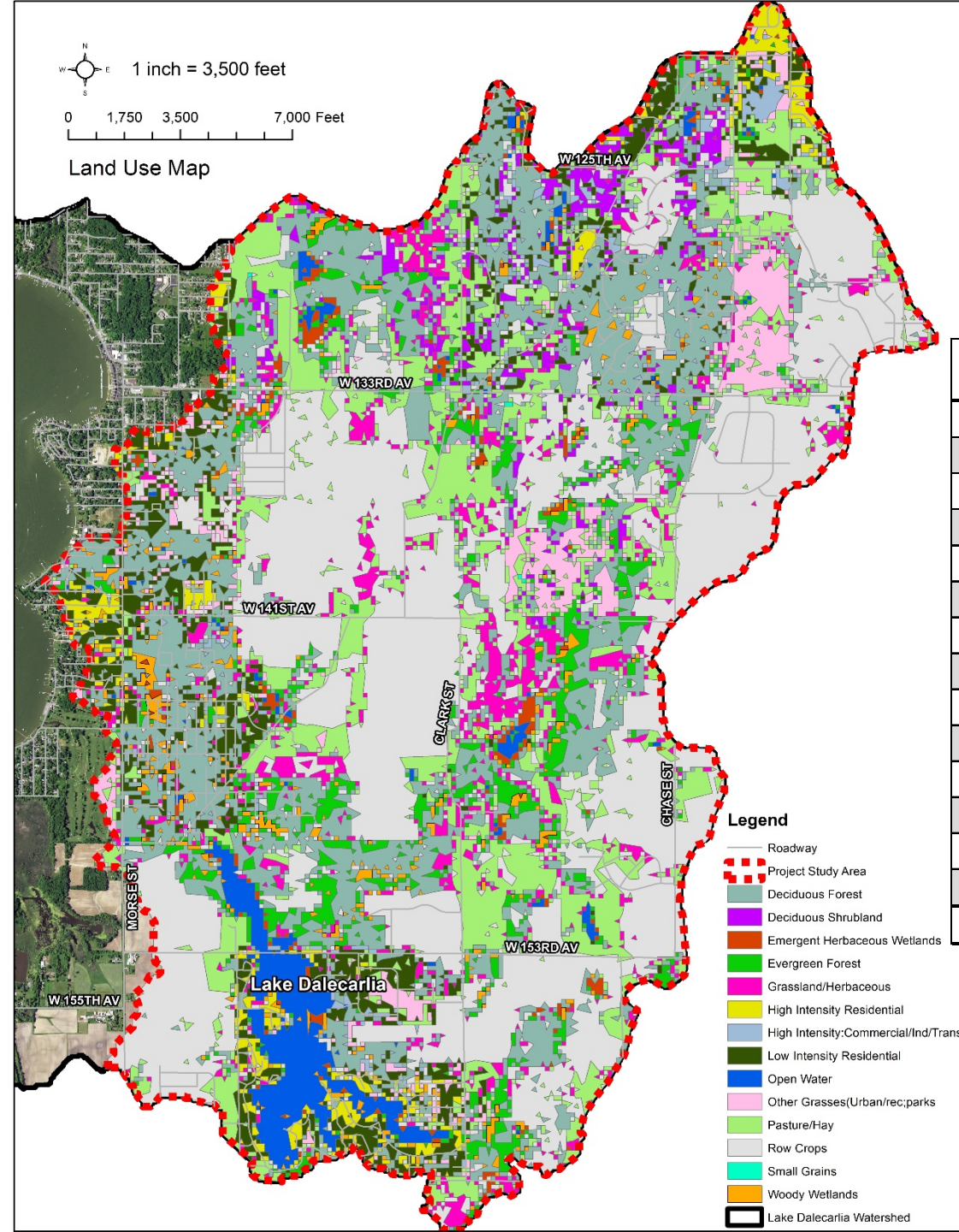
## Legend

- Roadway
- Project Study Area
- Lake Dalecarlia Watershed
- Cedar Lake
- Lake Dalecarlia
- Cedar Creek Subwatershed
- Cedar Lake Subwatershed
- SE Unnamed Tributary Subwatershed
- Foss Ditch Subwatershed
- Direct Drainage





Land Use Map

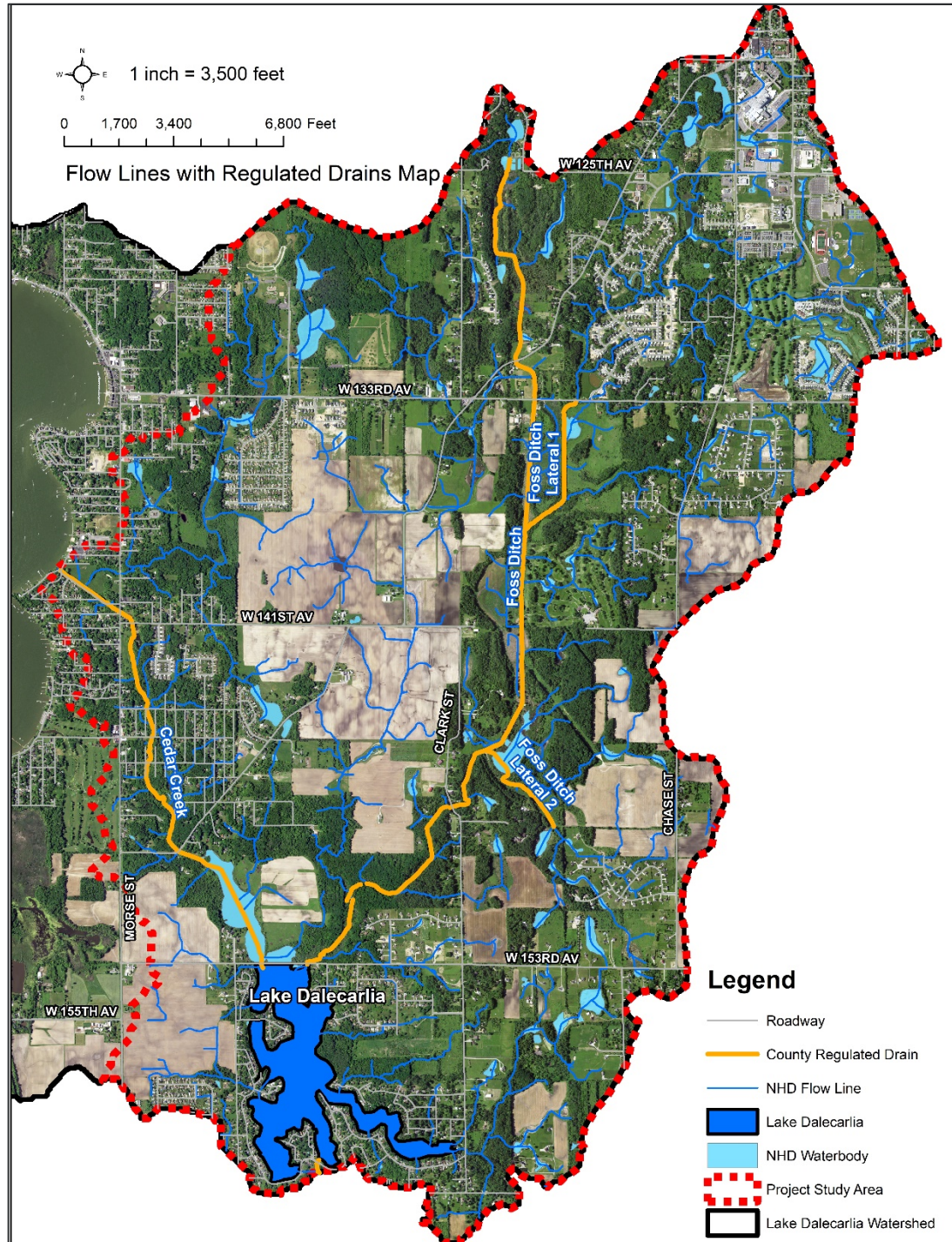


**Legend**

- Roadway
- Project Study Area
- Deciduous Forest
- Deciduous Shrubland
- Emergent Herbaceous Wetlands
- Evergreen Forest
- Grassland/Herbaceous
- High Intensity Residential
- High Intensity:Commercial/Ind/Trans
- Low Intensity Residential
- Open Water
- Other Grasses(Urban/rec;parks
- Pasture/Hay
- Row Crops
- Small Grains
- Woody Wetlands
- Lake Dalecarlia Watershed

Classification	Acres	Relative Percent (%)
Row Crops	2622.6	34.0
Deciduous Forest	1626.9	21.1
Pasture/Hay	1074.3	13.9
Low Intensity Residential	499.5	6.5
Grassland/Herbaceous	375.8	4.9
Evergreen Forest	340.6	4.4
Other Grasses(Urban/rec;parks	278.6	3.6
Open Water	239.0	3.1
High Intensity Residential	169.4	2.2
Deciduous Shrubland	168.6	2.2
Woody Wetlands	151.6	2.0
High Intensity:Commercial/Ind/Trans	93.3	1.2
Emergent Herbaceous Wetlands	72.4	0.9
Small Grains	1.1	0.0
<b>TOTAL</b>	<b>7713.8</b>	<b>100</b>

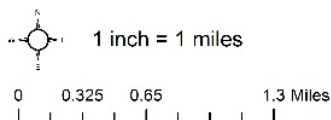




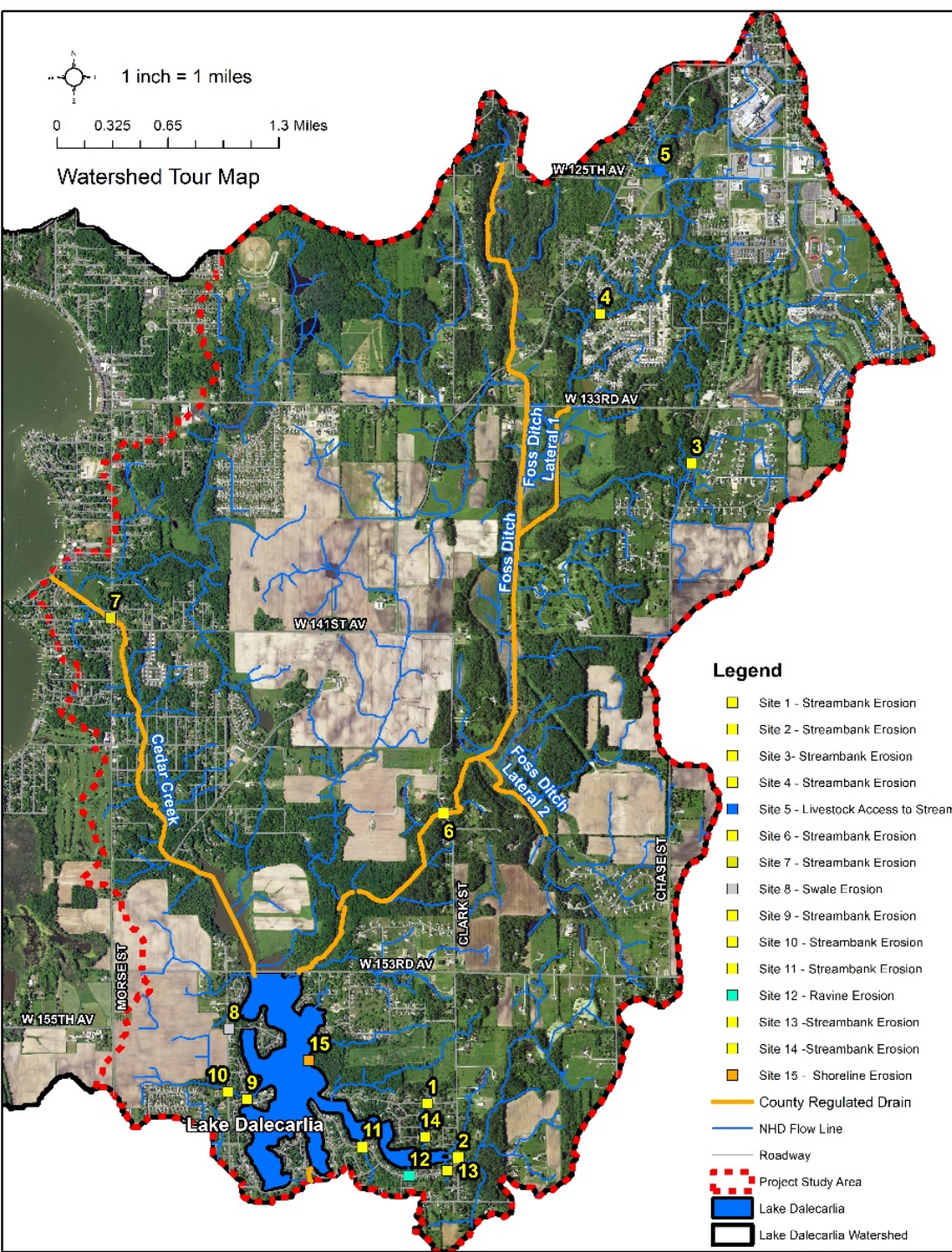
### Lake County Regulated Drains:

- Cedar Creek
- Foss Ditch
- Foss Ditch Lateral 1
- Foss Ditch Lateral 2





Watershed Tour Map



#### Legend

- Site 1 - Streambank Erosion
- Site 2 - Streambank Erosion
- Site 3 - Streambank Erosion
- Site 4 - Streambank Erosion
- Site 5 - Livestock Access to Stream
- Site 6 - Streambank Erosion
- Site 7 - Streambank Erosion
- Site 8 - Swale Erosion
- Site 9 - Streambank Erosion
- Site 10 - Streambank Erosion
- Site 11 - Streambank Erosion
- Site 12 - Ravine Erosion
- Site 13 - Streambank Erosion
- Site 14 - Streambank Erosion
- Site 15 - Shoreline Erosion
- County Regulated Drain
- NHD Flow Line
- Roadway
- - - Project Study Area
- Lake Dalecarlia
- - - Lake Dalecarlia Watershed

**Watershed Tour completed on April 15, 2022**

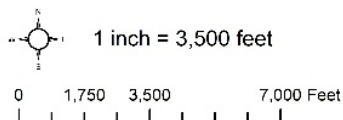
#### Identify Issues:

- Numerous drainage instability issues around lake
- Streambank erosion
- Potential animal access to stream
- Shoreline erosion
- Increased residential development

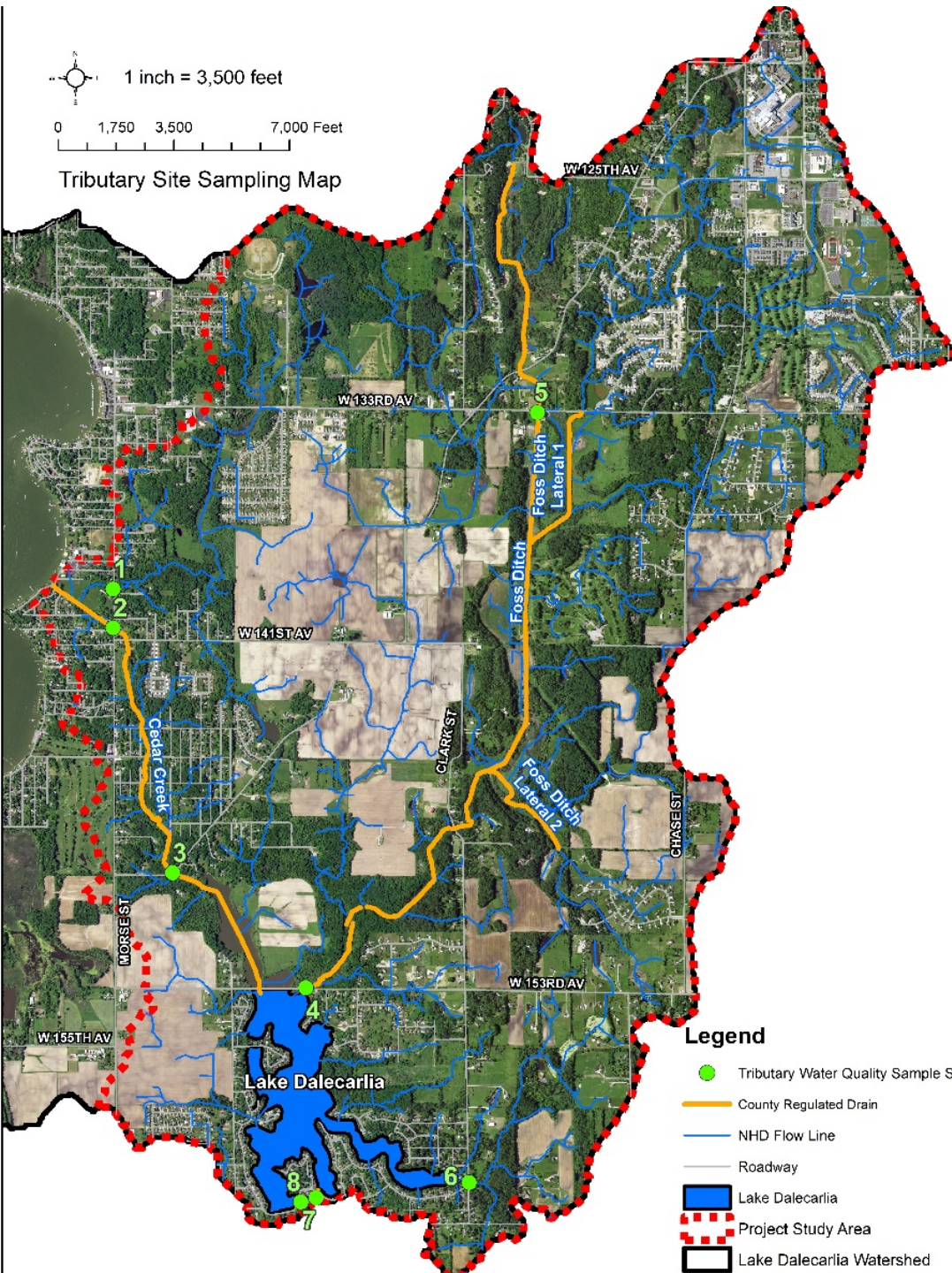
#### Positive Items:

- Modified tillage practices on most agricultural fields
- Cedar Creek nice floodplain in locations
- Stable stream reaches





Tributary Site Sampling Map



## Tributary/Watershed Sampling

### Sites:








1. Unnamed Trib to Cedar Creek Morse Rd
2. Cedar Creek at Morse Rd
3. Cedar Creek at Reeder Rd
4. Foss Ditch at 153<sup>rd</sup> Ave
5. Foss Ditch at W 133<sup>rd</sup> Ave
6. Unnamed Tributary Clark St
7. East Lake outlet
8. West Lake outlet

**Sampled during 6 events:** April, May, June, August (2 events), September

\*Low water levels in 2021 resulted in some difficulty sampling storm events.

Physical and Chemical metrics assessed.

### Legend

-  Tributary Water Quality Sample Site
-  County Regulated Drain
-  NHD Flow Line
-  Roadway
-  Lake Dalecarlia
-  Project Study Area
-  Lake Dalecarlia Watershed



Site	2021 Mean Values						
	NH3-N (mg/L)	NO3--N (mg/L)	TP-P (mg/L)	SRP-P (mg/L)	<i>E. coli</i> (MPN/100 mL)	TSS (mg/L)	Discharge (cfs)
Site 1 - Unnamed Tributary to Cedar Creek at Morse St.	0.036	0.161	0.159	0.0715	2966	37.7	1.455
Site 2 - Cedar Creek at Morse St.	0.278	0.180	0.188	0.0445	3643	38.3	3.969
Site 3 - Cedar Creek at W 149th Ave. (Reeder Rd.)	0.145	0.149	0.232	0.0258	627	79.6	*
Site 4 - Foss Ditch at 153rd Ave.	0.135	0.783	0.146	0.0571	517	15.7	7.527
Site 5 - Foss Ditch at 133rd Ave.	0.215	0.199	0.241	0.0921	3091	48.1	1.431
Site 6 - Unnamed Tributary at Clark St.	0.048	0.399	0.135	0.0673	3927	44.8	1.229
Site 7 - Eastern Lake Outlet	0.154	0.160	0.160	0.0437	63	35.4	0.572
Site 8 - Western Lake Outlet	0.27175	0.132	0.197	0.0437	132	41.1	6.930

### Trends Observed:

- **Ammonia (NH3-N)** - Exceeded Indiana Administrative Code (IAC) at all sites
- ***E. coli*** concentrations variable at all sites.
  - Lake outlets low below State Standard,
  - Foss Ditch Site 4 lowest from other sites
  - State Standard is 235 MPN/100 mL
- **Nitrate (NO3)** concentrations low- all below 1.0 which is good
- **Total phosphorus (TP-P)**- overall high- Would like to see below 0.1 mg/L
- **Soluble Reactive Phosphorus (SRP)** – similar to Total phosphorus high
- **Total Suspended Solids (TSS)** – less than 25 mg/L is acceptable- only Site 4 Foss Ditch achieved.
- Site 4: Foss Ditch had the most stable parameters throughout sampling period
  - chemical concentrations lower at downstream end
  - TSS lowest at Site 4-suggest sediment trap is working

Site	NH3-N (lb/yr)	NO3-N (lb/yr)	TP-P (lb/yr)	TSS (ton/yr)
Site 1 - Unnamed Tributary to Cedar Creek at Morse St.	103.1	461.0	455.3	54.0
Site 2 - Cedar Creek at Morse St.	2171.1	1405.7	1468.2	149.6
Site 4 - Foss Ditch at 153rd Ave.	1999.3	11595.8	2162.2	116.3
Site 5 - Foss Ditch at 133rd Ave.	605.5	560.5	678.7	67.7
Site 6 - Unnamed Tributary at Clark St.	116.1	964.8	326.4	54.2
Site 7 - Eastern Lake Outlet	173.4	180.2	180.2	19.9
Site 8 - Western Lake Outlet	3708.9	1799.9	2686.2	280.2

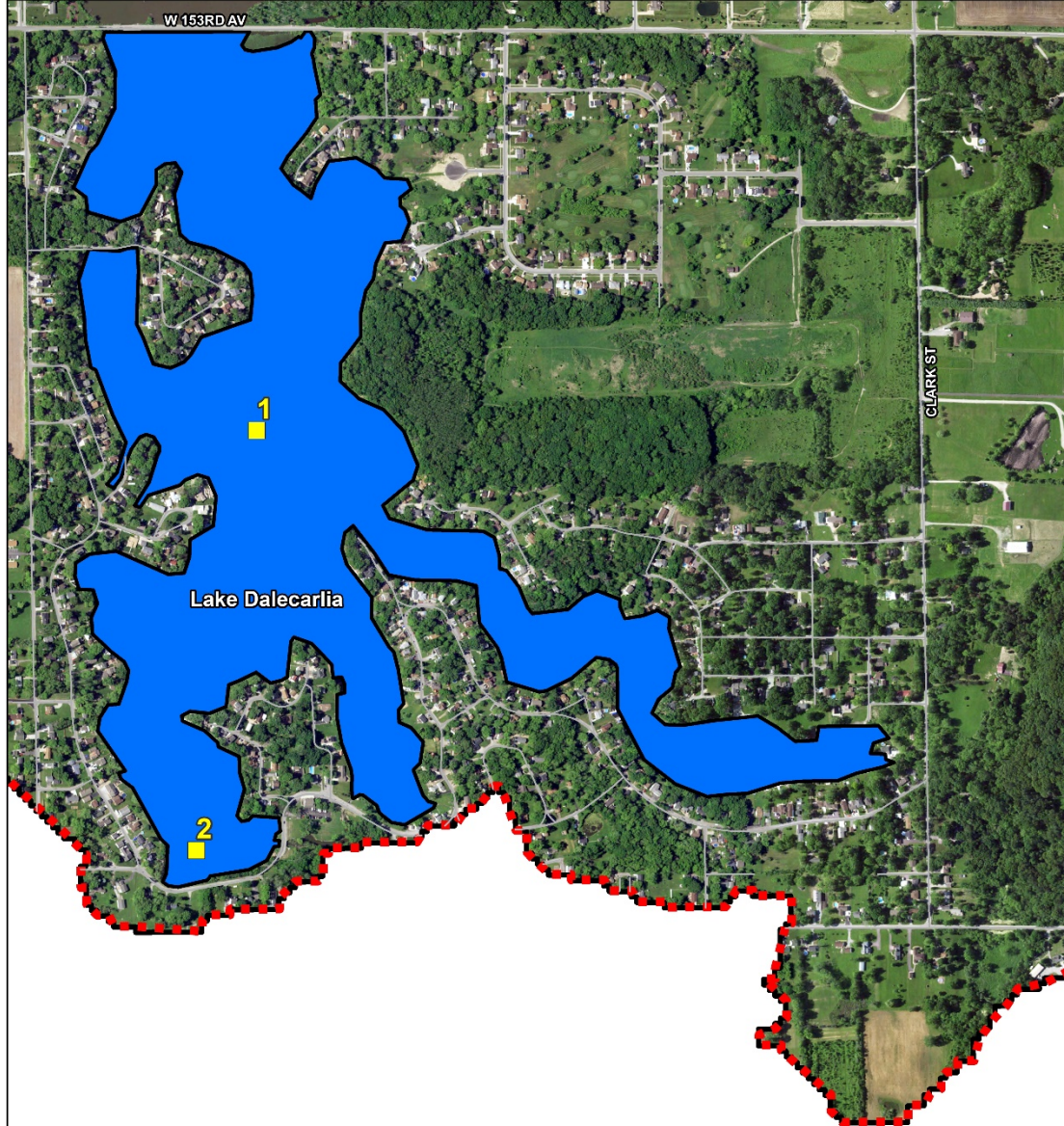
Note: Sites 7 and 8 are the outlets of the lake and represent nutrients and sediment leaving the lake.

- Site 2 = Cedar Creek watershed loading ; Site 4 = Foss Ditch watershed loading; Site 6 = SE Unnamed Tributary watershed loading
- Cedar Creek highest loading for TSS and ammonia nitrogen
- Foss Ditch highest loading for phosphorus and nitrate nitrogen
- Lake Dalecarlia is functioning as a “sediment sink” = less nutrients and sediment leaving than entering

Site/Watershed	NH3-N (lb/yr/ac)	NO3-N (lb/yr/ac)	TP-P (lb/yr/ac)	TSS (ton/yr/ac)
Site 2 - Cedar Creek at Morse St.	0.33	0.22	0.23	0.02
Site 4 - Foss Ditch at 153rd Ave.	0.40	2.35	0.44	0.02
Site 6 - Unnamed Tributary at Clark St.	0.25	2.05	0.69	0.12

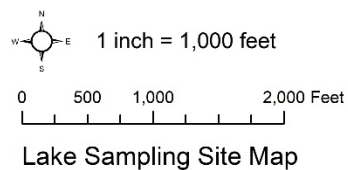
- Loading rates by per acre of watershed also important
- Site 6 has some of the highest loading rates by per acre of watershed





## Samples collected on August 17, 2021

- 2 locations
  - Center of lake (Site 1)
  - Near west outlet (Site 2)
- **Data Collected**
  - Water sample collected at top and bottom of water column
    - Epilimnion (surface)
    - Hypolimnion (bottom)
  - Temperature/Dissolved oxygen profile
  - Light extinction profile
  - Secchi Disk (water clarity)



### Legend

- Lake Sampling Site
- Roadway
- Lake Dalecarlia
- Project Study Area
- Lake Dalecarlia Watershed

Site Name	Date	Secchi Disk (ft)	pH	Cond. (µs/cm)	Turbidity (NTU)	NH3-N (mg/L)	NO3--N (mg/L)	SRP-P (mg/L)	TP-P (mg/L)
Site 1 Epilimnion	8/17/2021	0.8	7.53	501	54.90	<0.0098	<0.0060	0.039	0.162
Site 1 Hypolimnion	8/17/2021	-	7.75	479	69.90	<0.0098	<0.0060	0.035	0.179
Site 2 Epilimnion	8/17/2021	0.8	7.48	466	-	<0.0098	<0.0060	0.029	0.162
Site 2 Hypolimnion	8/17/2021	-	7.46	465	-	<0.0098	<0.0060	0.0217	0.166

- No change in characteristics from top to bottom of water column
  - Too shallow to stratify
  - No internal release of phosphorus from sediments suggested-also why SRP is low.
- Secchi Disk reading very low – poor water clarity – less than most Indiana lakes
- pH and conductivity normal
- Ammonia and Nitrate low because water column is oxygenated – lower than most Indiana lakes
- Total phosphorus is high – about average with most Indiana lakes
- Soluble Reactive Phosphorus is low – lower than most Indiana lakes
- Adequate dissolved oxygen within water column - all above 6 mg/L
- Light extinction profile estimates 1% light level is at 2.75 ft
  - Below 2.75 feet suggest no aquatic plants can grow.



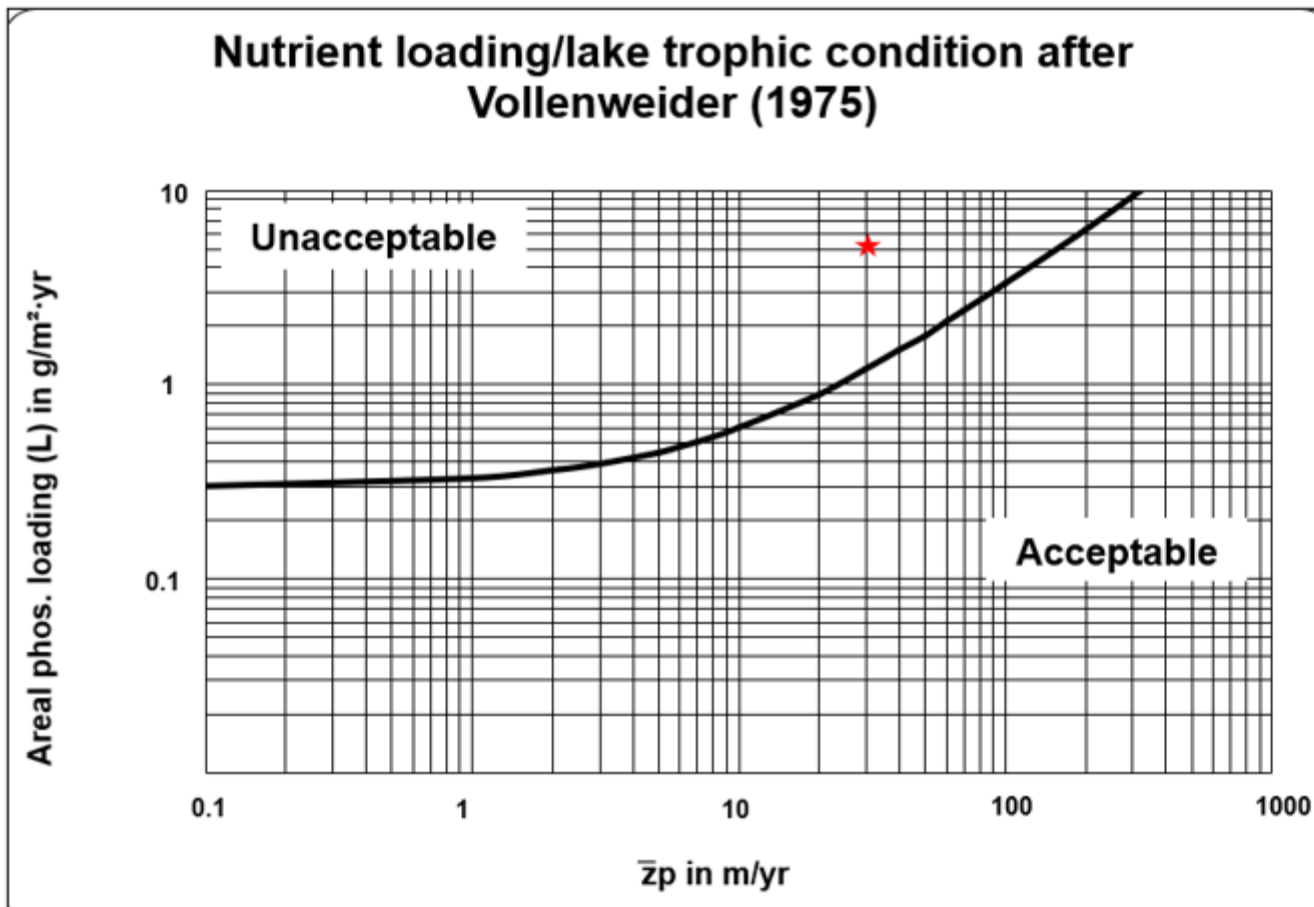
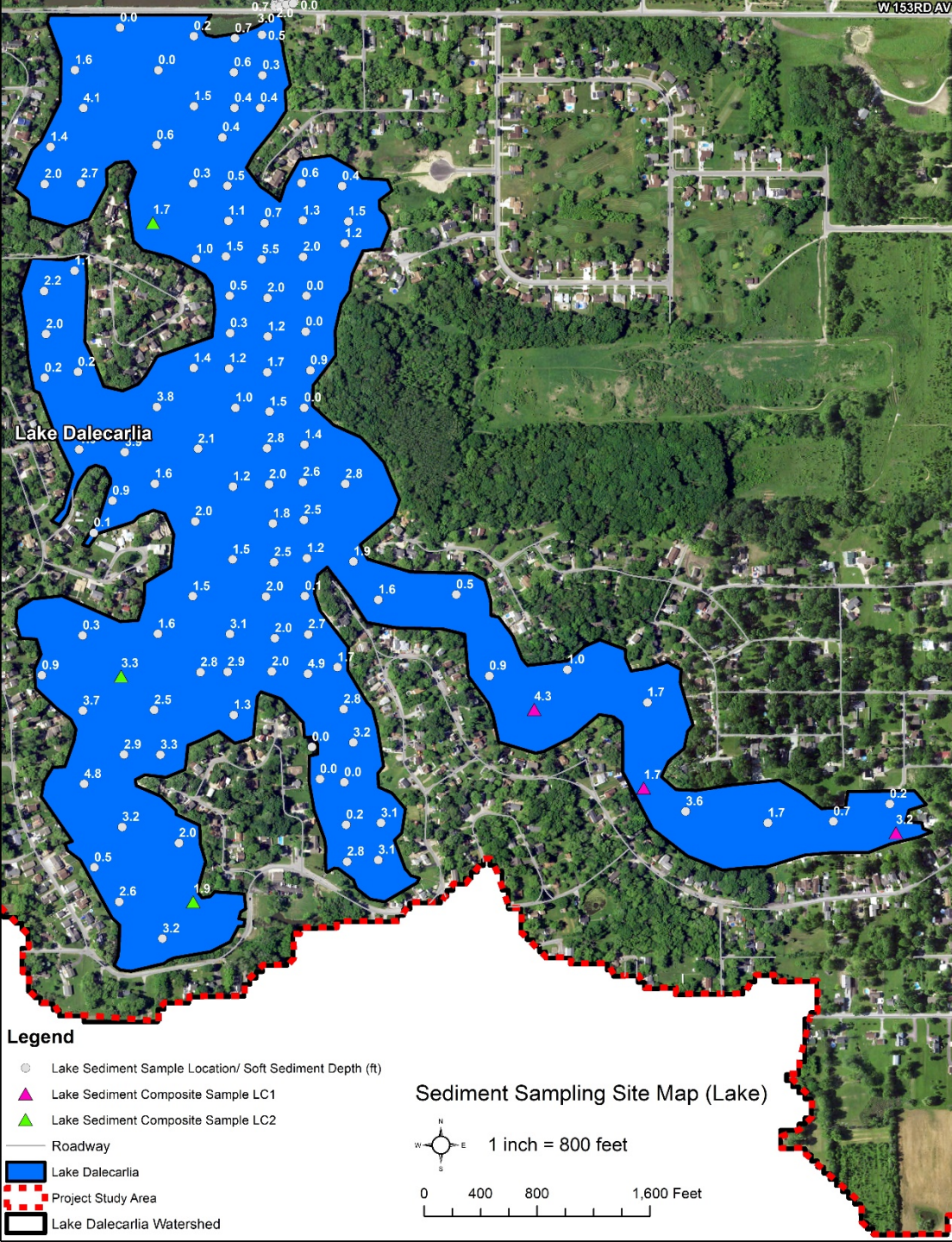


Figure 20. Phosphorus loading to Lake Dalecarlia compared to acceptable loadings determined from Vollenweider's model. The dark line represents the upper limit for acceptable loading. Current Lake Dalecarlia areal loading indicated by red star (5.090 g/m<sup>2</sup>-yr).

- Phosphorus modeling suggests **75% reduction** in phosphorus loading from watershed is needed to maintain acceptable phosphorus concentration in Lake Dalecarlia



- **Lake Dalecarlia Sediment Mapping**
- Average loose sediment depth 1.7 ft
- Range 0 – 4.8 ft
- Sediment was primarily silt or sand
- Total estimated loose sediment volume = 398,599 cubic yards

- **Foss Ditch sediment trap mapping**
- 0 – 3.4 ft
- Average 2.1 ft
- Total estimated loose sediment volume = 241 cubic yards



# Recommendations and Management Considerations

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- Lake Dalecarlia has reduced water quality due to excess sediment and nutrient loading
  - Watershed to lake area ratio of **75:1 Very High**
  - Management of watershed will take partnerships
- **Management Recommendations**
  - Professional Algae Treatment of lake area
  - Landowner Best Management Practices
  - Foss Ditch Sediment Trap Maintenance
    - Lake County Surveyors Office – Drainage Board
  - Foss Ditch and Cedar Creek Streambank stabilization feasibility study
    - Potential Indiana LARE funding \$35,000-50,000
  - Address 2021 watershed tour erosion issues within LDPOA footprint
    - Design/permitting \$5,000-12,000 each site. Potential to combine sites to save money
    - \$50-200 linear ft to implement
  - Lake Dalecarlia dredging
    - 398,599 cubic yards at \$8-10 a cubic yard = \$3,188,792 - 3,985,990 estimate
      - Could potentially be lower?
  - Develop partnerships for Watershed Management
    - Producers, County Surveyor, Municipalities, USDA, NRCS

# Thank you

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For more information

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