Little Swan Lake

Dam Inspection & Siltation Study

Prepared By: William Klingner, P.E., CFM

October 28, 2018

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Agenda

- Little Swan Lake Dam Inspection
- Theoretical Little Swan Lake Siltation Rate Calculations
- Measured Little Swan Lake Siltation Rate Calculations
- Siltation Study Results
- Proposed Alternatives to Address Siltation

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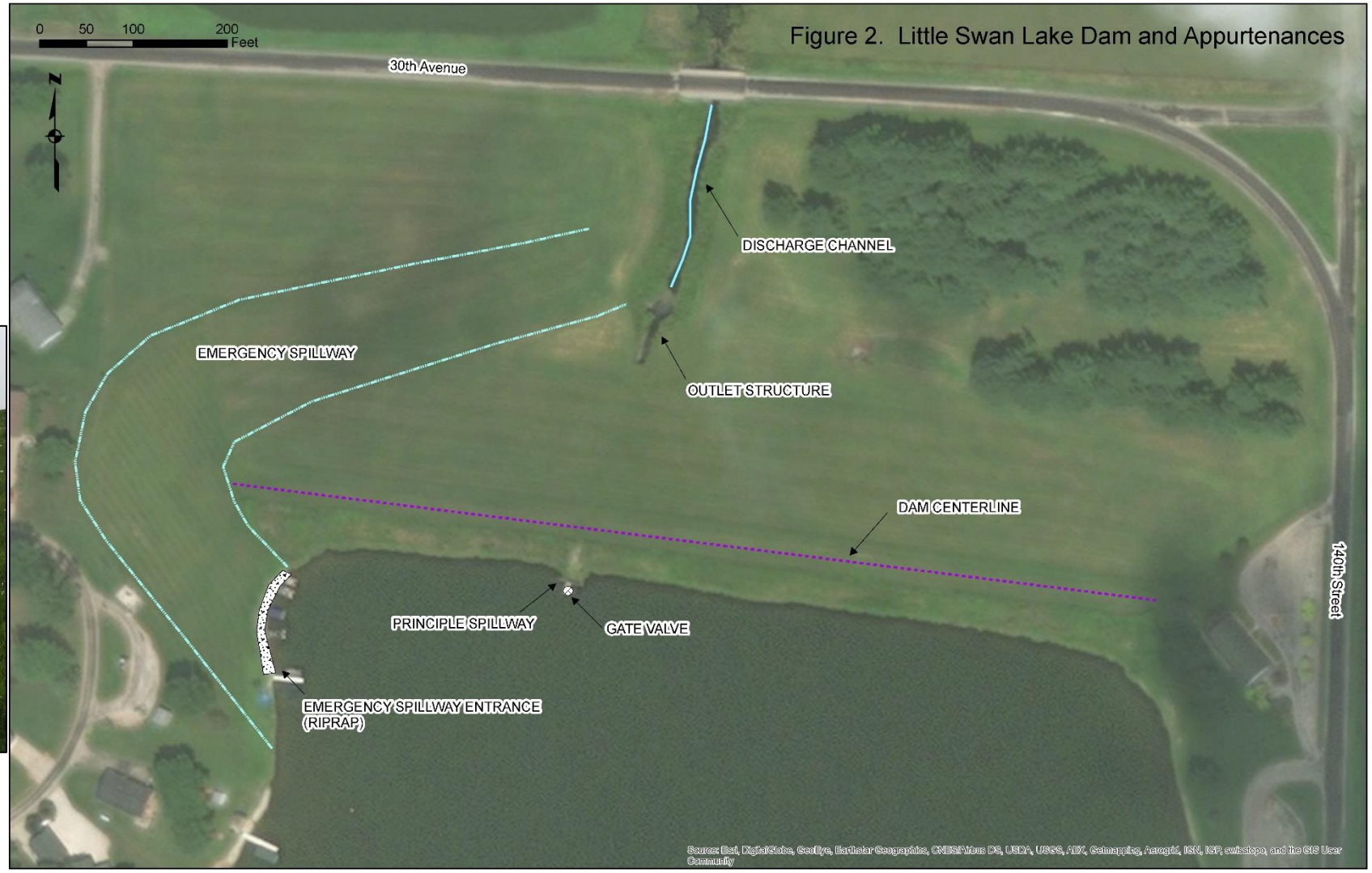
Dam Inspection - Findings



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Dam Inspection – Toe Drain Maintenance

TOE DRAIN OUTLETS

POTENTIAL SEEPAGE
AT TOE OF DAM

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Dam Inspection – Spillway Conduit, Gate/Sill, and Drop Box

66” Dia Principal Spillway Conduit

10’ DROP BOX & GATE VALVE

30” Dia Dewatering Conduit

SECTION ALONG ℄ OF SPILLWAY

TRENCHING & PLACEMENT DETAILS 66" PIPE CONDUIT

DEWATERING CONDUIT

TAIL-WATER CHANNEL

TRANSITION & PARABOLIC DROP

TRANSITION AND RISER STRUCTURE

PLAN

BILL OF REINFORCEMENT

BAR	NO.	LENGTH	SHAPE
#20	96	4'-10"	
21	48	11'-8"	
22	48	8'-1"	
23	144	3'-6"	
24	24	5'-0"	
25	16	3'-10"	
26	12	7'-8"	
27	12	5'-1"	
28	18	2'-4"	
29	8	3'-6"	

ESTIMATED QUANTITIES

CLASS X CONCRETE	C.Y.	24
REINFORCEMENT BARS	LBS.	1546
SPILLWAY CONDUIT-66"	L.F.	210
DEWATERING PIPE 30"	L.F.	60

SPILLWAY - GENERAL LAYOUT
EARTH DAM AND SPILLWAY
LITTLE SWAN LAKE ASSOCIATION
CASLER AND ASSOCIATES
CONSULTING ENGINEERS
JACKSONVILLE, ILLINOIS

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Dam Inspection – Miscellaneous Observations

Spalling and Cracked Concrete

Boats Docked in the Emergency Spillway

Animal Burrows

Woody Vegetation

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MUSLE – MODIFIED UNIVERSAL SOIL LOSS EQUATION

$$A = R * K * LS * C * P$$

Where:

R = Rainfall-Runoff Erosivity Factor (What is the Force of the Rainfall?)

K = Soils Erodibility Factor (How Susceptible is the Soil to Erosion?)

LS = Slope Length Factor (How Steep or Flat is the Watershed?)

C = Cover-Management Factor (What is the Landuse?)

P = Support Practice Factor (Are Their Any Alternative Conservation Practices?)

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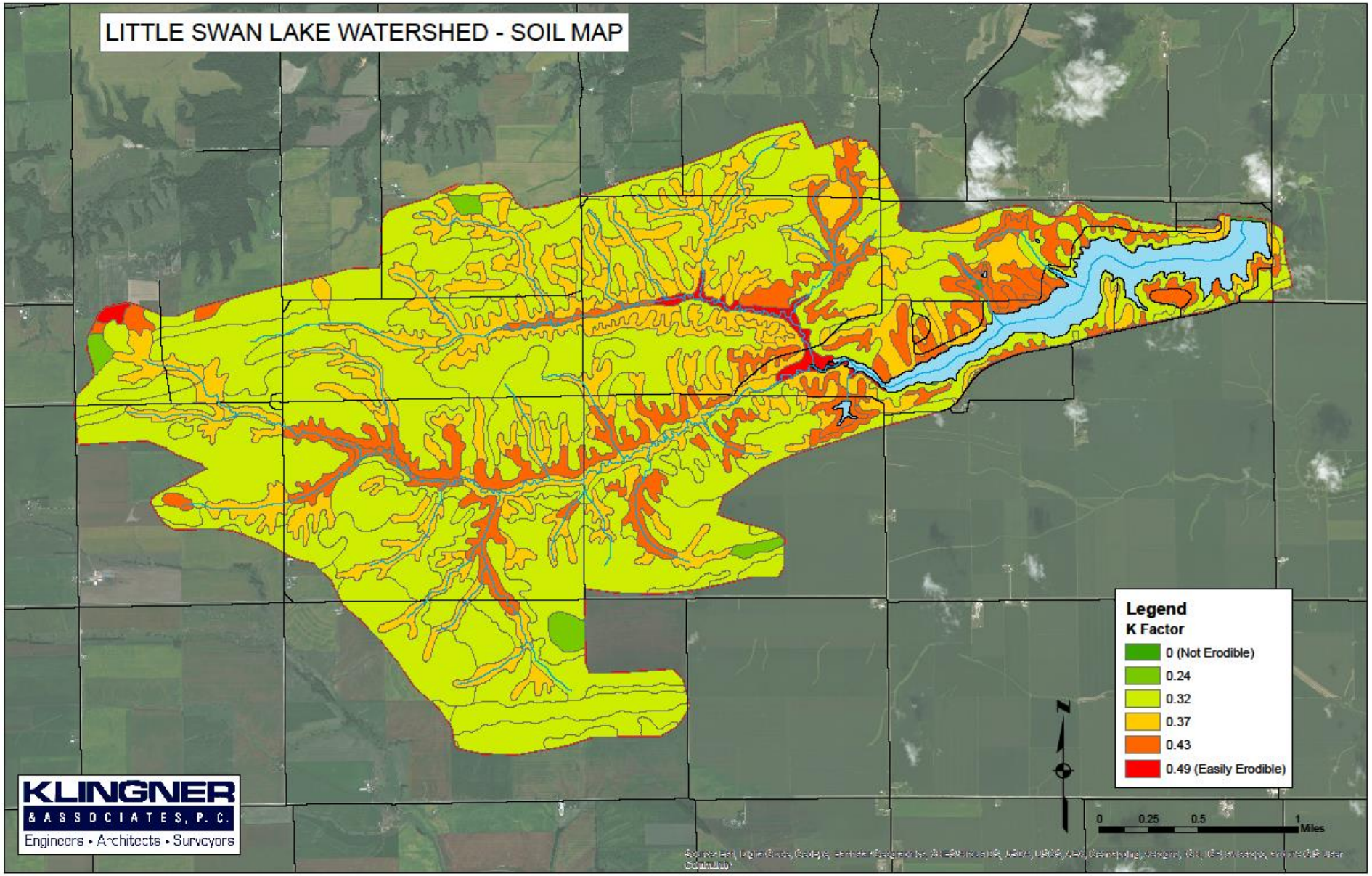
MUSLE – SOIL MAP



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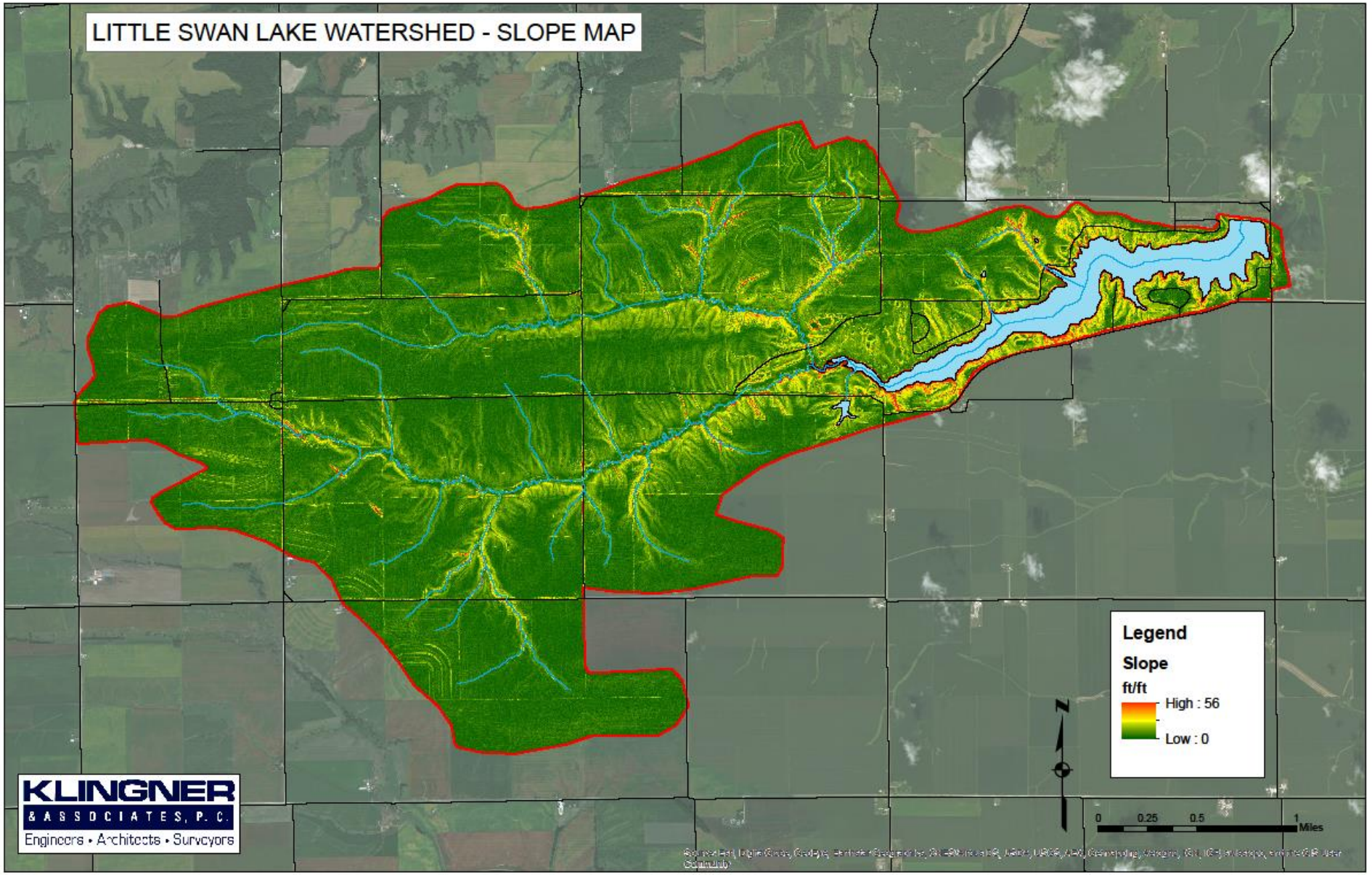
MUSLE – SLOPE MAP



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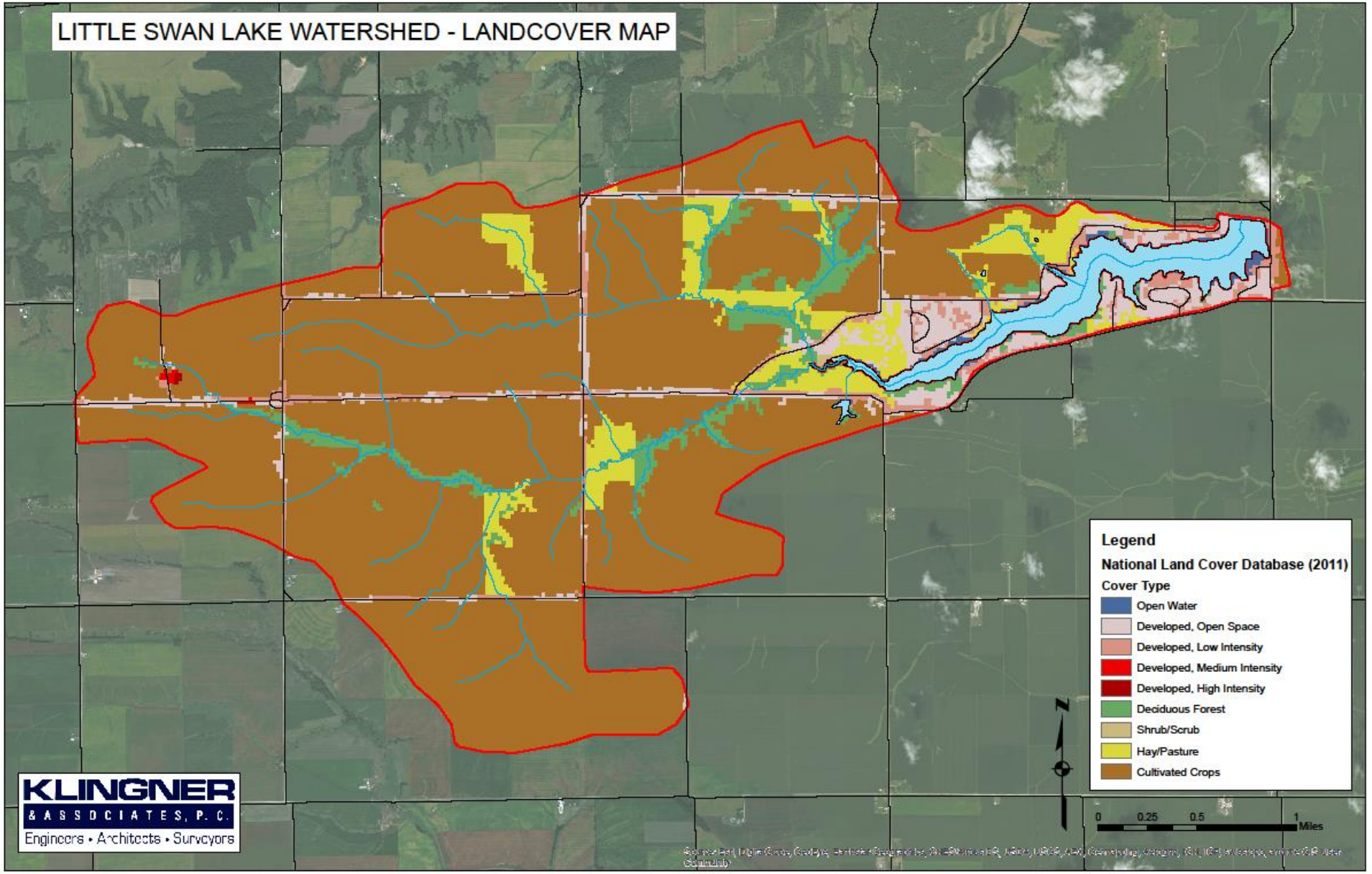
MUSLE – LANDUSE MAP



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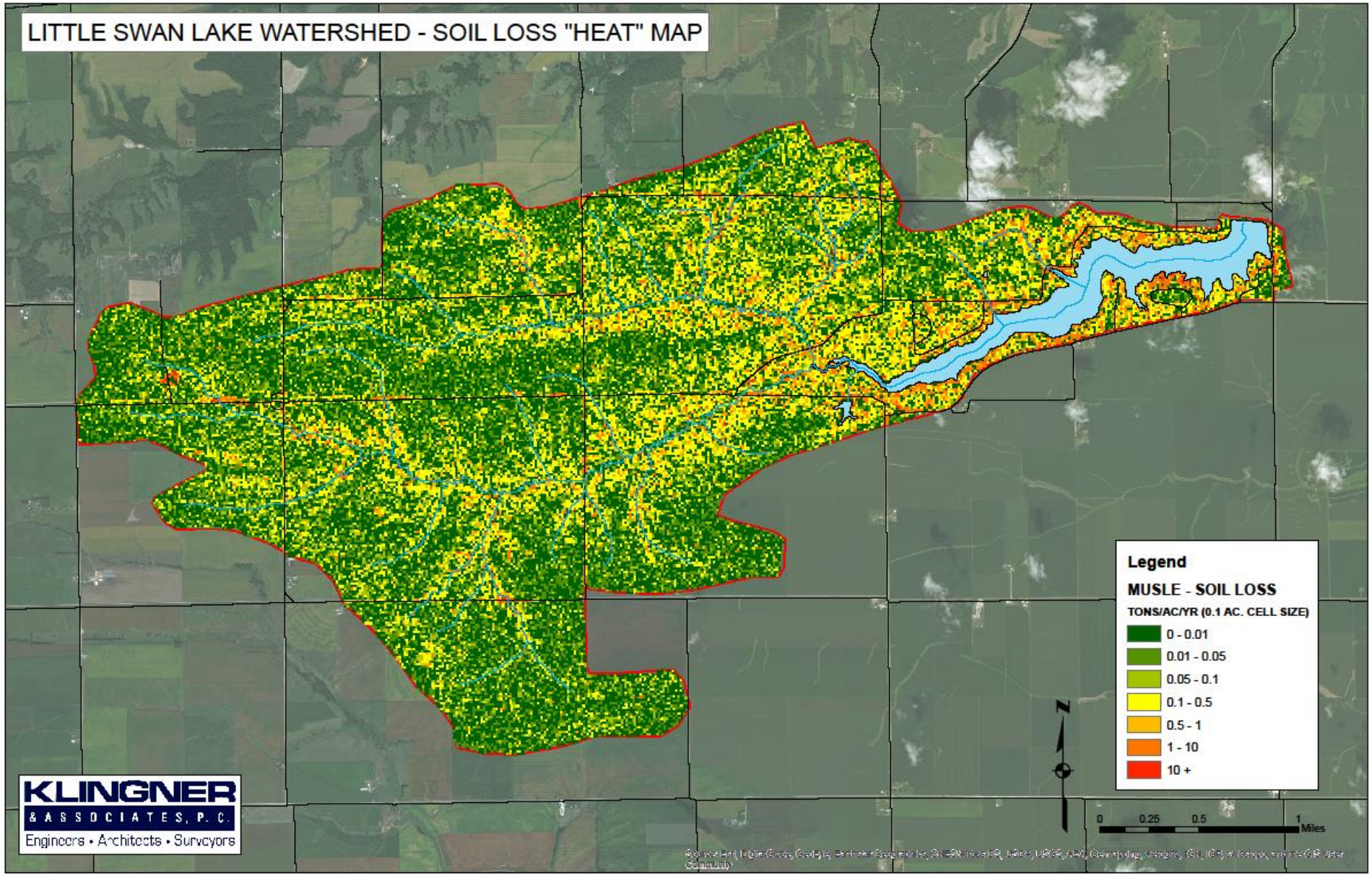
MUSLE – SOIL LOSS “HEAT MAP”

- Average Soil Loss for the Watershed was Approximately 0.5 Tons/Ac/Year
- This Equates to Approximately **2500 Tons of Sediment/Year**
- The average soil loss for a typical Illinois Watershed is approximately 3.0 Tons/Ac/year.
- The Little Swan Lake Watershed Produces Less Sediment than the Regional Average.



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BATHYMETRIC SURVEY

- Compared the Results of Three (3) Data Sources
  - Cochran & Wilken, Inc Report (2003)
  - Hartman Bathymetric Survey (2015)
  - Klingner Bathymetric Survey (2018)

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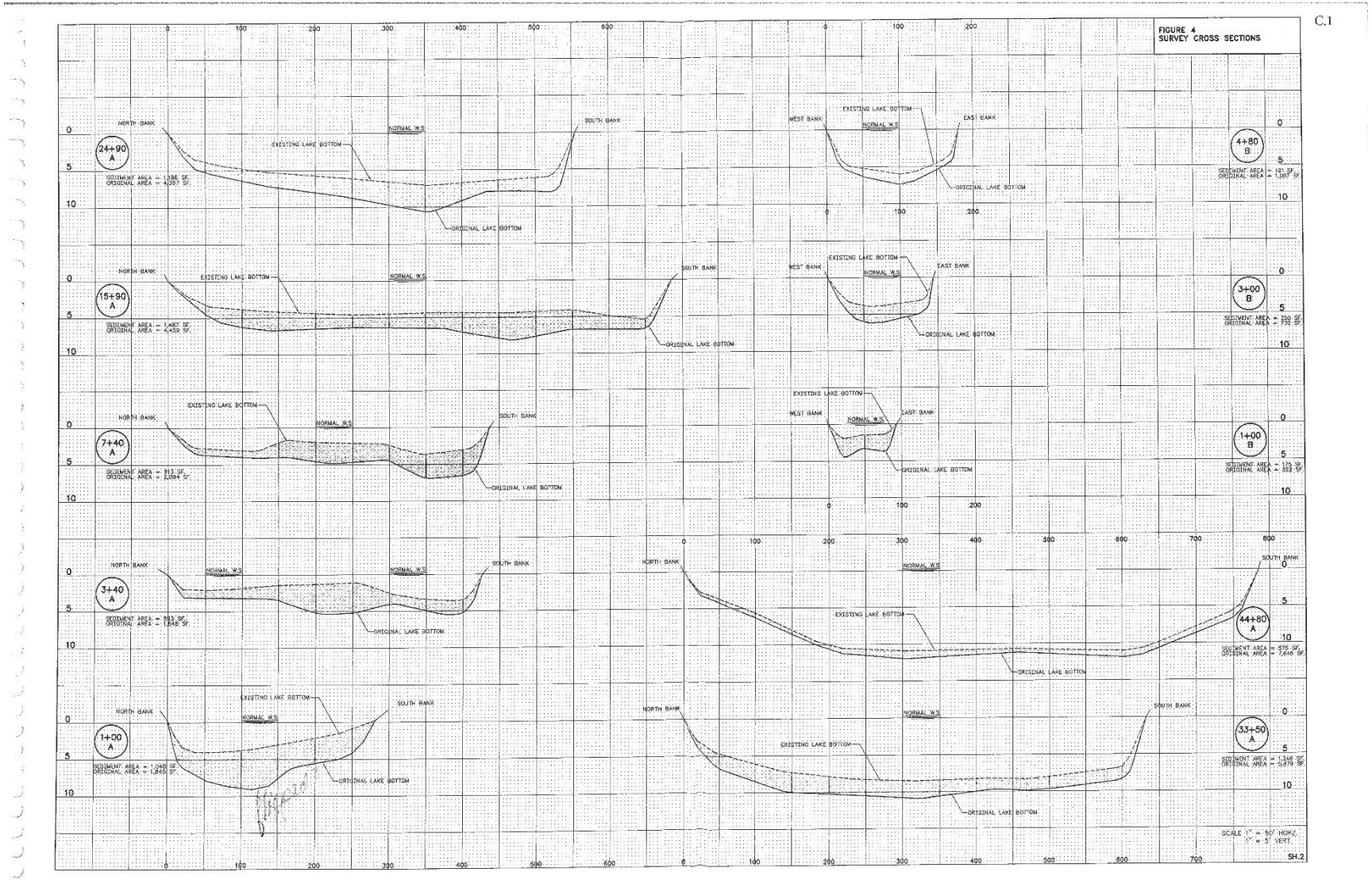
Cochran & Wilken, Inc Report (2003)

- Calculated 174,226 Cubic Yards of Siltation (178,600 Tons).
- This Equates to Approximately **4950 Tons/Yr or 0.8 Tons/Ac/Yr,** From 1968 to 2003.

- Using Measured Values, The Little Swan Lake Watershed Produces Less Sediment than the National and Regional Average.



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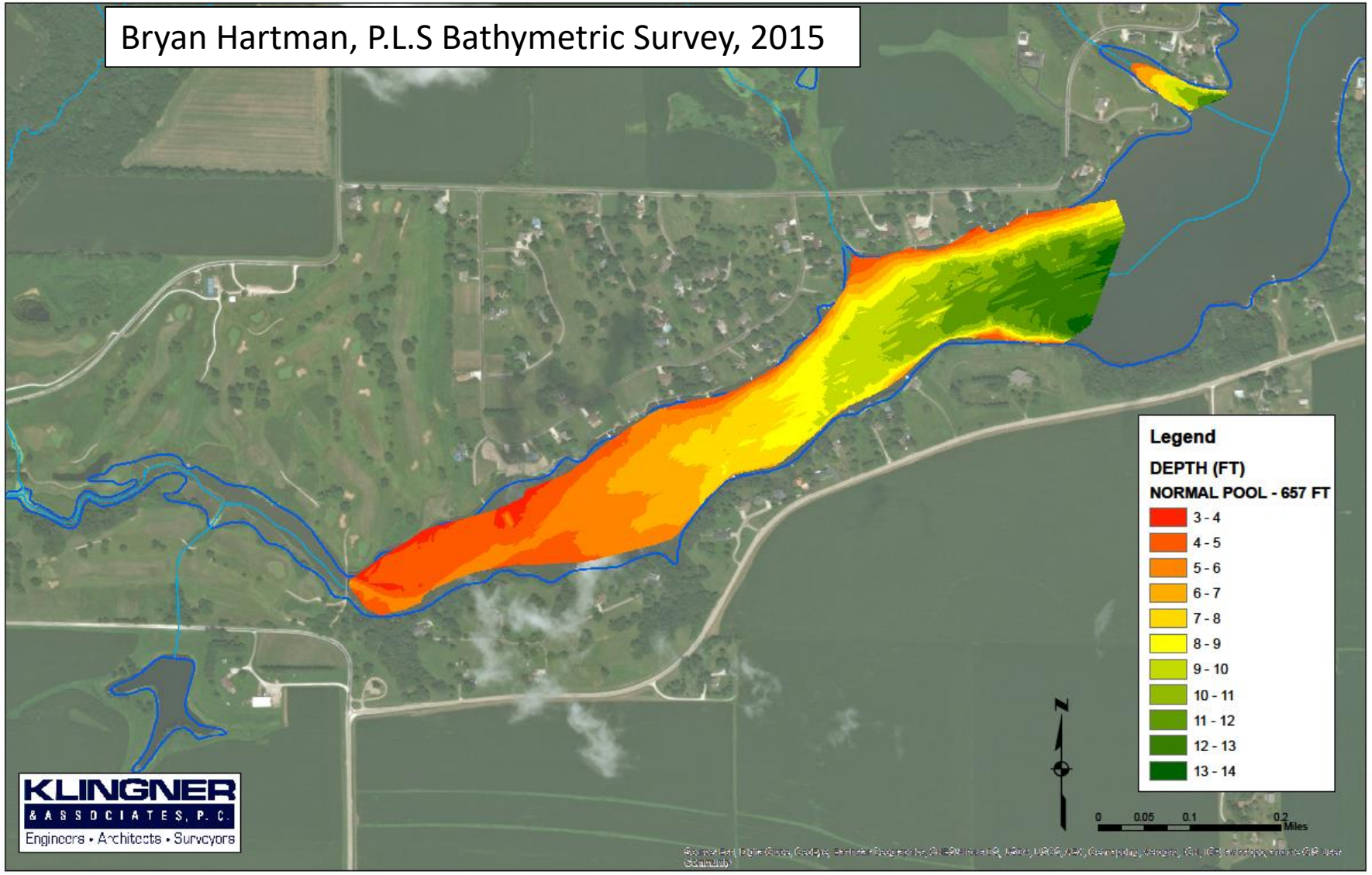
Hartman Bathymetric Survey (2015)

- Used GPS and Sonar to develop and dense network of depth measurements.
- Points were aggregated to create a water depth grid (based on an assumed water surface elevation of 657 FT).



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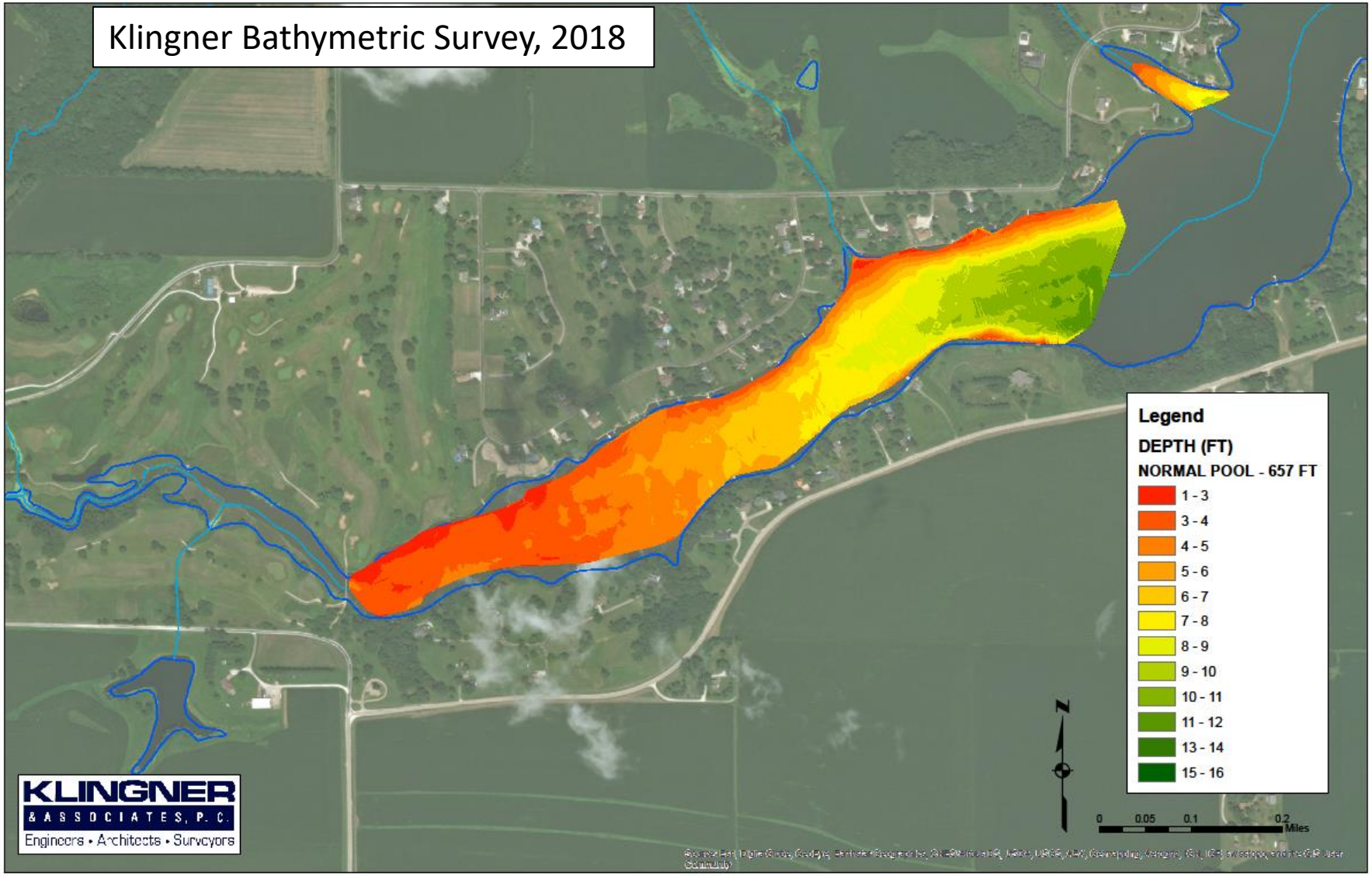
Klingner Bathymetric Survey (2018)

- Used a survey method similar to the Hartman 2015 Survey.



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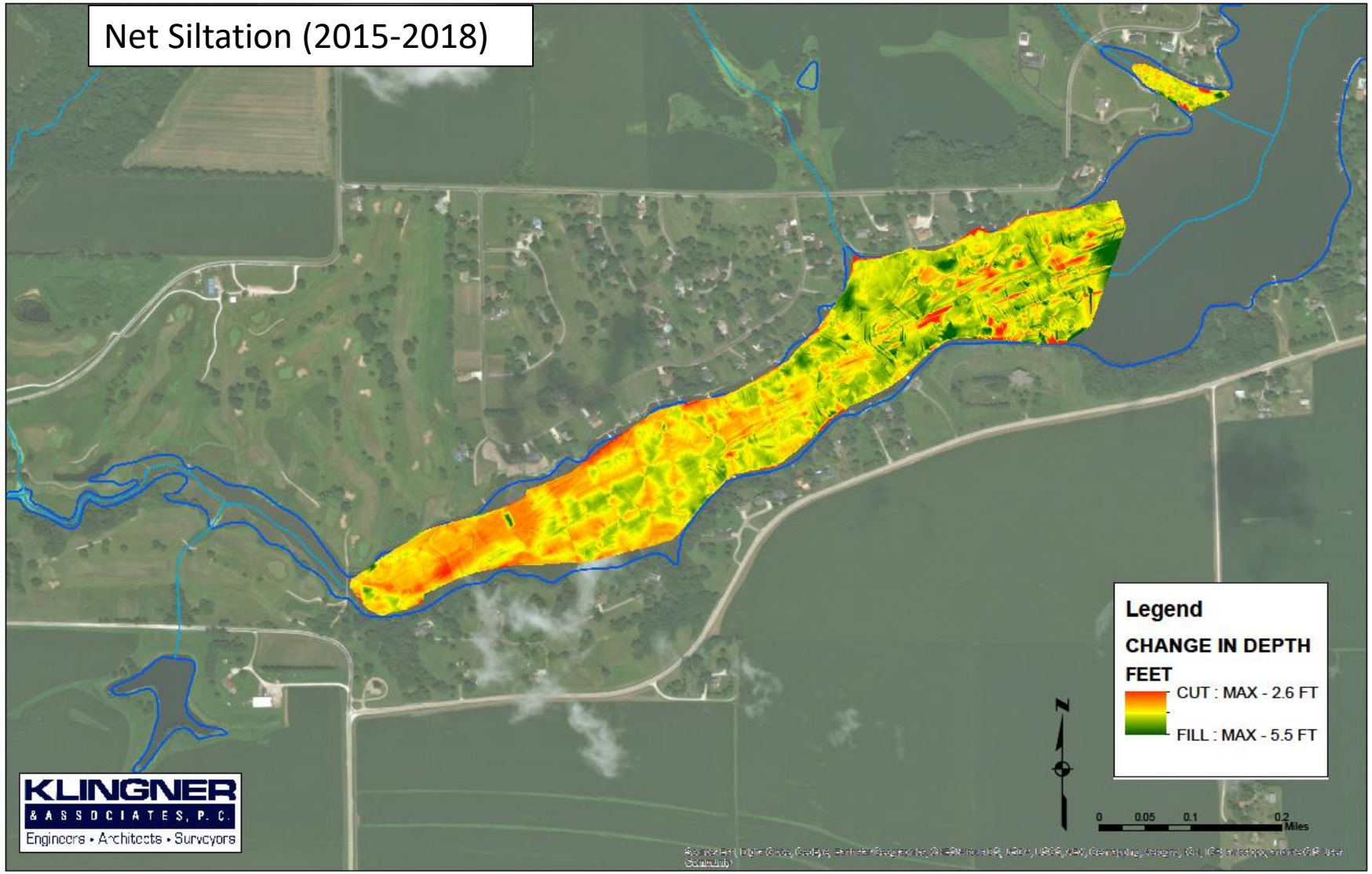
Siltation Pattern from 2015 to Today

- Overall water depths increased upstream and decreased downstream.
- This would indicate a deaccelerating of the siltation rate.
- Large amounts of silt that were previously in the Upper Reaches are migrating downstream, filling the main body of the lake.



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Siltation Study Results

- Using MUSLE, Expected Annual Sediment Load is Approximately 0.5 Tons/Ac/Yr
- Using Measured Values, Expected Annual Sediment Load is Approximately 0.8 Tons/Ac/Yr
- Both Methods Show that The Little Swan Lake is Expected to Produce Less Sediment than other similar locations in Illinois, 3.0 Tons/Ac/Yr *(USDA, 2015).*
- Bathymetric Survey Results Show The Lake Depth has Slightly Increased Upstream, and Decreased Downstream In the Timespan Between 2015 and Today. The overall increase in sediment over this time period has been relatively small.
- An estimate 110,000 Cubic Yards of sediment would need to be removed in order to return the lake to its original design depth.

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Alternative 1: Do Nothing

- On top of the existing sediment, silt will continue to accumulate at an estimated rate of 0.5 to 0.8 Tons/Ac/Yr
- The majority of the sediment will settle in the upper 3rd of the lake
- Recreational opportunities in this upper 3rd of the lake will continue to be limited
- In addition, excessive sediment can:
  - Reduce water clarity
  - Increase water temperatures
  - Lower oxygen levels
  - Smother fish eggs
  - Increase algae blooms
  - Promote fish kills
  - Impair the lakes ascetic qualities
  - Reduce property values

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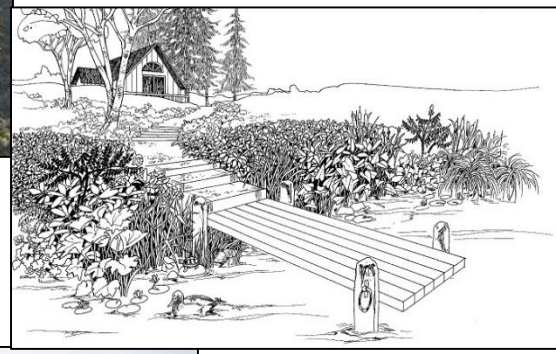
Alternative 2: Dredge Plus “Low Cost” Sediment Reduction Strategies

- Dredge approximately 110,000 cubic yards
- Adopt or construct several low cost sediment reduction strategies
  - Riprap check dams in the small ditches and swales leading into the lake
  - Buffer strips and/or riprap protection along the lake shoreline
  - Increase enforcement of the existing rules and adopt new erosion mitigation requirements, particularly during construction activities
  - Support and communicate with the NRCS and upland land owners to promote wise agricultural and forestry practices
- Estimated Cost: Check Dams - $33,600*

*Additional costs may be inherited by landowners



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Alternative 3: Wetland Development and/or Sediment Basins

- Wetlands provide a number of potential benefits
  - Improved water quality (lower nitrogen and phosphorus levels)
  - Wildlife habitat
  - Increased recreational opportunities
- Sediment Basins are highly effective, proven method to reduce sediment.
  - Work by impounding water and allowing sediments to fall out of suspension before entering the main water body.
- Cost share and funding opportunities are available
- Estimated Cost: Wetlands - $200,000-300,000

  Sediment Basin - $395,000

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Alternative 4: Dredge

- In order to restore the lake to its design depths, approximately 110,000 cubic yards of sediment will need to be dredged from the lake.
- This would restore boating and recreational opportunities
- However, it would not reduce the rate of sedimentation, which would expect to continue at 0.5 to 0.8 Tons/Ac/Year
- Dredging would continue to be required every 25 to 35 years
- Estimated cost: $1,025,000

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Conclusions