Saginaw Bay Sediment Separation

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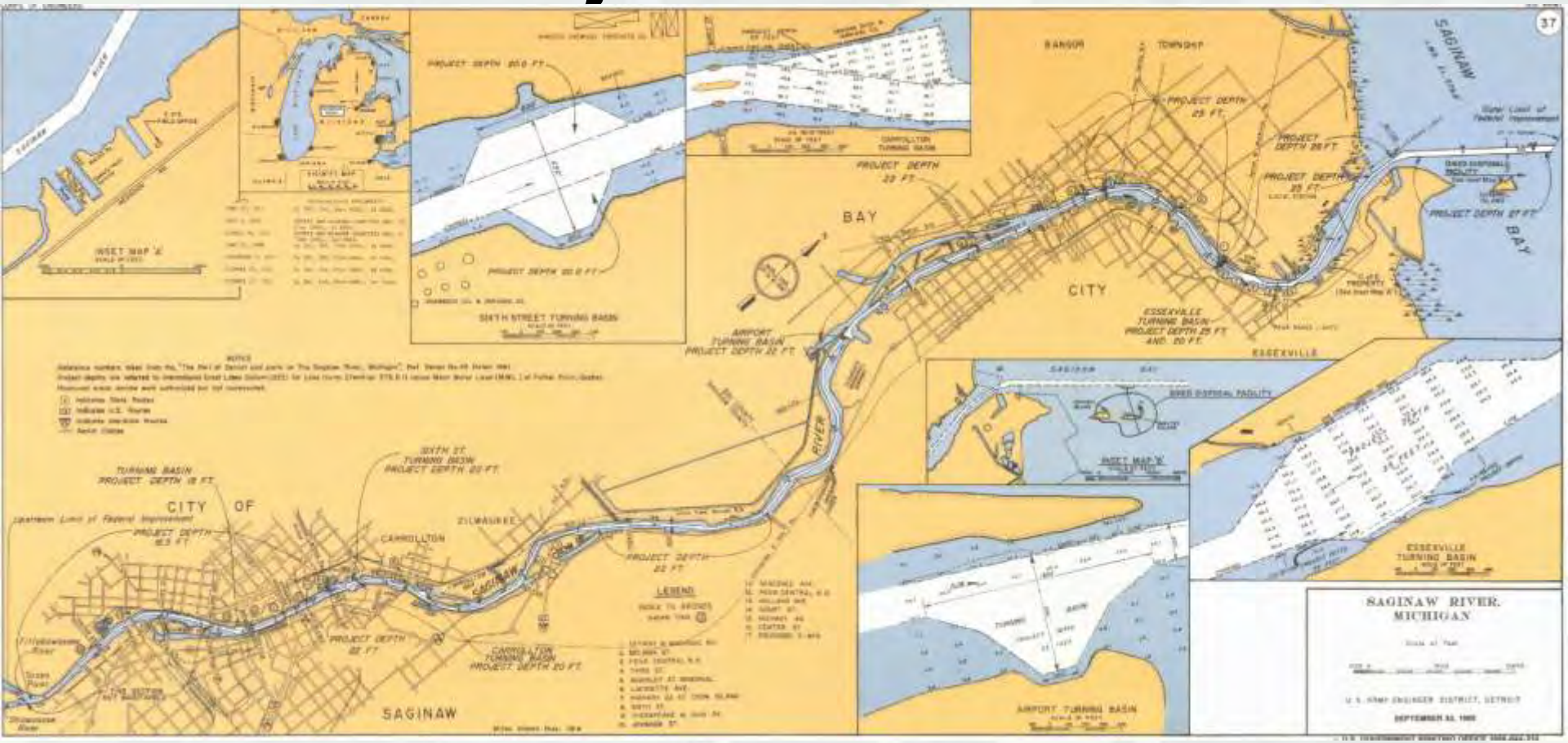
US Army Corps of Engineers

BUILDING STRONG®

SAGINAW RIVER, MI
Project Location



SAGINAW RIVER, MI
Project Description

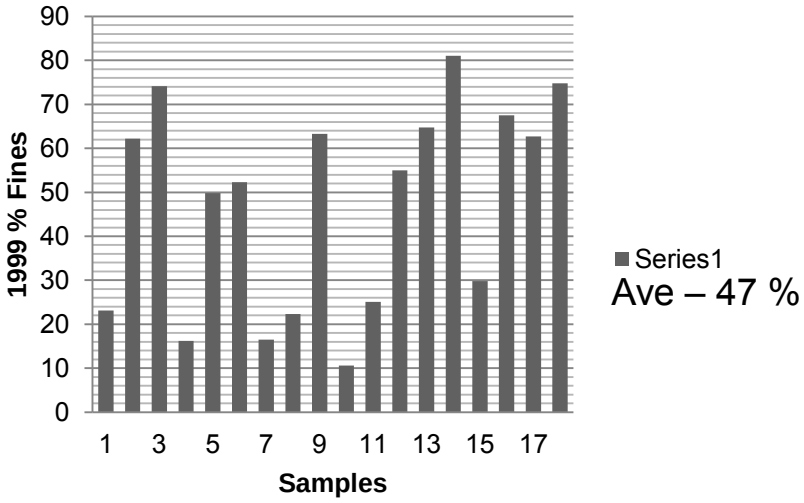
- formed by union of the Tittabawassee and Shiawassee Rivers
- 22 miles long
- flows northerly into the extreme inner end of Saginaw Bay, Lake Huron
- an entrance channel in the bay from the 27-foot contour in Saginaw Bay to the river mouth (approximately 10 miles long);
- varying channel depths in the river ranging from 26 feet at the downstream entrance, to 22 feet deep and 16.5 feet deep to the upstream limit at Green Point (not maintained) due to shallow depth)
- five turning basins (one 25 feet deep at Essexville, one 22 feet deep on the east of the channel about one mile upstream from Cass Avenue in Bay City, one 20 feet deep at Carrollton, one 20 feet deep on the east side of the channel just upstream from the Sixth Street Bridge in Saginaw, and one 15 feet deep between the Bristol Street and New York Central Railway Bridges in Saginaw.

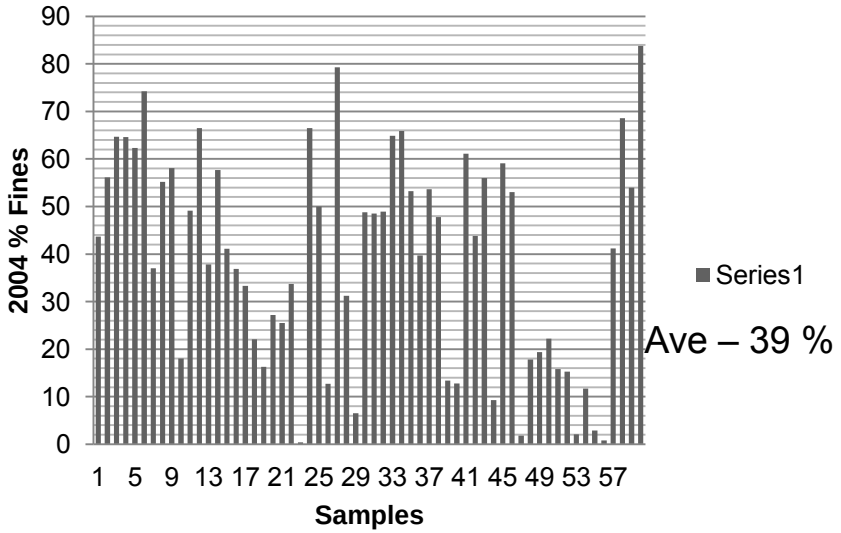
BACKGROUND

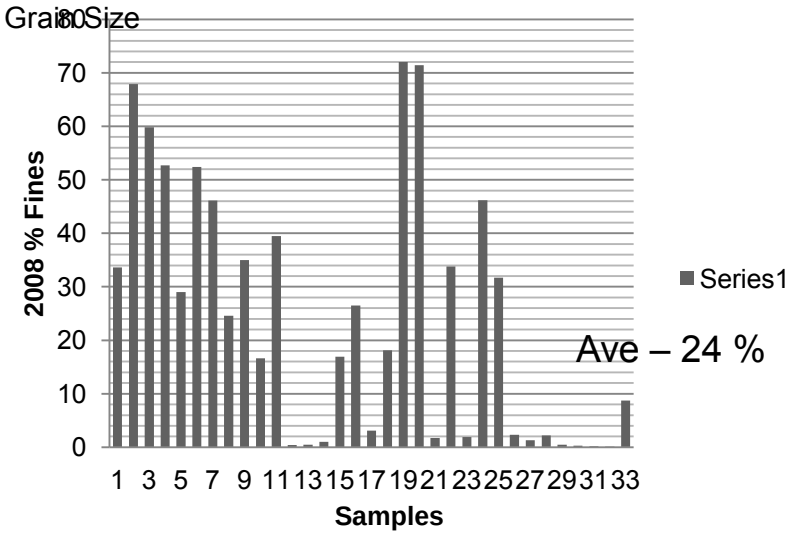
Project History

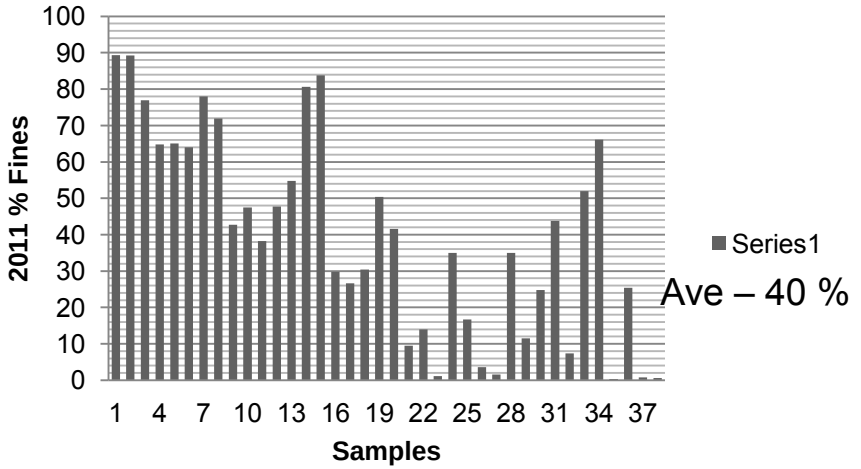
- Original contaminant of concern – PCBs
- Levels ranged from non-detectable up to 25 ppm
- Contructed CDFs under 91-611 to contain contaminated material
- PCB levels in river material declined over the years to non-detectable
- New contaminant of concern - dioxins

Saginaw River Dredged Material Characteristics 1999-2011



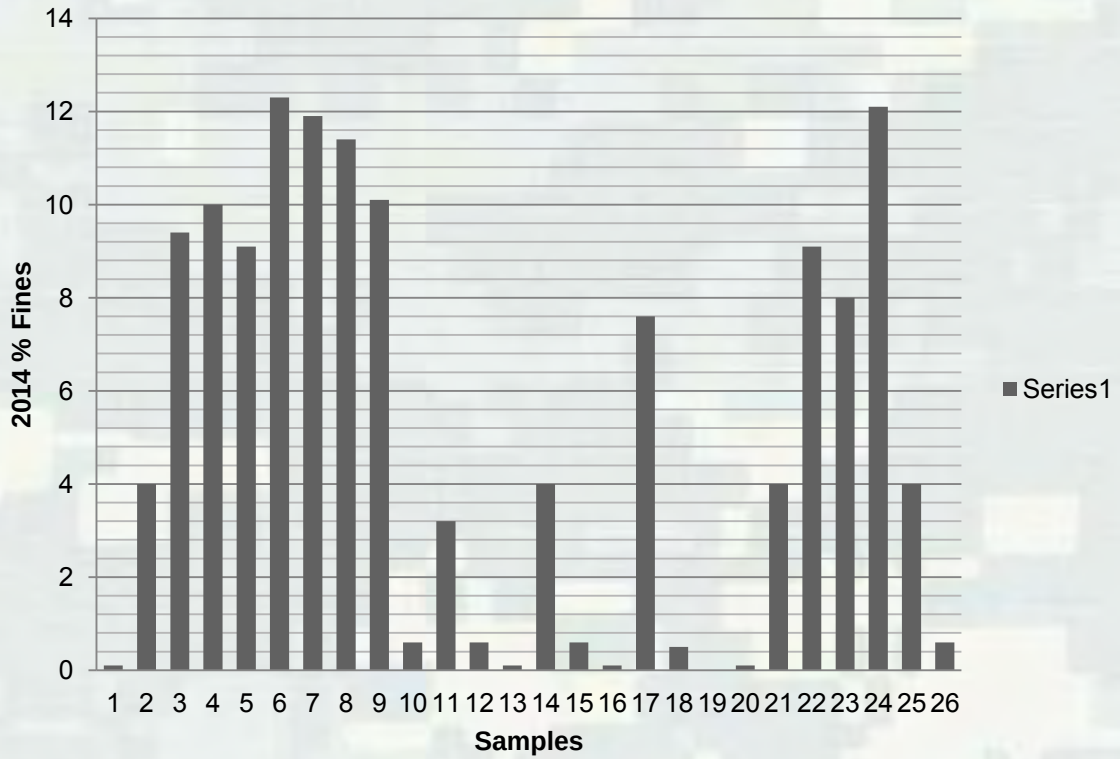






Grain Size

Saginaw River Dredged Material Characteristics - 2014

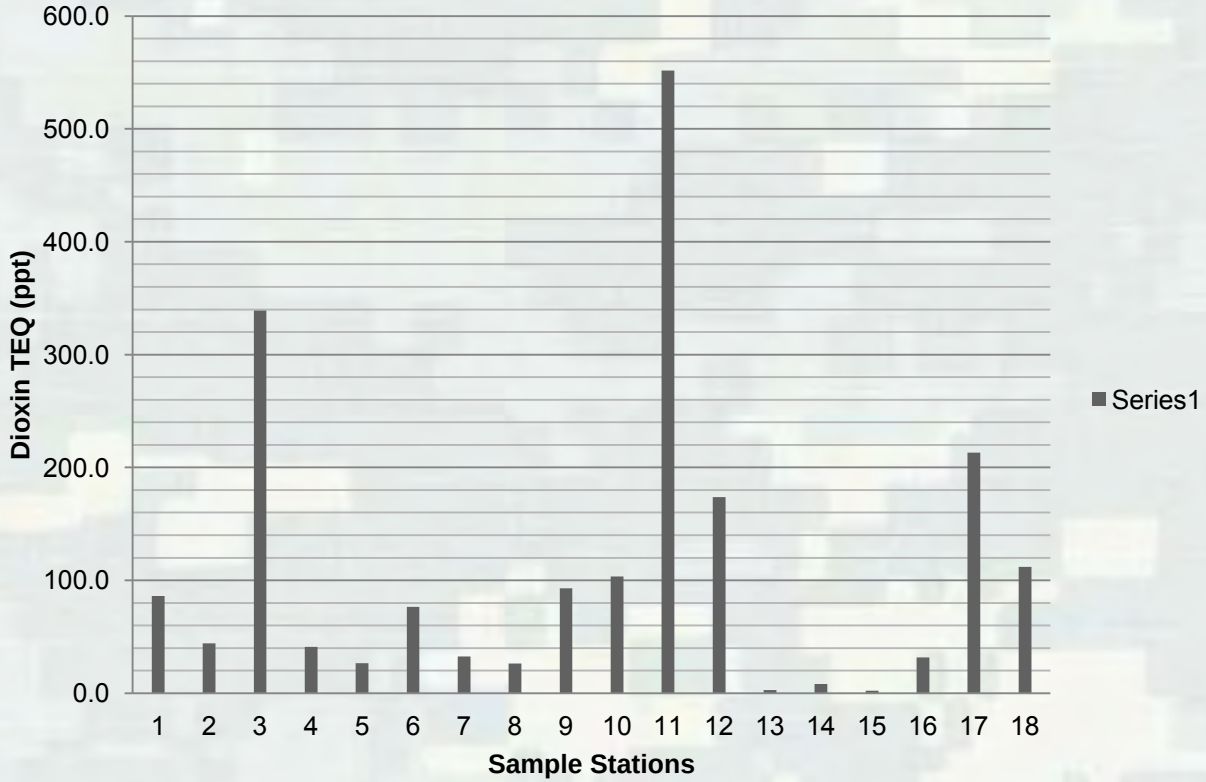


Grain Size

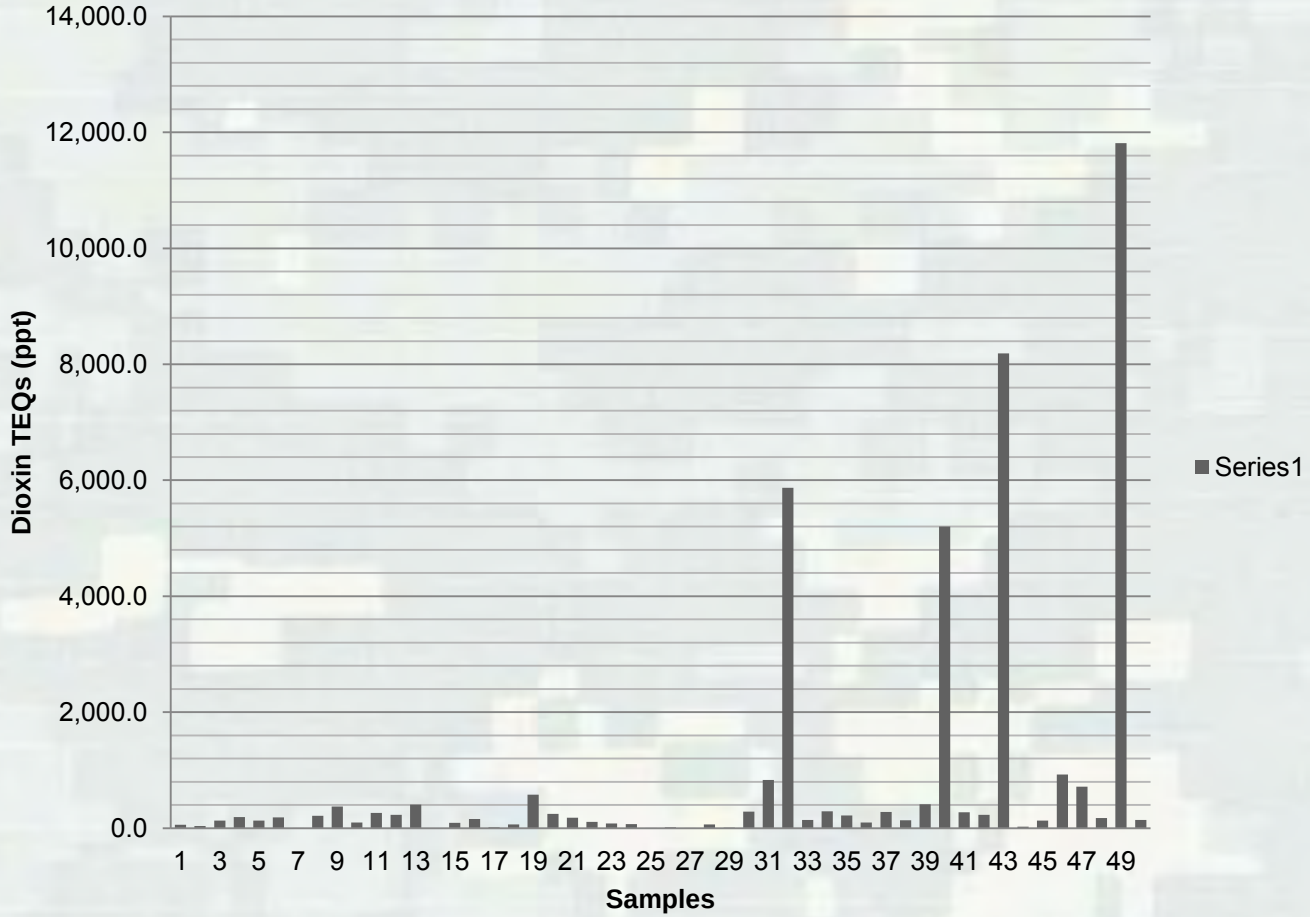
Saginaw River Dioxin Summary (TEQ ppt)

	1999	2004	2008	2011	2014
Count	18	50	29	40	20
Min	2.1	0.0	1.6	4.9	3.9
Max	551.8	11,812.8	620.0	3,700.0	3,800.0
Ave	109.1	808.9	90.9	545.6	615.6
Std Dev	140.0	2,209.9	135.1	931.2	1,039.4

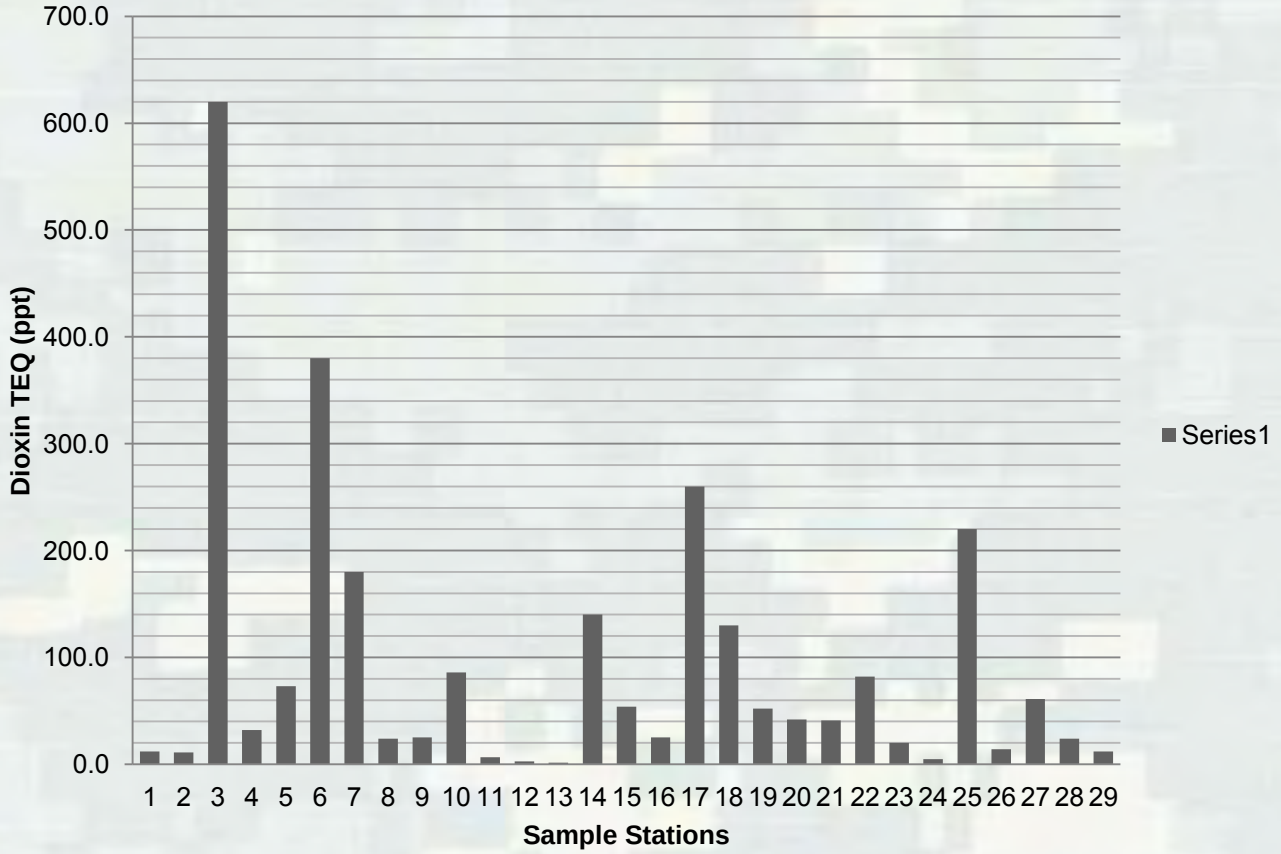
Saginaw River 1999 Dioxin Data



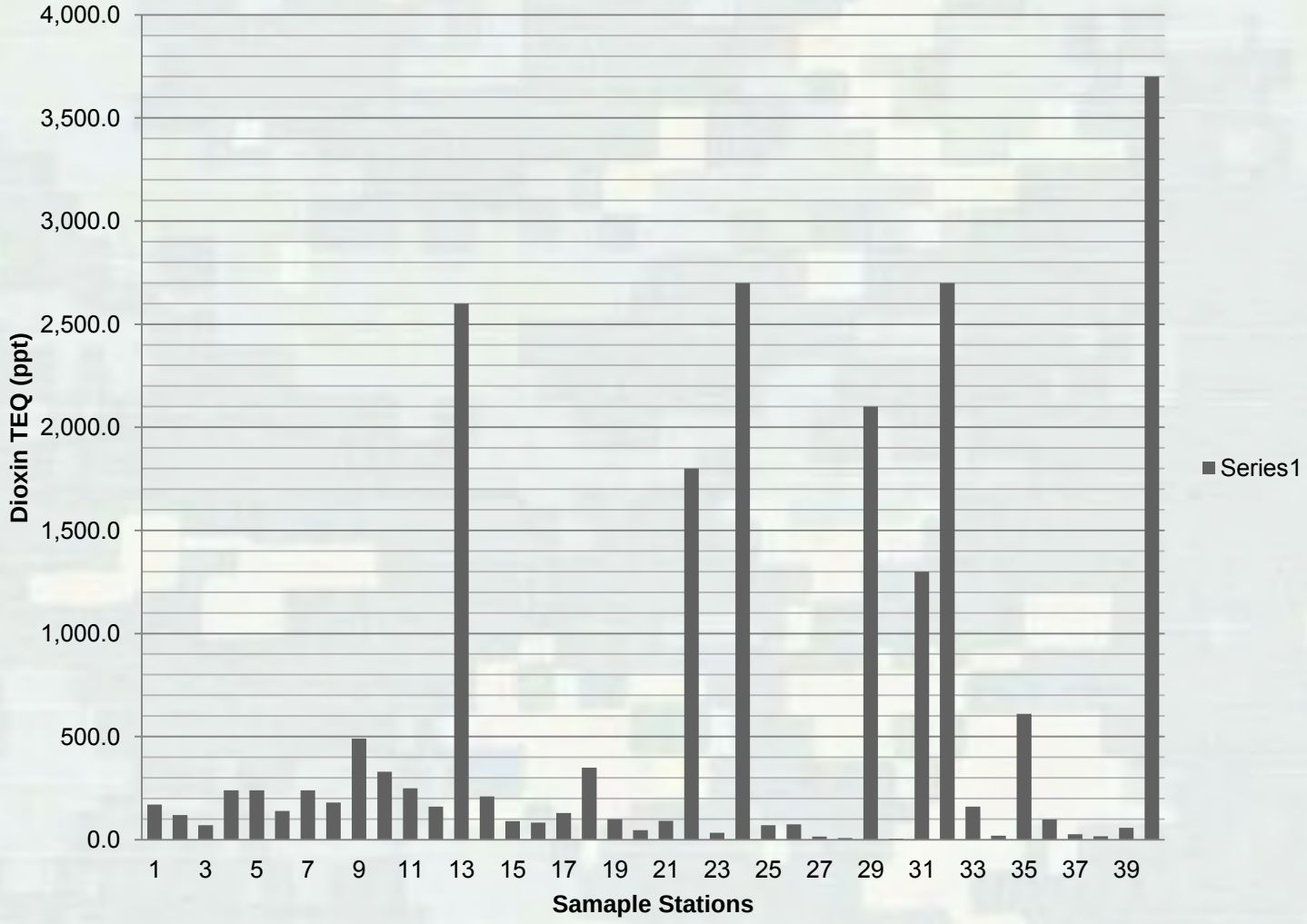
Saginaw River 2004 Dioxin Data



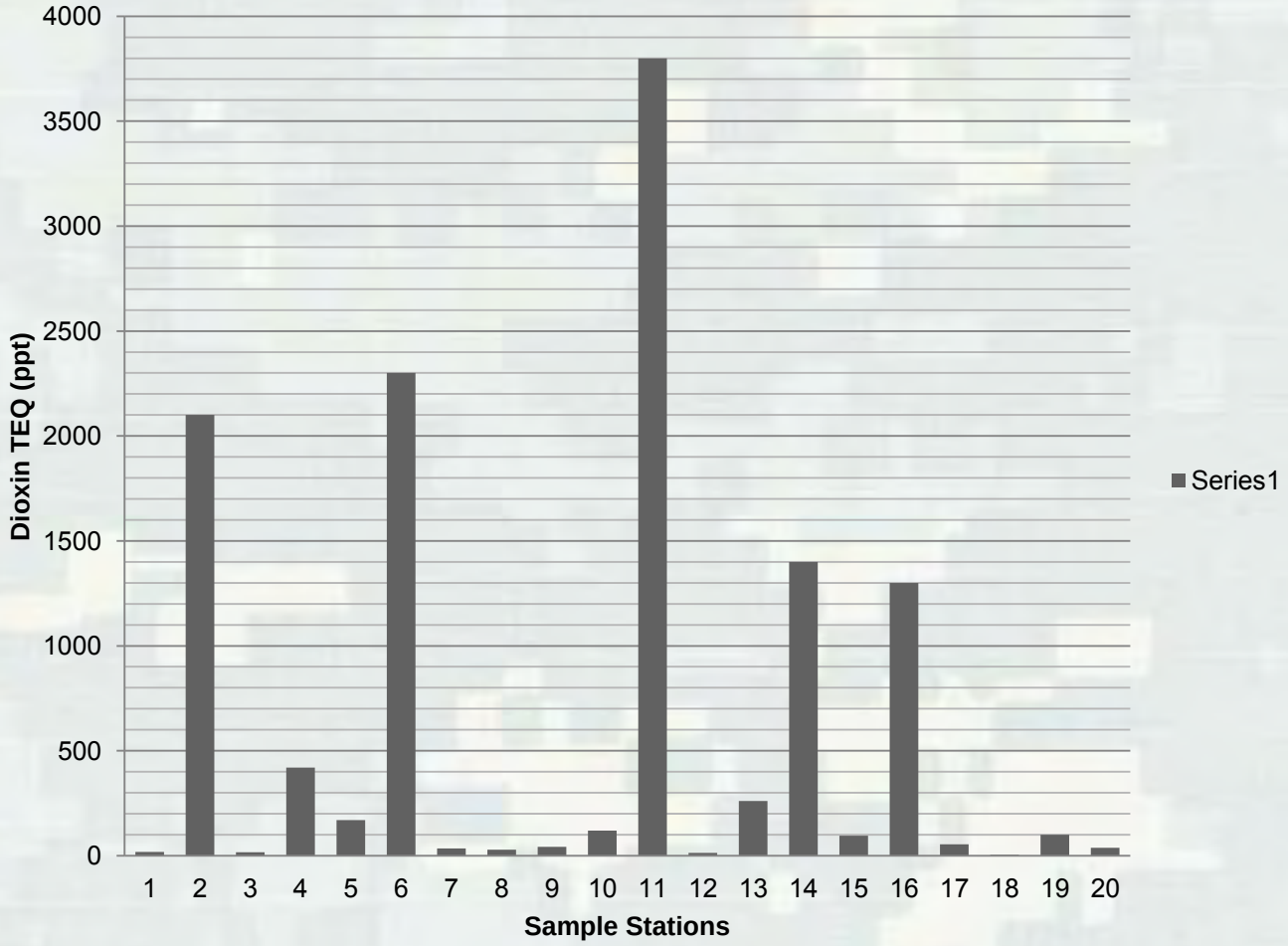
Saginaw River 2008 Dioxin Data



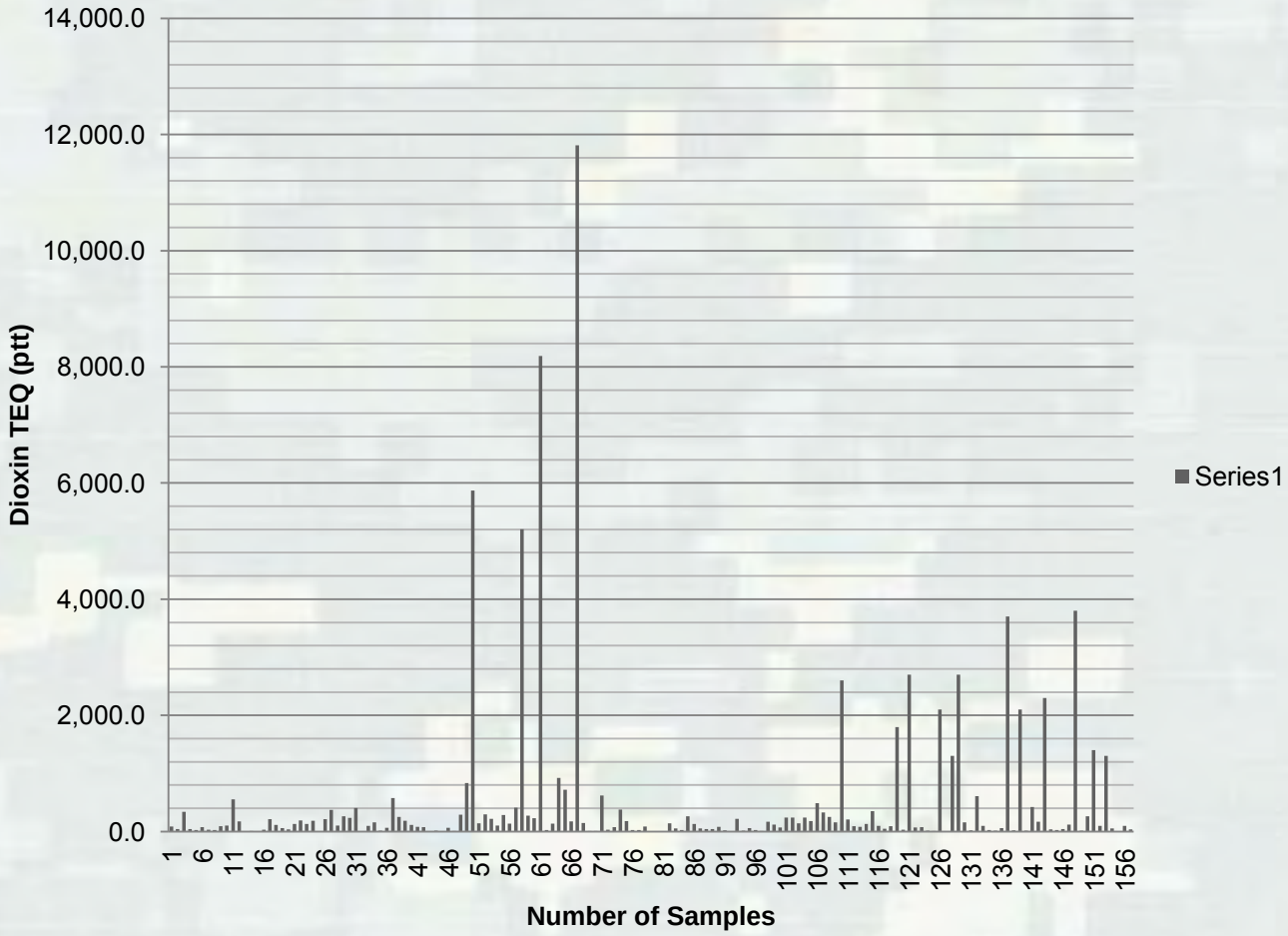
Saginaw River 2011 Dioxin Data



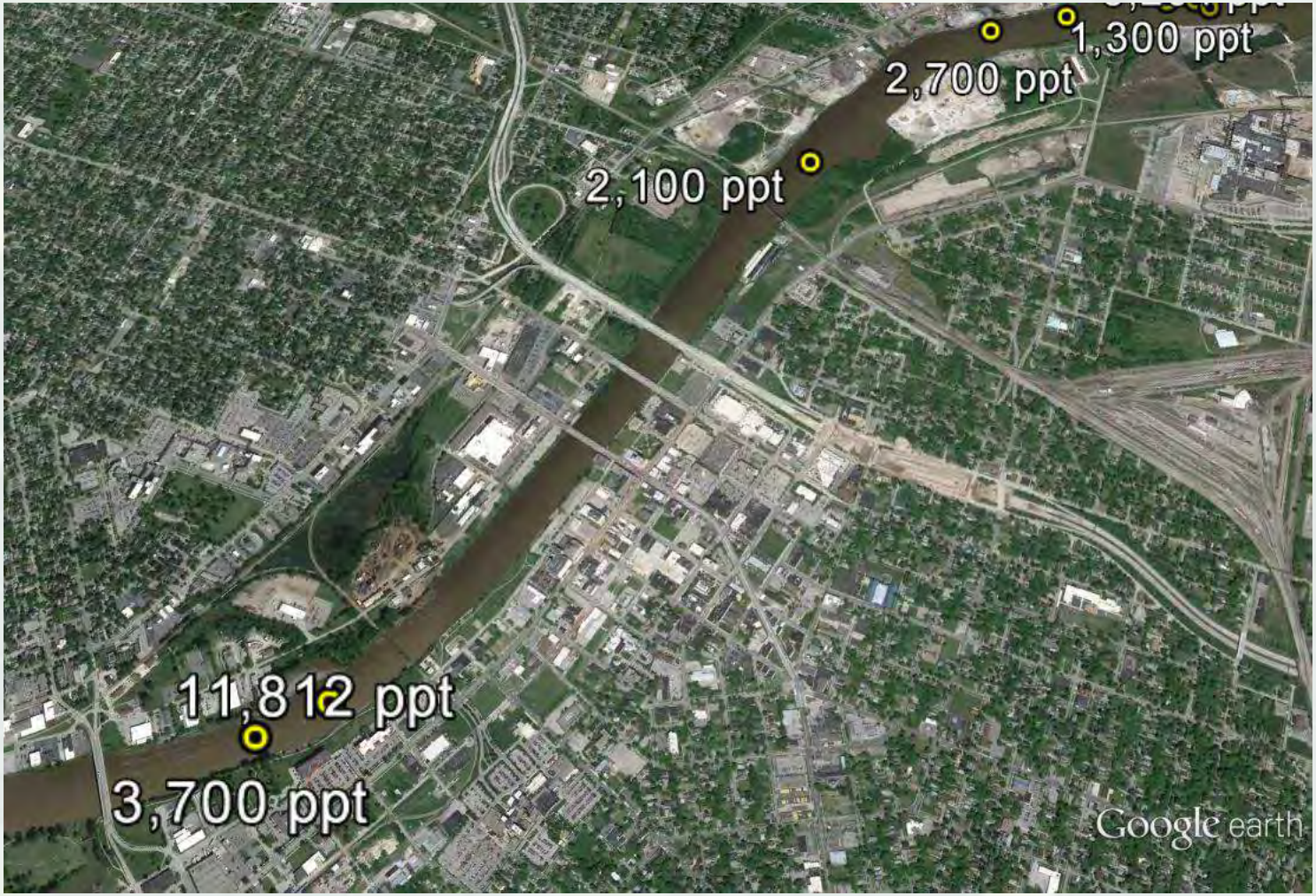
Saginaw River 2014 Dioxin Data



Saginaw River All Dioxin Data



Saginaw River – Highest Dioxin Locations



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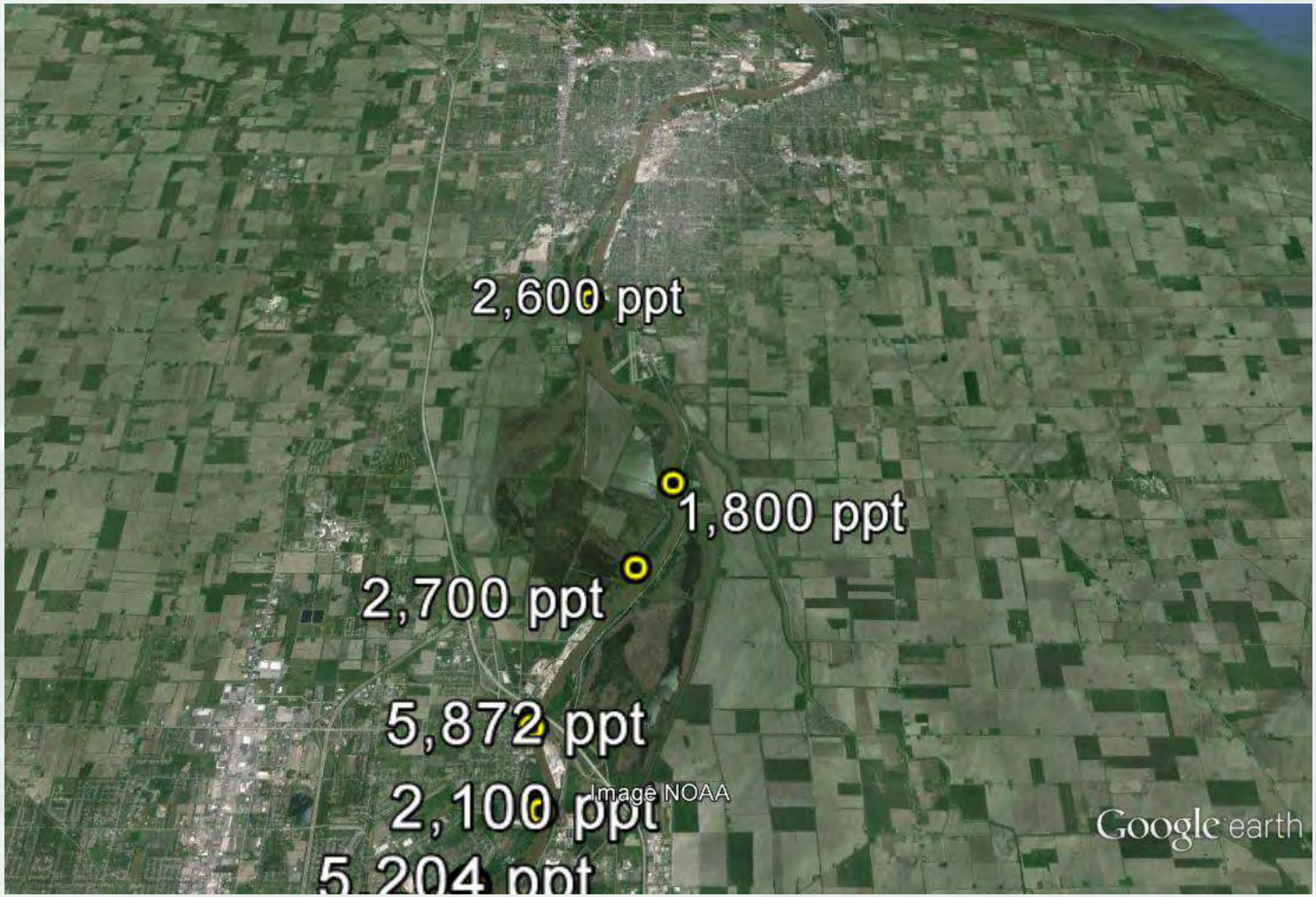


UPPER SAGINAW RIVER DMPF

Upper Saginaw River DMPF

- 281 acres
- Holds 3.1 million CY
- Clay dikes (11 feet)
- Site underlain with clay and sand lenses
- Cutoff wall down 10 feet

Issue

- Sandy dredged material placed in the Saginaw DMDF has potential beneficial uses but contains unacceptable levels of dioxins
- Previous testing of material has demonstrated uncertainty in actual concentrations and distribution

Core	TEQ, Pg/g	MDEQ Soil Standards
10-1	36.4	Res Particulate Soil - 71,000
10-2	17	Res Direct Contact - 90
10-3	5567	Non-Res Particulate – 59,000
10-4	213	Non-Res Direct Contact - 990
10-5	11	
10-6	9.2	
10-7	2282	
10-8	410	
10-9	171	Average - 901
10-10	299	Standard Deviation - 1777

Samples collected by USACE, Sep 2010

Solution – Improve Analytical Results

- Need less variability
- Need characterization of dioxin distribution in sediment fractions
- Need separation of dioxin from beneficial sand

Approach

- Sample cores over entire exposed sediment surface
- Characterize each core for particle size and presence of carbon (wood, coal, coke, etc)
- Composite cores based on these characteristics
- Improve analytical results by careful processing of samples

Sampling Methods



Electric hammer drill was used to collect cores to a depth of 40 inches.

Sample Preparation

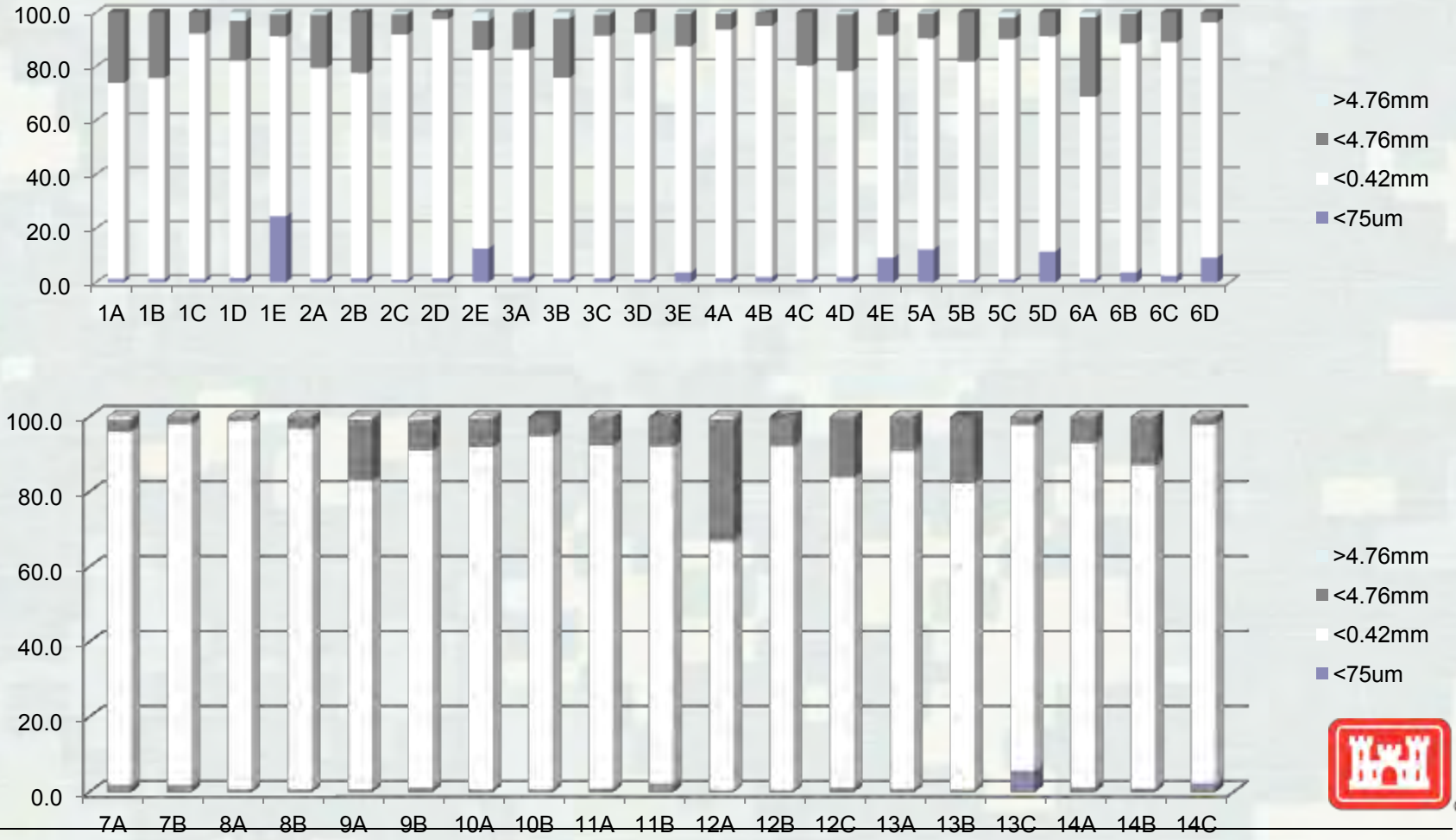
- A sample of each mixed core was collected and placed in a 120ml amber glass jar.
- The samples were dried in an oven at 42 deg C for 72 hrs.
- A 40-gram sub-sample was removed and lightly crushed in a mortar to reduce aggregates
- The sample was then sieved through ASTM # 4 (4.76mm), #40 (0.42mm) and #200 (75um).
- The various fractions were weighed separately to determine % of total mass.
- The remaining sample was ground in the mortar to ensure light black carbon particles were thoroughly mixed and a subsample was collected from each and submitted for Total Carbon analysis.

Sample Processing

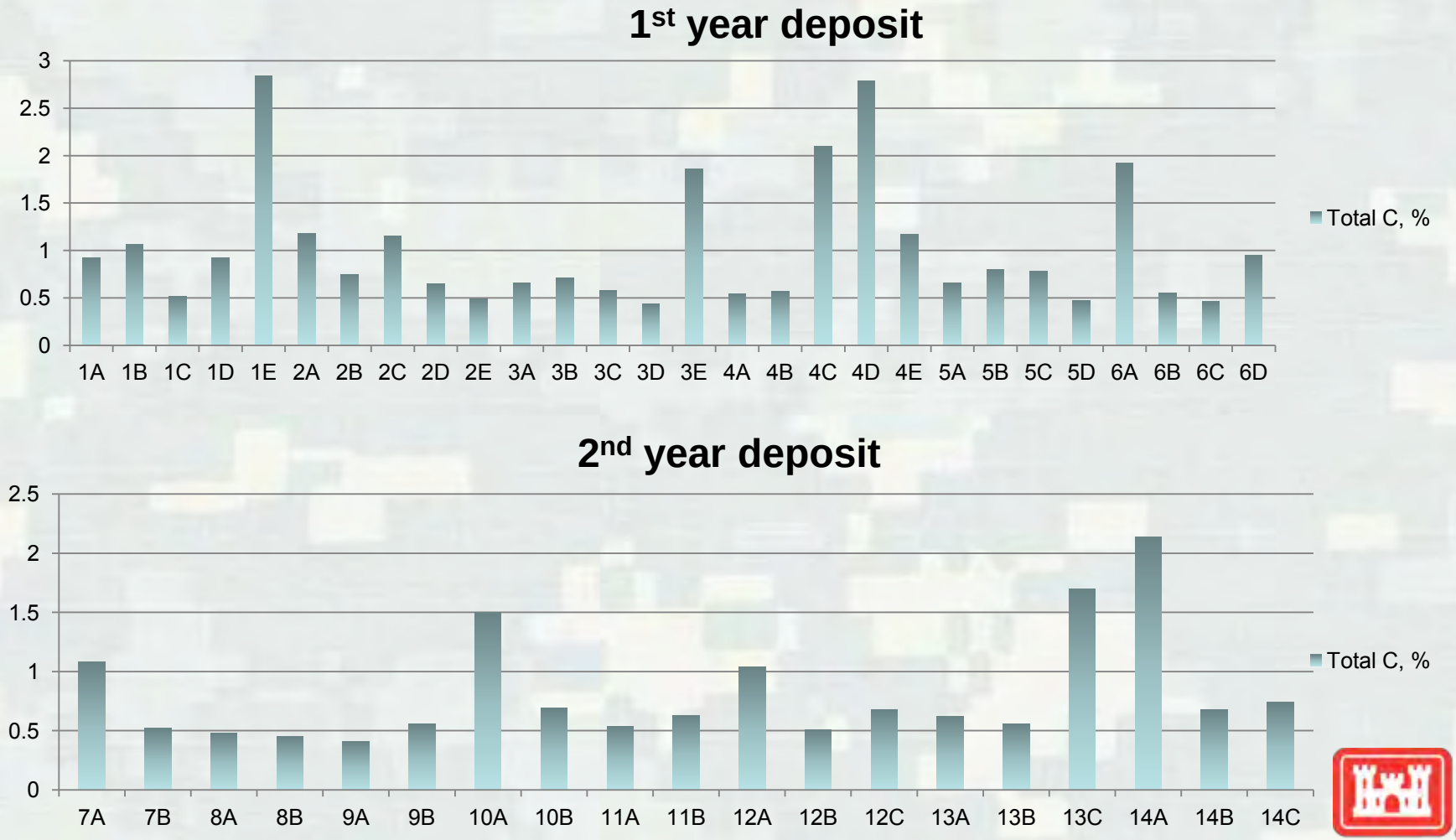
A subsample of each core was characterized based on grain size and composition. Cores were composed mostly of fine to medium sand between 74 and 420um. Coarser and finer grained particles were either silt/clay, pebbles and varying sizes of black carbon.

Separation of lighter density carbon vs silica sand during the sieving process following grinding in a mortar. Sample was ground until all passed a 250um sieve.

Particle Size Distribution, %
(separately shown for 2 placement operations)



Total carbon, %



Dioxin Analysis

- Cores were composited into three distinct particle size/TOC based samples. These are described as:
  - Sand – mostly fine to coarse sands with some larger fragments of shell, rock and coal/coke
  - Fine – mostly fine to moderate sands with silt, clay and fine organics
  - Carbon – mostly sand with elevated levels of organic carbon, primarily wood debris
- These composites prepared for analysis as follows:
  - lightly crushed to pass a 2mm screen and analyzed as 2mm sized fraction.
  - ground using a mortar and pestle to completely pass a 250um screen.
- *Purpose: Demonstrate the variability due to selective particle bound contamination*

Dioxin TEQ Results

Core Composites

	TEQ WHO2005 ND=0.5,pg/g					AVG	STDEV	DEV/AVG
Sand 250um	505	510	514	489	555	**514.60**	24.50	0.05
Sand 2mm	51.8	113	106	79.4	197	**109.44**	54.58	0.50
Fine 250um	860	1080	906	1410	866	**1024.40**	233.41	0.23
Fine 2mm	564	1190	727	944	219	**728.80**	369.48	0.51
Carbon 250um	829	788	1140	1040	839	**927.20**	153.95	0.17
Carbon 2mm	1030	620	471	936	4880	**1587.40**	1854.62	1.17

Separated Fractions

	TEQ WHO2005 ND=0.5,pg/g					AVG	STDEV	DEV/AVG
Carbon	NS	NS	NS	21,517.8	19,428.1	**20,473.0**	54.58	0.50
Fine	NS	NS	1,806.2	1,877.0	1,940.1	**1,874.6**	233.41	0.23
Sand	NS	NS	62.1	114.5	164.0	**113.6**	51.96	0.45
Sand Washed	2.1	2.0	1.9	2.6	2.5	**2.3**	0.297	0.13

Options and Path Forward

- Washing sand can significantly reduce dioxins to acceptable levels and render suitable for recovery and beneficial use
- Pilot scale project to evaluate effectiveness during dredging and/or pumping operations
- Consider implications of dioxin laden residuals
  - ▶ Removal for disposal
  - ▶ Allow settling in pond and cap