

US EPA ARCHIVE DOCUMENT

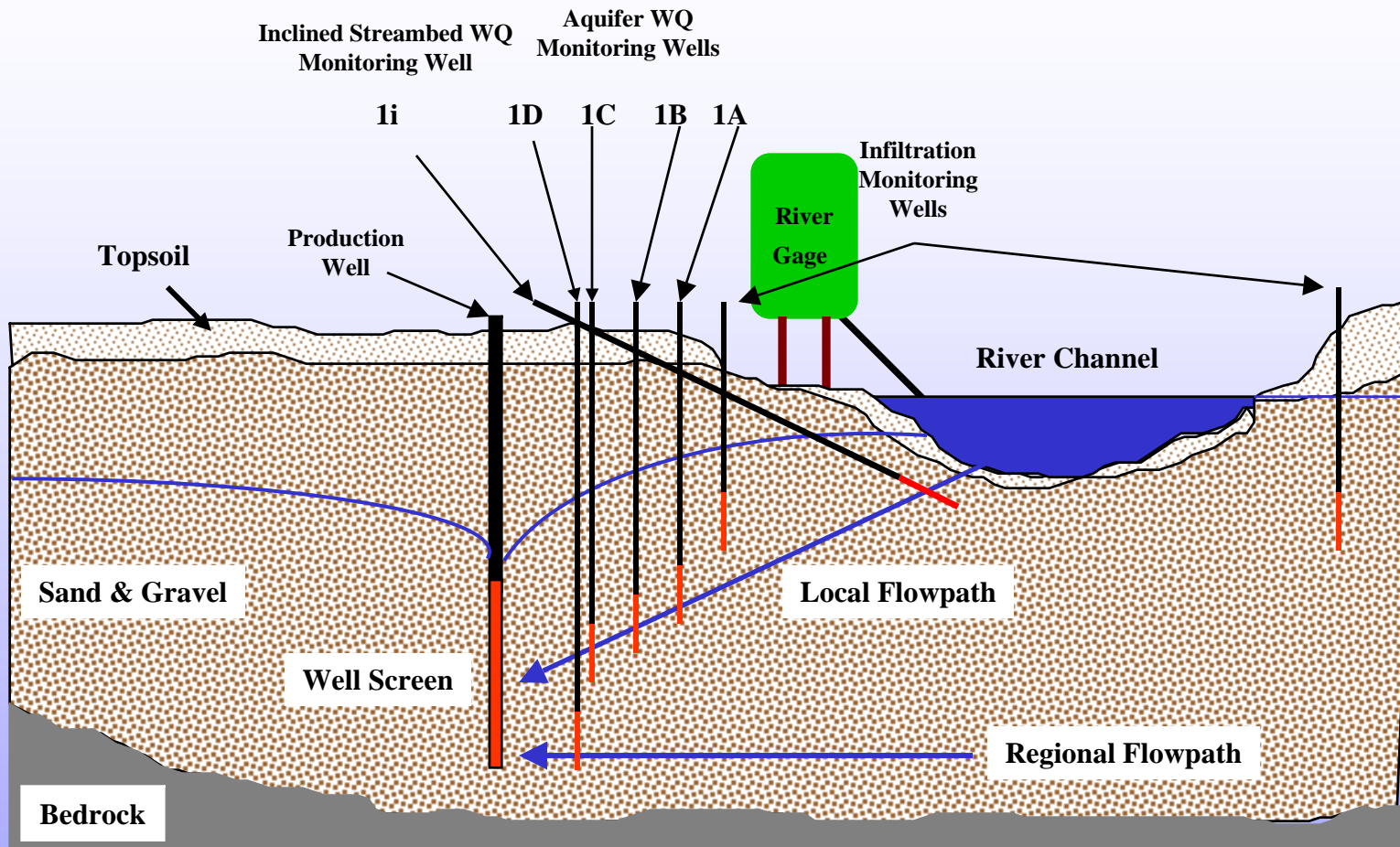
Riverbank Filtration at the Charles M. Bolton Well Field Organic and Particle Reduction

USEPA/USGS Meeting on Cryptosporidium
Removal by Bank Filtration
September 9-10, 2003



Bruce Whiteberry, Hydrogeologist
William Gollnitz, Supervisor of
Treatment
Jeffrey Vogt, Chemist

Conceptual Aquifer Profile @ Bolton Well Field





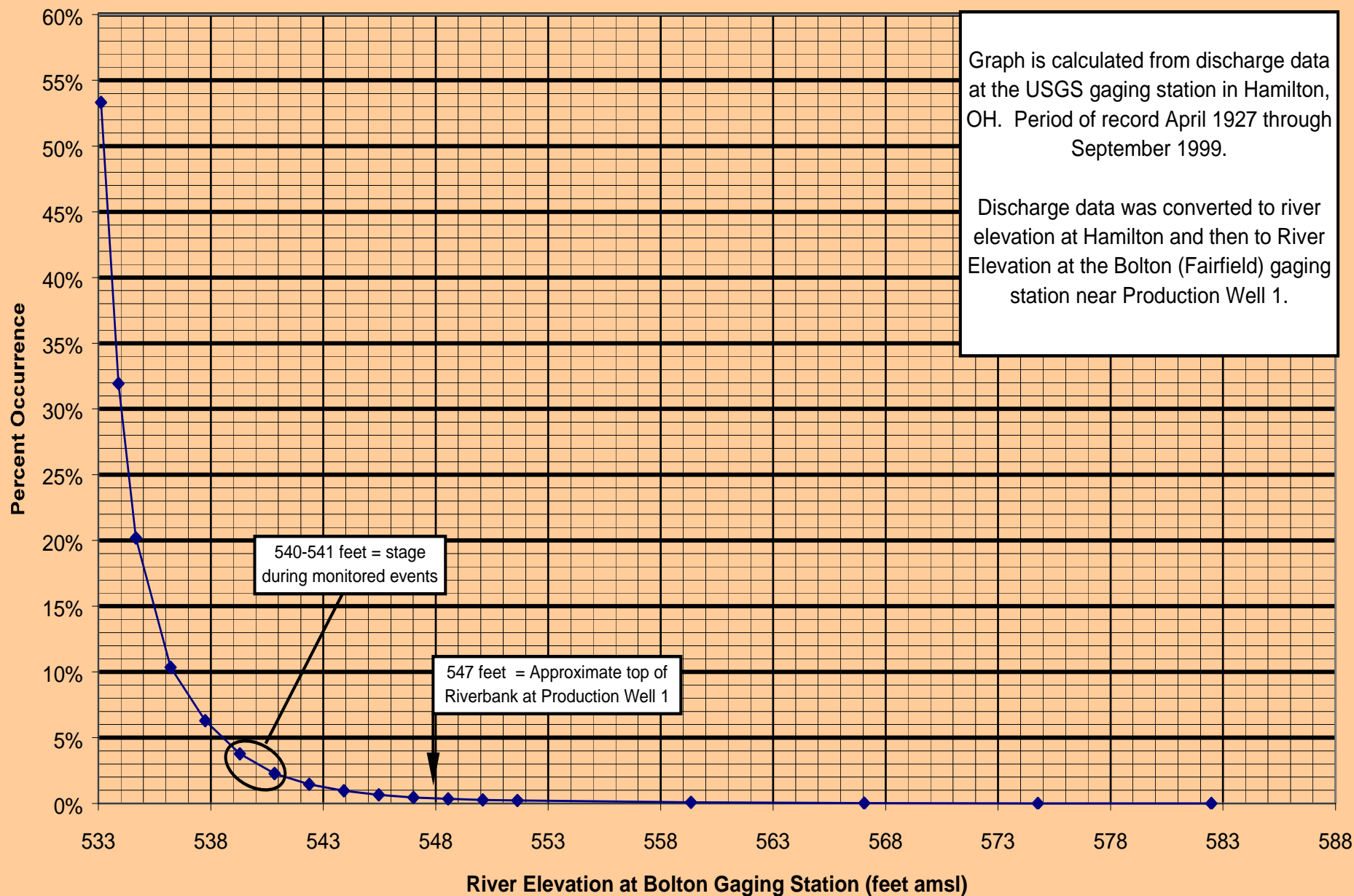
Great Miami River Characteristics

- ➔ Approximately 200+ feet wide
- ➔ At pool stage, depth ranges from <1 foot to 10+ feet
- ➔ Riverbed is a mixture of cobbles, gravel, silt and clay
- ➔ Riverbed Hydraulic Conductivity - 1.5 feet/day
- ➔ Aquifer Hydraulic Conductivity 200-500 feet/day

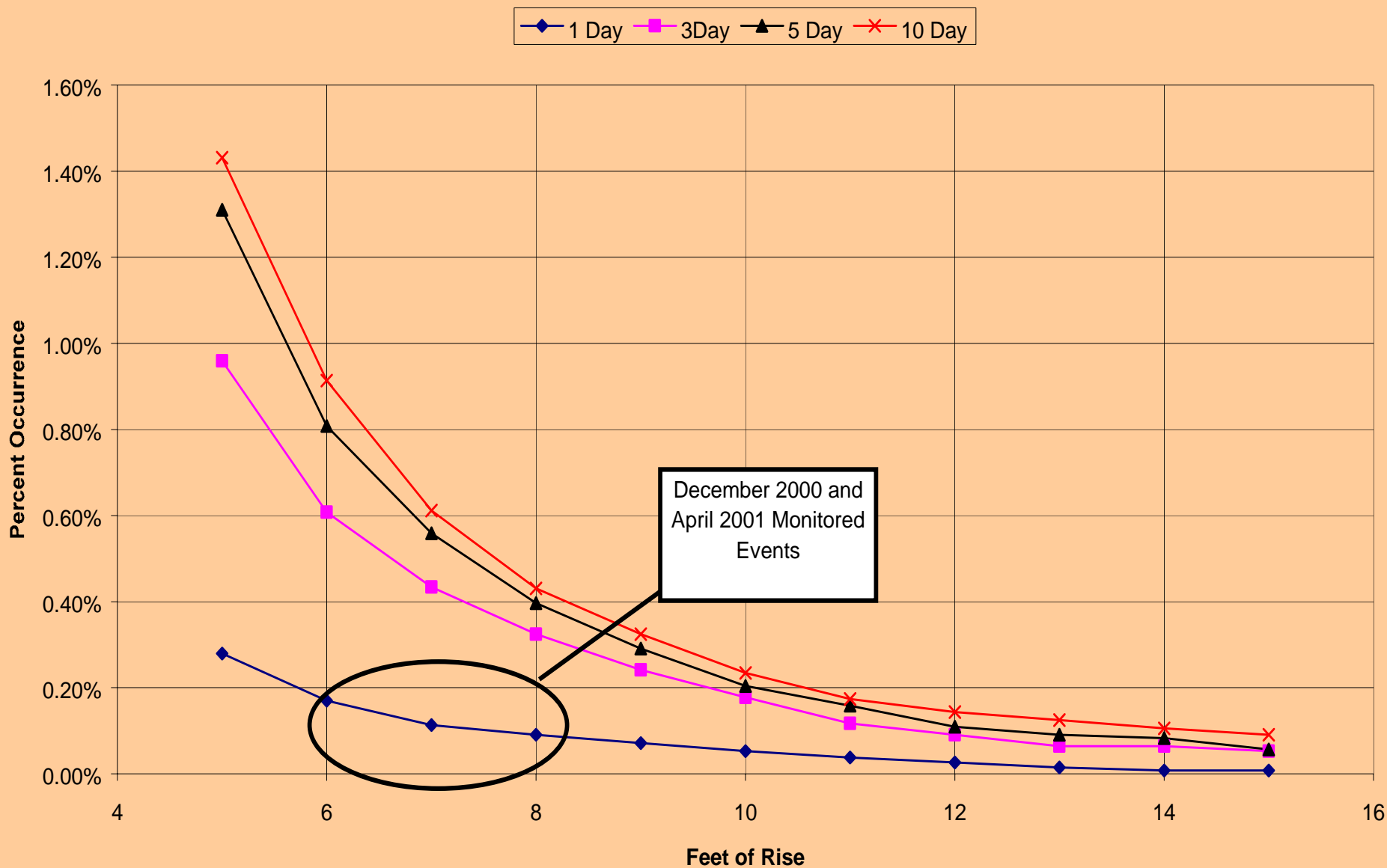
Stage Occurrences at C.M. Bolton Well Field

Graph is calculated from discharge data at the USGS gaging station in Hamilton, OH. Period of record April 1927 through September 1999.

Discharge data was converted to river elevation at Hamilton and then to River Elevation at the Bolton (Fairfield) gaging station near Production Well 1.



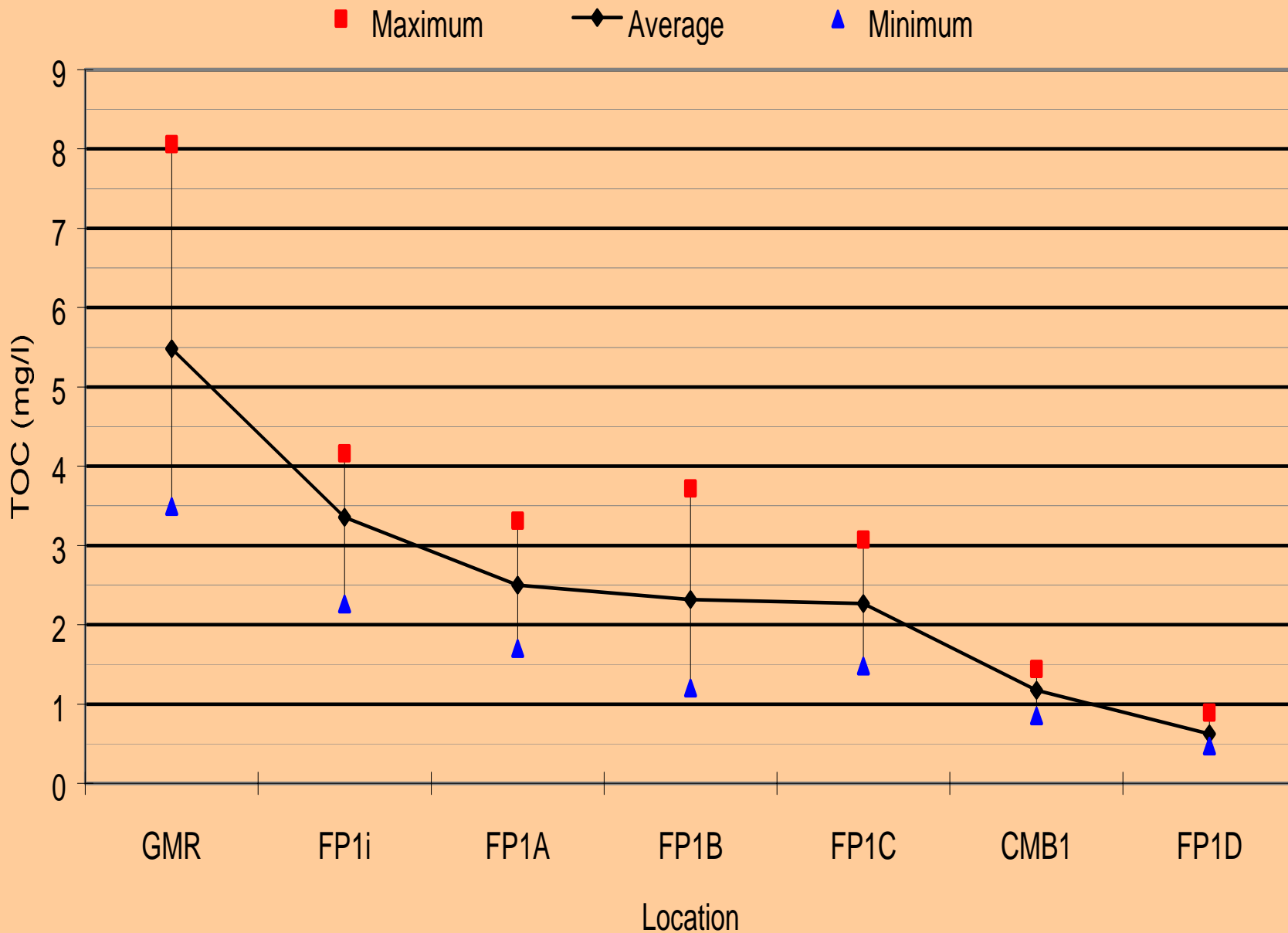
Frequency of Stage Increase Over Various Numbers of Days Great Miami River at Hamilton 1927-1999



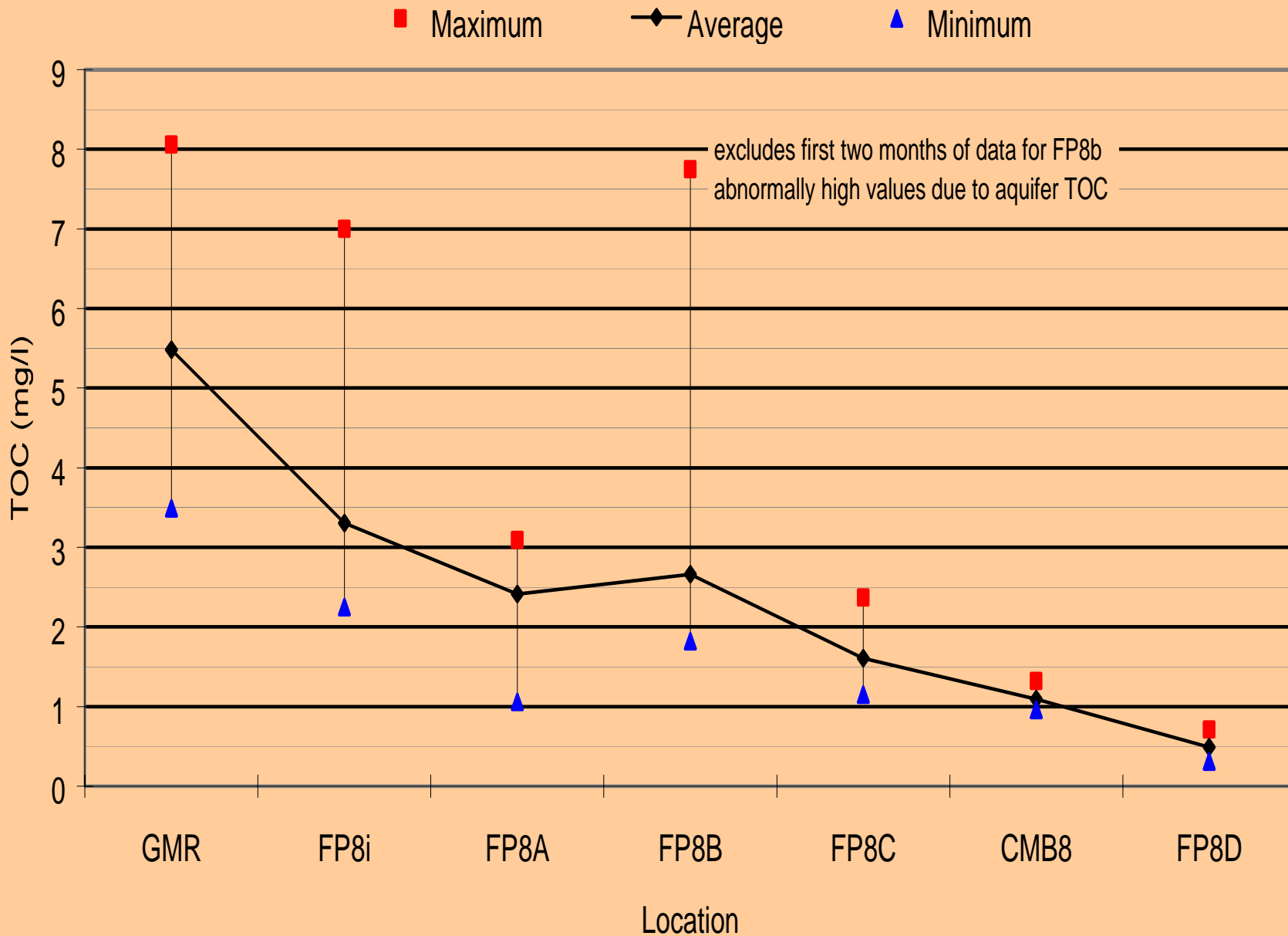
Water Quality Data

- Organic Reduction
- Particle Reduction

Site 1 Total Organic Carbon

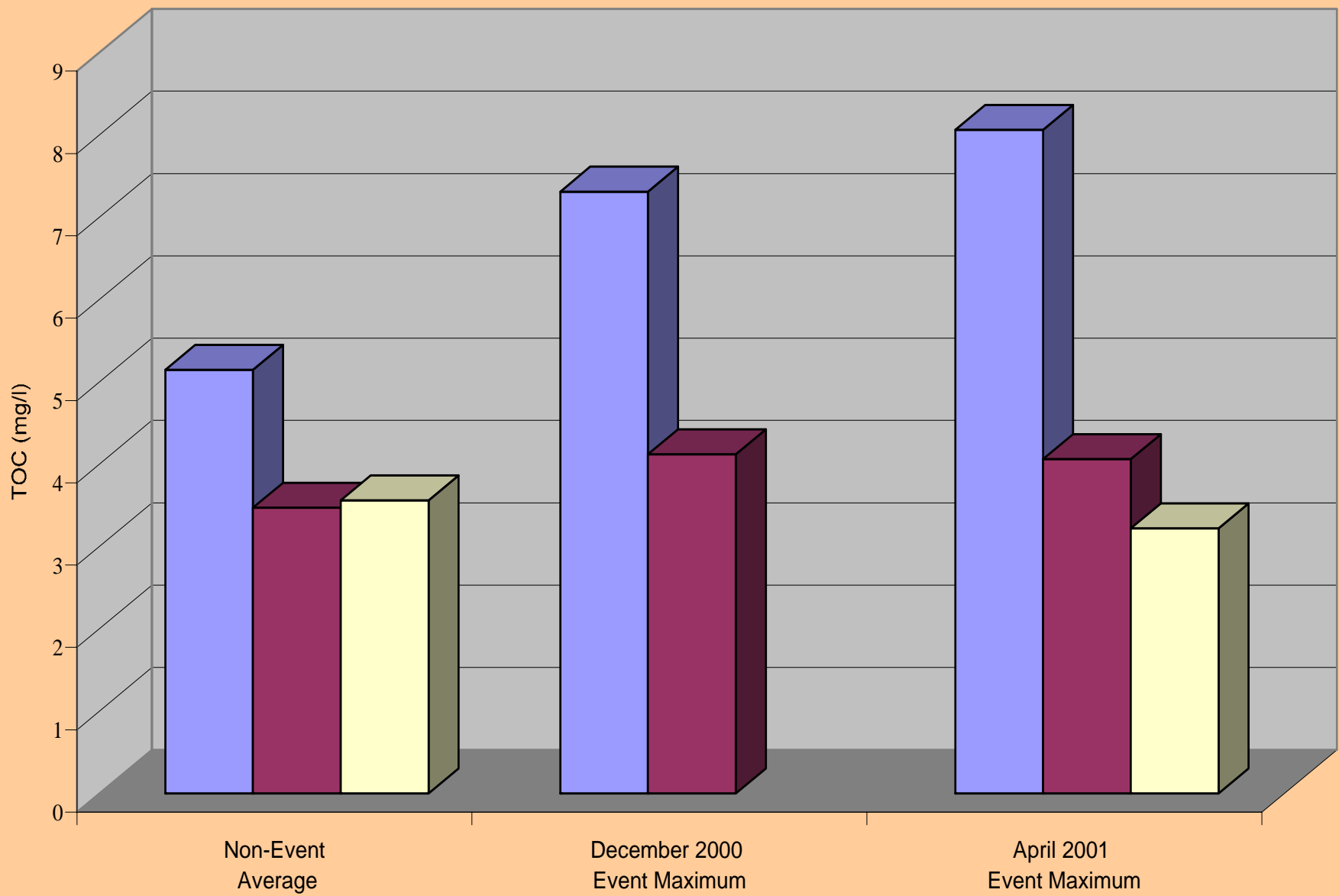


Site 8 Total Organic Carbon

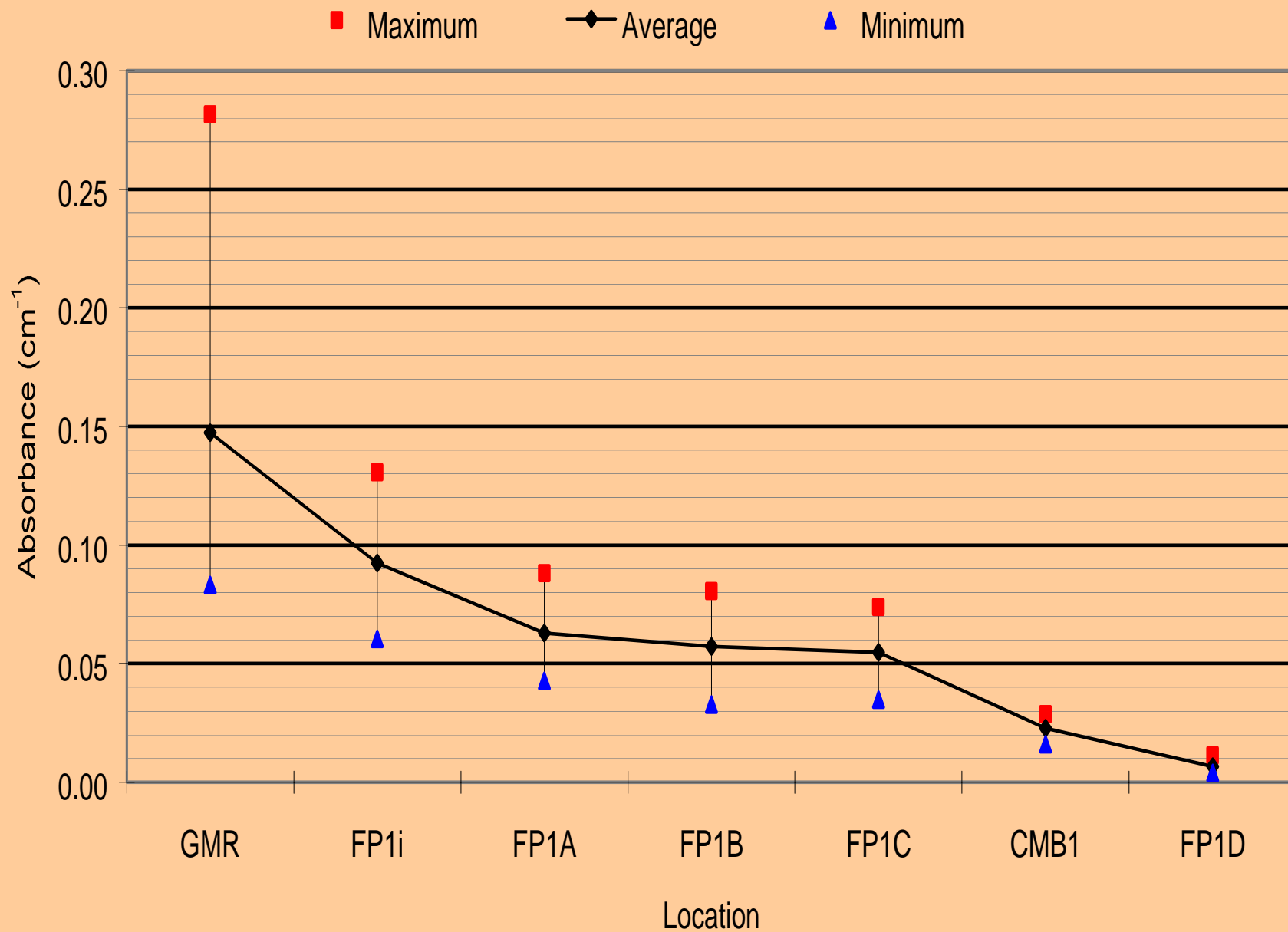


Total Organic Carbon

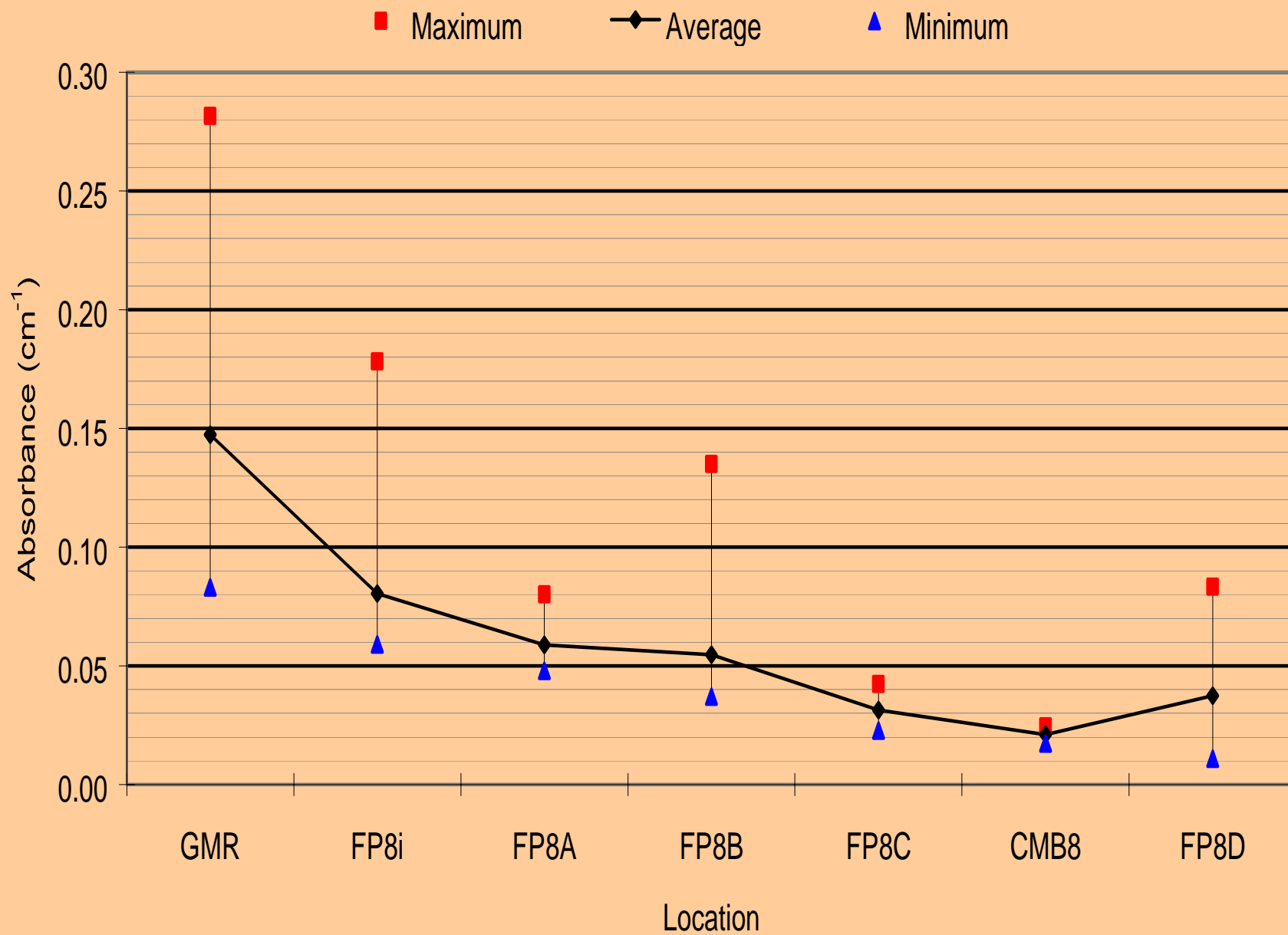
■ GMR ■ FP1i □ FP8i



Site 1 UV 254 Absorbance

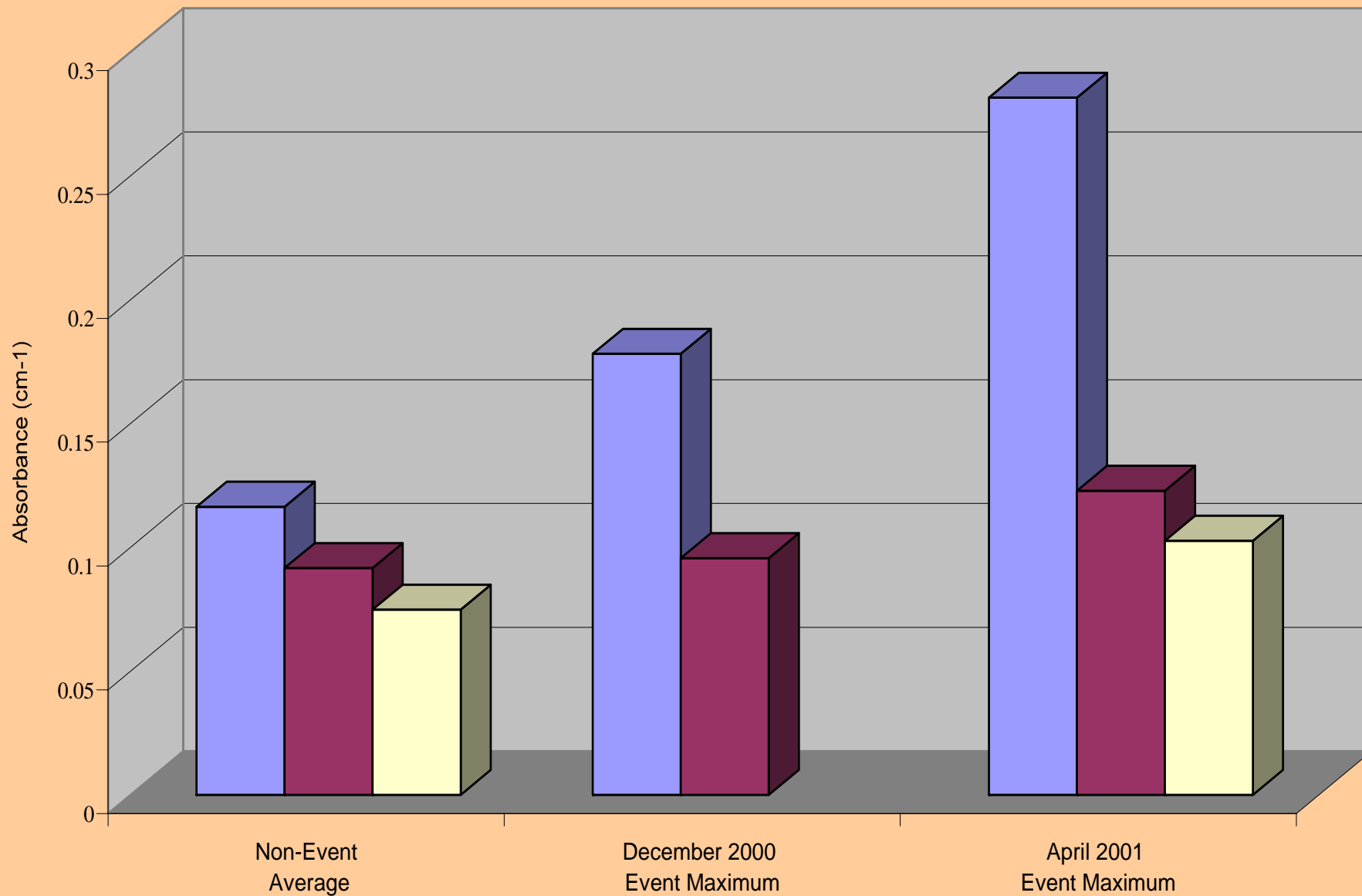


Site 8 UV 254 Absorbance



UV254

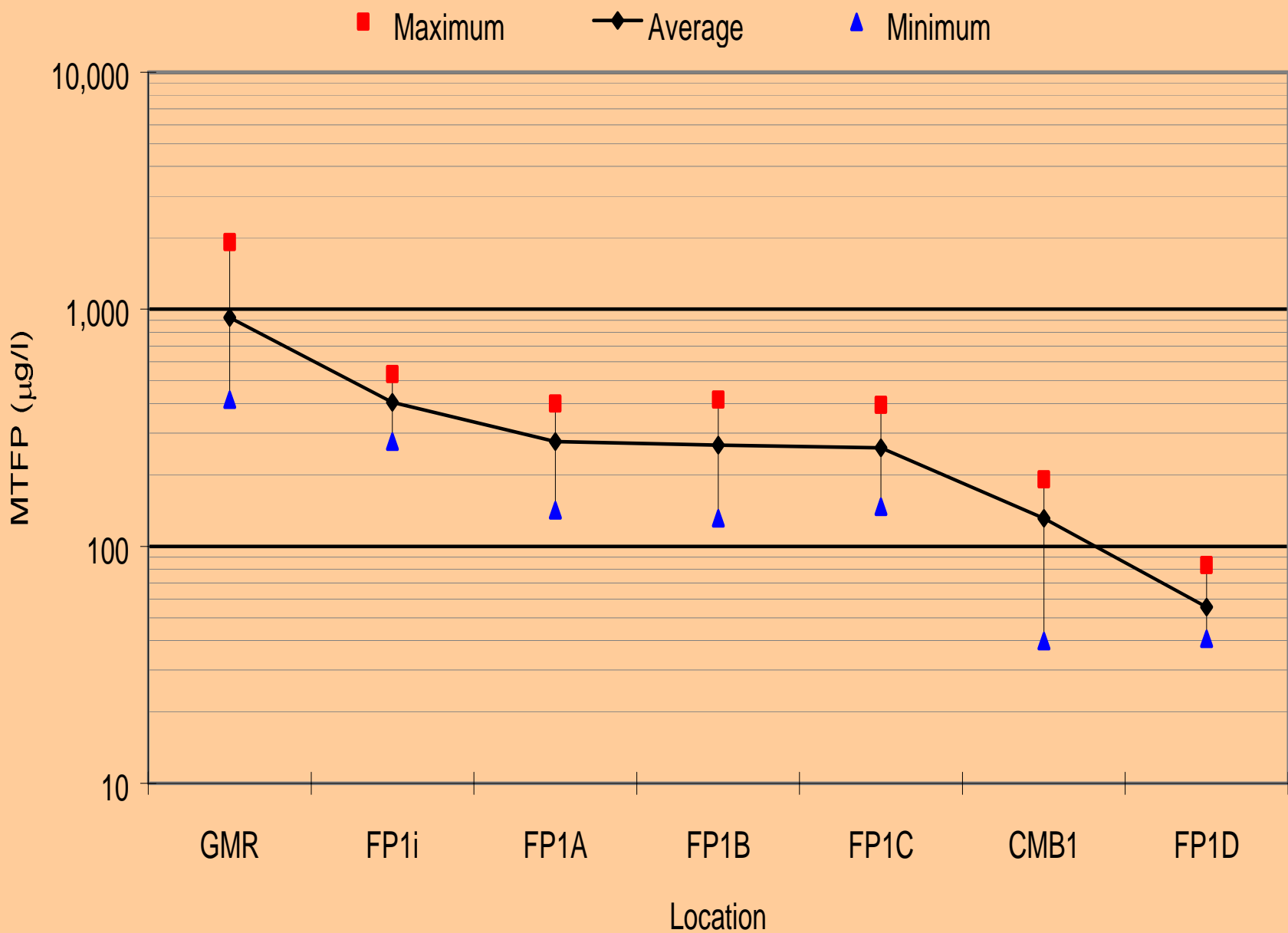
■ GMR ■ FP1i □ FP8i



Trihalomethane Maximum Formation Potential

- **Laboratory “Bench Test”**
- **Provides a theoretical maximum amount of THMs which would form with the tested water.**
- **Water is dosed with chlorine and held at a constant temperature and pH for 7 days.**
- **THMs analyzed after 7 days of incubation.**

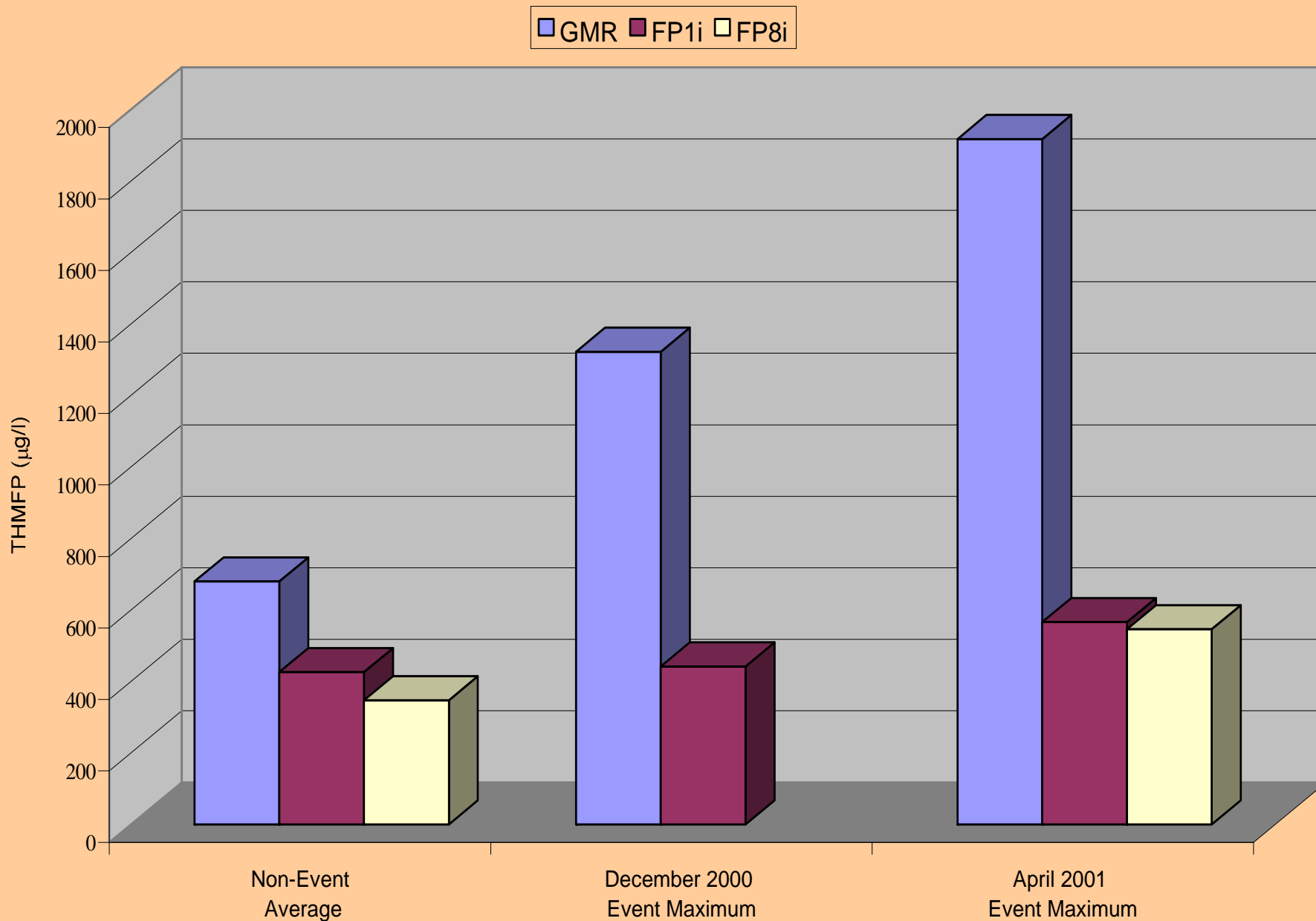
Site 1 Maximum Trihalomethane Formation Potential



Site 8 Maximum Trihalomethane Formation Potential

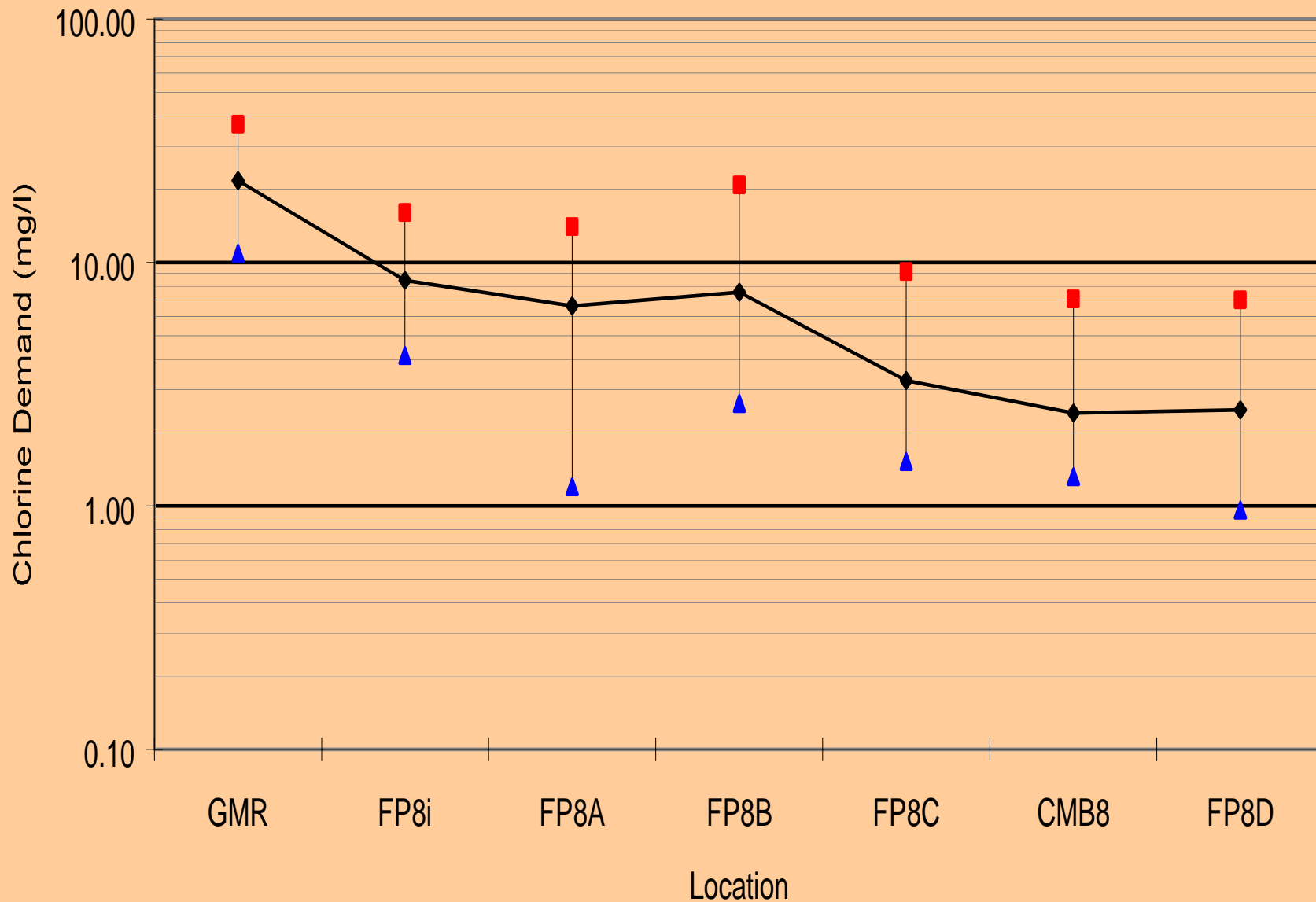


Maximum Trihalomethane Formation Potential



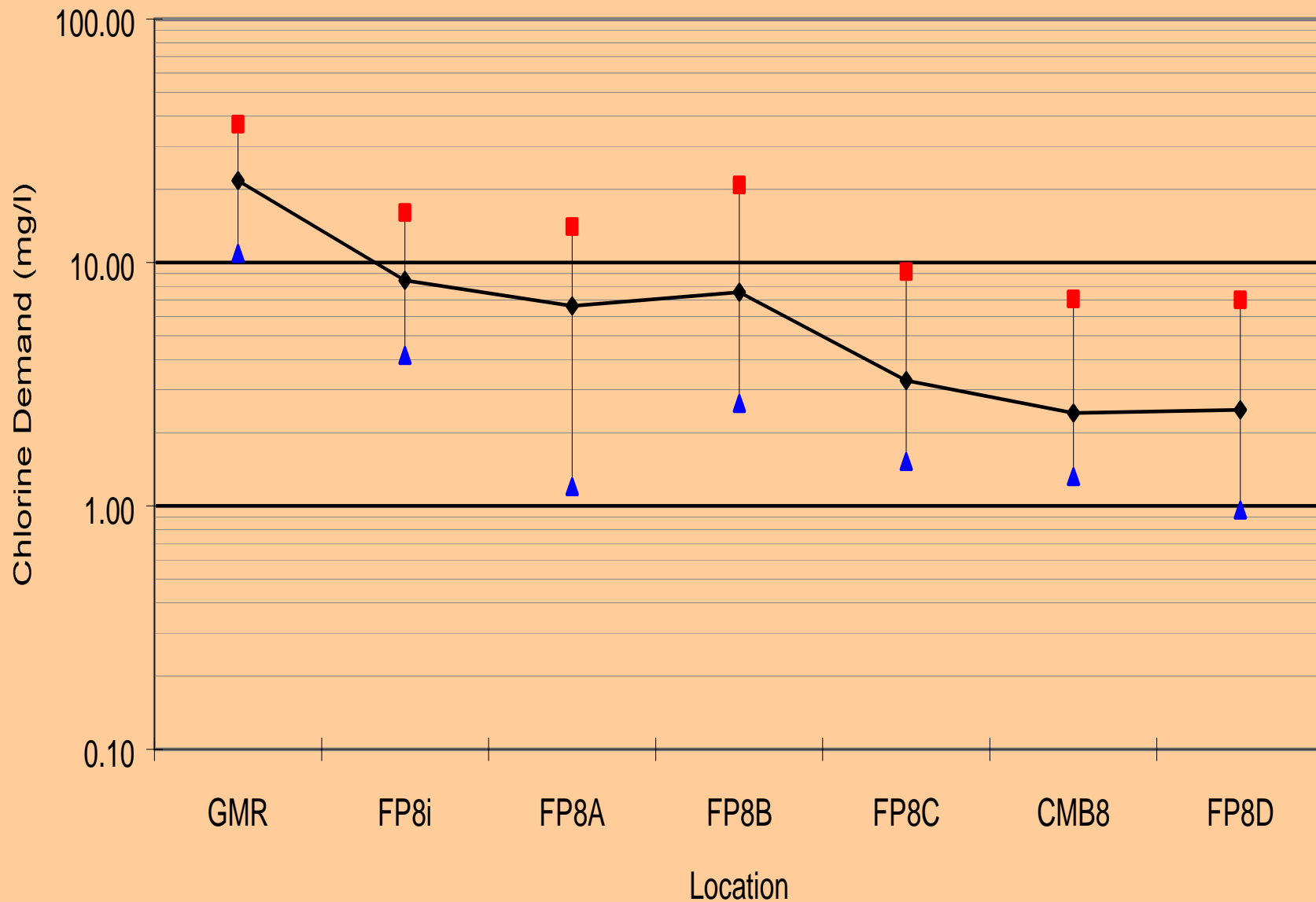
Site 8 Maximum Chlorine Demand

■ Maximum ◆ Average ▲ Minimum



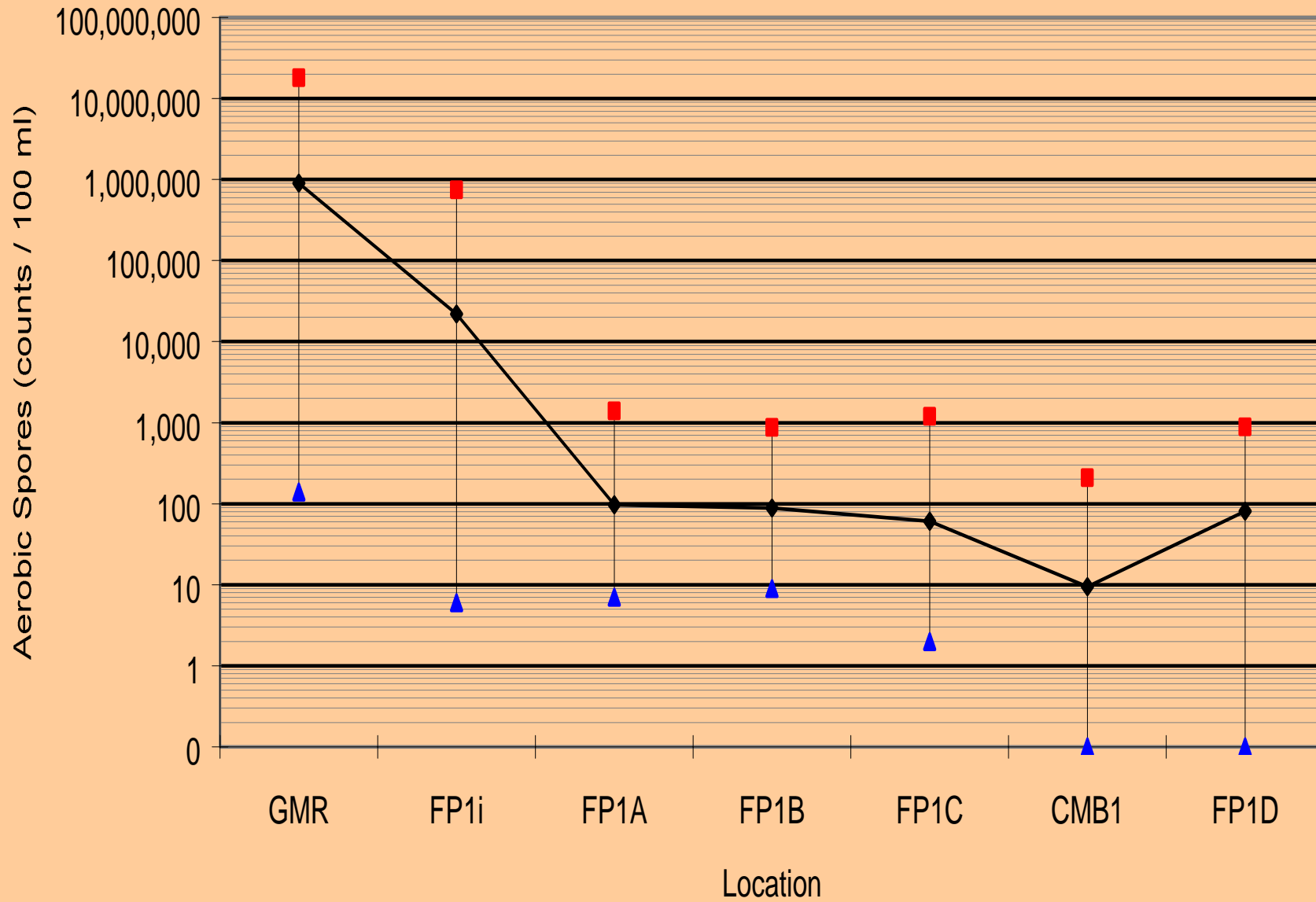
Site 8 Maximum Chlorine Demand

■ Maximum ◆ Average ▲ Minimum

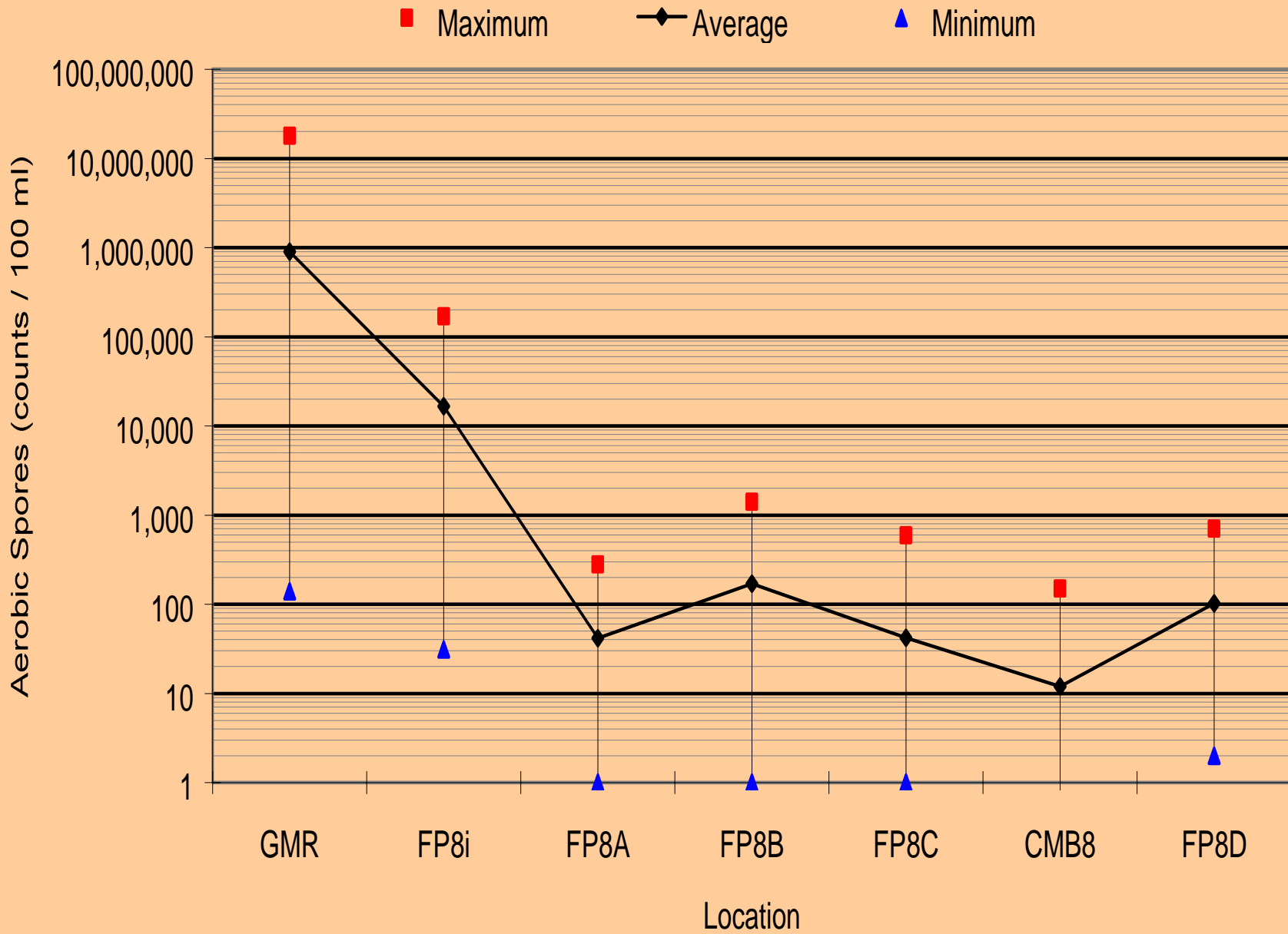


Site 1 Aerobic Spores

■ Maximum ◆ Average ▲ Minimum

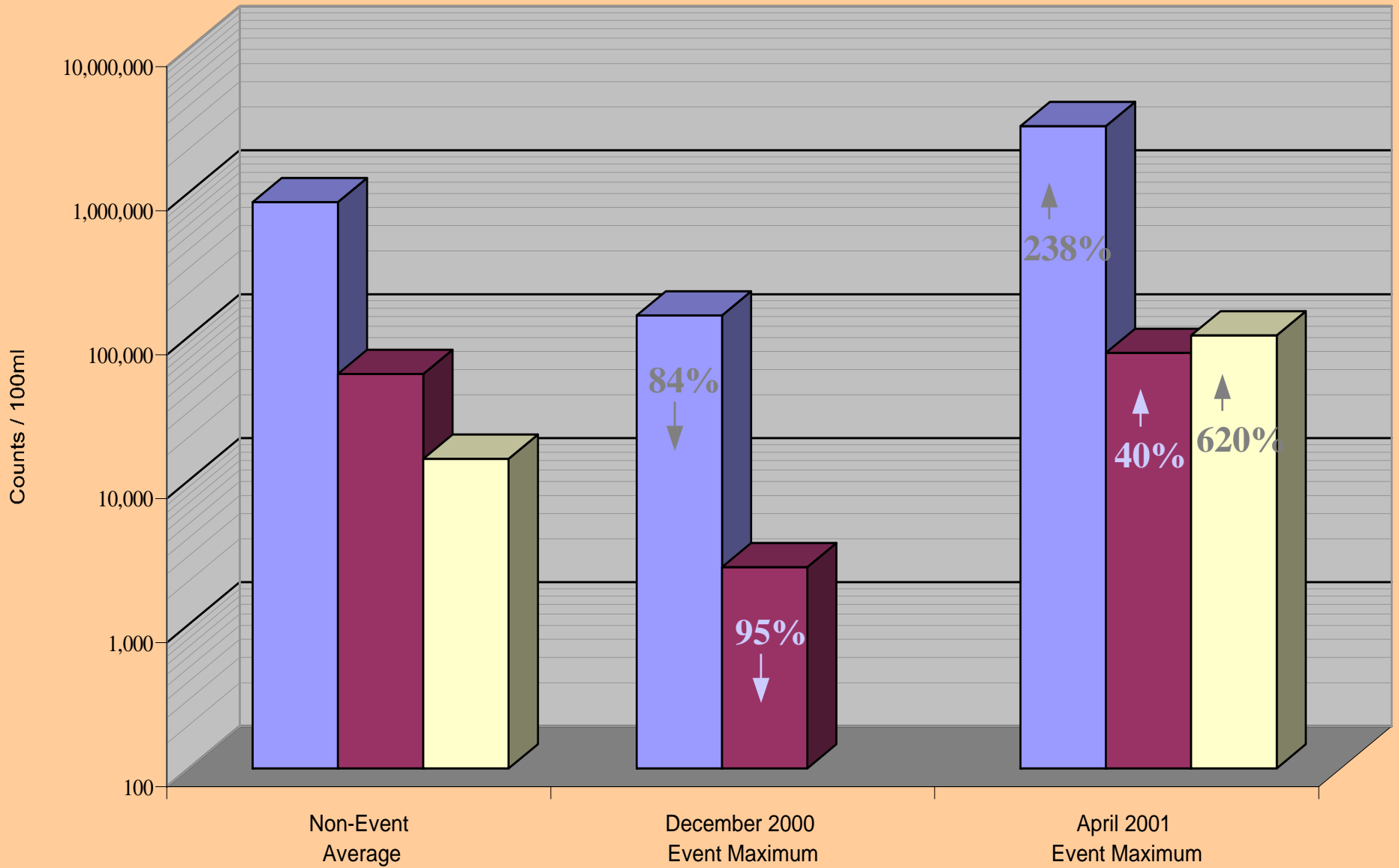


Site 8 Aerobic Spores

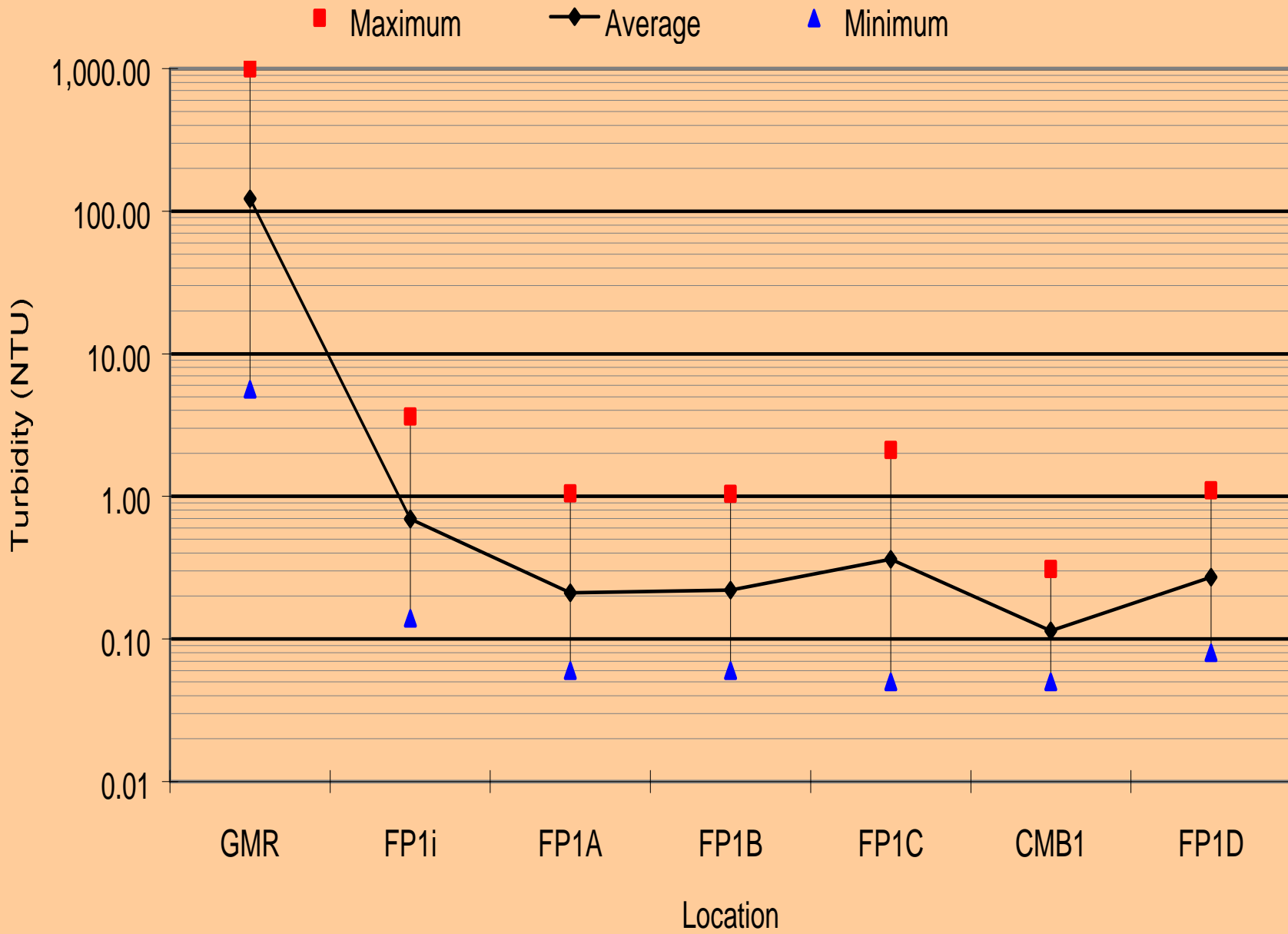


Aerobic Spores

GMR FP1i FP8i

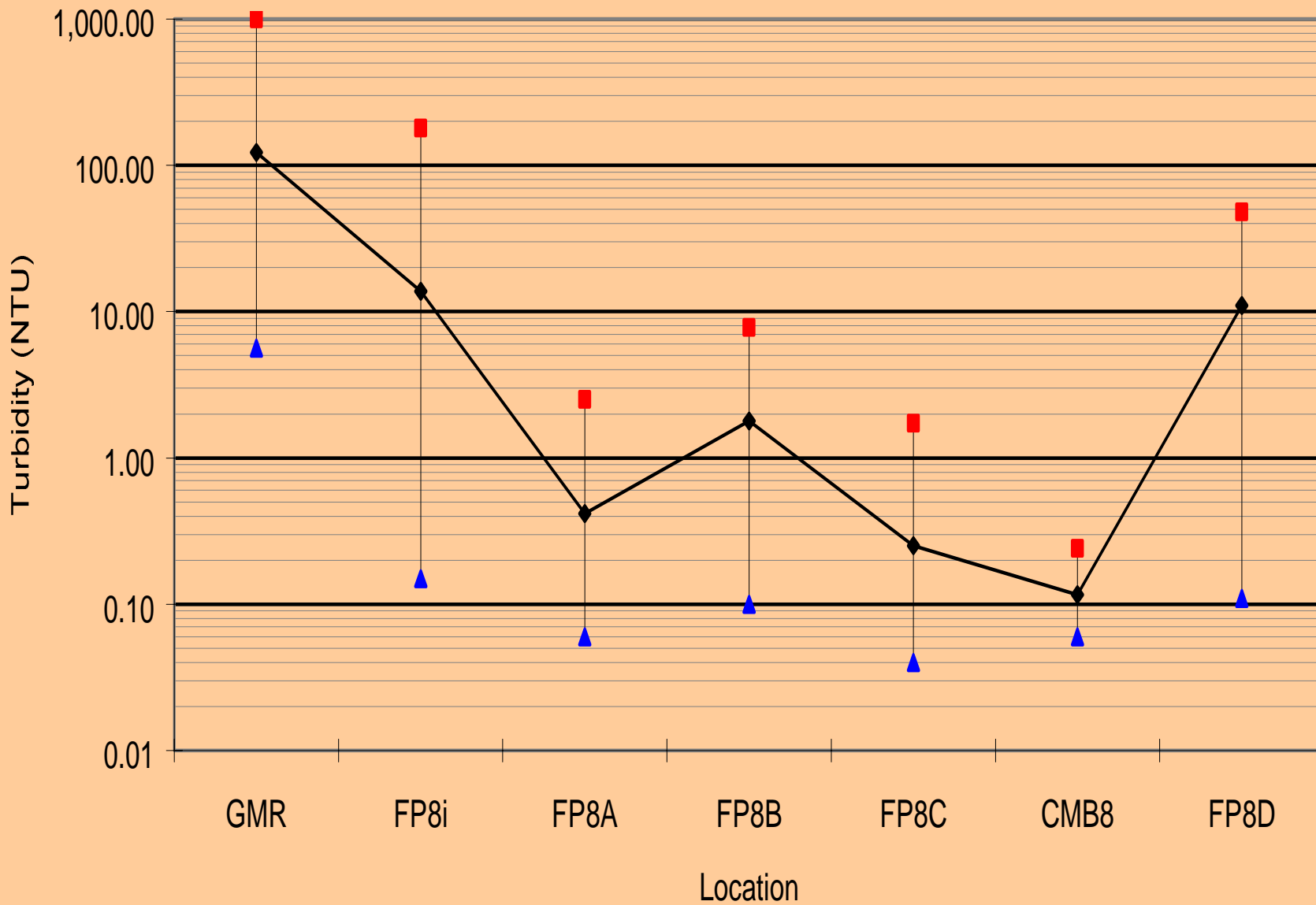


Site 1 Turbidity



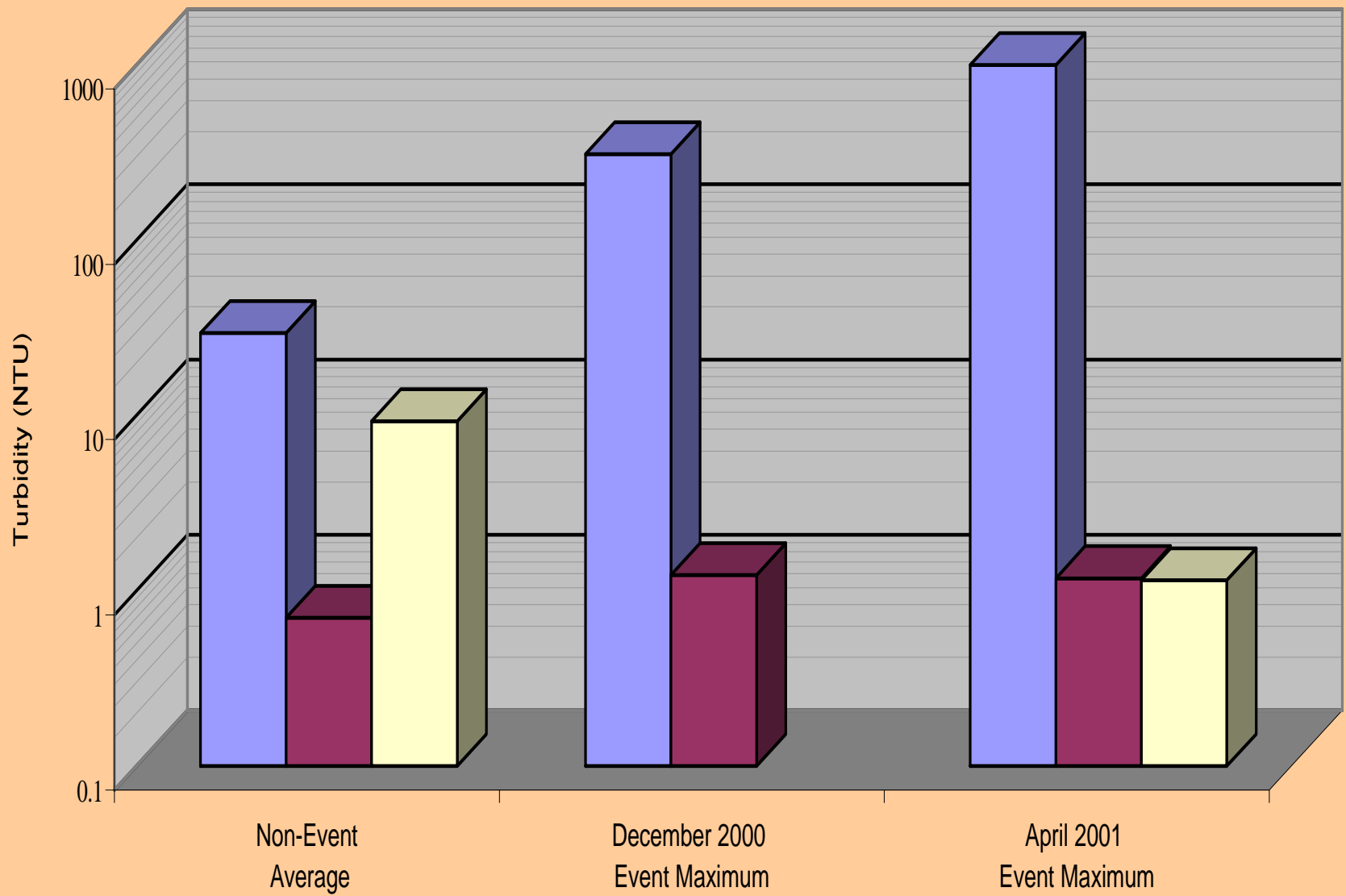
Site 8 Turbidity

■ Maximum ◆ Average ▲ Minimum



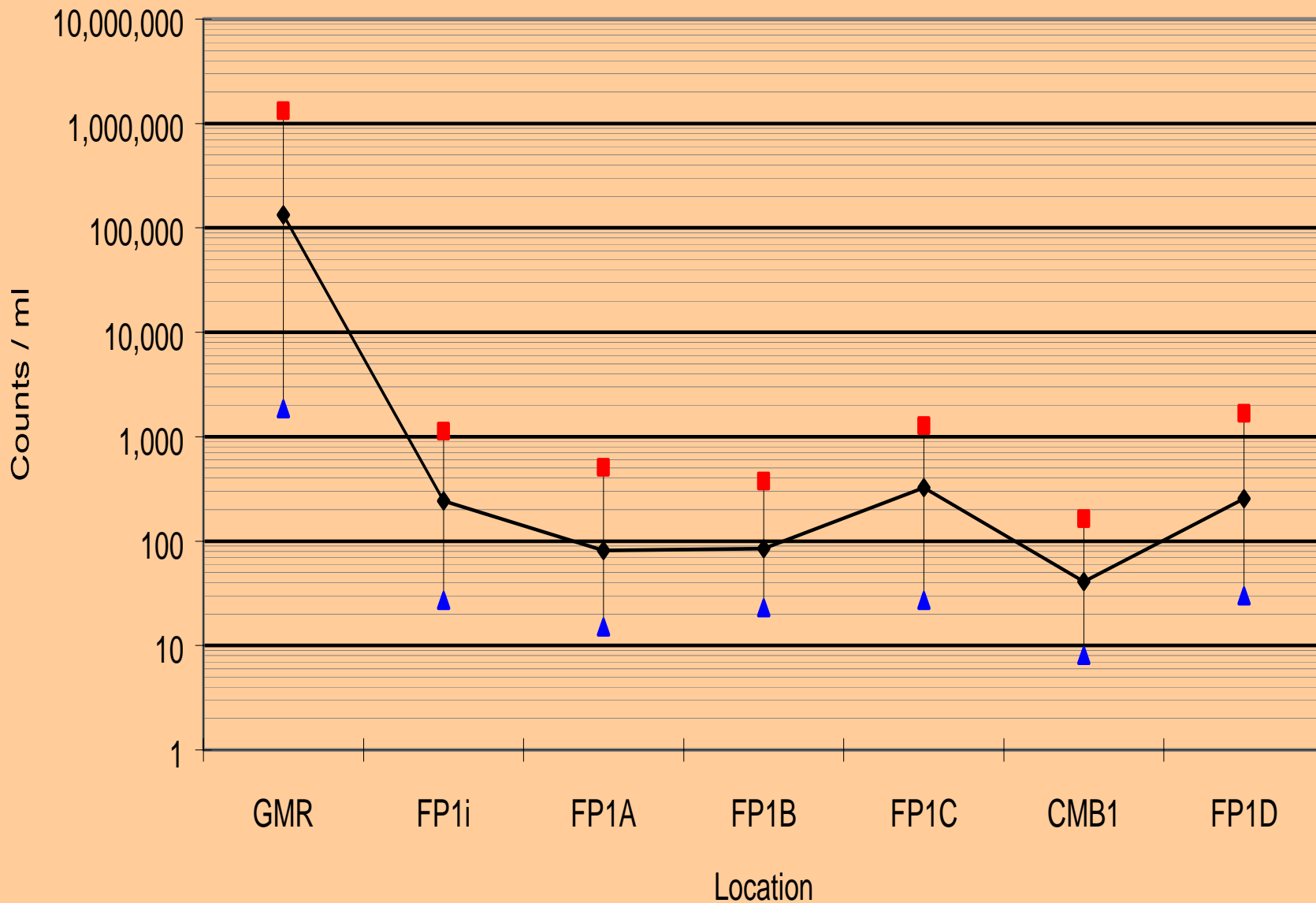
Turbidity

GMR FP1i FP8i



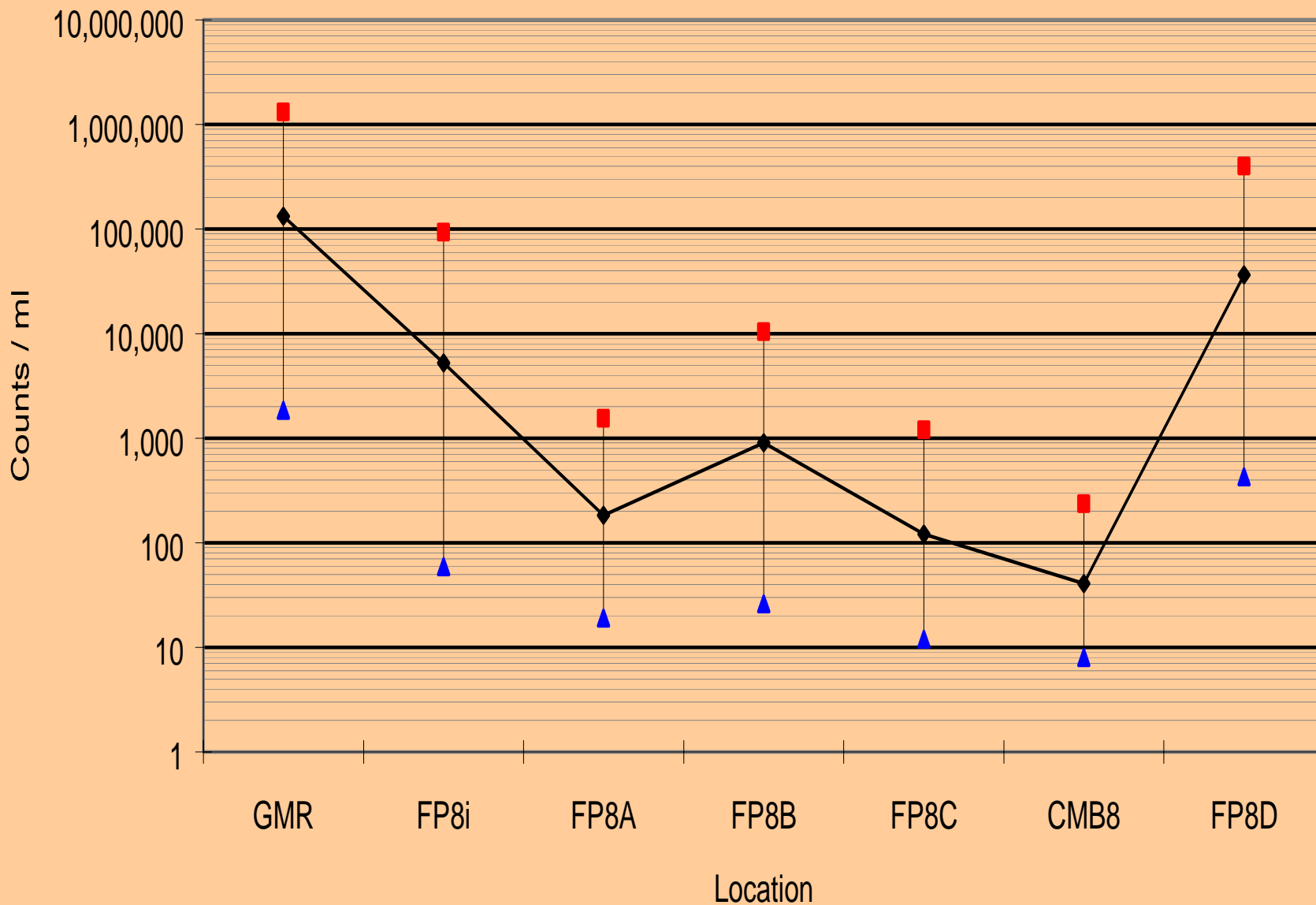
Site 1 Particle Counts 3-5 um Range

■ Maximum ◆ Average ▲ Minimum



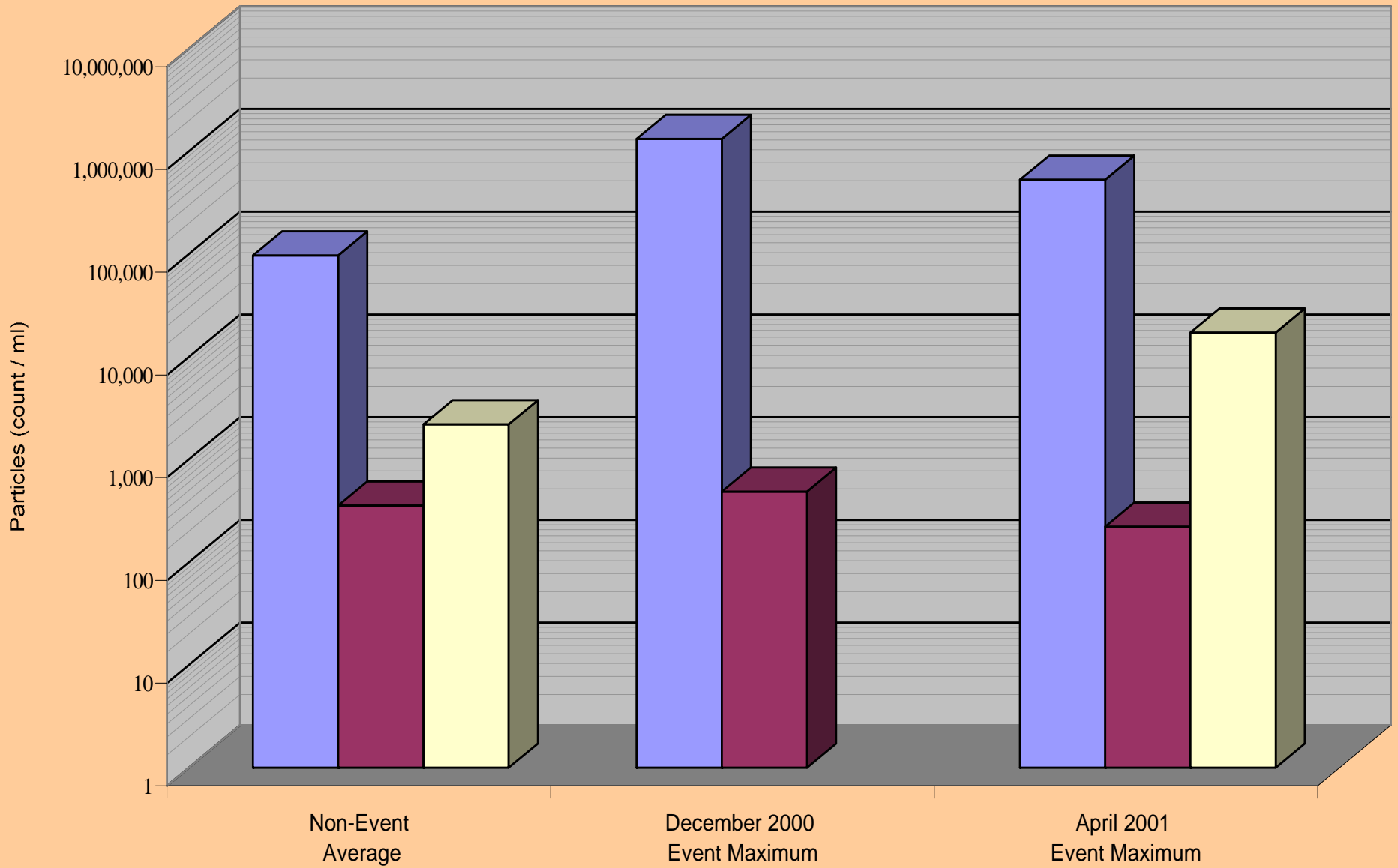
Site 8 Particle Counts 3-5 um Range

■ Maximum ◆ Average ▲ Minimum



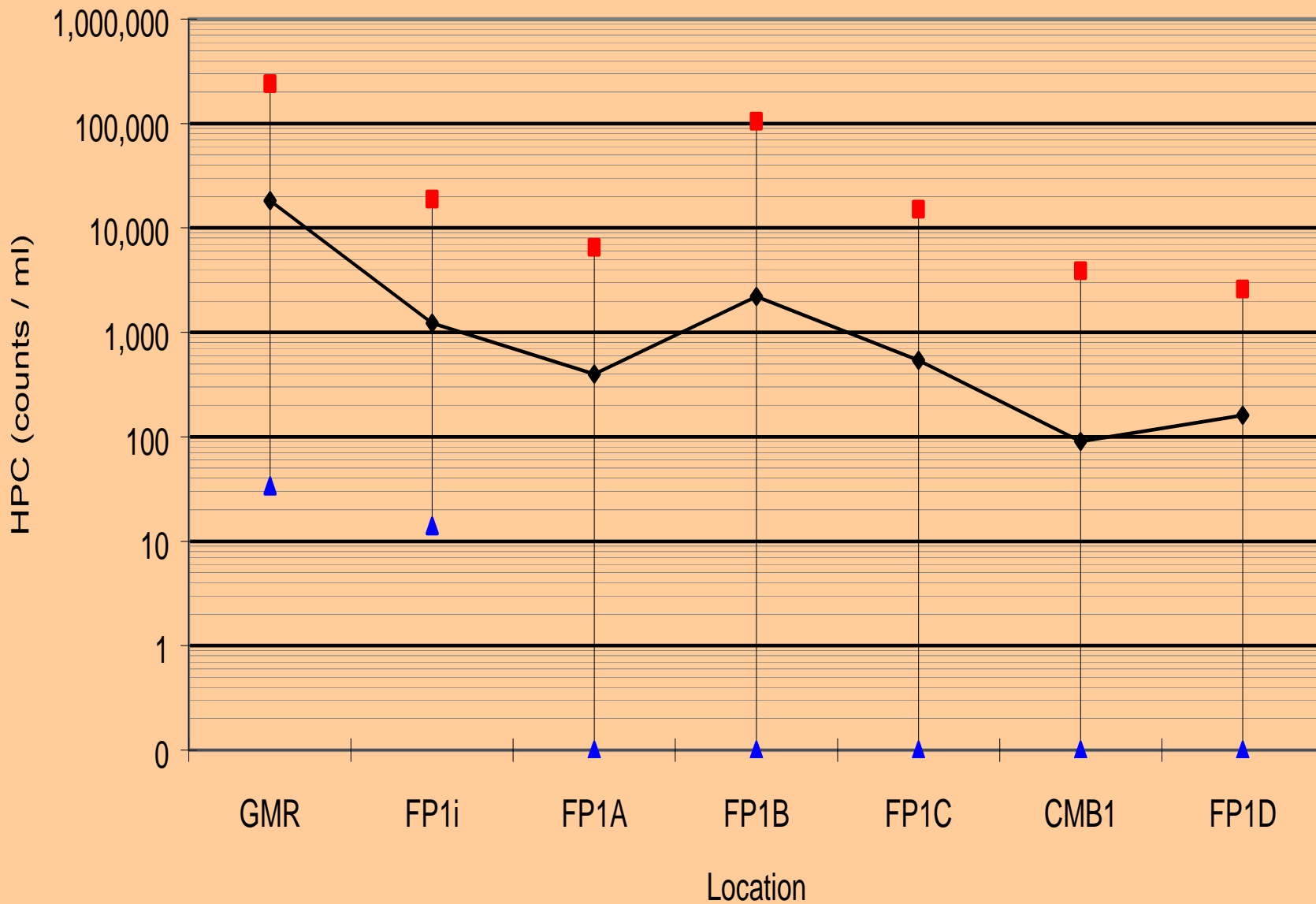
Particles (3-5 um)

■ GMR ■ FP1i □ FP8i



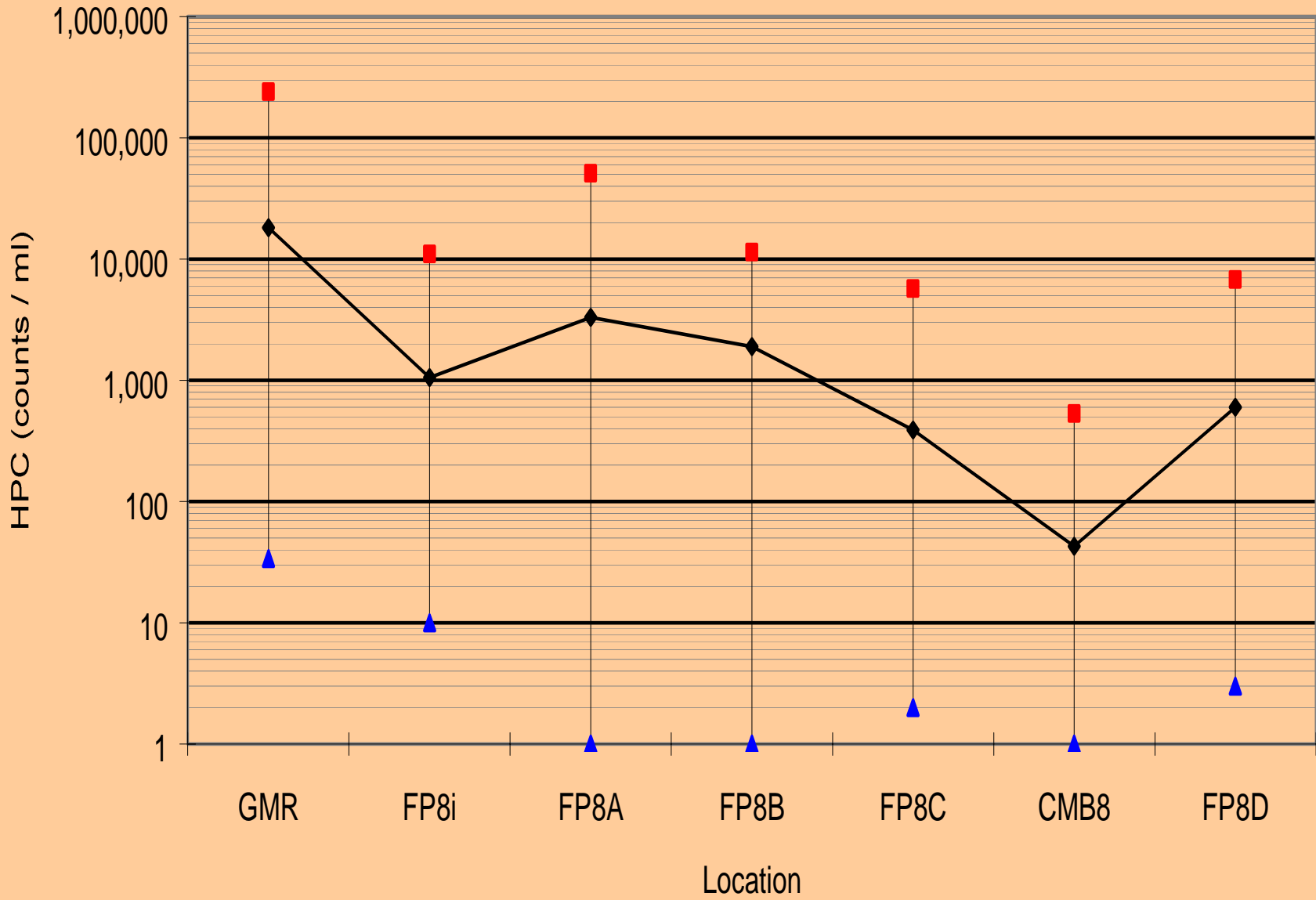
Site 1 Heterotrophic Plate Counts

■ Maximum ◆ Average ▲ Minimum

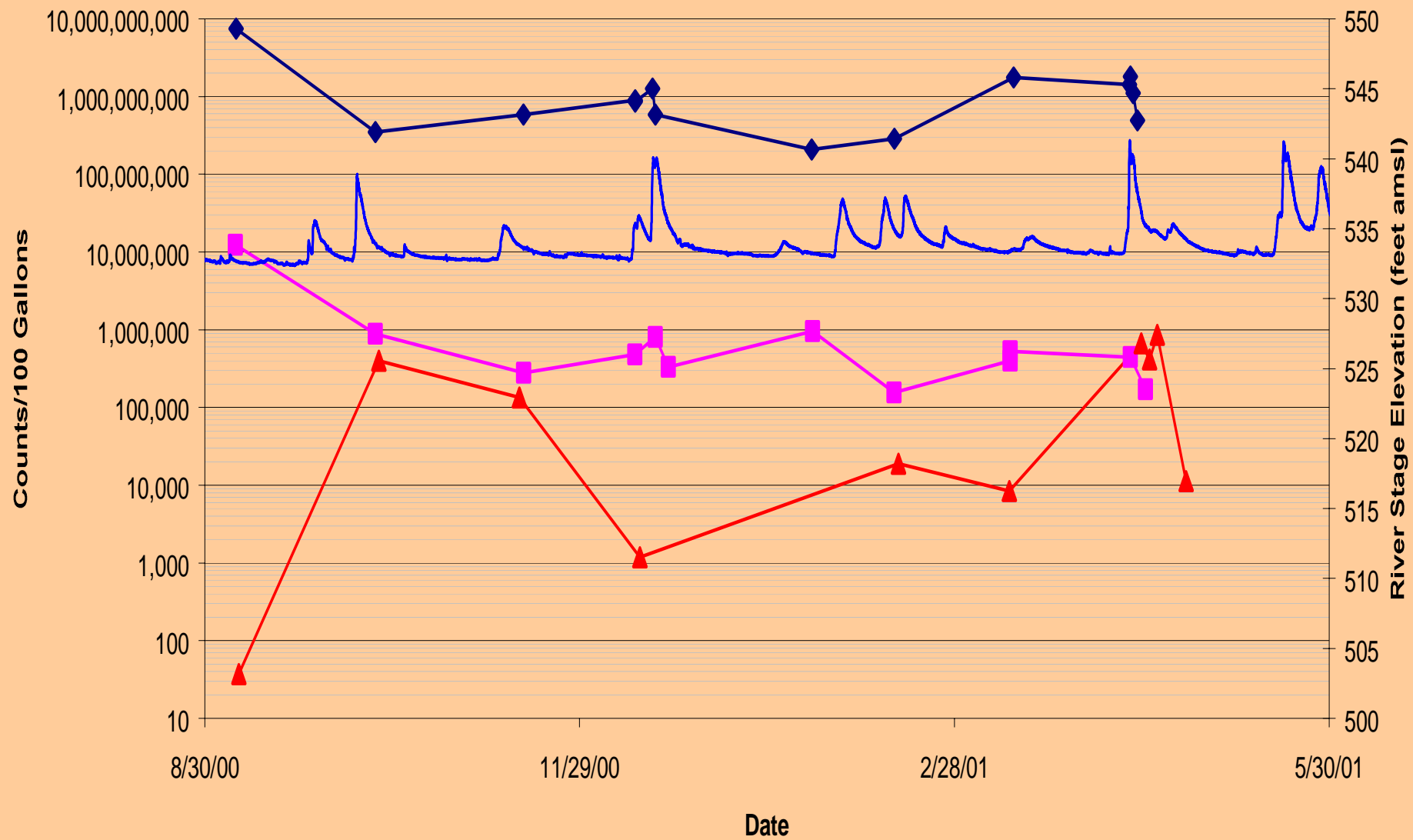


Site 8 Heterotrophic Plate Counts

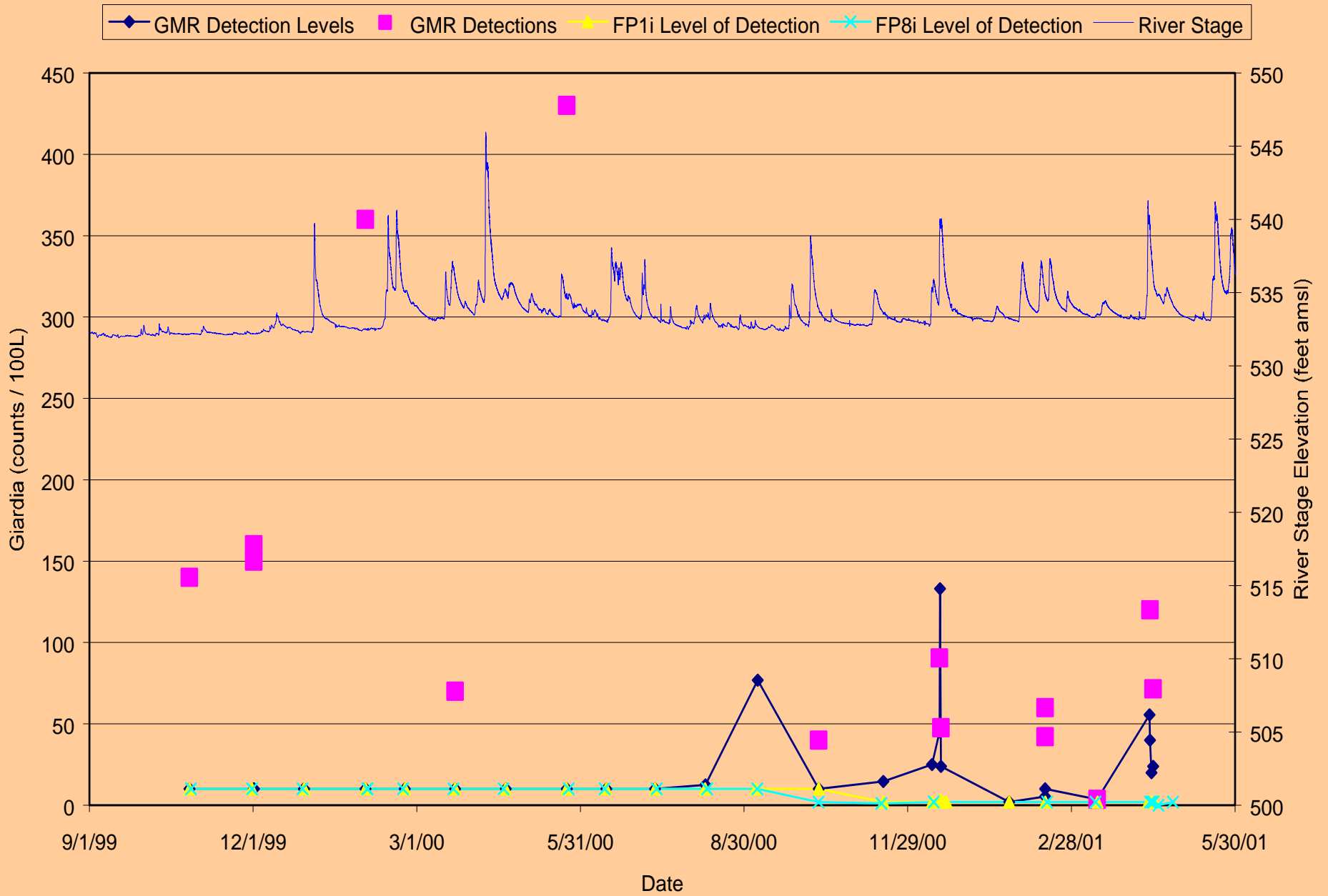
■ Maximum ◆ Average ▲ Minimum



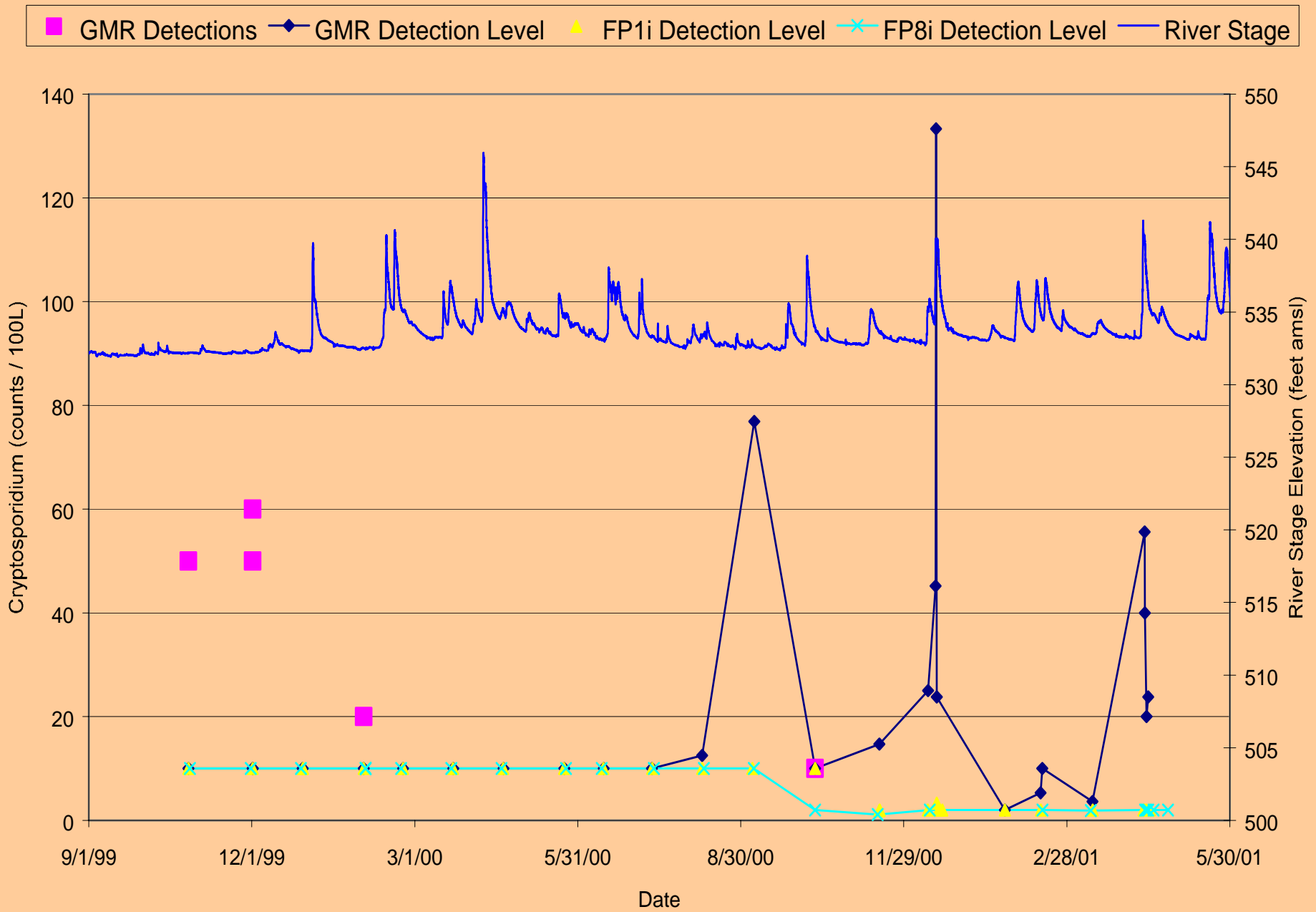
Total Algae



Giardia



Cryptosporidium



Conclusions

- No *Giardia* or *Cryptosporidium* detected in any of the 285 GW samples (71% using Method 1623)
- In general, streambed/aquifer provides a 2-6 log reduction of surrogates, even during events
 - Aerobic spores - 2 to 6 log
 - Turbidity - 3 to 4 log
 - Particle counts - 3 to 5 log
 - cysts size - 2 to 4 log
 - oocysts size - 2 to 3 log
 - Algae - 3 to 6 log
 - Total coliform - 3.5 to 5+
- Streambed is important in the reduction process

Conclusions (cont.)

- Conclusions drawn from water quality data, particularly monitoring wells, must be based on averages (or similar “multiple data point” statistics) and not on isolated sampling events.
- Monitoring wells are more affected by aquifer heterogeneity (both physical, chemical, and biological), than are properly developed production wells. This is due to short screened intervals and smaller capture zones.
- Riverbed dredging should not be done in the vicinity of a production well utilizing riverbank filtration.

Argument for RBF Credit

- Water quality from production wells continues to meet high standards, and is comparatively better than effluent from a conventional SW plant.
- Multiple surrogates demonstrate log reductions ranging from 2 to 6 log.
- No *Giardia* or *Cryptosporidium* have been found in any ground water samples, even those with relatively high concentrations of algae (i.e. inclined wells)
- Periods of high infiltration rates continue to produce high quality water
- Frequency and period of high infiltration rates events is low

Future Riverbank Filtration Research - Our Wish List

- Quantification of infiltration rate variability
- Quantification of riverbed conductivity during high stage events
- Streambed scour - How can it be measured?
- Duplicate modified Flowpath Study @ other sites
- Aquifer spiking studies - How do you do it?
- Similar studies to evaluate the impact of bank filtration from lakes and gravel pits (are the risks higher or lower?)

A Parting Thought

33 gallons filtered
from the river

1,100 gallons filtered
from 5 feet below
the riverbed

MPA
12-18-00
32.6 gal
N: 184
NW
09:40
Loc: PP 1 J
ON 12-17
OFF 12-18
Vol: 1100.3 gal
NTU
JAV