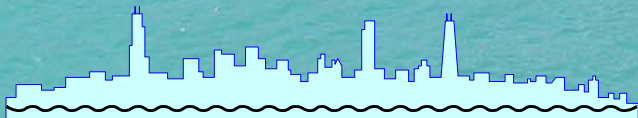


An aerial photograph of the Chicago River and city skyline. The river flows through the center, with a bridge crossing it. In the foreground, there are industrial structures and a large body of water. The city skyline is visible in the background with many skyscrapers.

An Epidemiological Study of Chicago Area Waterways

February 27, 2007



*Metropolitan Water Reclamation District of Greater Chicago
Protecting Our Water Environment*

Chicago Area Waterways UAA

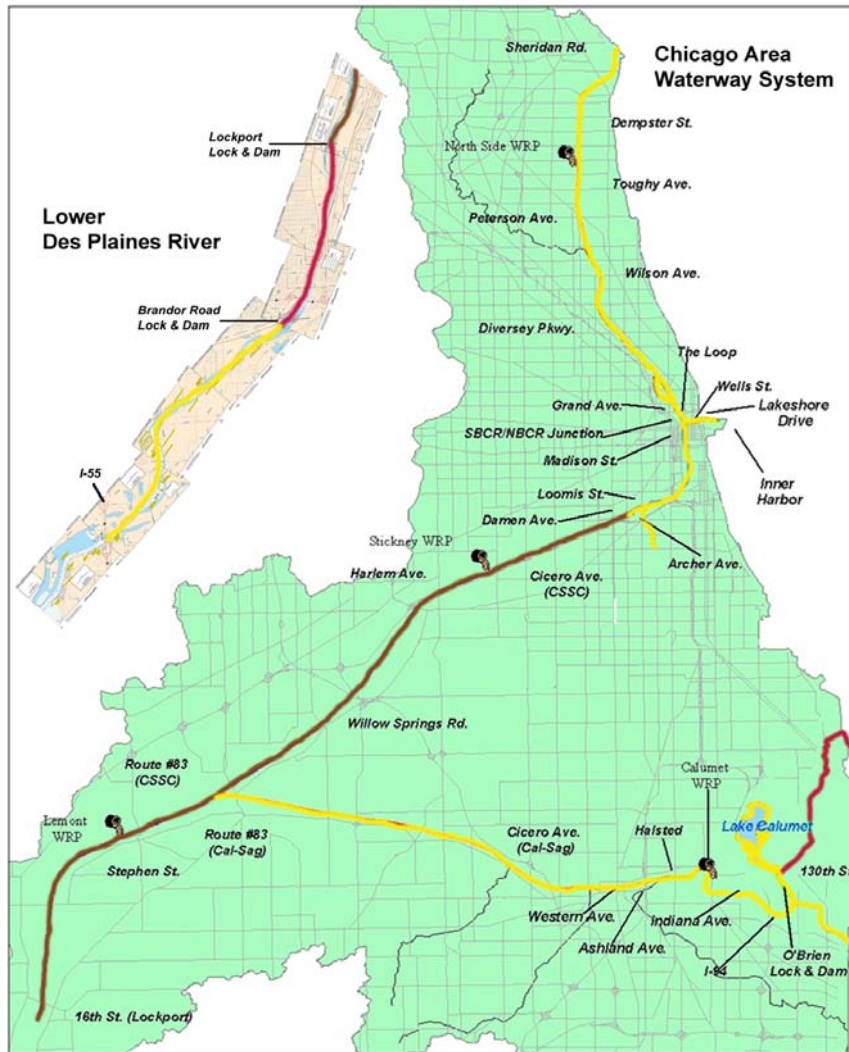
- UAA study being conducted by the IEPA is required by CWA (40 CFR 131.10j) because portions of the CAWs are designated as secondary contact and indigenous aquatic life use waters.
- UAA will determine whether a use upgrade for contact recreation is achievable and will determine whether recent upgrades of General Use reaches in the CAWs were appropriate.
- To develop appropriate protective standards.

Proposed CAWs Standards

- **Incidental Contact Recreation**: human contact with water is incidental and the probability of ingesting appreciable quantities of water is minimal (e.g. fishing, commercial boating, small craft recreational boating, wading). (Section 301.282)
- **Non-Contact Recreation**: human contact with the water is unlikely, such as pass through commercial navigation, and where physical or hydrologic configurations make direct human contact unlikely or dangerous. (Section 301.323)

Proposed CAWs Standards

- **Section 302.406 Bacteria Standards**
- **Beginning March 1, 2010, the following bacteria standards shall not be exceeded during the recreational season lasting from March 1 through November 30:**
 - **a) Incidental Contact Recreation Waters shall not exceed a 30-day geometric mean for *E. Coli* of 1030 cfu. (Based on 10 illnesses/1000)**
 - **b) Non-Contact Recreation Waters shall not exceed a 30-day geometric mean for *E. Coli* of 2740 cfu. (Based on 14 illnesses/1000)**
 - **c) There is no bacteria standard for the Non-Recreational Waters.**



Proposed Recreational Use Designations

- Incidental Contact Recreational
- Non-Contact Recreational
- Non-Recreational

Description of CAWs Study Reaches

- Chicago River System including:
 - North Shore Channel: 7.7 miles long, 90 ft wide, 5 to 10 ft deep, steep earthen side slopes
 - North Branch Chicago River: 7.7 miles long, 90 to 300 ft wide, 10 to 15 feet deep, steep earthen slopes and vertical dock walls
 - Chicago River: 1.5 miles long, 200 to 400 ft wide, 20 to 26 ft deep, vertical side walls
 - South Branch Chicago River: 4.5 miles long, 200 to 250 ft wide, 15 to 20 ft deep, vertical dock walls throughout

Description of CAWs Study Reaches

- Calumet River System including:
 - Little Calumet River: 6.9 miles long, 250 to 350 ft wide, 12 ft deep, vertical dock walls and earthen side slopes
 - Calumet Sag Channel: 16.2 miles long, 225 ft wide, 10 feet deep, earthen slopes and vertical north walls



UAA RESEARCH INITIATIVES

- **Engineering study to evaluate disinfection technologies and estimate cost of implementation**
- **Characterize fecal coliform content of CAWs during dry and wet weather conditions**
- **Conduct assessment of risk of recreating on CAWs with and without effluent disinfection**
- **Engineering study to evaluate feasibility and estimate cost of capturing and treating CAWs CSOs**
- **Conduct expert review of USEPA criteria for developing secondary contact recreation bacteria standards for CAWs**

Expert Review of USEPA Water Quality Criteria for Bacteria

- Expert Review Panel conducted a review of USEPA's Water Quality Criteria for Bacteria and draft implementation guidance document (EPA 1986 and 2003).
- Expert review panel found that there is currently no scientific basis for developing bacteria standards for the proposed CAWs recreational use designations.
- Expert review panel recommended conduct of risk assessment and/or epidemiological study to inform standard development.

Protecting Our Water Environment



Metropolitan Water Reclamation District of Greater Chicago

***“RISK ASSESSMENT OF HUMAN HEALTH IMPACTS
OF DISINFECTION VS. NO DISINFECTION OF THE
CHICAGO AREA WATERWAYS SYSTEM”***



The GeoSyntec Team

STUDY OBJECTIVES

Conduct a comparative risk assessment of the human health impact of not disinfecting versus disinfecting the effluents from the Calumet, North Side and Stickney Water Reclamation Plants (WRPs):

1. *Quantify the decrease if any in the incidence of disease to a representative recreational user of the CWS if effluent disinfection is initiated*
2. *Quantify the decrease if any in the incidence of disease that could be predicted for the entire number of estimated recreational users of the CWS if effluent disinfection is initiated*

Microbial Risk Assessment Study

VIRUSES:

- i) Total cultivable enteric viruses
- ii) Adenovirus
- iii) *Calicivirus*

PROTOZOA:

- i) Viable *Cryptosporidium parvum*
- ii) Viable *Giardia lamblia*

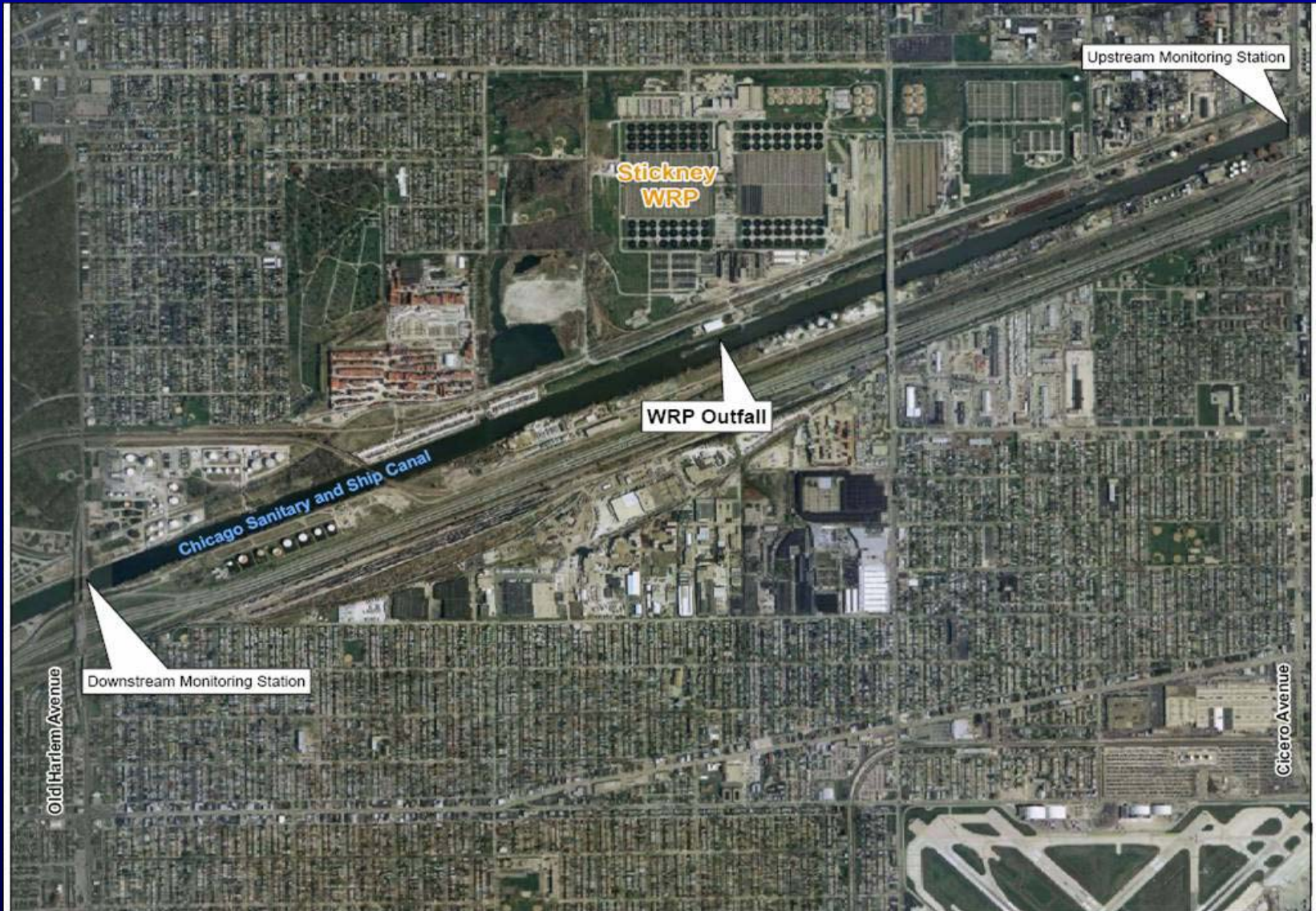
BACTERIA:

- i) *Salmonella* spp.
- ii) *Pseudomonas aeruginosa*,
- iii) *E. coli*
- iv) Fecal coliforms
- v) *Enterococci*

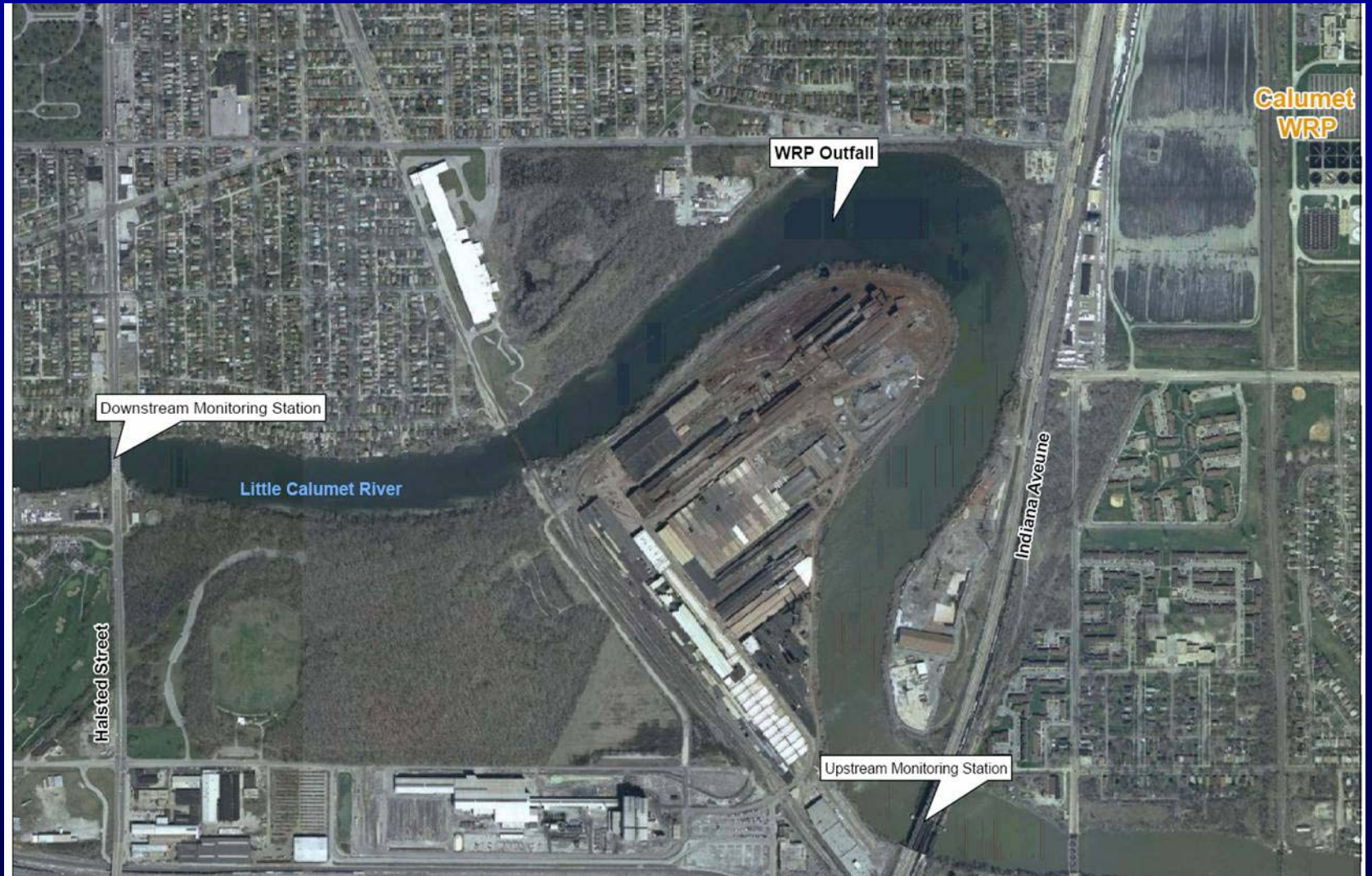
North Side WRP Dry Weather Sampling



Stickney WRP Dry Weather Sampling

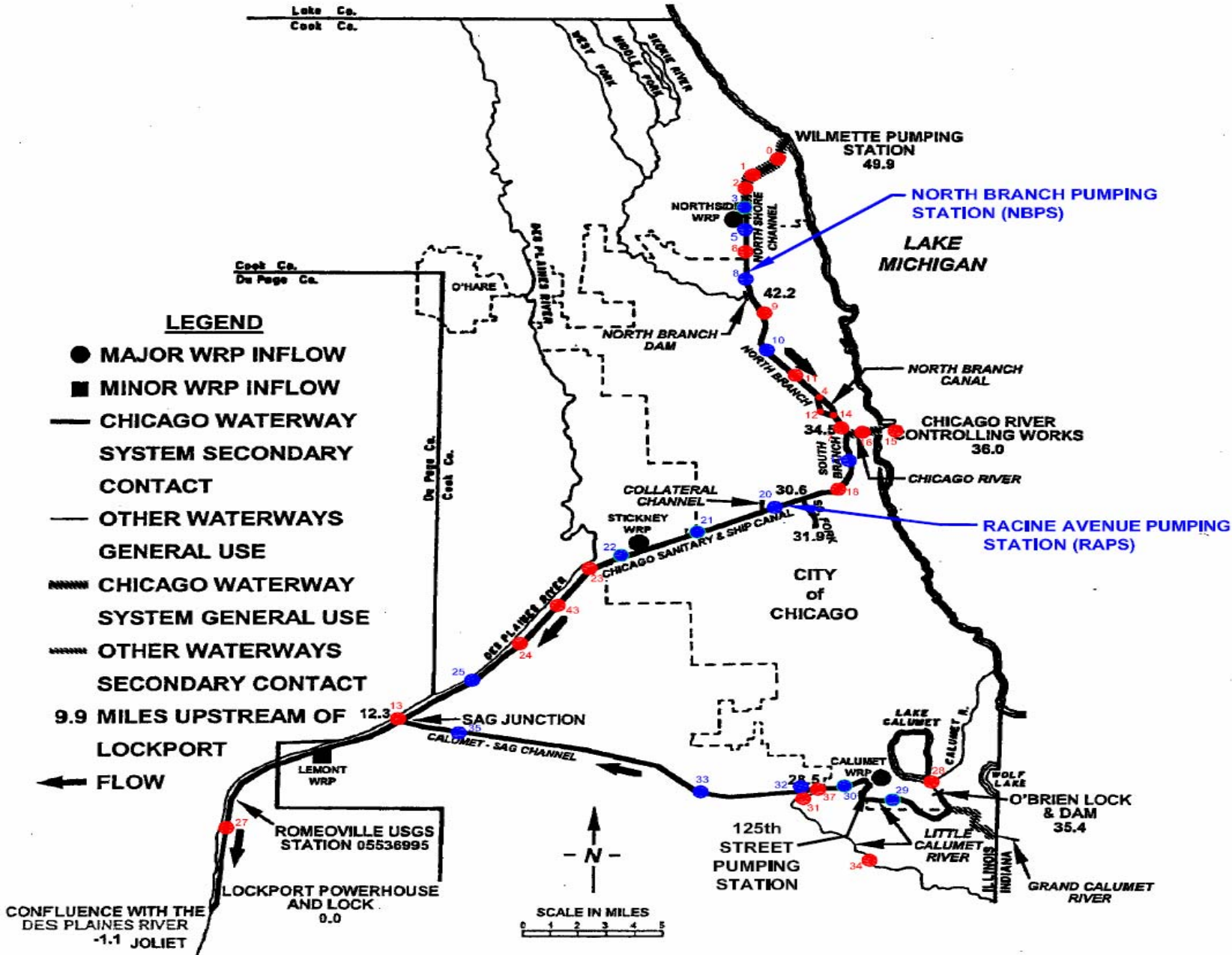


Calumet WRP Dry Weather Sampling



WET WEATHER SAMPLING

- Nine sampling events (June-October)
- Five waterway sampling locations and outfall
- Analyze for the same microorganisms as for dry weather



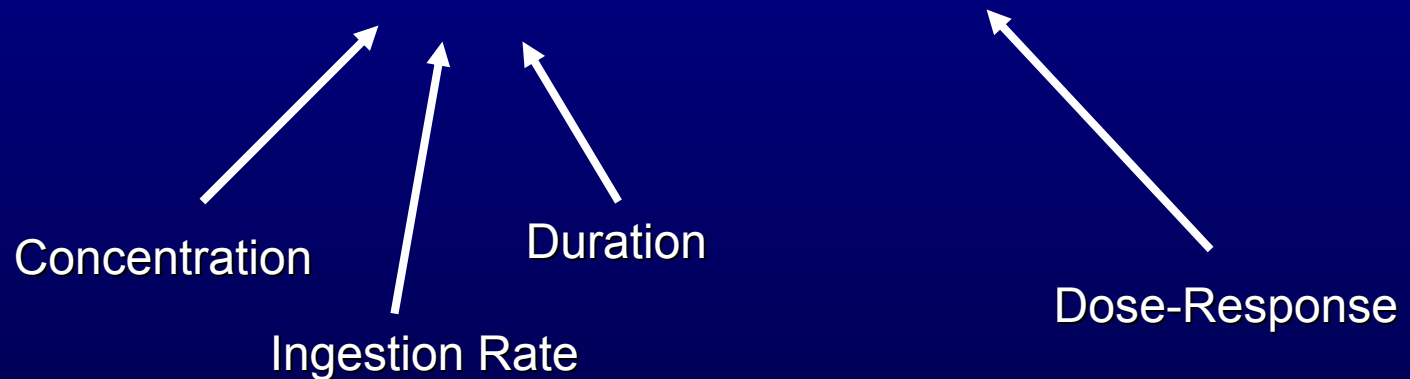
LEGEND

- MAJOR WRP INFLOW
- MINOR WRP INFLOW
- CHICAGO WATERWAY SYSTEM SECONDARY CONTACT
- OTHER WATERWAYS GENERAL USE
- ~~~~~ CHICAGO WATERWAY SYSTEM GENERAL USE
- ~~~~~ OTHER WATERWAYS SECONDARY CONTACT
- 9.9 MILES UPSTREAM OF LOCKPORT
- ← FLOW

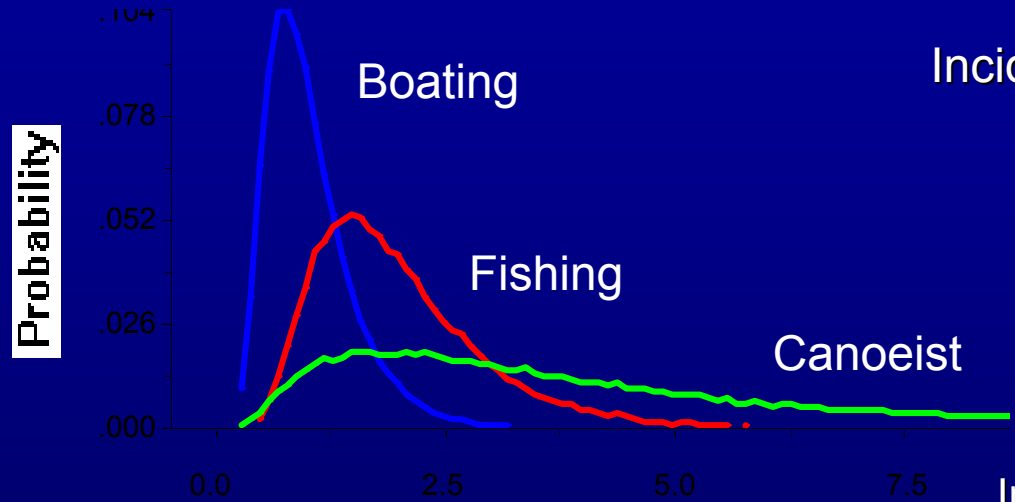


Risk Calculation

$$\text{Risk} = \text{Exposure} \times \text{Potency}$$



Ingestion Rate



Incidental ingestion of water developed using a lognormal distribution.

Samples were drawn from each input distribution.

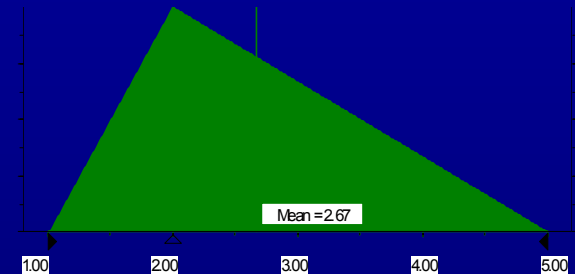
Ingestion Results from Simulations (mL/hr)

Percentiles	Boating	Fishing	Canoeing
10%	0.49	0.98	1.21
25%	0.65	1.30	2.02
50%	0.90	1.79	3.52
75%	1.23	2.47	6.15
90%	1.64	3.28	10.16
95%	1.95	3.89	13.84
97.5%	2.26	4.51	17.99
100%	6.43	20.13	30.00

Exposure Duration

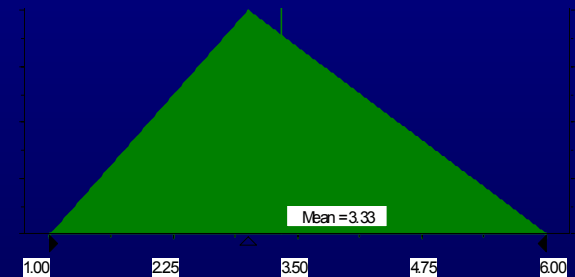
Canoeing - Triangular Distribution

- Minimum 1 hour
- Mode 2 hours
- Maximum 5 hours



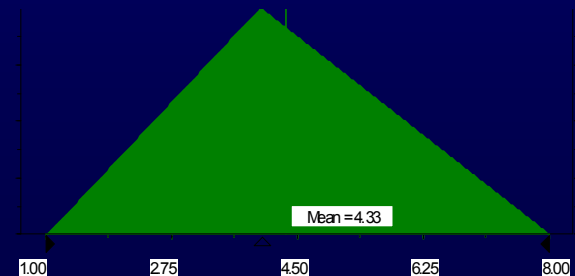
Fishing - Triangular Distribution

- Minimum 1 hour
- Mode 3 hours
- Maximum 6 hours



Pleasure Boating - Triangular Distribution

- Minimum 1 hour
- Mode 4 hours
- Maximum 8 hours



Exposure Data - UAA Survey

Proportion of Recreational Use

	Northside	Stickney	Calumet
Canoeing	20.2%	1.2%	0.5%
Fishing	72.2%	28.4%	47%
Pleasure Boating ¹	7.6%	70.4%	52.5%

¹Based on assumptions of 2.5 users per boat

Pathogen Risk Breakdown

	Illnesses per 1,000 Exposures		
Pathogen	Northside	Stickney	Calumet
<i>E coli</i> (pathogenic)	0.074	0.034	0.007
<i>Salmonella</i>	0.004	0.000	0.002
<i>Giardia</i>	0.000	0.000	0.000
<i>Cryptosporidium</i>	0.000	0.000	0.000
Enteric virus	0.002	0.000	0.000
Adenovirus	0.002	0.014	0.002
Total Primary Illnesses	0.082	0.045	0.009
Total Illnesses Including Secondary	0.287	0.150	0.028

Illness Rates for All Pathogens

Illness Rate Per One Thousand Exposure Events

Exposure Input	Waterway		
	Northside	Stickney	Calumet
Upstream Samples ^c	0.04	0.043	0.000
Downstream Samples ^c	0.55	0.220	0.046
Combined Upstream and Downstream Samples ^c	0.287	0.150	0.028
Average Outfall Samples	1.003	0.713	0.680

^a Includes all primary and secondary (family member) gastrointestinal illnesses expected from the waterway exposures.

^b Includes combined gastrointestinal illnesses from E. coli, salmonella, total enteric viruses, adenoviruses, giardia, and cryptosporidium.

^c Waterway concentration inputs for the simulations were randomly selected (bootstrap sampled) from datasets that includes the indicated sample sets.