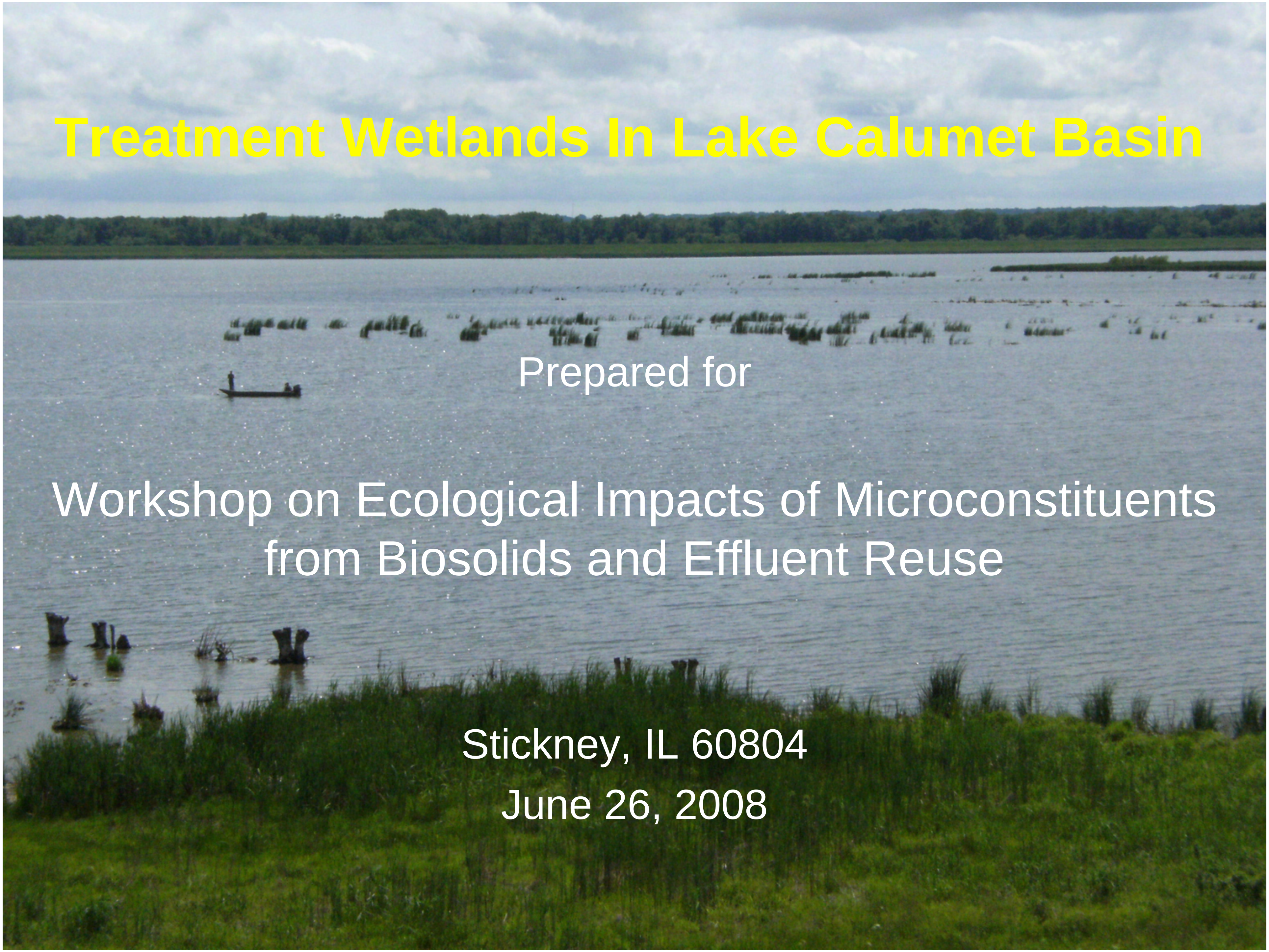

Treatment Wetlands In Lake Calumet Basin

Prepared for

Workshop on Ecological Impacts of Microconstituents from Biosolids and Effluent Reuse

Stickney, IL 60804

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Why Treatment Wetland

- Driving Force

  - Gulf of Mexico Hypoxia – Action plan called for significant nutrient load reduction in the Mississippi River Basin.

  - USEPA's Ambient Water Quality Criteria for Nutrients (USEPA 2000) – Requesting States to develop water quality standards for nutrients.

- Incentives

  - Cost and ecological benefits for removing nutrients by wetlands, compared to conventional processes (WERF 03-WSM-6CO)

- Big Picture Approach

  - Thinking globally & acting locally - Recent USEPA's National Water Program Strategy: Response to Climate Change, called for Increasing Watershed Sustainability and Resilience.

What is a Treatment Wetland

- Wikipedia definition: A **treatment wetland** is an engineered sequence of water bodies designed to filter and treat pollutants found in storm water runoff or effluent.[1] Naturally occurring **biological processes** can neutralize and capture most of the dissolved nutrients and toxins from the water, resulting in the discharge of clean water. [2]

[1] US EPA Constructed wetlands guidelines

[2] Wastewater Treatment Wetlands: Contaminant Removal Processes by William DeBusk, University of Florida, Institute of Food and Agricultural Sciences

Objectives of Calumet Treatment Wetland

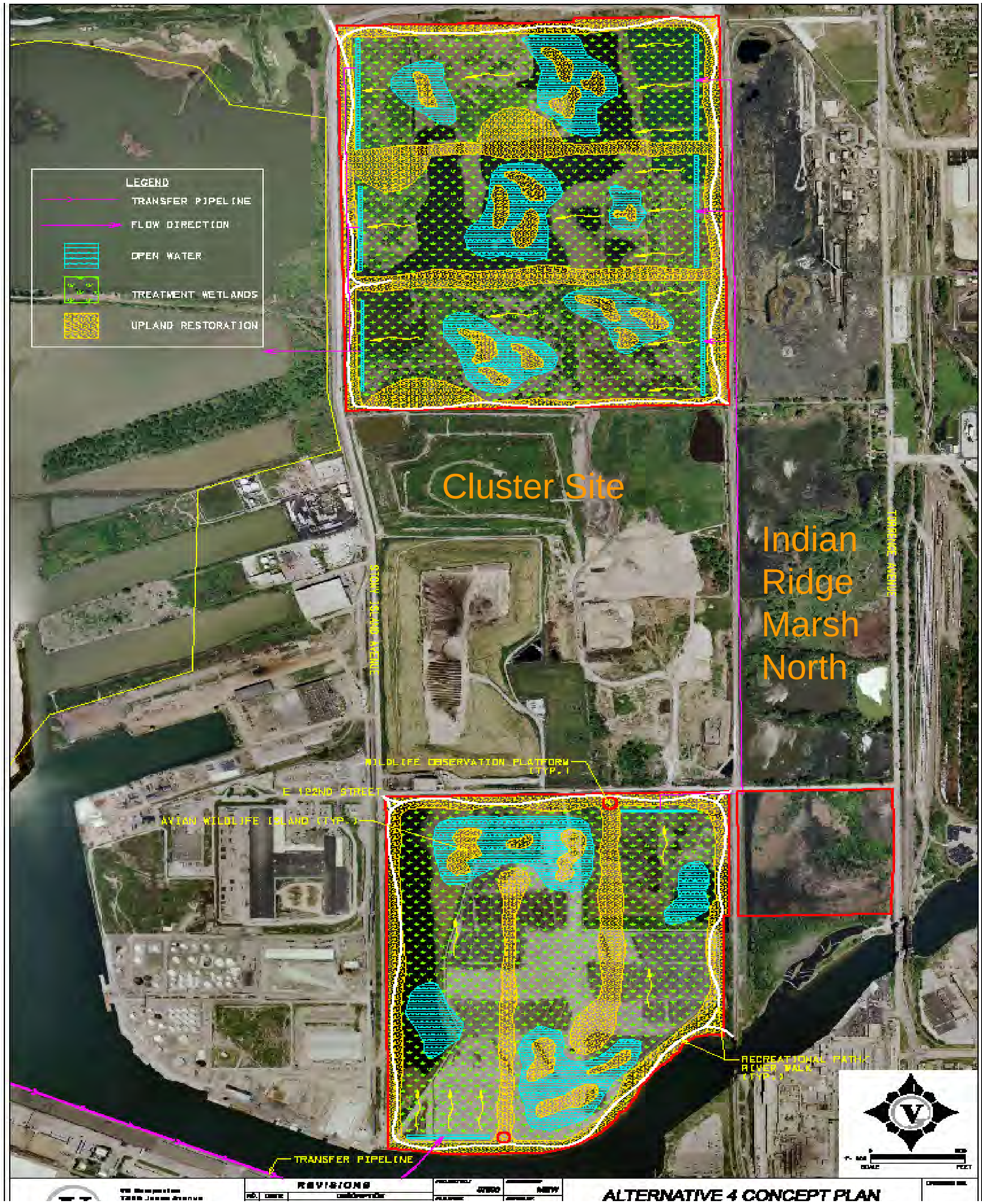
- Primarily remove nutrients (this could be a low cost option and definitely saves energy in operation)
- Offset Lake Michigan discretionary diversion (Lake diversion is used to improve water quality in the Calumet waterway system. The high quality water from the treatment wetland can be used for water quality improvement downstream)
- Restore the area to become more eco-friendly (possibly combine the treatment and ecological restoration features of wetlands)

Proposed Treatment Wetland Option at Calumet Area

- Including the following area:
  - Stony Island Biosolids Area
  - Deadstick Pond
  - Heron Pond
  - Big Marsh
- Total Area: 531 acres

  Wetted Area: 425 acres
- Pumping 25 to 50 MGD
- N removal: 173 – 227 t/yr

  P removal: 19 - 20 t/yr
- Least earthwork option



Water Quality of CWRP Effluent

- The treated water discharge from the CWRP may be characterized as nitrified, better-than-secondary effluent (Kadlec, 2004).
- Conventional pollutants are much lower than those permitted by the NPDES permit to discharge.
- Regulated metals and organics are lower than those permitted by Illinois Administrative Code Title 35, Part 302, Subpart B (General Use Water Quality Standards), Section 302.208, to discharge into general use water in Illinois.
- Most Priority Pollutants are below the detection limits.

Conventional Pollutants in the CWRP Effluent

Parameter		**2003**	**2004**	**2005**	**2006**	**2007**	**Permit**
Flow	MGD	246	252	224	283	273	354
pH		7.0	7.0	7.0	7.0	7.1	6 - 9
Temp	°C	15	15	15	15	15	n/a*
$CBOD_5$	mg/L	<3	<3	<3	<2	<2	10
TSS	mg/L	<5	<5	<4	<5	<5	15
TKN	mg/L	1.55	1.24	1.40	1.46	1.49	n/a
NH_3-N	mg/L	<0.17	<0.10	<0.15	<0.09	<0.15	2.5 / 4
NOx-N	mg/L	**7.61**	**8.05**	**8.73**	**8.92**	**8.28**	n/a
Total P	mg/L	**3.27**	**3.05**	**3.78**	**2.46**	**2.16**	n/a
Sol. P	mg/L	**3.16**	**2.88**	**3.66**	**2.32**	**2.03**	n/a
Cyanide	mg/L	<0.004	<0.004	<0.004	<0.003	<0.004	0.15

* n/a = no permit requirement.
Values in the table are annual average of daily values except for Permit.
MDL: 2 mg/L for CBOD and TSS, 0.04 mg/L for NH3-N and 0.003 mg/L for cyanide

Regulated Metals and Organics in the CWRP Effluent

Year	MDL[1]	2003	2004	2005	2006	2007	Standards[2]
TDS (mg/L)	20	726	751	740	707	758	1000
WAD Cyanide	0.4	0.9	< 1	< 1.1	< 0.9	< 1.1	5.2
Phenol	3.0	< 3	< 4	< 3	< 3	< 4	100
As	4.0	< 3	< 4	< 5	< 5	< 20	190
Ba	0.6	15.9	< 17.1	17.9	17.9	17.9	5000
Cd	0.2	< 0.3	< 0.2	< 0.4	< 0.2	< 0.6	2.2[3]
Cr (total)	2.0	< 1.7	< 2.0	< 2.0	< 2.0	< 2.0	11[3]
Cr+6	2.0	< 2	< 2	< 2	< 2	< 2	11[3]
Cu	1.0	< 6	< 5	<10	< 10	< 4	28[3]
Fe	10.0	110	131	116	150	110	1000
F	40.0	750	680	720	695	690	1400
Pb	3.0	< 2	< 3	< 3	< 3	< 4	49[3]
Mn	0.6	24.2	19.8	17.2	17.3	22.4	1000
Hg	0.1	< 0.1	< 0.07	< 0.05	< 0.05	< 0.05	1.1[3]
Ni	2.0	8	< 6	9	< 9	4	12[3]
Se	2.0	< 5	< 5	< 7	< 9	< 11	1000
Ag	0.6	< 0.4	< 0.6	< 0.7	< 0.6	< 0.3	5
Zn	7.0	52.7	48.9	50.0	46.0	49.0	53[3]
Benzene	2.0	< 2	< 2	< 2	< 2	< 2	860
Ethylbenzene	2.0	< 2	< 2	< 2	< 2	< 2	14
Toluene	2.0	< 2	< 2	< 2	< 2	< 3.1	600
Xylene(s)	2.0	< 2	< 2	< 2	< 2	< 2	360

Note: 1. MDL = Method Detection Limit, based on 2006 values. The unit for all values is **µg/L (ppb)** except for TDS.
2. Standards are the chronic standards for general use waters in Illinois.
3. The values were calculated based on hardness of 284 mg/L, which is the mean value for 2004 – 2007.

Summary of Priority Pollutants Detected in the CWRP Influent and Effluent from 2003 to 2007

	Compound	Reporting Limit, µg/L (ppb)	**Influent** (ppb)	**Effluent** (ppb)
1	Benzene	2	< 3.58	nd
2	Chloroform	2	< 2.73	nd
3	Ethyl benzene	2	< 2.0	nd
4	Methylene chloride	2	< 5.26	< 2.66
5	Tetrachloroethylene	2	< 4.6	< 2.10
6	Toluene	2	30.4	< 2.21
7	1,1,1-Trichloroethane	2	< 2.1	nd
8	Trichloroethylene	2	< 2.22	nd
9	Phenol	4	< 74.8	nd
10	Bis(2-ethylhexyl)phthalate	25	< 27.6	nd
11	Butylbenzyl phthalate	4	< 4.78	nd
12	Chrysene	2	< 2.0	nd
13	Diethyl phthalate	6	< 6.16	nd

Note: (1) Of 111 priority pollutants measured, only detected compounds are listed.

(2) The values for influent and effluent are the mean values of 8 measurements. If an individual measurement is below the reporting limit, the reporting limit is used in calculating the mean. If one of the measurements is below the reporting limit, the mean is listed as < mean value.

(3) nd = below the reporting limit.

Literature Information on Microconstituents in Treatment Wetland (Kadlec, 2008)

- In the biologically treated effluent, common estrogens are in the level of a few nanograms per liter (10^{-9} g/L) (Spenglar et al, 2001).
- Microconstituents can be reduced by 13% to 87% through sorption and biotransformation in treatment wetlands, based on case studies.
- Reduction mostly occurs near the inlet cells.
- Impact on ecological community may be alleviated through proper design, such as shallow water and dense vegetation in the first cell (discouraging fish growth).
- May be a good thing for receiving water downstream of a treatment wetland because portion of microconstituents is removed in the treatment wetlands.

Summary

- Treatment Wetlands may be an attractive option for removing nutrients and microconstituents, reducing the potential of global warming by saving energy, and providing benefits to ecological restoration.
- Treatment Wetlands in Lake Calumet Basin will be employed to primarily remove nutrients (N & P), not other conventional pollutants, nor metals, nor toxic organic compounds.
- Microconstituents exist in the treated effluent at nanograms per liter level. Fraction of these microconstituents may be retained by treatment wetlands via sorption and biotransformation. However, the impact on overall eco-system may be alleviated by proper design of the treatment wetlands.