Complying with National Pollutant Discharge Elimination System Permit (NPDES) Requirements

December 14, 2012

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Technical Services
Maintenance and Operations Department

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Aquatic Ecology and Water Quality Monitoring and Research Department
NPDES History

• Federal Clean Water Act (CWA), 1972
  – Established NPDES program that requires permits for discharge of treated municipal & industrial effluents and stormwater
  – Administered by the United States Environmental Protection Agency (USEPA); Delegated authority to states (Illinois Environmental Protection Agency)

• NPDES Permits Establish
  – Conditions that allow discharge
  – Monitoring / reporting requirements
MWRDGC Permit Overview

- Illinois Environmental Protection Agency (IEPA) Permit Types (31 Permits – Bureau of Water and Air)
  - National Pollutant Discharge Elimination System (NPDES) Permits (14 Permits)
    - Effluent Discharge (8 Permits)
    - Storm Water for Industrial Activities (5 WRP General Permits)
    - Pesticide Application Permit (1 General Permit for MWRD)
  - Water Pollution Control Permits (aka “Construction/Operating Permits”) (11 Permits)
- Permit Components and Process
NPDES Permits for All Seven WRPs and Lockport Powerhouse

<table>
<thead>
<tr>
<th>Facility</th>
<th>NPDES No.</th>
<th>Expiration Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stickney</td>
<td>IL0028053</td>
<td>2/28/2007</td>
</tr>
<tr>
<td>Calumet</td>
<td>IL0028061</td>
<td>2/28/2007</td>
</tr>
<tr>
<td>O’Brien</td>
<td>IL0028088</td>
<td>2/28/2007</td>
</tr>
<tr>
<td>Kirie</td>
<td>IL0047741</td>
<td>7/31/2009</td>
</tr>
<tr>
<td>Egan</td>
<td>IL0036340</td>
<td>8/31/2012</td>
</tr>
<tr>
<td>Hanover Park</td>
<td>IL0036137</td>
<td>3/31/2010</td>
</tr>
<tr>
<td>Lemont</td>
<td>IL0028070</td>
<td>1/31/2013</td>
</tr>
<tr>
<td>Lockport Powerhouse</td>
<td>IL0077305</td>
<td>2/28/2013</td>
</tr>
</tbody>
</table>
NPDES Monitoring and Reporting

- Limit Types
  - Loading (lbs/day)
  - Concentration (mg/L)
  - Limit Frequency (i.e., daily, weekly, monthly)

- Sample Frequency
  - Continuous
  - One to five days/week

- Sample Type
  - Grab
  - Composite
NPDES
Influent Monitoring and Reporting

- Permitted Parameters
  - Flow (MGD)
  - $BOD_5$ (mg/L)
  - Suspended Solids (mg/L)
NPDES
Effluent Monitoring and Reporting

• Permitted Parameters
  – Flow (MGD)
  – CBOD$_5$ (mg/L and lbs/day)
  – Suspended Solids (mg/L and lbs/day)
  – pH
  – Ammonia Nitrogen as N (mg/L and lbs/day)
    • All WRPs except Lemont
  – Copper (mg/L and lbs/day)
    • Hanover Park and Kirie WRPs
  – Cyanide – Weak Acid Dissociable and Total (mg/L and lbs/day)
    • Kirie WRP and Calumet WRP
  – Fats, Oil, and Grease (FOG) and Temperature (deg F)
    • Only Lockport Powerhouse; turbine oil/water separator
NPDES
Effluent Monitoring and Reporting (cont.)

- Permitted Parameters
  - Dissolved Oxygen (DO)
    - Current limit: daily minimum of 6.0 mg/l
      - Hanover Park
      - Egan
      - Kirie
      - Stickney
    - Daily minimum of 4.0 mg/L is in draft permit
      - O’Brien (5.0 mg/L – 16 hours)
      - Calumet
    - Chicago Area Waterways DO
      - Stickney, Calumet, O’Brien, Lemont WRPs
      - Use Attainability Analysis (UAA) dependent
NPDES
Effluent Monitoring and Reporting (cont.)

- Nickel (mg/L and lbs per day)
  - .013 mg/L Total Nickel proposed for Egan WRP
- Disinfection (Fecal Coliform and Chlorine Residual)
  - Hanover Park, Egan, and Kirie WRPs
  - UAA – Future O’Brien and Calumet WRPs
- Nutrients (Total Phosphorus and Total Nitrogen)
  - No current limits (1.0 mg/L TP is proposed in draft permits for O’Brien, Stickney, Calumet, and Kirie WRPs); Monitor TN Only
<table>
<thead>
<tr>
<th>Plant</th>
<th>Stickney</th>
<th>O’Brien</th>
<th>Calumet</th>
<th>Lemont</th>
<th>Hanover Park</th>
<th>Kirie</th>
<th>Egan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Permit No.</td>
<td>IL0028053</td>
<td>IL0028088</td>
<td>IL0028061</td>
<td>IL0028070</td>
<td>IL0036137</td>
<td>IL0047741</td>
<td>IL0036340</td>
</tr>
<tr>
<td>Modification Date</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>3/31/2008</td>
<td>None</td>
<td>8/20/2004</td>
<td>None</td>
</tr>
<tr>
<td>Correction Date</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>DAF (MGD)</td>
<td>1200 (732)</td>
<td>333 (240)</td>
<td>354 (274)</td>
<td>2.3 (2.5)</td>
<td>12 (9.0)</td>
<td>52 (39.8)</td>
<td>30 (27.2)</td>
</tr>
<tr>
<td>DMF (MGD)</td>
<td>1440</td>
<td>450</td>
<td>430</td>
<td>4.0</td>
<td>22</td>
<td>110</td>
<td>50</td>
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</table>

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Stickney</th>
<th>O’Brien</th>
<th>Calumet</th>
<th>Lemont</th>
<th>Hanover Park</th>
<th>Kirie</th>
<th>Egan</th>
</tr>
</thead>
<tbody>
<tr>
<td>DO</td>
<td>6.0</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>NH3-N</td>
<td>(2.5/4.0) 5.0/8.0s</td>
<td>(2.5/4.0) 5.0/8.0s</td>
<td>(2.5/4.0) 5.0/8.0s</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Fecal</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Res. Cl2</td>
<td>0.05*</td>
<td>0.05*</td>
<td>0.05*</td>
<td>0.05*</td>
<td>0.05*</td>
<td>0.05*</td>
<td>0.05*</td>
</tr>
<tr>
<td>Cu</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>CN</td>
<td>-</td>
<td>-</td>
<td>(0.15) 0.30</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>CN-WAD**</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

All values are maximum daily values (mg/l) except as follows:

1. DO has a minimum daily value.
2. pH has a minimum/maximum range.
3. Fecal coliform in counts/100ml - geometric mean.
4. pH in standard units.
5. [] = maximum weekly average.
6. () = maximum monthly average.
7. {} = average treated flow (2006-2010).
8. s = seasonal (April - Oct; Nov - Feb; March).
10. s* = seasonal (April - May/Sept - Oct; June - August; Nov - Feb; March).
11. s** = seasonal (March - May/Sept - Oct; June - August; Nov - Feb).

*Effective upon chlorination

**CN-WAD: Cyanide Weak Acid Dissociable
DAF - Design Average Flow
DMF - Design Maximum Flow
MGD - Million Gallons per Day
NPDES
Discharge Monitoring Reports (DMRs)

- Monthly submittals (due to the IEPA on the 20\textsuperscript{th} of each month)
  - All seven WRPs and Lockport Powerhouse
  - DO monitoring results (weekly grab samples)
  - Major pump station discharges (i.e., North Branch, Racine Avenue, 95\textsuperscript{th} Street), bypass streams (i.e., Egan’s 004), and emergency high level overflow (EHLO) points (i.e., Stickney’s 003)
<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>QUANTITY OR LOADING</th>
<th>QUALITY OR CONCENTRATION</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>AVERAGE</td>
<td>MAXIMUM</td>
</tr>
<tr>
<td></td>
<td>SAMPLE</td>
<td>MAXIMUM</td>
</tr>
<tr>
<td></td>
<td>MINIMUM</td>
<td>MAXIMUM</td>
</tr>
<tr>
<td></td>
<td>UNITS</td>
<td>UNITS</td>
</tr>
<tr>
<td></td>
<td>(26)</td>
<td>(11)</td>
</tr>
<tr>
<td>00300 1 00 EFFLUENT GROSS VALUE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PERMIT</td>
<td>Minimum</td>
<td>Maximum</td>
</tr>
<tr>
<td>Measurement</td>
<td>10.7</td>
<td>6.0</td>
</tr>
<tr>
<td></td>
<td>LBSDAY</td>
<td>MCGI</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>00400 1 00 EFFLUENT GROSS VALUE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PERMIT</td>
<td>Minimum</td>
<td>Maximum</td>
</tr>
<tr>
<td>Measurement</td>
<td>7.0</td>
<td>9.0</td>
</tr>
<tr>
<td></td>
<td>LBSDAY</td>
<td>SU</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SOLIDS, TOTAL SUSPENDED</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Measurement</td>
<td>439</td>
<td>58</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NITROGEN, AMMONIA TOTAL (AS N)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Measurement</td>
<td>&lt;11</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NITROGEN, AMMONIA TOTAL (AS N)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Measurement</td>
<td>391</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>COPPER, TOTAL (AS CO)</td>
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<td></td>
</tr>
<tr>
<td>Measurement</td>
<td>0.6</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PLOW IN CONDUIT OR TREATMENT PL</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Measurement</td>
<td>7.67</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NAME/TITLE PRINCIPAL EXECUTIVE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>OFFICER</td>
<td>MANJU PRAKASH SHARMA</td>
<td></td>
</tr>
<tr>
<td>TELEPHONE</td>
<td>312.751.5600</td>
<td></td>
</tr>
<tr>
<td>DATE</td>
<td>2011/02/18</td>
<td></td>
</tr>
</tbody>
</table>

**Note:** Read instructions before completing this form.
# NACWA Awards
(Compliance with NPDES Effluent Standards)

<table>
<thead>
<tr>
<th>YEAR</th>
<th>Hanover Park</th>
<th>Egan</th>
<th>Kirie</th>
<th>O’Brien</th>
<th>Stickney</th>
<th>Calumet</th>
<th>Lemont</th>
</tr>
</thead>
<tbody>
<tr>
<td>2006</td>
<td>Gold</td>
<td>Gold</td>
<td>Gold</td>
<td>Gold</td>
<td>Platinum (10)</td>
<td>Platinum (15)</td>
<td>Platinum (10)</td>
</tr>
<tr>
<td>2011</td>
<td>Gold (4)</td>
<td>Silver</td>
<td>Platinum (7)</td>
<td>Platinum (6)</td>
<td>Platinum (15)</td>
<td>Platinum (20)</td>
<td>Platinum (15)</td>
</tr>
</tbody>
</table>
NPDES
Special Conditions

- Pretreatment Program
- Financial and Fiscal Reports
- Biomonitoring - Whole Effluent Toxicity Testing
- Dry Weather Flow Quantification
- UAA (Operation of Aeration Stations)
- Sludge Management Reports
- Long Term Control Plans
- Authorization of Combined Sewer and Treatment Plant Discharges
  - Treatment Requirements for combined sewer overflows (CSOs) and plant bypasses (Primary and disinfection for 10X average dry weather flow; TARP equivalency)
  - Sensitive Area Considerations
  - Operation and Maintenance Plans
  - Sewer Use Ordinances (Control of Inflow and Infiltration; new Sewer Summit; Capacity Maintenance Operation and Management (CMOM) Requirements)
  - Nine Minimum Controls
  - Compliance with Water Quality Standards
## Combined Sewer Overflows

<table>
<thead>
<tr>
<th>Receiving Water Type</th>
<th>Number of Outfalls</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>City of Chicago</td>
<td>Suburbs</td>
</tr>
<tr>
<td>General Use</td>
<td>37</td>
<td>143</td>
</tr>
<tr>
<td>Secondary Contact</td>
<td>152</td>
<td>30</td>
</tr>
<tr>
<td>Total</td>
<td>189</td>
<td>173</td>
</tr>
<tr>
<td>Grand Total</td>
<td>397</td>
<td></td>
</tr>
</tbody>
</table>
NPDES
CSO Requirements

- Public notification program
- Quarterly reports (monitor and report on behalf of CSO communities)
  - Monitor 221 of 397 (56%) Active CSOs
- TARP equivalency to primary treatment for 10x average dry weather flow
CSO Community Reporting

- Arlington Heights
- Blue Island
- Broadview
- Brookfield
- Burnham
- Calumet City
- Calumet Park
- Chicago
- Des Plaines
- Dixmoor
- Dolton
- Evanston
- Forest Park
- Forest View
- Golf
- Harvey
- La Grange
- La Grange Park
- Lansing
- Lincolnwood
- Lyons
- Markham
- Melrose Park
- Morton Grove
- Mount Prospect
- Niles
- North Riverside
- Park Ridge
- Phoenix
- Posen
- River Forest
- River Grove
- Riverdale
- Riverside
- Schiller Park
- Skokie
- South Holland
- Stickney
- Summit
- Western Springs
- Wilmette
General NPDES Permit (ILR00)
Stormwater Discharges from Industrial Activities

• Stickney, Calumet, Kirie, Egan, and Hanover Park WRPs
  – O’Brien and Lemont WRPs are exempt – all on-site stormwater is routed to the head of the plant
• Regulates on-site overland flows of stormwater
• Annual Reports
• Development of Stormwater Pollution Prevention Plans (SWPPPs)
  – Quarterly inspections
  – Management of spills
  – Sampling
  – Overall good housekeeping
Water Pollution Control Permits
(State Construction/Operating Permits)

• Illinois Environmental Protection Act and Pollution Control Board Regulations
• Required for the Construction/Remodeling of:
  – New sewers, sewer connections, and sewage pumping stations
  – WRPs, pretreatment equipment, and Industrial WTPs
• Required for the Operation of:
  – Land application of biosolids
  – Non-discharge wastewater treatment systems
• USEPA 40 Code of Federal Regulation Part 503 promulgated in 1993
# MWRDGC Operating Permits

<table>
<thead>
<tr>
<th>Facility</th>
<th>Permit No.</th>
<th>Expiration Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Controlled Solids Distribution</td>
<td>2010-SC-0200(1,2)</td>
<td>4/30/2015</td>
</tr>
<tr>
<td>Hanover Park Fischer Farm</td>
<td>2012-SC-2255</td>
<td>12/31/2016</td>
</tr>
<tr>
<td>Land Application of Sewage Sludge</td>
<td>2009-SC-2056(1)</td>
<td>3/31/2014</td>
</tr>
<tr>
<td>Egan Solids Drying</td>
<td>2010-AO-0266</td>
<td>5/31/2015</td>
</tr>
<tr>
<td>Stickney WRP Solids Drying Areas</td>
<td>2010-AO-0267</td>
<td>5/31/2015</td>
</tr>
<tr>
<td>Cal WRP East &amp; West Drying Areas</td>
<td>2010-AO-0265</td>
<td>5/31/2015</td>
</tr>
<tr>
<td>Harlem Avenue Solids Drying Areas</td>
<td>2009-AO-2715(1)</td>
<td>8/31/2014</td>
</tr>
<tr>
<td>Fulton County Land Application</td>
<td>2009-SC-2921</td>
<td>12/31/2013</td>
</tr>
<tr>
<td>Stickney Septage Disposal</td>
<td>2010-HO-0464</td>
<td>6/30/2015</td>
</tr>
<tr>
<td>Gloria Alitto Majewski Reservoir</td>
<td>2010-AO-0991</td>
<td>11/30/2015</td>
</tr>
</tbody>
</table>
Operating Permit Requirements

- IEPA notifications (verbal and written)
  - User Information Forms
- Sampling of metals and other parameters in biosolids
  - Notice and Necessary Information
- Monthly and semi-annual reports
- Groundwater sampling
- Odor management
NOTICE AND NECESSARY INFORMATION (NANI)

This form is to assist compliance with the bulk sewage sludge (biosolids) notification requirements (503.12(f)). Please note, however, that if the biosolids meet the exceptional quality criteria, then the notification requirements do not apply. This form can be used by preparers of biosolids to transmit information to land applicators and also to land applicators to transmit information to land owners or lease holders.

Facility and Biosolids Type: EPA WRP, Certified Cake Sample
Monitoring Period: From 9/1/11 to 9/30/11

To be Completed by PREPARERS of Biosolids

A. Please provide pollutant concentrations

<table>
<thead>
<tr>
<th>Name</th>
<th>Concentration (mg/kg) Dry Weight</th>
<th>Pollutant Concentrations (Table 3, 40 CFR 503.13) (monthly average)</th>
<th>Ceiling Concentrations* (Table 1, 40 CFR 503.13) (daily maximum)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arsenic</td>
<td>10</td>
<td>41 mg/kg</td>
<td>75 mg/kg</td>
</tr>
<tr>
<td>Cadmium</td>
<td>4</td>
<td>39 mg/kg</td>
<td>85 mg/kg</td>
</tr>
<tr>
<td>Copper</td>
<td>646</td>
<td>1500 mg/kg</td>
<td>4300 mg/kg</td>
</tr>
<tr>
<td>Lead</td>
<td>45</td>
<td>300 mg/kg</td>
<td>840 mg/kg</td>
</tr>
<tr>
<td>Mercury</td>
<td>1.366</td>
<td>17 mg/kg</td>
<td>57 mg/kg</td>
</tr>
<tr>
<td>Molybdenum</td>
<td>0</td>
<td>N/A**</td>
<td>75 mg/kg</td>
</tr>
<tr>
<td>Nickel</td>
<td>41</td>
<td>420 mg/kg</td>
<td>420 mg/kg</td>
</tr>
<tr>
<td>Selenium</td>
<td>&lt;5</td>
<td>100 mg/kg</td>
<td>100 mg/kg</td>
</tr>
<tr>
<td>Zinc</td>
<td>725</td>
<td>2800 mg/kg</td>
<td>7500 mg/kg</td>
</tr>
</tbody>
</table>

*Nitrogen Concentration: 33,473 N/A

*Biosolids may not be land applied if any pollutant exceeds these values.
**EPA has temporarily removed molybdenum limits from Tables 2, 3 and 4 and has deleted chromium from all the Tables.

B. Pathogen Reduction (40 CFR 503.32) – Please indicate the level achieved and the alternative number or name:
   - Class A
   - Class B
   - Alternative: #2 (40 CFR 503.32.B.3)

C. Vector Attraction Reduction (40 CFR 503.33) – Please indicate the option performed
   - Option 1
   - Option 5
   - Option 2
   - Option 6
   - Option 3
   - Option 7
   - Option 4
   - Option 8

D. CERTIFICATION
   I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system or those persons directly responsible for gathering information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Name and Official Title (type or print) Sergio E. Serrano, Assistant Director of M&O
Area Code and Telephone Number 212.751.5102
Signature
Date Signed

Updated 8/12/20
Biosolids Utilization 2006-2011

<table>
<thead>
<tr>
<th>Year</th>
<th>MWRD Land</th>
<th>Pelletizer</th>
<th>Unsuitables</th>
<th>Reuse @ Landfill</th>
<th>Controlled Solids</th>
<th>Land Application</th>
<th>% Beneficial Util.</th>
</tr>
</thead>
<tbody>
<tr>
<td>2006</td>
<td>0</td>
<td>0</td>
<td>2,946</td>
<td>38,057</td>
<td>1,898</td>
<td>63,216</td>
<td>97.2%</td>
</tr>
<tr>
<td>2007</td>
<td>0</td>
<td>553</td>
<td>9,417</td>
<td>35,454</td>
<td>5,801</td>
<td>82,528</td>
<td>93.0%</td>
</tr>
<tr>
<td>2008</td>
<td>0</td>
<td>0</td>
<td>1,968</td>
<td>72,996</td>
<td>20,048</td>
<td>97,146</td>
<td>99.0%</td>
</tr>
<tr>
<td>2009</td>
<td>0</td>
<td>0</td>
<td>4,252</td>
<td>4,252</td>
<td>6,274</td>
<td>120,541</td>
<td>97.4%</td>
</tr>
<tr>
<td>2010</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>6,863</td>
<td>85,719</td>
<td>100.0%</td>
</tr>
<tr>
<td>2011</td>
<td>0</td>
<td>0</td>
<td>3,057</td>
<td>0</td>
<td>5,878</td>
<td>83,132</td>
<td>97.7%</td>
</tr>
</tbody>
</table>

% Beneficially Utilized

- Land Application
- Controlled Solids
- Reuse @ Landfill
- Unsuitables
- Pelletizer
- MWRD Land
Permit Process (5-Year Cycle)

• Application for renewal (3 to 6 months prior to expiration)
  – Seek input from Engineering, Law, M&R, and M&O Field Staff
• Draft permit issued
  – Public notice and/or public meeting
  – 30-day comment period
• Final Permit Issued
  – 30-day appeal period
• “Permit as a Shield” clause
  – Permit not issued prior to expiration
  – Operate under existing permit conditions
Factors that May Impact Permits

- USEPA rule-making
- Citizen groups (Lawsuits)
- Political trends
- UAA
- Anti-degradation
- Impaired waterway lists (303d)
  - *Total Maximum Daily Loads (TMDLs)*
- Consent Decrees
- Long Term Control Plans
- Compliance Schedules
- Permit Violations
- Variances
Permit Video
Whole Effluent Toxicity (WET) Testing

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Acknowledgment

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Auralene Gymph
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Section 124
Regulatory Background

• Clean Water Act
  – CWA section 101(a)(3)

• National Pollutant Discharge Elimination System (NPDES)
  – 3 Approaches
    • Chemical-Specific control
    • Biological criteria/Bioassessment
    • Whole Effluent Toxicity
What is WET Testing?

• Whole Effluent Toxicity (WET) Testing
  – “The aggregate toxic effect of an aqueous sample as measured by an organism’s response upon exposure to the sample (e.g., Lethality, impaired growth or reproduction)”
What is WET Testing?

• Expose aquatic organisms to a range of effluent concentrations
  – 100%, 50%, 25%, 12.5%, 6.25%, 0% (control)

• Exposure ranges from 24hrs – 7 days

• Biological endpoints:
  – Survival
  – Growth
  – Reproduction
Why do we do WET Testing?

• Clean Water Act

• NPDES Permits
  – WQ criteria for only a few of the thousands of chemicals.
  – Toxicity of chemicals combined in effluent.
  – “The District is the #1 environmental organization in Chicagoland”
What organisms do we use?

- **Fathead Minnows**
  - *(Pimephales promelas)*
    - 7-14 days old

- **Waterfleas**
  - *(Ceriodaphnia dubia)*
    - <24 hours old

- **Green Algae**
  - *(Selenastrum capricornutum)*
Types of WET Tests

- **Acute**  
  - Short-term
- **Chronic**  
  - Long-term
- **Static**  
  - Static Non-Renewal  
  - Static Renewal
- **Flow Through**
Acute

- **Endpoint**
  - Estimate the effluent concentration that is lethal to 50% of the test organisms. \((\text{LC}_{50})\)
  - Estimate the “safe” or “no effect” concentration (NOEC)

- **Duration**
  - 24-96hrs

- **Test Acceptability Criteria (TAC)**
  - 90% survival in control
Chronic

- **Objective**
  - Estimate the toxicant concentration that would cause a 25% reduction in reproduction or growth (IC$_{25}$)
  - Estimate the “safe” or “no effect” concentration (NOEC)

- **Duration**
  - 4 – 7 days

- **Test Acceptability Criteria (TAC)**
  - 80% survival in control
  - Average dry weight of fish $\geq 0.25$mg (fish)
  - 60% produced 3$^{rd}$ brood in 7 ± 1 days (waterfleas)
    - *number of young must be $\geq 15$*
  - Average cell density must $\geq 1 \times 10^6$ cells/mL (algae)
    - *Must not vary more than 20% among replicates*
Static Non-Renewal

- **Advantages**
  - Simple and inexpensive
  - Limited resources required
  - Smaller effluent sample required

- **Disadvantages**
  - Low dissolved oxygen may result
  - Possible loss of toxicants
  - Less sensitive
Static Renewal

- **Advantages**
  - Reduced possibility of dissolved oxygen depletion
  - Reduced possibility of loss of toxicants
  - Organisms fed (healthier)

- **Disadvantages**
  - Larger effluent sample volume required
  - Less sensitive than Flow-Through
Flow-Through

• **Advantages**
  – More representative evaluation
  – Dissolved oxygen is more easily maintained
  – Further reduced possibility of loss of toxicants

• **Disadvantages**
  – Greatest effluent sample volume required
  – More resources required
  – Difficult to perform multiple/overlapping tests
How do we do WET Testing?

• Coordinate collection of WRP final effluent
  – 5 grab samples 6hrs apart (24hr composite sample)
    • 0hr, 6hr, 12hr, 18hr, 24hr

• Dilute effluent
  – Using HSW or MHSW
    • 100%, 50%, 25%, 12.5%, 6.25%, 0% (straight HSW)

• Pour off 4 replicates of each concentration
How do we do WET Testing?

• Measure parameters
  – pH, dissolved oxygen, specific conductivity, Hardness, Alkalinity, Temperature, Total Ammonia, Residual Chlorine

• Randomize the cups

• Introduce organisms to samples
  – 5 organisms per replicate
• Introduce organisms to samples
  – 5 organisms per replicate
  – 4 replicates per concentration
  – 6 concentrations per test
  – 120 total organisms per test
How do we do WET Testing?

• Maintain/Renew/Count
  – Feed organisms 1hr before renewal
  – Replace 80% of the test solution

• Interpret data using statistical program
  – CETIS (Comprehensive Environmental Toxicity Information System)
Example CETIS Summary Report

CETIS Summary Report

Comparison Summary

- Analysis ID: 20-6902-6209
- Endpoint: 96th Survival Rate
- NOEL: 100
- LOEL: >100
- TOEL: N/A
- PMSD: 5.0%
- Method: Steel Many-One Rank Test

Point Estimate Summary

- Analysis ID: 6951-04251
- Endpoint: 96th Survival Rate
- LC50: >100
- Method: Linear Interpolation (ICP50)

Test Acceptability

- Analysis ID: 00-3223-04251
- Endpoint: Control Resp
- Test Stat: 0.9 - NL
- TAC Limits: Yes
- Decision: Result Within Limits

- Analysis ID: 20-6902-6209
- Endpoint: Control Resp
- Test Stat: 0.9 - NL
- TAC Limits: Yes
- Decision: Result Within Limits
What if Toxicity is found?

- **Toxicity Reduction Evaluation (TRE)**
  - “a site specific study conducted in a stepwise process designed to identify the causative agents of effluent toxicity, isolate the sources of toxicity, evaluate the effectiveness of toxicity control options, and then confirm the reduction in effluent toxicity”

- **Toxicity Identification Evaluation (TIE)**
  - 3 phase approach
    - *Characterization*
    - *Identification*
    - *Confirmation*
How do we QC WET tests?

- Reference Toxicant Testing
  - NaCl

- Control Charts
  - (2S) of LC_{50} cumulative mean

- Used to determine
  - Quality of the test organisms
  - Ongoing laboratory performance
When do we Test?

- Determined by NPDES Permits

- Currently no tests are being run
  - Permits are expired/expiring

- Previous tests were conducted:
  - 18, 15, 12, and 9 months prior to expiration of permit
Resources

• US Environmental Protection Agency

• “Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms”

• “Short Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms”

• “Technical Support Document for Water Quality Based Toxics Control”

• “Understanding and Accounting for Method Variability in Whole Effluent Toxicity Applications Under the NPDES Program”
  – (EPA 833-R-00-003), (6/1/2000)
Thank You...