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TRB
TRANSPORTATION RESEARCH BOARD

TRB WEBINAR PROGRAM

Winter Operations: Understanding Aircraft Deicers and Their Impact on Stormwater Runoff

March 14, 2017

2:00pm to 3:30pm ET

Purpose

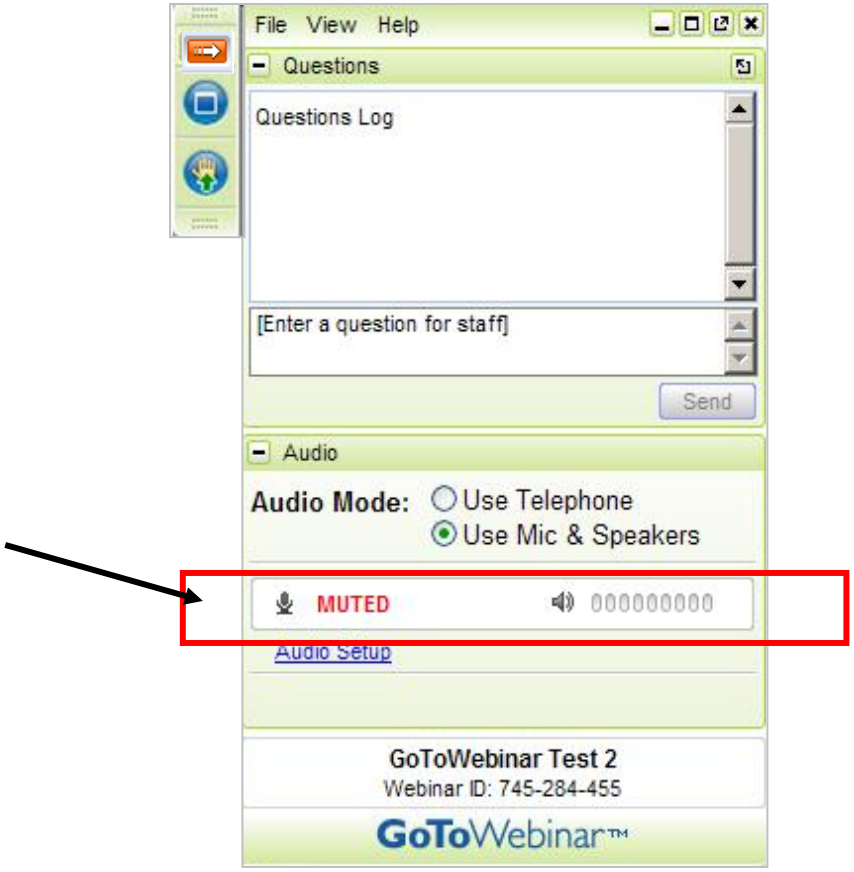
Discuss research conducted by TRB's Airport Cooperative Research Program (ACRP) that will assist airport operators and environmental managers in understanding the range of potential aircraft deicer treatment technologies and aquatic toxicity testing in order to measure the impact of deicers on stormwater.

Learning Objectives

At the end of this webinar, you will be able to:

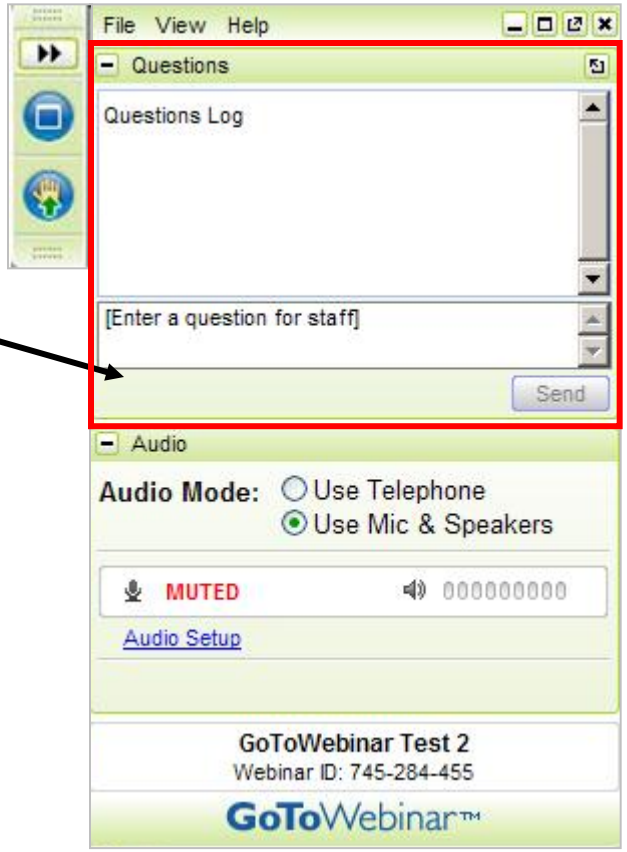
- List the range of potential deicer treatment technologies and their technology capabilities, applicability, and historical performance.
- Discuss the techniques for selecting deicer treatment technologies based on costs, performance, siting, operations, and maintenance.
- Discuss aquatic toxicity testing methods and procedures in order to understand the implications of their sampling methods and test exposure periods.
- Identify how to develop environmentally representative sampling and testing procedures.

All Attendees Are Muted



Questions and Answers

- Please type your questions into your webinar control panel
- We will read your questions out loud, and answer as many as time allows



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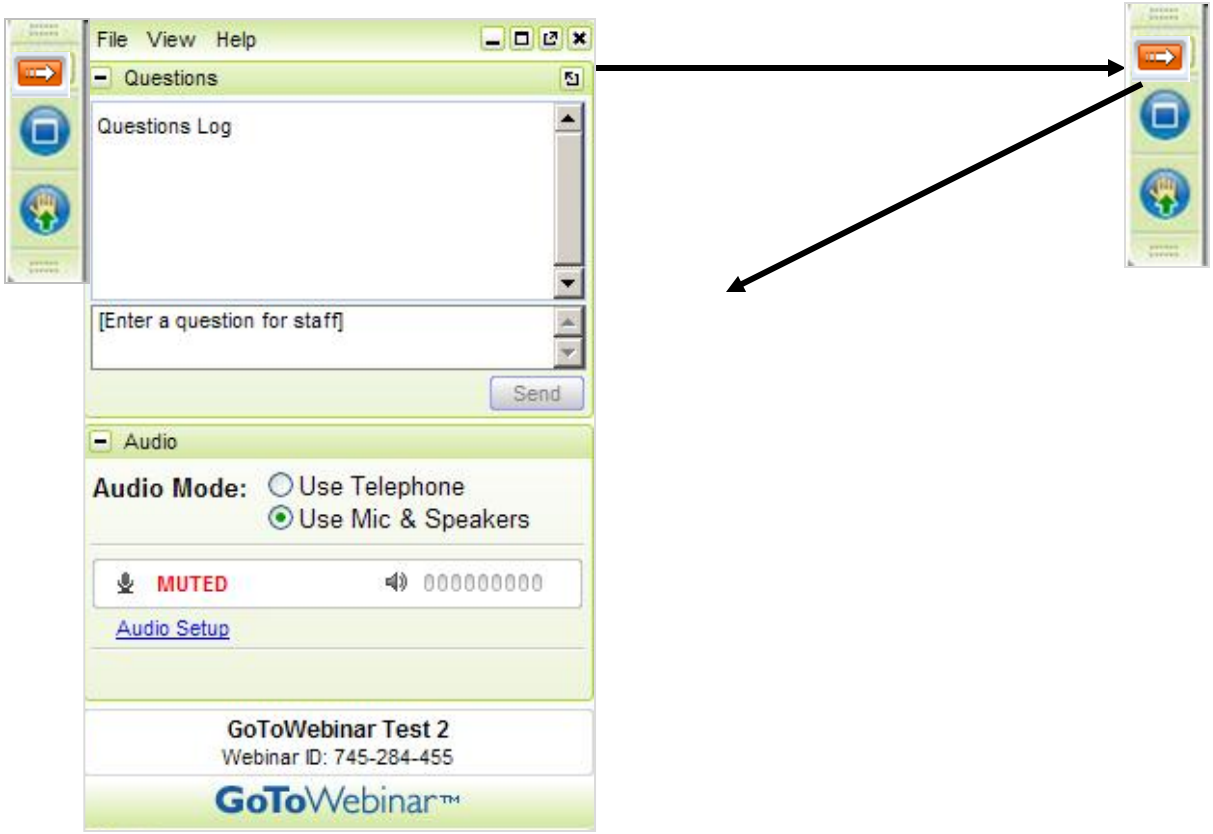

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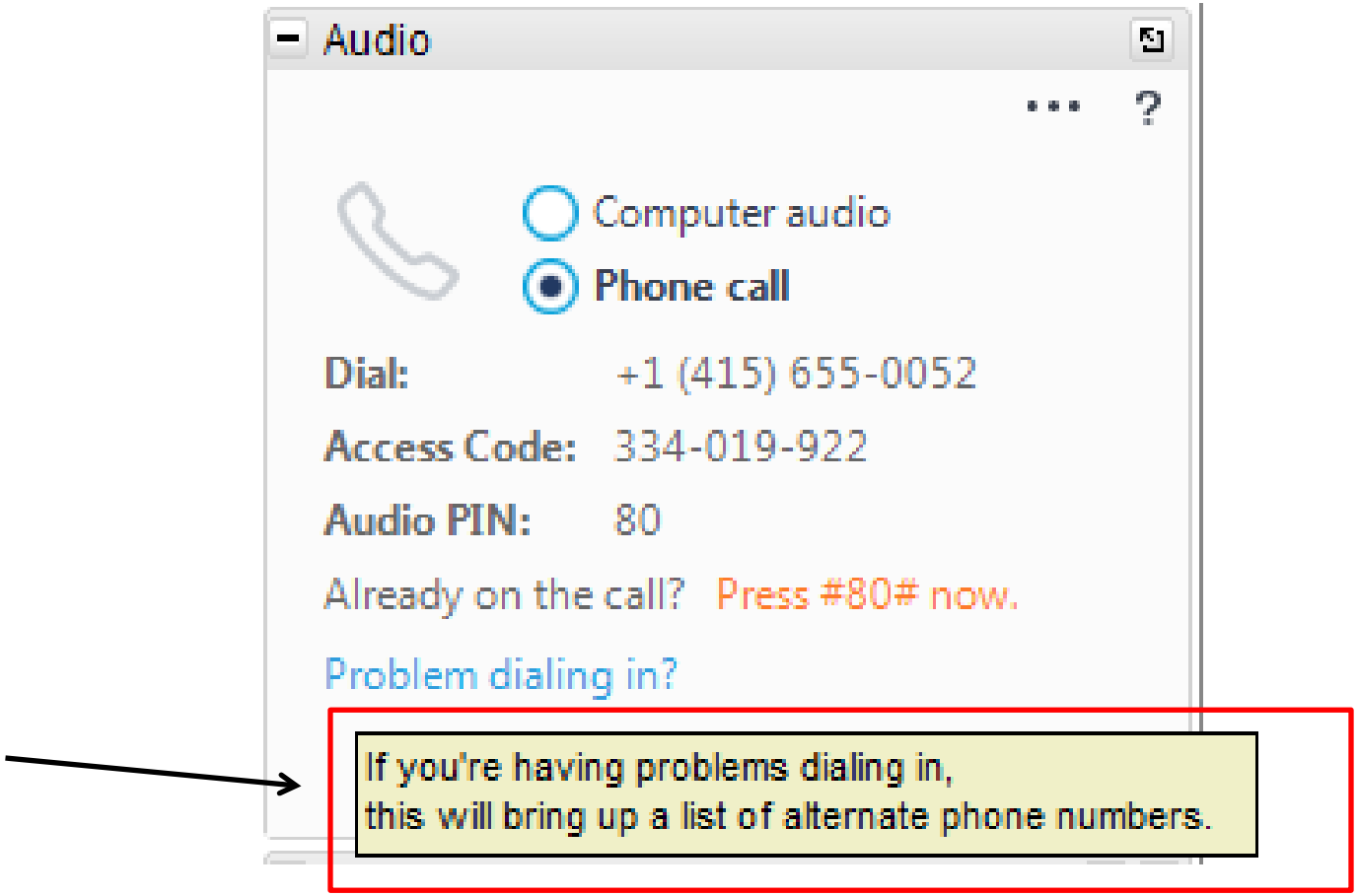

American Association of Airport Executives (AAAE)

1.5 Continuing Education Units (CEUs) are available to Accredited Airport Executives (A.A.E.)

Report your CEUs: www.aaae.org/ceu

American Institute for Certified Planners

The American Institute for Certified Planners has approved this webinar for 1.5 Certification Maintenance Credits.

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Panelists Presentations

http://onlinepubs.trb.org/onlinepubs/webinars/160314.pdf

After the webinar, you will receive a follow-up email containing a link to the recording

Today's Participants

- Asciatu Whiteside, *Dallas/Fort Worth Airport*, AWhiteside@dfwairport.com
- Tim Arendt, *Gresham, Smith, and Partners*, tim_arendt@gspnet.com
- Charles Pace, *Newfields,* cpace@newfields.com

Get Involved in ACRP

- Submit a research idea to ACRP.
- Volunteer to participate on a project panel.
- Prepare a proposal to conduct research.
- Get involved in TRB's Aviation Group of committees.
- Take part in the Champion or Ambassador Programs.

For more information:
http://www.trb.org/acrp/acrp.aspx

ACRP is an Industry-Driven Program

- Managed by TRB and sponsored by the Federal Aviation Administration (FAA).
- Seeks out the latest issues facing the airport industry.
- Conducts research to find solutions.
- Publishes and disseminates research results through free publications and webinars.

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Opportunities to Get Involved!

- ACRP's Champion program is designed to help early- to mid-career, young professionals grow and excel within the airport industry.
- Airport industry executives sponsor promising young professionals within their organizations to become ACRP Champions.
- Visit ACRP's website to learn more.

ACRP Champion

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Upcoming ACRP Webinars

Thursday, March 23rd

Advancing Collaborative Decision-Making (CDM)

Tuesday, April 25th

Reducing the Impact of Lead Emissions at Airports

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Additional ACRP Publications Available on this Topic

Report 72: Guidebook for Selecting Methods to Monitor Airport and Aircraft Deicing Materials

Report 81: Winter Design Storm Factor Determination for Airports

Report 115: Understanding Microbial Biofilms in Receiving Waters Impacted by Airport Deicing Activities

Report 123: A Guidebook for Airport Winter Operations

Synthesis 12: Preventing Vehicle–Aircraft Incidents During Winter Operations and Periods of Low Visibility

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Today's Speakers

Tim Arendt, P.E.
Gresham, Smith, and Partners

Presenting Report 99
Guidance for Treatment of Airport Stormwater Containing Deicers

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Charles Pace, M.S.
Newfields

Presenting Report 134
Applying Whole Effluent Toxicity Testing to Airport Deicing Runoff

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ACRP Report 99:
Guidance for Treatment of Airport Stormwater Containing Deicers

Tim Arendt, P.E.
Gresham, Smith and Partners

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Tim Arendt, P.E.
Principal Investigator

- Principal @ Gresham, Smith and Partners
- Environmental Engineer
- 23 Years of Consulting to Aviation Industry
- Deicing Compliance, Planning, Design, Operations

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ACRP Report 99
Oversight Panel / Research Team

Oversight Panel

- Bryan Wagoner, Wayne County Airport Authority (Chair)
- George Seaman, Port of Portland
- Jessica C. Dickman, City of Albuquerque Aviation Dept
- Mathew O. Knutson, Liesch Associates,
- Robert A. Kostinec, Minnesota Pollution Control Agency
- Andrew F. Matuson, JetBlue Airways
- Catherine Pociask, FAA Liaison
- Tim A. Pohle, Airlines for America Liaison
- Christine Gerencher, TRB Liaison
- Joe Navarrete, ACRP Senior Program Officer

Research Team

- Gresham, Smith and Partners
- Arcadis
- Inland Technologies
- McGuiness Unlimited
- Naturally Wallace
- Newfields

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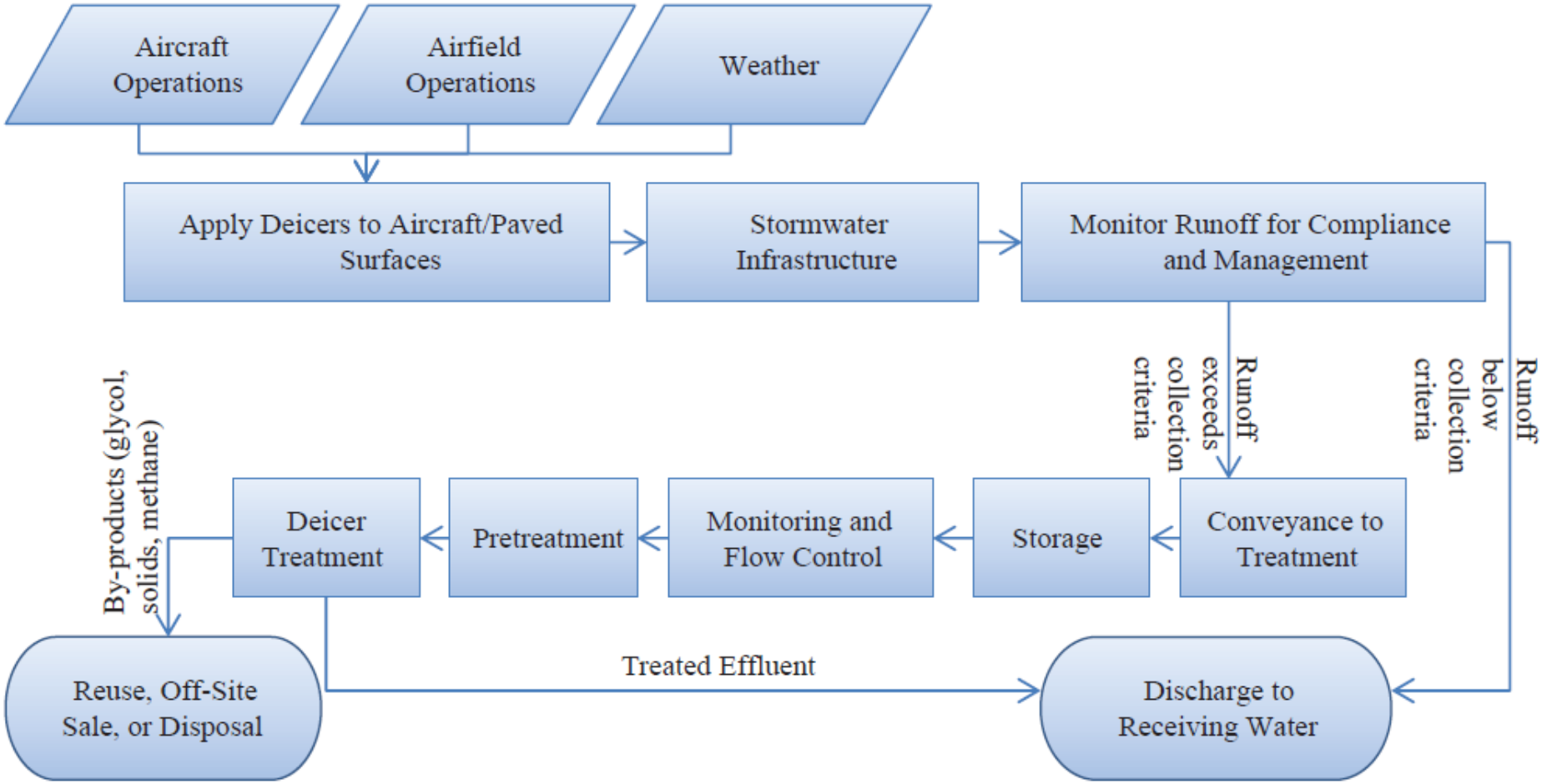
Role of Deicer Treatment



Defining Deicer Treatment

Deicer Treatment Technology

- Process to remove primary deicer constituents from stormwater
- Physical and biochemical processes

Deicer Treatment System

- Integrated set of unit processes
- Specific to each site

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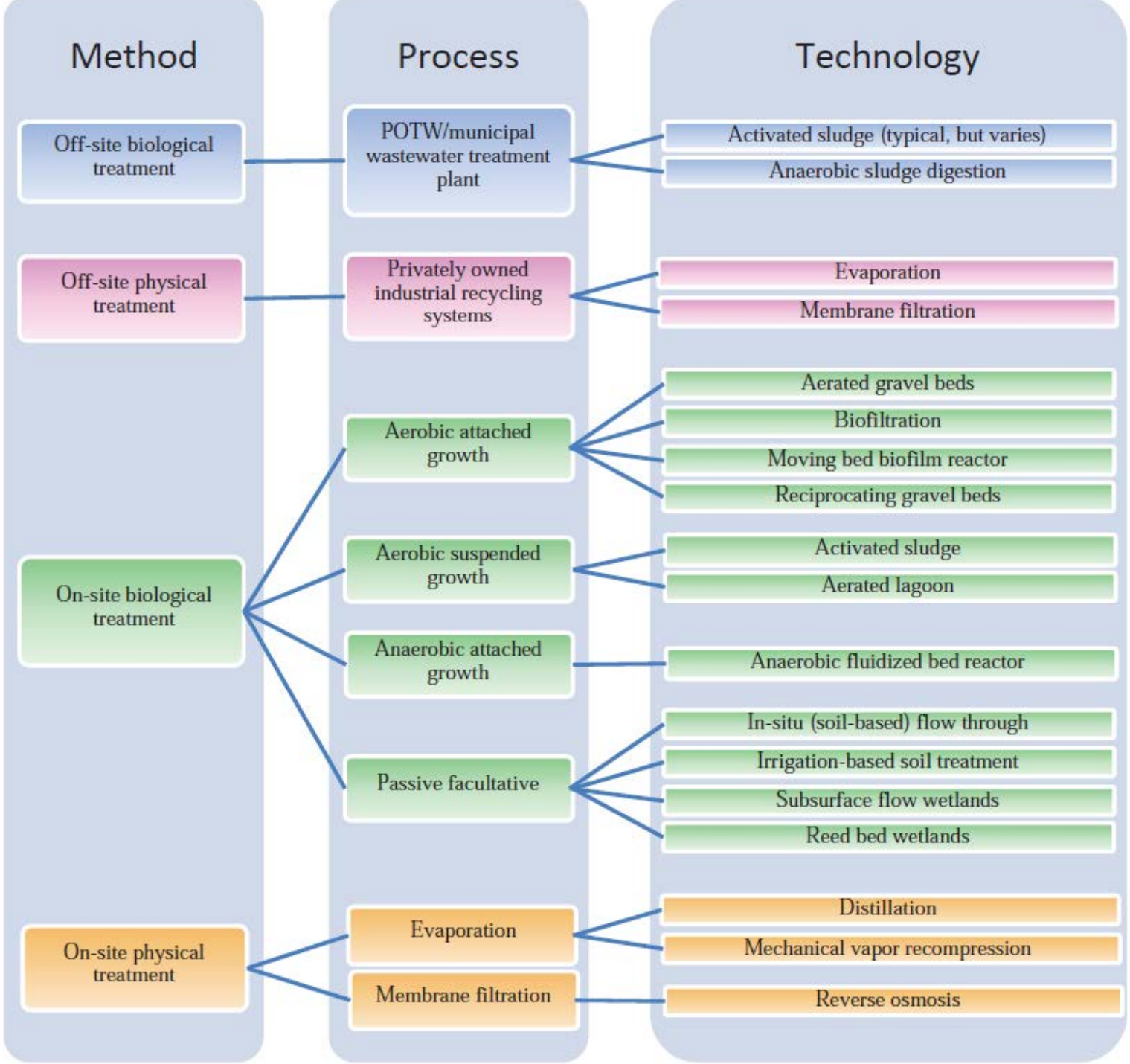

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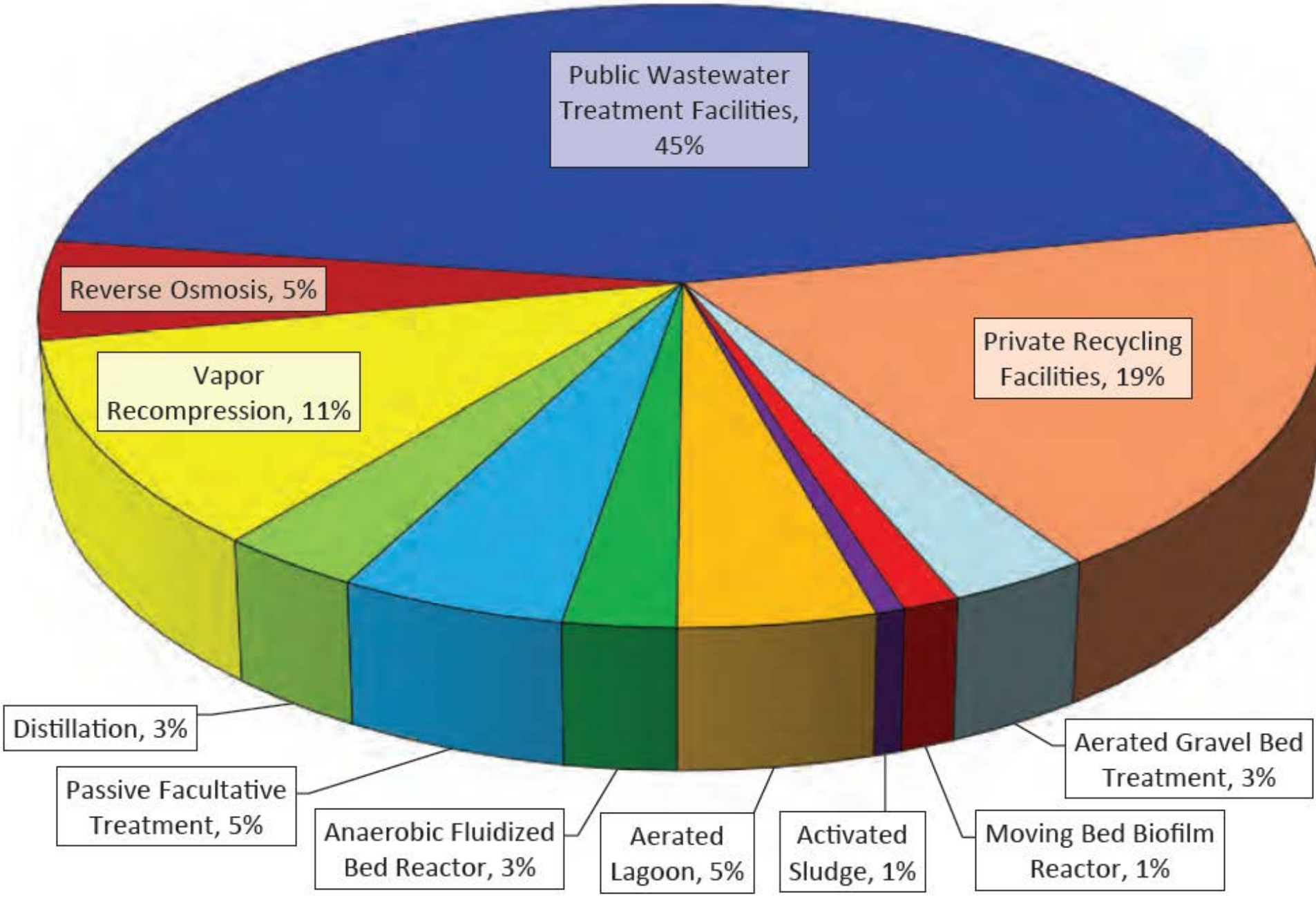
Public Wastewater Treatment Facilities, 45%
Reverse Osmosis, 5%
Vapor Recompression, 11%
Private Recycling Facilities, 19%
Distillation, 3%
Passive Facultative Treatment, 5%
Anaerobic Fluidized Bed Reactor, 3%
Aerated Lagoon, 5%
Activated Sludge, 1%
Moving Bed Biofilm Reactor, 1%
Aerated Gravel Bed Treatment, 3%

Research Approach

1. Provide procedures for selecting and implementing treatment technologies

2. Provide information on capabilities and limitations of technologies

Sources:

- Performance and design data
- Insights of individuals working in deicer treatment
- Lab studies

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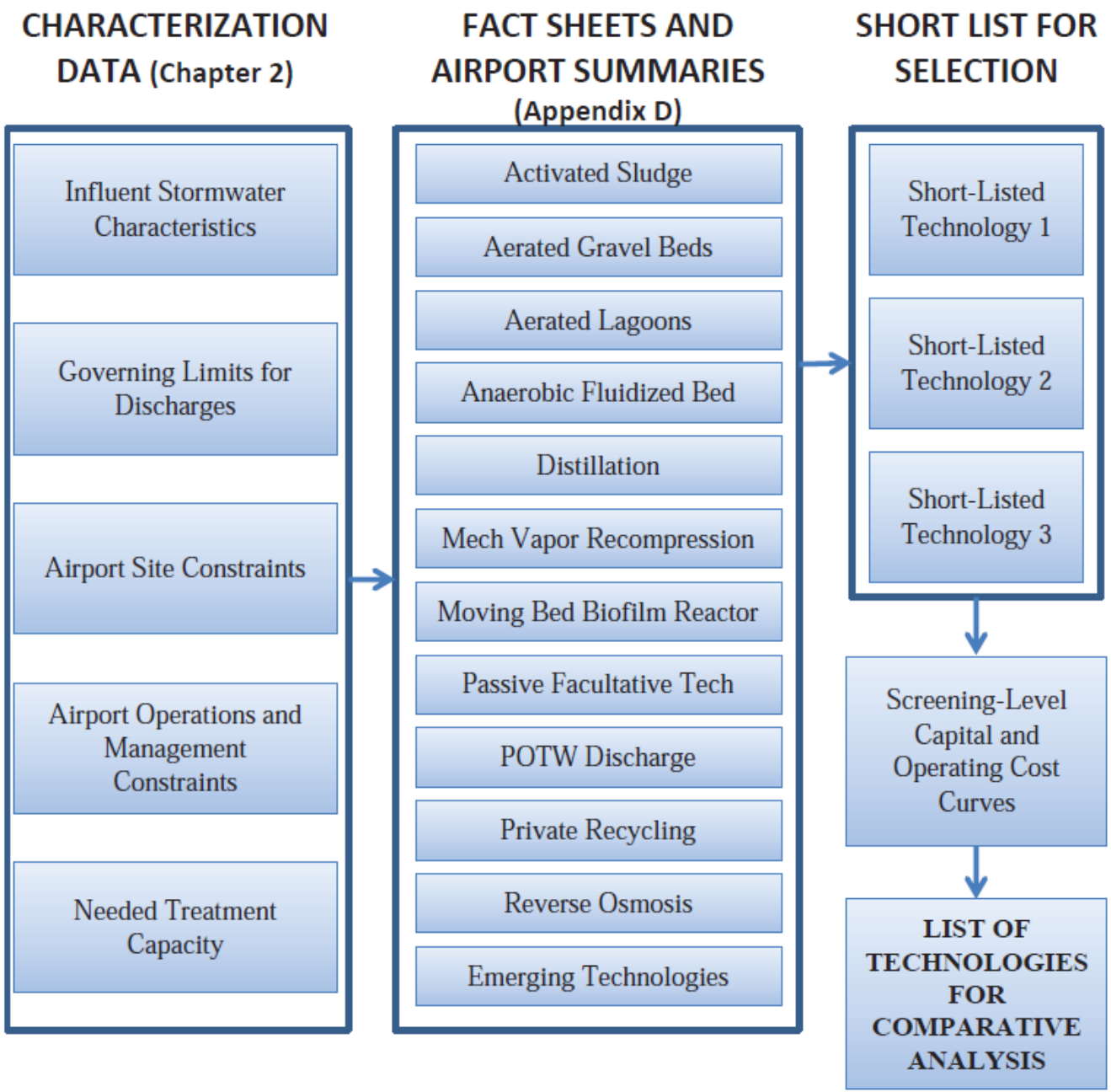
Method for Selecting Deicer Treatment Technologies



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Approach to Technology Screening

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Typical Screening Criteria

Stormwater Characteristics	Site and Operational Conditions		
Minimum PG	Land Available for On-Site Treatment*	Open Water*	Reliance on Off-Site Recycling and Market for Recycled Glycol!
Minimum EG	Maximum Available Footprint	Treatment Plant Operations*	Maximum Capital Funding
Minimum BOD_5	Maximum Allowable Height	Reliance on POTW to Accept Discharge!	Maximum Annual O&M Funding

Guidebook Contents – Treatment Technology Fact Sheets

PHYSICAL

Reverse Osmosis

Mechanical Vapor Recompression

Distillation

BIOLOGICAL

Activated Sludge

Aerated Lagoon

Aerated Gravel Bed

Anaerobic Fluidized Bed Reactor

Moving Bed Biofilm Reactor

Passive Facultative Treatment

OFFSITE

Sanitary Sewer Discharge

Private Offsite Recycling

Guidebook Contents – Treatment Technology Fact Sheets

Fact Sheet Section	Content Description
Process Description	How technology works
Process Variants	Similar technologies
Current Applications	Airports successfully using technology
Potential Applications	Situations best suited to technology
Performance Capabilities	Capabilities and limitations
Advantages & Disadvantages	Performance, maintenance, space, etc.
Required Support Systems	Pre-treatment, nutrients, power, etc
Useful Screening Criteria	Parameters used for comparison
Costs	Needed capacity vs. cost

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Guidebook Contents – Airport Treatment Summaries

Akron Canton Airport (Anaerobic Fluidized Bed Reactor)
Bradley International Airport (Reverse Osmosis)
Buffalo Niagara International Airport (Aerated Gravel Bed)
Cincinnati/Northern Kentucky Airport (Activated Sludge)
Denver International Airport (Mechanical Vapor Recompression, Distillation, POTW)
Detroit Metropolitan International Airport (Private Offsite Recycling, POTW)
Edmonton International Airport (Passive Facultative Treatment, Aerated Gravel Beds)
Halifax International Airport (Mechanical Vapor Recompression)
London Heathrow (Passive Facultative Treatment, Aerated Gravel Beds)
Oslo Gardermoen (Moving Bed Biofilm Reactor)
Portland International Airport (Anaerobic Fluidized Bed Reactor, POTW)
Westover Air Force Reserve Base (Passive Facultative Treatment)
Wilmington Airpark (Aerated Gravel Beds)
Zurich International Airport (Passive Facultative Biological Treatment)

Guidebook Contents – Airport Treatment Summaries

Treatment Technology Category

Years Operated

Deicer Management System Description

Technology Selection Considerations

Deicer Treatment Technology Description

Treatment System Performance

Cost Assessment

Conclusions on Performance

Lessons Learned

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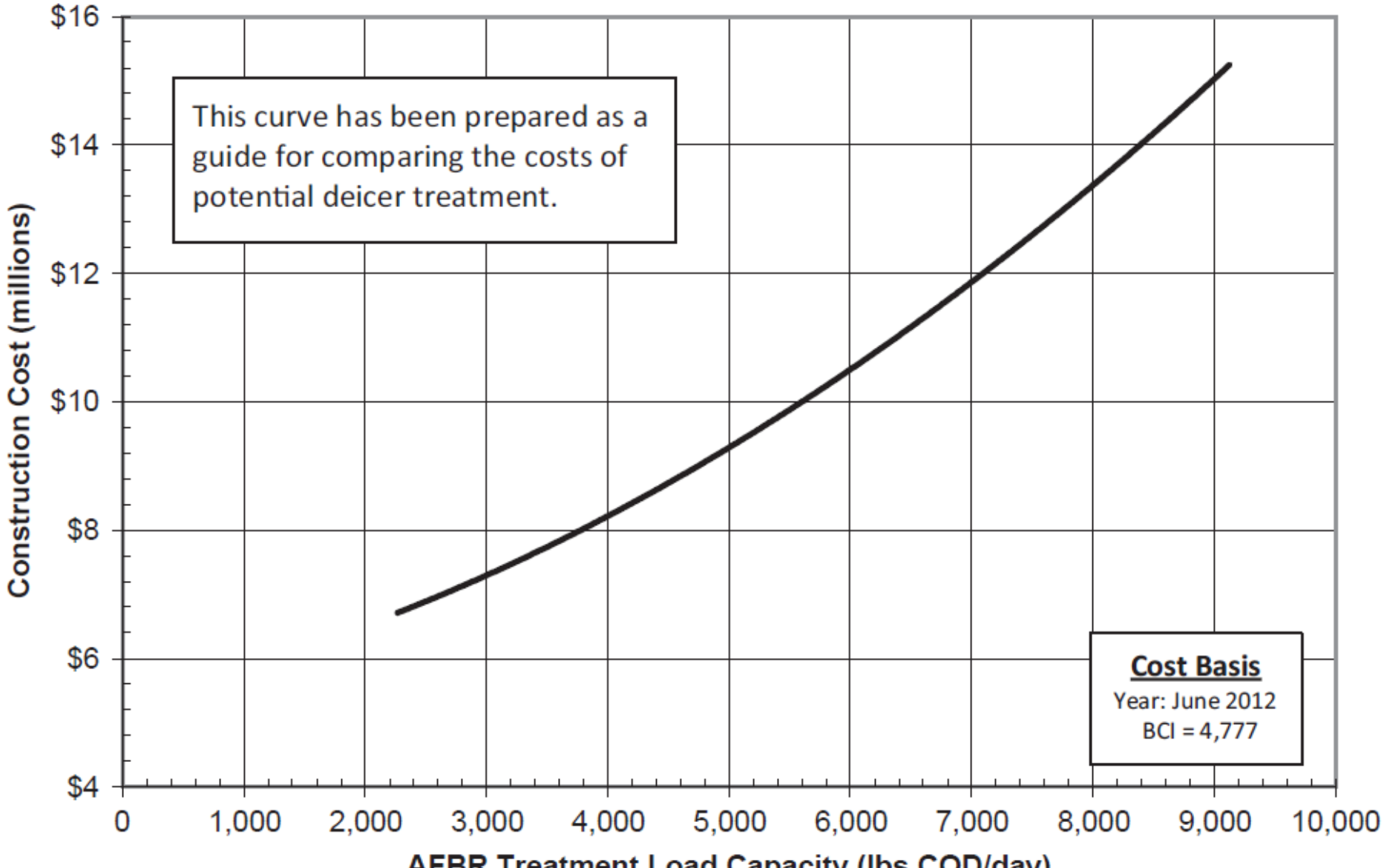
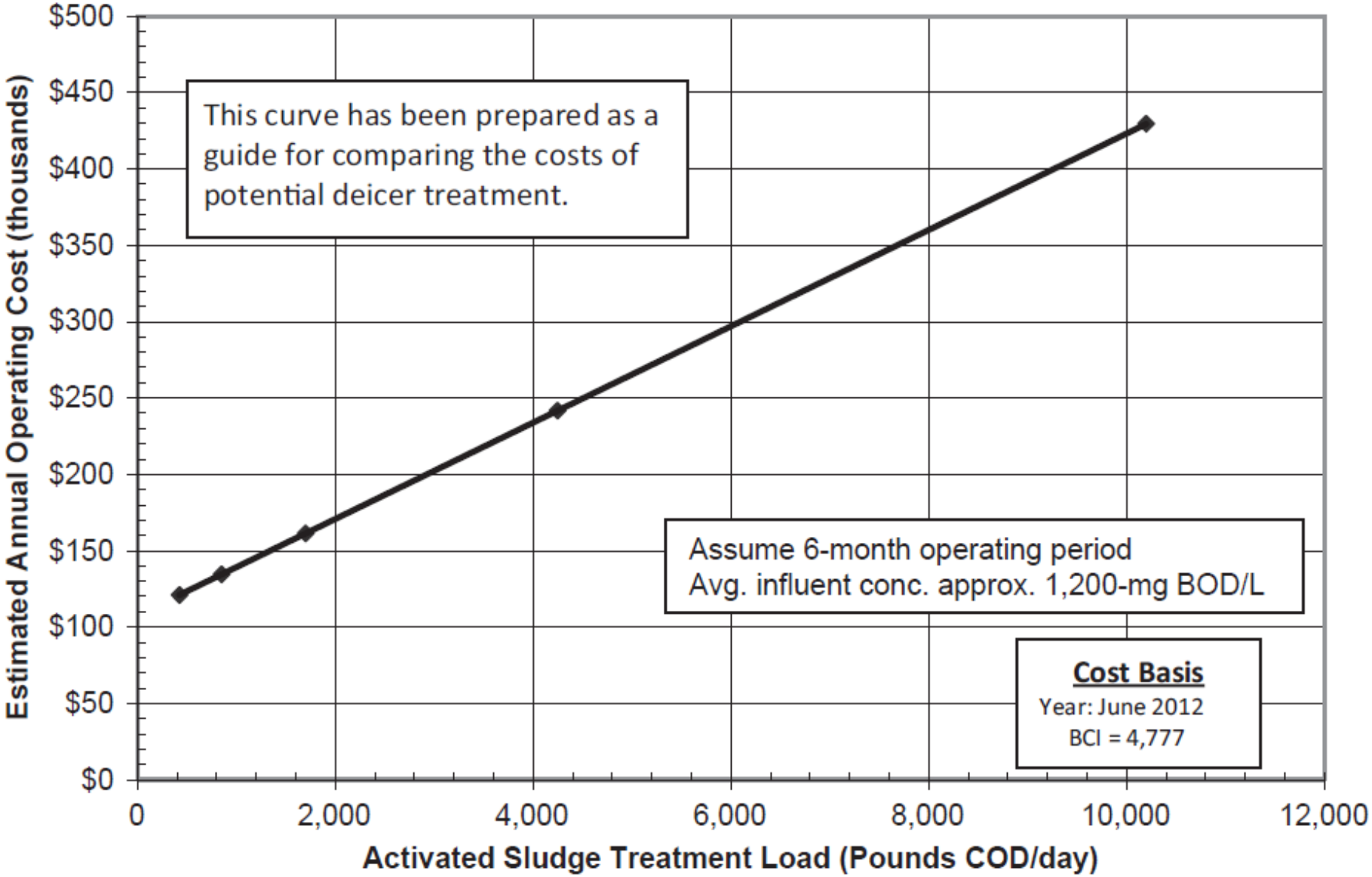
Guidebook Contents – Capital Cost Guidelines



Guidebook Contents – O&M Cost Guidelines



Guidebook Contents – Tools to Aid Screening Technologies

	Biological Treatment	Physical Treatment
Less pretreatment required	√	
Can produce saleable end product		√
Wider range of pollutants treated	√	
Better response start-up and shutdown sequences		√
Shorter start-up period		√
Less energy use	√	
Fewer odors		√
Less sludge production		√
Potential for off-gas to be used as fuel source	√	
Ability to treat at lower temperatures without heat addition		√
Ability to cost-effectively treat BOD <1% concentration	√	
Ability to cost-effectively treat BOD >1% concentration		√
Ability to cost-effectively treat deicer use <300,000 gal/year	√	
Ability to cost-effectively treat deicer use >300,000 gal/year		√
Ability to cost-effectively achieve low effluent concentrations	√	
Production of secondary waste stream requiring treatment	√	√

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Guidebook Contents – Tips on Operation and Management

Owner/Operator Management Tips for Successful Treatment Systems

Understand the System's Capacities and Operational Limitations

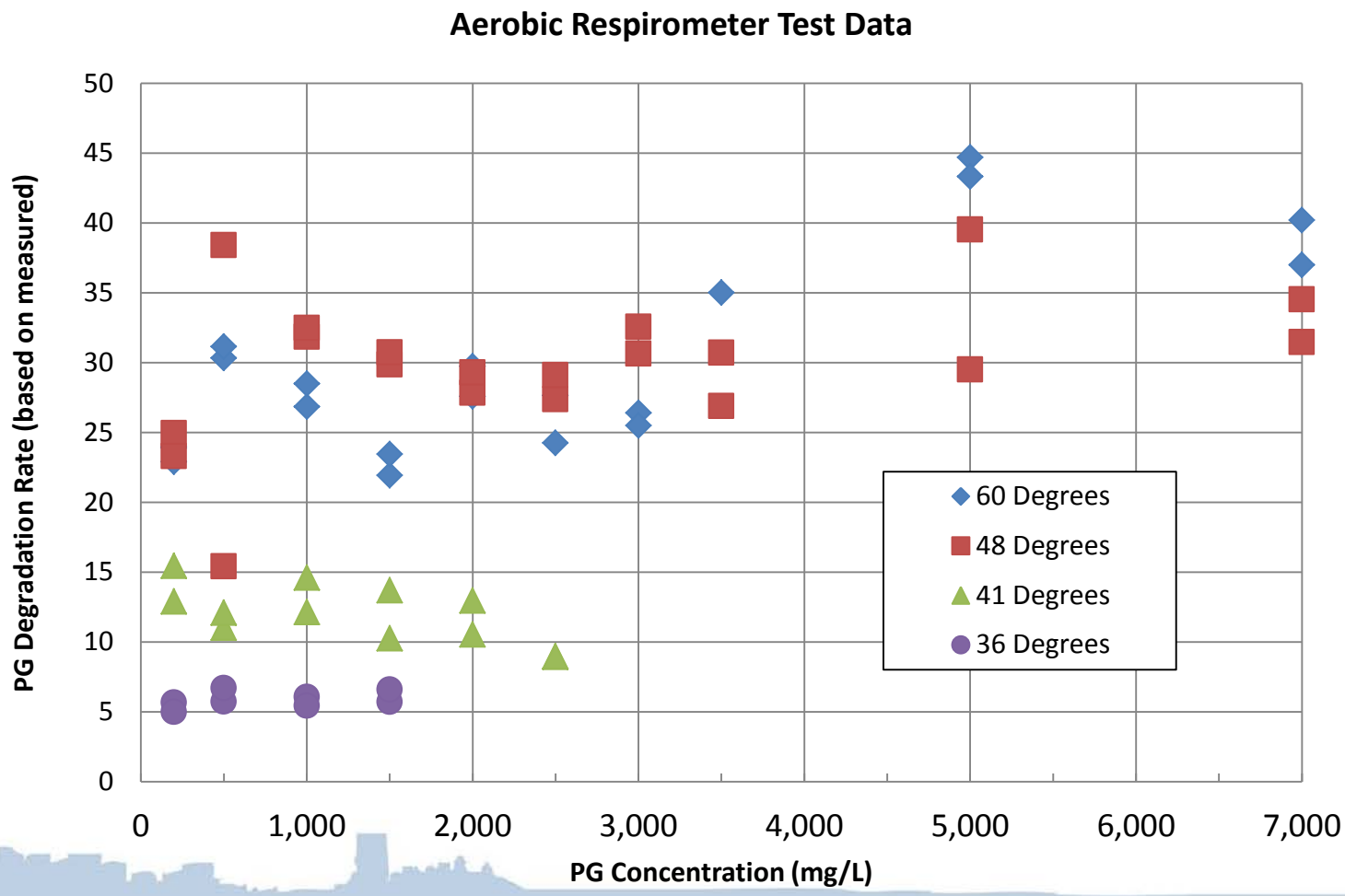
Understand How Economics Change Within Influent / Effluent Ranges

Understand Relationship Between Cost and Compliance Risk

Understand Aspects that Require Most Operator and Maintenance Attention

Regularly Monitor and Assess System Operational Parameters

Guidebook Contents – Data to Support Decision-making



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ACRP Report 99
Key Takeaways on Deicer Treatment

- For most airports, more than one treatment technology can work

- Directly using cost and performance of deicer treatment at other airports to guide selection is risky (context matters!)

- Sizing, design, control, and operation are as important as the type of technology

- Successful operation requires working within system capabilities

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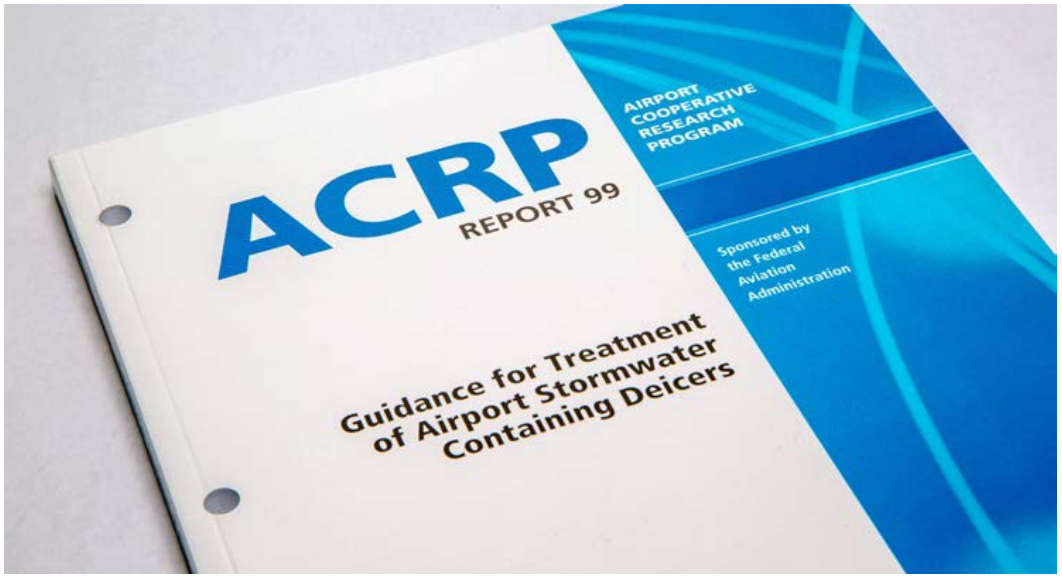
For Additional Information

ACRP Report 99*: Guidance for Treatment of Airport Stormwater Containing Deicers*



http://www.trb.org/Publications/Blurbs/170197.aspx

Tim Arendt - Gresham, Smith and Partners
tim_arendt@gspnet.com

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ACRP Report 134: Applying Whole Effluent Toxicity Testing to Aircraft Deicing Runoff

Charles Pace, PE
NewFields

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Charles (Chuck) Pace, PE
Principal Investigator

Senior Engineer and Partner, NewFields Environmental & Engineering LLC

In association with:

- –The Smart Associates
- –Maryland Environmental Service

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ACRP Report 134 Oversight Panel

Bryan C. Wagoner, Wayne County Airport Authority
Valerie J. Harwood, University of South Florida
Keith L. Johnson, Cryotech Deicing Technology
Michael B. Tate, Kansas Dept of Health and Environment
Abby E. Weinstein, United Airlines
Asciatu J. Whiteside, Dallas/Fort Worth International Airport
Charles S. Wisdom, Geosyntec Consultants
Al Fenedick, FAA Liaison
Tim A. Pohle, Airlines for America Liaison
Katherine B. Preston, Airport Council International – NA Liaison
William Swietlik, US EPA Liaison
Christine Gerencher, TRB Liaison
Joe Navarrete, ACRP Senior Program Officer

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ACRP Report 134: Applying Whole Effluent Toxicity Testing to Aircraft Deicing Runoff

- Describes how Whole Effluent Toxicity (WET) test have been applied to airport stormwater discharges
- Technically evaluates stormwater sampling technologies with respect to collection of representative samples
- Develops improved sampling methods in support of WET testing programs at airports and
- Provides guidance on the use and implementation of WET testing at airports for stormwater deicing discharges.
- Published June 2015

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Background

- Whole Effluent Toxicity testing has been utilized as one tool to regulate industrial and municipal discharges since 1985
- Regulatory approach is described in the Technical Support Document for Water Quality-Based Toxics Control (1985 and 1991)
- Test protocols are listed under 40 CFR 136 and are detailed in numerous EPA documents
- WET testing initially applied to continuous flow municipal and industrial discharges
- Over last 10-15 years, WET has been increasingly required by state regulators in airport discharge outfalls receiving stormwater

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Outline

- Overview of aquatic toxicity testing
- Identify testing inconsistencies and assess the impact of inconsistencies
- Identify operational considerations
- Identify environmentally representative testing approaches

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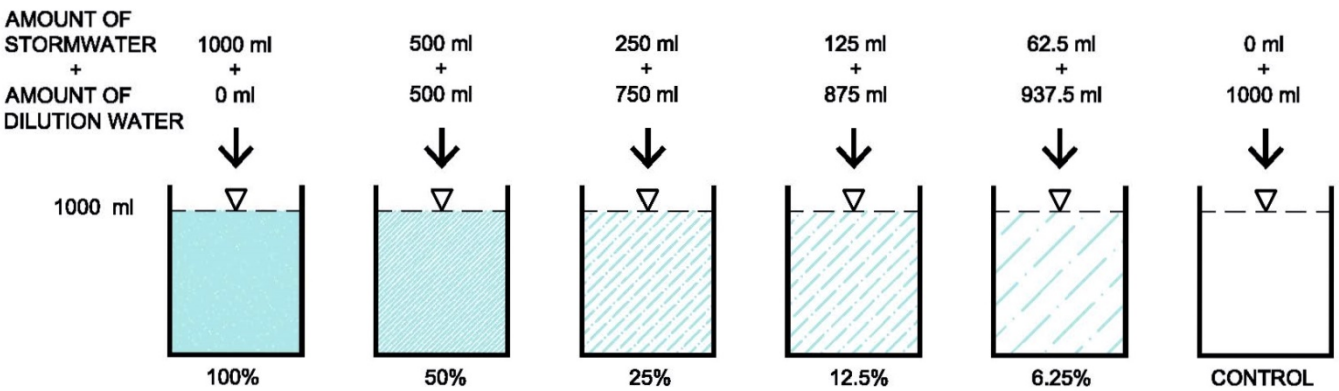
Overview of WET Testing

Preparation of test exposure concentrations

- Dilute stormwater sample with laboratory control water or receiving water to make a series of exposure concentrations.
- Add test organisms.
- Monitor water quality conditions and count surviving organisms.
- Renew test water if required.
- Calculate toxicity endpoints at test completion.



STORMWATER EXPOSURE CONCENTRATION

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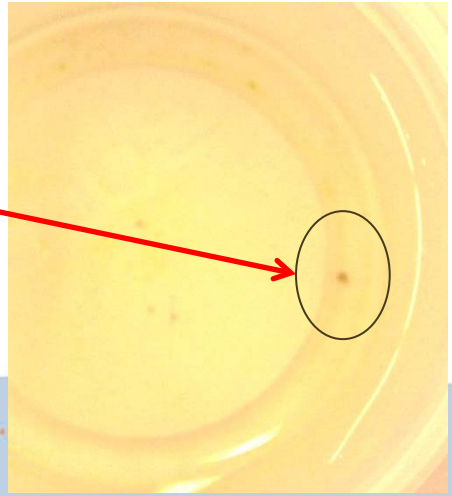
Overview of WET Testing

Common Freshwater Test Organisms



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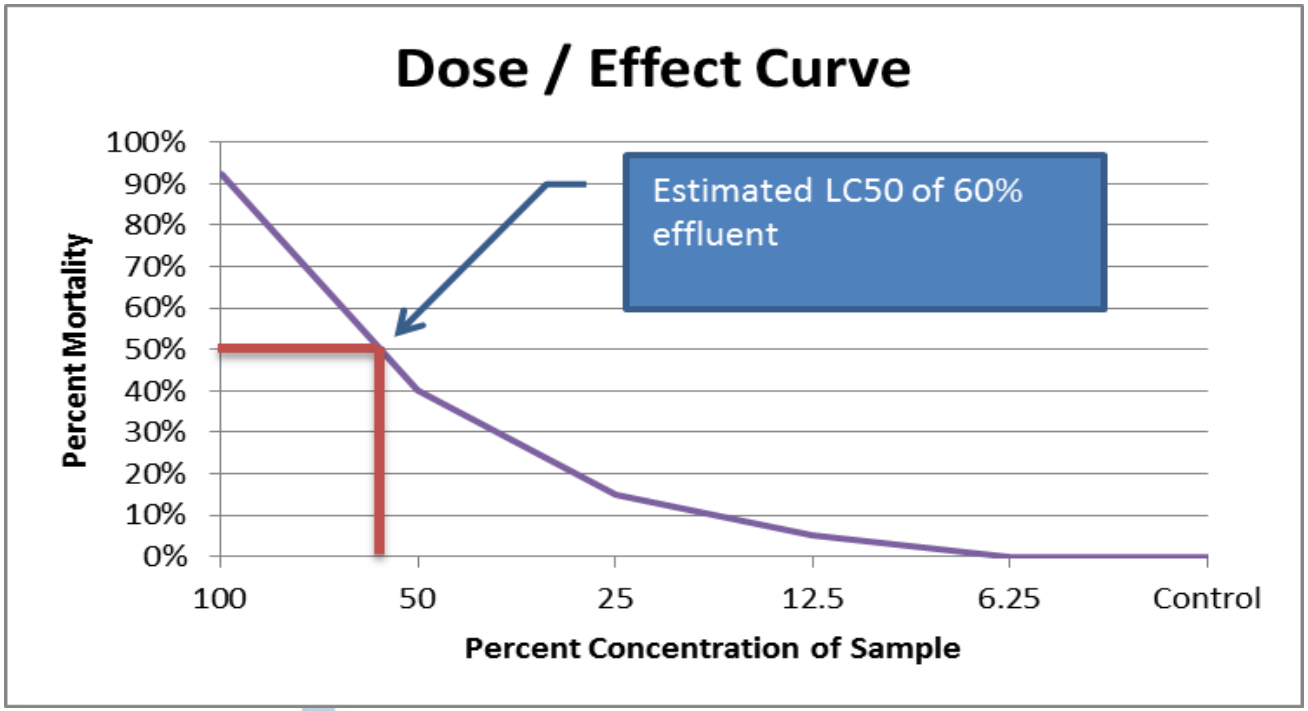
Overview of WET Testing

Test Completion

- Toxicity end points
  - Acute – lethality
  - Chronic – reproduction or growth
- QA/QC



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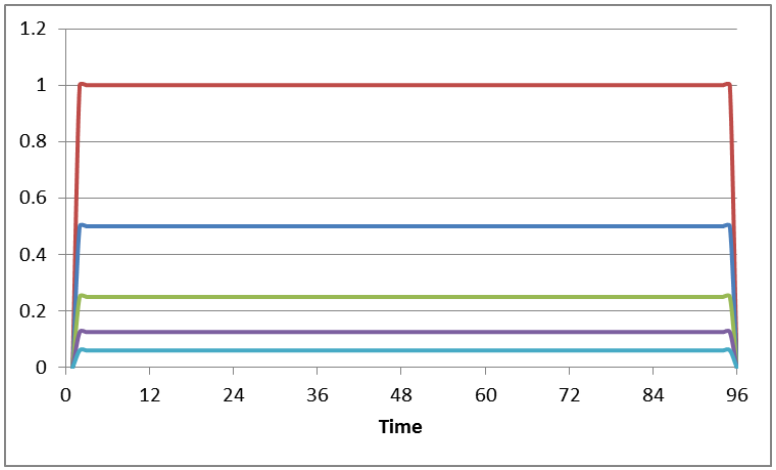
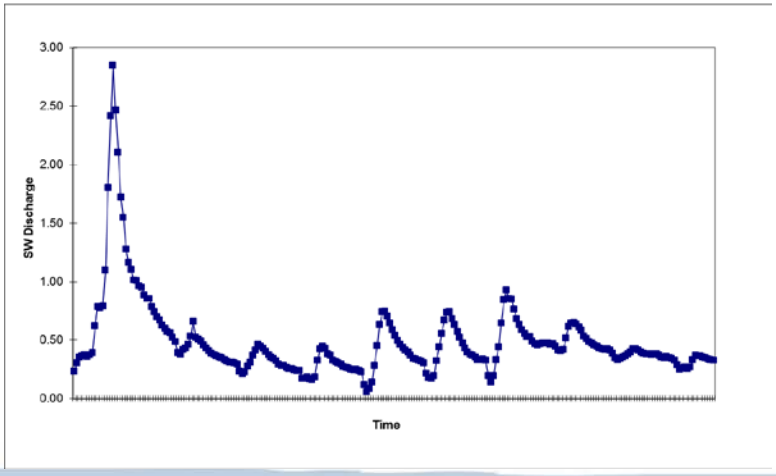
Testing vs Environmental Exposure Conditions

Continuous Test Exposure



vs

Actual Discharge Conditions



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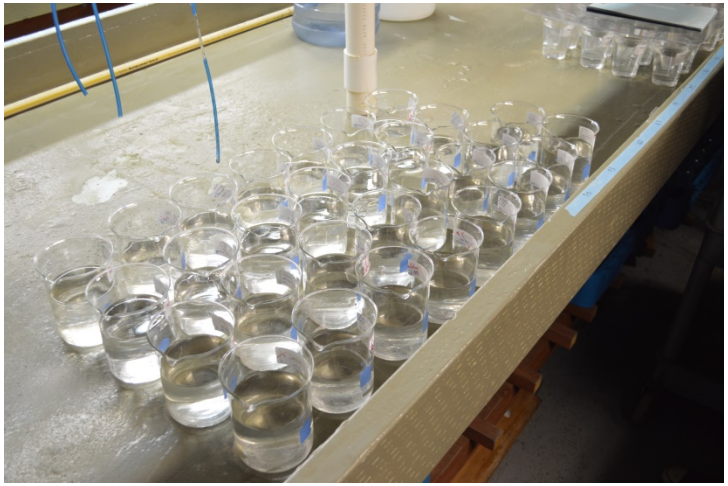
Testing vs Environmental Exposure Conditions

Test Temperature
20-25C



vs

Actual Field Exposure
4C

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Considerations of WET for Airport Stormwaters

- Toxicity Considerations
  - Discharge variability
  - Temperature / Dissolve Oxygen

- Operational Considerations
  - Planning horizon
  - Health and safety

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Discharge Variability

- Is there a difference in observed toxicity between continuous exposure and environmentally realistic, variable exposure conditions?
- To address this:
  - Conducted toxicity tests under varying exposure conditions using a synthetic stormwater.
  - Evaluated both declining exposure conditions and ascending exposure concentrations.
  - Tested 5 different exposure scenarios.

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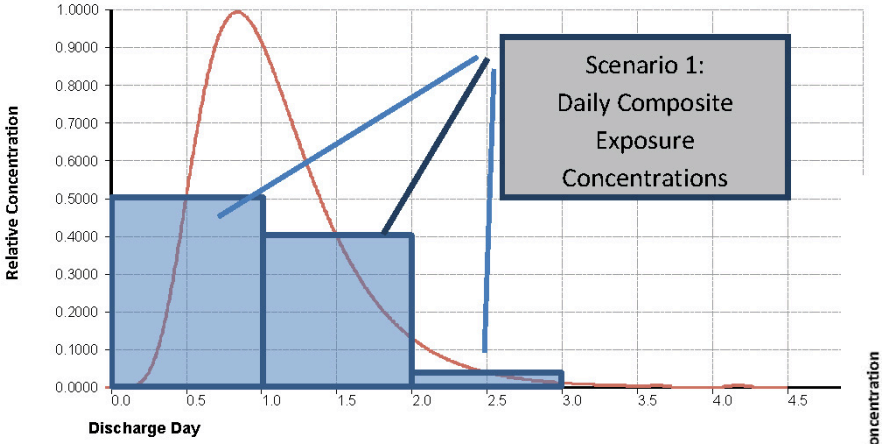
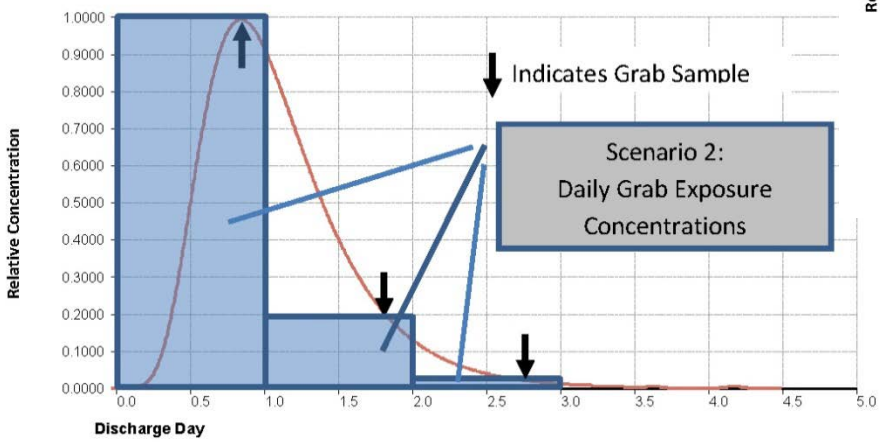
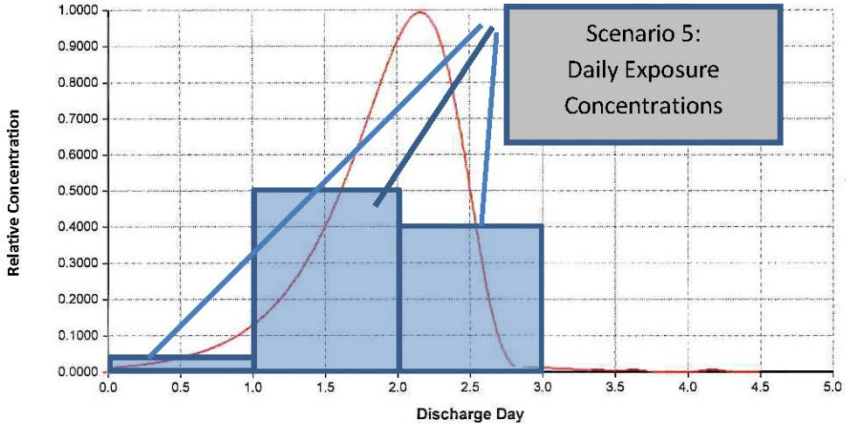
Exposure Scenarios







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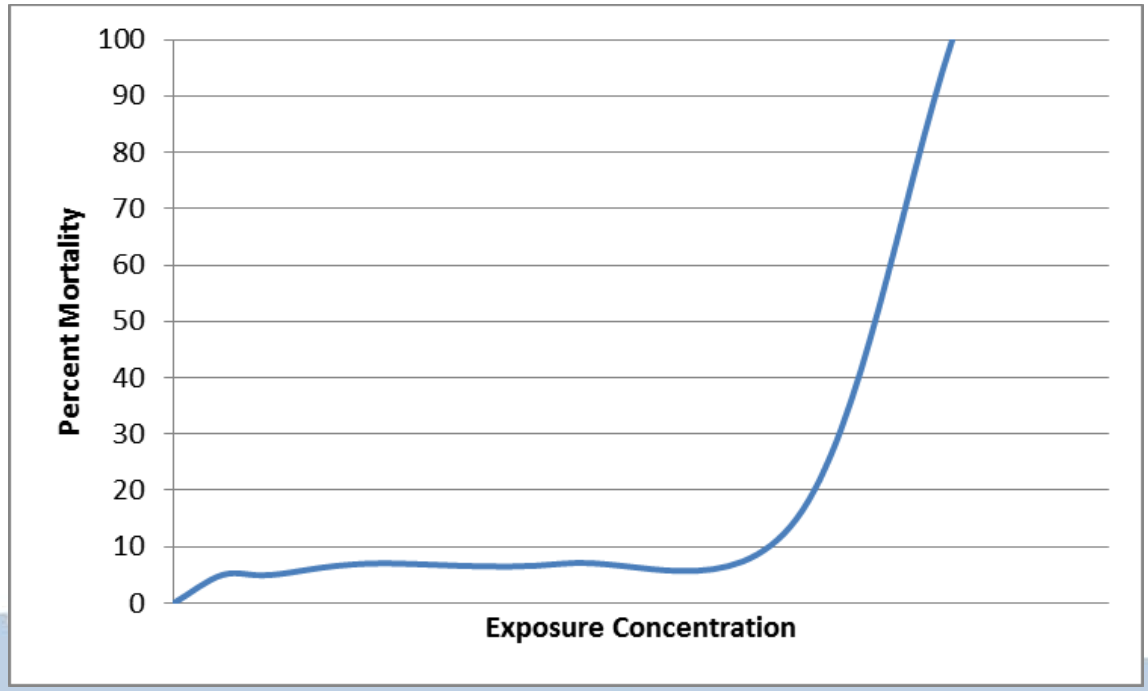
Findings

- The dose response curve is very steep
  - There appears to be an ‘all or none’ nature to the response
  - i.e., when a test concentration exceeds a ‘threshold’, mortality is observed



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Findings

- There was little difference between continuous and variable exposure toxicity responses for both *C. dubia* and *P. promelas*.
- There was a significant difference between toxicity responses when the exposure scenario was changed from a descending concentration to an ascending concentration.
- Composite samples were generally less toxic than grab samples but the results were not significant.

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Temperature

- Receiving water temperature ~2 – 6°C.
- Test temperatures 20 - 25°C
- Effects toxicity test results through 3 different mechanisms
  - Direct effects on the test organism
    - Results indicated minimal direct effect of temperature on the test organisms
  - Indirect
    - Rate of degradation of compounds within SW sample
    - Establishes limits on the amount of oxygen in the sample

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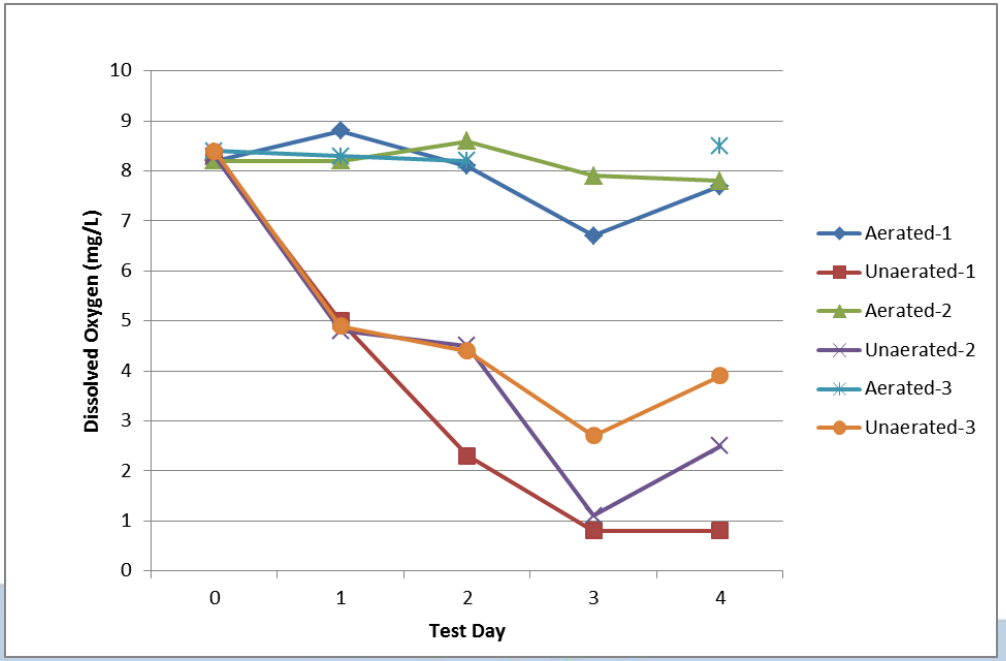
Temperature and DO

- Increased temperature increases the degradation rate of oxygen demanding substances
  - Result is decreased dissolved oxygen concentration over the course of the test
  - Toxicity testing artificially increases the temperature of the sample water leading to low test DO concentrations



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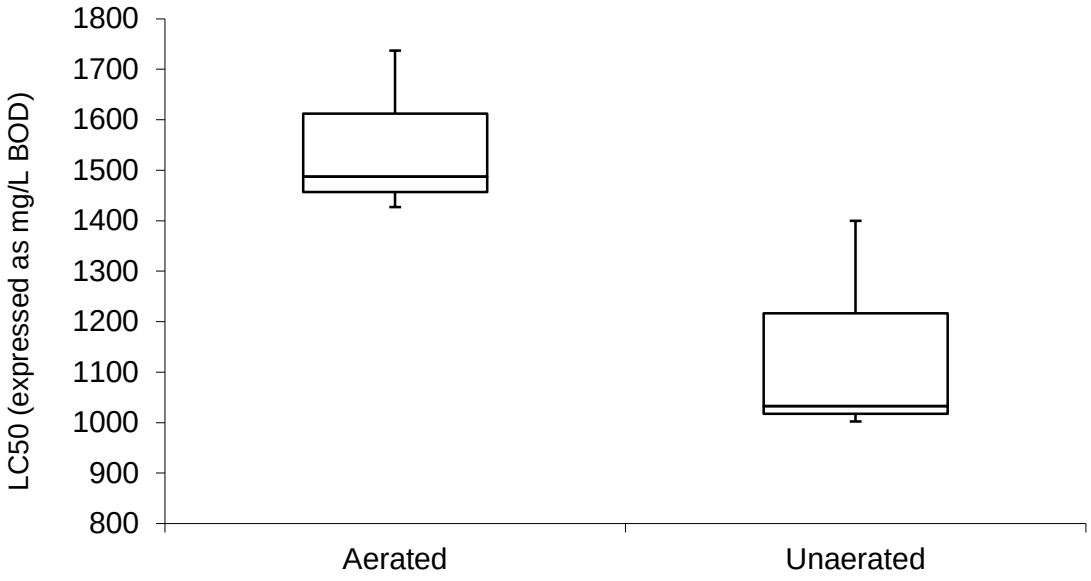
Temperature and DO

- EPA test protocols require the DO to be maintained above 4 mg/L to meet QA/QC requirements
- Low DO in the test could impact results



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Operational Consideration: Limited Planning Horizon

- Storm Prediction and Notification
  - Notification of the sampling team
  - Notification of the laboratory
    - 120 organisms per test; all within a specific age
    - Availability for weekend storm events
      - Samples must be <36 hrs old at test initiation

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Health and Safety

- Sampling is likely to be conducted…
  - Under the worst possible conditions – snow, sleet, freezing rain
  - Adjacent to aircraft/vehicular traffic areas
  - Adjacent to ditches, swales, creeks, rivers under high water conditions
- Sampling season preparation
  - Evaluate/improve outfall access routes
  - Provide hand-rails, work platforms, steps, lights to the extent possible
  - Limit time of day of sampling

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Recommendations

Collection of Representative Samples

- Single grab sample – short duration tests with minimal discharge variability.
- Multiple grab samples – longer duration test with increased discharge variability
- Composite sampling – longer duration test with variability in terms of flow and concentration.

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Recommendations

Toxicity testing

- Test renewals – daily renewal with fresh sample. What to do if no discharge? utilize laboratory / receiving water
- Dissolved Oxygen – Notify laboratory that sample may contain elevated levels of oxygen demanding substances. Request increased DO monitoring. Provide aeration if DO falls below 4 mg/L.

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Recommendations

Data Review and Application

- Concurrent monitoring – in addition to pH, DO, ammonia and conductivity, monitor for COD, BOD, glycols, calcium, sodium, potassium, magnesium
- PDM / ADF application records – data further allows the characterization of the deicing event.

Data Review

- Toxicity test data review – Ensure test results are defensible and meet QA/QC requirements

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For additional information:

ACRP Report 134*:* Applying Whole Effluent Toxicity Testing to Aircraft Deicing Runoff

http://www.trb.org/Publications/Blurbs/172751.aspx

Chuck Pace

cpace@newfields.com

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