Introduction to Data Quality Objectives

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Tarrant Regional Water District
Overview

• What is the DQO Process?
• Why do we need it?
• Steps in the Process
• QAPPs
• Data Quality Indicators
What is the DQO Process?

A systematic planning process for generating environmental data sufficient for an intended use.
What is the DQO Process?

- Or more precisely… planning for efficiently generating appropriate data...
- Balance resources with needs.
- Avoid Scope-Creep, endless What-If’s, and “Paralysis by Analysis”

You may be a Scope-Creeper if you’ve ever said...

“As long as we’re out there…”

“Wouldn’t it be nice to know…”

“It wouldn’t cost that much more to…”
Why do we need the DQO Process?

- All collected data have error.
- Nobody can afford absolute certainty.
- Defines tolerable error rates and decision risks.
- Fully evaluate options
- Stakeholder buy-in
- Sets expectations
  - effort, costs, outcomes
Steps in the DQO Process

1. State the Problem
2. Identify Goals/Decisions
3. Identify Information Inputs
4. Define Boundaries
5. Develop Analytical Approach
6. Specify Performance/Acceptance Criteria
7. Develop Monitoring Plan
1. **State the Problem**

What is the problem that motivates the study?

What are the resources & constraints?

<table>
<thead>
<tr>
<th>Table 1-1</th>
<th>TCEQ 2008 303(d) list – Carters Creek, Burton Creek, and Country Club Branch (TCEQ, 2008b)</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>SegID: 1209C</th>
<th>Carters Creek (unclassified water body)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Perennial stream from the confluence with the Navasota River southeast of College Station in Brazos County upstream to the confluence of an unnamed tributary 0.5 km upstream of FM 158 in Brazos County</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Area</th>
<th>Category</th>
<th>Year First Listed</th>
</tr>
</thead>
<tbody>
<tr>
<td>1209C_01</td>
<td>5a</td>
<td>1999</td>
</tr>
</tbody>
</table>
2. Identify Decisions

What are the study questions to be answered?

Do concentrations exceed criteria? When? Where?

Does the BMP lower pollutant concentrations?
3. Identify Inputs

What data and information are needed to answer the study questions?

- Types and potential sources
- Availability of appropriate methods
- Data gaps

Study Questions

- WQ Standards
- Temperature
- Rainfall
- Land-use coverage
- WWTF Flows
- Pollutant Concentrations
- Expected BMP reductions
4. Define Study Boundaries

- What is the target population?
- Types of samples
- Spatial & temporal boundaries
- Practical constraints
- Scale of decisions
5. Develop Analytical Approach

What are the analytical parameters to be used?
What is the logic for drawing conclusions from these parameters?

Long-Term Trends
Annual Averages

BMP Effectiveness
Median Concentration
6. Specify Acceptance Criteria

For Estimation Projects:
- Performance Metrics
- Acceptable Levels of Uncertainty

For Decision Projects:
- Probability limits for Decision Errors

Table 7. Statistical Hypothesis Tests Lead to Four Possible Outcomes

<table>
<thead>
<tr>
<th>Decision You Make by Applying the Statistical Hypothesis Test to the Collected Data</th>
<th>True Condition (Reality)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Baseline Condition is True</td>
<td>Alternative Condition is True</td>
</tr>
<tr>
<td>Decide that the Baseline Condition is True</td>
<td>Correct Decision</td>
<td></td>
</tr>
<tr>
<td>Decide that the Alternative Condition is True</td>
<td></td>
<td>Decision Error (False Rejection)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Correct Decision</td>
</tr>
</tbody>
</table>
7. Develop Monitoring Plan

- Compile information from Steps 1-6.
- Sample & Station Types
- Frequency & Duration
- Field & Lab Methods
- Quality Assurance
## Develop QAPP

<table>
<thead>
<tr>
<th>QAPP Section</th>
<th>DQO Step</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Project Management</td>
<td>1, 2, 3, 4, 5, 6</td>
</tr>
<tr>
<td>B. Data Generation and Acquisition</td>
<td>1, 3, 5, 7</td>
</tr>
<tr>
<td>C. Assessment and Oversight</td>
<td>7</td>
</tr>
<tr>
<td>D. Data Validation and Usability</td>
<td>3, 7</td>
</tr>
</tbody>
</table>

From Table A.3 of QA-R5, *EPA Requirements for Quality Assurance Project Plans*
Resources

- TCEQ Quality Assurance: http://www.tceq.texas.gov/field/qa
- TSSWCB Environmental Data Quality Management: https://www.tsswcb.texas.gov/quality
- EPA QA Training Courses: http://www.epa.gov/quality/trcourse.html
- EPA Quality Assurance Documents: http://www.epa.gov/quality/qa_docs.html
Thank You!
Supplemental
Data Quality Indicators

Measures of principal quality attributes

- bias
- precision
- sensitivity
- representativeness
- comparability
- completeness

Table A7.1  GBRA Measurement Performance Specifications

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>UNITS</th>
<th>MATRIX</th>
<th>METHOD</th>
<th>PARAMETER CODE</th>
<th>AWRL</th>
<th>LOQ</th>
<th>LOQ CHECK STD %Rec</th>
<th>PRECISION (RFD of LCS/LCS dup)</th>
<th>BIAS (%Rec. of LCS)</th>
<th>Lab</th>
</tr>
</thead>
<tbody>
<tr>
<td>Field Parameters</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>pH</td>
<td>pH units</td>
<td>water</td>
<td>SM 4500-H B &amp; TCEQ SOP, V1</td>
<td>00400</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>Field</td>
</tr>
<tr>
<td>DO</td>
<td>mg/L</td>
<td>water</td>
<td>SM 4500-O G &amp; TCEQ SOP, V1</td>
<td>00300</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>Field</td>
</tr>
<tr>
<td>Conductivity</td>
<td>umhos/cm</td>
<td>water</td>
<td>SM 2510 &amp; TCEQ SOP, V1</td>
<td>00094</td>
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<td>NA</td>
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<td>NA</td>
<td>NA</td>
<td>Field</td>
</tr>
<tr>
<td>Conductivity</td>
<td>umhos/cm</td>
<td>water</td>
<td>SM 2510</td>
<td>00095</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>GBRA</td>
</tr>
<tr>
<td>Temperature</td>
<td>°C</td>
<td>water</td>
<td>SM 2530 &amp; TCEQ SOP, V1</td>
<td>00010</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>Field</td>
</tr>
<tr>
<td>Flow</td>
<td>cfs</td>
<td>water</td>
<td>TCEQ SOP, V1</td>
<td>00061</td>
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<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>Field</td>
</tr>
</tbody>
</table>
Bias & Precision

• Bias is systematic or persistent distortion of a measurement process that causes error in one direction.

• Precision is random error, not in the same direction or of the same magnitude.

<table>
<thead>
<tr>
<th>Imprecise and biased</th>
<th>Imprecise and unbiased</th>
<th>Precise and biased</th>
<th>Precise and unbiased</th>
</tr>
</thead>
</table>

![Graph showing the comparison of Imprecise and biased, Imprecise and unbiased, Precise and biased, and Precise and unbiased across different analysis numbers.](chart.png)
Representativeness

- The degree to which data characterize a population.
  - Sampling site, Watershed, Segment/AU
  - Storm event, Season

- Evaluate whether measurements are made and physical samples collected in such a manner that the resulting data appropriately reflect the environment or condition being measured or studied.
Comparability

- Confidence that one data set can be compared to another and can be combined for analysis
- Determine comparability by evaluating sample collection and handling methods, sample preparation and analytical procedures, holding times.
Completeness

• Measure of the amount of valid data obtained, as a percentage of those that were planned

• Consider scale and target populations.

• Evaluate where missing samples occurred – will this affect ability to characterize a condition of interest?