Monitoring Strategy and Design

- Developing a monitoring strategy
- Selecting pollutants of interest
- Standard air toxics sampling and analysis techniques
- Selecting frequency and duration of sampling
- Importance of meteorological measurements
- Leveraging with other studies
- Building quality into the plan

Developing a Monitoring Strategy

The monitoring strategy is a function of

- Project objectives
- Size of area to be assessed
- Number and distribution of sources
- Existing monitoring
- Number and types of pollutants
- Specificity, sensitivity of analytical technique
- Sampling frequency and duration
- Magnitude of concentration expected
- Available resources ($, manpower, schedule)
Nine Steps for Designing an Air Toxics Monitoring Project

1. Engage all stakeholders
2. Agree on project goals
3. Develop data quality objectives
4. Develop several measurement approaches; evaluate costs, resources, schedule; and select best alternative
5. Include plan to use all (collected and available) data during data interpretation

6. Ensure that you will get an answer, even if your prior understanding is wrong
7. Plan for time to share preliminary results with all stakeholders
8. Vet final plan with stakeholders
9. Develop actionable recommendations
Toxics Monitoring Measurement
Design Issues to Address

• Understand detailed objectives, when results are needed, the audience for results, etc.
• When does the impact of interest occur? Annual, seasonal, daily, diurnal, short- or long-term, etc.
• Where is the impact of interest relative to the monitoring location?
• What are the available funds and resources?

Project Strategy: JATAP

• The JATAP steering committee developed a four-year research road map, or blueprint.
• The blueprint originally called for nine monitoring sites, emissions inventory development, air toxics modeling, and communication/outreach.
Project Strategy: JATAP (cont.)

- A pilot study was run for a year at a small number of sites
- For the larger-scale study, monitoring was to be conducted for at least a full calendar year
  - focus on annual average concentrations for comparison to chronic risk levels
- Tribal sites, analysis of Tribal data, and their data reports were originally handled separately

JATAP Objectives and Strategies

<table>
<thead>
<tr>
<th>Short-term</th>
<th>Long-term</th>
</tr>
</thead>
<tbody>
<tr>
<td>Summarize current knowledge</td>
<td>Facilitate communication among JATAP members</td>
</tr>
<tr>
<td>Through monitoring, determine risk by HAP at selected sites</td>
<td>Develop an effective collaborative organization</td>
</tr>
<tr>
<td>Characterize spatial pattern of HAPs</td>
<td>Develop technical and organizational capacity, especially for tribes</td>
</tr>
<tr>
<td>Quantify risk across the Maricopa/Pinal Urban area</td>
<td>Diversify funding sources</td>
</tr>
<tr>
<td>Identify hot spots and EJ issues</td>
<td>Promote data sharing</td>
</tr>
<tr>
<td>Communicate risk to affected communities</td>
<td>Influence future EPA policy directions on toxics</td>
</tr>
<tr>
<td>Develop emissions reduction strategies</td>
<td>Work for program sustainability</td>
</tr>
</tbody>
</table>

Human Health Organizational
Monitoring Strategy: Michigan

- The Michigan DEQ project did not entail new monitoring because it focused on data analysis.

- The data analysis strategy built upon previous projects and was designed (partly) to address unanswered questions.

Monitoring Strategy: Nez Perce

[Map of Monitoring Locations]
Data Quality Objectives

- EPA has developed and refined a framework for planning data collection known as the Data Quality Objective (DQO) process.
- The DQO process addresses the project planning cycle for a project from problem statement through the data collection design with a goal of providing data of sufficient quality for decision-making.
DQO Process

1. State the problem.
   – Concisely describe the problem to be studied.
   – Review prior studies and existing information to gain sufficient understanding to define the problem.
   – Why are new data needed?

2. Identify the decision.
   – What questions will the study attempt to resolve with this data?
   – What actions may result?

DQO Process (cont.)

3. Identify inputs to the decision.
   – What information is needed?
   – What measurements are required to resolve the decision statement?

4. Define study boundaries.
   – What are the study’s time periods and spatial area?
   – Where and when should data be collected?
DQO Process (cont.)

5. Develop a decision rule.
   – “If x happens, then y will be done.”

6. Specify limits on decision errors.
   – What are acceptable levels of uncertainty? (Consider consequences of making an incorrect decision.)

7. Optimize the study design.
   – Balance resources and study design.
   – Choose the most resource-effective design that meets all DQOs.

DQO Example

• Southeastern States Regional Air Toxics Analysis
  – Meta-analysis of existing air quality measurements from southeastern states
  – Two categories of DQOs for different types of analyses; quantitative and qualitative

• Balance DQO requirements with data availability
  – For example, data with >50% below MDL included but colored or flagged
• Quantitative results had more stringent DQOs than qualitative

<table>
<thead>
<tr>
<th>Quantitative</th>
<th>Qualitative</th>
</tr>
</thead>
<tbody>
<tr>
<td>Statistical summaries</td>
<td>NATA comparison</td>
</tr>
<tr>
<td>Annual trends</td>
<td>Spatial variability</td>
</tr>
<tr>
<td>National perspective</td>
<td>Effectiveness of control strategies</td>
</tr>
<tr>
<td>Comparison to health benchmarks</td>
<td>MDL comparison</td>
</tr>
</tbody>
</table>
Monitoring Strategy

- **Physical location characteristics** – geophysical setting, meteorology, types and characteristics of sources, and existing monitoring programs.
- **Precision and accuracy** – how precisely or accurately do pollutants need to be measured to meet DQOs?
- **Sampling plan** – pollutants, sampling frequency and duration, length of campaign, and monitoring and analytical methods.
- **QA/QC** – quality assurance project plan (QAPP), standard operating procedures (SOPs), audits, intercomparisons, collocated data requirements, QA programs for analytical laboratories, and data validation guidelines for ambient data.
- **Options for data analysis and exploration** – including available tools, data analyses, data needs, and training needs.

Monitoring Platforms

- movable platforms
- temporary sites
- fixed (long-term) sites
- vehicles
- carried by individuals
Sampling Options

- Passive
- Active
- Grab sample
- Integrated
- Direct-read instruments
- Manual
- Automated
- Open path

Example Considerations When Selecting Monitoring or Sampling Options

- **Passive samplers – advantages**
  - Inexpensive, compact, portable
  - Useful for assessing personal and environmental exposures over varying time frames (e.g., one day to two weeks)
  - Useful for assessing average spatial variations in pollutant concentrations

- **Passive samplers – disadvantages**
  - Do not provide information for trace levels of pollutants or for short time frames
  - Available pollutant list is relatively limited
Monitoring Tips

• Build adequate time into your plan
  – to acquire equipment
  – to perform bench and field tests to ensure the equipment operate as expected
  – to obtain adequate training for equipment new to you (e.g., timers, data acquisition system)
• Develop plan for sample storage, shipping, and handling
• Include quality assurance plans

“In trace level pollutant sampling, the little things matter.”

Sampler/Monitor Placement

• At receptors of concern
• Near the source
• At existing sites, if parameters of interest are not measured there
• To augment existing measurements
How Many Sites Do I Need?

A function of the following:

- Resources, funds, people
- Distance between source and receptor
- Need for background measurement
- Location of receptors of concern (e.g., receptors only in direction of predominant wind or in multiple directions?)
- Expected spatial gradients (due to wind direction, wind speed, geography, etc.)
- Statistical power needed for results

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Monitoring Scales

Monitoring scale is the area represented by the data collected at the site (varies by pollutant). More important for projects that are trying to characterize neighborhood/urban level.

<table>
<thead>
<tr>
<th>Scale</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collocated</td>
<td>1 to 10 m</td>
</tr>
<tr>
<td>Micro-scale (i.e., near-source)</td>
<td>10 to 100 m</td>
</tr>
<tr>
<td>Middle-scale (i.e., gradients from sources such as roadways)</td>
<td>100 to 500 m</td>
</tr>
<tr>
<td>Neighborhood-scale</td>
<td>500 m to 4 km</td>
</tr>
<tr>
<td>Urban-scale</td>
<td>4 to 100 km</td>
</tr>
<tr>
<td>Regional-scale</td>
<td>100 to 1,000 km</td>
</tr>
</tbody>
</table>
Frequency and Duration of Sampling Considerations

The following example alternatives are based on about $80,000-120,000 plus in-kind resources (labor, existing sites, etc.), or the equivalent of about 264 24-hr canisters in one year, including 10% QA.

<table>
<thead>
<tr>
<th>Method</th>
<th>Frequency</th>
<th>Duration</th>
<th>Operating Period</th>
<th>No. Samples per site</th>
<th># of Sites</th>
</tr>
</thead>
<tbody>
<tr>
<td>TO-15</td>
<td>1-in-12 day</td>
<td>24-hr</td>
<td>One Year</td>
<td>30</td>
<td>8</td>
</tr>
<tr>
<td>TO-15</td>
<td>1-in-6 day</td>
<td>24-hr</td>
<td>One Year</td>
<td>60</td>
<td>4</td>
</tr>
<tr>
<td>TO-15</td>
<td>1-in-3 day</td>
<td>24-hr</td>
<td>One Year</td>
<td>120</td>
<td>2</td>
</tr>
<tr>
<td>TO-15</td>
<td>Daily</td>
<td>24-hr</td>
<td>One Month</td>
<td>30</td>
<td>8</td>
</tr>
<tr>
<td>TO-15</td>
<td>1-in-2 day</td>
<td>24-hr</td>
<td>One Month</td>
<td>15</td>
<td>16</td>
</tr>
<tr>
<td>Auto-GC (FID)</td>
<td>1-hr</td>
<td>1-hr</td>
<td>Three Months</td>
<td>2400</td>
<td>1</td>
</tr>
<tr>
<td>Passive</td>
<td>Weekly</td>
<td>164-hr (1 week)</td>
<td>One Year</td>
<td>52</td>
<td>20</td>
</tr>
</tbody>
</table>

Note the trade-off between # of samples and # of sites for a given budget.

Frequency and Duration of Sampling Considerations (cont.)

The following example alternatives are based on about $80,000-120,000 plus in-kind resources (labor, existing sites, etc.), or the equivalent of about 264 24-hr canisters in one year, including 10% QA.

<table>
<thead>
<tr>
<th>Project Objective</th>
<th>Method</th>
<th>TO-15 24-hr</th>
<th>Auto-GC</th>
<th>Passive</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Data Needed</td>
<td>1-in-12</td>
<td>1-in-6</td>
<td>1-in-3</td>
</tr>
<tr>
<td>Health effect assessment</td>
<td>Annual averages, multiple sites</td>
<td>X</td>
<td>X</td>
<td>\</td>
</tr>
<tr>
<td>Community baseline</td>
<td>Annual averages, multiple sites</td>
<td>X</td>
<td>X</td>
<td>\</td>
</tr>
<tr>
<td>Characterizing emissions sources</td>
<td>Temporally or spatially resolved, meteorology</td>
<td>\</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Support exposure modeling and evaluation efforts</td>
<td>Multiple sites, temporal resolution</td>
<td>\</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

No one alternative meets all objectives.
Example: Potentially Different Locations for Different Segments of the Population

Selecting Pollutants of Interest

- Defined by your project goals
- Are additional pollutants needed to meet project goals?
  - Validating emissions profiles
  - Characterizing confounding factors/source types
  - Providing adequate data for source apportionment
Selecting Pollutants of Interest (cont.)

Measurement technique partially defines the time-resolution, cost, and specificity of analysis

- Are detection limits sufficient to quantify at levels of concern?
- Is technology available to meet required detection limits?
- Are data reporting practices consistent with needs?

Other Pollutants to Consider (and Why)

- Chemical markers for sources
  - Ni, V for oil combustion
  - SO\textsubscript{2} for high-sulfur content fuel combustion
  - Al, Si, Ca for soil
  - Black or elemental carbon for gasoline, diesel fuel combustion
  - CO, NO\textsubscript{x} for combustion
- Additional species
  - If performing analysis of air samples for air toxics, consider expanding the analysis to include non-toxic VOCs to aid in source identification
Sampling and Analysis Techniques

- Because air toxics are present in the atmosphere in gaseous, particulate, and semi-volatile form, no single measurement technique is adequate.

- EPA offers 17 approved sampling and analysis methods for toxic gases; among the most commonly used methods are the following:
  - **Compendium method TO-11A.** Used to measure formaldehyde and other carbonyl compounds.
  - **Compendium method TO-13A.** Used to measure Polycyclic Aromatic Hydrocarbon (PAH) compounds.
  - **Compendium method TO-15.** Created to target 97 compounds on the list of 187 hazardous air pollutants.

Sampling and Analysis Techniques (cont.)

- EPA-approved methods for collection and analysis of suspended particulate matter are documented in the “Compendium of Methods for the Determination of Inorganic Compounds in Ambient Air.”
  - Chapter IO-3, Chemical Species Analysis of Filter-Collected Suspended Particulate Matter (SPM), is of considerable importance to the air toxics ambient monitoring program.
  - Several different methods for speciated particulate analyses are available.
  - Each have advantages and disadvantages depending on the target analytes and desired minimum detection limits.
  - For Hazardous Air Pollutant (HAP) metals, IO-3.5 (Inductively Coupled Plasma / Mass Spectrometry [ICP/MS]) offers the lowest detection limits.
<table>
<thead>
<tr>
<th>Example Priority HAPS</th>
<th>1-in-a-million Cancer Risk (ug/m3)</th>
<th>Noncancer Threshold HI=1 (ug/m3)</th>
<th>Analysis Method</th>
<th>MDL (ug/m3)</th>
<th>Modeled Cancer Risk (in a million)</th>
<th>Noncancer Risk (HI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acrolein</td>
<td>0.02</td>
<td>TO-15*</td>
<td>NA</td>
<td>0.07</td>
<td>1.86</td>
<td>5.78</td>
</tr>
<tr>
<td>Coke oven</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Diesel PM a</td>
<td>0.0033</td>
<td>TO-13A*</td>
<td>NIOSH 5040</td>
<td>0.4</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>POM/PAH</td>
<td>0.0000510</td>
<td>TO-13A*</td>
<td>NIOSH 5040</td>
<td>0.0000024</td>
<td>1.34</td>
<td>0.000081</td>
</tr>
<tr>
<td>Chromium 6</td>
<td>0.0000083</td>
<td>0.1</td>
<td>Modified CARB Method 039</td>
<td>0.0000011</td>
<td>1.65</td>
<td>0.000081</td>
</tr>
<tr>
<td>Hydrozine</td>
<td>0.00020</td>
<td>0.2</td>
<td>OHSA 106</td>
<td>0.076</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Vinyl</td>
<td>0.00020</td>
<td>0.2</td>
<td>NIOSH 1061</td>
<td>0.02</td>
<td>0.0058</td>
<td>0.000081</td>
</tr>
<tr>
<td>Nickel compounds</td>
<td>0.006</td>
<td>0.065</td>
<td>TO-3.5</td>
<td>0.000023</td>
<td>0.15</td>
<td>0.001477</td>
</tr>
<tr>
<td>Arsenic Compounds</td>
<td>0.00022</td>
<td>0.03</td>
<td>TO-3.5</td>
<td>0.000079</td>
<td>0.38</td>
<td>0.000081</td>
</tr>
<tr>
<td>Benzidine</td>
<td>0.000015</td>
<td>10</td>
<td>TO-13A 0940</td>
<td>0.25</td>
<td>0.02</td>
<td>0.000081</td>
</tr>
<tr>
<td>Ethylene oxide</td>
<td>0.011</td>
<td>30</td>
<td>NIOSH 1854</td>
<td>0.04</td>
<td>0.45</td>
<td>0.000081</td>
</tr>
<tr>
<td>2,4-Toluene Disocyanate</td>
<td>0.021</td>
<td>0.07</td>
<td>NIOSH 1522</td>
<td>0.0000020</td>
<td>0.03</td>
<td>0.04</td>
</tr>
<tr>
<td>Cadmium compounds</td>
<td>0.000056</td>
<td>0.02</td>
<td>TO-3.5</td>
<td>0.000058</td>
<td>0.16</td>
<td>0.000081</td>
</tr>
<tr>
<td>Hexamethylenetetramine</td>
<td>0.01</td>
<td>TO-162</td>
<td>NIOSH 1522</td>
<td>0.0000040</td>
<td>0.0045</td>
<td>0.000081</td>
</tr>
<tr>
<td>Methyleneurea</td>
<td>7</td>
<td>OSHA PV-296</td>
<td>0.20</td>
<td>0.000059</td>
<td>0.20</td>
<td>0.000081</td>
</tr>
<tr>
<td>1,3-Benzenesine</td>
<td>0.033</td>
<td>2</td>
<td>TO-15*</td>
<td>0.080</td>
<td>3.99</td>
<td>0.000081</td>
</tr>
<tr>
<td>Hydrochloric acid</td>
<td>20</td>
<td>TO-15*</td>
<td>NIOSH 7903</td>
<td>0.000012</td>
<td>0.0009</td>
<td>0.000081</td>
</tr>
<tr>
<td>Nitric acid</td>
<td>0.7</td>
<td>TO-15*</td>
<td>NIOSH 3512</td>
<td>0.000043</td>
<td>0.0092</td>
<td>0.000081</td>
</tr>
<tr>
<td>Manganese compounds</td>
<td>0.06</td>
<td>TO-3.5</td>
<td>0.0000065</td>
<td>0.0038</td>
<td>0.000081</td>
<td>0.000081</td>
</tr>
<tr>
<td>Perchloroethylene</td>
<td>0.200</td>
<td>270</td>
<td>TO-15*</td>
<td>0.43</td>
<td>1.54</td>
<td>0.000081</td>
</tr>
<tr>
<td>ARSPOxy</td>
<td>0.143</td>
<td>30</td>
<td>TO-15*</td>
<td>0.20</td>
<td>10.46</td>
<td>0.000081</td>
</tr>
<tr>
<td>Formaldehyde a</td>
<td>0.077</td>
<td>9.8</td>
<td>TO-11A</td>
<td>0.0.010</td>
<td>0.000006</td>
<td>0.152</td>
</tr>
<tr>
<td>Sulfuric acid</td>
<td>0.009</td>
<td>3</td>
<td>TO-13A</td>
<td>0.000000019</td>
<td>0.19</td>
<td>0.0521</td>
</tr>
<tr>
<td>Carbon tetrachloride</td>
<td>0.067</td>
<td>40</td>
<td>TO-15*</td>
<td>0.33</td>
<td>3.29</td>
<td>0.000081</td>
</tr>
</tbody>
</table>

* Based on CALEPA URE 1 SIM mode
* POM cancer threshold utilized most potent compound
* Particulate Diesel as elemental carbon
* Uses IRIS value that is undergoing review
* Total of all PAHs using PUF

### Sampling and Analysis Issues

- **Acrolein** is an analytical challenge. See EPA’s website for current discussions and guidance: [http://www.epa.gov/ttn/amtic/airtox.html](http://www.epa.gov/ttn/amtic/airtox.html)
- Effective methods for hexavalent chromium have been developed, and discussion is also available on the above website.
- Continuous formaldehyde measurements remain a challenge.
Selecting Frequency and Duration of Sampling

The duration of a monitoring program is a function of:

- Monitoring objectives
- Number of samples needed for analysis and certainty
- Frequency at which samples are collected
- Resources available

Continuous data (e.g., 1-hr) are useful for:
- Wind sector and trajectory analyses
- Investigating diurnal variation
- Tying pollutant concentrations to meteorological conditions (e.g., mixing height)
- Allowing detailed exploration of high concentration episodes

Not all species can be monitored using continuous methods.

Integrated samples are useful for many analyses, but a sufficient number of samples are needed to separate out day-of-week, seasonal, and annual variations.
Selecting Frequency and Duration of Sampling (cont.)

- Advantages of integrated (e.g., 24-hr) samples over continuous methods
  - More species are measurable
  - Easier to operate
  - Suitable for a wider range of monitoring locations
  - Typically well understood methods
- Disadvantages
  - Temporal coverage is poor
  - Trajectory and wind sector analysis is difficult
  - Diurnal analysis is impossible

Frequency and Duration Considerations

For any data analysis, more samples improve your certainty in results
- Therefore, higher frequency and shorter duration sampling is better for data analysis, but this approach is more expensive.
- Which project objectives get the most out of the additional samples?

<table>
<thead>
<tr>
<th>Objective</th>
<th>Sample Number, Frequency, and Duration Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emissions characterization</td>
<td>Large improvements available from high sampling frequency and short duration. Source apportionment benefits from larger sample sizes.</td>
</tr>
<tr>
<td>Health assessment</td>
<td>24-hr average and 1-in-6 day sampling are sufficient for characterizing annual average concentrations</td>
</tr>
<tr>
<td>Trends</td>
<td>24-hr average and 1-in-6 day sampling are sufficient for characterizing annual average concentrations</td>
</tr>
<tr>
<td>Community baseline</td>
<td>24-hr average and 1-in-6 day sampling are sufficient for characterizing annual average concentrations</td>
</tr>
</tbody>
</table>
Emissions Characterization – Speciation, Frequency, Duration, and Sample Numbers

Emissions can be characterized using
• Chemically unique tracer species
• Emissions activity (diurnal, day-of-week, seasonal)
• Meteorological analysis (pollution roses, trajectory analysis)
• Spatial gradients (site comparisons by wind direction)
• Source apportionment (temporal variability and chemical speciation)

Blue categories are improved by having short-duration, high-frequency sampling.

Importance of Meteorological Measurements

• Surface met measurements at “nearby” sites may be inadequate to meet your goals
• Collocated, good quality surface meteorological data are necessary for supporting data analysis objectives:
  – Understanding diurnal changes in concentration associated with meteorology (temperature, wind speed, mixing height), especially during data validation and interpretation
  – Correlating/understanding observed concentrations with known emissions sources
  – Assessing trajectories in transport analyses
  – Assessing trajectory- and quadrant-specific speciation in emissions inventory analysis using wind direction and wind speed
  – Assisting with model evaluation using wind direction and wind speed data
Pre-Study Analysis of Available Winds

Wind speed and direction data were available at North Las Vegas Air Terminal and at McCarran International Airport, north and southeast of schools (A, along US95, now US95/I-515).

Wind Directions Are Different at Existing Sites North and Southeast of Schools

So we’d better measure winds at the study sites!
Pollutant Concentrations Depend on Wind Direction and Source Locations

When winds turned to blow toward the freeway (10 p.m. on 3/21/08), NO concentrations dropped significantly.

Upper-Air Meteorological Measurements

Upper air met data are useful in supporting
- Assessment of daily mixing height and mixing height evolution
- Understanding pollutant transport
- Evaluation models
Monitoring Strategy: JATAP

- Originally, nine monitoring sites were planned
  - Final decision about monitor placement determined by jurisdictional issues, available resources, and the availability of the monitoring equipment
  - Some compromises on monitoring locations had to be made
- Existing sites used: three sites for the pilot, seven sites for the study

Pilot study indicated MDLs from first lab used were too high, so a new lab was selected.

Leveraging

- Leveraging is a vital component of any study because it helps you extend your resources
- Be familiar with
  - lessons learned from previous studies
  - other studies in the area
- Design your study around routine monitoring
Leveraging: Michigan

Michigan study built on numerous previous and ongoing monitoring projects and data analysis studies

- MDEQ and LADCO supplemented air toxics data with continuous EC/OC, carbon black measurements, and speciated organic carbon at some sites
- Community monitoring project conducted by MDEQ in Delray, Newberry School (speciated organics, criteria pollutants, BC)
- Detroit Exposure Aerosol Research Project (DEARS)
- Detroit Children’s Health Study
- Detroit Cardiovascular Health Study
- Extensive data analysis of a range of data sets prior to the study

Leveraging: Nez Perce

The Nez Perce study built on previous air toxics studies in the area:

- 1990 study of chloroform concentrations near the mill
- Mid-1990s study with 13 sites, focused on five VOCs
- 2003 study on mill emissions
Building Quality Into Your Plan

- QAPPs will be required for all projects
- [http://www.epa.gov/quality/qapps.html](http://www.epa.gov/quality/qapps.html)
  - QA/R-5: Requirements for QAPPs
  - G-5: Guidance for QAPPs
  - G-5S: Guidance on choosing sampling design for environmental data collection
- Budget for QA activities should be ~10% to 15% of project dollars

Implementing Your Plan

- Allocate adequate time (schedule) and resources (budget, staff) to your project.
- Balancing project goals (scope) and your budget and schedule is challenging.
  - The budget, scope, and schedule are linked.
- Build in contingency planning.
Be SMART

- In your project, be SMART about how you run the project, set goals, designate tasks:
  - S - specific, significant, stretching
  - M - measurable, meaningful, motivational
  - A - attainable, agreed upon, achievable, acceptable, action-oriented
  - R - results-oriented, realistic, relevant, reasonable, rewarding
  - T - time-bound, timely, tangible, trackable

Provide Project Leadership

- Manage expectations
  - Have a well thought out project plan
  - Lead the execution of the plan
- Own your project (accountability)
  - Encourage creativity and innovation
- Communicate
  - Early and often!
  - Use multiple approaches (find out what works best for your team)
Lessons Learned in Monitoring Strategy

- Complete an emissions inventory, site visits, and screening modeling/monitoring before finalizing monitoring locations and targeting which air toxics to monitor
- Ensure lab/method can give you the detection limits you need
- Understand the area to be monitored
- Get the right people together to develop the strategy

Lessons Learned in Project Planning

- Schedule
  - Set a realistic schedule
  - Allow more time for the project to account for monitor siting and setup issues
  - Consider data processing and analysis requirements (i.e., leave enough time and budget to do a good job)
Lessons Learned in Project Planning (cont.)

• Monitoring
  – Assess laboratory detection limits, data reporting methods, and comparability
  – If using more than one lab, perform a comparability study up front
  – Perform a micro-scale emissions inventory before selecting pollutants to measure and monitoring locations
  – Consider security measures for monitoring
  – If the project is NOT testing new sampling or analysis methods, use methods with a proven “track record”
  – Consider meteorology and geography in monitor location placement