View from roof of science building at Western High School; monitoring trailer and US 95 in foreground
Summary: US 95 MSAT Project Example

- US 95 mobile source air toxics (MSAT) project (Nevada Dept. of Transportation, NDOT)
- Example of community-scale study
- Review each of the steps below and how they influenced the final results and mitigation actions

1. Establish a stakeholder group
2. Assess issues of concern
3. Set project goals
4. Design full project
5. Collect and QC data
6. Interpret data & recommend actions
7. Take action
A Court Settlement Agreement was reached between the Sierra Club and NDOT/Federal Highway Administration (FHWA) regarding urban freeway expansion where three schools are adjacent to the roadway.

Both mitigation and monitoring were required to reduce and assess student exposure.

- MSAT monitoring study at schools (this study)
- Filtration added to heating, ventilation, and cooling (HVAC) systems at schools
- Bus retrofit program
- Bus idling education
- FHWA gradient study (with EPA)
Assess Issues of Concern

Expansion of US 95 in Las Vegas, Nevada, where three adjacent schools were located within a few hundred meters of the roadway.

Issue: Student exposures to MSATs.

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Assess Issues of Concern (cont.)

Western High School    Fyfe Elementary School
Characterize outdoor and indoor concentrations of MSATs at three schools, and thus characterize students’ exposure to MSATs at the schools.

Determine the contribution of vehicle traffic on US 95 to students’ exposure.

Determine the effectiveness and MSAT removal efficiencies of air management systems to be installed at each school.

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Six MSATs from settlement agreement
- Diesel particulate matter (DPM)
- Diesel exhaust organic gases (DEOG), specifically benzene, 1,3-butadiene, acrolein
- formaldehyde, acetaldehyde

Other pollutants to help determine US 95 contributions:
- Carbon monoxide (CO), nitrogen oxide (NO), nitrogen dioxide (NO₂)
Design Project: Critical Issues

- Measurement methods
- Measurement siting issues
- Meteorological data issues
- Informational and logistical needs (Clark County School District)
- Traffic data needs (NDOT)
- Measurement strategy issues
- Additional critical issues
No current reference or standard method for DPM

Two potential surrogate methods:
- Particulate-PAH; correlates with 4- & 5-ring PAHs
- Black carbon ([BC], at 2 wavelengths, BC and UV)
- Both methods can operate at about 10-minute and 1-hr frequency.

Also use species ratios (to CO, NO, and NO₂, but at fewer sites?)

Example of Collected Filter

PM collected on 1” wide filter tape; note different degrees of black.
Benzene, 1,3-butadiene, and acrolein can be measured using canister sampling and analysis (EPA method TO-15).

Formaldehyde and acetaldehyde can be measured using DNPH cartridge samples and HPLC/UV absorption analysis (EPA method TO-11).

These methods and expected concentrations away from roadway likely require 1-hr or longer samples.

- Background concentrations
- Method detection limit
- Range of expected concentrations
**Design Project: Monitoring Locations**

- How many are needed outdoors at each school?
  - Cost will restrict this.

- Where should they be placed?
  - Likely at playground/sports fields; also, near air inlets of classrooms.

- What is the influence of sound walls?

View from roof of science building at Western High School; monitoring trailer and US 95 in foreground.
Wind Directions Are Different at Existing Sites North and Southeast of Schools

Average Wind Speed and Direction 7 AM to 2 PM

North Las Vegas Air Terminal

McCarran International Airport

Winter

Summer

So we’d better measure winds at the study sites!
Design Project: School District Information and Logistics

- School calendar details for 2006–2007 and 2007–2008 years
- When and where for installation of air management systems; also, operational characteristics (on/off times, days, changes, etc.)
- Bus operations (location, timing, frequency, changes, etc.)
- Guidance on outdoor locations that would be acceptable (and not acceptable)
- Need for space, power, phone/Internet, safety, security, access
- Need to be creative for indoor locations (space, noise, classroom disruption)
- Opportunities for community education and outreach, and for science instruction in the classroom?
"Exposure" objective could be met with average samples (up to a complete school day).

"Removal efficiency" objective could also be met with average samples.

However, in order to meet “contribution” objective, changes in atmospheric and traffic conditions and in student activities require shorter averaging times.

Thus, a combination of continuous and average samples are likely required.
Measurements Issues: Indoor

- Need classrooms “in operation”
- Represent indoor concentrations before and after air management system installation and operation (if possible)
- Consider realistic ranges of ventilation, including seasonal variations
- Possibly deploy at one routine indoor location and perform multi-location indoor intensives, possibly rotating to the three schools
- Recognize difficult logistics inside classrooms (noise, space, disruption)
**Collect and QC Data**

**Figure H-2.** Scatter plot comparison of four collocated samples from the summer IOP. Large outliers are circled and the pollutant identified. The lines indicate the 1:1 ratio (solid) and the 30% uncertainty (dotted) range.

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Selected MSAT concentration ranges at each school during both intensive operating periods and the national ranges during 2003–2005 (5th to 95th percentiles) (McCarthy et al., 2009).
Diurnal pattern is important for school day exposures

Potential option for mitigation of exposure is to change hours of operation for high school
• Near-road school concentrations were higher when winds were from the road.
• Near-road school concentrations were 2 to 3 times higher than upwind school concentrations.
• Concentrations are greatest when winds are lowest.
Average hourly weekday volumes for small vehicles (less than 21 feet in length) and large vehicles (greater than 40 feet in length) pre-expansion (June–August 2007) and post-expansion (June–August 2008).
Pre-expansion (summer 2007, gray) and post-expansion (summer 2008, black) concentrations for Fyfe (left) and Hancock (right) on weekdays.
Gaseous MSAT Concentrations Before and After US 95 Expansion

2-hr. integrated samples at 9–11AM and 1–3 PM on 14 days in 2007 and 14 days in 2008.

Too few samples to identify significant differences.

Pre-expansion (May–June 2007, red) and post-expansion (January 2008, blue) concentration ratios for Fyfe/Hancock.
Effective filter efficiency: original system about 74%; improved system about 97%.

Effective filter efficiency: original system about 61%; improved system about 78%.
Take Action

- Filtration system installation at near-road schools
- Behavior modification
  - Leave doors/windows closed in classrooms that have doors to the outside
  - Avoid early morning recess/gym class near roads
  - Change timing of HVAC system operations to avoid early morning intake of air
  - Implement bus anti-idling measures

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Wrap Up

- Establish a stakeholder group
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- Set project goals
- Design full project
- Collect and QC data
- Interpret data & recommend actions
- Take action

- Resources and references
- Evaluation forms
Resources and References

- Resources are available at [http://www.epa.gov/ttn/amtic/toxdat.html](http://www.epa.gov/ttn/amtic/toxdat.html)
  - Presentations made on air toxics studies conducted by EPA, tribal, state, and local organizations.
  - Air Toxics Data Analysis Workbook and Training Presentations and Webinars.

- References for citations in this training session are provided in the Air Toxics Data Analysis Workbook