Three Projects and Six QA Tips

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TDEnviro

About TD Enviro

We work with State, Local, Tribal government and Community Groups on study design, measurements, data analysis, and insights.
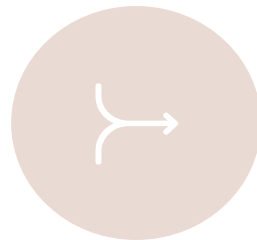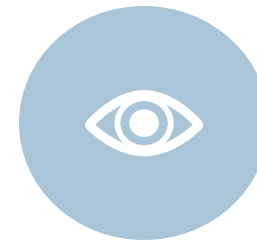

OBJECTIVE

INSTRUMENTS & SENSORS

DATA MANAGEMENT SYSTEMS

DATA AGGREGATORS

ANALYSIS & VISUALIZATION

INTERPRETATION

ACTION
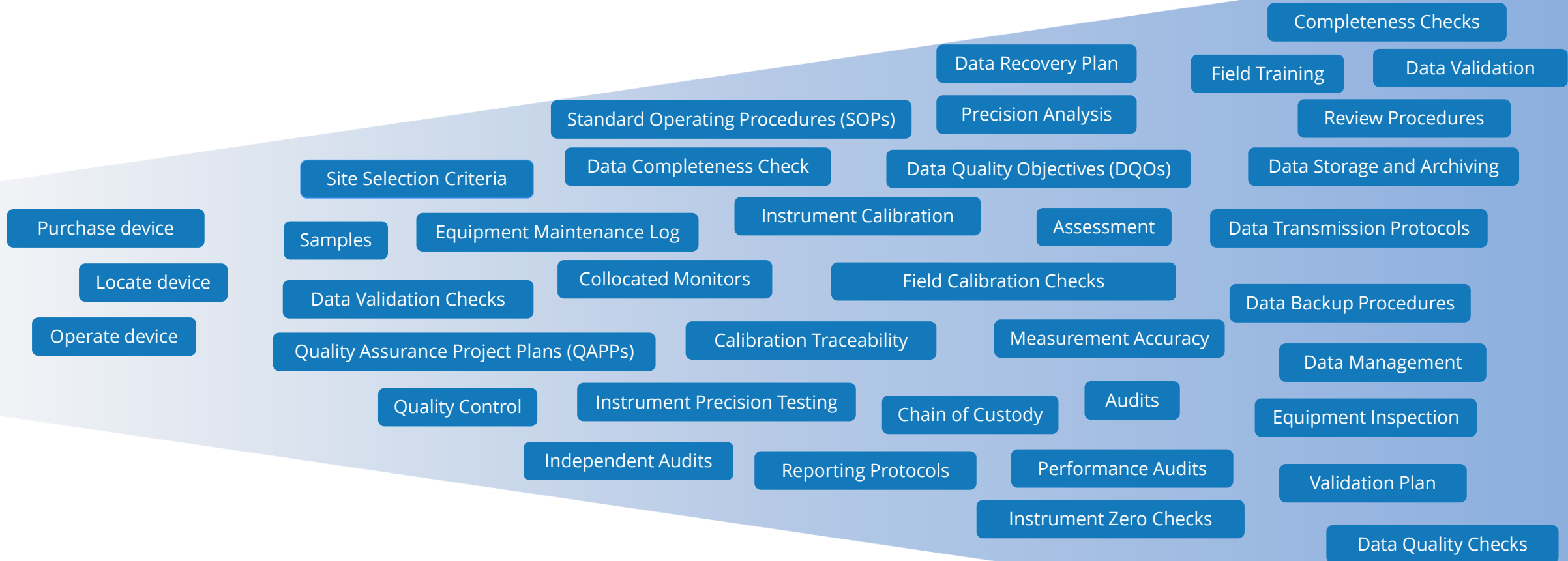
BENEFITS

Cover three projects and some of the QA decisions we made.

More QA Activities = More Applications

Completeness Checks

Data Recovery Plan

Field Training

Data Validation

Standard Operating Procedures (SOPs)

Precision Analysis

Review Procedures

Data Completeness Check

Data Quality Objectives (DQOs)

Data Storage and Archiving

Site Selection Criteria

Instrument Calibration

Purchase device

Equipment Maintenance Log

Assessment

Data Transmission Protocols

Samples

Locate device

Collocated Monitors

Field Calibration Checks

Data Validation Checks

Data Backup Procedures

Operate device

Quality Assurance Project Plans (QAPPs)

Calibration Traceability

Measurement Accuracy

Data Management

Quality Control

Instrument Precision Testing

Chain of Custody

Audits

Equipment Inspection

Independent Audits

Reporting Protocols

Performance Audits

Validation Plan

Instrument Zero Checks

Data Quality Checks

Increasing data quality and confidence

Few Applications

Lots of Applications

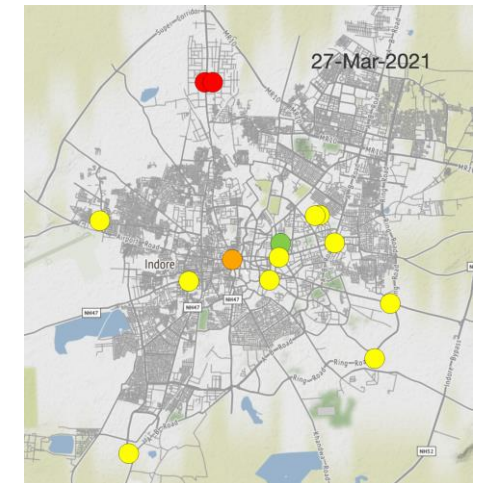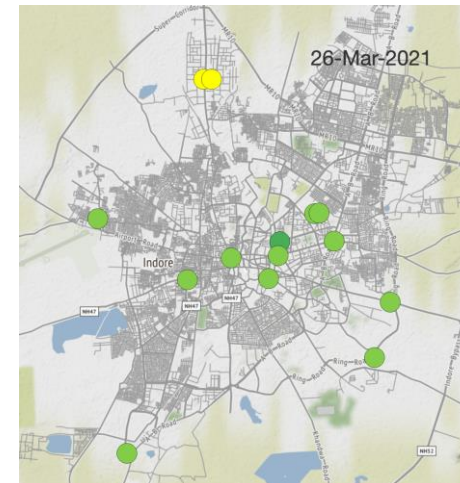TD Enviro

Community-Led Study in Indore, India

Agency: US Agency for International Development

Objective: Detect air quality throughout a city of 3.2M with only one real-time air monitoring station. Community members need access to data and air quality education and actions they can take to protect themselves and reduce pollution.

Approach:

- People first

- Clean Air Guides (local community members) deployed and maintained sensors; conducted local outreach

- Quarterly analysis/interpretation

- Reviewed summaries with Clean Air Guides

Team: JSI, TD Enviro

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Community-Led Study in Indore, India

Procurement - Wrote lots of requirements into the Tender for sensor manufacturers to submit bids

- Prior independent evaluations
- Collocation – beginning, during, and end of project
- Data correction and quarterly data deliveries
- Data management system
- Training
- Support in India

All of these have a direct affect on QA

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Community-Led Study in Indore, India

Collocation – City and State Agencies were skeptical of air sensors, so a collocation was needed.

2-week collocation & training

U.S. EPA metric	EPA target value	Value from MPPCB collocation site (Chhoti Gwaltoli)	Result
Bias slope	1.0 ± 0.35	0.85	✓ Meets target
Intercept (b)	$-5 \leq b \leq 5$ µg/m³	+4.55 ug/m³	✓ Meets target
Linearity coefficient of determination (R^2)	> 0.70	0.85	✓ Meets target
Normalized root mean square error	<30%	27%	✓ Meets target
Data completeness	>75%	93%	✓ Meets target

Collocation results at the PCB site (Chhoti Gwaltoli) show that the $PM_{2.5}$ air sensors (after correction) meet the U.S. EPA's Performance Metrics and Target Values for $PM_{2.5}$ Air Sensors.

Collocation with reference for the study

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AQEarth: TriChapter Region of the Navajo Nation

Agency: NIH/National Institutes of Environmental Health Sciences

Partners: Ojo Encino, Counselor, and Torreon Chapters the Navajo Nation

Objective: SBIR to help communities with air monitoring needs of five very different locations.

Approach:
- Planning and study design
- Deployment of instruments and sensors
- Training of site techs
- Data assessment and management
- Data analysis

Team: 2B Tech, TD Enviro, Montrose

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AQEarth: TriChapter Region of the Navajo Nation

Air monitoring objectives:

- Establish an air quality **baseline** to better understand local influences and background air quality in terms of O_3, $PM_{2.5}$, and NO_x

- Generate data that can be used to quantify and **understand local pollution exposure**

- Investigate spatial distribution patterns of measured pollutants across the area to characterize air quality by space and time. Understand if pollutants are **transported into (or out of)** the TriChapter region, such as ozone from Albuquerque or other distant source regions.
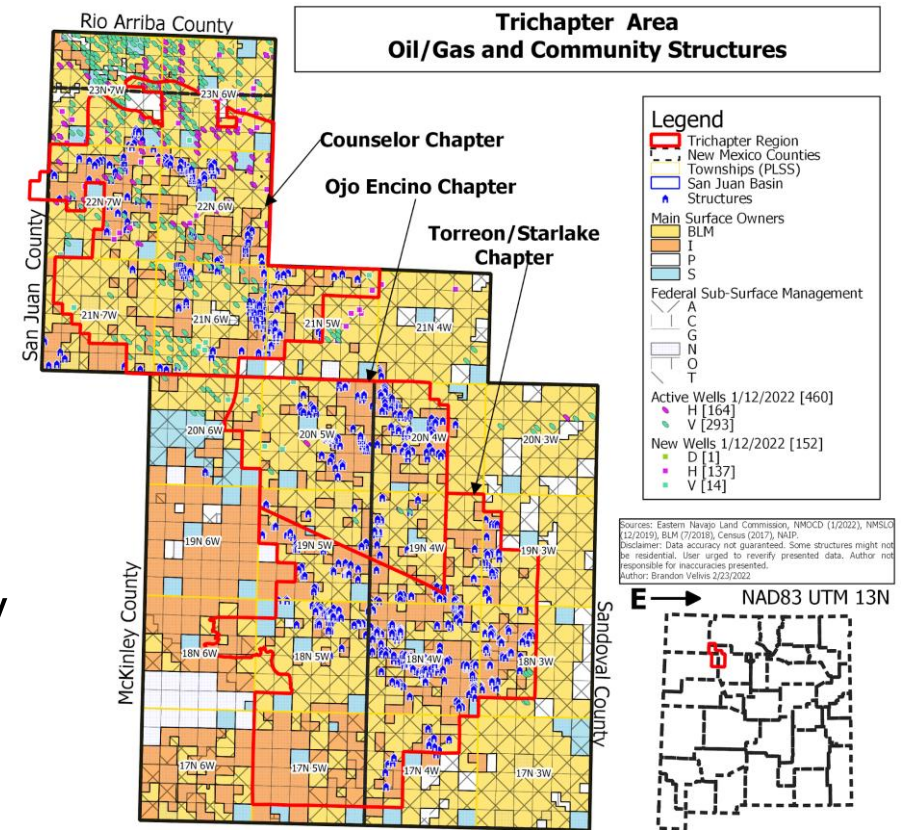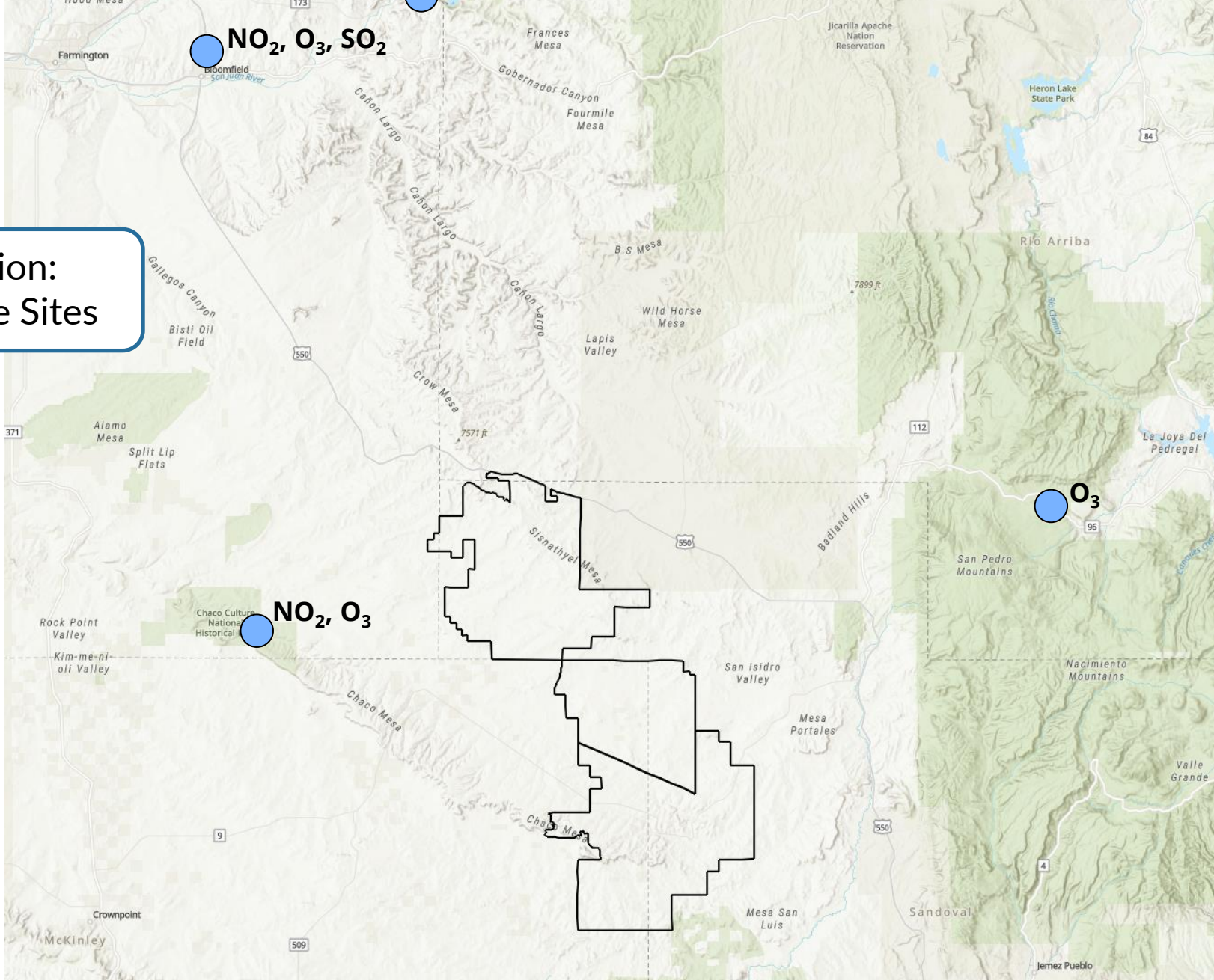

Used these to guide Quality Assurance Project Plan development

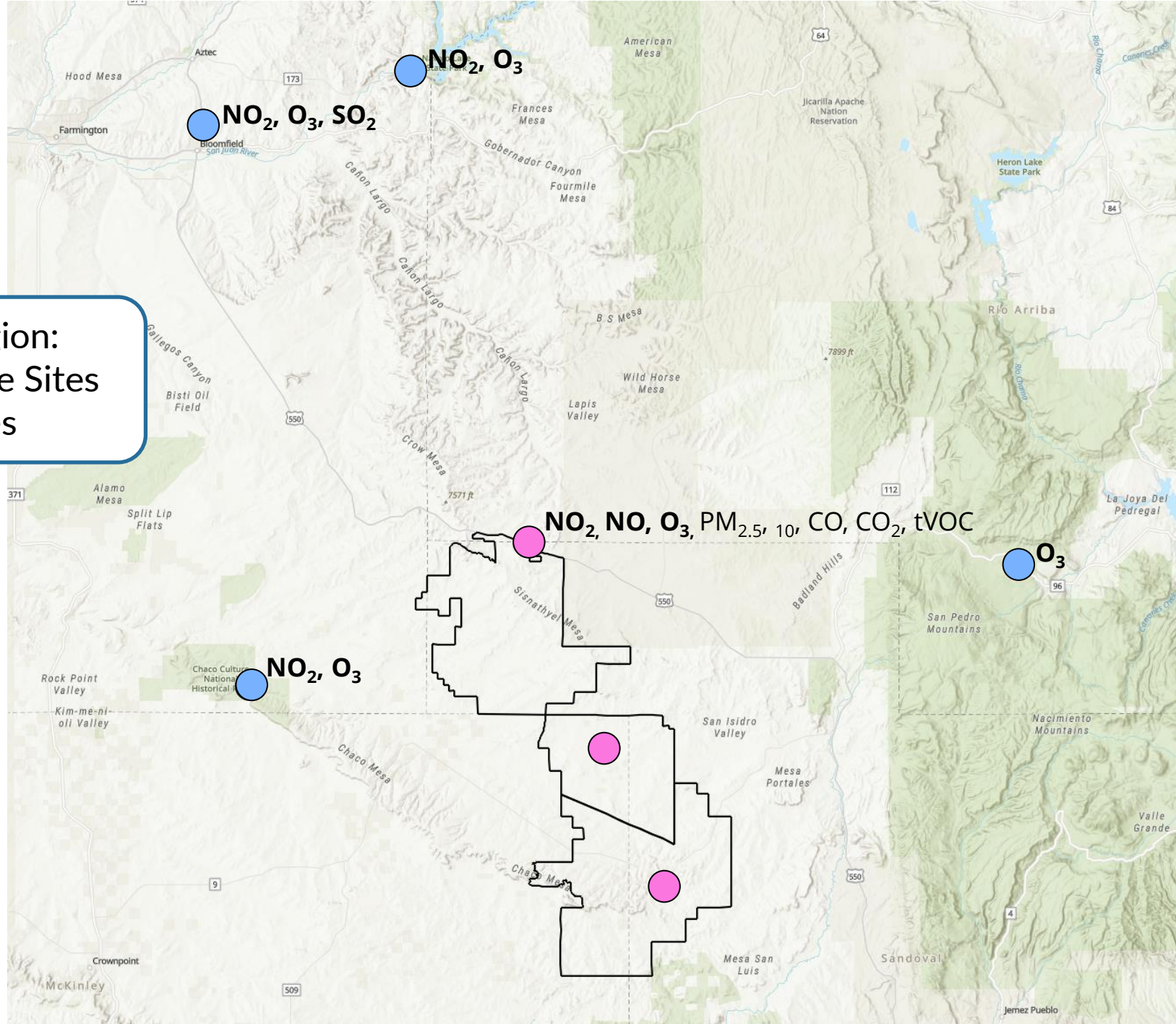# Regional Map

TriChapter Region: Existing Reference Sites

NO₂, O₃, SO₂

O₃

NO₂, O₃

Regulatory Monitors

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Regional Map

TriChapter Region:
Existing Reference Sites
AQSync Sites

NO₂, O₃

NO₂, O₃, SO₂

NO₂, NO, O₃, PM$_{2.5, 10}$, CO, CO₂, tVOC

O₃

NO₂, O₃

Regulatory Monitors

AQSyncs

Regional Map

TriChapter Region:
Existing Reference Sites
AQSync and AQLite Sites

NO_2, O_3

NO_2, O_3, SO_2

NO_2, NO, O_3, $PM_{2.5, 10}$, CO, CO_2, tVOC

O_3

NO_2, O_3

Regulatory Monitors
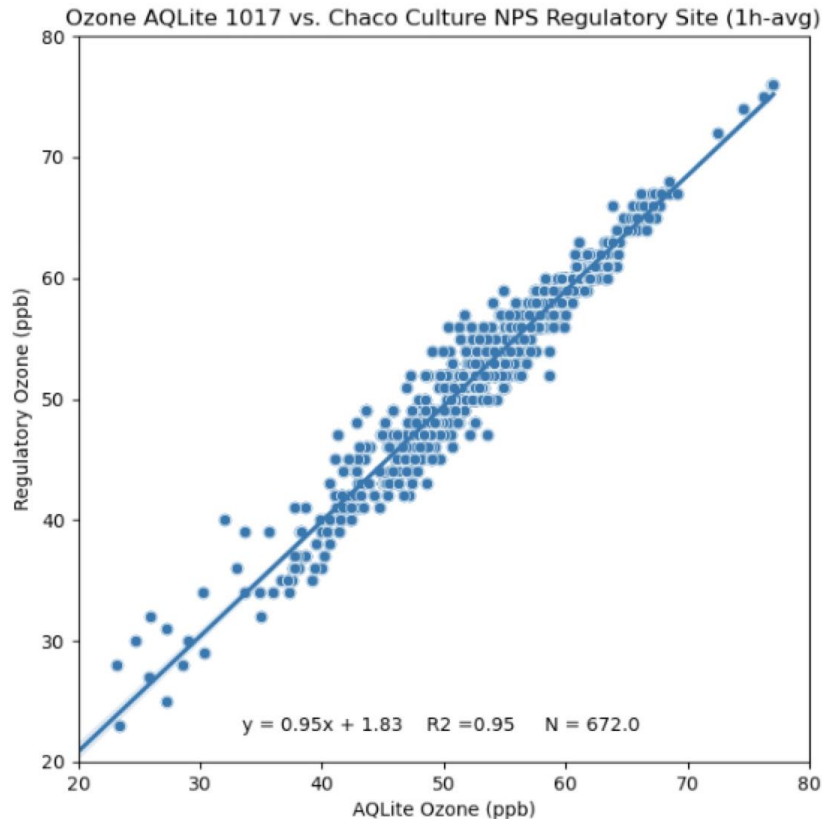
AQSyncs

AQLites

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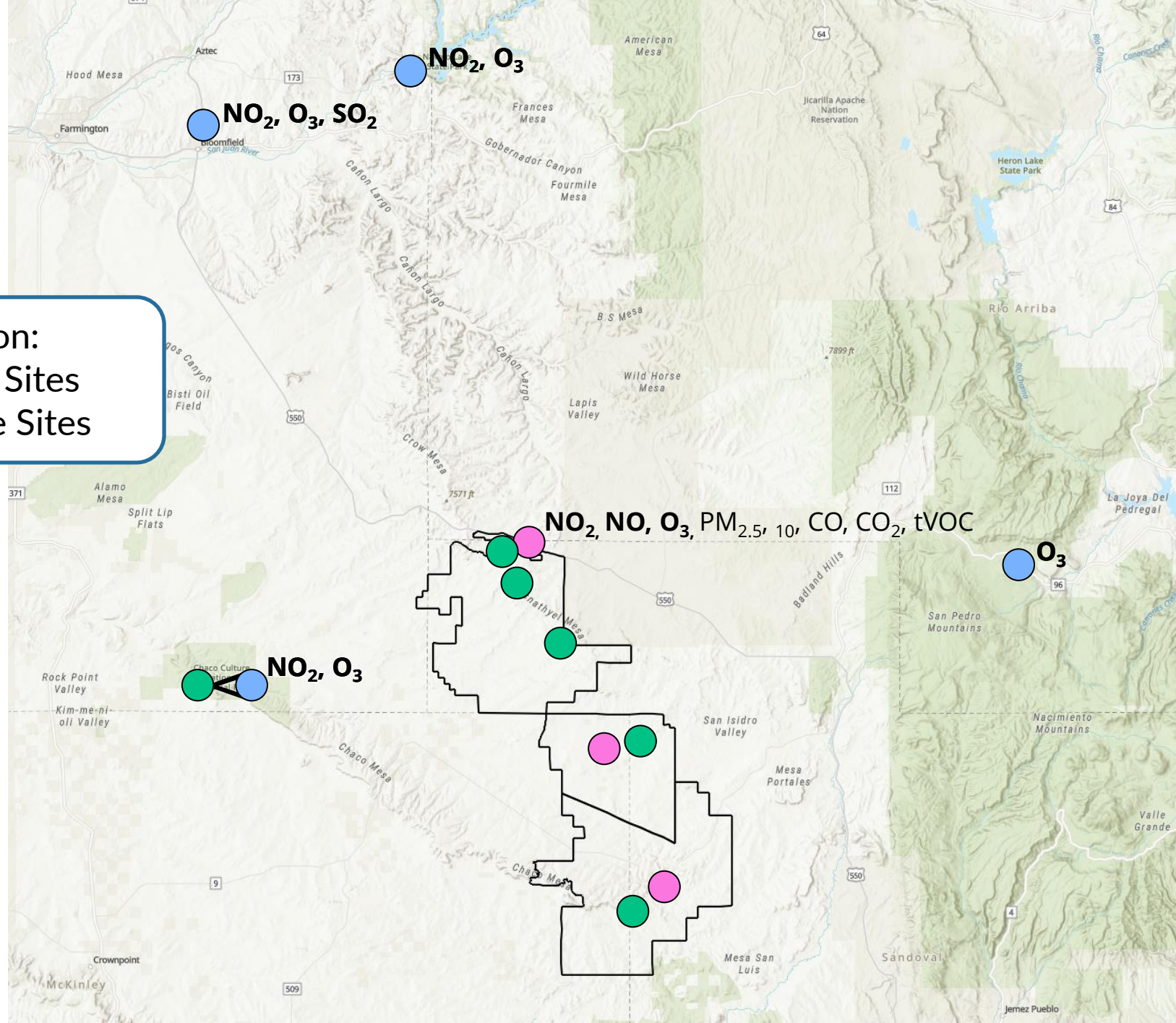
AQEarth: TriChapter Region of the Navajo Nation

Quality Assurance Project Plan was critical in guiding our team and establishing credibility for this hybrid air monitoring program.

- Developed a programmatic way to create and update QAPPs to streamline the process. This will
  - Make it easier to create QAPPs
  - Allows us (and others) to spend less time on the mechanics of creating a QAPP
  - More time on study designs, outcomes, DQOs, etc.
  - Update the QAPP when things change (project team, schedule, etc.)
- Working on ways to streamline establishing Data Quality Objectives
  - Tool to compare different sensors/instruments to determine that DQOs are needed to achieve a monitoring objective
  - For example, experiment to see if *sensor A* or *instrument B* can meet the study objectives and establish the number of samples needed to meet the DQOs.

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AQEarth: TriChapter Region of the Navajo Nation

Collocation was needed to demonstrate that this type of monitoring with instruments (O_3) and air sensors ($PM_{2.5}$) is accurate and credible.

Ozone AQLite 1017 vs. Chaco Culture NPS Regulatory Site (1h-avg)

$y = 0.95x + 1.83 \quad R2 = 0.95 \quad N = 672.0$

Chaco Canyon Monitoring Station
Image Credit: Katy Warner, NPS

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Bay Air Center

Agency: Bay Area Air Quality Mgmt. District

Bay Air Center

- Provide technical assistance to communities interested in understanding air quality
- Build technical capacity in local organizations
- Provide accessible resources on best practices and methods
- Support Air District initiatives and staff

Team: TD Enviro, Kearns & West, T&B Systems, and InterEthnica,

Services

- ✓ Support community-led monitoring
- ✓ Data & information analysis
- ✓ Capacity building & training
- ✓ Awareness and outreach support
- ✓ Action development
- ✓ Grant support

Bay Air Center: Community Support

SVS collocated with eight Clarity sensors measuring NO_2

The Sensor Verification System (SVS):

- Flexible approach to sensor QA/QC
- Quantify sensor response as deployed in the field
- Check all sensors in a network over time

What's in the SVS:

- FEM instruments – FEM (O3, NO2)
- High-quality instrument (BC, PM2.5)
- A rugged case, easy setup (<5 mins)
- Powered by wall and battery (up to 24 hours)
- Automate communications (cellular)
- Onboard display screen to ensure it's operating

brightline DEFENSE

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Bay Air Center: Community Support

- Running PM$_{2.5}$ network since 2016
- Wanted to establish a baseline of Black Carbon for *"Diesel Free by 33."*
- Applied for CARB grant
- Work with them on their proposal with:
  - Monitoring objectives
  - Network design and site types
  - Collocation plan for this hybrid network
  - Budget estimating
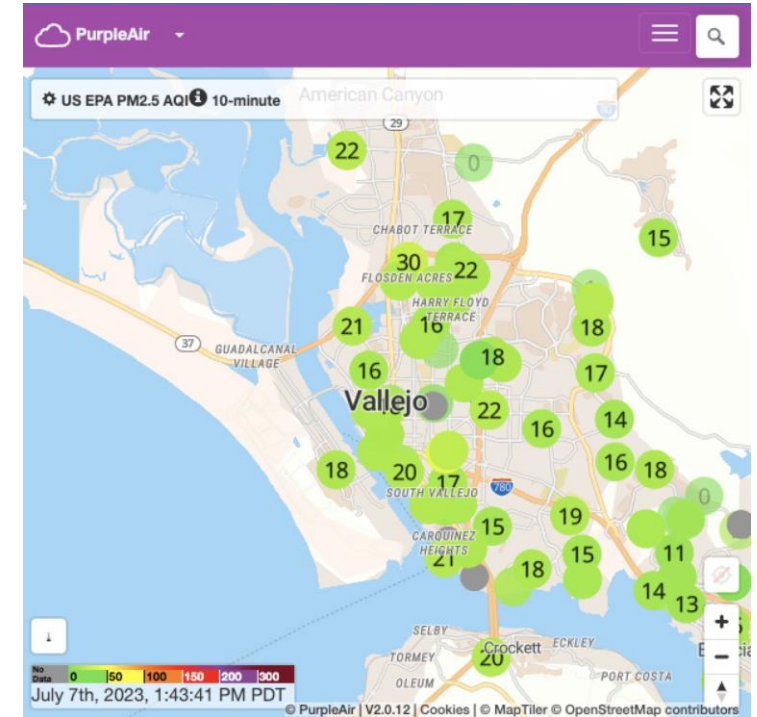
Need monitoring?

Do you really need to monitor? If you had the ideal data now, what would you do next?

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Matchmaking is a must.

In advance, match the device and its performance with the objectives, analysis, and outcomes you're seeking.

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Plan or Fail.

Plan, plan, and plan.....and don't buy anything without a plan in place.

You NEED to collocate.

Collocation is a fundamental requirement to build confidence and trust in your devices, operations, and resulting data.

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25/75% Rule.

Spend <25% of your budget on hardware/software

Invest >75% of your budget on people, training, operations, data analysis, and communications

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4X Rule.

When working with groups new to air quality, plan for spending more time on meetings, listening, discussing, and fully understanding. This in-depth capacity building help improves QA across the whole project.

Contact

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Contact us to help with any aspect of your
air monitoring programs:
- Study design
- Measurements
- Data management
- Analytics
- Training & mentoring
- Community engagement
- Capacity building

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