Utah Air Quality Monitoring Network

Five-year Network Assessment

State of Utah

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EXECUTIVE SUMMARY

A technical assessment of Utah air monitoring network was conducted, in accordance with federal regulations (40 CFR, section 58.10). The assessment consisted of determining if new sites are needed or existing sites are no longer needed and whether the network meets monitoring objectives. The monitoring objectives included evaluating whether the network supports compliance with the NAAQS, Air Quality Index (AQI) reporting, air quality models, air pollution research studies as well as SIP development and maintenance. Minimum federal monitoring requirements, EPA siting criteria, population growth and budgetary constraints were also considered in the evaluation process. This assessment also satisfies the requirements for the annual network plan for 2015.

The proposed network modifications are summarized as follows:

- Establish a site in northern Salt Lake County to help assess population exposure in this area.
- Complete the set-up of a new multi-pollutant monitoring station, Copper View, in the southeast area of Salt Lake County, with objective to support air pollution modeling efforts and supply air quality data to the increasing population in the southern area of Salt Lake Valley. FRM/FEM $PM_{2.5}$, NO_2, O_3, NO_y will be monitored at this site.
- Complete the re-location of Tooele #3 (T3) station to Erda, a high-ozone concentration area in Tooele County. Ozone, FRM/FEM $PM_{2.5}$ and NO_2 will be measured at this site.
- Establish a site in Cedar City, Iron County, by 2018 when its population is projected to reach the federal monitoring threshold for $PM_{2.5}$ and ozone.
- Establish near-road NO_2 monitoring sites in Salt Lake City, Provo-Orem and Ogden-Clearfield CBSAs as soon as funding becomes available.
- Shut down Logan #4 (L4) site by 2016 and replace it by Smithfield station due to violation of siting criteria.
- To reduce monitoring redundancy, consolidate North Provo and Lindon sites at a new location.
- Re-locate the Spanish Fork (SF) station to a nearby site due to planned construction works at its current location.
- Add a continuous $PM_{2.5}$ sampler at Vernal #4 (V4).
- Add a CO sampler at near-road NO_2 monitoring site in Salt Lake City CBSA once the site is established.

Utah Division of Air Quality will continue reviewing all stations to ensure that they meet required acceptance criteria and monitoring objectives. Any sites that do not meet the requirements will be evaluated for future action.

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1. Background and Overview

1.1 Meteorology and Topography

Given its unique topography and meteorology, Utah continually faces severe air quality challenges, mainly in the Salt Lake Valley along the Wasatch Front and the Uinta Basin. The Wasatch Mountains east of the valley, Oquirrh Mountains to the west and the Traverse Mountain to the south form a basin-like topography. The valley is open to the Great Salt Lake to the northwest, with weak nighttime down-valley flows often carrying polluted air over the lake. The air is then carried back into the valley as a lake breeze on the following day. The Uinta Basin is an enclosed basin that lies in the northeast corner of Utah. The Basin is bounded on the north by the Uinta Mountain range, on the south by the Tavaputs Plateau, on the west by the Wasatch Range and on the east by elevated terrain separating it from Piceance Basin in Colorado. Significant topographical variations, on the order of tens to hundreds of feet, exist within the Basin, which is mostly comprised of Duchesne and Uintah Counties. High-pressure weather systems and high solar zenith angle during winter lead to cold-air pools that periodically trap precursor gases in the Uinta Basin and Salt Lake Valley.

1.2 Major Pollutants and Emission Sources

Utah is often susceptible, during winter-time inversions, to elevated levels of ozone in the Uinta Basin and fine particulate matter ($PM_{2.5}$) along the Wasatch Front and the Cache Valley. These pollutants are of greatest concern in this state, particularly ozone since its formation in the Basin occurs in winter during inversions. High-pressure weather systems during winter lead to cold-air pools that periodically trap precursor gases, most notably volatile organic compounds (VOCs) and nitrogen oxides (NO_x), in the valleys between the Wasatch and Oquirrh Mountains. These precursor gases subsequently react in the stagnant air to form ozone and $PM_{2.5}$, leading to pollution levels occasionally exceeding the federal National Ambient Air Quality Standards (NAAQS). Snow cover can also enhance ozone formation by increasing sunlight reflection (surface albedo) into the atmosphere[1]. The complex chemical reactions and unique circumstances involving the formation of these pollutants make it challenging to develop effective control strategies. Summertime ozone formation over the Great Salt Lake and along the Wasatch Front is also of concern. High levels of ozone were recorded near the Great Salt Lake during 2010-2013[2].

[1]UDAQ, 2014 Uinta Basin Winter Ozone Study Final Report.
[2] UDAQ, 2012 Utah Ozone Study.

Major industrial sources in the Salt Lake Valley include Kennecott Copper mine and smelter located at the base of the Oquirrh Mountains in addition to oil refineries located between Salt Lake City and Bountiful to the north. Major roadways in the valley consist of Interstates 15, 80 and 215. I-15 spans the length of the Salt Lake Valley from north to south while I-80 runs from east to west across the valley and through Salt Lake City. I-215, on the other hand, forms a loop around the northern portion of the valley. Main industrial sources in the Uinta Basin comprise oil and gas wells, which displayed a considerable increase in production in recent years. Currently, about 12000 gas- and oil-producing wells are in operation, with about 1000 wells added each year (Utah Department of Natural Resources, Division of Oil, gas and mining[3]). Moreover, a 500-megawatt coal fired power plant (Bonanza) operates in the Basin. There is also some agricultural production, primarily alfalfa and corn along with other hay and grain crops.

1.3 Demography

The state of Utah can be divided into 10 core based statistical areas (CBSAs) with population estimates as shown in table 1. Each CBSA corresponds to a metropolitan or micropolitan statistical area (MSA and µSA, respectively), depending on its population size. The list of CBSAs was derived from the U.S. Census Bureau while the population estimates for each CBSA were retrieved from the sub-county population projections report produced by Utah's Governor's Office of Management and Budget (http://gomb.utah.gov/budget-policy/demographic-economic-analysis/). The reported projections were derived using 2010 Census data as a baseline.

1.4 Emission Inventories

Table 2 lists the emission rates (in tons/year) of criteria and hazardous air pollutants, including CO, NO_x, PM_{10}, $PM_{2.5}$, SO_x and VOCs, by county. Data was acquired from the 2011 triennial emissions inventory, which corresponds to the most current inventory at the time of writing. The inventory covers over 440 individual point sources, 99 area source categories as well as 12 non- and on-road source categories. Statewide source-specific emission estimates (in tons/year) are shown in figure 1 for common criteria and hazardous air pollutants.

[3] Utah Oil and Gas: http://oilgas.ogm.utah.gov.

Table 1. Core Based Statistical Areas (CBSAs), including metropolitan and micropolitan statistical areas (MSA and µSA, respectively), and their corresponding population estimates in the state of Utah.

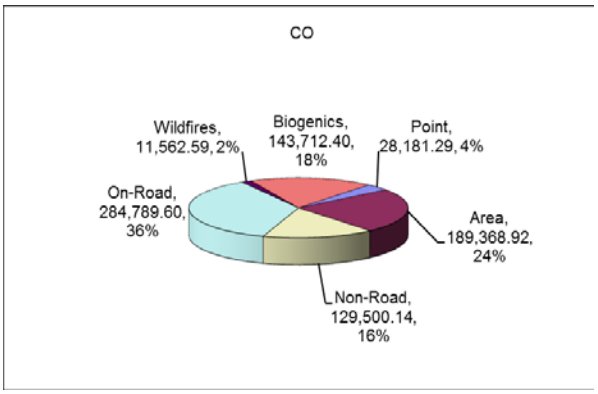
CBSA	Counties	Census 2010	Population estimate (2020)	Population estimate (2030)
Salt Lake City MSA	Tooele, UT Salt Lake, UT	1,087,873	1,255,736	1,440,329
Provo-Orem MSA	Juab, UT Utah, UT	526,810	682,314	850,304
Ogden-Clearfield MSA	Box Elder, UT Davis, UT Morgan, UT Weber, UT	597,159	681,907	766,860
Heber µSA	Wasatch, UT	23,530	32,741	44,549
Logan UT-ID MSA	Cache, UT Franklin, ID	Total: 125,442 Cache County, UT: 112,656	Cache County, UT: 139,228	Cache County, UT: 168,136
Saint George MSA	Washington, UT	138,115	196,762	280,558
Cedar City µSA	Iron, UT	46,163	57,055	71,687
Price µSA	Carbon, UT	21,403	21,602	22,092
Vernal µSA	Uintah, UT	32, 588	38,982	41,099
Summit Park µSA	Summit, UT	36,324	45,491	56,890

Table 2. 2011 emission inventory estimates (tons/year) by county for CO, NO_x, PM_{10}, $PM_{2.5}$, SO_x and VOCs.

County	CO	NO_x	PM_{10}	$PM_{2.5}$	SO_x	VOCs
Beaver	13,876.11	2,078.78	2,654.91	435.75	75.43	26,490.32
Box Elder	40,011.70	7,365.61	10,313.27	2,121.20	163.36	38,770.82
Cache	22,510.87	3,842.06	10,853.50	1,646.53	171.90	13,437.44
Carbon	11,115.87	7,152.88	4,676.13	1,151.84	8,381.46	17,875.37
Daggett	3,858.12	1,324.00	604.13	94.49	2.42	8,386.19
Davis	38,461.71	9,368.20	7,601.20	1,806.84	474.24	12,718.38
Duchesne	19,793.48	11,934.27	6,911.63	1,081.65	144.44	57,798.47
Emery	30,834.95	22,211.84	5,390.12	1,133.08	7,245.87	36,804.91
Garfield	23,180.30	1,056.79	2,717.87	506.42	16.81	44,847.92
Grand	22,148.98	3,124.67	1,831.09	445.87	26.76	37,252.92
Iron	26,642.81	4,254.25	6,178.28	1,177.85	166.82	37,643.98
Juab	18,322.63	3,319.29	2,845.94	567.19	94.11	26,898.15
Kane	22,008.49	1,264.25	2,226.77	358.35	22.42	43,727.23
Millard	35,525.31	33,160.33	7,269.87	1,889.21	5,084.95	51,878.47
Morgan	5,963.71	2,581.89	2,898.26	377.24	385.47	7,401.38
Piute	6,527.57	309.09	838.20	145.77	6.43	8,931.86
Rich	7,018.27	547.32	1,421.66	274.58	8.66	8,961.72
Salt Lake	145,225.46	31,940.71	31,873.80	6,747.42	4,207.51	35,626.08
San Juan	36,430.76	3,051.58	6,673.49	952.28	53.40	85,753.34
Sanpete	10,699.55	1,515.50	5,847.13	790.96	85.02	15,801.64
Sevier	12,780.24	2,092.08	6,756.62	916.45	91.36	18,106.24
Summit	15,065.71	4,465.99	7,736.40	1,144.95	215.35	18,903.71
Tooele	37,605.71	8,243.43	8,057.50	2,359.79	223.87	45,444.17
Uintah	26,282.06	12,347.51	9,546.65	1,419.76	228.44	109,809.23
Utah	63,420.55	14,612.66	12,551.21	3,045.32	426.02	30,939.27
Wasatch	8,704.82	1,448.23	3,688.95	596.57	16.39	12,590.25
Washington	39,317.60	6,026.07	11,644.41	1,697.22	91.64	44,442.68
Wayne	10,747.14	528.52	1,439.57	192.13	25.56	22,362.52
Weber	33,034.45	6,811.43	10,331.65	1,815.10	221.75	12,085.62
Statewide County Totals	**787,114.94**	**207,979.20**	**193,380.23**	**36,891.84**	**28,357.85**	**931,690.27**
Point Source Portables	*162.73*	*393.93*	*86.06*	*37.50*	*60.39*	*39.19*
Total	**787,277.67**	**208,373.14**	**193,466.28**	**36,929.34**	**28,418.24**	**931,729.46**

Figure 1a-f. 2011 Statewide emissions inventory (in tons/year and percent contribution), by source category, for a) CO, b) NOx, c) PM10, d) PM2.5, e) SOx and f) VOCs.

a)



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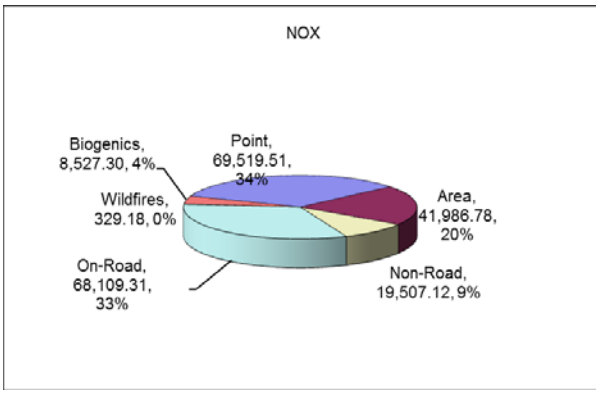
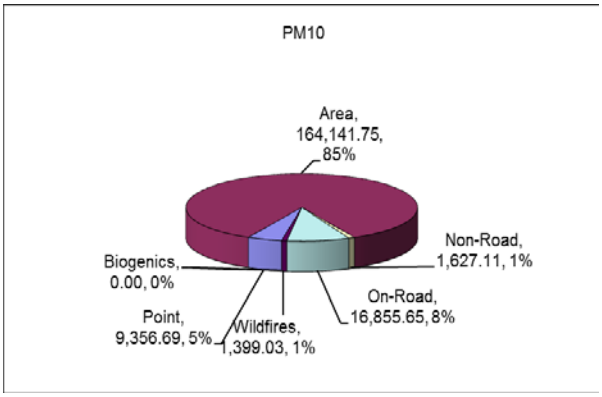


c)



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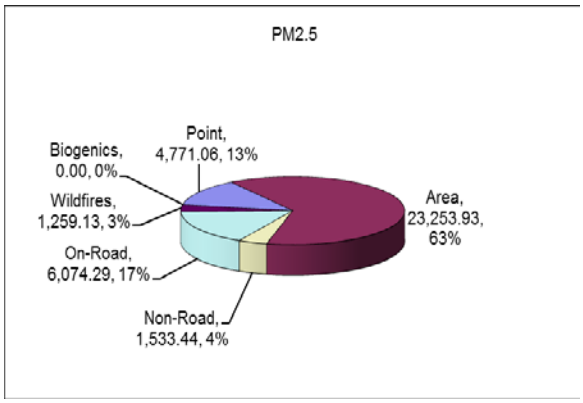
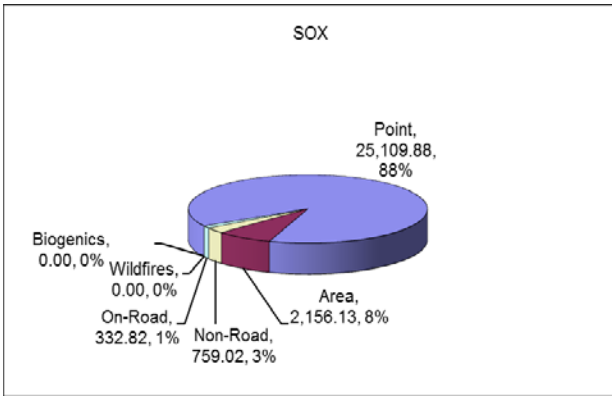
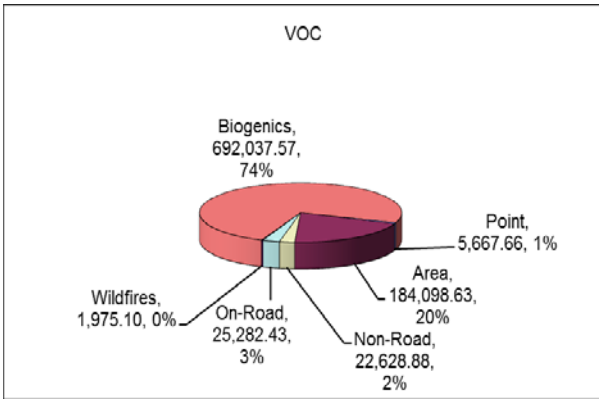


e)



f)



2. Air Monitoring Network Design

The air monitoring network at the Utah Division of Air Quality (UDAQ) currently includes twenty-four sites (including sites currently being setup) located throughout the state of Utah. The monitoring stations are strategically situated to measure both local and regional levels of air pollutants, including particulate matter (PM) and gaseous pollutants. Meteorological parameters are also concurrently measured with air pollution parameters at some of the sampling sites. The location and elevation of the monitoring sites, EPA Air Quality System (AQS) site codes and measurement parameters at each station are shown in tables 3 and 4.

Data collected at these stations is primarily used for the following objectives:

- Evaluating population exposure to air pollutants
- Tracking the spatial distribution of air pollutants
- Assessing historical trends in air pollution
- Supporting compliance with ambient air quality standards (primary and secondary)
- Supporting air quality models and research studies
- Informing the general public of air pollution levels
- Developing state implementation plans (SIPs) and legislative air pollution control measures
- Tracking the effectiveness of air pollution control strategies
- Activating control measures during high air pollution episodes, such as banning wood burning during winter-time inversions
- Monitoring of specific emission sources and air pollutants

The sampling sites are strategically located to meet the aforementioned monitoring objectives. For instance, some sites are selected to measure PM concentrations in highly-populated areas while others are selected to determine the extent of ozone (and its precursors) transport from the Wasatch Front to the Uinta Basin. Site-specific objectives as well as measurement parameters, sampling frequency and method are provided in appendix A. The monitoring objectives and spatial scale of representativeness at each site are also presented.

However, considering the continuously-evolving federal air quality standards, growing economy and population as well as budgetary constraints, efficient and representative pollution monitoring in the state of Utah necessitates further optimization of the air monitoring network. This includes reducing monitoring redundancy, adding new sites or sampling equipment, focusing on monitoring pollutants of current and local concern (e.g. air toxics, ozone and its precursors) as well as conducting special studies to address pressing air quality issues, as discussed in the subsequent sections. To that end, the following factors were considered in the air monitoring network review:

- EPA siting requirements (40 CFR, part 58).
- Compliance with the NAAQS

- Air Quality Index (AQI) reporting and forecasting
- SIP development and maintenance
- Air quality models and control strategy selection
- Air quality research studies and special monitoring programs
- Population growth
- Funding
- Logistical issues

Table 3. Utah air monitoring network.

County	AQS code	Station Name	Station Address	Latitude	Longitude	Elevation (m)
Cache County	49-005-0004	Logan, L4	125 W. Center St., Logan City	41.7312	-111.8375	1380
	49-005-0007	Smithfield, SM	675 W. 220 N., Smithfield	41.842778	-111.851944	1377
Box Elder County	49-003-0003	Brigham City, BR	140 W. Fishburn, Brigham City	41.4928	-112.0187	1334
Weber County	49-057-1003	Harrisville, HV	425 W. 2550 N., Harrisville	41.3028	-111.9883	1331
	49-057-0002	Ogden #2, O2	228 E. 32nd St., Ogden City	41.207	-111.9751	1316
Davis County	49-011-0004	Bountiful Viewmont, BV	1380 N. 200 W., Bountiful	40.903129	-111.885569	1309
	49-011-6001	Antelope Island, AI	No street address; on an island	41.0393	-112.2313	1359
	49-011-6002	Syracuse, SY	4700 W. 1700 S., Syracuse	41.0885	-112.1188	1284
Salt Lake County	49-035-3011	Air Monitoring Center, AMC	2861 W. Parkway Blvd., West Valley	40.7119	-111.9610	1292
	49-035-3012	Herriman #3, H3	14058 Mirabella Dr., Herriman	40.496408	-112.036305	1534
	49-035-3005	Saltair, SA	6640 W. 1680 N., Salt Lake City	40.8059	-112.0498	1282
	49-035-2005	Copper View, CV**	8449 S. Monroe St., Midvale	40.598056	-111.894167	-
	49-035-3006	Hawthorne, HW	1675 S. 600 E., Salt Lake City	40.7335	-111.8717	1306
	49-035-1001	Magna, MG	2935 S. 8560 W., Magna	40.7035	-112.0938	1317
	49-035-3010	Rose Park, RP	1400 W. Goodwin Ave., Salt Lake City	40.7955	-111.9309	1295
Utah County	49-049-4001	Lindon, LN	50 N. Main St., Lindon	40.3388	-111.7133	1442
	49-049-0002	North Provo, NP	1355 N. 200 W., Provo City	40.2535	-111.6632	1402
	49-049-5010	Spanish Fork, SF	2050 N. 300 W., Spanish Fork (airport)	40.1363	-111.6602	1380
Tooele County	49-049-0003	Tooele #3, T3*	451 N. 50 W., Tooele	40.5393	-112.2998	1511
	49-045-0004	Erda, ED**	2135 W. Erda Way	40.600353	-112.355284	-
	49-045-6001	Badger Island, BI	No street address; on an island	40.9421	-112.562	1282
Duchesne County	49-013-0002	Roosevelt, RS	290 S. 1000 W., Roosevelt	40.2941	-110.009	1588
Uintah County*	49-047-1003	Vernal, VL*	220 S. 1000 E., Vernal	40.4523	-109.5097	1603
Uintah County	49-047-1003	Vernal, V4**	628 N. 1700 W., Vernal	40.464971	-109.560733	1667
Carbon County	49-007-1003	Price, P2	351 S. 2500 E., Price, UT	39.5958	-110.77	1740
Washington County	49-053-0007	Hurricane, HC	147 N. 870 W., Hurricane, UT	37.179	-113.3052	992

*Site shut down in January 2015.
**Site setup in progress

Table 4. Measured parameters at the sampling stations in Utah air monitoring network.

Site	Measurement Parameters																			
	$PM_{2.5}$ Filter			$PM_{2.5}$ Cont.	PM_{10} Filter		PM_{10} Cont.	CO	O_3	SO_2	NO_2, NO, NO_x	NO_y	Pb	Hg	MET	VOCs, SVOCs	Carb. Comp.	BC	NH_3	OC /EC
	24-hr	24-hr, co-located	24-hr, Spec.		24-hr	24-hr, co-located														
Logan	x	x		x	x				x		x				x					
Smithfield	x				x															
Brigham City	x			x					x						x					
Harrisville									x						x					
Ogden #2	x			x	x		x	x	x		x				x					
Bountiful Viewmont,	x		x		x (metals)	x (metals)			x		x				x	x	x	x		
Antelope Island															x					
Syracuse															x					
Air Monitoring Center														x	x				x	
Herriman #3					x				x		x				x					
Saltair															x					
Hawthorne	x		x	x	x		x	x	x	x	x	x	x		x		x			x
Magna	x				x								x		x					
Rose Park	x	x																		
Copper View	Site setup currently in progress																			
Lindon	x	x	x	x	x		x								x					
North Provo	x			x	x	x	x	x	x		x				x					
Spanish Fork	x								x						x					
Tooele #3*	x			x					x						x					

Table 4 (cont'd.)

Site	Measurement Parameters																			
	$PM_{2.5}$ Filter			$PM_{2.5}$ Cont.	PM_{10} Filter		PM_{10} Cont.	CO	O_3	SO_2	NO_2, NO, NOx	NO_y	Pb	Hg	MET	VOCs, SVOCs	Carb. Comp.	BC	NH_3	OC /EC
	24-hr	24-hr, co-located	24-hr, Spec.		24-hr	24-hr, co-located														
Badger Island															x					
Erda	Site setup currently in progress																			
Roosevelt				x					x		x				x					
Vernal, VL*				x					x		x				x					
Vernal, V4									x		x				x					
Price #2									x		x				x					
Hurricane	x			x	x				x		x				x					

*Site shut down in January 2015.

Acronyms and their definitions

MET: meteorological parameters
O_3: ozone
NO_2: nitrogen dioxide
NO: nitric oxide
NO_x: nitrogen oxides
NO_y: total reactive nitrogen
NH_3: ammonia
CO: carbon monoxide
SO_2: sulfur dioxide
EC: elemental carbon
OC: organic carbon
BC: Black carbon
Hg: mercury
Pb: lead
VOCs: volatile organic compounds
SVOCs: semi-volatile organic compounds
Carb. Comp.: carbonyl compounds
24-hr, Spec.: 24-hr speciated PM2.5

3. Network Technical Assessment

The network assessment was conducted using the tools provided by U.S. EPA (NetAssess v0.6b), including the correlation matrix, removal bias, exceedance probability and area served tools. The assessment consisted of evaluating the sites' monitoring objectives and spatial scales (40 CFR, part 58 Appendix D) as well as determining redundant sites or additional sites for inclusion within a geographical area. The assessment also involved evaluating whether the number of monitors within a CBSA meets minimum federal monitoring requirements (40 CFR, part 58, appendix D 4.7) and whether the sites meet EPA siting criteria (40 CFR, part 58). Population estimates within a CBSA were determined using the latest available census data (i.e. 2010 decennial census). Sites' redundancy was determined using the correlation matrix and removal bias tools. The correlation matrix provides the Pearson correlation coefficient (R), relative concentration difference and distance between pairs of sites, where potentially redundant sites exhibit low average relative difference and fairly high correlations with their respective counterparts. The removal bias tool provides an estimate of the concentration at a given location if its existing monitor was removed. The tool uses the nearest monitors to each site to estimate the concentration at the site's location if its monitor had never existed, then calculates the bias by taking the difference between the interpolated value and the measured concentration. A near-zero value indicates a negligible bias if the monitor were removed. On the other hand, a positive or negative average bias suggests that the surrounding monitors would respectively indicate an estimated concentration that is larger or lower than the measured concentration, if the site being examined were removed. Determining whether extra sites should be added to the network was based on results obtained by applying the area served and exceedance probability tools, which provide geographic and demographic information for a given area and indicate the probability that the area will exceed a certain threshold at least once a year.

3.1 Particle Monitoring

3.1.1 FRM $PM_{2.5}$ network

UDAQ currently operates 24-hour Federal Reference Method (FRM) $PM_{2.5}$ samplers throughout the state to demonstrate compliance with NAAQS, evaluate population exposure, support SIP development and model performance evaluation as well as monitor PM levels in source and receptor areas.

3.1.1.1 Area and population served

The area and population served, including sensitive groups (elderly and children), by each FRM $PM_{2.5}$ monitor are shown in table 5. In this analysis, the sites are ranked according to the population they represent, thus reflecting the site's importance in representing population exposure.

Table 5. Area and population served by FRM $PM_{2.5}$ samplers in Utah air monitoring network.

Site	Population Served					Area Served (km^2)
	Total Population	Total Male Population	Total Female Population	Total Population, Age 65 and over	Total Population, Age 0 to 4	
Hawthorne	622,063	310,613	311,450	67,052	46,873	622
Ogden #2	382,127	192,356	189,771	32,907	36,819	1,240
Lindon	311,351	157,862	153,489	18,999	36,728	1,137
Magna	297,997	149,682	148,315	13,825	32,596	555
Spanish Fork	214,191	108,587	105,604	20,965	21,876	14,599
North Provo	156,428	77,897	78,531	11,116	13,742	2,320
Bountiful Viewmont	151,745	75,752	75,993	16,039	14,278	1,760
Hurricane	148,602	73,194	75,408	27,237	13,306	7,580
Logan #4	121,333	60,388	60,945	9,479	12,228	2,267
Rose Park	108,882	55,970	52,912	8,549	11,134	87
Tooele #3	81,343	41,341	40,002	6,483	8,188	24,684
Brigham City	52,013	26,209	25,804	5,776	5,098	4,256
Smithfield	NA					
Herriman #3	NA					

3.1.1.2 Exceedance probability

Figure 2 shows the surface probability map for exceedance of the 24-hr $PM_{2.5}$ NAAQS. It provides information on the spatial distribution of the highest daily values for $PM_{2.5}$ and their probability to exceed 35 $\mu g/m^3$. As can be seen, most monitors are concentrated in areas where the maximum probability of $PM_{2.5}$ exceeding 35 $\mu g/m^3$ is greater than 90%.

3.1.1.3 Historical trends and deviations from NAAQS

National ambient air quality standards for $PM_{2.5}$ were initially established in 1997 then subsequently revised in December 2006 and 2012. EPA lowered the 24-hour $PM_{2.5}$ standard from 65 $\mu g/m^3$ to 35 $\mu g/m^3$ in 2006 then lowered the annual standard from 15 $\mu g/m^3$ to 12 $\mu g/m^3$ in 2012. Both standards are evaluated by considering data collected during a three-year period. The 24-hour standard is met when the three-year average of the 98^{th} percentile 24-hr values is less than or equal to 35 $\mu g/m^3$. The annual standard is met when the three-year average of the annual mean is below 12 $\mu g/m^3$.

Figures 3 and 4 show the three-year average of the 98^{th} percentile and annual mean concentrations in Utah for the period 2000-2014. $PM_{2.5}$ monitoring was discontinued at North Salt Lake in 2007 and Cottonwood and Highland in 2011 because the sites no longer met EPA siting criteria, as demonstrated in the 2010 five-year network assessment report. Moreover, the $PM_{2.5}$ sampler at Harrisville was shut down on December 31, 2013 due to low recorded values relative to other sites within the same CBSA area. As can be observed, while the state is in

compliance with the annual standard of 12 µg/m^3, most areas are not in compliance with the revised 24-hour standard of 35 µg/m^3. For each site, the number of exceedances of 24-hr $PM_{2.5}$ NAAQS during 2012-2014 is shown in table 6.

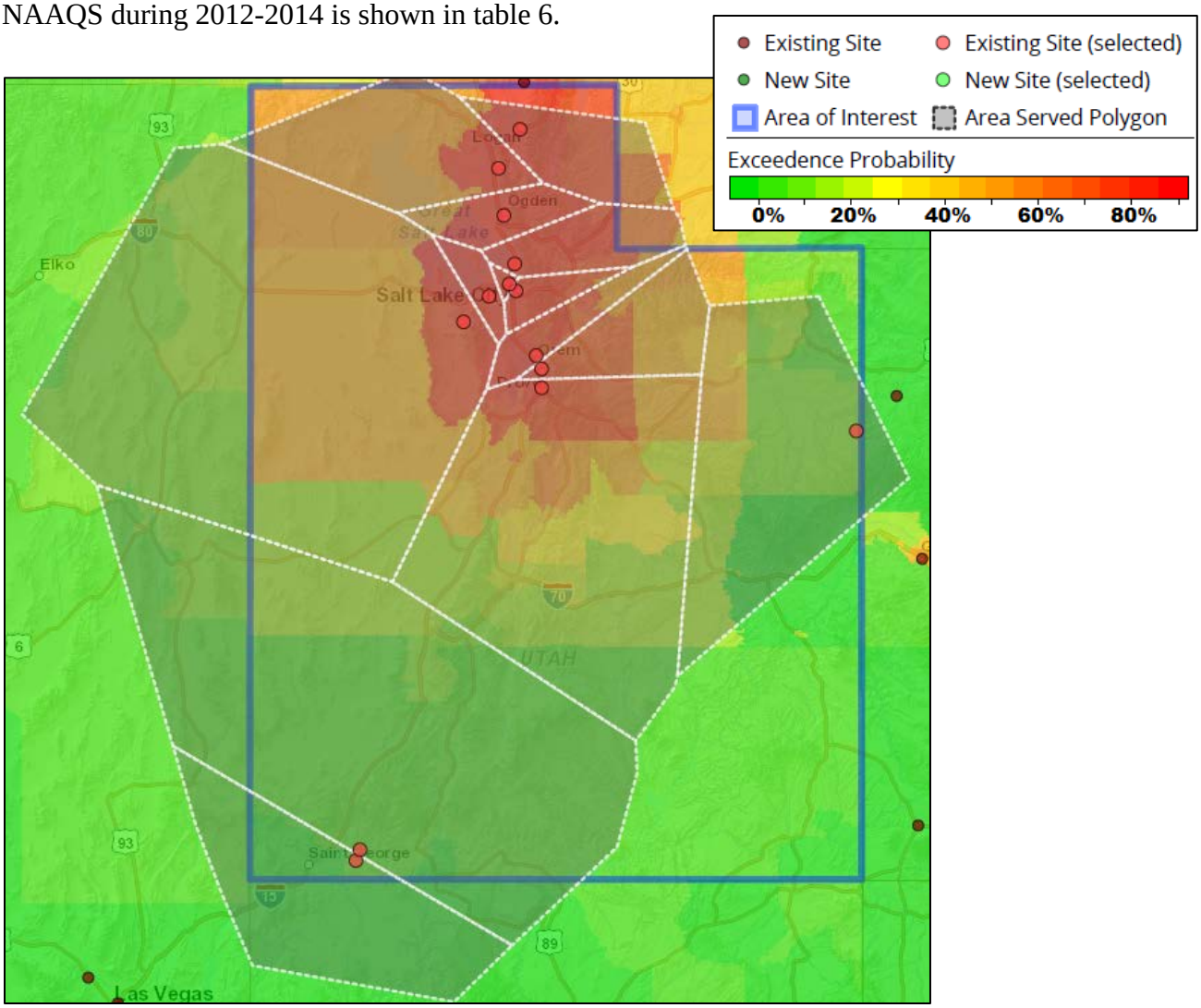


Figure 2. Area served and surface probability map for $PM_{2.5}$. 24-hr NAAQS of 35 µg/m^3 was selected as a threshold.

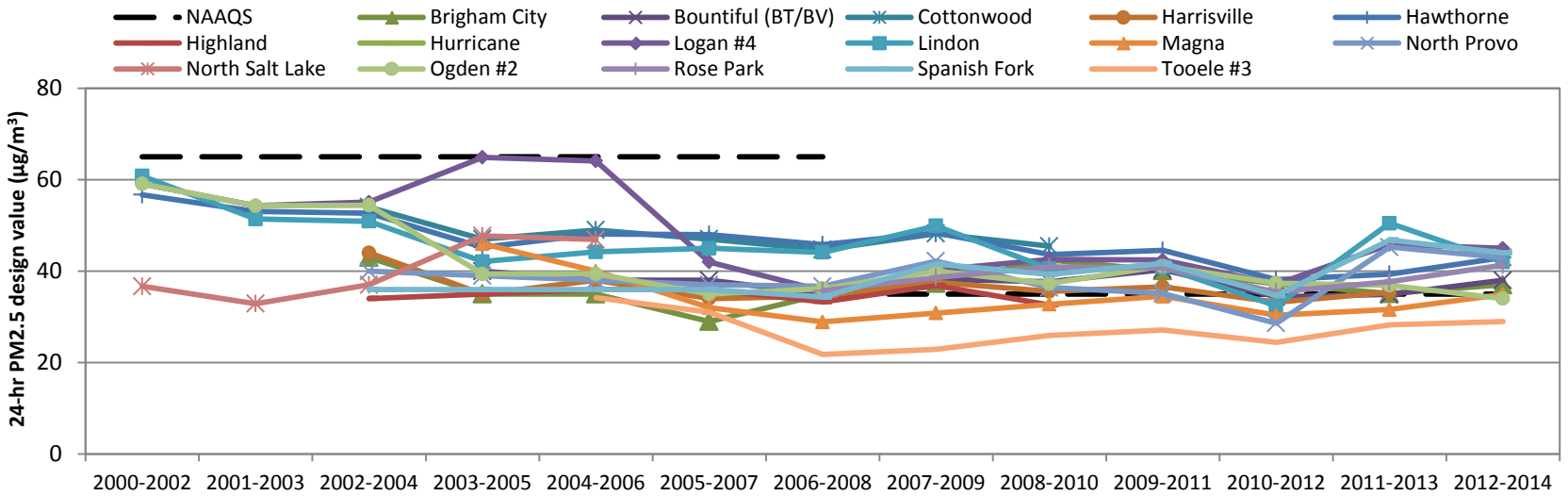


Figure 3. 24-hr design value trends and comparison to NAAQS for FRM $PM_{2.5}$ during the period 2000-2014.

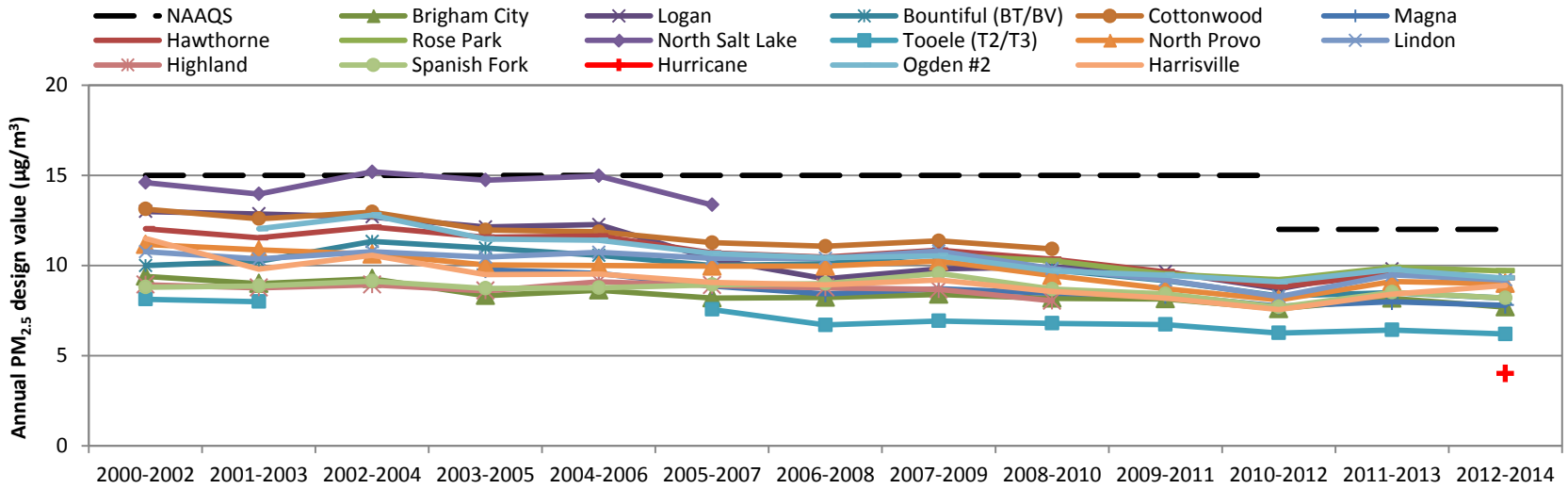


Figure 4. Annual design value trends and comparison to NAAQS for FRM $PM_{2.5}$ during the period 2000-2014.

Table 6. Number of exceedances of $PM_{2.5}$ 24-hr 2013 NAAQS for the period 2012-2014.

	Number of Exceedances of $PM_{2.5}$ 24-hr 2013 NAAQS (primary/secondary)		
	2012	**2013**	**2014**
Brigham City	0/0	5/5	2/2
Logan #4	2/2*	3/3	11/11
Bountiful Viewmont	0/0	9/9	4/4
Magna	0/0	8/8	5/5
Hawthorne	0/0	35/35	13/13
Rose Park	1/1	26/26*	13/13
Tooele #3	0/0	3/3	0/0
Vernal	0/0	-	-
North Provo	0/0	27/27	2/2
Lindon	0/0	33/33	3/3
Spanish Fork	0/0	10/10	1/1
Ogden #2	2/2*	22/22	4/4*
Harrisville	0/0*	6/6	-

*Excluding values corresponding to concurred events.

3.1.1.4 Site-by-site analysis

Federal regulations require state and local agencies to operate $PM_{2.5}$ sites for various locations, depending upon MSA boundaries and population size as well as most recent three-year design value, expressed as a percentage of the $PM_{2.5}$ NAAQS (40 CFR, part 58, appendix D). Minimum federal monitoring requirements for $PM_{2.5}$ sampling and the number of active FRM $PM_{2.5}$ monitors in each CBSA are presented in tables 7 and 8, respectively.

Detailed evaluation of the monitors within each CBSA and recommendations for monitors' removal or addition are provided below. Results are also summarized in table 13.

Table 7. Minimum monitoring requirements for $PM_{2.5}$.

MSA population	Most recent 3-year design value ≥ 85% of any $PM_{2.5}$ NAAQS	Most recent 3-year design value <85% of any $PM_{2.5}$ NAAQS
>1,000,000	3	2
500,000-1,000,000	2	1
50,000-<500,000	1	0

Table 8. Number of active FRM $PM_{2.5}$ monitors in each CBSA.

CBSA	Counties	Census 2010	Population estimate (2020)	Minimum number of required monitors	Number of active monitors
Salt Lake City MSA	Tooele, UT Salt Lake, UT	1,087,873	1,255,736	3	3
Provo-Orem MSA	Juab, UT Utah, UT	526,810	682,314	2	3
Ogden-Clearfield MSA	Box Elder, UT Davis, UT Morgan, UT Weber, UT	597,159	681,907	2	3
Heber µSA	Wasatch, UT	23, 530	32,741	0	0
Logan UT-ID MSA	Cache, UT Franklin, ID	Total: 125,442 Cache County, UT: 112, 656	Cache County: 139,228	1	2 (in Utah)
Saint George MSA	Washington, UT	138, 115	196,762	NA*	1
Cedar City µSA	Iron, UT	46,163	57,055	0	0
Price µSA	Carbon, UT	21, 403	21,602	0	0
Vernal µSA	Uintah, UT	32, 588	38,982	0	0
Summit Park µSA	Summit, UT	36, 324	45, 491	0	0

*No estimate since three-year design value is unavailable as site was established on 01/01/2014.

Salt Lake City CBSA

The State of Utah DAQ (UDAQ) currently operates three FRM $PM_{2.5}$ monitors in Salt Lake City CBSA, which is in agreement with federal monitoring requirements (table 8). According to federal regulations (40 CFR, part 58, appendix D, table D-5), a CBSA with a population above 1,000,000 and the most recent three-year design value greater than 85% of $PM_{2.5}$ NAAQS, must have a minimum of three active $PM_{2.5}$ monitors. The monitors are located at Hawthorne (HW), Magna (MG) and Rose Park (RP) sampling sites in Salt Lake City. $PM_{2.5}$ monitors at Hawthorne and Rose Park operate on a daily schedule while the sampler at Magna follows a 3-day schedule. The network also used to include a $PM_{2.5}$ FRM monitor at Tooele #3 (T3) in Tooele city. UDAQ discontinued $PM_{2.5}$ sampling at T3 in January 2015 and is now working on setting up a replacement site in Erda.

For each pair of sites, while the concentrations measured at the sites were strongly correlated ($R \geq 0.85$), their average relative difference was generally high (25-45%), with Tooele #3 and Magna exhibiting the lowest concentrations (tables 9 and 10). Paired t-tests showed that the concentrations measured at Magna and Tooele #3 are statistically significantly lower ($p<0.001$) than those measured at the remaining sites. Despite the low measured concentrations at Magna and Tooele, UDAQ recommends continuing $PM_{2.5}$ monitoring in Tooele County and at MG. Continuing $PM_{2.5}$ sampling at Magna and in Tooele County is essential since the monitor at Magna is necessary for monitoring particle emissions from nearby Kennecott copper mine and the sampler at Tooele was the sole monitor in Tooele County. As aforementioned, UDAQ is in the process of relocating the Tooele station to a nearby site in Erda, also located in Tooele County. Special studies conducted by the Air Monitoring Center at UDAQ revealed similar $PM_{2.5}$ concentrations but greater ozone levels in Erda compared to Tooele site[4]. UDAQ discontinued FRM $PM_{2.5}$ sampling at Tooele #3 in January 2015 and is now working on setting up a replacement site in Erda. Electrical power has already been routed to the site. UDAQ is also working on establishing a new monitoring station, Copper View, in the southeast area of Salt Lake County, with objective to support air pollution modeling efforts and supply air quality data to the increasing population in the southern area of Salt Lake Valley. While the station has been set up, UDAQ is still working on providing electrical power to the site.

[4] UDAQ, 2012 Utah Ozone Study.

Table 9. Pearson correlation coefficient (R), average relative concentration difference and distance between pairs of sites in Salt Lake City CBSA.

Site 1	Site 2	R	N	Absolute average relative difference	Distance (km)
Hawthorne	Rose Park	0.94	968	0.25	7
Hawthorne	Magna	0.95	327	0.31	19
Hawthorne	Tooele	0.88	314	0.40	42
Rose Park	Magna	0.95	323	0.33	16
Rose Park	Tooele	0.85	312	0.45	41
Magna	Tooele	0.90	313	0.32	25

Table 10. Results of two-tailed paired t-test for FRM $PM_{2.5}$ pairings in Salt Lake City CBSA.

	Hawthorne	Rose Park	Hawthorne	Magna	Hawthorne	Tooele #3	Rose Park	Magna	Rose Park	Tooele #3	Magna	Tooele #3
N*	960	960	327	327	314	314	317	317	305	305	313	313
Mean	9.0	9.8	9.5	8.0	9.4	6.5	10	7.8	9.9	6.4	8.0	6.5
Standard deviation	9.6	9.4	10.5	8.0	10.3	6.3	9.6	7.7	9.4	6.2	8.1	6.3
Standard error	0.31	0.30	0.58	0.44	0.58	0.35	0.54	0.43	0.54	0.36	0.46	0.35
p-value	< 0.001		< 0.001		< 0.001		< 0.001		< 0.001		< 0.001	

*Data covering period 01/01/2011-12/31/2013

Provo-Orem CBSA

DAQ operates three FRM $PM_{2.5}$ monitors within the Provo-Orem CBSA, which exceeds federal monitoring requirements (table 8). These are located at Lindon (LN), North Provo (NP) and Spanish Fork (SF) monitoring sites. NP and LN monitors operate on a daily schedule while the SF monitor follows a 1-in-3 day schedule.

A correlation analysis showed that, for each pair of sites, the concentrations measured at the sites were strongly correlated ($R \geq 0.96$), with North Provo and Lindon displaying a fairly small average relative concentration difference (19%), suggesting redundancy among these sites (table 11). North Provo may be particularly eligible for removal as suggested by results of the removal bias analysis, obtained using EPA NetAssess tool v0.6b (figure 5). However, even though North Provo may consistently show a small bias in relation to Lindon site, UDAQ does not recommend consolidating all sampling equipment at LN. Because of potential siting criteria violation at LN, DAQ suggests finding a new site and consolidating both NP and LN at this new location, where a multi-pollutant site can be established. The air monitoring group will work with the air quality modeling team to find a suitable high-concentration area site. Moreover, UDAQ will relocate the Spanish Fork station to a nearby site due to planned construction works at its location. The Spanish Fork site, which is located at the Spanish Fork airport in Utah County, should be moved in the next two years due to airport construction. An alternative location is across the street from the current location. UDAQ, however, will evaluate other sites in the area before proceeding with any changes.

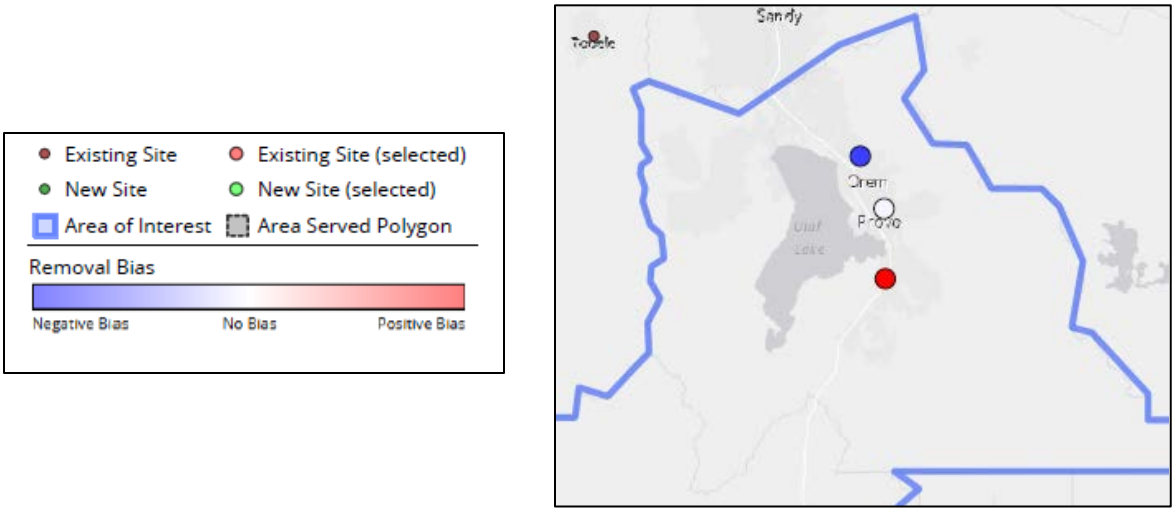


Figure 5. Results of removal bias analysis, obtained using EPA NetAssess tool v0.6b.

Table 11. Pearson correlation coefficint (R), average relative concentration difference and distance between pairs of sites in Provo-Orem CBSA.

Site 1	Site 2	R	N	Absolute average relative difference	Distance (km)
North Provo	Lindon	0.97	924	0.194	11
North Provo	Spanish Fork	0.96	323	0.249	13
Lindon	Spanish Fork	0.97	326	0.279	23

Ogden-Clearfield CBSA

DAQ operates three active FRM $PM_{2.5}$ monitors within the Ogden-Clearfield CBSA, which is in excess of minimum monitoring requirements (table 8). The monitors are located at Bountiful (BV), Ogden #2 (O2) and Brigham City (BR) monitoring stations. The BV and BR monitors operate on a 1-in-3 day schedule while the O2 monitor operates on a daily schedule.

Although the number of active monitors exceeds minimum federal requirements, a correlation analysis showed that while the concentrations measured at each pair of sites were strongly correlated ($R \geq 0.89$), their average relative difference (27-34%) was somewhat large (table 12), with Ogden #2 being the only monitor that provides $PM_{2.5}$ monitoring for Weber county. UDAQ, therefore, would like to maintain $PM_{2.5}$ monitoring at all sites within this CBSA. An evaluation of the FRM $PM_{2.5}$ samplers within this CBSA is provided in table 13.

Table 12. Pearson correlation coefficients (R), average relative concentration difference and distance between pairs of sites in Ogden-Clearfield CBSA.

Site 1	Site 2	R	N	Absolute average relative difference	Distance (km)
Brigham City	Bountiful Viewmont	0.89	328	0.34	67
Brigham City	Ogden #2	0.95	326	0.33	32
Bountiful Viewmont	Ogden #2	0.92	326	0.27	35

Logan CBSA

UDAQ currently operates two FRM monitors within the Logan CBSA, which is in excess of federal requirements (table 8). However, due to violation of siting criteria, UDAQ will shut down the Logan site, located in Cache County. Smithfield station, which UDAQ recently established (January 2015), will permanently replace the Logan site. This station is located in the same county, but farther north. Data collected at both stations will be compared for about a year before Logan site is shut down.

St. George and Cedar City CBSAs

UDAQ operates one FRM monitor in St. George CBSA, which satisfies federal monitoring requirements (table 8). UDAQ therefore does not recommend making any changes to the monitoring network within this CBSA. Moreover, UDAQ does not currently operate any $PM_{2.5}$ monitor in Cedar City CBSA. The total population of this CBSA is, however, expected to increase to 57,055 (table 1) in 2020, which is above the threshold of federal monitoring requirements. UDAQ will therefore establish a site in Cedar City CBSA, Iron County, by 2018.

Table 13. List of FRM $PM_{2.5}$ monitors in Utah air monitoring network and recommendations for network modification.

Site	County	Monitor type	Spatial scale	Monitoring objective	Pollutant/Method	Value	Recommendation
Hawthorne	Salt Lake	SLAMS	Population Neighborhood	Population exposure	$PM_{2.5}$ FRM/Manual gravimetric	**High**– design value above $PM_{2.5}$ NAAQS; NCore site; supports model performance evaluation and SIP development	Continue monitoring
Magna		SLAMS	Population Neighborhood	Population exposure	$PM_{2.5}$ FRM/ Manual gravimetric	**High**– design value close to $PM_{2.5}$ NAAQS; monitors emissions from Kennecott copper mine; supports model performance evaluation	Continue monitoring
Rose Park		SLAMS	Population Neighborhood	Population exposure	$PM_{2.5}$ FRM/ Manual gravimetric	**High**– design value above $PM_{2.5}$ NAAQS; supports model performance evaluation and SIP development	Continue monitoring
				Precision and accuracy assessment	$PM_{2.5}$ FRM/ Manual gravimetric co-located		
Copper View		New SLAMS	Population Neighborhood	Population exposure	$PM_{2.5}$ FRM/ Manual gravimetric	**New**– Identified in assessment as area for assessing population exposure in southeast Salt Lake County	Establish site in 2015
Erda	Tooele	New SLAMS	Population Neighborhood	Population exposure	$PM_{2.5}$ FRM/ Manual gravimetric	**New**– established to replace Tooele #3; identified in assessment as area of potential high ozone exposure	Site setup in progress
Lindon	Utah	SLAMS	Population Neighborhood	Population exposure	$PM_{2.5}$ FRM/ Manual gravimetric	**Low**– Although design value is above $PM_{2.5}$ NAAQS and site supports model performance evaluation/SIP development, site is redundant with North Provo site	Consolidate with North Provo site at a new location
				Precision and accuracy assessment	$PM_{2.5}$ FRM/ co-located manual gravimetric		

Table 13 (cont'd.)

Site	County	Monitor type	Spatial scale	Monitoring objective	Pollutant/Method	Value	Recommendation
North Provo	Utah	SLAMS	Population Neighborhood	Population exposure	$PM_{2.5}$ FRM/ Manual gravimetric	**Low**– Although design value is above $PM_{2.5}$ NAAQS and site supports model performance evaluation/SIP development, site is redundant with Lindon site	Consolidate with Lindon site at a new location
Spanish Fork		SLAMS	Transport Regional	Population exposure	$PM_{2.5}$ FRM/ Manual gravimetric	**High**– design value above $PM_{2.5}$ NAAQS; supports model performance evaluation and SIP development	Relocate site due to logistical issues
Brigham City	Box Elder	SLAMS	Population Neighborhood	Population exposure	$PM_{2.5}$ FRM/ Manual gravimetric	**High**– design value above $PM_{2.5}$ NAAQS; supports model performance evaluation and SIP development	Continue monitoring
Bountiful Viewmont	Davis	SLAMS	Population Neighborhood	Population exposure	$PM_{2.5}$ FRM/ Manual gravimetric	**High**– design value above $PM_{2.5}$ NAAQS; supports model performance evaluation and SIP development	Continue monitoring
Ogden #2	Weber	SLAMS	High Neighborhood	Population exposure	$PM_{2.5}$ FRM/ Manual gravimetric	**Moderate**– only monitor that provides $PM_{2.5}$ monitoring for Weber county; supports model performance evaluation and SIP	Continue monitoring
Logan #4	Cache	SLAMS	Population Neighborhood	Population exposure	$PM_{2.5}$ FRM/ Manual gravimetric	**Low**– violation of siting criteria	Shut down site by 2016 and replace by Smithfield
				Precision and accuracy assessment	$PM_{2.5}$ FRM/ Manual gravimetric co-located		

Table 13 (cont'd.)

Site	County	Monitor type	Spatial scale	Monitoring objective	Pollutant/Method	Value	Recommendation
Smithfield	Cache	SLAMS	Population Neighborhood	Population exposure	$PM_{2.5}$ FRM/ Manual gravimetric	**New**– Site established on 01/01/2015 to replace Logan #4	Continue monitoring
Hurricane	Washington	SLAMS	Population Neighborhood	Population exposure	$PM_{2.5}$ FRM/ Manual gravimetric	**Moderate**– Site established on 01/01/14 to provide a baseline of levels in the St. George MSA; monitor is the only monitor that provides $PM_{2.5}$ monitoring for Washington county	Continue monitoring
Cedar city	Iron	New SLAMS	Population Neighborhood	Population exposure	$PM_{2.5}$ FRM/ Manual gravimetric	**New**– Identified in assessment as area of projected population growth	Establish site by 2018

3.1.2 FEM $PM_{2.5}$ network

UDAQ currently operates Federal Equivalent Method (FEM) $PM_{2.5}$ samplers at 8 sampling sites, distributed throughout the state. Most monitors are operated in co-location with FRM filter-based measurements for comparability assessment. Once the comparability assessment criteria are met, the FEM continuous monitors will replace existing FRM monitors in the network, which will reduce the resources and labor required to maintain the FRM samplers and handle the filter samples. Currently, the data obtained from the continuous monitors is primarily used to support forecasting and reporting of the Air Quality Index (AQI). The continuous samplers supply data on an hourly basis to update the AQI on our local website as well as AIRNow (www.airnow.gov). Furthermore, noteworthy is that UDAQ is working on optimizing the continuous $PM_{2.5}$ monitoring instruments in its network. Existing continuous monitors will be replaced with upgraded models (1405-DF TEOM) that are currently being tested before deployment to the field. Additionally, continuous monitors will be added at a few sites, including Vernal #4, Erda and Copper View. UDAQ is currently working on setting up the latter two sites, as previously mentioned. The continuous monitor at Logan #4 will also be moved to Smithfield while the monitors at Lindon and North Provo will be consolidated at a new location. An evaluation of FEM $PM_{2.5}$ continuous monitors in Utah air monitoring network is provided in table 14.

Table 14. List of FEM $PM_{2.5}$ samplers in Utah air monitoring network and recommendations for network modification.

Site	County	Monitor Type	Spatial scale	Monitoring objective	Pollutant/Method	Value	Recommendation
Hawthorne	Salt Lake	SLAMS	Population Neighborhood	Air pollution index	$PM_{2.5}$ continuous/ TEOM FDMS	**High**– supports AQI reporting/forecasting; NCore site	Continue monitoring
Copper View		New SLAMS	Population Neighborhood	Air pollution index	-	**New**– Identified in assessment as area for assessing population exposure in southeast Salt Lake County	Establish site in 2015
Erda	Tooele	New SLAMS	Population Neighborhood	Air quality index	-	**New**– established to replace Tooele #3	Site setup in progress; add continuous $PM_{2.5}$ monitor
Lindon	Utah	SLAMS	Population Neighborhood	Air quality index	$PM_{2.5}$ continuous/ TEOM FDMS	**Low**– supports AQI reporting/forecasting but redundant with North Provo	Consolidate with North Provo site at a new location
North Provo		SLAMS	Population Neighborhood	Air quality index	$PM_{2.5}$ continuous/ TEOM FDMS	**Low**– supports AQI reporting/forecasting but redundant with Lindon	Consolidate with Lindon site at a new location
Brigham City	Box Elder	SLAMS	Population Neighborhood	Air quality index	$PM_{2.5}$ continuous/ TEOM FDMS	**Moderate**– supports AQI reporting/forecasting	Continue monitoring
Ogden #2	Weber	SLAMS	High Neighborhood	Air quality index	$PM_{2.5}$ continuous/ TEOM FDMS	**Moderate**– supports AQI reporting/forecasting	Continue monitoring

Table 14 (cont'd.)

Site	County	Monitor Type	Spatial scale	Monitoring objective	Pollutant/Method	Value	Recommendation
Logan #4	Cache	SLAMS	Population Neighborhood	Air quality index	$PM_{2.5}$ continuous/ TEOM FDMS	**Low**– violation of siting criteria	Shut down site by 2016 and replace by Smithfield
Smithfield	Cache	New SLAMS	Population Neighborhood	Population exposure	-	**New**– Site established on 01/01/2015 to replace Logan #4	Move continuous monitor from Logan #4 to Smithfield
Vernal #4	Uintah	New SLAMS	Population Neighborhood	Air quality index	-	**New**– established to replace Vernal site (VL), which was shut down in January 2015 due to property development	Add continuous $PM_{2.5}$ monitor
Roosevelt	Duchesne	SLAMS	Population Neighborhood	Air quality index	$PM_{2.5}$ continuous/ Sharp 5030	**Moderate**– supports AQI reporting/forecasting	Continue monitoring
Hurricane	Washington	SLAMS	Population Neighborhood	Air quality index	$PM_{2.5}$ continuous/ Sharp 5030	**Moderate**– Site established on 01/01/14 to provide a baseline of levels in the St. George MSA; monitor is the only monitor that provides $PM_{2.5}$ monitoring for Washington county	Continue monitoring

3.1.3 FRM PM_{10} network

UDAQ currently operates 24-hour Federal Reference Method (FRM) PM_{10} samplers throughout the state to demonstrate compliance with NAAQS, evaluate population exposure, support PM maintenance plans and monitor PM levels in high-concentration areas.

3.1.3.1 Historical trends and deviations from NAAQS

In 1987, EPA established a 24-hour air quality standard of 150 $\mu g/m^3$ for PM_{10}. The standard is not to be exceeded more than once per year on average over three years.

The state of Utah is occasionally affected by exceptional events, such as dust storms and wildfires, leading to high concentration values. For instance, Utah experienced a dust storm on March 30 2010, resulting in very high PM_{10} levels across the network. No dust storm or wildfire exceptional events were recorded in 2012, 2013 and 2014. Excluding data impacted by exceptional events, Utah has been in compliance with the PM_{10} NAAQS, as demonstrated in figure 6. Figure 6 shows the second-highest 24-hour PM_{10} concentration following exclusion of values influenced by exceptional events while figure 7 displays all second-highest 24-hour PM_{10} concentrations measured at each station since 2000. Moreover, no exceedances of the 24-hr PM_{10} standard have been recorded during the period 2012-2014, as shown in table 15.

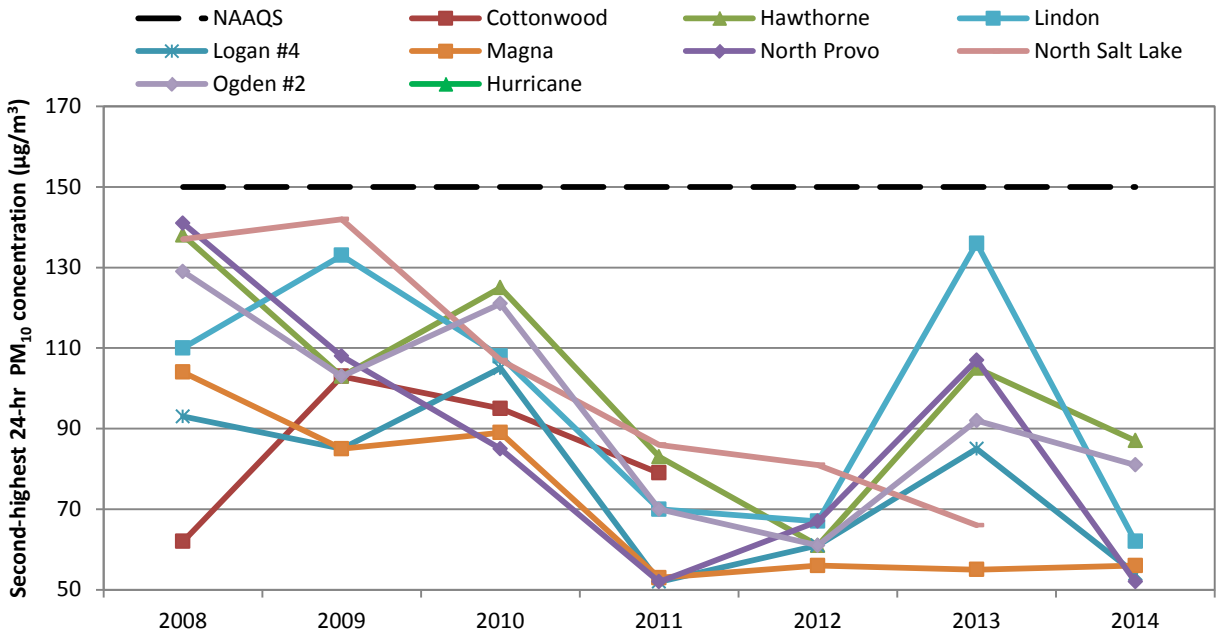


Figure 6. Comparison to NAAQS and trends in second-highest 24-hour PM_{10} concentration for the period 2000-2014 following exclusion of values influenced by exceptional events.

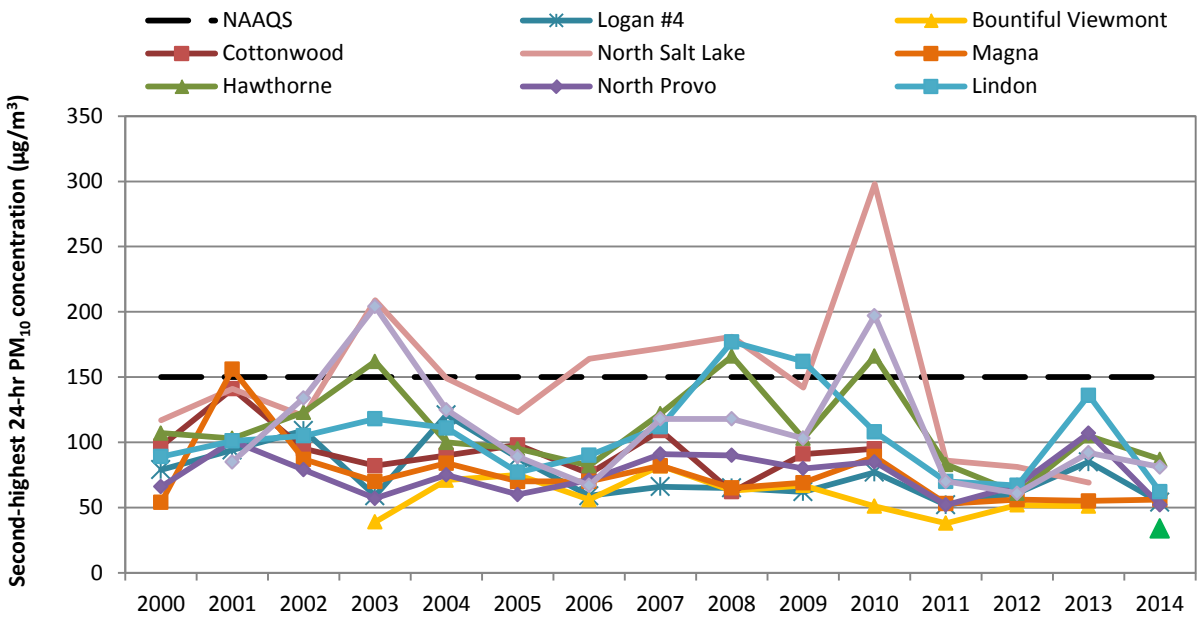


Figure 7. Comparison to NAAQS and trends in second-highest 24-hour PM_{10} concentration for the period 2000-2014.

Table 15. Number of exceedances of PM_{10} 24hr-2006 NAAQS for the period 2012-2014.

	Number of Exceedances of PM_{10} 24hr-2006 NAAQS (primary/secondary)		
	2012	**2013**	**2014**
North Salt Lake	0/0	0/0	-
Magna	0/0	0/0	0/0
Hawthorne	0/0	0/0	0/0
North Provo	0/0	0/0	0/0
Lindon	0/0	0/0	0/0
Ogden #2	0/0	0/0	0/0
Logan #4	0/0	0/0	0/0
Bountiful Viewmont	0/0	0/0	-
Roosevelt	0/0	-	-
Hurricane	-	-	0/0

3.1.3.2 Site-by-site analysis

Federal regulations require that state and local agencies operate PM_{10} sites for various locations, depending upon MSA boundaries and population size as well as ambient PM_{10} concentrations relative to the PM_{10} NAAQS (40 CFR, appendix D, part 58). Minimum federal monitoring requirements for PM_{10} sampling and the number of active FRM PM_{10} monitors in each CBSA are presented in tables 16 and 17, respectively. A detailed evaluation of PM_{10} FRM monitors within each CBSA is provided below. Results are also summarized in table 20.

Table 16. Minimum monitoring requirements for PM_{10}.

MSA population	High concentration[1]	Medium concentration[2]	Low concentration[3]
>1.000.000	6-10	4-8	2-4
500,000-1,000,000	4-8	2-4	1-2
250,000-500,000	3-4	1-2	0-1
100,000 -250,000	1-2	0-1	0

[1]High concentration areas are those for which ambient PM_{10} data show ambient concentrations exceeding the PM_{10} NAAQS by 20 percent or more.
[2]Medium concentration areas are those for which ambient PM_{10} data show ambient concentrations exceeding 80 percent of the PM_{10} NAAQS.
[3]Low concentration areas are those for which ambient PM_{10} data show ambient concentrations less than 80 percent of the PM_{10} NAAQS.

Table 17. Number of active FRM PM_{10} monitors in each CBSA.

CBSA	Counties	Census 2010	Population estimate (2020)	Minimum number of required monitors	Number of active monitors
Salt Lake City MSA	Tooele, UT Salt Lake, UT	1,087,873	1,255,736	2-4*	3
Provo-Orem MSA	Juab, UT Utah, UT	526,810	682,314	1-2	2
Ogden-Clearfield MSA	Box Elder, UT Davis, UT Morgan, UT Weber, UT	597,159	681,907	1-2	1
Heber µSA	Wasatch, UT	23, 530	32,741	0	0
Logan UT-ID MSA	Cache, UT Franklin, ID	Total: 125,442 Cache County, UT: 112, 656	Cache County: 139,228	0	2 (in Utah)
Saint George MSA**	Washington, UT	138,115	196,762	0	1
Cedar City µSA	Iron, UT	46,163	57,055	0	0
Price µSA	Carbon, UT	21, 403	21,602	0	0
Vernal µSA	Uintah, UT	32, 588	38,982	0	0
Summit Park µSA	Summit, UT	36, 324	45, 491	0	0

* Excluding exceptional events.

Salt Lake City CBSA

The State of Utah DAQ currently operates three FRM PM_{10} monitors in Salt Lake City CBSA, which is in agreement with federal monitoring requirements. According to federal regulations (40 CFR, part 58, appendix D, table D-5), a CBSA with a population above 1,000,000 and ambient PM_{10} concentrations less than 80 percent of the PM_{10} NAAQS, must have a minimum of two active PM_{10} monitors. The monitors are located at Hawthorne (HW), Herriman #3 (H3) and Magna (MG) sampling sites, with the samplers at HW and H3 operating on a daily schedule and the sampler at Magna operating on a 1-in-3 day schedule. The station at Herriman was recently established (October 2014) to supply air quality data to the increasing population in the southwestern areas of Salt Lake County.

A correlation analysis showed that PM_{10} levels at Magna and Hawthorne were moderately correlated (R = 0.85), with Hawthorne displaying a statistically significantly larger concentration than Magna ($p<0.001$) (table 18). Moreover, the relative difference between the concentrations measured at the two sites was somewhat large (31.1%), further suggesting a difference in PM_{10} levels between the monitoring sites. DAQ, therefore, recommends continuing PM_{10} sampling at all sites in the Salt Lake City CBSA. Moreover, a new monitoring station will be established in northern Salt Lake County to replace the previous station, North Salt Lake 2 (N2), which was closed in September 2013 due to infrastructure issues (replacement of a damaged sewage pipe running beneath the site). The site will help assess population exposure in this area where petroleum refineries as well as sand and gravel extraction facilities are located.

Table 18. Results of two-tailed paired t-test for FRM PM_{10} pairings in Salt Lake City CBSA.

	Hawthorne	Magna
N*	336	336
R	0.85	
Mean	20.4	18.1
Standard deviation	14.9	12.2
p-value	< 0.001	
Average relative concentration difference	0.31	

*Data covering period 10/01/2011-09/30/2014

Provo-Orem CBSA

DAQ operates two FRM PM_{10} monitors within the Provo-Orem CBSA, which satisfies minimum federal monitoring requirements (table 17). These are located at Lindon (LN) and North Provo (NP) monitoring sites. The monitor at LN operates on a daily schedule while the monitor at NP follows a 1-in-3 day schedule.

A correlation analysis showed that PM_{10} levels at North Provo and Lindon were strongly correlated (R = 0.94), with mean levels that are not statistically significantly different (p=0.59), suggesting redundancy between sites (table 19). This is further suggested by the fairly small average relative difference between the concentrations measured at the two sites (20%). DAQ,

thus, recommends consolidating North Provo and Lindon sites at a new location, as aforementioned.

Table 19. Results of two-tailed paired t-test for FRM PM_{10} pairings in Provo-Orem CBSA.

	Lindon	North Provo
N*	301	301
R	0.94	
Mean	21.4	21.6
Standard deviation	16.4	16.4
p-value	0.59	
Average relative concentration difference	0.20	

*Data covering period 10/01/2011-09/30/2014

Ogden-Clearfield CBSA

DAQ operates one FRM PM_{10} monitor within the Ogden-Clearfield CBSA, which satisfies minimum federal monitoring requirements (table 17). The monitor is located at Ogden #2 (O2) station and operates on a daily schedule. UDAQ does not recommend making any changes to the PM_{10} network within this CBSA.

Logan and St. George CBSAs

UDAQ operates one FRM monitor at the St. George CBSA and two FRM monitors at the Logan CBSA, which exceeds federal monitoring requirements (table 17). These are located at Logan #4, Smithfield and Hurricane sites. However, in order to meet siting requirements, UDAQ will shut down the Logan site, located in Cache County, by 2016. Smithfield station, which UDAQ recently established (January 2015), will replace the Logan site. This station is located in the same county, but farther north. Data collected at both stations will be compared for about a year before the Logan site is shut down. Excluding the relocation of the Logan station, UDAQ does not recommend making any changes to the monitoring network within these CBSAs.

3.1.4 Continuous PM_{10} network

UDAQ currently operates continuous PM_{10} samplers at 10 sampling sites, with primary purpose to support air quality forecasting and model performance evaluation. The samplers are deployed at four distinct sites located throughout the state of Utah, as shown in table 21. Noteworthy is that UDAQ is currently working on optimizing the PM_{10} network. Existing continuous monitors will be replaced with newer models (1405-DF TEOM) that are currently being tested before deployment to the field.

Table 20. List of FRM PM_{10} samplers in Utah air monitoring network and recommendations for network modification.

Site	County	Monitor Type	Spatial scale	Monitoring objective	Pollutant/Method	Value	Recommendation
Hawthorne	Salt Lake	SLAMS	Population Neighborhood	Population exposure	PM_{10} FRM/ Manual gravimetric	**High**– design value location for PM_{10} NAAQS; NCore site; supports PM_{10} maintenance demonstration	Continue monitoring
Magna		SLAMS	Population Neighborhood	Population exposure	PM_{10} FRM/ Manual gravimetric	**High**– design value location for PM_{10} NAAQS; supports PM_{10} maintenance demonstration; monitors emissions from Kennecott copper mine	Continue monitoring
Herriman #3		New SLAMS	Population Neighborhood	Population exposure	PM_{10} FRM/ Manual gravimetric	**New**– Site recently established to assess population exposure in southwest Salt Lake County	Continue monitoring
North Salt Lake		New SLAMS	Population Neighborhood	Population exposure	PM_{10} FRM/ Manual gravimetric	**New**– Identified in assessment as area for assessing population exposure in northern Salt Lake County	Establish site
Lindon	Utah	SLAMS	Population Neighborhood	Population exposure	PM_{10} FRM/ Manual gravimetric	**Low**– Although site supports PM_{10} maintenance demonstration and is a design value location for PM_{10} NAAQS, site is redundant with North Provo	Consolidate with North Provo site at a new location
North Provo		SLAMS	Population Neighborhood	Population exposure	PM_{10} FRM/ Manual gravimetric	**Low**– Although site supports PM_{10} maintenance demonstration and is a design value location for PM_{10} NAAQS, site is redundant with Lindon	Consolidate with Lindon site at a new location
Ogden #2	Weber	SLAMS	High Neighborhood	Population exposure	PM_{10} FRM/ Manual gravimetric	**Moderate**– design value location for PM_{10} NAAQS, monitor is the only monitor that provides PM_{10} monitoring for Weber county; supports PM_{10} maintenance demonstration	Continue monitoring

Table 20 (cont'd.)

Site	County	Monitor Type	Spatial scale	Monitoring objective	Pollutant/Method	Value	Recommendation
Logan #4	Cache	SLAMS	Population Neighborhood	Population exposure	PM_{10} FRM/ Manual gravimetric	**Low**– violation of siting requirements	Shut down site by 2016 and replace by Smithfield
Smithfield		New SLAMS	Population Neighborhood	Population exposure	PM_{10} FRM/ Manual gravimetric	**New**– Site established on 1/1/2015 to replace Logan #4	Continue monitoring
Hurricane	Washington	SLAMS	Population Neighborhood	Population exposure	PM_{10} FRM/ Manual gravimetric	**Moderate**– Site established on 01/01/14 to provide a baseline of levels in the St. George MSA; monitor is the only monitor that provides PM_{10} monitoring for Washington county	Continue monitoring

Table 21. List of continuous PM_{10} samplers in Utah air monitoring network.

Site	County	Monitor Type	Spatial scale	Monitoring objective	Pollutant/Method	Value	Recommendation
Hawthorne	Salt Lake	SLAMS	Population Neighborhood	Air pollution index	PM_{10} continuous/ TEOM FDMS	**High**– NCore site; supports forecasting and model performance evaluation.	Continue monitoring
Lindon	Utah	SLAMS	Impact Neighborhood	Air quality index	PM_{10} continuous/ TEOM FDMS	**Low**– supports forecasting and model performance evaluation; redundant with North Provo	Consolidate with North Provo site at a new location
North Provo		SLAMS	Population Neighborhood	Air quality index	PM_{10} continuous/ TEOM FDMS	**Low**– supports forecasting and model performance evaluation; redundant with Lindon	Consolidate with Lindon site at a new location
Ogden #2	Weber	SLAMS	High Neighborhood	Air quality index	PM_{10} continuous/ TEOM FDMS	**Moderate**– supports forecasting and model performance evaluation	Continue monitoring

3.2 Gaseous monitoring

3.2.1 Ozone Network

3.2.1.1 Area and Population Served

The area and population served, including sensitive demographics, by each ozone monitor are shown in table 22, where the sites are sorted according to the population they represent.

Table 22. Area and population served by ozone monitors in Utah air monitoring network

Site	Population Served					Area Served (km^2)
	Total Population	Total Male Population	Total Female Population	Total Population, Age 65 and	Total Population, Age 0 to 4	
Hawthorne	993,674	499,899	493,775	88,016	85,276	804
North Provo	417,541	208,845	208,696	26,848	46,220	1,528
Ogden	304,589	153,338	151,251	25,248	29,932	598
Bountiful	158,332	78,985	79,347	16,469	15,300	695
Hurricane	146,565	72,167	74,398	26,898	13,192	6,946
Spanish Fork	145,801	74,147	71,654	11,342	16,061	4,783
Logan #4	124,631	62,023	62,608	10,558	12,532	2,795
Harrisville	77,538	39,018	38,520	7,659	6,887	542
Beach	70,104	35,465	34,639	3,153	7,825	1,789
Tooele	69,615	35,184	34,431	5,173	7,179	8,716
Price #2	49,292	24,759	24,533	6,647	4,158	6,192
Brigham City	48,861	24,566	24,295	5,497	4,779	884
Vernal	9,511	4,844	4,667	862	1,099	304
Fruitland	7,632	3,784	3,848	630	971	181
Roosevelt			NA			173

3.2.1.2 Exceedance Probability

Figure 8 shows the probability that ozone in a given area will exceed 65 ppb at least one day in a year. A threshold of 65 ppb is selected since EPA is expected to revise, by October 2015, the current ozone standard of 75 ppb to a value within the range of 65 to 70 ppb. As can be seen, most monitors are concentrated in areas where the maximum probability of ozone exceeding 65

ppb is greater than 70%. Note that some of the monitors shown in figure 8 are located at sites within the Interagency Monitoring of Protected Visual Environments (IMPROVE) network.

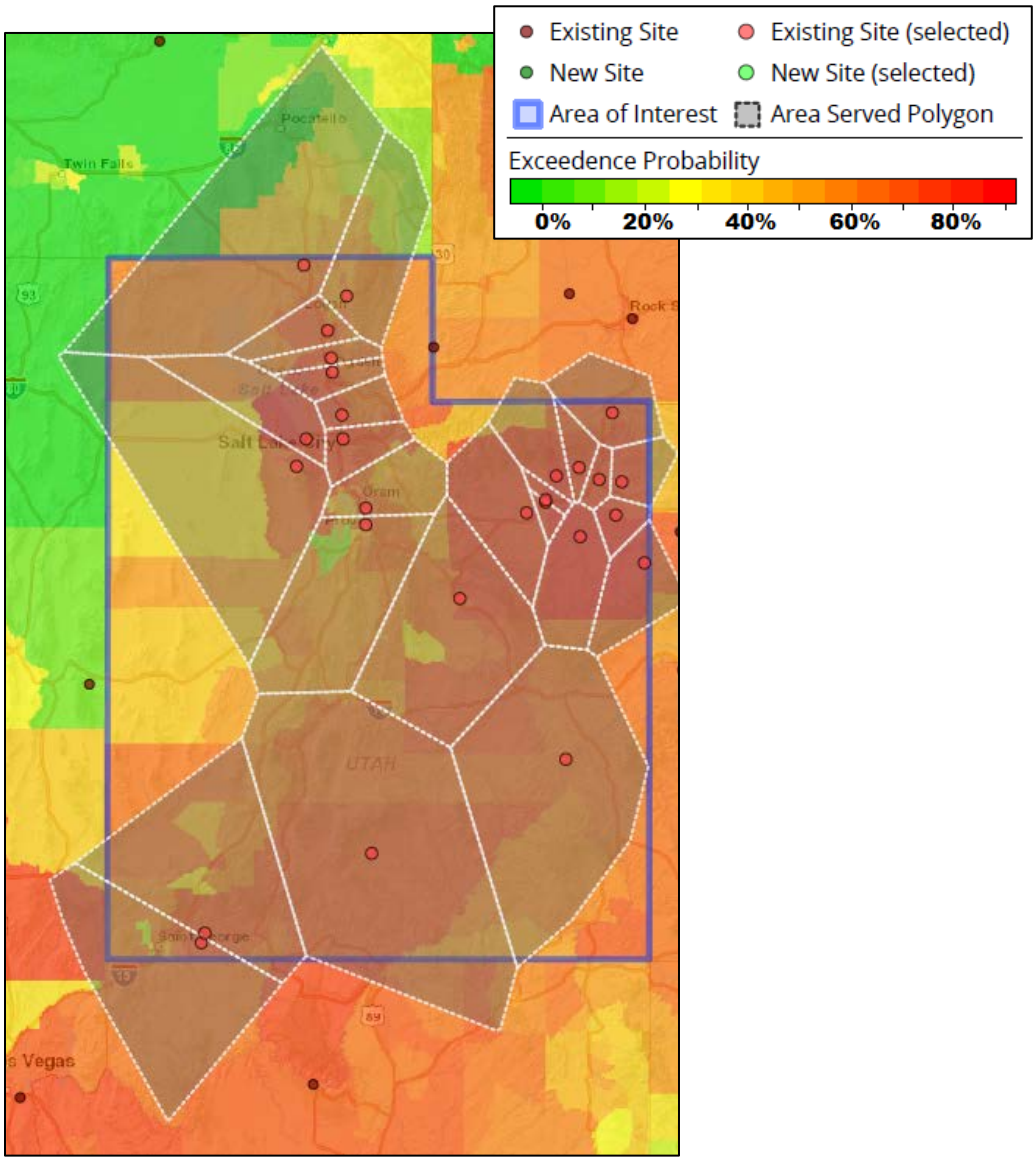


Figure 8. Area served and surface probability map for ozone. A threshold of 65 ppb was selected.

3.2.1.3 Historical trends and deviations from NAAQS

Ozone is formed through photochemical reactions between nitrogen oxides (NOx) and volatile organic compounds (VOCs). Its production is a year-round phenomenon, with highest ozone levels generally occurring during summer when solar radiation and temperature are strongest. Utah is, however, often susceptible, during winter-time inversions, to elevated levels of ozone in the Uinta Basin. High-pressure weather systems and high solar zenith angle during winter lead to cold-air pools that periodically trap precursor gases, most notably VOCs and NO_x, in the valleys between the Wasatch and Oquirrh Mountains. These precursor gases subsequently react in the

stagnant air to form ozone. Snow cover can also enhance ozone formation by increasing sunlight reflection (surface albedo) into the atmosphere. Research is on-going to better understand the chemical processes leading to winter-time ozone production.

The current 8-hr NAAQS for ozone is 75 ppb. The standard is met when the annual fourth-highest daily maximum 8-hr concentration, averaged over 3 years, is less than 75 ppb. The number of NAAQS exceedances at the sampling sites for the period 2012-2014 is provided in table 23.

Figures 9 and 10 show the annual fourth-highest eight-hour ozone concentration and the three-year average of the annual fourth-highest daily maximum eight-hour ozone concentration at the sampling sites. As can be deduced, with the exception of ozone levels at Vernal and Roosevelt sites in Uintah and Duchesne Counties, all measured ozone levels in 2014 are below the NAAQS. Nonetheless, if the ozone standard is strengthened as proposed by EPA, several regions in Utah could be in non-attainment of the revised NAAQS. UDAQ is currently working, through the Ozone Advance Program, with the Ute Tribe and EPA to develop emission control strategies and reduce winter-time ozone levels in the Uinta Basin.

Table 23. Number of exceedances of ozone 8-hr 2008 NAAQS for the period 2012-2014.* Excluding values corresponding to concurred events.

	Number of Exceedances of Ozone 8-hr 2008 NAAQS (primary/secondary)		
	2012	**2013**	**2014**
Brigham City	2/2*	2/2	1/1
Beach	5/5*	2/2	0/0
Logan #4	0/0	0/0	0/0
Bountiful Viewmont	0/0	2/2	2/2
Roosevelt	0/0	26/26	0/0
Fruitland	0/0	0/0	-
Hawthorne	7/7*	4/4	1/1
Tooele	1/1	1/1	0/0
Price	1/1	0/0	0/0
Vernal	0/0	25/25	0/0
North Provo	4/4	4/4	0/0
Spanish Fork	4/4	1/1	4/4
Santa Clara	1/1	-	-
Hurricane	0/0	0/0	0/0
Ogden	0/0	4/4	0/0
Harrisville	4/4*	2/2	1/1

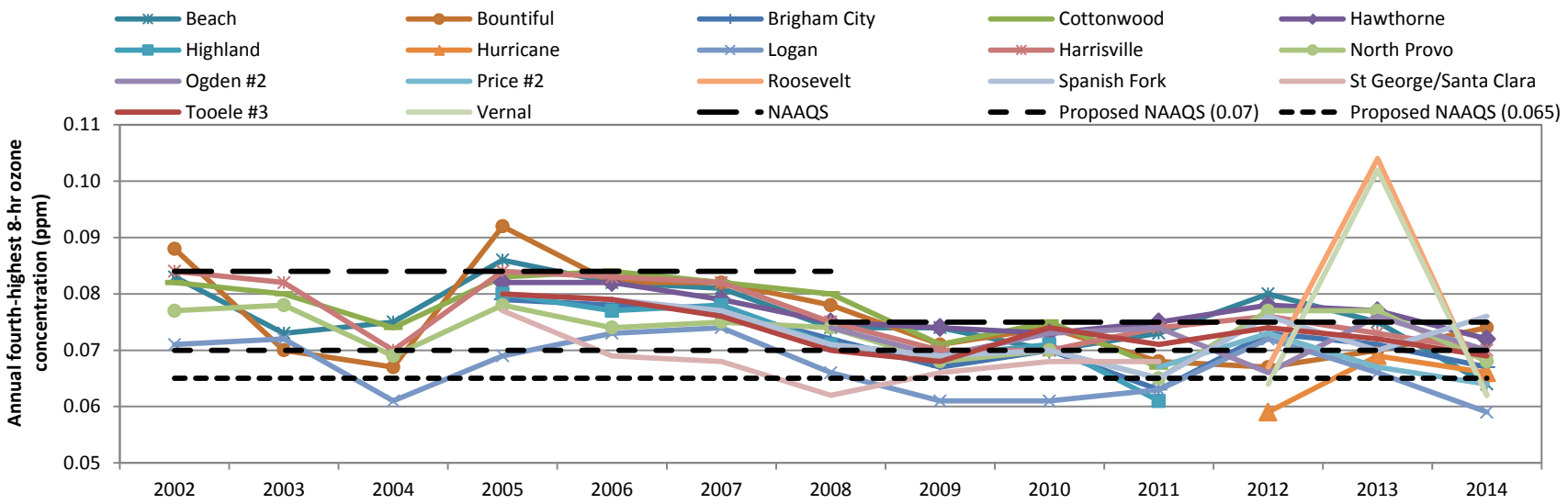


Figure 9. Trends in annual fourth-highest eight-hour ozone concentration and comparison to NAAQS. Values corresponding to concurred events were excluded.

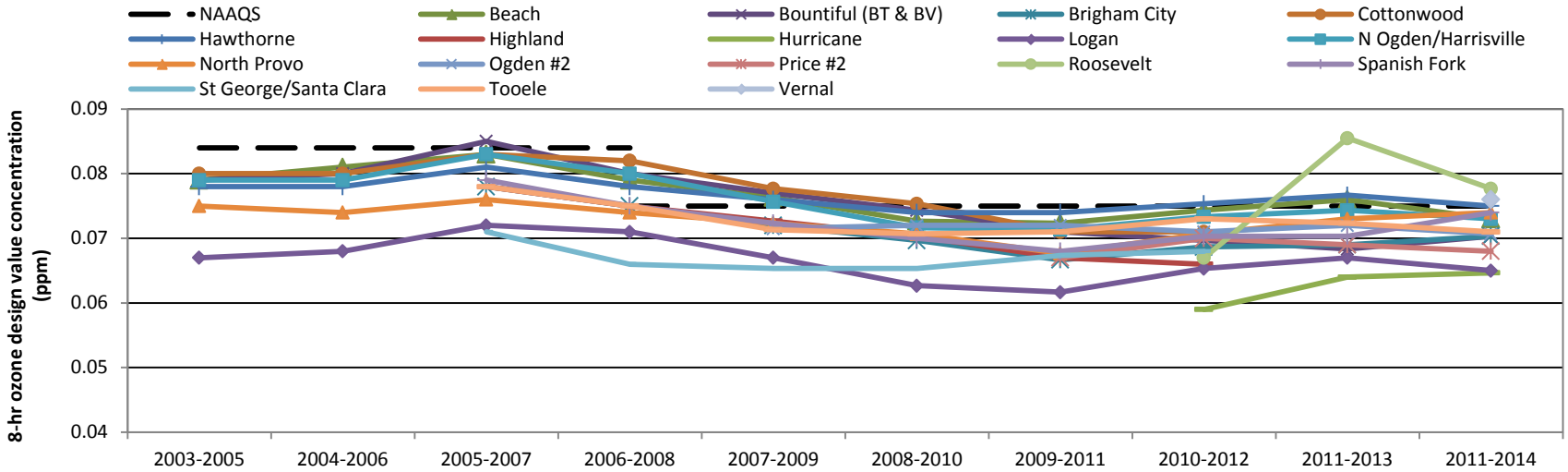


Figure 10. 8-hr design value trends and comparison to NAAQS for ozone during the period 2004-2014.

3.2.1.4 Site-by-site analysis

Federal regulations require state and local agencies to operate ozone sites for various locations, depending on MSA boundaries and population size as well as most recent three-year design value, expressed as a percentage of the ozone NAAQS (40 CFR, appendix D, part 58). Minimum federal monitoring requirements for ozone sampling and the number of active ozone monitors in each CBSA are presented in tables 24 and 25, respectively. A detailed evaluation of the ozone monitors in each CBSA is provided below. Results are also summarized in table 30, which shows current sites that operate ozone monitors and recommendations for network modification based on the results of the technical assessment.

Table 24. Minimum monitoring requirements for ozone.

MSA population	Most recent 3-year design value ≥85% of any ozone NAAQS	Most recent 3-year design value <85% of any ozone NAAQS
>10,000,000	4	2
4,000,000-10,000,000	3	1
350,000-<4,000,000	2	1
50,000-<350,000	1	0

Table 25. Number of active ozone monitors in each CBSA.

CBSA	Counties	Census 2010	Population estimate (2020)	Minimum number of required monitors	Number of active monitors
Salt Lake City MSA	Tooele, UT Salt Lake, UT	1,087,873	1,255,736	2	2
Provo-Orem MSA	Juab Utah	526,810	682,314	2	2
Ogden-Clearfield MSA	Box Elder, UT Davis, UT Morgan, UT Weber, UT	597,159	681,907	2	4
Heber µSA	Wasatch, UT	23, 530	32,741	0	0
Logan UT-ID MSA	Cache, UT Franklin, ID	Total: 125,442 Cache County, UT: 112, 656	Cache County: 139,228	0	1 (in Utah)
Saint George UT MSA*	Washington, UT	138, 115	196,762	NA	1
Cedar City µSA	Iron, UT	46,163	57,055	0	0
Price µSA	Carbon, UT	21, 403	21,602	0	1
Vernal UT µSA	Uintah, UT	32, 588	38,982	0	1
Summit Park µSA	Summit, UT	36, 324	45, 491	0	0

*3-year design value unavailable as site was established on 1/1/2014.

Salt Lake City CBSA

According to federal regulations (40 CFR, part 58, table D2), a CBSA with a population between 350,000 and 4,000,000 and the most recent 3-year design value greater than 85% of ozone NAAQS, must have a minimum of two active ozone monitors. Furthermore, at least one O_3 site for each MSA, or CSA, must be designed to record the maximum concentration for that particular area. UDAQ currently operates two ozone monitors in the Salt Lake City CBSA, located at Hawthorne (HW) and Herriman #3 (H3) sampling sites. The monitors are located in Salt Lake County and operate continuously. The monitoring site at Herriman was recently established (October 2014) by UDAQ in order to represent population exposure in the southwestern areas of Salt Lake County. The network also used to include ozone monitors at Beach (B4) and Tooele #3 (T3) stations, which were shut down in October 2014 and January 2015, respectively.

Table 26. Pearson correlation coefficient (R), average relative concentration difference and distance between pairs of sites in Salt Lake City CBSA.

Site 1	Site 2	R	n	Absolute Average Rel. Diff	Distance (km)
Beach	Hawthorne	0.76	500	0.093	29
Beach	Tooele	0.87	477	0.074	23
Hawthorne	Tooele	0.84	475	0.078	42

Correlation analysis showed that the concentrations measured at Beach and Tooele sites were strongly correlated (R = 0.87) and their average relative difference was small (7.4%), suggesting possible redundancy among the sites, which are about 23 km (14 miles) apart. Additionally, special ozone studies conducted by the Air Monitoring Center at UDAQ revealed greater ozone concentrations in Erda compared to Beach monitoring station[5]. Given that federal regulations require that at least one ozone site within a CBSA be designed to record the maximum concentration for that area, UDAQ shut down the Beach station in October 2014. UDAQ also relocated the Tooele site to Erda, which is located about ten miles south and west of B4 in Tooele County. UDAQ therefore recommends continuing monitoring at Hawthorne and Herriman #3 as well as establishing a new ozone monitoring site in Erda. A new station, Copper View, with objective to support air pollution modeling efforts and supply air quality data to the growing population in the southern area of Salt Lake Valley, will also be established in the southeast area of Salt Lake County, as previously mentioned.

Provo-Orem CBSA

DAQ currently operates two ozone monitors within the Provo-Orem CBSA, which is in agreement with minimum federal monitoring requirements for a CBSA with a population between 350,000 and 4,000,000. The monitors are located at North Provo (NP) and Spanish Fork (SF) monitoring sites. NP operates on a daily schedule while the SF monitor follows a seasonal

[5] UDAQ, 2012 Utah Ozone Study.

schedule, beginning on May 1st and ending on September 30th, in accordance with federal regulations.

Correlation analysis showed that the concentrations measured at the two sites were strongly correlated (R = 0.90) and their relative difference was low, averaging 5.3%. Both sites also displayed 3-year design values (73 and 72 ppb) that are close to the current NAAQS of 75 ppb but in excess of the anticipated and more stringent standard. Given these design values and minimum federal monitoring requirements, UDAQ does not recommend discontinuing ozone monitoring at SF and NP sites. UDAQ is, however, required to relocate the SP site within the next two years due to planned construction works at its current location at the Spanish Fork Airport in Utah County, as aforementioned. To maintain consistency with the current site's objectives, a potential location is across the street from the existing site, which would still allow DAQ to monitor both local and regional levels of ozone. Additionally, as previously mentioned, UDAQ will consolidate the NP and LN sites at a new location.

Table 27. Pearson correlation coefficient (R), average relative concentration difference and distance between pairs of sites in Provo-Orem CBSA.

Site 1	Site 2	R	n	Absolute average relative difference	Distance (km)
North Provo	Spanish Fork	0.90	486	0.053	13

Ogden-Clearfield CBSA

DAQ currently operates four ozone monitors within the Ogden-Clearfield CBSA, which exceeds minimum federal monitoring requirements for a CBSA with a population above 350,000 but less than 4,000,000. The monitors are located at Bountiful Viewmont (BV), Brigham City (BR), Harrisville (HV) and Ogden #2 (O2) monitoring sites. The monitor at O2 operates continuously while the monitors at BV, BR and HV operate on a seasonal schedule, beginning on May 1st and ending on September 30th. The site at Harrisville was established in response to an ozone saturation study, which identified the site as a potentially high-ozone concentration area.

Results of the correlation analysis showed that the concentrations measured, at each pair of sites, were overall reasonably strongly correlated ($R \geq 0.78$), with statistically significantly greater mean levels at Harrisville and Brigham City compared to the remaining sites (tables 28 and 29). However, despite excessive monitoring, UDAQ does not recommend discontinuing ozone monitoring at the sampling sites within this CBSA. The monitors at Ogden #2 and Bountiful Viewmont are located in well-urbanized, highly-populated areas and are essential for ozone measurement on neighborhood scales. Furthermore, the O3 data collected at BV provides valuable information that can be used in conjunction with CO, NOx, and VOC data, also monitored at this location. Additionally, the ozone monitors at HV and BR are crucial for monitoring high ozone levels in the area, with the monitor at BR being the only one in Box Elder County.

Table 28. Pearson correlation coefficient (R), average relative difference and distance between pairs of sites for ozone in Ogden-Clearfield CBSA.

Site 1	Site 2	R	N*	Absolute average relative difference	Distance (km)
Brigham City	Bountiful Viewmont	0.78	488	0.14	67
Brigham City	Ogden #2	0.78	474	0.08	32
Brigham City	Harrisville	0.90	456	0.06	21
Bountiful Viewmont	Ogden #2	0.92	724	0.14	35
Bountiful Viewmont	Harrisville	0.86	478	0.15	45
Harrisville	Ogden #2	0.85	465	0.08	11

*Based on 8-hr average ozone concentration data

Table 29. Results of two-tailed paired t-test for ozone pairings in Ogden-Clearfield CBSA.

	Bountiful Viewmont	Harrisville	Ogden #2	Bountiful Viewmont	Brigham City	Bountiful Viewmont	Harrisville	Ogden #2	Harrisville	Brigham City	Ogden #2	Brigham City
N*	9086	9086	10443	10443	8890	8890	8754	8754	9283	9283	8566	8566
Mean (ppb)	38.8	45.4	35	37.8	45.5	39.0	45.5	36.5	45.06	45.13	36.7	45.6
Standard deviation (ppb)	14.2	15.0	20.9	13.9	13.7	14.1	14.7	19.9	14.9	13.6	19.8	13.5
Standard error (ppb)	0.149	0.157	0.20	0.14	0.145	0.149	0.16	0.21	0.15	0.14	0.21	0.15
p-value	< 0.001		0		0		0		0.38		0	

*Based on hourly ozone data collected during May-September for the period 2011-2013.

Roosevelt site, Price and Vernal CBSAs

DAQ operates one ozone monitor at each of these sites or CBSAs, which exceeds minimum federal monitoring requirements (table 25). These monitors were installed to investigate the uncharacteristically high winter-time ozone levels in the Uinta Basin. DAQ, therefore, does not recommend making any changes to these ozone monitoring sites.

Logan and St. Georges CBSAs

DAQ operates one ozone monitor at each of these CBSAs, which is in agreement with or exceeds minimum federal monitoring requirements (table 25). These monitors were installed to represent population exposure in their respective counties. However, as aforementioned, due to violation of siting requirements, UDAQ will shut down the Logan site, located in Cache County, by 2016. Smithfield station, which UDAQ recently established (January 2015), will replace the Logan site. This station is located in the same county, but farther north. Excluding the relocation of the Logan site, UDAQ does not recommend making any changes to the ozone monitoring network within these CBSAs

Cedar City, CBSA

UDAQ currently does not operate any ozone monitor in Cedar City CBSA. The total population of this CBSA is, however, expected to increase to 57,055 (table 25) in 2020, which is above the threshold of federal monitoring requirements. UDAQ will therefore establish a site for ozone and $PM_{2.5}$ monitoring in Cedar City CBSA, Iron County, by 2018, as aforementioned (section 3.1.1.4).

Table 30. List of ozone monitors in UDAQ network and recommendations for network modification.

Site	County	Monitor Type	Spatial scale	Monitoring objective	Method/Schedule	Value	Recommendation
Hawthorne	Salt Lake	SLAMS	High Neighborhood	Population exposure	Instrumental Ultra Violet/Continuous	**High**– NCore site; design value very close to ozone NAAQS; supports model performance evaluation and ozone maintenance demonstration	Continue monitoring
Herriman #3		New SLAMS	Population Neighborhood	Population exposure	Instrumental Ultra Violet/Continuous	**New**–site recently established to assess population exposure in southwest Salt Lake County	Continue monitoring
Copper View		New SLAMS	Population Neighborhood	Population exposure	-	**New**– Identified in assessment as area for assessing population exposure in southeast Salt Lake County	Establish site in 2015
Erda	Tooele	New SLAMS	Population Neighborhood	Population exposure	-	**New**– Identified in assessment as high-ozone concentration area	Establish site in 2015
North Provo	Utah	SLAMS	Population Neighborhood	Population exposure	Instrumental Ultra Violet/Continuous	**Moderate**– design value close to ozone NAAQS; supports model performance evaluation/ ozone maintenance demonstration; redundant with Lindon	Consolidate with Lindon at a new location
Spanish Fork		SLAMS	Population Neighborhood	Population exposure	Instrumental Ultra Violet/Seasonal	**Moderate**– design value close to ozone NAAQS; supports model performance evaluation/ozone maintenance demonstration; local high-ozone concentration area	Relocate site due to logistical issues and continue monitoring

Table 30 (cont'd.)

Site	County	Monitor Type	Spatial scale	Monitoring objective	Method/Schedule	Value	Recommendation
Bountiful Viewmont	Davis	SLAMS	High Neighborhood	Population exposure	Instrumental Ultra Violet/Seasonal	**Moderate**– design value location for ozone NAAQS; historically reported highest ozone concentrations in the network; supports model performance evaluation and maintenance plan	Continue monitoring
Brigham City	Box Elder	SLAMS	Population Neighborhood	Population exposure	Instrumental Ultra Violet/Seasonal	**Moderate**– design value location for ozone NAAQS	Continue monitoring
Harrisville	Weber	SLAMS	Population Neighborhood	Population exposure	Instrumental Ultra Violet/Seasonal	**High**– site established in response to an ozone saturation study; high-ozone concentration area	Continue monitoring
Ogden #2		SLAMS	Population Neighborhood	Population exposure	Instrumental Ultra Violet/Continuous	**Moderate**– design value location for ozone NAAQS	Continue monitoring
Hurricane	Washington	SLAMS	Regional	High winter ozone study	Instrumental Ultra Violet/Continuous	**Moderate**– Site established on 01/01/14 to provide a baseline of levels in the St. George MSA; monitor is the only monitor that provides ozone monitoring for Washington County.	Continue monitoring
Logan #4	Cache	SLAMS	Population Neighborhood	Population exposure	Instrumental Ultra Violet/Continuous	**Low**– violation of siting criteria	Shut down site by 2016 and replace by Smithfield
Smithfield		SLAMS	Population Neighborhood	Population exposure	Instrumental Ultra Violet/Continuous	**New**– Site established on 1/1/2015 to replace Logan #4	Continue monitoring

Table 30 (cont'd.)

Site	County	Monitor Type	Spatial scale	Monitoring objective	Method/Schedule	Value	Recommendation
Price #2	Carbon	SPM	Regional	High winter ozone study	Instrumental Ultra Violet/Continuous	**High**– site established in response to a three-state ozone study; potentially high-ozone concentration area	Continue monitoring
Roosevelt	Duchesne	SPM	Regional	High winter ozone study	Instrumental Ultra Violet API/Continuous	**High**– site established to determine maximum ozone concentrations in Duchesne county; design value above ozone NAAQS	Continue monitoring
Vernal #4	Uintah	New SLAMS	Regional	High winter ozone study	Instrumental Ultra Violet/Continuous	**New**– established to replace Vernal site (VL), which was established in response to an ozone study and displayed a design value above ozone NAAQS	Continue monitoring
Cedar city	Iron	New SLAMS	Population Neighborhood	Population exposure	-	**New**– Identified in assessment as area of projected population growth	Establish site by 2018

3.2.2 Sulfur Dioxide (SO_2) Network

3.2.2.1 Historical trends and deviations from NAAQS

UDAQ currently operates one SO_2 monitor, located at Hawthorne NCore site within the Salt Lake City CBSA. The monitor is designated as population-oriented and satisfies NCore requirements. In addition to the SO_2 monitor at Hawthorne site, UDAQ network used to include five other monitors. These were located at Beach (B4), Magna (MG), North Salt Lake (N2), Bountiful Viewmont (BV) and Roosevelt (RS) sites. The monitors located at B4, MG and N2 in Salt Lake City CBSA were shut down in 2013/2014 because they produced excessive data and 75% of the recorded values were equal to or below 8 ppb during 2011-2013, with occasional spikes in hourly concentrations rarely reaching the NAAQS. For each site, the number of exceedances of the primary 1-hr 2010 SO_2 NAAQS and the 75th percentile of the daily maximum 1-hr average SO_2 concentration (ppb) are shown in tables 31 and 32, respectively. SO_2 monitoring at Bountiful Viewmont and Roosevelt was discontinued in 2012/2013 since the samplers did not record any exceedances of the 1-hr NAAQS. The 1-hr primary standard for SO_2 is 75 ppb. The standard is met when the 99th percentile of the 1-hour daily maximum concentrations, averaged over 3 years, is less than 75 ppb. The secondary standard of 0.5 ppm is not to be exceeded more than once per year. As illustrated in figure 11, no SO_2 NAAQS violations occurred in the state of Utah during the period 2007-2014. Moreover, all sites display a decreasing trend in SO_2 concentration, with levels reaching less than 25 ppb.

Table 31. Number of exceedances of primary 1-hr SO_2 NAAQS during 2011-2014.

	Number of exceedances of primary 1-hr 2010 SO2 NAAQS			
	2011	**2012**	**2013**	**2014**
Beach	0	0	1	-
Magna	0	0	0	-
North Salt Lake	0	0	0	-
Hawthorne	0	0	0	0
Bountiful Viewmont	0	0	0	-
Roosevelt	-	0	-	-

Table 32. 75th percentile of daily maximum 1-hr average SO_2 concentration during 2011-2014.

	75th percentile of daily maximum1-hr average SO2 concentration (ppb)			
	2011	**2012**	**2013**	**2014**
Beach	4	4	5	-
Magna	5	5	7	-
North Salt Lake	6	8	7	-
Hawthorne	2.5	2.4	1.7	1.5
Bountiful Viewmont	3	3	3	-
Ro–osevelt	-	0	-	-

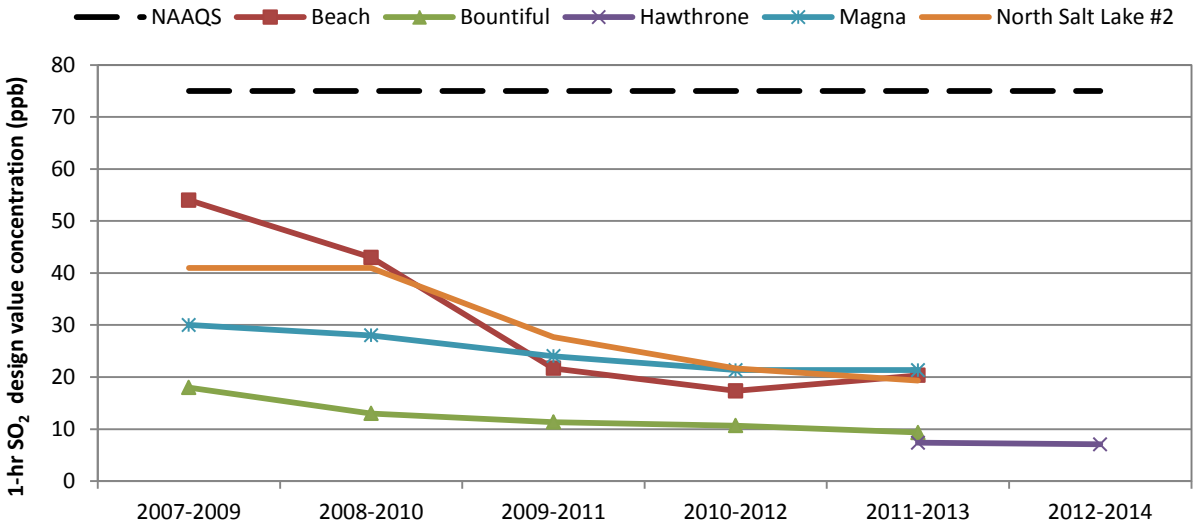


Figure 11. 1-hr design value trends and comparison to NAAQS for SO_2 during the period 2007-2014.

3.2.2.2 Site-by-site analysis

Given the consistent decrease in SO_2 concentration, non-violation of the NAAQS as well as NCore and minimum monitoring requirements, UDAQ only maintained SO_2 monitoring at Hawthorne site. Federal regulations require a minimum of three SO_2 monitors within a CBSA with a calculated Population Weighted Emissions Index (PWEI) value equal to or greater than 1,000,000. The PWEI is calculated by multiplying the population of each CBSA by the total amount of SO_2 (in tons per year) emitted within the CBSA area, then dividing the resulting product by one million. The population is estimated using the most current census data or estimates while SO_2 emissions are calculated using an aggregate of the most recent county level emissions data available in the National Emissions Inventory. For any CBSA with a calculated PWEI value equal to or greater than 100,000, but less than 1,000,000, a minimum of two SO_2 monitors are required within that CBSA. For any CBSA with a calculated PWEI value equal to or greater than 5,000, but less than 100,000, a minimum of one SO_2 monitor is required within that CBSA. PWEI for the Salt Lake CBSA is 5053.9, indicating that the monitor at Hawthorne satisfies minimum monitoring requirements for this CBSA. Remaining CBSAs have a PWEI value less than 5,000, suggesting that no monitor is needed within these CBSAs (table 33). UDAQ would therefore like to maintain the current SO_2 network unchanged. An evaluation of SO_2 monitors in UDAQ network is provided in table 34.

Table 33. Number of active SO_2 monitors in each CBSA and minimum number of required monitors.

CBSA	Counties	Population estimate (2013)	PWEI (Million persons- tons/year)	Minimum number of required monitors	Number of active monitors
Salt Lake City MSA	Salt Lake, UT Tooele, UT	1,140,483	5,053.9	1	1
Provo-Orem MSA	Juab, UT Utah, UT	562,239	292.4	0	0
Ogden-Clearfield MSA	Box Elder, UT Davis, UT Morgan, UT Weber, UT	621,580	773.8	0	0
Heber µSA	Wasatch, UT	26,437	0.43	0	0
Logan UT-ID MSA	Cache, UT Franklin, ID	Total: 129,763 Cache County: 116,909	20.1	0	0
Saint George UT MSA	Washington, UT	147,800	13.5	0	0
Cedar City µSA	Iron, UT	46,780	7.8	0	0
Price µSA	Carbon, UT	20,988	175.9	0	0
Vernal UT µSA	Uintah, UT	35,555	8.1	0	0
Summit Park µSA	Summit, UT	38,486	8.3	0	0

Table 34. List of SO_2 monitors in Utah air monitoring network and recommendations for network modification.

Site	County	Monitor Type	Spatial scale	Monitoring objective	Sampling and Analysis Method	Value	Recommendation
Hawthorne	Salt Lake	SLAMS	Population Neighborhood	Population exposure	Continuous Pulsed fluorescence	**High**– NCore site	Continue monitoring

3.2.3 Nitrogen Dioxide (NO_2) Network

3.2.3.1 Historical trends and deviations from NAAQS

National standards for NO_2 include hourly and annual standards of 100 and 53 ppb, respectively. The hourly standard is met when the 98th percentile of 1-hour daily maximum concentrations, averaged over 3 years, is less than 100 ppb. The annual standard is met when the annual mean is less than 53 ppb. Although there were three 1-hr values above the hourly NAAQS during 2012-2014 (table 35), Utah has been in compliance with these standards (figures 12 and 13). Note that the Santa Clara site has been replaced by Hurricane (HC). Moreover, the Fruitland (FL) station, which was contracted to UDAQ to operate by the State of Utah Bureau of Land Management (UBLM), has been removed from UDAQ network in early 2014. As of January 1, 2014, UBLM has been maintaining the site while UDAQ has only been responsible for auditing and calibrating the air quality instruments.

Table 35. Number of exceedances of primary 1-hr NO_2 NAAQS during 2011-2014.

	Number of exceedances of primary 1-hr 2010 SO2 NAAQS		
	2012	**2013**	**2014**
Bountiful Viewmont	0	1	0
Logan #4	0	0	0
Price	1	0	0
Roosevelt	0	0	0
Hawthorne	0	0	0
Vernal	0	0	0
North Provo	0	0	0
Hurricane	0	0	0
Ogden #2	0	0	0
Fruitland	0	1	-

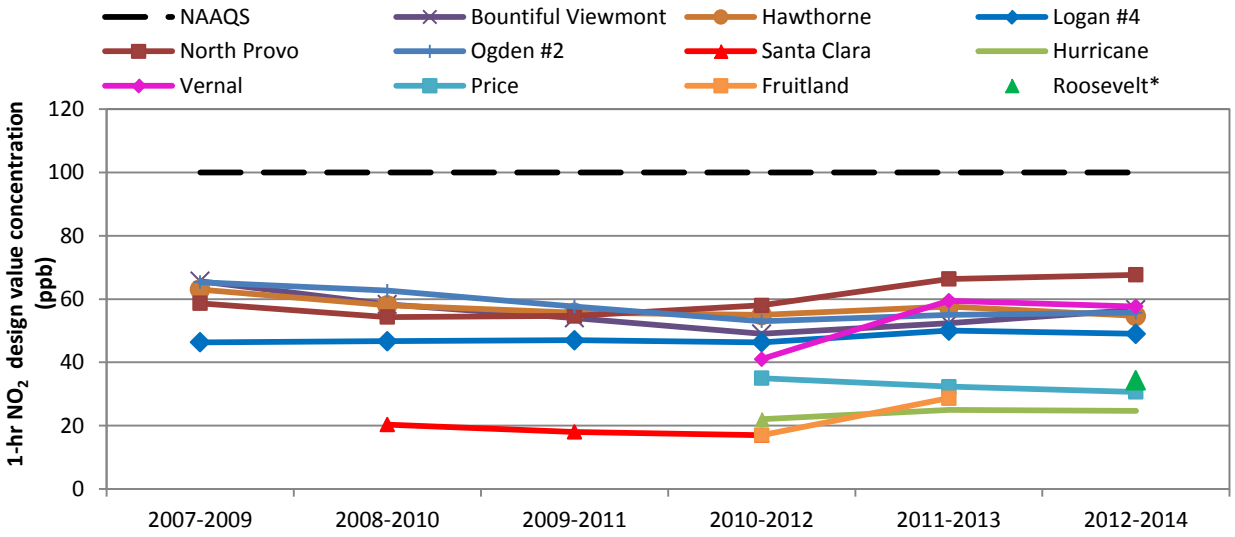


Figure 12. 1-hr design value trends and comparison to NAAQS for NO_2 during the period 2007-2009.
**** Only includes 2014 data values.***

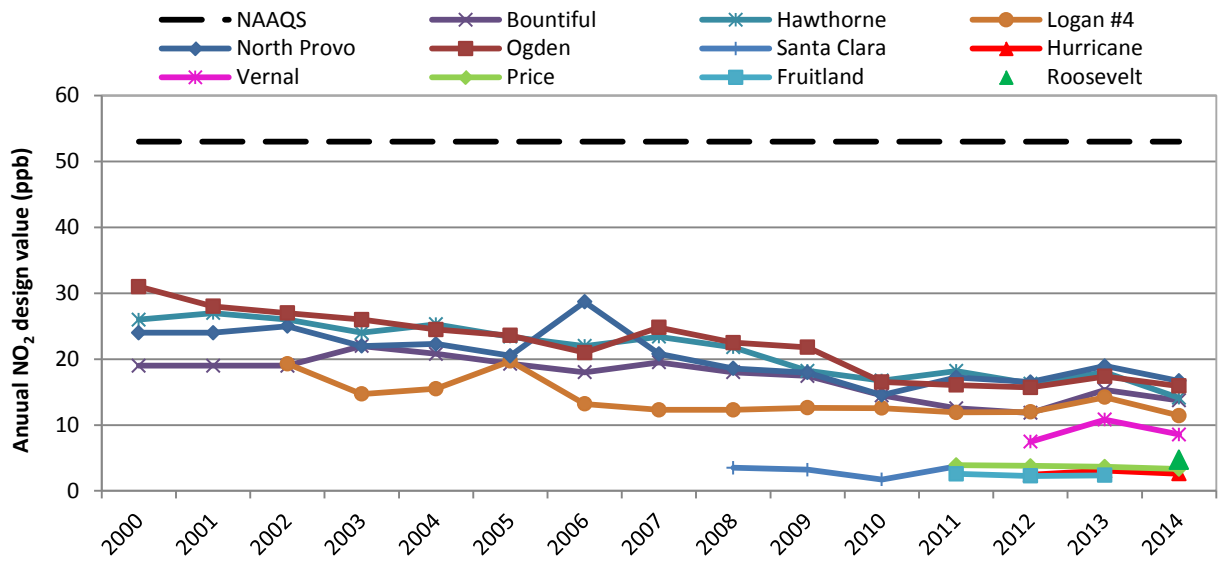


Figure 13. Annual design value trends and comparison to NAAQS for NO_2 during the period 2000-2014.

3.2.3.2 Site-by-site analysis and near-road NO_2 monitoring

Although Utah has demonstrated compliance with NO_2 standards, UDAQ would like to maintain NO_2 monitoring at all sites since emissions of this pollutant can lead to increased ozone and $PM_{2.5}$ formation, often resulting in pollution levels exceeding the NAAQS. Photochemical reactions between NO_2 and volatile organic compounds lead to the formation of ground-level ozone along the Wasatch Front and the Uinta Basin during summer and winter, respectively[6,7]. NO_2 can also react with ammonia to form nitrate-$PM_{2.5}$ during winter. Therefore, to support efforts towards understanding and controlling high $PM_{2.5}$ and ozone levels, particularly during winter, UDAQ would like to maintain NO_2 monitoring at all current sites. UDAQ will also add NO_2 monitors at the Erda and Copper View sites. As aforementioned, UDAQ is in the process of relocating the Tooele station to a nearby site in Erda, which represents a high-ozone concentration area in Tooele County. UDAQ is also in the process of establishing a site, Copper View, with purpose to represent population exposure in southeast Salt Lake County. Additionally, to satisfy federal monitoring requirements, a near-road site will be established in Salt Lake County. Federal regulations require that a minimum of one monitor be placed in any urban area with a population greater than or equal to one million people in order to assess community-wide concentrations. Regulations also require that at least one monitor be located near a major road in urban areas with a population greater than or equal to 500,000 people and that monitors be placed in other areas where maximum concentrations are expected. With the exception of the Salt Lake City, Provo-Orem and Ogden-Clearfield CBSAs, all sites satisfy minimum federal NO_2 monitoring requirements, with a few stations exceeding the requirements. The minimum number of required NO_2 monitors and a count of active NO_2 monitors in UDAQ

[6] UDAQ, 2012 Utah Ozone Study
[7] UDAQ, 2014 Uinta Basin Winter Ozone Study Final Report

network are provided in table 36. The Salt Lake City CBSA has two NO_2 monitors located at Hawthorne and Herriman monitoring stations. The monitors satisfy federal requirements for community-based (area-wide) NO_2 monitoring; but not near-road monitoring. A near-road monitor is required within this CBSA as well as within the Provo-Orem and Ogden-Clearfield CBSAs. DAQ plans on establishing near-road sites in Salt Lake, Utah and Davis counties within these CBSAs. The monitoring sites, however, will not be established and operated until funding becomes available. Other monitoring objectives currently have a higher priority due to the scarcity of resources. An evaluation of NO_2 monitors in UDAQ network is provided in table 37.

Table 36. Number of active NO_2 monitors in each CBSA and minimum number of required monitors.

CBSA	Counties	Census 2010	Population estimate (2020)	Minimum number of required near-road monitors	Minimum number of required area-wide monitors	Number of active monitors
Salt Lake City MSA	Tooele, UT Salt Lake, UT	1,087,873	1,255,736	1	1	2 (area-wide)
Provo-Orem MSA	Juab Utah	526,810	682,314	1	0	1 (area-wide)
Ogden-Clearfield MSA	Box Elder, UT Davis, UT Morgan, UT Weber, UT	597,159	681,907	1	0	2 (area-wide)
Heber µSA	Wasatch, UT	32,741	26, 437	0	0	0
Logan UT-ID MSA	Cache, UT Franklin, ID	Total: 125,442 Cache County, UT: 112, 656	Cache County: 139,228	0	0	1
Saint George UT MSA	Washington, UT	138, 115	196,762	0	0	1
Cedar City µSA	Iron, UT	46,163	57,055	0	0	0
Price µSA	Carbon, UT	21, 403	21,602	0	0	1
Vernal UT µSA	Uintah, UT	32, 588	38,982	0	0	1
Summit Park	Summit, UT	36, 324	45, 491	0	0	0

Table 37. List of NO_2 monitors in Utah air monitoring network and recommendations for network modification.

Site	County	Monitor Type	Spatial scale	Monitoring objective	Pollutant/Method	Value	Recommendation
Hawthorne	Salt Lake	SLAMS	High Neighborhood	Population exposure	Nitrogen dioxide/Instrumental Chemiluminescence	**High**– NCore site; supports model performance evaluation and NAAQS maintenance demonstration; high-exposure area	Continue monitoring
Herriman #3		New SLAMS	Population Neighborhood	Population exposure	Nitrogen oxides/Instrumental Chemiluminescence	**New**– Site recently established to assess population exposure in southwest Salt Lake County	Continue monitoring
Copper View		New SLAMS	Population Neighborhood	Population exposure	-	**New**– Identified in assessment as area for assessing population exposure in southeast Salt Lake County	Establish site in 2015
Bountiful Viewmont	Davis	SLAMS	Population Neighborhood	Population exposure	Nitrogen dioxide/Instrumental Chemiluminescence	**Moderate**– supports model performance evaluation	Continue monitoring
Hurricane	Washington	SLAMS	Regional	High ozone winter study	Nitrogen dioxide/Instrumental Chemiluminescence	**High**– supports model performance evaluation and control of high winter-time ozone levels	Continue monitoring
Logan #4	Cache	SLAMS	Population Neighborhood	Population exposure	Nitrogen dioxide/Instrumental Chemiluminescence	**Low**– violation of siting requirements	Shut down site by 2016 and replace by Smithfield

Table 37 (cont'd.)

Site	County	Monitor Type	Spatial scale	Monitoring objective	Pollutant/Method	Value	Recommendation
North Provo	Utah	SLAMS	High Neighborhood	Population exposure	Nitrogen dioxide/Instrumental Chemiluminescence	**High**– supports model performance evaluation and NAAQS maintenance demonstration; high-exposure area; redundant with Lindon	Consolidate with Lindon at a new location
Ogden #2	Weber	SLAMS	High Neighborhood	Population exposure	Nitrogen dioxide/Instrumental Chemiluminescence	**High**– supports model performance evaluation and NAAQS maintenance demonstration; high-exposure area	Continue monitoring
Price #2	Carbon	SPM	Regional	High ozone winter study	Nitrogen dioxide/Instrumental Chemiluminescence	**High**– supports model performance evaluation and control of high winter-time ozone levels	Continue monitoring
Roosevelt	Duchesne	SLAMS	Population Neighborhood	High ozone winter study	Nitrogen dioxide/Instrumental Chemiluminescence	**High**– supports model performance evaluation and control of high winter-time ozone levels	Continue monitoring
Vernal #4	Uintah	New SLAMS	Regional	High ozone winter study	Nitrogen dioxide/Instrumental Chemiluminescence	**New**– established to replace Vernal site (VL), which was shut down in January 2015; supports control of high winter-time ozone levels	Continue monitoring
Erda	Tooele	New SLAMS	Population Neighborhood	Population exposure	-	**New**– established to replace Tooele #3; identified in assessment as high-ozone exposure area	Establish site by 2015

3.2.4 Carbon Monoxide (CO) Network

3.2.4.1 Historical trends and deviations from NAAQS

The national 1-hr and 8-hr standards for CO are 35 and 9 ppm, respectively. The standards are not to be exceeded more than once per year. Three cities in Utah, including Salt Lake City, Ogden and Provo, were at one time designated as non-attainment areas for CO. However, given recent improvements in motor vehicle technology, Salt Lake City, Ogden and Provo have been successfully re-designated as attainment areas in 1999, 2001 and 2006, respectively. All areas in Utah are currently in compliance with CO NAAQS, as shown in figures 14-15 and table 38. Note that CO monitoring at Washington Boulevard and Cottonwood stations was discontinued in 2013 and 2012, respectively. Cottonwood station was closed due to violations of EPA siting criteria and data redundancy with Hawthorne site. Washington Boulevard was shut down because CO was the only measured parameter at this site and the collected data was redundant with that monitored at Ogden site, located about 1 mile south. Further details on the closure of these sites are provided in the 2010 five-year network assessment report.

Table 38. Number of exceedances of primary 1-hr and 8-hr CO NAAQS during 2012-2014.

	Number of exceedances of 1-hr/8-hr 1971 CO NAAQS		
	2012	**2013**	**2014**
Hawthorne	0/0	0/0	0/0
North Provo	0/0	0/0	0/0
Ogden #2	0/0	0/0	0/0
Washington boulevard #2	0/0	0/0	-

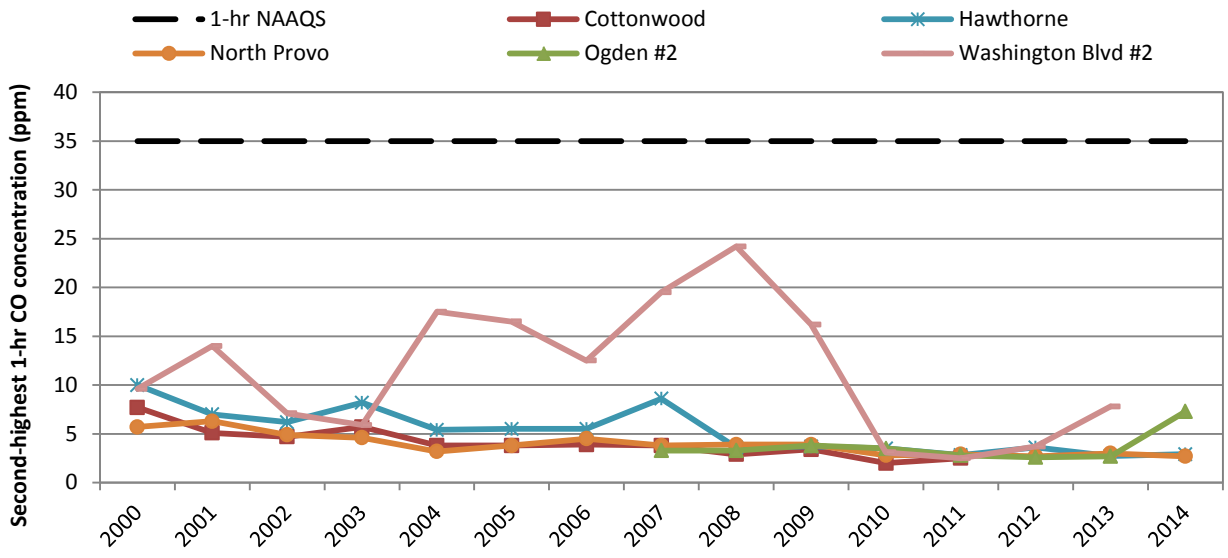


Figure 14. Second-highest 1-hr concentration trends and comparison to NAAQS for CO during the period 2000-2014.

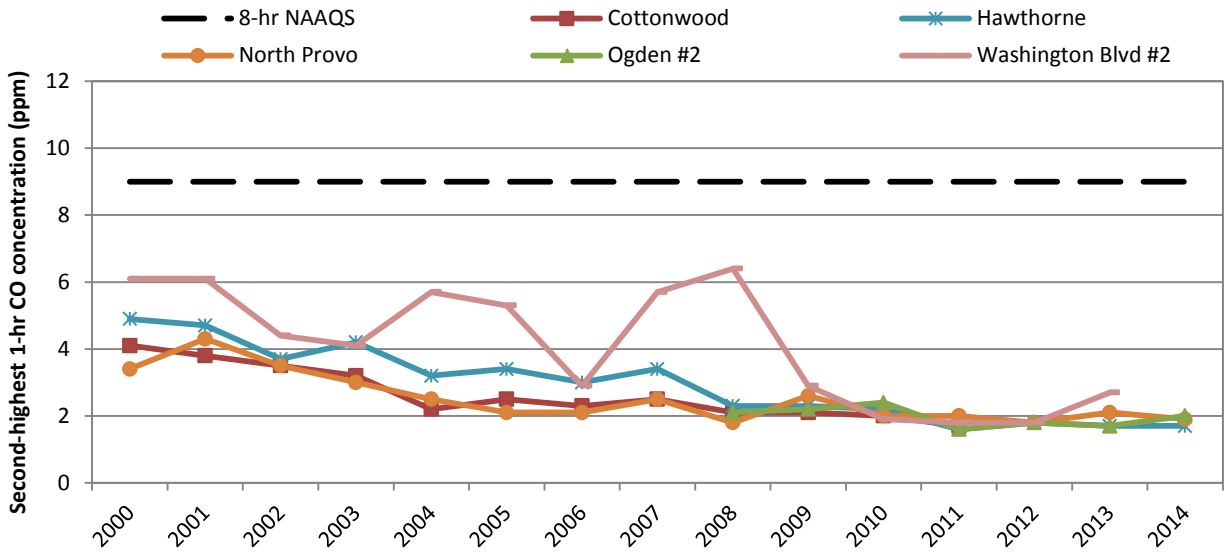


Figure 15. Second-highest 8-hr concentration trends and comparison to NAAQS for CO during the period 2000-2014.

3.2.4.2 Site-by-site analysis

UDAQ currently operates three CO monitors within its network. These are located at Hawthorne (HW), Ogden #2 (O2) and North Provo (NP) sites and are operated continuously. Minimum federal monitoring requirements for CO and an evaluation of CO monitors in UDAQ network are provided in tables 39 and 40, respectively.

Salt Lake City CBSA

According to federal regulations, one CO monitor is required to operate co-located with one required near-road NO_2 monitor in CBSAs having a population of 1,000,000 or more persons. If a CBSA has more than one required near-road NO_2 monitor, only one CO monitor is required to be co-located with a near-road NO_2 monitor within the CBSA. UDAQ currently operates one CO monitor within the Salt Lake City CBSA. The monitor is located at NCore Hawthorne site, which is classified as a high-exposure area. Although the site represents a high-concentration location and satisfies NCore requirements, the monitor does not meet minimum monitoring requirements for near-road sampling. A near-road NO_2 monitoring site is not yet established by UDAQ, but will be set up as soon as resources become available. UDAQ will add a CO monitor at the near-road site as soon as established.

Provo-Orem and Ogden-Clearfield CBSAs

UDAQ currently operates one CO monitor in each of the Provo-Orem and Ogden-Clearfield CBSAs, which exceeds minimum federal monitoring requirements. The samplers, which are located at North Provo and Ogden #2, are used to monitor population exposure to emissions from anthropogenic activities in the area as well as to support CO maintenance plans. UDAQ would therefore like to maintain CO monitoring at these sites, but will consolidate the NP site with the Lindon site, as aforementioned.

Table 39. Number of active CO monitors in each CBSA and minimum number of required monitors.

CBSA	Counties	Census 2010	Population estimate (2020)	Minimum number of required near-road NO_2 monitors	Minimum number of required CO monitors	Number of active CO monitors
Salt Lake City MSA	Tooele, UT Salt Lake, UT	1,087,873	1,255,736	1	1 (co-located with near-road NO_2 monitor)	1 (area-wide)
Provo-Orem MSA	Juab, UT Utah, UT	526,810	682,314	1	0	1
Ogden-Clearfield MSA	Box Elder, UT Davis, UT Morgan, UT Weber, UT	597,159	681,907	1	0	1
Heber µSA	Wasatch, UT	23, 530	32,741	0	0	0
Logan UT-ID MSA	Cache, UT Franklin, ID	Total: 125,442 Cache County, UT: 112, 656	Cache County, UT: 139,228	0	0	0
Saint George MSA	Washington, UT	138, 115	196,762	0	0	0
Cedar City µSA	Iron, UT	46,163	57,055	0	0	0
Price µSA	Carbon, UT	21, 403	21,602	0	0	0
Vernal µSA	Uintah, UT	32, 588	38,982	0	0	0
Summit Park µSA	Summit, UT	36, 324	45, 491	0	0	0

Table 40. List of CO monitors in Utah air monitoring network and recommendations for network modification.

Site	County	Monitor Type	Spatial scale	Monitoring objective	Sampling and Analysis Method	Value	Recommendation
Hawthorne	Salt Lake	SLAMS	High Neighborhood	Population exposure	Instrumental Gas Phase Correlation/ Continuous	**High**– NCore site; high-exposure area; design value location for CO NAAQS; supports CO maintenance plan and model performance evaluation	Continue monitoring
Ogden #2	Weber	SLAMS	Population Neighborhood	Population exposure	Instrumental Gas Phase Correlation/ Continuous	**Moderate**– design value location for CO NAAQS; supports CO maintenance plan and model performance evaluation	Continue monitoring
North Provo	Utah	SLAMS	Population Neighborhood	Population exposure	Instrumental Gas Phase Correlation/ Continuous	**Moderate**– supports CO maintenance plan/model performance evaluation; design value location for CO NAAQS, redundant with Lindon	Consolidate with Lindon at a new location

3.3 Lead (Pb) Network

3.3.1 Historical trends and deviations from NAAQS

Historically, major sources of lead consisted of on-road motor vehicle fuel emissions. However, given that leaded gasoline for automobiles was completely phased out by the end of 1995 in the U.S., current sources of lead in Utah include extraction and processing of metallic ores as well as piston-engine aircrafts.

On November 12 2008, EPA revised the primary and secondary NAAQS for lead to 0.15 µg/m^3 in total suspended particles (TSP). The previous standards, which were issued by EPA in 1978, were ten times higher (1.5 µg/m^3). To meet the standard, a rolling three-month average lead concentration may not exceed 0.15 µg/m^3. The state of Utah has been in compliance with lead NAAQS since 1982, with EPA authorizing the discontinuation of lead monitoring in Utah in 2005. However, given that EPA established new requirements for lead monitoring in 2008 and 2010, UDAQ resumed lead monitoring at Magna, a point source site near Kennecott copper smelter, in 2009. As can be seen in figure 16, Magna displays low Pb levels, with peak three-month average concentration in 2014 accounting for 66.6% of the standard.

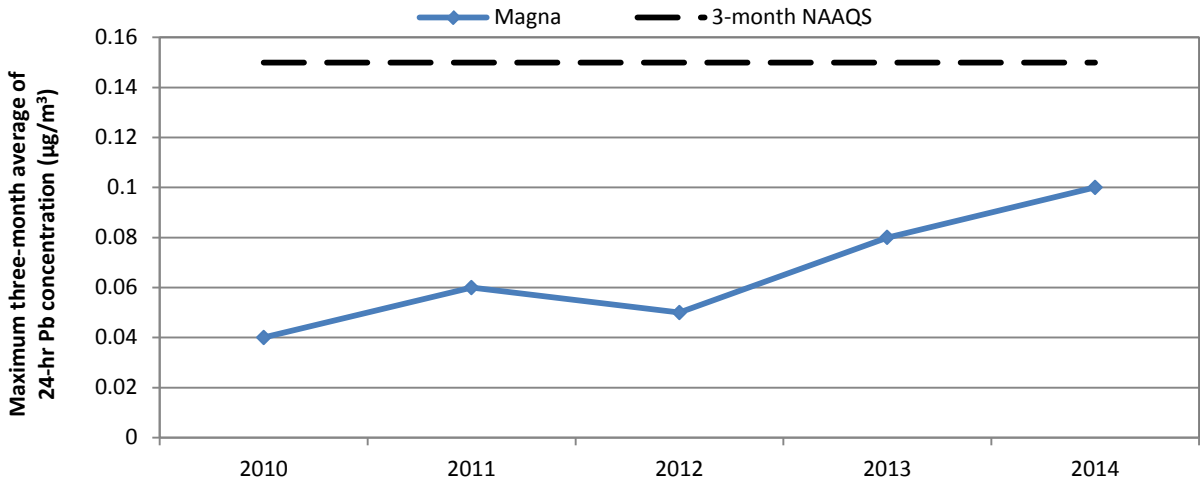


Figure 16. Trends in maximum three-month average 24-hr Pb concentration during the period 2010-2014 and comparison to NAAQS.

3.3.2 Site-by-site analysis

Federal regulations require a lead monitor at NCore sites in CBSAs with more than 500,000 people. They also require source-oriented monitoring to measure maximum ambient Pb concentration, resulting from non-airport lead sources which emit more than 0.50 tons per year. The refining and smelting plant of Kennecott Utah Copper Corporation, near Magna, represents the state's largest source of lead (2011 National Emissions Inventory). To meet minimum monitoring requirements, UDAQ recommends continuing Pb monitoring at Magna as well as NCore Hawthorne site. UDAQ started lead monitoring, using an FRM PM_{10} sampler, at Hawthorne in December 2011. An evaluation of Pb monitors in UDAQ network is provided in table 41.

Table 41. List of Pb samplers in Utah air monitoring network and recommendations for network modification.

Site	County	Monitor Type	Spatial scale	Monitoring objective	Pollutant/Method	Value	Recommendation
Hawthorne	Salt Lake	SLAMS	Population Neighborhood	Population exposure	Pb-PM_{10}/ PM_{10} FRM; ED XRF	**High**– NCore site	Continue monitoring
Magna	Salt Lake	SLAMS	High Neighborhood	Population exposure	Pb-TSP/ Hi-vol; ICP-MS Pb-TSP co-located/ Hi-vol; ICP-MS	**High**– High-exposure area; monitors emissions from Kennecott copper smelter; supports NAAQS maintenance demonstration	Continue monitoring

3.4 Chemical Speciation Network (CSN)

UDAQ currently operates three $PM_{2.5}$ chemical speciation sites, including Hawthorne, Bountiful Viewmont and Lindon (table 42). The Hawthorne site in Salt Lake County is an EPA-designated CSN monitoring station, operating on a 1-in-3 day sampling schedule. The Bountiful Viewmont site in Davis County and Lindon station in Utah County are SLAMS $PM_{2.5}$ speciation sites, operating on a 1-in-6 day sampling schedule. Data from the speciation network is primarily used to determine $PM_{2.5}$ chemical composition and sources as well as the spatial and temporal variation in its components.

3.5 NCore Network

UDAQ currently operates one NCore site, Hawthorne, located in Salt Lake County. NCore monitoring started at Hawthorne, which is an existing STN site, on January 2011. The site is equipped with several advanced measurement systems to monitor PM ($PM_{2.5}$, PM_{10} and $PM_{10-2.5}$), ozone, NO_2, trace levels of CO, SO_2 and total reactive nitrogen (NO_y), as well as meteorological parameters (ambient temperature, ambient pressure, solar radiation, wind speed, wind direction and relative humidity). Carbonyl Compounds, organic and elemental carbon are also monitored at this site. A list of measured parameters and analyses methods at this site is provided in table 43.

3.6 Air Toxics Trends Network

UDAQ has been participating in the EPA-funded Urban Air Toxics Monitoring Program since 1999. In January 2003, the air toxics monitoring equipment was re-located from West Valley to Bountiful Viewmont (BV) in order to co-locate the air toxics monitors with $PM_{2.5}$ speciation samplers, which would provide a more complete characterization of monitored air pollutants. Sampling for hexavalent Chromium (TSP method), aldehydes and PM_{10}-metals was also subsequently initiated. A list of measured parameters and analyses methods at this site is provided in table 44. Noteworthy is that this site also satisfies federal requirements for Photochemical Assessment Monitoring Station (PAMS) network program.

3.7 Mercury Deposition Network

Mercury is of significant health and environmental concern in Utah. Advisories limiting the consumption of fish have been issued for certain lakes and watersheds due to their elevated mercury levels. UDAQ is part of the National Mercury Deposition Network. It started measuring mercury wet deposition in May 2007. Monitoring of mercury dry deposition began in 2009. The samplers are located at UDAQ Air Monitoring Center (AMC) in West Valley. Reactive gaseous, particle-bound and gaseous elemental mercury as well as atmospheric ammonia are monitored at the AMC site. To support the assessment of mercury deposition, meteorological parameters and leaf wetness are also measured at this station. UDAQ does not recommend making any changes to this network (table 45).

Table 42. List of chemical speciation sites in Utah air monitoring network and recommendations for network modification.

Site	County	Monitor Type	Spatial scale	Monitoring objective	Pollutant/Method	Value	Recommendation
Bountiful Viewmont	Davis	SLAMS	Population Neighborhood	Population exposure	$PM_{2.5}$ speciation/ Manual EPA CSN	**High**– design value above $PM_{2.5}$ NAAQS; supports model performance evaluation and SIP development	Continue monitoring
Hawthorne	Salt Lake	SLAMS	Population Neighborhood	Population exposure	$PM_{2.5}$ speciation/ Manual EPA CSN	**High**– design value above $PM_{2.5}$ NAAQS; NCore site; supports model performance evaluation and SIP development	Continue monitoring
Lindon	Utah	SLAMS	Population Neighborhood	Population exposure	$PM_{2.5}$ speciation/ Manual EPA CSN	**Moderate**– Design value above $PM_{2.5}$ NAAQS; supports model performance evaluation/SIP development; redundant with North Provo	Consolidate with North Provo site at a new location

Table 43. List of NCore network sites and recommendations for network modification.

Site	County	Monitor Type	Spatial scale	Monitoring objective	Pollutant/Method	Value	Recommendation
Hawthorne	Salt Lake	SLAMS	Population Neighborhood	Population exposure	$PM_{2.5}$ speciation/ Manual EPA CSN	**High**– supports air quality model evaluation, SIP development and NAAQS maintenance plans; design value location for NAAQS; design value above $PM_{2.5}$ NAAQS; supports AQI reporting/forecasting	Continue monitoring
					$PM_{2.5}$ FRM/Manual gravimetric		
					PM_{10} FRM/Manual gravimetric		
					$PM_{10-2.5}$/Manual gravimetric subtraction		
			High Neighborhood		NO_2/ Instrumental Chemiluminescence		
			Population Neighborhood		NOy/ Instrumental Chemiluminescence		
					SO_2/Pulsed fluorescence		
			High Neighborhood		O_3/Instrumental Ultra Violet		
					CO/ Instrumental Gas Phase Correlation		
			Population Neighborhood		OC, EC/NIDR		
				Air Quality Index	PM_{10} continuous /TEOM FDMS		
					$PM_{2.5}$ continuous /TEOM FDMS		
				Ozone modeling input	PAMS C2 to C12/ Instrumental gas chromatography		
			Urban	-	Surface meteorology		

Table 44. List of National Air Toxics Trends Stations (NATTS) and recommendations for network modification.

Site	County	Monitor Type	Spatial scale	Monitoring objective	Pollutant/Method	Value	Recommendation
Bountiful Viewmont	Davis	SLAMS	Population Neighborhood	Population exposure	VOCs/ Manual EPA NTTN	**High**– NATTS site; toxics data co-located with $PM_{2.5}$ speciation data and gaseous monitors; monitors emissions from nearby oil refineries	Continue monitoring
					Semi-volatiles/ Manual EPA NTTN		
					Carbonyl Compounds/Manual EPA NTTN		
					PM_{10} metals/ Manual Gravimetric		
					PM_{10} metals co-located/ Manual Gravimetric		
					Hexavalent Chromium/ Manual EPA NTTN		

Table 45. List of Mercury Deposition Network (MDN) sites in Utah air monitoring network and recommendations for network modification.

Site	County	Monitor Type	Spatial scale	Monitoring objective	Pollutant/Method	Value	Recommendation
Air Monitoring Center (AMC)	Salt Lake	SPM	Transport regional	Population exposure	Dry mercury deposition/Cold Vapor Atomic Absorption/continuous	**High**– MDN site; measurements co-located with leaf wetness and meteorological parameters	Continue monitoring
					Wet mercury deposition/ Manual NADP MDN/ 7-day integrated		
					Ammonia/ Manual NADP AMoN/ 14-day integrated		

3.8 Meteorological Monitoring Network

To adequately represent the complex wind patterns and micrometeorology in Utah's airshed, meteorological parameters, including ambient temperature, temperature differential, relative humidity, ambient pressure, solar radiation as well as wind speed and direction, are currently measured at multiple sites throughout the state of Utah. Meteorological data is mainly collected to support air quality models and trends in co-located air pollutants. UDAQ does not recommend making any changes to the meteorological monitoring network. Note that the West Jordan station, which was initially established to collect meteorological data for air quality models, was shut down in June 2014 because it provided data of limited value. Meteorological parameters were the only variables measured at this station. Table 46a-f lists measured meteorological parameters, including a) relative humidity, b) ambient temperature and temperature difference, c) barometric pressure, d) wind speed, e) wind direction, f) standard deviation in wind direction (WD sigma) and g) solar radiation, in Utah air monitoring network.

Table 46a-f. List of measured meteorological parameters, including a) relative humidity, b) ambient temperature and temperature difference, c) barometric pressure, d) wind speed, e) wind direction, f) standard deviation in wind direction (WD sigma) and g) solar radiation, in Utah air monitoring network and recommendations for network modification.

a) Relative humidity

Site	County	Spatial scale	Pollutant/Method	Operating schedule	Tower height (m)	Value	Recommendation
Logan #4	Cache	Urban	Relative humidity/Elec. Thin film	Continuous	10	**Low**– violation of siting criteria	Shut down site by 2016 and replace by Smithfield
Ogden #2	Weber	Urban	Relative humidity/Elec. Thin film	Continuous	10	**High**– MET data co-located with air pollutants	Continue monitoring
Roosevelt	Duchesne	Urban	Relative humidity/Elec. Thin film	Continuous	10	**High**– MET data co-located with ozone measurements	Continue monitoring
Air Monitoring Center	Salt Lake	Urban	Relative humidity/Elec. Thin film	Continuous	4	**High**– MET data co-located with mercury deposition measurements	Continue monitoring
Saltair		Urban	Relative humidity/Elec. Thin film	Continuous	10	**Moderate**– supports air quality modeling	Continue monitoring
Hawthorne		Urban	Relative humidity/Elec. Thin film	Continuous	10	**High**– NCore site; MET data co-located with air pollutants	Continue monitoring
Syracuse	Davis	Urban	Relative humidity/Elec. Thin film	Continuous	10	**Moderate**– supports air quality modeling	Continue monitoring
Antelope Island		Urban	Relative humidity/Elec. Thin film	Continuous	6	**High**– supports modeling of lake emissions	Continue monitoring
Bountiful Viewmont		Urban	Relative humidity/Elec. Thin film	Continuous	10	**High**– MET data co-located with air pollutants	Continue monitoring

Table 46a (cont'd.)

Site	County	Spatial scale	Pollutant/Method	Operating schedule	Tower height (m)	Value	Recommendation
Badger Island	Tooele	Urban	Relative humidity/Elec. Thin film	Continuous	10	**High**– supports modeling of lake emissions	Continue monitoring
Lindon	Utah	Urban	Relative humidity/Elec. Thin film	Continuous	10	**Moderate**– MET data co-located with air pollutants but site redundant with North Provo	Consolidate with North Provo at a new location

b) Ambient temperature and temperature difference

Site	County	Spatial scale	Pollutant/Method	Operating schedule	Tower height (m)	Value	Recommendation
Brigham City	Box Elder	Urban	Ambient temperature/Elec. resistance	Continuous	10	**High**– MET data co-located with air pollutants	Continue monitoring
Logan #4	Cache	Urban	Ambient temperature/Elec. resistance	Continuous	10	**Low**– violation of siting criteria	Shut down site by 2016 and replace by Smithfield
Price #2	Carbon	Regional	Ambient temperature/Elec. resistance	Continuous	10	**High**– MET data co-located with air pollutants	Continue monitoring
Syracuse	Davis	Urban	Ambient temperature/Elec. resistance	Continuous	10	**Moderate**– supports air quality modeling	Continue monitoring
Antelope Island		Urban	Ambient temperature/Elec. resistance	Continuous	6	**High**– supports modeling of lake emissions	Continue monitoring

Table 46b (cont'd.)

Site	County	Spatial scale	Pollutant/Method	Operating schedule	Tower height (m)	Value	Recommendation
Bountiful Viewmont	Davis	Urban	Ambient temperature/Elec. resistance	Continuous	10	**High**– MET data co-located with air pollutants	Continue monitoring
Roosevelt	Duchesne	Urban	Ambient temperature/Elec. resistance	Continuous	10 2	**High**– MET data co-located with ozone measurements	Continue monitoring
			Temperature difference/Math Channel		10-2		
Air Monitoring Center	Salt Lake	Urban	Ambient temperature/Elec. resistance	Continuous	4	**High**– MET data co-located with mercury deposition measurements	Continue monitoring
Saltair		Urban	Ambient temperature/Elec. resistance	Continuous	10	**Moderate**– supports air quality modeling	Continue monitoring
Hawthorne		Urban	Ambient temperature/Elec. resistance	Continuous	10	**High**– NCore site; MET data co-located with air pollutants	Continue monitoring
Magna		Urban	Ambient temperature/Elec. resistance	Continuous	10	**High**– MET data co-located with air pollutants	Continue monitoring
Badger Island	Tooele	Urban	Ambient temperature/Elec. resistance	Continuous	10	**High**– supports modeling of lake emissions	Continue monitoring
Vernal #4	Uintah	New Regional	Ambient temperature/Elec. resistance	Continuous	10	**New**–established to replace Vernal site (VL), which was shut down due to property development; MET data co-located with air pollutants	Continue monitoring

Table 46b (cont'd.)

Site	County	Spatial scale	Pollutant/Method	Operating schedule	Tower height (m)	Value	Recommendation
Lindon	Utah	Urban	Ambient temperature/Elec. resistance	Continuous	10	**Low**– MET data co-located with air pollutants but site redundant with North Provo	Consolidate with North Provo at a new location
North Provo		Urban	Ambient temperature/Elec. resistance	Continuous	10	**Low**– MET data co-located with air pollutants but site redundant with Lindon	Consolidate with Lindon at a new location
Spanish Fork		Urban	Ambient temperature/Elec. resistance	Continuous	10	**High**– MET data co-located with air pollutants	Relocate site due to logistical issues
Hurricane	Washington	Regional	Ambient temperature/Elec. resistance	Continuous	10	**High**– MET data co-located with air pollutants	Continue monitoring
Ogden #2	Weber	Urban	Ambient temperature/Elec. resistance	Continuous	10	**High**– MET data co-located with air pollutants	Continue monitoring
Harrisville		Urban	Ambient temperature/Elec. resistance	Continuous	10	**Moderate**– MET data co-located with ozone measurements	Continue monitoring

c) Barometric pressure

Site	County	Spatial scale	Pollutant/Method	Operating schedule	Tower height (m)	Value	Recommendation
Bountiful Viewmont	Davis	Urban	Barometric pressure/Pressure transducer	Continuous	1	**High**– MET data co-located with air pollutants	Continue monitoring
Air Monitoring Center	Salt Lake	Urban	Barometric pressure/Pressure transducer	Continuous	2	**High**– MET data co-located with mercury deposition measurements	Continue monitoring
Hawthorne		Urban	Barometric pressure/Pressure transducer	Continuous	3	**High**– NCore site; MET data co-located with air pollutants	Continue monitoring
Vernal #4	Uintah	New Regional	Barometric pressure/Pressure transducer	Continuous	2	**New**–established to replace Vernal site (VL), which was shut down due to property development; MET data co-located with air pollutants	Continue monitoring
Hurricane	Washington	Regional	Barometric pressure/Pressure transducer	Continuous	2	**High**– MET data co-located with air pollutants	Continue monitoring

d) Wind speed

Site	County	Spatial scale	Pollutant/Method	Operating schedule	Tower height (m)	Value	Recommendation
Brigham City	Box Elder	Urban	Wind speed/Elec. Chopped signal Level 1	Continuous	10	**High**– MET data co-located with air pollutants	Continue monitoring
Logan #4	Cache	Urban	Wind speed/Elec. Chopped signal Level 1	Continuous	10	**Low**– violation of siting requirements	Shut down site by 2016 and replace by Smithfield
Price #2	Carbon	Regional	Wind speed/Elec. Chopped signal Level 1	Continuous	10	**High**– MET data co-located with air pollutants	Continue monitoring
Syracuse	Davis	Urban	Wind speed/Elec. Chopped signal Level 1	Continuous	10	**Moderate**– supports air quality modeling	Continue monitoring
Antelope Island		Urban	Wind speed/Elec. Chopped signal Level 1	Continuous	6	**High**– supports modeling of lake emissions	Continue monitoring
Bountiful Viewmont		Urban	Wind speed/Elec. Chopped signal Level 1	Continuous	10	**High**– MET data co-located with air pollutants	Continue monitoring
Roosevelt	Duchesne	Urban	Wind speed/Sonic method	Continuous	10	**High**– MET data co-located with ozone measurements	Continue monitoring
Air Monitoring Center	Salt Lake	Urban	Wind speed/Sonic 2D	Continuous	4	**High**– MET data co-located with mercury deposition measurements	Continue monitoring
Saltair		Urban	Wind speed/Elec. Chopped signal Level 1	Continuous	10	**Moderate**– supports air quality modeling	Continue monitoring
Hawthorne		Urban	Wind speed/Elec. Chopped signal Level 1	Continuous	10	**High**– NCore site; MET data co-located with air pollutants	Continue monitoring

Table 46d (cont'd.)

Site	County	Spatial scale	Pollutant/Method	Operating schedule	Tower height (m)	Value	Recommendation
Magna	Salt Lake	Urban	Wind speed/Elec. Chopped signal Level 1	Continuous	10	**High**– MET data co-located with air pollutants	Continue monitoring
Badger Island	Tooele	Urban	Wind speed/Elec. Chopped signal Level 1	Continuous	10	**High**– supports modeling of lake emissions	Continue monitoring
Vernal #4	Uintah	New Regional	Wind speed/Elec. Chopped signal Level 1	Continuous	10	**New**–established to replace Vernal site (VL), which was shut down due to property development; MET data co-located with air pollutants	Continue monitoring
Lindon	Utah	Urban	Wind speed/Elec. Chopped signal Level 1	Continuous	10	**Low**– MET data co-located with air pollutants but site redundant with North Provo	Consolidate with North Provo at a new location
North Provo		Urban	Wind speed/Elec. Chopped signal Level 1	Continuous	10	**Low**– MET data co-located with air pollutants but site redundant with Lindon	Consolidate with Lindon at a new location
Spanish Fork		Urban	Wind speed/Elec. Chopped signal Level 1	Continuous	10	**High**– MET data co-located with air pollutants	Relocate site due to logistical issues
Hurricane	Washington	Regional	Wind speed/Elec. Chopped signal Level 1	Continuous	10	**High**– MET data co-located with air pollutants	Continue monitoring
Ogden #2	Weber	Urban	Wind speed/Elec. Chopped signal Level 1	Continuous	10	**High**– MET data co-located with air pollutants	Continue monitoring
Harrisville		Urban	Wind speed/Elec. Chopped signal Level 1	Continuous	10	**Moderate**– MET data co-located with ozone measurements	Continue monitoring

e) Wind direction

Site	County	Spatial scale	Pollutant/Method	Operating schedule	Tower height (m)	Value	Recommendation
Brigham City	Box Elder	Urban	Wind direction/Elec. Resistance Level 1	Continuous	10	**High**– MET data co-located with air pollutants	Continue monitoring
Logan #4	Cache	Urban	Wind direction/Elec. Resistance Level 1	Continuous	10	**Low**– violation of siting requirements	Shut down site by 2016 and replace by Smithfield
Price #2	Carbon	Regional	Wind direction/Elec. Resistance Level 1	Continuous	10	**High**– MET data co-located with air pollutants	Continue monitoring
Syracuse	Davis	Urban	Wind direction/Elec. Resistance Level 1	Continuous	10	**Moderate**– supports air quality modeling	Continue monitoring
Antelope Island		Urban	Wind direction/Elec. Resistance Level 1	Continuous	6	**High**– supports modeling of lake emissions	Continue monitoring
Bountiful Viewmont		Urban	Wind direction/Elec. Resistance Level 1	Continuous	10	**High**– MET data co-located with air pollutants	Continue monitoring
Roosevelt	Duchesne	Urban	Wind direction/Sonic method	Continuous	10	**High**– MET data co-located with ozone measurements	Continue monitoring
Air Monitoring Center	Salt Lake	Urban	Wind direction/Sonic 2D	Continuous	4	**High**– MET data co-located with mercury deposition measurements	Continue monitoring
Saltair		Urban	Wind direction/Elec. Resistance Level 1	Continuous	10	**Moderate**– supports air quality modeling	Continue monitoring
Hawthorne		Urban	Wind direction/Elec. Resistance Level 1	Continuous	10	**High**– NCore site; MET data co-located with air pollutants	Continue monitoring

Table 46e (cont'd.)

Site	County	Spatial scale	Pollutant/Method	Operating schedule	Tower height (m)	Value	Recommendation
Magna	Salt Lake	Urban	Wind direction/Elec. Resistance Level 1	Continuous	10	**High** – MET data co-located with air pollutants	Continue monitoring
Badger Island	Tooele	Urban	Wind direction/Elec. Resistance Level 1	Continuous	10	**High**– supports modeling of lake emissions	Continue monitoring
Vernal #4	Uintah	New Regional	Wind direction /Elec. Chopped signal Level 1	Continuous	10	**New**–established to replace Vernal site (VL), which was shut down due to property development; MET data co-located with air pollutants	Continue monitoring
Lindon	Utah	Urban	Wind direction/Elec. Resistance Level 1	Continuous	10	**Low**– MET data co-located with air pollutants but site redundant with North Provo	Consolidate with North Provo at a new location
North Provo		Urban	Wind direction/Elec. Resistance Level 1	Continuous	10	**Low**– MET data co-located with air pollutants but site redundant with Lindon	Consolidate with Lindon at a new location
Spanish Fork		Urban	Wind direction/Elec. Resistance Level 1	Continuous	10	**High**– MET data co-located with air pollutants	Relocate site due to logistical issues
Hurricane	Washington	Regional	Wind direction/Elec. Resistance Level 1	Continuous	10	**High** – MET data co-located with air pollutants	Continue monitoring
Ogden #2	Weber	Urban	Wind direction/Elec. Resistance Level 1	Continuous	10	**High** – MET data co-located with air pollutants	Continue monitoring
Harrisville		Urban	Wind direction/Elec. Resistance Level 1	Continuous	10	**Moderate**– MET data co-located with ozone measurements	Continue monitoring

f) WD sigma

Site	County	Spatial scale	Pollutant/Method	Operating schedule	Tower height (m)	Value	Recommendation
Brigham City	Box Elder	Urban	WD Sigma/Elec. EPA method	Continuous	10	**High**– MET data co-located with air pollutants	Continue monitoring
Logan #4	Cache	Urban	WD Sigma/Elec. EPA method	Continuous	10	**Low**– violation of siting criteria	Shut down site by 2016 and replace by Smithfield
Price #2	Carbon	Regional	WD Sigma/Elec. EPA method	Continuous	10	**High**– MET data co-located with air pollutants	Continue monitoring
Syracuse	Davis	Urban	WD Sigma/Elec. EPA method	Continuous	10	**Moderate**– supports air quality modeling	Continue monitoring
Antelope Island		Urban	WD Sigma/Elec. EPA method	Continuous	6	**High**– supports modeling of lake emissions	Continue monitoring
Bountiful Viewmont		Urban	WD Sigma/Elec. EPA method	Continuous	10	**High** – MET data co-located with air pollutants	Continue monitoring
Roosevelt	Duchesne	Urban	WD Sigma/Elec. EPA method	Continuous	10	**High**– MET data co-located with ozone measurements	Continue monitoring
Air Monitoring Center	Salt Lake	Urban	WD Sigma/Elec. EPA method	Continuous	4	**High**– MET data co-located with mercury deposition measurements	Continue monitoring
Saltair		Urban	WD Sigma/Elec. EPA method	Continuous	10	**Moderate**– supports air quality modeling	Continue monitoring
Hawthorne		Urban	WD Sigma/Elec. EPA method	Continuous	10	**High**– NCore site; MET data co-located with air pollutants	Continue monitoring
Magna		Urban	WD Sigma/Elec. EPA method	Continuous	10	**High** – MET data co-located with air pollutants	Continue monitoring
Badger Island	Tooele	Urban	WD Sigma/Elec. EPA method	Continuous	10	**High**– supports modeling of lake emissions	Continue monitoring

Table 46f (cont.)

Site	County	Spatial scale	Pollutant/Method	Operating schedule	Tower height (m)	Value	Recommendation
Vernal #4	Uintah	New Regional	WD Sigma/Elec. EPA method	Continuous	10	**New**–established to replace Vernal site (VL), which was shut down due to property development; MET data co-located with air pollutants	Continue monitoring
Lindon	Utah	Urban	WD Sigma/Elec. EPA method	Continuous	10	**Low**– MET data co-located with air pollutants but site redundant with North Provo	Consolidate with North Provo at a new location
North Provo		Urban	WD Sigma/Elec. EPA method	Continuous	10	**Low**– MET data co-located with air pollutants but site redundant with Lindon	Consolidate with Lindon at a new location
Spanish Fork		Urban	WD Sigma/Elec. EPA method	Continuous	10	**High**– MET data co-located with air pollutants	Relocate site due to logistical issues
Hurricane	Washington	Regional	WD Sigma/Elec. EPA method	Continuous	10	**High**– MET data co-located with air pollutants	Continue monitoring
Ogden #2	Weber	Urban	WD Sigma/Elec. EPA method	Continuous	10	**High**– MET data co-located with air pollutants	Continue monitoring
Harrisville		Urban	WD Sigma/Elec. EPA method	Continuous	10	**Moderate**– MET data co-located with ozone measurements	Continue monitoring

g) Solar radiation

Site	County	Spatial scale	Pollutant/Method	Operating schedule	Tower height (m)	Value	Recommendation
Logan #4	Cache	Urban	Solar radiation/Elec. Licor	Continuous	10	**Low**– violation of siting requirements	Shut down site by 2016 and replace by Smithfield
Saltair	Salt Lake	Urban	Solar radiation/Elec. Licor	Continuous	2	**Moderate**– supports understanding of atmospheric photochemistry	Continue monitoring
Hawthorne		Urban	Solar radiation/Elec. EPPLY	Continuous	4	**High**– NCore site; data co-located with air pollutants; supports understanding of atmospheric photochemistry	Continue monitoring
Badger Island	Tooele	Urban	Solar radiation/Elec. Licor	Continuous	2	**High**– supports modeling of lake emissions	Continue monitoring

4. Summary of Proposed Network Modifications

To ensure efficient and representative pollution monitoring in the state of Utah, UDAQ would like to implement the following network modifications:

Sites' addition:

- Establish a site in northern Salt Lake County, with purpose to replace the previous station which was closed in September 2013 due to infrastructure issues. The site will help assess population exposure in this area.
- Complete the set-up of a new monitoring station, Copper View, in the southeast area of Salt Lake County, with objective to support air pollution modeling efforts and supply air quality data to the increasing population in the southern area of Salt Lake Valley. A site has been located but UDAQ is still working on setting up the site. The site is expected to be a multi-pollutant station where $PM_{2.5}$ (FRM and real-time), O_3, NO_2 and NO_y will be measured.
- Complete the re-location of Tooele #3 (T3) site to Erda in Tooele County. The new site represents a high-ozone concentration area in Tooele County with similar $PM_{2.5}$ levels to those at T3. UDAQ is currently in the process of setting up the site. Ozone, FRM/FEM $PM_{2.5}$ and NO_2 will be monitored at this site.
- Establish a site in Cedar City, Iron County, by 2018 due to expected population growth. The total population of Cedar City CBSA is expected to exceed the threshold of federal monitoring requirements in 2020. FRM PM2.5 and ozone will be monitored at this site.
- Establish near-road NO_2 monitoring sites in Salt Lake City, Provo-Orem and Ogden-Clearfield CBSAs as soon as funding becomes available. Other monitoring objectives currently have a higher priority due to the scarcity of resources.

Sites' elimination/relocation:

- Due to violation of siting criteria, shut down Logan #4 (L4) site by 2016 and permanently replace it by Smithfield station, which is located farther north.
- To reduce monitoring redundancy, consolidate North Provo and Lindon sites at a new location, situated halfway between both sites.
- Re-locate the Spanish Fork (SF) station to a nearby site due to planned construction works at its current location. SF site, which is located at the Spanish Fork Airport in Utah County, should be moved in the next two years due to airport construction. An alternative location is across the street from the current location. DAQ, however, will evaluate other sites in the area before proceeding with any changes

Monitors' addition:

- Add a CO sampler at near-road NO_2 monitoring site in Salt Lake City CBSA once the site is established.

- Add a continuous $PM_{2.5}$ sampler at Vernal #4 (V4), which was established to replace Vernal (VL) site that was shut down due to property development.

Lastly, UDAQ will continue reviewing all stations to ensure that they constantly meet acceptance criteria and monitoring objectives. Any sites that do not meet the requirements will be evaluated for future action.

Appendix A

Site: Air Monitoring Center (AMC)
AQS#: 49-035-3011
Address: 2861 West Parkway Blvd.
City: West Valley
County: Salt Lake

Longitude: -111.9612
Latitude: 40.7118
Elevation (m): 1292

Station Type: SPM
MSA: Salt Lake City

Site Objective:
This site is established to determine Mercury in Wet Deposition and Dry Deposition.
Does the site meet the objective:
Yes, all objectives are met.
Site Description:
The site is located at the Air Monitoring Center, in the city of West Valley, Salt Lake County.
Can data from this site be used to evaluate NAAQS ?: No

Gaseous/Particulate parameters:

Parameter	Sampling & Analysis Method	Operating Schedule	Monitoring Objective	Spatial Scale
Dry Dep. Mercury	Cold Vapor Atomic Absorption	Continuous	Population Exposure	SPM- Transport Regional
Wet Dep. Mercury	Manual NADP MDN	Integrated 7 days	Population Exposure	SPM- Transport Regional
Ammonia	Manual NADP AMoN	Integrated 14 days	Population Exposure	SPM- Transport Regional

Meteorological parameters:

Parameter	Sampling & Analysis Method	Operating Schedule	Tower Height	Spatial Scale
Ambient pressure	Barometric pressure transducer	Continuous	2 meters	Urban
Relative Humidity	Elec. Thin Film	Continuous	4 meters	Urban
Leaf Wetness		Continuous	4 meters	Urban
Ambient Temperature	Elec. Resistance	Continuous	4 meters	Urban
Wind Direction	Sonic 2D	Continuous	4 meters	Urban
WD Sigma	Elec. EPA method	Continuous	4 meters	Urban
Wind Speed	Sonic 2D	Continuous	4 meters	Urban

Site:	Antelope Island (AI)	**Longitude:**	-112.2313	**Station Type:**	SPM
AQS#:	49-011-6001	**Latitude:**	41.0393	**MSA:**	Ogden-Clearfield
Address:	Antelope Island	**Elevation (m):**	1359		
City:	NA				
County:	Davis				

Site Objective:

This site is established to collect meteorological information for air quality modeling inputs.

Does the site meet the objective:

Yes, all objectives are met.

Site Description:

The site is on Antelope Island state park, near the ranger residences, in Davis County.

Can data from this site be used to evaluate NAAQS ?: No

Meteorological parameters:

Parameter	Sampling & Analysis Method	Operating Schedule	Tower Height	Spatial Scale
Relative Humidity	Elec. Thin Film	Continuous	6 meters	Urban
Ambient Temperature	Elec. Resistance	Continuous	6 meters	Urban
Wind Direction	Elec. Resistance Level 1	Continuous	6 meters	Urban
WD Sigma	Elec. EPA method	Continuous	6 meters	Urban
Wind Speed	Elec. Chopped signal Level 1	Continuous	6 meters	Urban

Site:	Badger Island (BI)	**Longitude:**	-112.5620	**Station Type:**	SPM
AQS#:	49-045-6001	**Latitude:**	40.942	**MSA:**	Salt Lake City
Address:	Badger Island	**Elevation (m):**	1282		
City:	NA				
County:	Tooele				

Site Objective:

This site is established to collect meteorological information for air quality modeling inputs.

Does the site meet the objective:

Yes, all objectives are met.

Site Description:

The site is located on the south end of the Great Salt Lake on the remnants of Badger Island in Tooele County.

Can data from this site be used to evaluate NAAQS ?: No

Meteorological parameters:

Parameter	Sampling & Analysis Method	Operating Schedule	Tower Height	Spatial Scale
Precipitation	Tipping cup	Continuous	2 meters	Urban
Relative Humidity	Elec. Thin Film	Continuous	10 meters	Urban
Solar Radiation	Elec. LiCor	Continuous	2 meters	Urban
Ambient Temperature	Elec. Resistance	Continuous	10 meters	Urban
Wind Direction	Elec. Resistance Level 1	Continuous	10 meters	Urban
WD Sigma	Elec. EPA method	Continuous	10 meters	Urban
Wind Speed	Elec. Chopped signal Level 1	Continuous	10 meters	Urban

Site:	Bountiful Viewmont (BV)	**Longitude:**	-111.8845	**Station Type:**	SLAMS
AQS#:	49-011-0004	**Latitude:**	40.903	**MSA:**	Ogden-Clearfield
Address:	1380 N. 200 W.	**Elevation (m):**	1316		
City:	Bountiful				
County:	Davis				

Site Objective:

The Bountiful Viewmont site is established to determine public exposure to air pollution. The site also monitors emissions from nearby oil refineries and local sand and gravel operations. Previous monitoring and saturation studies have recorded high ozone concentrations. This site is chosen for intensive speciation of PM2.5 under the EPA Chemical Speciation Network (CSN) and gaseous Volatile Organic Compounds under the EPA National Air Toxics Trends Network (NTTN) including hexavalent chromium and carbonyl compounds. Nitrogen dioxide is monitored in support of the ozone monitoring.

Does the site meet the objective:

Yes, all objectives are met.

Site Description:

The site is located near Viewmont High School at the north end of the city of Bountiful, Davis County.

Can data from this site be used to evaluate NAAQS ?: Yes

Gaseous/Particulate parameters:

Parameter	Sampling & Analysis Method	Operating Schedule	Monitoring Objective	Spatial Scale
Nitrogen Dioxide	Instrumental Chemiluminescence	Continuous	Population Exposure	SLAMS- Population Neighborhood
Ozone	Instrumental Ultra Violet	Seasonal	Population Exposure	SLAMS-High Neighborhood
$PM_{2.5}$	Manual Gravimetric	1 in 3 days	Population Exposure	SLAMS- Population Neighborhood
PM10 metals	Manual Gravimetric	1 in 6 days	Population Exposure	SLAMS- Population Neighborhood
PM10 metals co-located	Manual Gravimetric	6 samples/year	Population Exposure	SLAMS- Population Neighborhood
$PM_{2.5}$ Speciation	Manual EPA CSN	1 in 6 days	Population Exposure	SLAMS- Population Neighborhood
VOC	Manual EPA NTTN	1 in 6 days	Population Exposure	SLAMS- Population Neighborhood
Semi-volatile	Manual EPA NTTN	1 in 6 days	Population Exposure	SLAMS- Population Neighborhood
Carbonyl compounds	Manual EPA NTTN	1 in 6 days	Population Exposure	SLAMS- Population Neighborhood
Black Carbon	Aethalometer	Continuous	Population Exposure	SLAMS- Population Neighborhood

Meteorological parameters:

Parameter	Sampling & Analysis Method	Operating Schedule	Tower Height	Spatial Scale
Ambient Pressure	Barometric Pressure Transducer	Continuous	1 meter	Urban
Relative Humidity	Elec. Thin Film	Continuous	10 meters	Urban
Ambient Temperature	Elec. Resistance	Continuous	10 meters	Urban
Wind Direction	Elec. Resistance Level 1	Continuous	10 meters	Urban
WD Sigma	Elec. EPA method	Continuous	10 meters	Urban
Wind Speed	Elec. Chopped signal Level 1	Continuous	10 meters	Urban

Site:	Brigham City (BR)	**Longitude:**	-112.0176	**Station Type:**	SLAMS
AQS#:	49-003-0003	**Latitude:**	41.4929	**MSA:**	Ogden-Clearfield
Address:	140 West Fishburn Dr.	**Elevation (m):**	1334		
City:	Brigham City				
County:	Box Elder				

Site Objective:

This site is established to determine the boundary of ozone concentrations greater than the NAAQS and PM2.5 comparison to Cache County

Does the site meet the objective:

Yes, all objectives are met.

Site Description:

The site is located in a neighborhood area of Brigham City in Box Elder County.

Can data from this site be used to evaluate NAAQS ?: Yes

Gaseous/Particulate parameters:

Parameter	Sampling & Analysis Method	Operating Schedule	Monitoring Objective	Spatial Scale
Ozone	Instrumental Ultra Violet	Seasonal	Population Exposure	SLAMS- Population Neighborhood
$PM_{2.5}$	Manual Gravimetric	1 in 3 days	Population Exposure	SLAMS- Population Neighborhood
$PM_{2.5}$ Real time	Instrumental TEOM FDMS	Continuous	Population Exposure	SLAMS- Population Neighborhood

Meteorological parameters:

Parameter	Sampling & Analysis Method	Operating Schedule	Tower Height	Spatial Scale
Ambient Temperature	Elec. Resistance	Continuous	10 meters	Urban
Wind Direction	Elec. Resistance Level 1	Continuous	10 meters	Urban
WD Sigma	Elec. EPA method	Continuous	10 meters	Urban
Wind Speed	Elec. Chopped signal Level 1	Continuous	10 meters	Urban

Site:	Harrisville (HV)	**Longitude:**	-111.9865	**Station Type:**	SLAMS
AQS#:	49-057-1003	**Latitude:**	41.3028	**MSA:**	Ogden-Clearfield
Address:	425 West 2550 North	**Elevation (m):**	1322		
City:	Harrisville				
County:	Weber				

Site Objective:

This site is established in response to an ozone saturation study indicating this as a potentially high ozone concentration area.

Does the site meet the objective:

Yes, all objectives are met.

Site Description:

The site is located on the grounds of an elementary school in the city of Harrisville, Weber County.

Can data from this site be used to evaluate NAAQS ?: Yes

Gaseous/Particulate parameters:

Parameter	Sampling & Analysis Method	Operating Schedule	Monitoring Objective	Spatial Scale
Ozone	Instrumental Ultra Violet	Seasonal	Population Exposure	SLAMS- Population Neighborhood

Meteorological parameters:

Parameter	Sampling & Analysis Method	Operating Schedule	Tower Height	Spatial Scale
Ambient Temperature	Elec. Resistance	Continuous	10 meters	Urban
Wind Direction	Elec. Resistance Level 1	Continuous	10 meters	Urban
WD Sigma	Elec. EPA method	Continuous	10 meters	Urban
Wind Speed	Elec. Chopped signal Level 1	Continuous	10 meters	Urban

Site:	Hawthorne (HW)	**Longitude:**	-111.8721	**Station Type:**	SLAMS
AQS#:	49-035-3006	**Latitude:**	40.7343	**MSA:**	Salt Lake City
Address:	1675 South 600 East	**Elevation (m):**	1312		
City:	Salt Lake City				
County:	Salt Lake				

Site Objective:

This site is established to represent population exposure in the Salt Lake City area. The Hawthorne site is also designated as the EPA Ncore site for Utah.

Does the site meet the objective:

Yes, all current objectives are met. NCore monitoring began in January 2011.

Site Description:

The site is located at Hawthorne Elementary School in the southeast section of Salt Lake City, Salt Lake County.

Can data from this site be used to evaluate NAAQS ?: Yes

Gaseous/Particulate parameters:

Parameter	Sampling & Analysis Method	Operating Schedule	Monitoring Objective	Spatial Scale
Carbon Monoxide, trace	Instrumental Gas Phase Correlation	Continuous	Population Exposure	SLAMS-High Neighborhood
Nitrogen Dioxide	Instrumental Chemiluminescence	Continuous	Population Exposure	SLAMS-High Neighborhood
Ozone	Instrumental Ultra Violet	Continuous	Population Exposure	SLAMS-High Neighborhood
NOy trace level	Instrumental Chemiluminescence	Continuous	Population Exposure	SLAMS- Population Neighborhood
SO2 trace level	Pulsed fluorescence	Continuous	Population Exposure	SLAMS- Population Neighborhood
$PM_{2.5}$	Manual Gravimetric	Daily	Population Exposure	SLAMS- Population Neighborhood
$PM_{2.5}$ Speciation	Manual EPA CSN	1 in 3 days	Population Exposure	SLAMS- Population Neighborhood
$PM_{2.5}$ Real time NCore	Instrumental TEOM FDMS	Continuous	Air Pollution Index	SLAMS- Population Neighborhood
PM_{10}	Manual Gravimetric	Daily	Population Exposure	SLAMS- Population Neighborhood
PM_{10} Real time NCore	Instrumental TEOM FDMS	Continuous	Air Pollution Index	SLAMS- Population Neighborhood
PM_{coarse}	Manual Gravimetric subtraction	Daily	Population Exposure	SLAMS- Population Neighborhood
Organic & Elemental Carbon	NIDR	Continuous	Population Exposure	SLAMS- Population Neighborhood
PAMS C2 to C12	Instrumental gas chromatography	Continuous	Ozone modeling input	Population Neighborhood
Visibility	Instrumented	Continuous	Public Information	Population Neighborhood

Meteorological parameters:

Parameter	Sampling & Analysis Method	Operating Schedule	Tower Height	Spatial Scale
Ambient Pressure	Barometric Pressure Transducer	Continuous	3 meters	Urban
Relative Humidity	Elec. Thin Film	Continuous	10 meters	Urban
Solar Radiation	Elec. EPPLY	Continuous	4 meters	Urban
Ambient Temperature	Elec. Resistance	Continuous	10 meters	Urban
Wind Direction	Elec. Resistance Level 1	Continuous	10 meters	Urban
WD Sigma	Elec. EPA method	Continuous	10 meters	Urban
Wind Speed	Elec. Chopped signal Level 1	Continuous	10 meters	Urban

Site:	Herriman #3 (H3)	**Longitude:**	-112.036305	**Station Type:**	SLAMS
AQS#:	49-035-3012	**Latitude:**	40.496408	**MSA:**	Salt Lake City
Address:	14058 Mirabella Dr.	**Elevation (m):**	1534		
City:	Herriman				
County:	Salt Lake				

Site Objective:

Site established to assess population exposure in southwest Salt Lake County.

Does the site meet the objective:

Yes, all objectives are met.

Site Description:

The site is located at Fort Herriman Middle School in southwest Salt Lake County.

Can data from this site be used to evaluate NAAQS ?: Yes

Gaseous/Particulate parameters:

Parameter	Sampling & Analysis Method	Operating Schedule	Monitoring Objective	Spatial Scale
Ozone	Instrumental Ultra Violet	Continuous	Population Exposure	SLAMS- Population Neighborhood
PM_{10}	Manual Gravimetric	Daily	Population Exposure	SLAMS- Population Neighborhood
Nitrogen dioxide	Instrumental Chemiluminescence	Continuous	Population Exposure	SLAMS- Population Neighborhood

Meteorological parameters:

Parameter	Sampling & Analysis Method	Operating Schedule	Spatial Scale
Ambient Temperature	Instrumental/ Elec. Resistance	Continuous	Urban
Wind Direction	Elec. Resistance Level 1	Continuous	Urban
Wind Speed	Instrumental/ Elec. Chopped signal Level 1	Continuous	Urban
Barometric Pressure	Pressure transducer	Continuous	Urban
Relative humidity	Instrumental/ Elect. thin film	Continuous	Urban

Site:	Hurricane (HC)	**Longitude:**	-113.3051	**Station**	SLAMS
AQS#:	49-053-0007	**Latitude:**	37.1791	**MSA:**	St George
Address:	147 North 870 West	**Elevation (m):**	992		
City:	Hurricane				
County:	Washington				

Site Objective:

This site is established to determine population exposure to ozone in Washington County.

Does the site meet the objective:

Yes, all objectives are met.

Site Description:

This site is located behind the Hurricane City offices. This site replaces Santa Clara.

Can data from this site be used to evaluate NAAQS ?: Yes

Gaseous/Particulate parameters:

Parameter	Sampling & Analysis Method	Operating Schedule	Monitoring Objective	Spatial Scale
Ozone	Instrumental Ultra Violet	Continuous	High winter ozone study	Regional
Nitrogen dioxide	Instrumental Chemiluminescence	Continuous	High winter ozone study	Regional
$PM_{2.5}$	Manual Gravimetric	1 in 3 days	Population Exposure	SLAMS- Population Neighborhood
PM_{10}	Manual Gravimetric	1 in 3 days	Population Exposure	SLAMS- Population Neighborhood
$PM_{2.5}$ Real time	Thermo Sharp 5030	Continuous	Air Quality Index	SLAMS- Population Neighborhood

Meteorological parameters:

Parameter	Sampling & Analysis Method	Operating Schedule	Tower Height	Spatial Scale
Ambient Temperature	Elec. Resistance	Continuous	10 meters	Regional
Wind Direction	Elec. Resistance Level 1	Continuous	10 meters	Regional
WD Sigma	Elec. EPA method	Continuous	10 meters	Regional
Wind Speed	Elec. Chopped signal Level 1	Continuous	10 meters	Regional
Barometric Pressure	Pressure Transducer	Continuous	2 meters	Regional

Site:	Lindon (LN)	**Longitude:**	-111.7133	**Station**	SLAMS
AQS#:	49-049-4001	**Latitude:**	40.3396	**MSA:**	Provo - Orem
Address:	30 North Main	**Elevation (m):**	1442		
City:	Lindon				
County:	Utah				

Site Objective:

This site is established to determine PM emissions from commercial and industrial sources. Historically this site has reported the highest PM values in Utah County.

Does the site meet the objective:

Yes, all objectives are met.

Site Description:

The site is located at the Lindon Elementary School in the City of Lindon, Utah County.

Can data from this site be used to evaluate NAAQS ?: Yes

Gaseous/Particulate parameters:

Parameter	Sampling & Analysis Method	Operating Schedule	Monitoring Objective	Spatial Scale
$PM_{2.5}$	Manual Gravimetric	Daily	Population Exposure	SLAMS- Population Neighborhood
$PM_{2.5}$	Manual Gravimetric co-located	1 in 12 days	Precision and accuracy	SLAMS- Population Neighborhood
$PM_{2.5}$ Speciation	Manual EPA CSN	1 in 6 days	Population Exposure	SLAMS- Population Neighborhood
$PM_{2.5}$ Real time	Instrumental TEOM FDMS	Continuous	Air Pollution Index	SLAMS- Population Neighborhood
PM_{10}	Manual Gravimetric	Daily	Population Exposure	SLAMS-Impact Neighborhood
PM_{10} Real time	Instrumental TEOM	Continuous	Air Pollution Index	SLAMS-Impact Neighborhood

Meteorological parameters:

Parameter	Sampling & Analysis Method	Operating Schedule	Tower Height	Spatial Scale
Relative Humidity	Elec. Thin Film	Continuous	10 meters	Urban
Ambient Temperature	Elec. Resistance	Continuous	10 meters	Urban
Wind Direction	Elec. Resistance Level 1	Continuous	10 meters	Urban
WD Sigma	Elec. EPA method	Continuous	10 meters	Urban
Wind Speed	Elec. Chopped signal Level 1	Continuous	10 meters	Urban

Site:	Logan #4 (L4)	**Longitude:**	-111.8382	**Station Type:**	SLAMS
AQS#:	49-005-0004	**Latitude:**	41.731	**MSA:**	Logan
Address:	125 West Center Street	**Elevation (m):**	1384		
City:	Logan				
County:	Cache				

Site Objective:

This site is established to determine general population exposure based on increased population.

Does the site meet the objective:

Yes, all objectives are met.

Site Description:

The site is located downtown in the city of Logan, Cache County.

Can data from this site be used to evaluate NAAQS ?: Yes

Gaseous/Particulate parameters:

Parameter	Sampling & Analysis Method	Operating Schedule	Monitoring Objective	Spatial Scale
Nitrogen Dioxide	Instrumental Chemiluminescence	Continuous	Population Exposure	SLAMS- Population Neighborhood
Ozone	Instrumental Ultra Violet	Continuous	Population Exposure	SLAMS- Population Neighborhood
$PM_{2.5}$	Manual Gravimetric	Daily	Population Exposure	SLAMS- Population Neighborhood
$PM_{2.5}$	Manual Gravimetric co-located	1 in 12 days	Precision and accuracy	SLAMS- Population Neighborhood
$PM_{2.5}$ Real time	Instrumental TEOM FDMS	Continuous	Air Pollution Index	SLAMS- Population Neighborhood
PM_{10}	Manual Gravimetric	1 in 3 days	Population Exposure	SLAMS-High Neighborhood

Meteorological parameters:

Parameter	Sampling & Analysis Method	Operating Schedule	Tower Height	Spatial Scale
Relative Humidity	Elec. Thin Film	Continuous	10 meters	Urban
Solar Radiation	LiCor	Continuous	10 meters	Urban
Ambient Temperature	Elec. Resistance	Continuous	10 meters	Urban
Wind Direction	Elec. Resistance Level 1	Continuous	10 meters	Urban
WD Sigma	Elec. EPA method	Continuous	10 meters	Urban
Wind Speed	Elec. Chopped signal Level 1	Continuous	10 meters	Urban

Site:	Magna (MG)	**Longitude:**	-112.0947	**Station Type:**	SLAMS
AQS#:	49-035-1001	**Latitude:**	40.7068	**MSA:**	Salt Lake City
Address:	2935 South 8560 West	**Elevation (m):**	1308		
City:	Magna				
County:	Salt Lake				

Site Objective:

This site is established to determine particulate matter and Pb concentrations from Kennecott smelter.

Does the site meet the objective:

Yes, all objectives are met.

Site Description:

The site is located on the roof of Brockbank Junior High School in the city of Magna in western Salt Lake County.

Can data from this site be used to evaluate NAAQS ?: Yes

Gaseous/Particulate parameters:

Parameter	Sampling & Analysis Method	Operating Schedule	Monitoring Objective	Spatial Scale
$PM_{2.5}$	Manual Gravimetric	1 in 3 days	Population Exposure	SLAMS- Population Neighborhood
PM_{10}	Manual Gravimetric	1 in 3 days	Population Exposure	SLAMS-High Neighborhood
Pb	Manual Gravimetric	1 in 6 days	Population Exposure	SLAMS-High Neighborhood
Pb co-located	Manual Gravimetric	1 in 12 days	Population Exposure	SLAMS-High Neighborhood

Meteorological parameters:

Parameter	Sampling & Analysis Method	Operating Schedule	Tower Height	Spatial Scale
Ambient Temperature	Elec. Resistance	Continuous	10 meters	Urban
Wind Direction	Elec. Resistance Level 1	Continuous	10 meters	Urban
WD Sigma	Elec. EPA method	Continuous	10 meters	Urban
Wind Speed	Elec. Chopped signal Level 1	Continuous	10 meters	Urban

Site:	North Provo (NP)	**Longitude:**	-111.6633	**Station Type:**	SLAMS
AQS#:	49-049-0002	**Latitude:**	40.2538	**MSA:**	Provo - Orem
Address:	1355 North 200 West	**Elevation (m):**	1410		
City:	Provo				
County:	Utah				

Site Objective:

This site is established to determine population exposure to air pollutants.

Does the site meet the objective:

Yes, all objectives are met.

Site Description:

The site is located at north end of the city of Provo, Utah county. It is located on the grounds of the Dale Rex Army Armory.

Can data from this site be used to evaluate NAAQS ?: Yes

Gaseous/Particulate parameters:

Parameter	Sampling & Analysis Method	Operating Schedule	Monitoring Objective	Spatial Scale
Carbon Monoxide	Instrumental Gas Phase Correlation	Continuous	Population Exposure	SLAMS- Population Neighborhood
Nitrogen Dioxide	Instrumental Chemiluminescence	Continuous	Population Exposure	SLAMS-High Neighborhood
Ozone	Instrumental Ultra Violet	Continuous	Population Exposure	SLAMS- Population Neighborhood
$PM_{2.5}$	Manual Gravimetric	Daily	Population Exposure	SLAMS- Population Neighborhood
$PM_{2.5}$ Real time	Instrumental TEOM FDMS	Continuous	Air Pollution Index	SLAMS- Population Neighborhood
PM_{10}	Manual Gravimetric	1 in 3 days	Population Exposure	SLAMS- Population Neighborhood
PM_{10}	Manual Gravimetric co-located	1 in 12 days	Precision and accuracy	SLAMS- Population Neighborhood
PM_{10} Real time	Instrumental TEOM FDMS	Continuous	Air Pollution Index	SLAMS- Population Neighborhood

Meteorological parameters:

Parameter	Sampling & Analysis Method	Operating Schedule	Tower Height	Spatial Scale
Ambient Temperature	Elec. Resistance	Continuous	10 meters	Urban
Wind Direction	Elec. Resistance Level 1	Continuous	10 meters	Urban
WD Sigma	Elec. EPA method	Continuous	10 meters	Urban
Wind Speed	Elec. Chopped signal Level 1	Continuous	10 meters	Urban

Site:	Ogden #2 (O2)	**Longitude:**	-111.9751	**Station Type:**	SLAMS
AQS#:	49-057-0002	**Latitude:**	41.207	**MSA:**	Ogden-Clearfield
Address:	228 East 32nd Street	**Elevation (m):**	1318		
City:	Ogden				
County:	Weber				

Site Objective:

This site is established replace the original Ogden site to determine population exposure to air pollutants.

Does the site meet the objective:

Yes, all objectives are met.

Site Description:

The site is located in the city of Ogden in Weber County.

Can data from this site be used to evaluate NAAQS ?: Yes

Gas/Particulate parameters:

Parameter	Sampling & Analysis Method	Operating Schedule	Monitoring Objective	Spatial Scale
Carbon Monoxide	Instrumental Gas Phase Correlation	Continuous	Population Exposure	SLAMS-Population Neighborhood
Ozone	Instrumental Ultra Violet	Continuous	Population Exposure	SLAMS-Population Neighborhood
Nitrogen Dioxide	Instrumental Chemiluminescence	Continuous	Population Exposure	SLAMS-High Neighborhood
$PM_{2.5}$	Manual Gravimetric	Daily	Population Exposure	SLAMS-High Neighborhood
$PM_{2.5}$ Real time	Instrumental TEOM FDMS	Continuous	Air Pollution Index	SLAMS-High Neighborhood
PM_{10}	Manual Gravimetric	Daily	Population Exposure	SLAMS-High Neighborhood
PM_{10} Real time	Instrumental TEOM	Continuous	Air Pollution Index	SLAMS-High Neighborhood

Meteorological parameters:

Parameter	Sampling & Analysis Method	Operating Schedule	Tower Height	Spatial Scale
Relative Humidity	Elec. Thin Film	Continuous	10 meters	Urban
Ambient Temperature	Elec. Resistance	Continuous	10 meters	Urban
Wind Direction	Elec. Resistance Level 1	Continuous	10 meters	Urban
WD Sigma	Elec. EPA method	Continuous	10 meters	Urban
Wind Speed	Elec. Chopped signal Level 1	Continuous	10 meters	Urban

Site:	Price #2 (P2)	**Longitude:**	-110.77	**Station Type:**	SPM
AQS#:	49-007-1003	**Latitude:**	39.5958	**MSA:**	Price
Address:	351 South Weasel Run Road	**Elevation (m):**	1738		
City:	Price				
County:	Carbon				

Site Objective:

This site is established in response to a three state ozone study. It is funded by the Bureau of Land Management.

Does the site meet the objective:

Yes, all objectives are met.

Site Description:

This site is located in a farm field 3.6 Km east of Price.

Can data from this site be used to evaluate NAAQS?: Yes

Gaseous/Particulate parameters:

Parameter	Sampling & Analysis Method	Operating Schedule	Monitoring Objective	Spatial Scale
Ozone	Instrumental Ultra Violet	Continuous	High ozone winter study	Regional
Nitrogen dioxide	Instrumental Chemiluminescence	Continuous	High ozone winter study	Regional

Meteorological parameters:

Parameter	Sampling & Analysis Method	Operating Schedule	Tower Height	Spatial Scale
Ambient Temperature	Elec. Resistance	Continuous	10 meters	Regional
Wind Direction	Elec. Resistance Level 1	Continuous	10 meters	Regional
WD Sigma	Elec. EPA method	Continuous	10 meters	Regional
Wind Speed	Elec. Chopped signal Level 1	Continuous	10 meters	Regional

Site:	Roosevelt (RS)	**Longitude:**	-110.009	**Station Type:**	SPM
AQS#:	49-013-0002	**Latitude:**	40.2941	**MSA:**	NA
Address:	1000 West 290 South	**Elevation (m):**	1588		
City:	Roosevelt				
County:	Duchesne				

Site Objective:

This site is established to determine maximum ozone and PM2.5 concentrations in Duchesne County.

Does the site meet the objective:

Yes, all objectives are met.

Site Description:

The site is located in the city park North West section of Roosevelt

Can data from this site be used to evaluate NAAQS?: Yes

Gas/Particulate parameters:

Parameter	Sampling & Analysis Method	Operating Schedule	Monitoring Objective	Spatial Scale
Ozone	Instrumental Ultra Violet	Seasonal	High ozone winter study	Regional
Nitrogen dioxide	Instrumental Chemiluminescence	Continuous	High ozone winter study	SLAMS-Population Neighborhood
PM2.5 Real time	Thermo 5030 Sharp	Continuous	Population exposure	SLAMS-Population Neighborhood

Meteorological parameters:

Parameter	Sampling & Analysis Method	Operating Schedule	Tower Height	Spatial Scale
Ambient Temperature	Elec. Resistance	Continuous	10 meters	Urban
Wind Direction	Sonic method	Continuous	10 meters	Urban
WD Sigma	Elec. EPA method	Continuous	10 meters	Urban
Wind Speed	Sonic method	Continuous	10 meters	Urban
Relative Humidity	Elec. Thin Film	Continuous	10 meters	Urban
Ambient Temperature	Elec. Resistance	Continuous	2 meters	Urban
Temperature Difference	Math channel	Continuous	10-2 meters	Urban

Site:	Rose Park (RP)	**Longitude:**	-111.9309	**Station Type:**	SLAMS
AQS#:	49-035-3010	**Latitude:**	40.7955	**MSA:**	Salt Lake City
Address:	1354 West Goodwin Avenue	**Elevation (m):**	1295		
City:	Salt Lake City				
County:	Salt Lake				

Site Objective:

This site is established to better represent $PM_{2.5}$ exposure in this area of Salt Lake City.

Does the site meet the objective:

Yes, all objectives are met.

Site Description:

The site is located in the community of Rose Park at the north end of Salt Lake City, Salt Lake County.

Can data from this site be used to evaluate NAAQS?: Yes

Gas/Particulate parameters:

Parameter	Sampling & Analysis Method	Operating Schedule	Monitoring Objective	Spatial Scale
$PM_{2.5}$	Manual Gravimetric	Daily	Population Exposure	SLAMS- Population Neighborhood
$PM_{2.5}$	Manual Gravimetric co-located	1 in 12 days	Precision and accuracy assessment	SLAMS- Population Neighborhood

Site:	Saltair (SA)	**Longitude:**	-112.0497	**Station Type:**	SPM
AQS#:	49-035-3005	**Latitude:**	40.8061	**MSA:**	Salt Lake City
Address:	6640 West 1680 North	**Elevation (m)**	1282		
City:	Salt Lake City				
County:	Salt Lake				

Site Objective:

This site is established to collect meteorological information for air quality models.

Does the site meet the objective:

Yes, all objectives are met.

Site Description:

The site is located west of the Salt Lake Airport in Salt Lake County.

Can data from this site be used to evaluate NAAQS?: No

Meteorological parameters:

Parameter	Sampling & Analysis Method	Operating Schedule	Tower Height	Spatial Scale
Relative Humidity	Elec. Thin Film	Continuous	10 meters	Urban
Solar Radiation	Elec. LiCor	Continuous	2 meters	Urban
Ambient Temperature	Elec. Resistance	Continuous	10 meters	Urban
Wind Direction	Elec. Resistance Level 1	Continuous	10 meters	Urban
WD Sigma	Elec. EPA method	Continuous	10 meters	Urban
Wind Speed	Elec. Chopped signal Level 1	Continuous	10 meters	Urban

Site:	Smithfield (SM)	**Longitude:**	-111.851944	**Station Type:**	SLAMS
AQS#:	49-005-0007	**Latitude:**	41.842778	**MSA:**	Logan
Address:	675 W. 220 N.	**Elevation (m):**	1377		
City:	Smithfield				
County:	Cache				

Site Objective:

Site established to replace Logan site.

Does the site meet the objective:

Yes, all objectives are met.

Can data from this site be used to evaluate NAAQS ?: Yes

Gaseous/Particulate parameters:

Parameter	Sampling & Analysis Method	Operating Schedule	Monitoring Objective	Spatial Scale
$PM_{2.5}$	Manual Gravimetric	Daily	Population Exposure	SLAMS- Population Neighborhood
PM_{10}	Manual Gravimetric	1 in 3 days	Population Exposure	SLAMS- Population Neighborhood

Site:	Spanish Fork (SF)	**Longitude:**	-111.6603	**Station Type:**	SLAMS
AQS#:	49-049-5010	**Latitude:**	40.1364	**MSA:**	Provo - Orem
Address:	312 West 2050 North	**Elevation (m):**	1395		
City:	Spanish Fork				
County:	Utah				

Site Objective:

This site is established to determine the boundary of the high ozone and $PM_{2.5}$ concentrations in Utah County.

Does the site meet the objective:

Yes, all objectives are met.

Site Description:

The site is located at the Spanish Fork airport in the city of Spanish Fork, Utah County.

Can data from this site be used to evaluate NAAQS?: Yes

Gas/Particulate parameters:

Parameter	Sampling & Analysis Method	Operating Schedule	Monitoring Objective	Spatial Scale
Ozone	Instrumental Ultra Violet	Seasonal	Population Exposure	SLAMS-Population Neighborhood
$PM_{2.5}$	Manual Gravimetric	1 in 3 days	Population Exposure	SLAMS-Transport Regional

Meteorological parameters:

Parameter	Sampling & Analysis Method	Operating Schedule	Tower Height	Spatial Scale
Ambient Temperature	Elec. Resistance	Continuous	10 meters	Urban
Wind Direction	Elec. Resistance Level 1	Continuous	10 meters	Urban
WD Sigma	Elec. EPA method	Continuous	10 meters	Urban
Wind Speed	Elec. Chopped signal Level 1	Continuous	10 meters	Urban

Site:	Syracuse (SY)	**Longitude:**	-112.1185	**Station Type:**	SPM
AQS#:	49-011-6002	**Latitude:**	41.0886	**MSA:**	Ogden-Clearfield
Address:	4700 West 1700 South	**Elevation (m):**	1284		
City:	Syracuse				
County:	Davis				

Site Objective:

This site is established to collect meteorological information for air quality models.

Does the site meet the objective:

Yes, all objectives are met.

Site Description:

The site is located in the city of Syracuse near the causeway to Antelope Island State Park, Davis County.

Can data from this site be used to evaluate NAAQS?: No

Meteorological parameters:

Parameter	Sampling & Analysis Method	Operating Schedule	Tower Height	Spatial Scale
Relative Humidity	Elec. Thin Film	Continuous	10 meters	Urban
Ambient Temperature	Elec. Resistance	Continuous	10 meters	Urban
Wind Direction	Elec. Resistance Level 1	Continuous	10 meters	Urban
WD Sigma	Elec. EPA method	Continuous	10 meters	Urban
Wind Speed	Elec. Chopped signal Level 1	Continuous	10 meters	Urban

Site:	Vernal (V4)	**Longitude:**	-109.560733	**Station Type:**	SLAMS
AQS#:	49-047-1003	**Latitude:**	40.464971	**MSA:**	NA
Address:	628 N 1700 W	**Elevation (m):**	1667		
City:	Vernal				
County:	Uinta				

Site Objective:

This site is established to replace pervious Vernal (VL) site, which was set up in response to an ozone study.

Does the site meet the objective:

Yes, all objectives are met.

Can data from this site be used to evaluate NAAQS?: Yes

Gaseous/Particulate parameters

Parameter	Sampling & Analysis Method	Operating Schedule	Tower Height	Spatial Scale
Ozone	Instrumental Ultra Violet	Continuous	High winter ozone study	Regional
Nitrogen dioxide	Instrumental Ultra Violet	Continuous	High winter ozone study	Regional
PM2.5 Real time	Instrumental Ultra Violet	Continuous	Air Quality Index	SLAMS-Population Neighborhood

Meteorological parameters:

Parameter	Sampling & Analysis Method	Operating Schedule	Tower Height	Spatial Scale
Relative Humidity	Elec. Thin Film	Continuous	10 meters	Regional
Ambient Temperature	Elec. Resistance	Continuous	10 meters	Regional
Wind Direction	Elec. Resistance Level 1	Continuous	10 meters	Regional
WD Sigma	Elec. EPA method	Continuous	10 meters	Regional
Wind Speed	Elec. Chopped signal Level 1	Continuous	10 meters	Regional
Barometric pressure	Pressure transducer	Continuous	2 meters	Regional