NATIONAL AIR TOXICS TRENDS STATIONS QUALITY ASSURANCE ANNUAL REPORT CALENDER YEAR 2010

FINAL

Environmental Protection Agency
Office of Air Quality, Planning and Standards
Air Quality Analysis Division
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Research Triangle Park, NC 27711

FORWARD

In Winter 2011, Research Triangle Institute (RTI) prepared a technical report under Contract No. EP-D-08-047 Work Assignment 04-09. The report describes the Quality Assurance (QA) data collected within the calendar year 2010. The report was prepared for Dennis K. Mikel, Work Assignment Manager within the Office of Air Quality Planning and Standards (OAQPS) in Research Triangle Park, North Carolina. The draft report was written by Larry Michael and Jeff Nichols of RTI.

Please note that this report contains a change to the analysis that differs from previous reports that are posted on this website. The change pertains to the analysis of the precision data. In previous reports, all precision data records that reported a value, whether is was below, equal to or above the method detection limit (MDL) were used in the precision calculations as described in Section 2.3. However in this report, data are utilized for the precision calculations for each site and analyte: 1) where both replicate values were non-zero and 2) where both replicate values exceeded the MDL.

Additional work on this report was provided by AQAD staff. Comments and questions should be submitted to:

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NATIONAL AIR TOXICS TRENDS STATIONS QUALITY ASSURANCE ANNUAL REPORT CALENDAR YEAR 2010

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RTI International

For:
U.S. Environmental Protection Agency
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Air Quality Analysis Division
109 TW Alexander Drive
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Under:
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Work Assignment 04-09, Task 4

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*RTI International is the trade name for Research Triangle Institute

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1.0 INTRODUCTION

As mandated under the Government Performance Results Act, the U.S. Environmental Protection Agency (EPA) is focused on reducing risk of cancer and other serious health effects associated with hazardous air pollutants (HAPs) by achieving a 75% reduction in air toxics emissions chemicals, based on 1993 levels. The current inventory of HAPs includes 188 chemicals regulated under the Clean Air Act that have been linked to numerous adverse human health and ecological effects, including cancer, neurological effects, reproductive effects, and developmental effects. Current agency attention is targeting risk reduction associated with human exposure to air toxics.

The National Air Toxics Trends Station (NATTS) network was established to create a database of air quality data to assess progress in reducing ambient concentrations of air toxics and concomitant exposure-associated risk. During 2010, the NATTS network consisted of 27 stations in the contiguous 48 states. To ensure the quality of the data collected under the NATTS network, EPA has implemented a Quality System comprising two primary components: (1) Technical Systems Audits (TSAs) and (2) Instrument Performance Audits (IPAs) for both the network stations and the associated sample analysis laboratories. As an integral part of the Quality System, EPA has also instituted semiannual analysis of proficiency testing (PT) samples for volatile organic compounds (VOCs) and carbonyls and annual analysis of PT samples for metals and polycyclic aromatic hydrocarbons (PAHs) to provide quantitative assessment of laboratory performance and to ensure that sampling and analysis techniques are consistent with precision, bias, and method detection limits (MDLs) specified by the NATTS Measurement Quality Objectives (MQOs).

This report describes and summarizes the quality assurance (QA) data generated by the NATTS program during calendar year (CY) 2010. For data retrieved from EPA's Air Quality Systems (AQS) database, only data collected in 2010 and posted prior to October 31, 2011, are included. Although this report contains substantive information about air concentrations of 2   different chemicals of interest, it focuses primarily on results for four classes of toxic ambient air constituents (VOCs, carbonyls, PAHs, and PM_{10} metals) as represented by seven pollutants: benzene, 1,3-butadiene, formaldehyde, acrolein, naphthalene, chromium (VI), and PM_{10} arsenic. At the request of EPA, these seven pollutants were selected as having particular interest by virtue of associated health risk and the frequency of their occurrence at measurable concentrations. Although no group of compounds can provide unequivocal representation of their respective compound groups, these seven analytes were selected by EPA as reasonable representatives of the four main categories of HAPs routinely measured in the NATTS program and thus provide the framework for this summary report. It is presumed that if the NATTS program can meet the data quality objectives (DQOs) for these seven compounds, the additional 20 compounds of concern will be of comparable quality by virtue of the representativeness of the physicochemical properties and the consistency of the collection and analysis methodologies of these seven compounds.

The comprehensive information in this Quality Assurance Annual Report (QAAR) was compiled from data acquired from numerous sources. The following general categories of information are presented:

- Descriptive background information on the AQS site identities, compounds of interest, and MQOs;
- Assessment of the completeness of the data available in the AQS database;
- Precision estimates, independently, for analytical and overall sampling error computed for as many of the 27 applicable compounds and for as many of the 27 NATTS sites as available for CY2010;
- Evaluation of an analytical laboratory's accuracy (or bias), based on analysis of blind audit PT samples for many of the 27 compounds;
- Field bias data, which are expressed as the differences between actual and measured sampler flow readings for each of the four different sampler types associated with VOCs, carbonyls, PAHs, and PM_{10} metals, for primary and collocated samplers (where available) at the eight sites visited during the IPAs conducted during CY2010; and
- MDL data for each site and/or analytical laboratory. The AQS database, specifically the ALT_MDL variable, was used as the primary source of MDLs for 2010. However, because this MDL field in AQS is not a required field, it was necessary to augment the information with direct contacts to several NATTS state and local agencies and affiliated laboratories to compile MDL data for the 27 compounds of interest at all sites. This modification improved both acquisition efficiency and the accuracy of the MDL data.

Where possible, all data analyses were performed in SAS, version 9.2. Method Detection Limits obtained from individual laboratories and Proficiency Testing data were recorded and compiled using Microsoft Excel.

2.0 NATTS QUALITY ASSURANCE DATA FOR CY2010

The NATTS network included 27 sites in 2010. **Table 1** presents the EPA Regions in which the sites are located, a descriptive location of the sites (site identifier), the urban or rural character of each site, and the unique AQS identification code [1].

Although a city and state are typically used as the site identifier, the county name is used for the two Florida sites on either side of Tampa Bay and for Harrison County, TX. Historical consistency has been maintained for the Grand Junction, CO, site, where two separate codes are used, one for VOCs, carbonyls, and PAHs (-0018) and the other for metals (-0017). This convention is unique to this site and is used because the organics and metals samplers are present at two separate physical locations at the sampling site. There was one new site added in 2010: Horicon, WI to replace Mayville, WI. The Bronx site was moved in mid-year 2010, but remained in Bronx, NY.

Table 1. EPA Region Numbers, NATTS Sites, Site Type, and Air Quality Systems Site Codes.

EPA Region	Site Identifier	Type	AQS Site Code
I	Boston-Roxbury, MA	Urban	25-025-0042
I	Underhill, VT	Rural	50-007-0007
I	Providence, RI	Urban	44-007-0022
II	Bronx, NY	Urban	36-005-0110[a], -0080[b]
II	Rochester, NY	Urban	36-055-1007
III	Washington, DC	Urban	11-001-0043
III	Richmond, VA	Urban	51-087-0014
IV	Chesterfield, SC	Rural	45-025-0001
IV	Decatur, GA	Urban	13-089-0002
IV	Grayson Lake, KY	Rural	21-043-0500
IV	Hillsborough County, FL	Urban	12-057-3002
IV	Pinellas County, FL	Urban	12-103-0026
V	Dearborn, MI	Urban	26-163-0033
V	Horicon, WI		55-027-0001[c]
V	Northbrook, IL	Urban	17-031-4201
VI	Deer Park, TX	Urban	48-201-1039
VI	Harrison County, TX	Rural	48-203-0002
VII	St. Louis, MO	Urban	29-510-0085
VIII	Bountiful, UT	Urban	49-011-0004
VIII	Grand Junction, CO	Rural	08-077-0017[d], -0018[e]
IX	Phoenix, AZ	Urban	04-013-9997
IX	San Jose, CA	Urban	06-085-0005
IX	Rubidoux, CA	Urban	06-065-8001
IX	Los Angeles, CA	Urban	06-037-1103
X	La Grande, OR	Rural	41-061-0119
X	Portland, OR	Urban	41-051-0246
X	Seattle, WA	Urban	53-033-0080

[a] Discontinued June 2010.
[b] Added July 2010.
[c] Added January 2010.
[d] Metals only.
[e] VOCs, carbonyls, PAHs, and Cr(VI) only.

The 27 specific HAPs measured in the NATTS program, presented in **Table 2** along with their unique AQS identification codes, are compounds that EPA has identified as being of significant health concern. These include 16 VOCs, 2 carbonyls, 2 PAHs, 6 PM_{10} metals, and chromium (VI). Succinct abbreviations of each chemical name are provided to facilitate table and figure creation and interpretation throughout this report.

Table 2. The 23 Unique Hazardous Air Pollutants[a] and their Air Quality Systems Parameter Codes.

Analyte Abbreviation[a]	Compound Name	Exact AQS Label	AQS Code	Compound Group
BENZ[b]	benzene	Benzene	45201	VOC
BUTA[b]	1,3-butadiene	1,3-Butadiene	43218	VOC
CTET	carbon tetrachloride	Carbon Tetrachloride	43804	VOC
CLFRM	chloroform	Chloroform	43803	VOC
EDB	1,2-dibromoethane	Ethylene Dibromide	43843	VOC
DCP	1,2-dichloropropane	1,2-Dichloropropane	43829	VOC
EDC	1,2-dichloroethane	Ethylene Dichloride	43815	VOC
MECL	dichloromethane	Dichloromethane	43802	VOC
TCE1122	1,1,2,2-tetrachloroethane	1,1,2,2-Tetrachloroethane	43818	VOC
PERC	tetrachloroethylene	Tetrachloroethylene	43817	VOC
TCE	trichloroethylene	Trichloroethylene	43824	VOC
VCM	vinyl chloride	Vinyl Chloride	43860	VOC
cDCPEN	cis-1,3-dichloropropene	Cis-1,3-Dichloropropylene	43831	VOC
tDCPEN	trans-1,3-dichloropropene	Trans-1,3-Dichloropropylene	43830	VOC
ACRO[c,e]	acrolein	Acrolein	43505[d]	VOC[c]
ACRO[d,e]	acrolein	Acrolein	43509[e]	VOC[c]
ACRY	acrylonitrile	Acrylonitrile	43704	VOC
NAPH[b]	naphthalene	Naphthalene (TSP) STP		PAH
BaP	benzo[a]pyrene	Benzo[A]Pyrene (TSP) STP		PAH
FORM[b]	formaldehyde	Formaldehyde	43502	Carbonyl
ACET	acetaldehyde	Acetaldehyde	43503	Carbonyl
As[b]	arsenic	Arsenic PM_{10} STP	82103	Metal
Be	beryllium	Beryllium PM_{10} STP	82105	Metal
Cd	cadmium	Cadmium PM_{10} STP	82110	Metal
Pb	lead	Lead PM_{10} STP	82128	Metal
Mn	manganese	Manganese PM_{10} STP	82132	Metal
Ni	nickel	Nickel PM_{10} STP	82136	Metal
CrVI[b]	chromium (VI)	Chromium (VI) TSP STP	12115	Metal
As[f]	arsenic	Arsenic PM_{10} LC	85103	Metal
Be[f]	beryllium	Beryllium PM_{10} LC	85105	Metal
Cd[f]	cadmium	Cadmium PM_{10} LC	85110	Metal
Pb[f]	lead	Lead PM_{10} LC	85128	Metal
Mn[f]	manganese	Manganese PM_{10} LC	85132	Metal
Ni[f]	nickel	Nickel PM_{10} LC	85136	Metal
CrVI[f]	chromium (VI)	Chromium (VI) TSP LC	14115	Metal

[a] Mercury has been intentionally excluded from all data analyses in this report, per U.S. EPA directive.
[b] Results presented are representative of completeness for other chemicals in this class.
[c] Unverified results.
[d] Verified results.
[e] Completeness based on verified and unverified results.
[f] Some sites reported results for metal analytes at local conditions (LC), instead of STP (STP), using these parameter codes. For this report, data reported in STP and LC units are combined, under the assumption that the difference between the two values is negligible.

2.1 Measurement Quality Objectives

MQOs for completeness, precision, laboratory bias, and MDLs, established for the NATTS network to ensure data quality within the network, were unchanged from 2008 and were based on the

Technical Assistance Document [2] applicable on April 1, 2009. The stated DQO for the NATTS program is "to be able to detect a 15 percent difference (trend) between two consecutive 3-year annual mean concentrations within acceptable levels of decision error" [3]. MQOs for the six compounds of primary importance to the NATTS program (benzene, 1, 3-butadiene, formaldehyde, PM_{10} arsenic, chromium (VI), naphthalene) are summarized in **Table 3**.

Table 3. Measurement Quality Objectives for the NATTS Program [2].

Compound	Completeness	Precision (Coefficient of Variation)	Laboratory Bias	Method Detection Limit (MDL)
Benzene	> 85%	< 15%	< 25%	0.130 $\mu g/m^3$
1,3-butadiene	> 85%	< 15%	< 25%	0.100 $\mu g/m^3$
formaldehyde	> 85%	< 15%	< 25%	0.0074 $\mu g/m^3$ [a]
Arsenic	> 85%	< 15%	< 25%	1.0 ng/m^3 [b]
chromium(VI)	>85%	<15%	<25%	0.0043 ng/m^3
naphthalene	>85%	<15%	<25%	29.0 ng/m^3

[a] Assumes a sampling volume of 1,000 L.
[b] Assumes high-volume sampling with a sampling volume of 1,627 m^3 (1.13 m^3/min [40 ft^3/min] for 24 hours) and that one-eighth of the sampled area of the filter is extracted for analysis.

As intended by the NATTS network, the MQOs require that

(1) sampling occurs every 6th day;
(2) sampling is successful 85% of the time;
(3) precision, as measured by the coefficient of variation (CV), is within 15% based on duplicate and collocated samples; and
(4) laboratory (measurement) bias is less than 25%, based on laboratory PT results.

Furthermore, actual MDLs, as reported by the laboratories supporting the NATTS sites or their sponsoring federal, state, or municipal agencies, are compared with the target MDLs as listed in the applicable edition of the NATTS Technical Assistance Document (TAD) [2].

Data acquired to assess compliance with the above stated MQOs were derived from a variety of sources. These sources are given in **Table 4**.

Table 4. Data Sources Used to Evaluate Measurement Quality Objectives.

Measurement Quality Objective	Data Source
Completeness	AQS
Analytical and Overall Precision	AQS
Bias—Laboratory	Proficiency testing results reported by Alion
Bias—Field	Audits of sampler flow rates conducted by RTI International
MDL	AQS augmented with information from the analytical laboratories

Data retrievals from AQS for relevant samples collected in 2010 and uploaded to the AQS database prior to October 28, 2011, were analyzed to assess completeness and to estimate precision from results of replicate analyses and collocated and duplicate sampling. PT samples were distributed by EPA contractor Alion Science, Inc., to participating laboratories for determination of analytical bias. Field bias was evaluated by independent measurement of sampler flow rates with National Institute of Standards and Technology (NIST)-traceable flowmeters during on-site IPAs. Finally, MDL data were extracted from AQS, where present, and augmented by values obtained by direct contact with the individual laboratories.

2.2 Completeness of NATTS Data

The AQS database was queried for data records corresponding to relevant samples collected from the 27 NATTS sites during calendar year 2010 and entered into the AQS database prior to October 28, 2011. Any data that might have been contributed to AQS by participating laboratories after October 28, 2011, are not reflected in the completeness calculations presented in Table 5 below. Specifically, completeness of the 2010 AQS dataset was assessed for seven compounds representative of the entire suite of 27 compounds presented previously in Table 2: benzene, 1,3-butadiene, acrolein, formaldehyde, naphthalene, chromium (VI), and arsenic. Based on the NATTS requirement of a 1-in-6 day sample collection frequency, 60 records for the primary parameter occurrence code (POC) would represent 100% completeness. Depending on the first date of collection in 2010, some sites might exhibit slightly greater than 100% completeness if 61 samples were collected during that year. For purposes of this completeness calculation, non-detects were counted equivalently with measurable values. Conversely, missing values were not counted toward the percentage complete. Completeness statistics for the Bronx, NY site was adjusted for abbreviated collection periods because this site was not operated for the entire 12 months during 2010. In addition, completeness for the Grayson Lake, KY [VOCs], Harrison County and Deer Park, TX [Cr (VI)] sites were adjusted because of problems in their analytical laboratories.

Completeness statistics were computed for primary samples or, if the primary measurement was missing, for the collocated samples collected at the same location during the same sampling period. To ensure that only a single record was included for each site and date, the maximum value of the measurements was retained across primary and collocated samples. In this way, if one of the measurements was missing and the other was not detected/measured, the maximum would capture the not detected/measured record. If both primary and collocated records contained a missing value, only one record would be tallied for the completeness count. Finally, if both records contained a not detected or measured value, the larger of the two would be captured for the completeness count. Because sample collection at some locations was performed more frequently to meet the requirements of other sampling networks or for other specific purposes, only records that occurred at the required 1-in-6 day sample collection frequency (days 0, 6, 12, 18, 24, 30, etc.), starting with the first collection date for each site in calendar year 2010, were counted. For this and other reasons, it is not possible to discern from the AQS database when makeup samples are collected. The individual enumeration of valid samples from each and every site would be an extremely tedious task and presumes that only NATTS sample records are present in the database for a given parameter occurrence code. Therefore, to account for makeup samples collected near the time of the scheduled collection date, the interval of days since the last collection event was allowed to vary between 4 and 8. No correction was applied for compound-specific missing data (e.g., the value for benzene was missing, but the value for dichloromethane was non-missing). It is assumed that this discrepancy does not significantly distort the percentage completeness.

The results of the completeness assessment are presented for each collection location and representative compound in **Table 5** and in **Figures 1** through **7**. Mean and median completeness values across all NATTS laboratories for a given analyte and across all analytes for a given site are also presented. In cases where no data were reported, the particular analyte class was not collected at that NATTS site, as indicated by table notes.

Although most sites achieved their MQO completeness objective of 85% in 2010, there were a number of sites that did not meet this objective for specific analyte groups. Non-achievement was most notable for VOCs and varied by analyte, suggesting a laboratory contribution. The preponderance of completeness metrics over 100% reflects the fact that most sites collected 61 samples during 2010 and completeness is based on the collection of 60 samples.

2.3 Precision of NATTS Data

Three basic sample types are collected at NATTS sites:

- Primary samples—a single sample that represents a particular sampling event.
- Duplicate samples—a replicate sample, collected simultaneously with the primary sample, that represents a second measurement from the same sample stream (e.g., the inlet stream of an outdoor air monitor) but employs an independent sample collection device (e.g., sampling pump) and collection substrate (e.g., filter) from the primary sample. Duplicate samples provide the basis for assessing the aggregate variability associated with the collection device, sampling substrate, and sample analysis.

Table 5. Percentage Completeness[a] of the 2010 AQS Dataset by Site for Seven Hazardous Air Pollutants.

AQS Site ID	Parameter Code → Site Name	45201 BENZ	43218 BUTA	43502 FORM	43505 ACRO	17141 NAPH	12115 CRVI	82103 AS
25-025-0042	Boston, MA	102	102	102	102	102	102	102
49-011-0004	Bountiful, UT	100	100	102	100	102	102	98
36-005-0110	Bronx, NY	50	93	100	93	93	93	93
45-025-0001	Chesterfield, SC	77	75	42	50	102	100	--[d]
26-163-0033	Dearborn, MI	95	95	102	95	102	100	102
13-089-0002	Decatur, GA	102	102	100	102	102	100	102
48-201-1039	Deer Park, TX	100	100	98	102	102	100	102
08-077-0017[b], -0018[c]	Grand Junction, CO	102	102	102	102	102	102	--[d]
21-043-0500	Grayson Lake, KY	100	100	102	100	102	102	102
48-203-0002	Harrison County, TX	97	97	98	97	90	100	102
12-057-3002	Hillsborough County, FL	70	70	102	70	102	102	102
55-027-0001	Horicon, WI	90	90	90	90	83	102	93
41-061-0119	La Grande, OR	88	85	82	--[d]	75	95	90
06-037-1103	Los Angeles, CA	92	92	100	92	100	102	102
17-031-4201	Northbrook, IL	102	102	102	102	102	98	102
04-013-9997	Phoenix, AZ	97	97	102	97	102	102	97
12-103-0026	Pinellas County, FL	102	102	102	102	102	102	100
41-051-0246	Portland, OR	82	97	93	.	88	98	93
44-007-0022	Providence, RI	102	102	102	102	93	98	102
51-087-0014	Richmond, VA	102	102	102	102	102	102	102
36-055-1007	Rochester, NY	102	102	102	102	102	102	102
06-065-8001	Rubidoux, CA	93	93	95	93	102	102	100
06-085-0005	San Jose, CA	102	102	102	102	100	--[d]	102
53-033-0080	Seattle, WA	102	102	102	102	102	102	102
29-510-0085	St. Louis, MO	95	95	95	95	102	95	102
50-007-0007	Underhill, VT	100	100	102	100	98	98	98
11-001-0043	Washington, DC	102	102	102	102	98	100	100
	Mean	94	96	97	96	98	100	100
	Std. Dev.	12	8	12	12	7	2	3
	Median	100	100	102	100	102	101	102

[a] Data pulled from AQS on 8/31/2011.
[b] Metals only.
[c] Carbonyls, VOCs, and PAHs only.
[d] Not reported for this site.

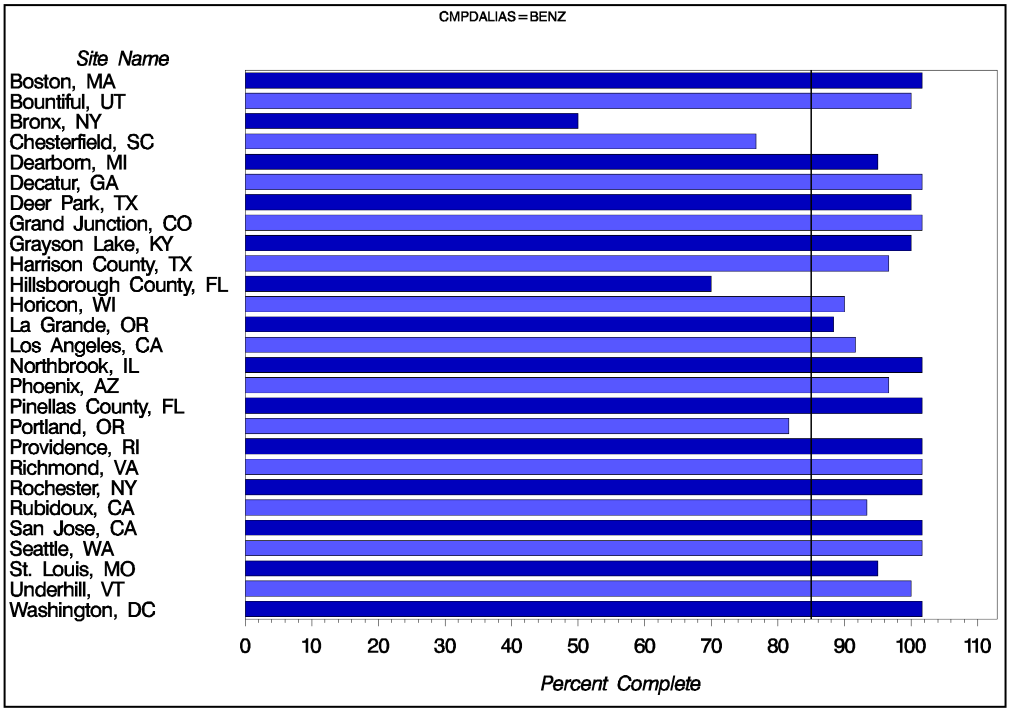


Figure 1. Completeness for Benzene at NATTS Sample Collection Sites in 2010 (MQO reference indicated at 85%).

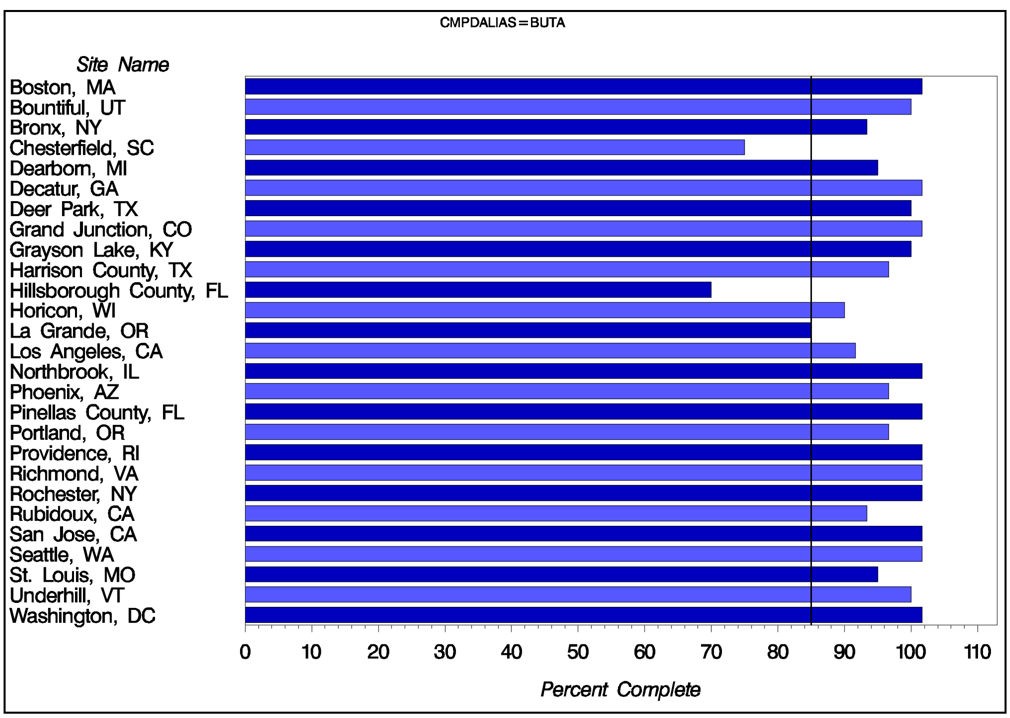


Figure 2. Completeness for 1, 3-Butadiene at NATTS Sample Collection Sites in 2010 (MQO reference indicated at 85%).

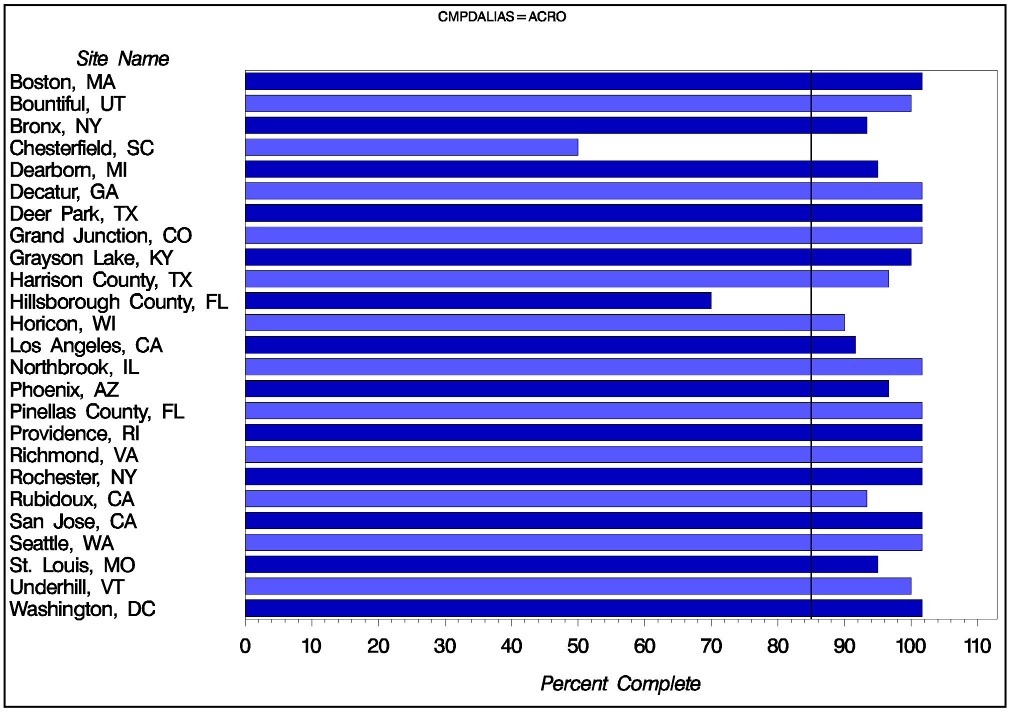


Figure 3. Completeness for Acrolein at NATTS Sample Collection Sites in 2010 (MQO reference indicated at 85%).

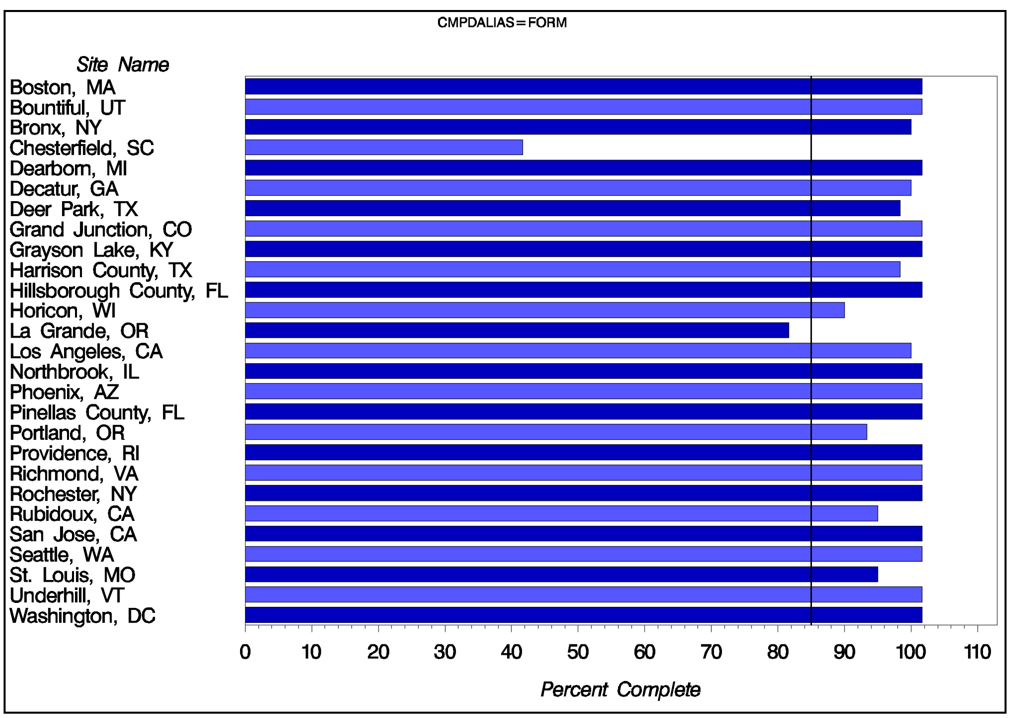


Figure 4. Completeness for Formaldehyde at NATTS Sample Collection Sites in 2010 (MQO reference indicated at 85%).

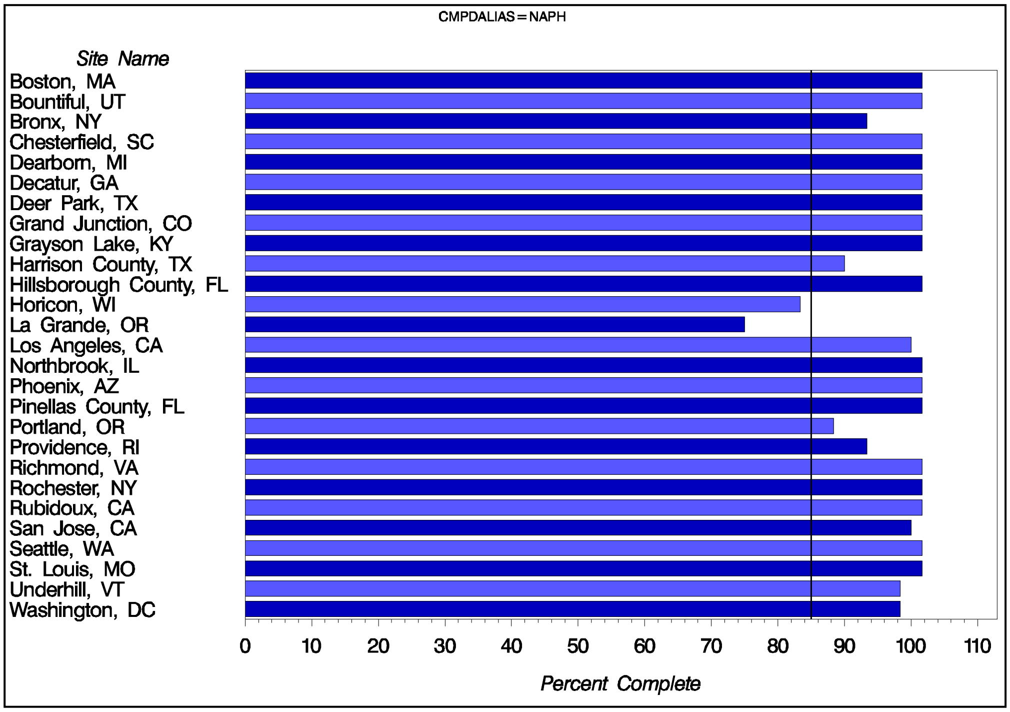


Figure 5. Completeness for Naphthalene at NATTS Sample Collection Sites in 2010 (MQO reference indicated at 85%).

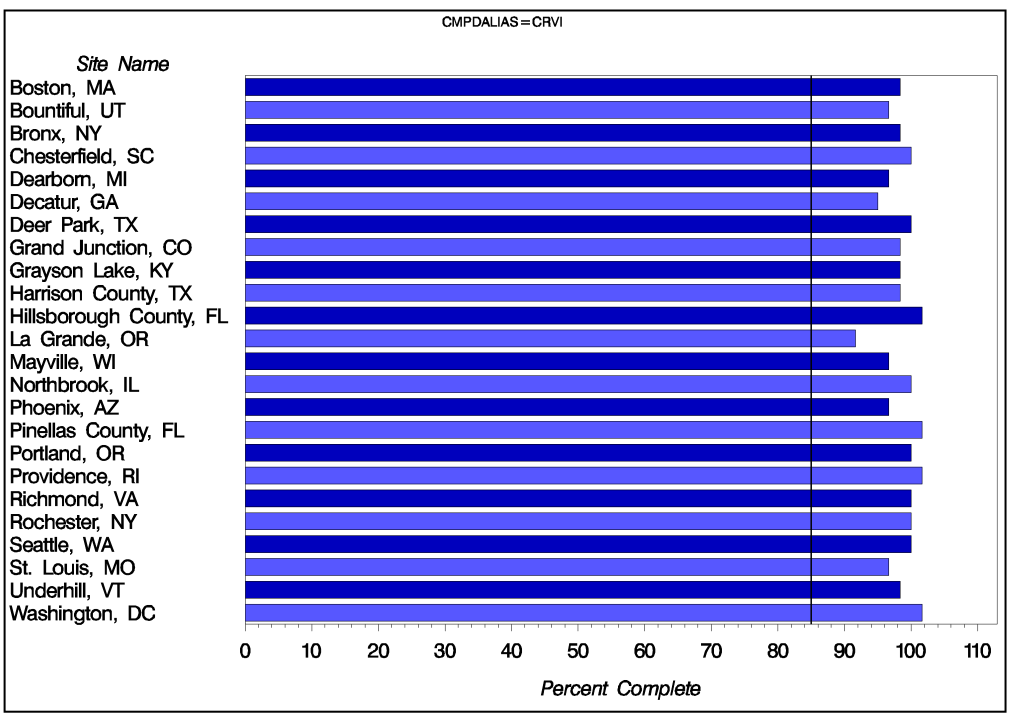


Figure 6. Completeness for Chromium (VI) at NATTS Sample Collection Sites in 2010 (MQO reference indicated at 85%).

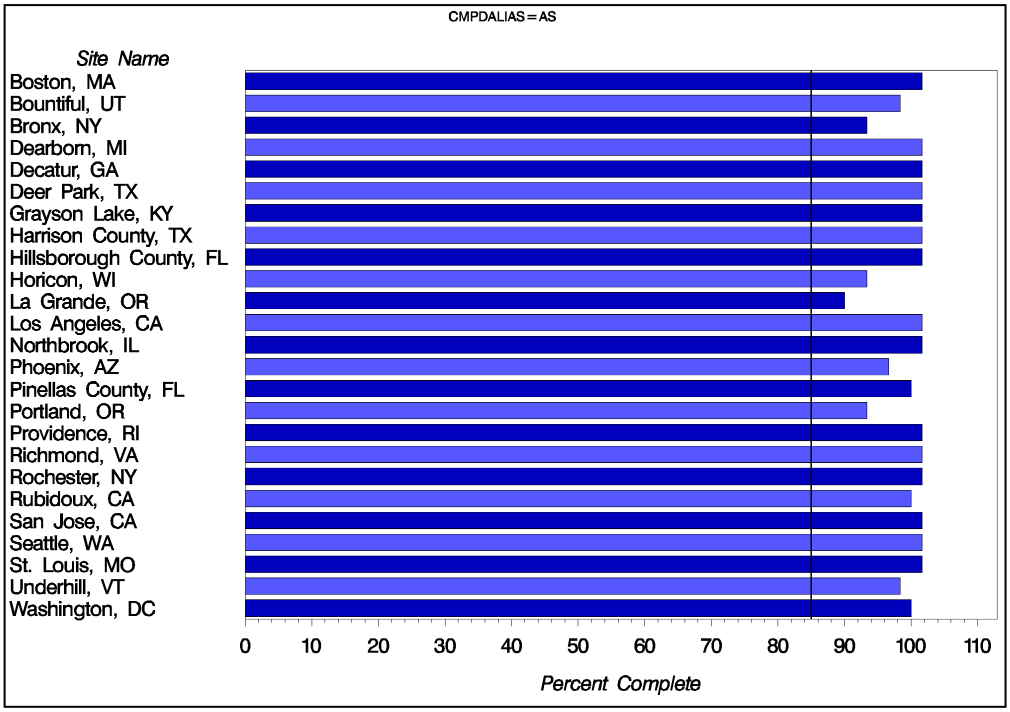


Figure 7. Completeness for Arsenic at NATTS Sample Collection Sites in 2010 (MQO reference indicated at 85%).

- Collocated samples—a replicate sample, collected simultaneously with the primary sample, that represents a second measurement from a completely independent (but spatially close, usually 1 to 2 meters away from the primary sampler) sample stream, collection device, and collection substrate from the primary sample. Collocated samples provide the basis for assessing the total variability associated with all components of the sample collection and analysis scheme; thus, the analyst can assume that the air collected by the primary and collocated samplers is absolutely identical in its composition. Samples collected at different sites violate this basic premise of collocation and were excluded from these precision analyses at the direction of EPA.

- Replicate Sampling:

Replicate sampling refers, generally, to both duplicate and collocated sample collections as described above and as differentiated within the AQS database. Precision assessments associated with replicate sampling are distinctly different from those associated with replicate analyses as the latter are derived from a second chemical analysis of a single sample and the former are derived from single chemical analyses of two different samples. For this report, precision analyses were performed exclusively on NATTS sites; surrogate, non-NATTS sites with collocated samplers have not been included. The methodological precision for the NATTS data was assessed from both analytical (i.e., instrumental) and overall (i.e., instrumental + sampling) perspectives. Analytical precision measures the variability in reported results due exclusively to differences in analytical instrument performance and was estimated by comparing results from two analyses of a single sample, whether that sample be primary, duplicate, or collocated. Overall sampling precision was assessed by comparing the results from primary and collocated samples or from primary and duplicate samples and accounts for the combined variability associated with sample collection and sample analysis. Despite the differences, albeit subtle, between duplicate and collocated samples, this report provides separate overall precision estimates for these two replicate sample types.

For the purposes of these precision assessments, the AQS database was queried for two distinct record types: RP records and RD records. RP records contain data for various types of replicate samples and analyses associated with a particular sampling date, site, and chemical parameter. Different types of replicates are identified by the value of the precision ID variable (PRECISID) according to the following scheme:

- PRECISID = 1: Collocated sample data
- PRECISID = 2: Replicate analysis of a primary sample
- PRECISID = 3: Replicate analysis of a collocated sample

With the exception of the Pinellas County, FL site, analytical precision for this report was computed from the replicate pairs of data coded with either Precision ID 2 or 3. Additional Precision IDs were employed for Pinellas County. Overall precision was computed using the data in the raw data records as described below.

In addition to the replicate records, raw data (AQS RD) transactions provide a second source of primary and collocated data in AQS. Using the POCs shown for each NATTS site listed in **Table 6**, it is possible to distinguish among primary, duplicate, and collocated sampling events. For example, primary samples collected at the Chesterfield, SC, NATTS site are assigned a parameter occurrence code of 1, while collocated samples collected at the same site are assigned a parameter occurrence code of 2. This results in the creation of two distinct records for each sampling event at which a collocated sample is collected. Duplicate samples are similarly identified. Because the assignment of a particular POC is made at the discretion of each NATTS site, extensive effort was required to ensure that the POCs for each site were correctly identified. POCs for primary, duplicate, and collocated samples of each chemical class were determined by hierarchical exploration of three principal pieces of information:

1) POCs used by each NATTS collection site in 2007, 2008 and 2009 were used as the reference for POCs assigned in 2010.
2) POCs assigned in previous years were confirmed by results of frequency analysis performed on RD records for samples collected in 2010.
3) Discrepancies and/or uncertainties about POC assignments were resolved by direct contact with NATTS administrators for specific collection sites.

Table 6. Parameter Occurrence Codes by NATTS Site and Analyte Type.

			Parameter Occurrence Codes (POCs)[a]														
			VOC			Carbonyls			Metals			PAHs			Chromium (VI)		
Region	Site Identifier	AQS Site Code	P[b]	D[c]	C[d]	P	D	C	P	D	C	P	D	C	P	D	C
I	Boston, MA	25-025-0042	10	11		3	4		6	7		6			6	7	
I	Underhill, VT	50-007-0007	1			1			3		4	6			6	7	
I	Providence, RI	44-007-0022	2			5		7	1		2	6			6		7
II	Bronx, NY	36-005-0110, 0080	2			2			1		2	6			6		7
II	Rochester, NY	36-055-1007	2			2			1			6			6		7
III	Washington, DC	11-001-0043	4		2	2			1			1			1		2
III	Richmond, VA	51-087-0014	4	7		2			1			6			6		7
IV	Chesterfield, SC	45-025-0001	1		2	1		2	1		2	6			6	7	
IV	Decatur, GA[e]	13-089-0002	1,3		2,4	2		3	1		2	6		7	6		7
IV	Grayson Lake, KY	21-043-0500	6	7		1	2		1	2		6			6		7
IV	Hillsborough County, FL	12-057-3002	1			6			5			6		7	6		7
IV	Pinellas County, FL	12-103-0026	1			6			5			6		7	6		7
V	Dearborn, MI	26-163-0033	1		2	1		2	1		9	1		2	1		2
V	Horicon, WI	55-027-0001	1		2	1		2	1		2	6[g],1[h]			6		7
V	Northbrook, IL	17-031-4201	6		7	6		7	6		7	6			6		7
VI	Deer Park, TX	48-201-1039	2		3	3			1			1	2	6	1[i],6[j]		2[i],7[j]
VI	Harrison County, TX	48-203-0002	1			1			1			1			1[i].6[j]		
VII	St. Louis, MO	29-510-0085	6			6			6		7	6			6		7
VIII	Bountiful, UT	49-011-0004	6			6			1		2	6			6		7
VIII	Grand Junction, CO	08-077-0017, -0018	6			6			3		4	6			6		7
IX	Phoenix, AZ	04-013-9997	6		7	30		31	1			3			6		7
IX	Los Angeles, CA	06-037-1103	4		5	4		5	2		3	6			4		5
IX	Rubidoux, CA	06-065-8001	4		5	4		5	2		4	6	7		4		5
IX	San Jose, CA	06-085-0005	3		5	3		1	1			1					
X	La Grande, OR	41-061-0119	7			7			7			7			7		
X	Portland, OR	41-051-0246	7		9	7		9	7		9	7		9	7		9
X	Seattle, WA	53-033-0080	6		7	6		7	6			6	7		6	7	

[a] As reported by the NATTS site administrator. Multiple POCs reflect different analytes or changes in assignments during the monitoring year.
[b] P = Primary
[c] D = Duplicate
[d] C = Collocated
[e] Benzene on POCs 3 and 4; all other VOCs on POCs 1 and 2.
[f] Initiated June 2010
[g] January-June 2010
[h] July-December 2010
[i] January 2010; analysis performed by TCEQ.
[j] February-December 2010; analysis performed by ERG.

Multiple POCs for a given site, analyte, and sample type reflect a number of factors unique to a site during 2010, largely made for reasons known only to the NATTS site administrators. Overall precision estimates were computed by comparing primary and collocated records for a particular site, chemical parameter, and sample collection date.

To reflect possible differences in analytical and overall precision based on the magnitude of the contributing measurements, precision was computed, as percent CV, for each site and analyte: 1) where both replicate values were non-zero and 2) where both replicate values exceeded the MDL. An additional differentiation is provided to graphically illustrate the proportions of rural and urban measurements. **Figures 8** through **14** illustrate the distributions of all sample values from RD records, among several measurement categories, on samples collected in 2010 for the representative analytes. With the exception of 1, 3-butadiene, the predominance of measurements occurred in the ">MDL" and ">MQO" categories.

Table 7, complemented by **Table 8**, presents the laboratories that analyzed specific sample types for each NATTS site. Of particular note is the fact that some laboratories provided analytical chemistry services for multiple NATTS sites. Laboratory codes presented in **Table 8** were assigned by Alion Science, Inc., to track PT samples and their results. The Grayson Lake, KY site switched from KYDES to ERG in 2010 for VOCs, carbonyls, and PAHs. Deer Park and Harrison County, TX sites switched from TCEQ to ERG in February 2010 for Chromium (VI).

Table 7. Laboratories Performing Analyses for the Different Analyte Types for Each NATTS Site in 2010.

Site Identifier	VOCs[a]	Carbonyls	Metals	PAHs	Chromium (VI)
Boston-Roxbury, MA	RIDOH	MADEP	ERG	ERG	ERG
Underhill, VT	ERG	VTDEC	ERG	ERG	ERG
Providence, RI	RIDOH	RIDOH	RIDOH	ERG	ERG
Bronx, NY	NYSDEC	NYSDEC	RTI	ERG	ERG
Rochester, NY	NYSDEC	NYSDEC	RTI	ERG	ERG
Washington, DC	MDE	PAMSL	WVDEP	ERG	ERG
Richmond, VA	VA DCLS	VA DCLS	VA DCLS	ERG	ERG
Chesterfield, SC	SCDHEC	SCDHEC	SCDHEC	ERG	ERG
Decatur, GA	GADNR	GADNR	GADNR	ERG	ERG
Grayson Lake, KY	ERG[b]	ERG[b]	ERG[b]	ERG	ERG
Hillsborough County, FL	PCDEM	ERG	EPCHC	ERG	ERG
Pinellas County, FL	PCDEM	ERG	EPCHC	ERG	ERG
Dearborn, MI	ERG	ERG	MIDEQ	ERG	ERG
Horicon, WI	WSLH	WSLH	WSLH	ERG	ERG
Northbrook, IL	ERG	ERG	ERG	ERG	ERG
Deer Park, TX	TCEQ	TCEQ	TCEQ	TCEQ	ERG[c]
Harrison County, TX	TCEQ	TCEQ	TCEQ	TCEQ	ERG[c]
St. Louis, MO	ERG	ERG	ERG	ERG	ERG
Bountiful, UT	ERG	ERG	ERG	ERG	ERG
Grand Junction, CO	ERG	ERG	CDPHE	ERG	ERG
Phoenix, AZ	ERG	ERG	ERG	ERG	ERG
San Jose, CA	BAAQMD	BAAQMD	ERG	ERG	CARB

Table 7. Laboratories Performing Analyses for the Different Analyte Types for Each NATTS Site in 2010.

Site Identifier	VOCs[a]	Carbonyls	Metals	PAHs	Chromium (VI)
Rubidoux, CA	SCAQMD	SCAQMD	SCAQMD	ERG	CARB
Los Angeles, CA	SCAQMD	SCAQMD	SCAQMD	ERG	CARB
La Grande, OR	ODEQ	ODEQ	ODEQ	ODEQ	ODEQ
Portland, OR	ODEQ	ODEQ	ODEQ	ODEQ	ODEQ
Seattle, WA	ERG	ERG	ERG	ERG	ERG

[a] Includes acrolein.

[b] Switched from KYDES to ERG effective June 2010.

[c] Switched from TCEQ to ERG effective February 2010.

Table 8. Laboratory Abbreviations and Descriptions for NATTS Laboratories.

Laboratory Code(s)	Laboratory Abbreviation	Laboratory Description
01-01-C,V,M	RIDOH	Rhode Island Department of Health
01-02-C,V	VTDEC	Vermont Department of Environmental Conservation
01-03-C	MADEP	Massachusetts Department of Environmental Protection
01-04-M	USEPAR1	U.S. EPA Region 1 Laboratory
02-01-C,V	NYSDEC	New York State Department of Environmental Conservation
03-01-V	MDE	Maryland Department of the Environment
03-01-C	PAMSL	Philadelphia Air Management Services Laboratory
03-01-M	WVDEP	West Virginia Department of Environmental Protection
03-02-C,M,V	VADCLS	Virginia Division of Consolidated Laboratory Services
04-01-M	EPCHC	Environmental Protection Commission of Hillsborough County
04-01-V	PCDEM	Pinellas County Department of Environmental Management
04-02-C,M,V,P	SCDHEC	South Carolina Department of Health and Environmental Control
04-03-C,M,V	KYDES	Kentucky Division of Environmental Services
04-04-C,M,V	GADNR	Georgia Department of Natural Resources
05-01-M	MIDEQ	Michigan Department of Environmental Quality
05-03-C,M,V	WSLH	Wisconsin State Laboratory of Hygiene
06-01-C,M,V,P,Cr	TCEQ	Texas Commission on Environmental Quality
08-02-M	CDPHE	Colorado Department of Public Health and Environment
09-03-C,V	BAAQMD	Bay Area Air Quality Management District
09-08-C	SCAQMD	South Coast Air Quality Management District
10-02-C,M,V,Cr	ODEQ	Oregon Department of Environmental Quality
11-01-C,M,V,Cr	ERG[a]	Eastern Research Group
11-02-M	RTI	RTI International

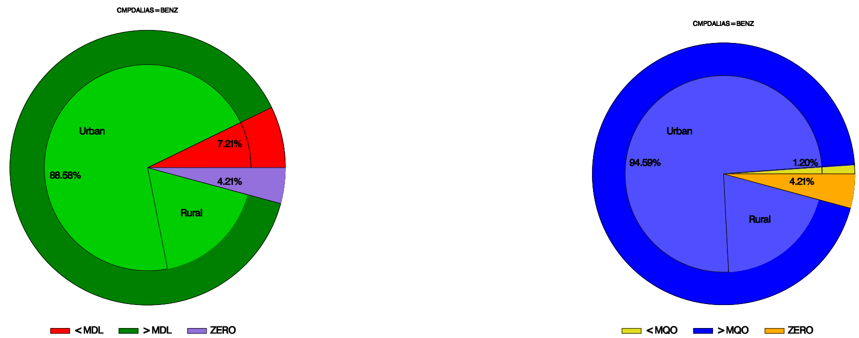


Figure 8. Distribution of 2010 Measurements Among Various Levels for Benzene.

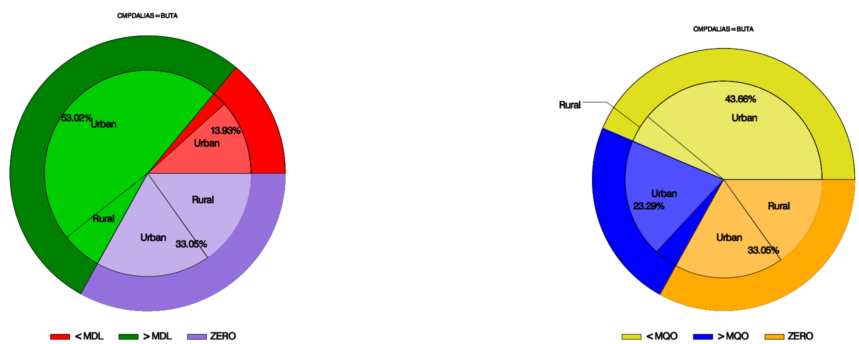


Figure 9. Distribution of 2010 Measurements Among Various Levels for Butadiene.

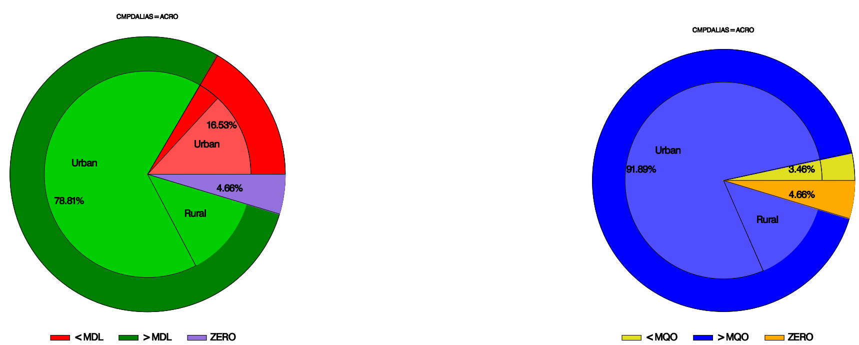


Figure 10. Distribution of 2010 Measurements Among Various Levels for Acrolein.

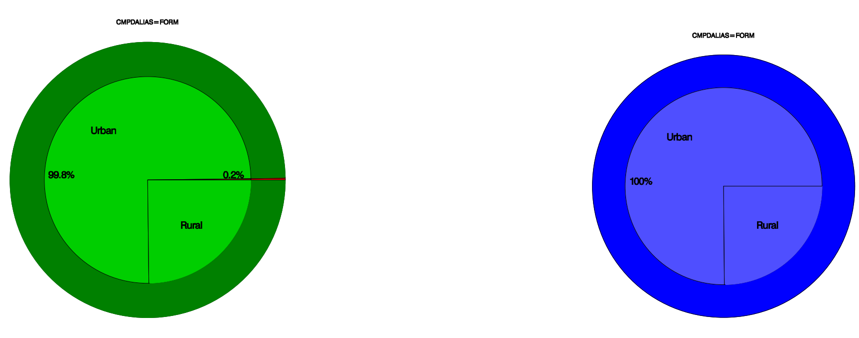


Figure 11. Distribution of 2010 Measurements Among Various Levels for Formaldehyde.

Figure 12. Distribution of 2010 Measurements Among Various Levels for Naphthalene.

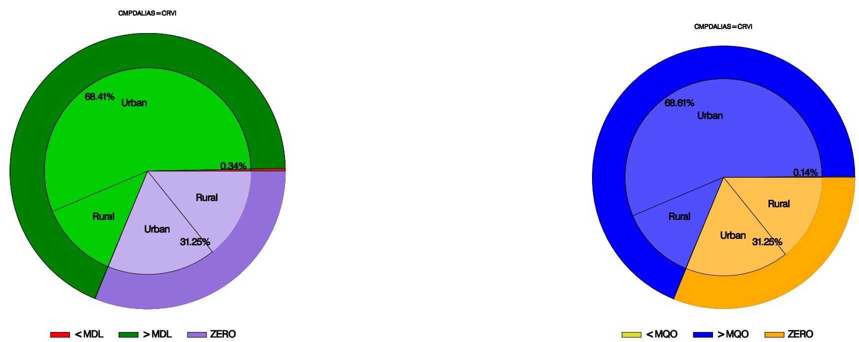


Figure 13. Distribution of 2010 Measurements Among Various Levels for Chromium (VI).

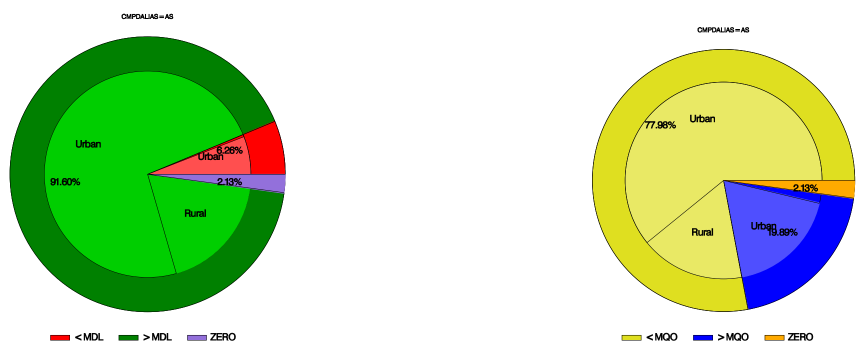


Figure 14. Distribution of 2010 Measurements Among Various Levels for Arsenic.

2.3.1 Analytical Precision Results

Analytical precision was computed from the results of the primary and collocated samples and their respective replicate analyses extracted from RP records in the AQS database. This measure of agreement, expressed as the percentage coefficient of variation (% CV), is defined algebraically in Eq. 1:

$$\%CV = 100 \cdot \sqrt{\frac{\sum_{i=1}^{n}\left[\frac{(p_i - r_i)}{0.5 \cdot (p_i + r_i)}\right]^2}{2n}} \qquad \text{(Eq. 1)}$$

where

p_i = the result of the principal analysis on sample *i*,

r_i = the result of the replicate analysis on sample *i*, and

n = the number of principal-replicate analysis pairs.

The analytical precision for all measurable HAPs analyzed in samples collected in CY2010 is presented in **Table 9** with selected analytes summarized graphically in **Figures 15** through **21**. **Table 10** displays the analytical precision for replicate samples that were evaluated with the method detection limits (measurements below the method detection limits removed).

As in previous reporting years, the agreement between replicate analyses of the same samples is highly variable across sites/laboratories but largely still within the MQO guidelines. Specific analytes at a few isolated sites, notably: benzene at Grand Junction, CO; formaldehyde at Bountiful, UT; arsenic at Underhill, VT, show marked higher CVs than those for other sites. All laboratories show agreement within the MQO for chromium (VI). With the one exception noted above, agreement between formaldehyde re-analyses is consistently well within the MQO for all sites. Similarly, naphthalene exhibits agreements below 4% for the five reporting sites, well below CVs reported for VOCs.

The remarkable agreement between CVs computed from all measurements vs. computed only from those greater than the MDL must be interpreted cautiously since both measurements had to be non-zero in order for a measurement pair to contribute to the "All Values" CV. This requirement eliminates all cases where one of the values was measurable but the other was not. In the few instances where a difference in CVs was observed between the "All Values" and ">MDL" cases, the CV was lower for the latter.

Table 9. Analytical Precision[a] for Replicate Analyses of 2010 NATTS Data: All Non-Zero Measurements Included.

AQS Site Code	Site Description	BENZ	BUTA	CTET	CLFRM	EDB	DCP	EDC	MECL	TCE1122	PERC	TCE	VCM
04-013-9997	Phoenix, AZ	3.7 (11)	5.7 (11)	5.2 (11)	7.3 (11)	---	---	---	4.3 (11)	---	5.5 (11)	0 (2)	---
06-065-8001	Rubidoux, CA	---	---	---	---	---	---	---	---	---	---	---	---
06-085-0005	San Jose, CA	4.8 (18)	4.1 (5)	5.7 (18)	16.7 (16)	---	---	---	18.4 (16)	---	4.9 (18)	18.5 (13	---
08-077-0017	Grand Junction, CO	---	---	---	---	---	---	---	---	---	---	---	---
08-077-0018	Grand Junction, CO	33.7 (10)	13 (8)	21.2 (10	6.2 (9)	0 (1)	---	25.1 (2)	39.2 (10)	---	34.3 (10	6.8 (2)	---
11-001-0043	Washington, DC	---	---	---	---	---	---	---	---	---	---	---	---
12-057-3002	Hillsborough County, FL	---	---	---	---	---	---	---	---	---	---	---	---
12-103-0026	Pinellas County, FL	4.7 (84)	13.3 (84	3.5 (84)	11.9 (84	43 (1)	---	11.2 (83)	16.1 (84)	28.7 (19)	15.3 (83)	22.7 (17)	15.7 (2)
13-089-0002	Decatur, GA	---	---	---	---	---	---	---	---	---	---	---	---
17-031-4201	Northbrook, IL	4.1 (16)	4.7 (11)	5.2 (16)	6 (16)	---	---	0 (1)	3.3 (16)	---	3 (16)	7.5 (7)	4.8 (2)
21-043-0500	Grayson Lake, KY	4.2 (8)	8 (4)	3.4 (8)	3 (5)	---	---	---	4 (8)	---	14.8 (4)	---	---
25-025-0042	Boston, MA	---	---	---	---	---	---	---	---	---	---	---	---
26-163-0033	Dearborn, MI	4.4 (12)	12.1 (12)	3.7 (12)	4.7 (12)	---	---	8.6 (2)	4.1 (12)	---	4.4 (10)	15 (4)	---
29-510-0085	St. Louis, MO	4.1 (8)	12.6 (8)	5.2 (8)	5 (6)	---	---	---	10.6 (8)	---	3.8 (5)	---	---
36-005-0110	Bronx, NY	---	---	---	---	---	---	---	---	---	---	---	---
36-055-1007	Rochester, NY	---	---	---	---	---	---	---	---	---	---	---	---
44-007-0022	Providence, RI	---	---	---	---	---	---	---	---	---	---	---	---
45-025-0001	Chesterfield, SC	---	---	---	---	---	---	---	---	---	---	---	---
48-201-1039	Deer Park, TX	---	---	---	---	---	---	---	---	---	---	---	---
49-011-0004	Bountiful, UT	9.6 (10)	7.6 (10)	22.4 (10)	4.2 (8)	---	---	---	14.4 (10)	---	10.3 (10)	17.1 (2)	---
50-007-0007	Underhill, VT	---	---	---	---	---	---	---	---	---	---	---	---
51-087-0014	Richmond, VA	---	---	---	---	---	---	---	---	---	---	---	---
53-033-0080	Seattle, WA	2.5 (12)	3.5 (10)	3.3 (12)	3.1 (12)	---	---	2.4 (2)	3.8 (12)	---	3 (10)	---	---
55-027-0001	Horicon, WI	---	---	---	---	---	---	---	---	---	---	---	---
	Overall Mean	9.1 (189)	11.3 (163)	8.1 (189)	10.2 (179)	30.4 (2)	---	11.4 (90)	15.8 (187)	28.7 (19)	13.9 (177)	18 (47)	11.6 (4)

Table 9. Analytical Precision[a] for Replicate Analyses of 2010 NATTS Data: All Non-Zero Measurements Included (continued).

AQS Site Code	Site Description	cDCPEN	tDCPEN	ACRO	ACRY	NAPH	BaP	FORM	ACET	AS	BE	CD	PB	MN	NI	CRVI
04-013-9997	Phoenix, AZ	---	---	5 (11)	11.8 (2)	---	---	0.5 (7)	1 (7)	---	---	---	---	---	---	5.6 (14)
06-065-8001	Rubidoux, CA	---	---	---	---	3.9 (11)	6.8 (4)	---	---	---	---	---	---	---	---	---
06-085-0005	San Jose, CA	---	---	---	---	---	---	0.4 (8)	0.6 (8)	---	---	---	---	---	---	---
08-077-0017	Grand Junction, CO	---	---	---	---	---	---	---	---	---	---	---	---	---	---	4.4 (9)
08-077-0018	Grand Junction, CO	---	---	38.7 (10)	---	---	---	1.5 (12)	1.3 (12)	---	---	---	---	---	---	---
11-001-0043	Washington, DC	---	---	---	---	---	---	---	---	---	---	---	---	---	---	9.5 (6)
12-057-3002	Hillsborough County, FL	---	---	---	---	3.7 (12)	5.6 (2)	5.4 (12)	7 (12)	---	---	---	---	---	---	4.7 (9)
12-103-0026	Pinellas County, FL	3.4 (6)	9.8 (5)	17 (84)	19.4 (65)	---	---	1.4 (12)	2.2 (12)	---	---	---	---	---	---	13.3 (11
13-089-0002	Decatur, GA	---	---	---	---	2.5 (10)	6.9 (2)	---	---	---	---	---	---	---	---	8.8 (7)
17-031-4201	Northbrook, IL	---	---	5.6 (16)	---	---	---	0.9 (13)	0.7 (13)	1.8 (54)	18.6 (45	4.9 (54)	3.9 (54)	3.7 (54)	5.7 (54)	6 (14)
21-043-0500	Grayson Lake, KY	---	---	4.2 (8)	---	---	---	---	---	---	---	---	---	---	---	7.7 (8)
25-025-0042	Boston, MA	---	---	---	---	---	---	---	---	2.5 (72)	33.3 (61	7.2 (72)	1.5 (72)	1.2 (72)	1.8 (72)	5.4 (6)
26-163-0033	Dearborn, MI	---	---	6.7 (11)	---	1.3 (12)	4 (10)	0.5 (11)	0.4 (11)	---	---	---	---	---	---	6.1 (9)
29-510-0085	St. Louis, MO	---	---	26.7 (8)	---	---	---	1.9 (12)	1.8 (12)	1.1 (22)	9.2 (21)	5 (22)	1.4 (22)	2.2 (22)	3.6 (22)	4.8 (10)
36-005-0110	Bronx, NY	---	---	---	---	---	---	---	---	---	---	---	---	---	---	6.5 (6)
36-055-1007	Rochester, NY	---	---	---	---	---	---	---	---	---	---	---	---	---	---	7.6 (9)
44-007-0022	Providence, RI	---	---	---	---	---	---	---	---	---	---	---	---	---	---	4.6 (8)
45-025-0001	Chesterfield, SC	---	---	---	---	---	---	---	---	---	---	---	---	---	---	9.8 (3)
48-201-1039	Deer Park, TX	---	---	---	---	---	---	---	---	---	---	---	---	---	---	5.6 (8)
49-011-0004	Bountiful, UT	---	---	25.4 (10)	---	---	---	64.2 (12)	64.4 (12)	---	---	---	---	---	---	4.5 (13)
50-007-0007	Underhill, VT	---	---	---	---	---	---	---	---	31.4 (12	48.7 (3)	0 (12)	3 (12)	3.2 (12)	5.7 (12)	3 (6)
51-087-0014	Richmond, VA	---	---	---	---	---	---	---	---	---	---	---	---	---	---	6.2 (7)
53-033-0080	Seattle, WA	---	---	6.3 (12)	---	2.2 (12)	4.3 (4)	0.5 (12)	0.4 (12)	---	---	---	---	---	---	6.2 (12)
55-027-0001	Horicon, WI	---	---	---	---	---	---	---	---	---	---	---	---	---	---	6.6 (8)
	Overall Mean	3.4 (6)	9.8 (5)	17.7 (170)	19.2 (67)	2.9 (57)	5.1 (22)	21.2 (111)	21.3 (111)	8.8 (160)	26.6 (130)	5.9 (160)	2.7 (160)	2.6 (160)	4.1 (160)	6.8 (183)

[a] Expressed as percentage coefficient of variation (%CV) with number of contributing data pairs presented in parentheses. Metals results are reported at STP at most sites and LC at others.
[b] Sample not collected or analyte not reported.
[c] Across all sites.

Table 10. Analytical Precision[a] for Replicate Analyses of 2010 NATTS Data: Measurements Below the Method Detection Limit Excluded.

AQS SiteCode	Site Description	BENZ	BUTA	CTET	CLFRM	EDB	DCP	EDC	MECL	TCE1122	PERC	TCE	VCM
04-013-9997	Phoenix, AZ	3.7 (11)	5.7 (11)	5.2 (11)	7.3 (11)	---	---	---	4.3 (11)	---	5.5 (11)	0 (1)	---
06-065-8001	Rubidoux, CA	---	---	---	---	---	---	---	---	---	---	---	---
06-085-0005	San Jose, CA	4.8 (18)	4.1 (5)	5.7 (18)	0 (13)	---	---	---	18.4 (16)	---	4.9 (18)	0 (5)	---
08-077-0017	Grand Junction, CO	---	---	---	---	---	---	---	---	---	---	---	---
08-077-0018	Grand Junction, CO	33.7 (10)	13 (8)	21.2 (10	6.4 (8)	---	---	25.1 (2)	39.2 (10)	---	36.6 (8)	---	---
11-001-0043	Washington, DC	---	---	---	---	---	---	---	---	---	---	---	---
12-057-3002	Hillsborough County, FL	---	---	---	---	---	---	---	---	---	---	---	---
12-103-0026	Pinellas County, FL	4.7 (84)	13.3 (84)	3.5 (84)	11.9 (84	43 (1)	---	11.2 (83)	16.1 (84)	40.6 (4)	15.7 (77)	7.5 (9)	15.7 (2)
13-089-0002	Decatur, GA	---	---	---	---	---	---	---	---	---	---	---	---
17-031-4201	Northbrook, IL	4.1 (16)	4.7 (11)	5.2 (16)	6 (16)	---	---	0 (1)	3.3 (16)	---	3.1 (15)	4.8 (5)	4.8 (2)
21-043-0500	Grayson Lake, KY	4.2 (8)	5.4 (3)	3.4 (8)	1.8 (3)	---	---	---	4 (8)	---	---	---	---
25-025-0042	Boston, MA	---	---	---	---	---	---	---	---	---	---	---	---
26-163-0033	Dearborn, MI	4.4 (12)	12.1 (12	3.7 (12)	4.7 (12)	---	---	8.6 (2)	4.1 (12)	---	4.1 (8)	6.5 (2)	---
29-510-0085	St. Louis, MO	4.1 (8)	12.6 (8)	5.2 (8)	5.1 (5)	---	---	---	10.6 (8)	---	3.8 (5)	---	---
36-005-0110	Bronx, NY	---	---	---	---	---	---	---	---	---	---	---	---
36-055-1007	Rochester, NY	---	---	---	---	---	---	---	---	---	---	---	---
44-007-0022	Providence, RI	---	---	---	---	---	---	---	---	---	---	---	---
45-025-0001	Chesterfield, SC	---	---	---	---	---	---	---	---	---	---	---	---
48-201-1039	Deer Park, TX	---	---	---	---	---	---	---	---	---	---	---	---
49-011-0004	Bountiful, UT	9.6 (10)	7.6 (10)	22.4 (10)	4 (6)	---	---	---	14.4 (10)	---	10.3 (10)	17.1 (2)	---
50-007-0007	Underhill, VT	---	---	---	---	---	---	---	---	---	---	---	---
51-087-0014	Richmond, VA	---	---	---	---	---	---	---	---	---	---	---	---
53-033-0080	Seattle, WA	2.5 (12)	3.5 (10)	3.3 (12)	3.2 (11)	---	---	2.4 (2)	3.8 (12)	---	1.5 (8)	---	---
55-027-0001	Horicon, WI	---	---	---	---	---	---	---	---	---	---	---	---
	Overall Mean	9.1 (189)	11.3 (162)	8.1 (189)	9.1 (169)	43 (1)	---	11.4 (90)	15.8 (187)	40.6 (4)	14.1 (160)	7.4 (24)	11.6 (4)

Table 10. Analytical Precision[a] for Replicate Analyses of 2010 NATTS Data: Measurements Below the Method Detection Limit Excluded (continued).

AQS SiteCode	Site Description	cDCPEN	tDCPEN	ACRO	ACRY	NAPH	BaP	FORM	ACET	AS	BE	CD	PB	MN	NI	CRVI
04-013-9997	Phoenix, AZ	---	---	5 (11)	11.8 (2)	---	---	0.5 (7)	1 (7)	---	---	---	---	---	---	5.6 (14)
06-065-8001	Rubidoux, CA	---	---	---	---	3.9 (11)	1.6 (2)	---	---	---	---	---	---	---	---	---
06-085-0005	San Jose, CA	---	---	---	---	---	---	0.4 (8)	0.6 (8)	---	---	---	---	---	---	---
08-077-0017	Grand Junction, CO	---	---	---	---	---	---	---	---	---	---	---	---	---	---	4.4 (9)
08-077-0018	Grand Junction, CO	---	---	38.7 (10	---	---	---	1.5 (12)	1.3 (12)	---	---	---	---	---	---	---
11-001-0043	Washington, DC	---	---	---	---	---	---	---	---	---	---	---	---	---	---	9.5 (6)
12-057-3002	Hillsborough County, FL	---	---	---	---	3.7 (12)	2.9 (1)	5.4 (12)	7 (12)	---	---	---	---	---	---	4.7 (9)
12-103-0026	Pinellas County, FL	3.4 (6)	3.4 (1)	13.8 (31	19.4 (65	---	---	1.4 (12)	2.2 (12)	---	---	---	---	---	---	13.3 (11
13-089-0002	Decatur, GA	---	---	---	---	2.5 (10)	6.9 (2)	---	---	---	---	---	---	---	---	8.8 (7)
17-031-4201	Northbrook, IL	---	---	5.6 (16)	---	---	---	0.9 (13)	0.7 (13)	1.8 (54)	6.5 (31)	1.6 (30)	4 (52)	3.7 (54)	2.2 (8)	6 (14)
21-043-0500	Grayson Lake, KY	---	---	4.2 (8)	---	---	---	---	---	---	---	---	---	---	---	7.7 (8)
25-025-0042	Boston, MA	---	---	---	---	---	---	---	---	2.5 (72)	10.9 (37	7.1 (70)	1.5 (70)	1.2 (72)	0.9 (9)	5.4 (6)
26-163-0033	Dearborn, MI	---	---	6.7 (11)	---	1.3 (12)	4 (10)	0.5 (11)	0.4 (11)	---	---	---	---	---	---	6.1 (9)
29-510-0085	St. Louis, MO	---	---	26.7 (8)	---	---	---	1.9 (12)	1.8 (12)	1.1 (22)	8.5 (20)	5 (22)	1.4 (18)	2.2 (22)	---	4.8 (10)
36-005-0110	Bronx, NY	---	---	---	---	---	---	---	---	---	---	---	---	---	---	6.5 (6)
36-055-1007	Rochester, NY	---	---	---	---	---	---	---	---	---	---	---	---	---	---	7.6 (9)
44-007-0022	Providence, RI	---	---	---	---	---	---	---	---	---	---	---	---	---	---	4.6 (8)
45-025-0001	Chesterfield, SC	---	---	---	---	---	---	---	---	---	---	---	---	---	---	9.8 (3)
48-201-1039	Deer Park, TX	---	---	---	---	---	---	---	---	---	---	---	---	---	---	5.6 (8)
49-011-0004	Bountiful, UT	---	---	25.4 (10	---	---	---	64.2 (12	64.4 (12	---	---	---	---	---	---	4.5 (13)
50-007-0007	Underhill, VT	---	---	---	---	---	---	---	---	9.2 (10)	---	0 (12)	3 (12)	3.2 (12)	5.7 (12)	3 (6)
51-087-0014	Richmond, VA	---	---	---	---	---	---	---	---	---	---	---	---	---	---	6.2 (7)
53-033-0080	Seattle, WA	---	---	6.3 (12)	---	2.2 (12)	3 (2)	0.5 (12)	0.4 (12)	---	---	---	---	---	---	6.2 (12)
55-027-0001	Horicon, WI	---	---	---	---	---	---	---	---	---	---	---	---	---	---	6.6 (8)
	Overall Mean	3.4 (6)	3.4 (1)	17.3 (117)	19.2 (67)	2.9 (57)	4.1 (17)	21.2 (111)	21.3 (111)	3.1 (158)	9 (88)	5.6 (134)	2.7 (152)	2.6 (160)	3.9 (29)	6.8 (183)

[a] Expressed as percentage coefficient of variation (%CV) with number of contributing data pairs presented in parentheses. Metals results are reported at STP at most sites and LC at others.
[b] Sample not collected or analyte not reported.
[c] Across all sites.

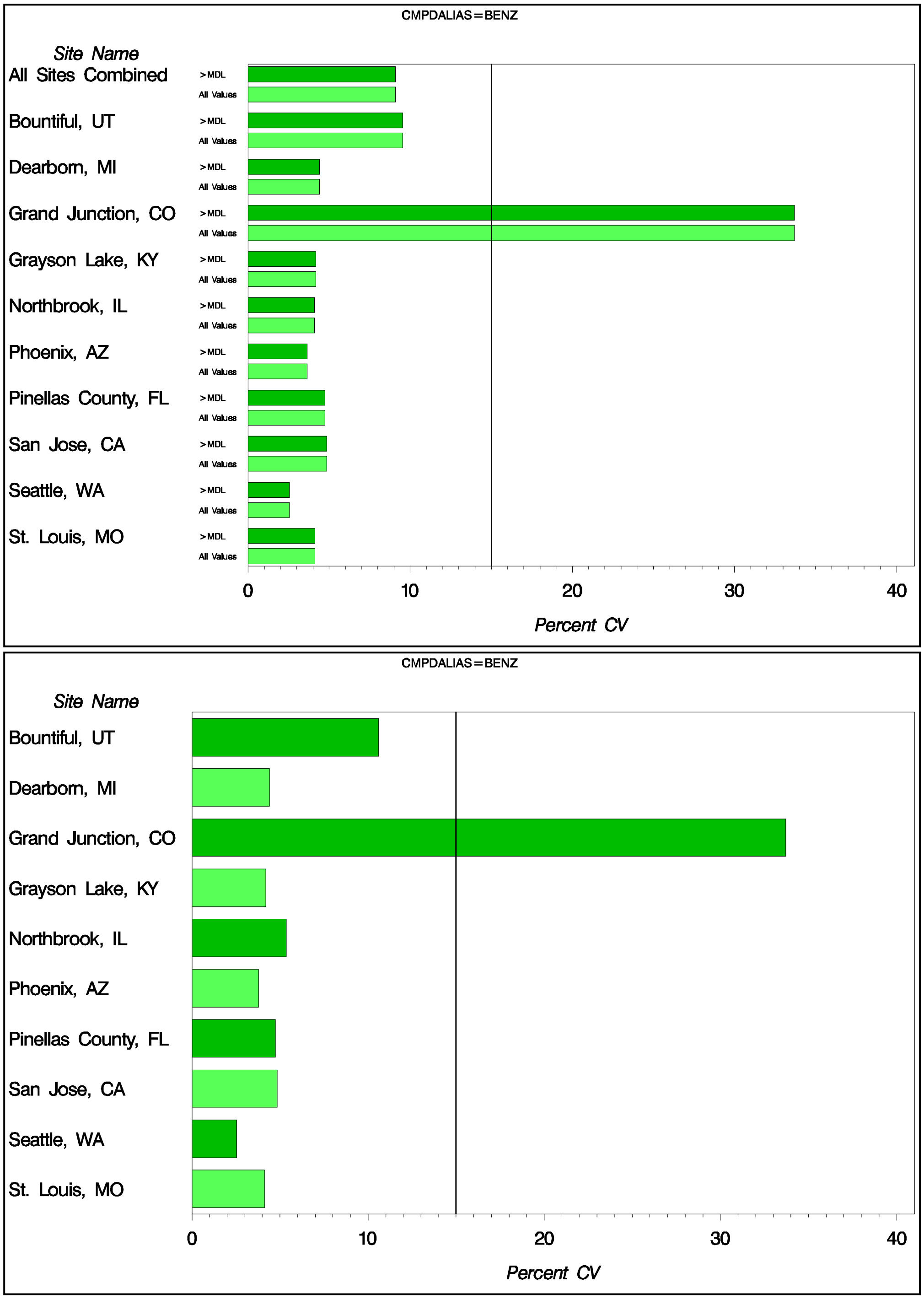
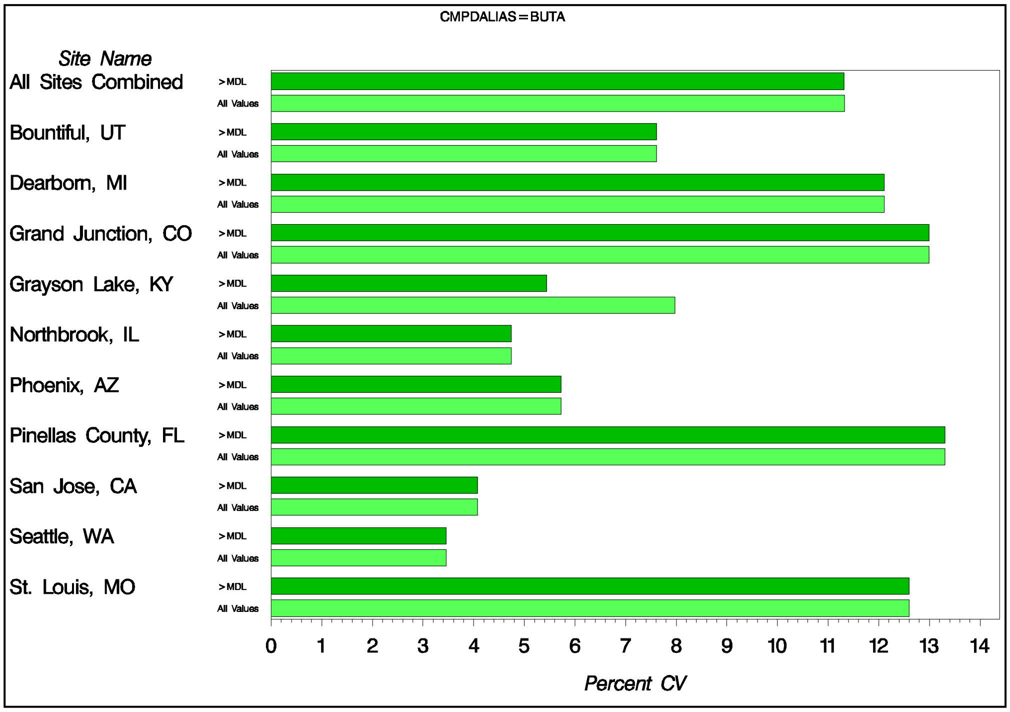


Figure 15. Analytical Precision Summary for Benzene at NATTS Sample Collection Sites in 2010 (MQO reference indicated at 15%).



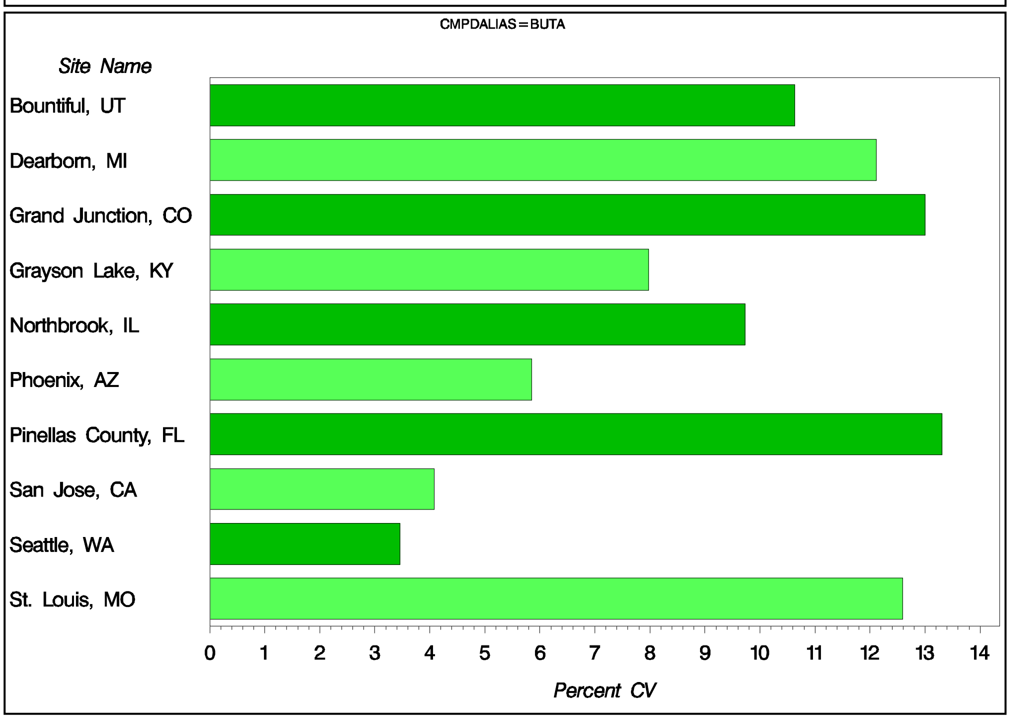


Figure 16. Analytical Precision Summary for 1,3-Butadiene at NATTS Sample Collection Sites in 2010.

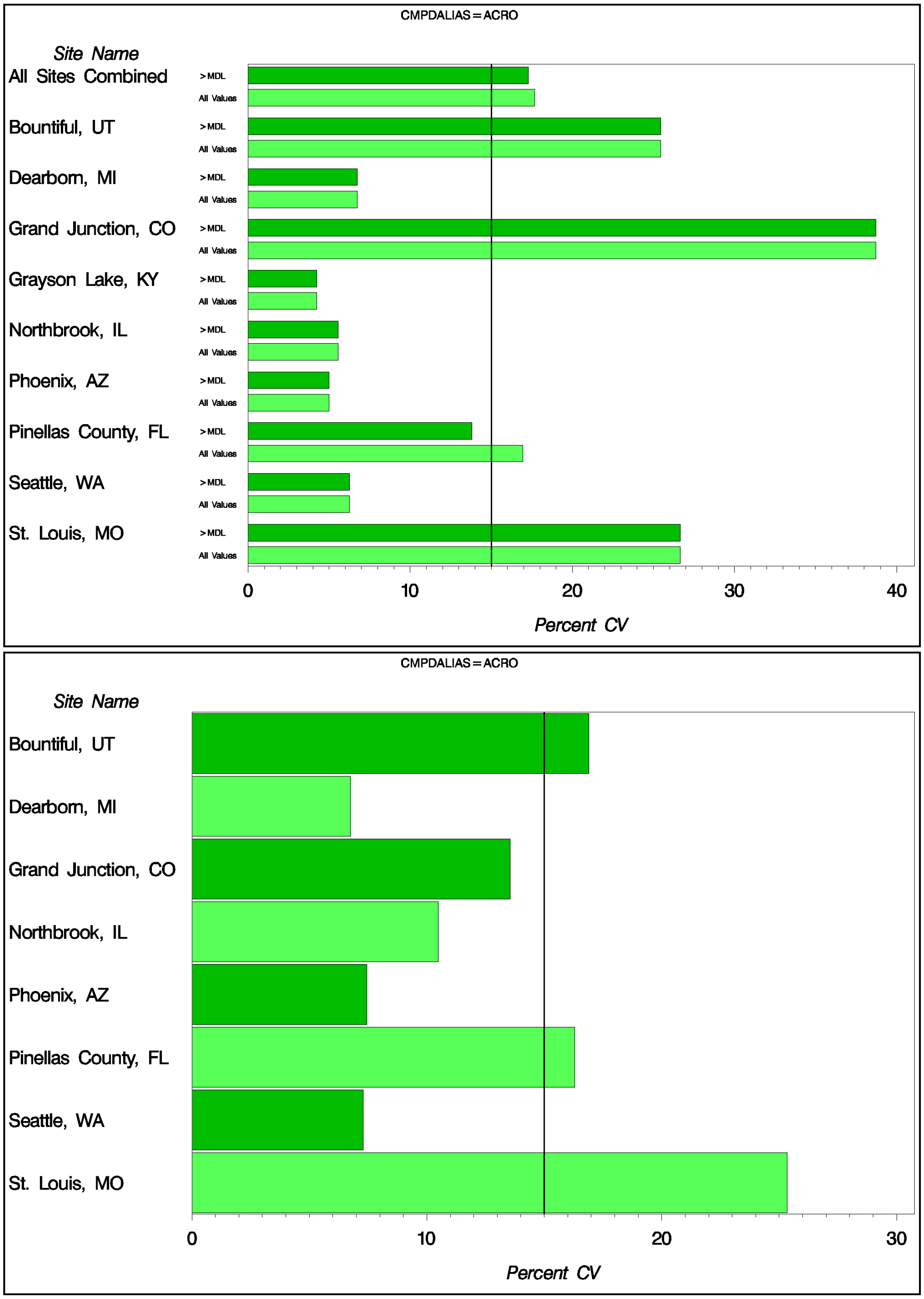
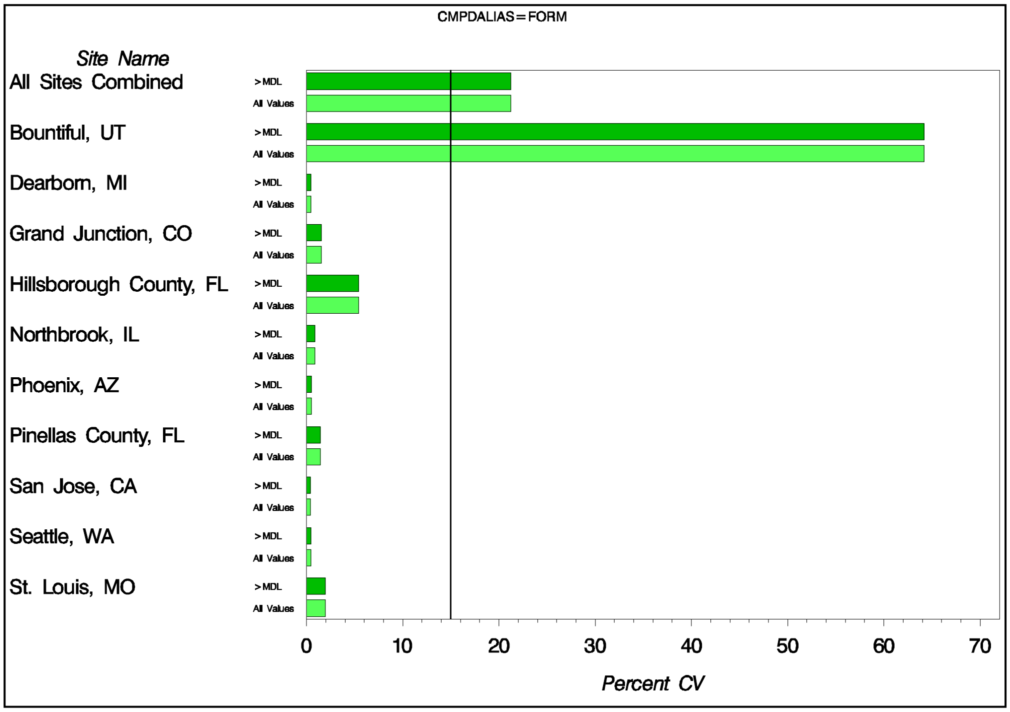


Figure 17. Analytical Precision Summary for Acrolein at NATTS Sample Collection Sites in 2010 (MQO reference indicated at 15%).



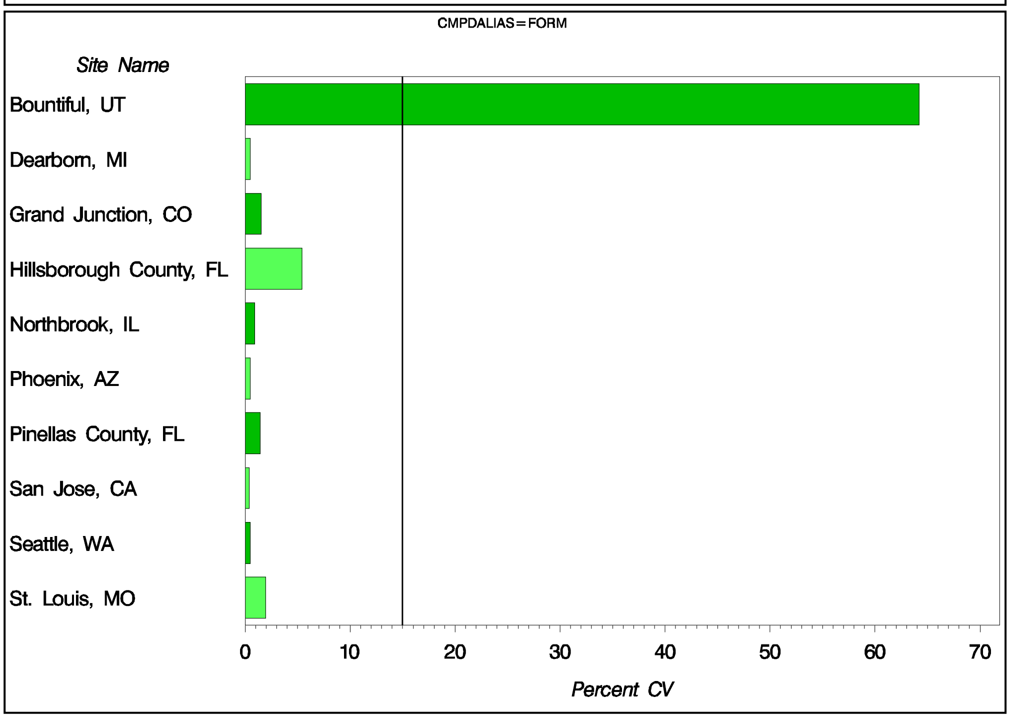


Figure 18. Analytical Precision Summary for Formaldehyde at NATTS Sample Collection Sites in 2010 (MQO reference indicated at 15%).

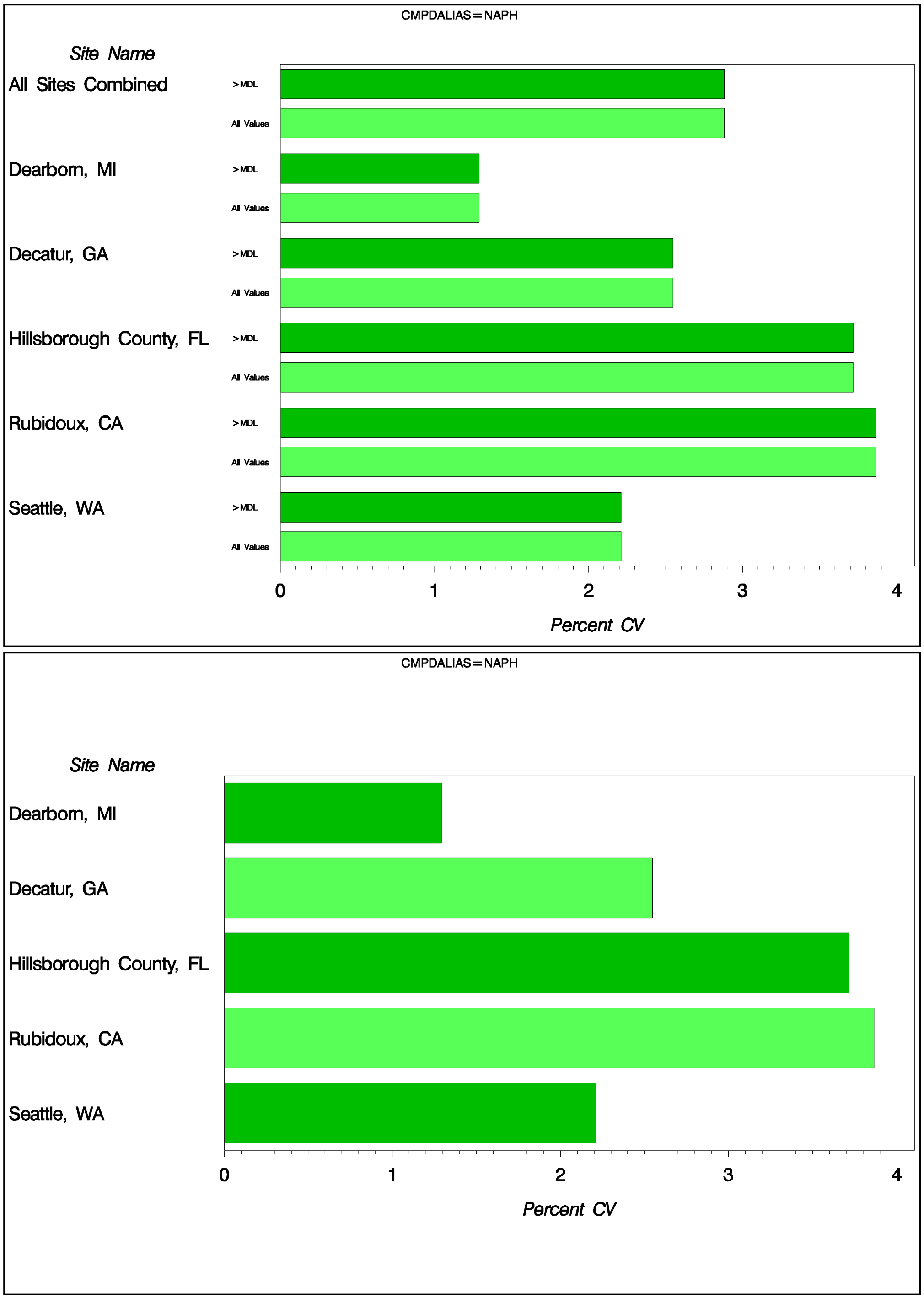


Figure 19. Analytical Precision Summary for Naphthalene at NATTS Sample Collection Sites in 2010.

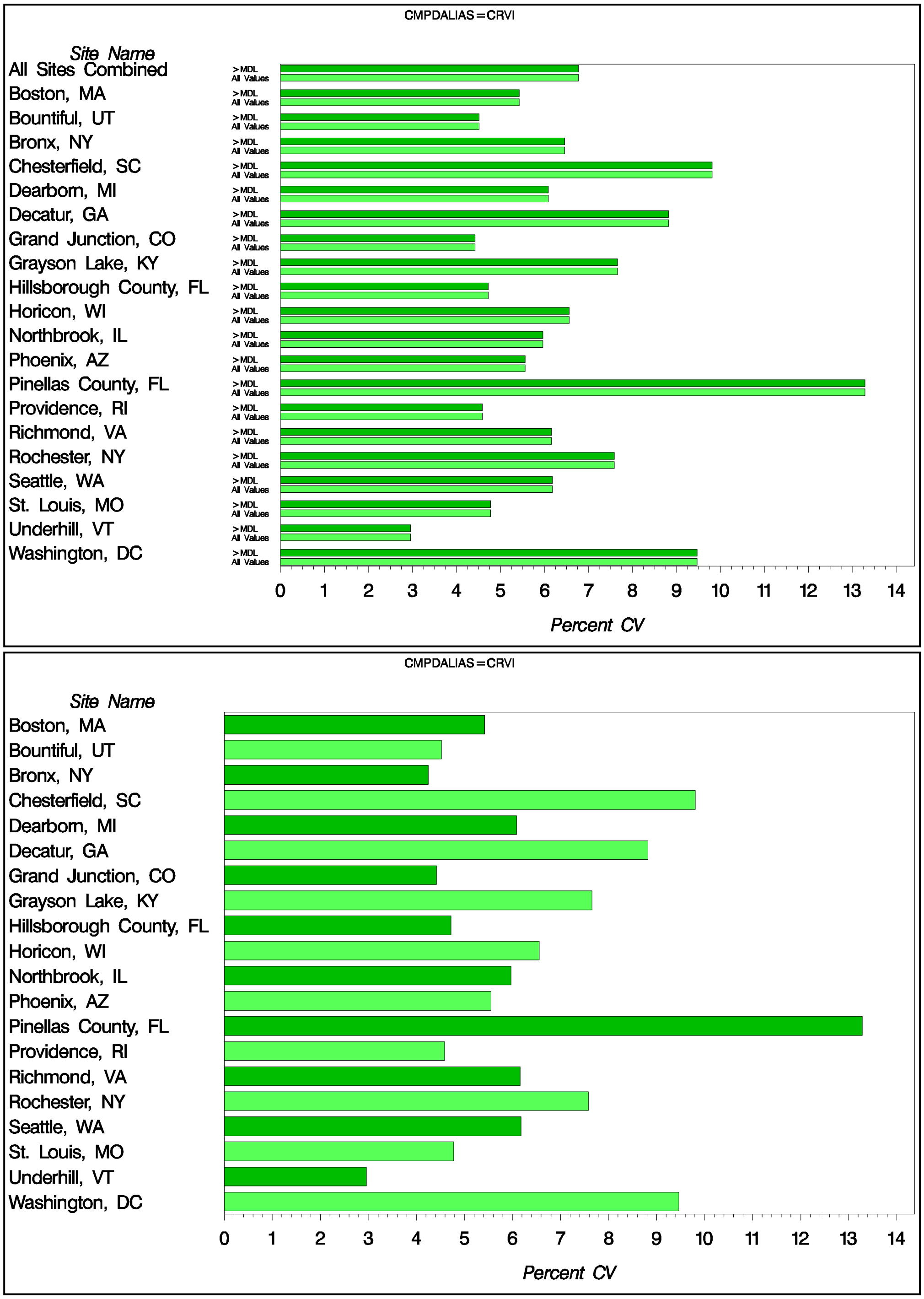


Figure 20. Analytical Precision Summary for Chromium (VI) at NATTS Sample Collection Sites in 2010.

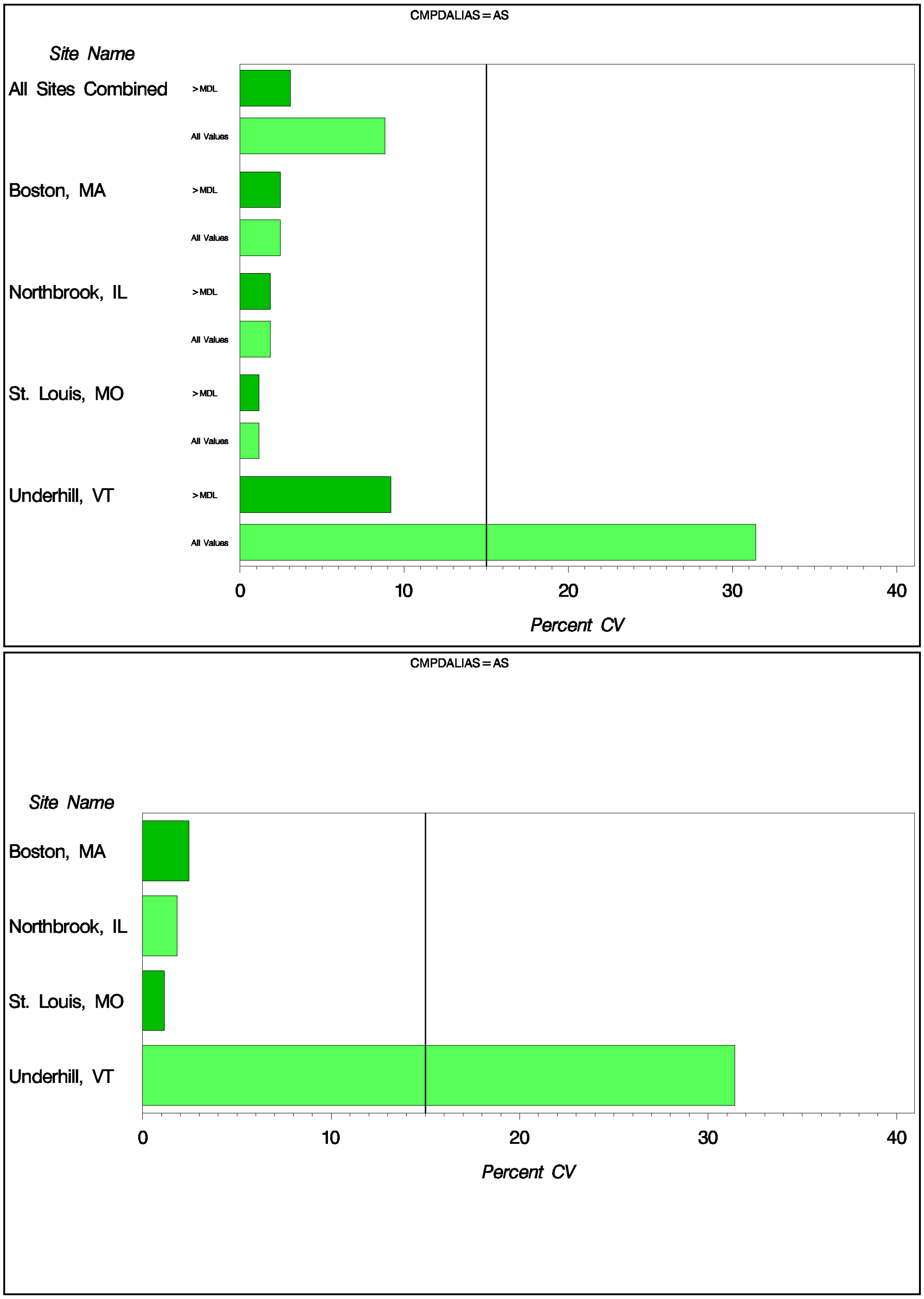


Figure 21. Analytical Precision Summary for Arsenic at NATTS Sample Collection Sites in 2010 (MQO reference indicated at 15%).

2.3.2 Overall Precision Results

Overall precision was computed from the results of the primary, duplicate, and collocated samples extracted from RD records in the AQS database. This measure of agreement, expressed as the % CV, is defined algebraically in Eq. 2:

$$\%CV = 100 \cdot \sqrt{\frac{\sum_{i=1}^{n} \left[\frac{(p_i - r_i)}{0.5 \cdot (p_i + r_i)} \right]^2}{2n}} \qquad \text{(Eq. 2)}$$

where

p_i = the result of the principal analysis on primary sample i,

r_i = the result of the principal analysis on collocated sample i, and

n = the number of primary-collocated sample pairs.

The overall precision results for samples collected in CY2010 are presented in **Table 10** and summarized graphically in **Figures 22** through **28**. For cases where either the primary or collocated sample yielded a result of zero, the data pairs were excluded from the overall precision estimate. All data pairs with reported values were included in the computation.

Examination of **Figures 22** through **28** reveals that aggregate precision associated with sample collection and analysis varies substantially by collection site and analyte significantly greater than the analytical variability shown in **Figures 15** through **21**. Although, some of this variability may be attributable to one or more extreme values, substantial effort would be needed to determine the extent of this impact. The fact that many sites exhibit percentage CVs above the MQO target level points to a collection methodology contribution to the overall variability. With the exception of acrolein where only two sites achieved the MQO in 2010, the distribution of precisions among sites and analytes shows that the 15% threshold is a reasonable target for the MQO. Without identifying specific sites, the percentages of reporting sites with percentage CV above the MQO threshold are 19%, 69%, 79%, 29%, 43%, 50%, and 50% for benzene, 1, 3-butadiene, acrolein, formaldehyde, naphthalene, chromium (VI), and arsenic, respectively. These percentages are consistent with variations in collection and analysis challenges posed by different analytes, with more problematic analytes (e.g., butadiene, and acrolein) showing poorer attainment of the MQO. That fact notwithstanding, the percentage CVs computed across sites by analyte shown in **Table 11**(all measurements) and **Table 12** (measurements above method detection limits) may be influenced by atypically large CVs at selected sites. Previous NATTS QA reports [4, 5, 6, and 7] warned of the danger of extracting duplicate and collocated results using only the RP records. For that reason—and despite the considerable difficulty in determining the specific primary, duplicate, and collocated POCs for each site—the data presented here are based primarily on the RD records. The two exceptions were the duplicate data for VOCs from the Washington, DC and Pinellas County, FL sites that were uploaded to AQS only as RP records and were, therefore, extracted as such.

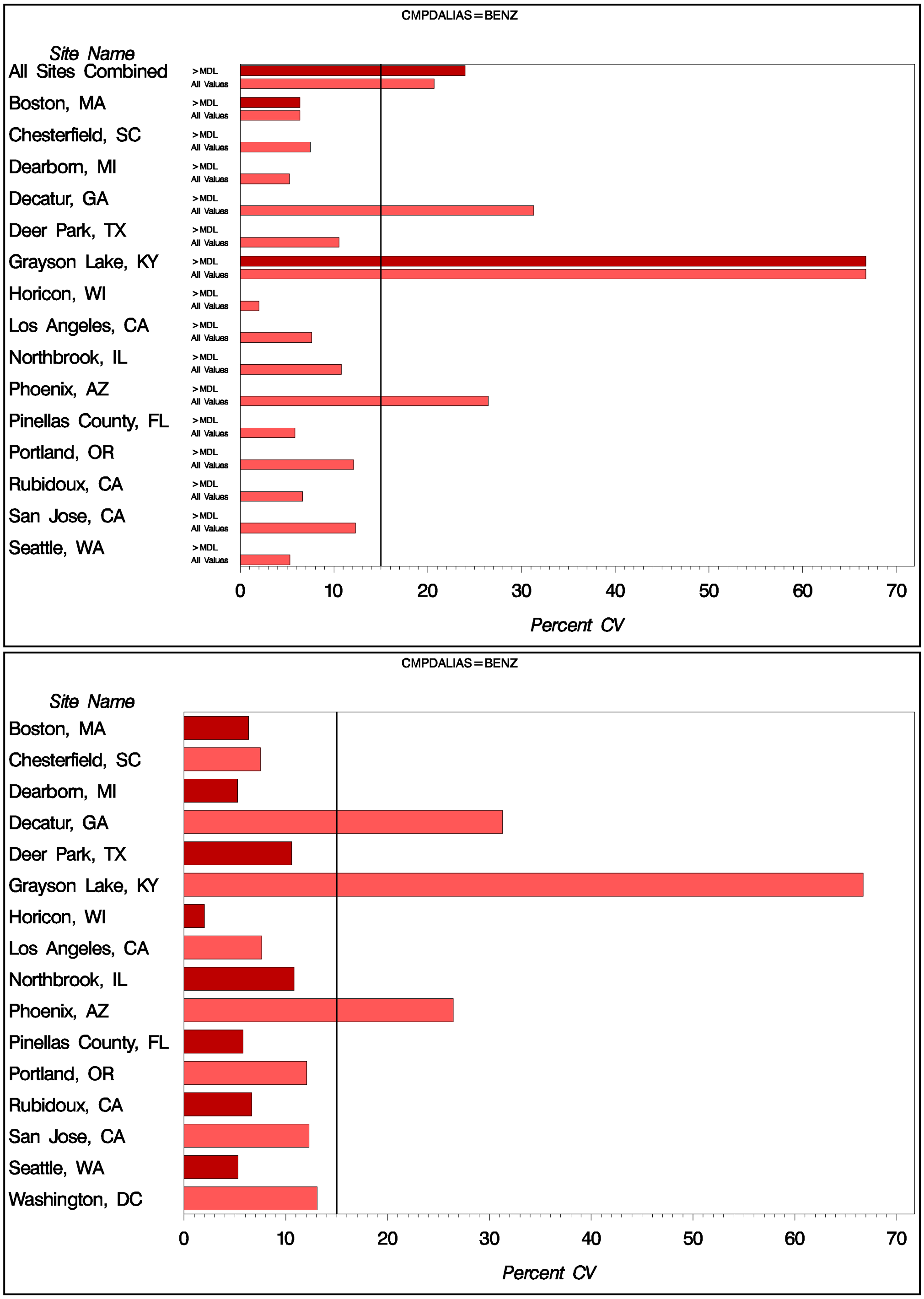


Figure 22. Overall Precision Summary for Benzene at NATTS Sample Collection Sites in 2010 (MQO reference indicated at 15%).

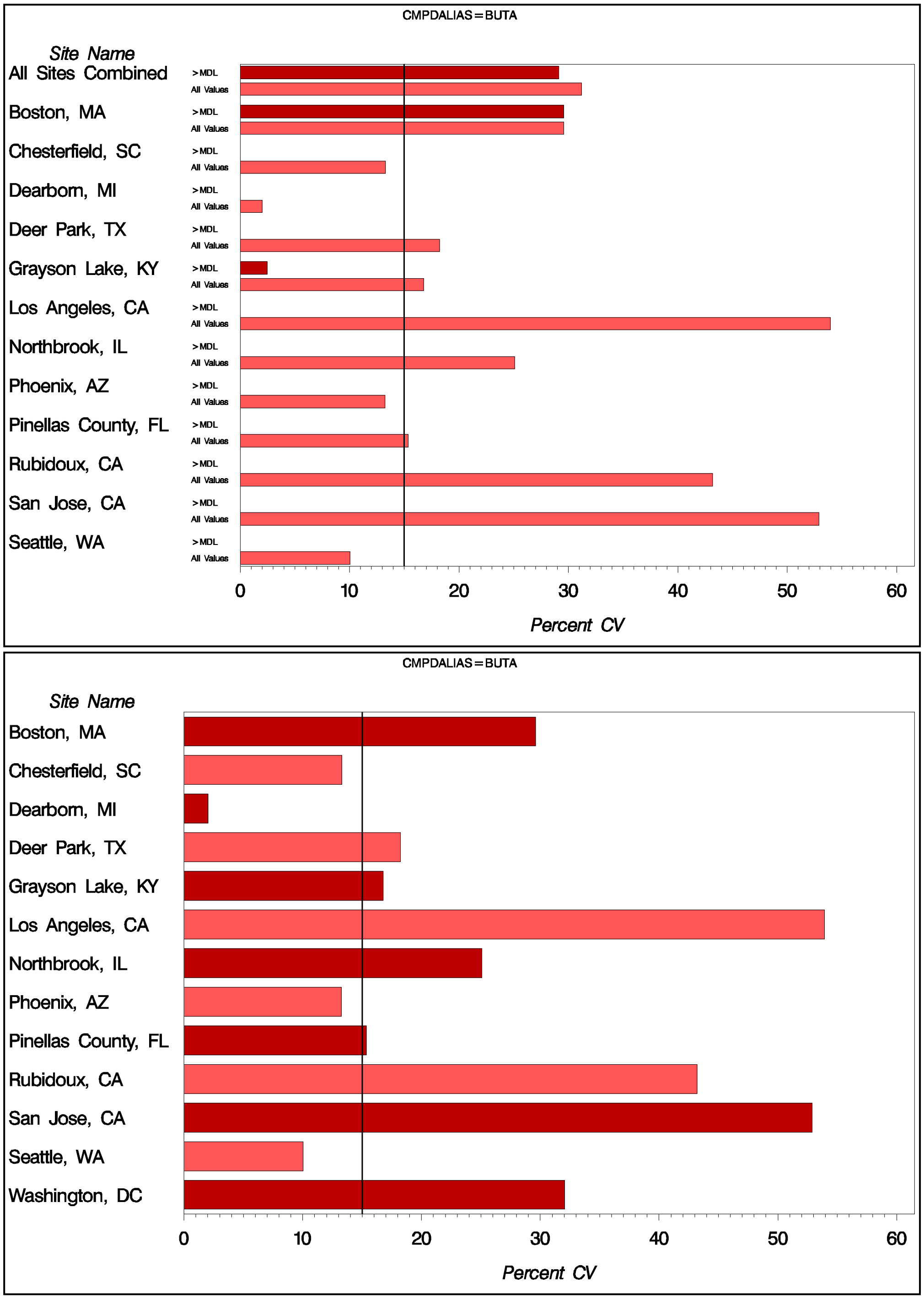


Figure 23. Overall Precision Summary for 1, 3-Butadiene at NATTS Sample Collection Sites in 2010 (MQO reference indicated at 15%).

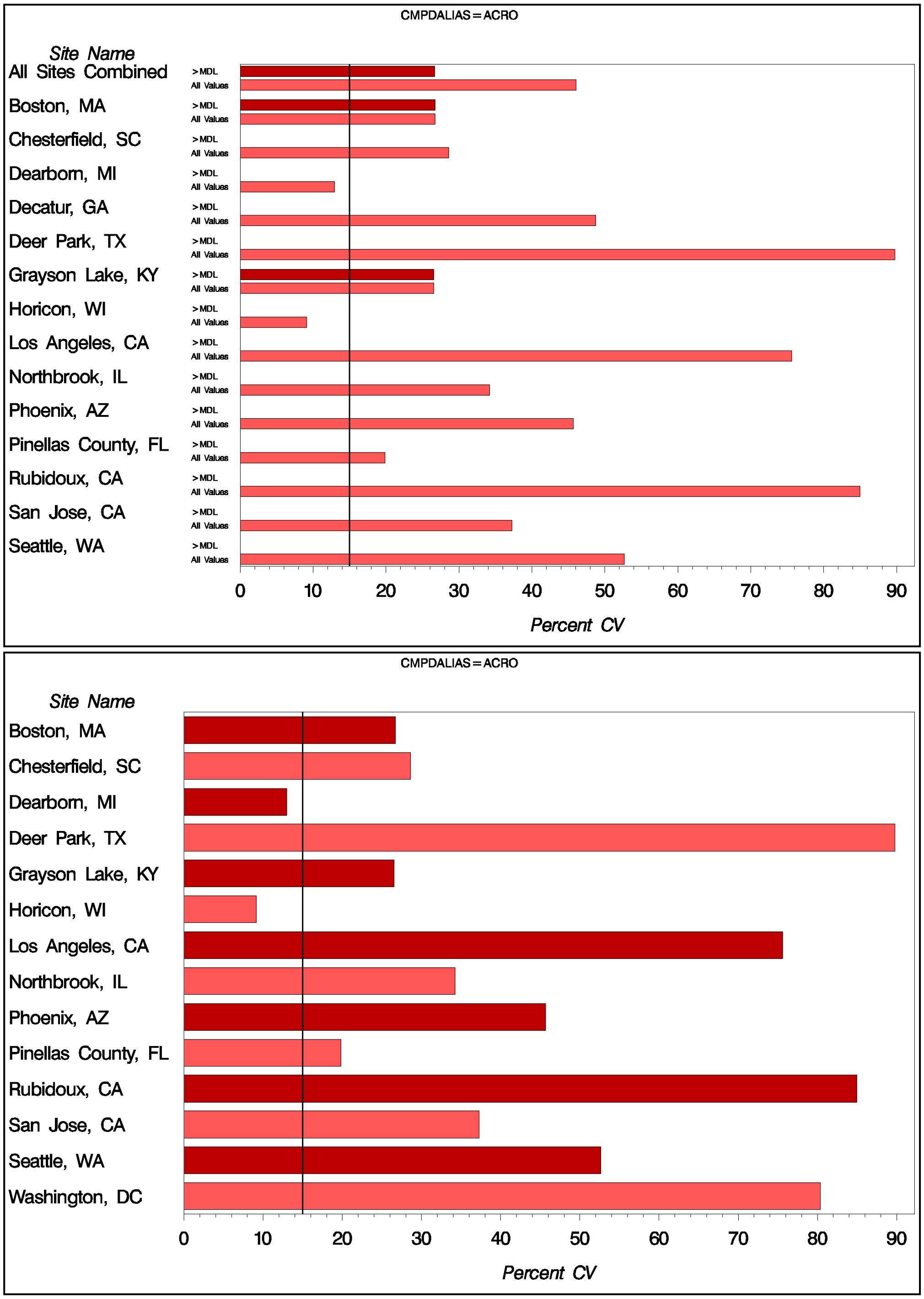


Figure 24. Overall Precision Summary for Acrolein at NATTS Sample Collection Sites in 2010 (MQO reference indicated at 15%).

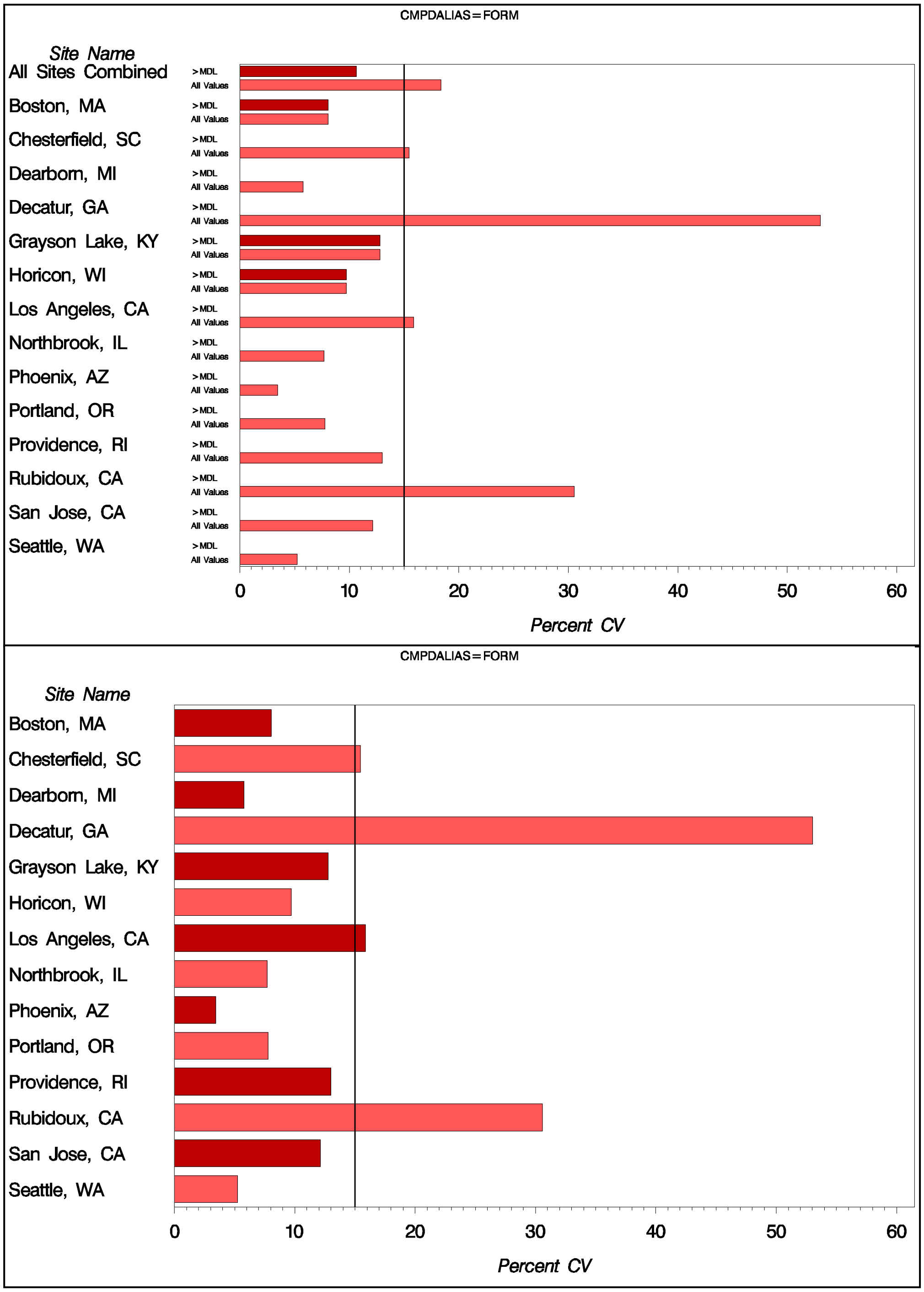


Figure 25. Overall Precision Summary for Formaldehyde at NATTS Sample Collection Sites in 2010 (MQO reference indicated at 15%).

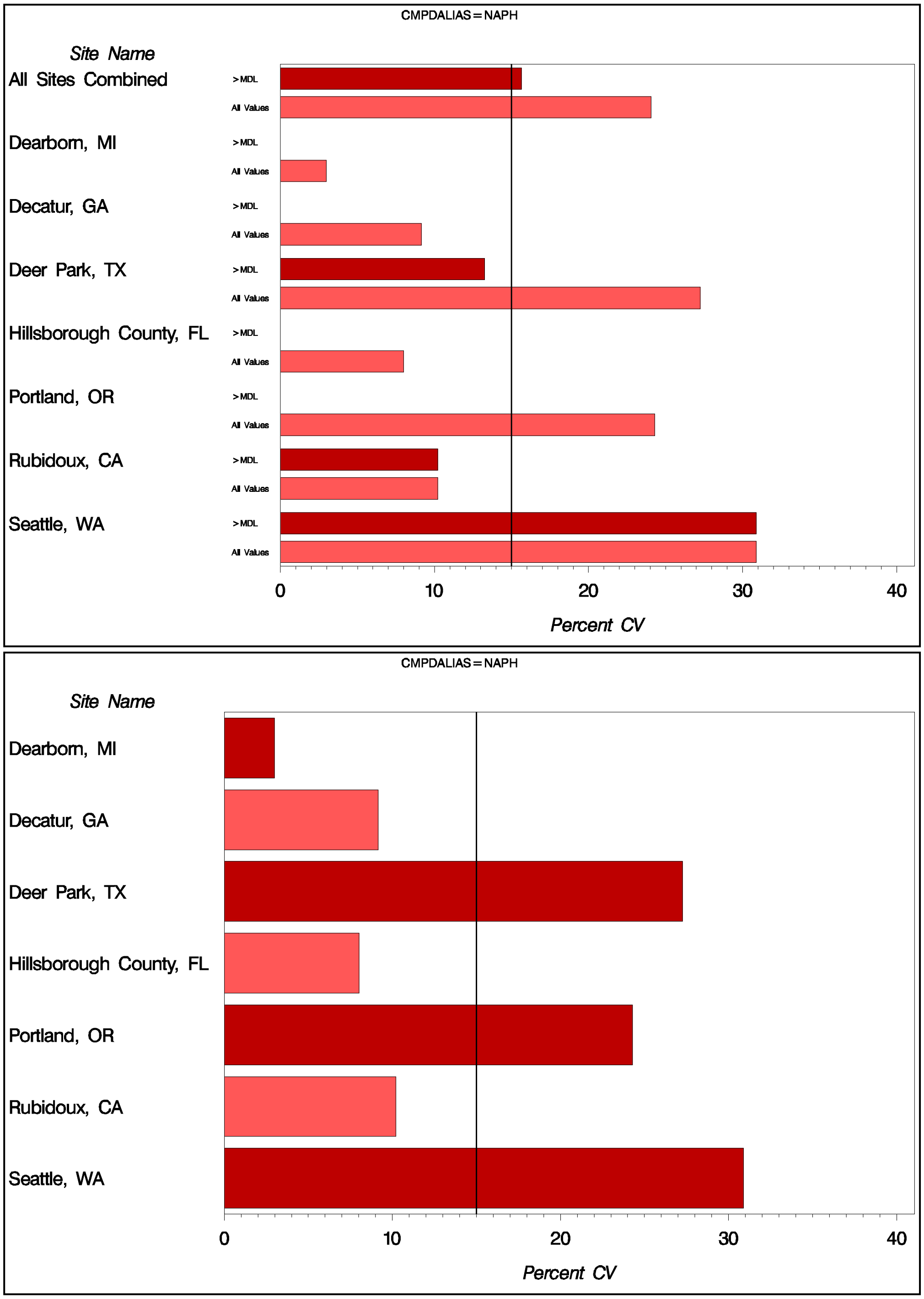
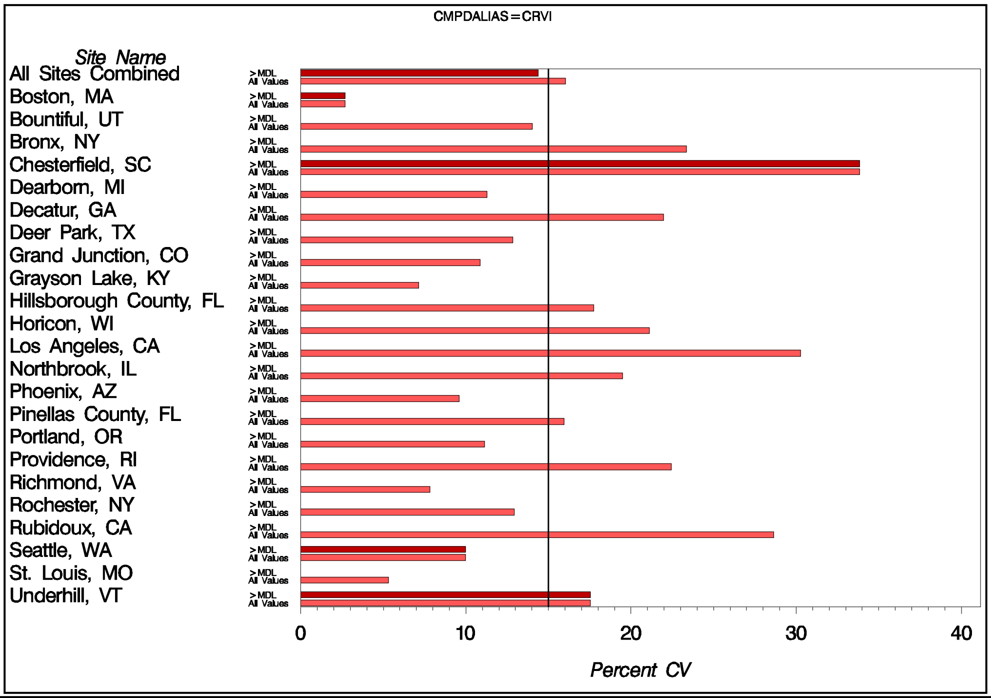


Figure 26. Overall Precision Summary for Naphthalene at NATTS Sample Collection Sites in 2010 (MQO reference indicated at 15%).



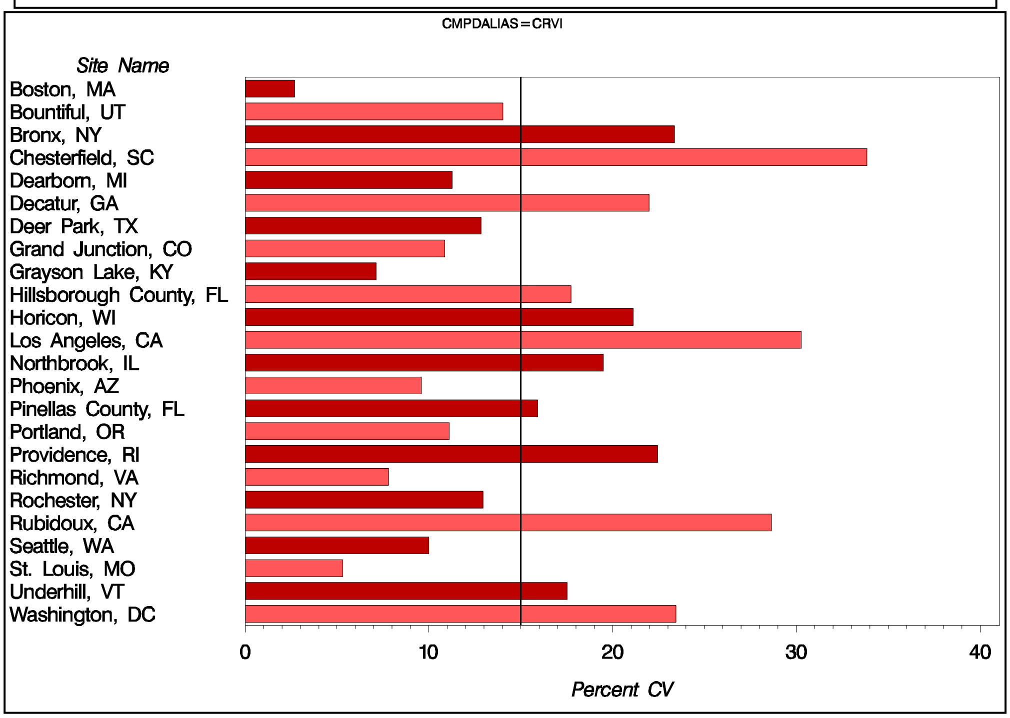


Figure 27. Overall Precision Summary for Chromium (VI) at NATTS Sample Collection Sites in 2010 (MQO reference indicated at 15%).

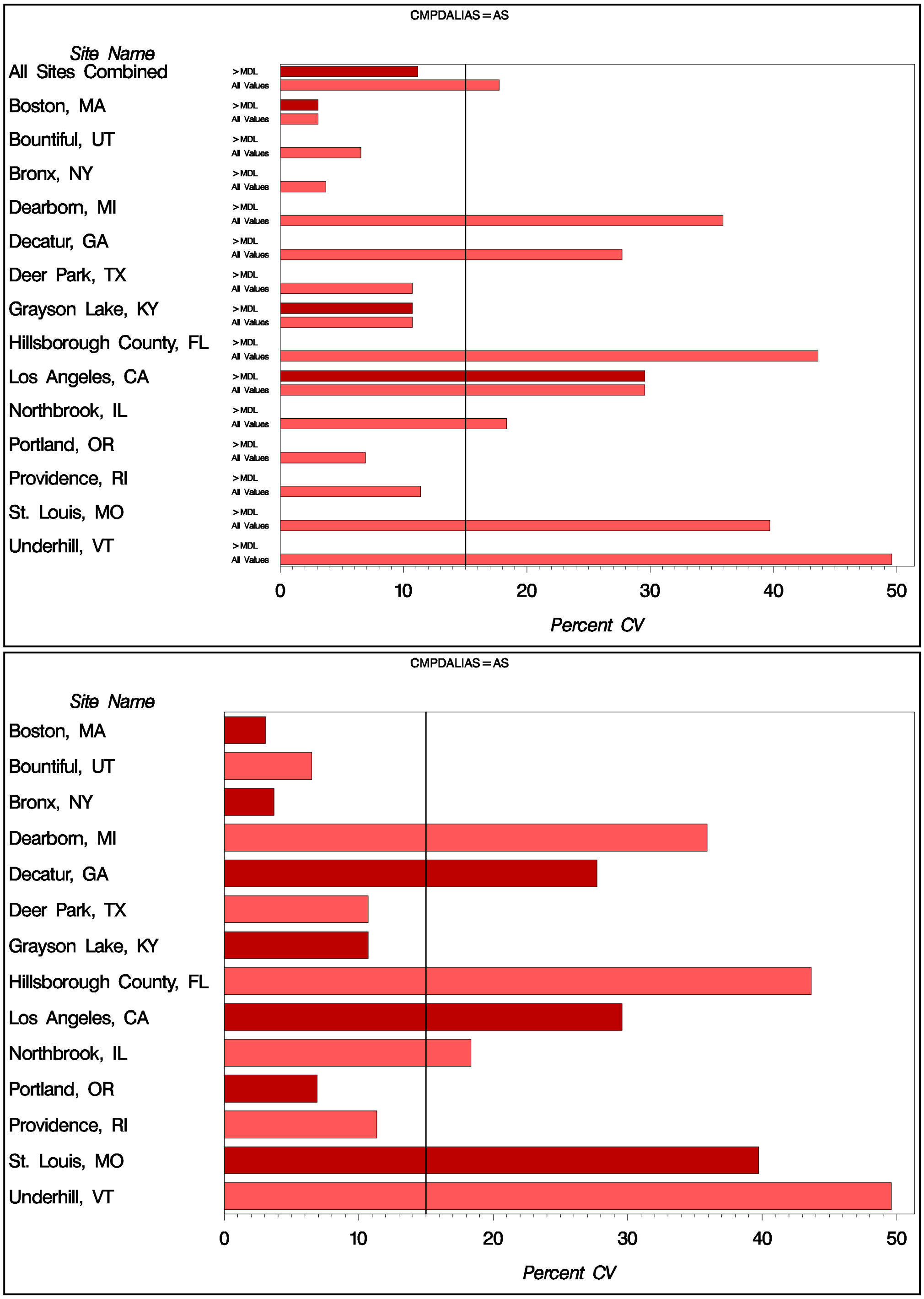


Figure 28. Overall Precision Summary for Arsenic at NATTS Sample Collection Sites in 2010 (MQO reference indicated at 15%).

Unlike analytical precision, overall precision shows a much greater proportion of values where at least one of the measurements was zero, with CVs calculable only for the “All Values” cases for many site-analyte combinations. Where both CVs are shown, however, the CV attributable to the “All Values” case was either equal to or greater than the CV computed from values above the method detection limit.

Table 11. Overall Precision[a] for Primary and Collocated Samples from 2010: All Non-Zero Measurements Included.

AQS Site Code	Site Description	Duplicate Type	BENZ	BUTA	CTET	CLFRM	EDB	DCP	EDC	MECL	TCE1122	PERC	TCE	VCM
04-013-9997	Phoenix, AZ	Collocate	26.4 (6)	13.2 (5)	9.3 (6)	9.1 (6)	---	---	---	58.3 (6)	---	8.4 (6)	---	---
04-013-9997	Phoenix, AZ	Duplicate	---	---	---	---	---	---	---	---	---	---	---	---
06-037-1103	Los Angeles, CA	Collocate	7.6 (23)	53.9 (21)	10.7 (23)	14.7 (23)	---	---	---	40.6 (23)	---	24.5 (22)	35.4 (20)	---
06-037-1103	Los Angeles, CA	Duplicate	---	---	---	---	---	---	---	---	---	---	---	---
06-065-8001	Rubidoux, CA	Collocate	6.7 (24)	43.2 (22)	11.7 (22)	22.8 (24)	---	---	---	49.9 (24)	---	19.1 (21)	1.2 (4)	---
06-065-8001	Rubidoux, CA	Duplicate	---	---	---	---	---	---	---	---	---	---	---	---
06-085-0005	San Jose, CA	Collocate	12.3 (27)	52.9 (4)	19.8 (25)	37.2 (25)	---	---	---	40.8 (25)	---	36.4 (27)	33.3 (23)	---
06-085-0005	San Jose, CA	Duplicate	---	---	---	---	---	---	---	---	---	---	---	---
08-077-0017	Grand Junction, CO	Collocate	---	---	---	---	---	---	---	---	---	---	---	---
08-077-0017	Grand Junction, CO	Duplicate	---	---	---	---	---	---	---	---	---	---	---	---
08-077-0018	Grand Junction, CO	Collocate	---	---	---	---	---	---	---	---	---	---	---	---
08-077-0018	Grand Junction, CO	Duplicate	---	---	---	---	---	---	---	---	---	---	---	---
12-057-3002	Hillsborough County, FL	Collocate	---	---	---	---	---	---	---	---	---	---	---	---
12-057-3002	Hillsborough County, FL	Duplicate	---	---	---	---	---	---	---	---	---	---	---	---
12-103-0026	Pinellas County, FL	Collocate	5.8 (23)	15.3 (23)	3.8 (23)	14.3 (23)	94.3 (1)	---	10.2 (23)	30.6 (23)	36.9 (4)	10.9 (23)	11.9 (4)	---
12-103-0026	Pinellas County, FL	Duplicate	---	---	---	---	---	---	---	---	---	---	---	---
13-089-0002	Decatur, GA	Collocate	31.3 (60)	---	12.6 (11)	0 (1)	---	---	---	8.3 (2)	---	47.3 (2)	---	---
13-089-0002	Decatur, GA	Duplicate	---	---	---	---	---	---	---	---	---	---	---	---
17-031-4201	Northbrook, IL	Collocate	10.8 (7)	25.1 (4)	10.5 (7)	66.4 (7)	---	---	0 (1)	52.5 (7)	---	21.1 (7)	2 (3)	---
17-031-4201	Northbrook, IL	Duplicate	---	---	---	---	---	---	---	---	---	---	---	---
21-043-0500	Grayson Lake, KY	Collocate	---	---	---	---	---	---	---	---	---	---	---	---
21-043-0500	Grayson Lake, KY	Duplicate	66.7 (4)	16.8 (2)	33.9 (4)	5.9 (2)	---	---	---	33.4 (4)	---	16.5 (3)	---	---
25-025-0042	Boston, MA	Collocate	---	---	---	---	---	---	---	---	---	---	---	---
25-025-0042	Boston, MA	Duplicate	6.3 (29)	29.6 (29)	4.5 (29)	5.7 (29)	---[b]	11.2 (18)	8.4 (29)	23.9 (29)	---	8.3 (29)	16.4 (27)	10.1 (4)
26-163-0033	Dearborn, MI	Collocate	5.2 (6)	2 (6)	6.1 (6)	45.8 (6)	---	---	12.1 (1)	33.8 (6)	---	1.7 (5)	3.9 (2)	---
26-163-0033	Dearborn, MI	Duplicate	---	---	---	---	---	---	---	---	---	---	---	---
29-510-0085	St. Louis, MO	Collocate	---	---	---	---	---	---	---	---	---	---	---	---
29-510-0085	St. Louis, MO	Duplicate	---	---	---	---	---	---	---	---	---	---	---	---

AQS Site Code	Site Description	Duplicate Type	BENZ	BUTA	CTET	CLFRM	EDB	DCP	EDC	MECL	TCE1122	PERC	TCE	VCM
36-005-0110	Bronx, NY	Collocate	---	---	---	---	---	---	---	---	---	---	---	---
36-005-0110	Bronx, NY	Duplicate	---	---	---	---	---	---	---	---	---	---	---	---
36-055-1007	Rochester, NY	Collocate	---	---	---	---	---	---	---	---	---	---	---	---
36-055-1007	Rochester, NY	Duplicate	---	---	---	---	---	---	---	---	---	---	---	---
41-051-0246	Portland, OR	Collocate	12.1 (14)	---	0 (1)	0 (1)	---	---	---	39.1 (7)	---	10.9 (1)	---	---
41-051-0246	Portland, OR	Duplicate	---	---	---	---	---	---	---	---	---	---	---	---
41-061-0119	La Grande, OR	Collocate	---	---	---	---	---	---	---	---	---	---	---	---
41-061-0119	La Grande, OR	Duplicate	---	---	---	---	---	---	---	---	---	---	---	---
44-007-0022	Providence, RI	Collocate	---	---	---	---	---	---	---	---	---	---	---	---
44-007-0022	Providence, RI	Duplicate	---	---	---	---	---	---	---	---	---	---	---	---
45-025-0001	Chesterfield, SC	Collocate	7.5 (12)	13.3 (10)	3.8 (8)	49.1 (3)	---	---	---	44.4 (12)	0 (1)	---	---	---
45-025-0001	Chesterfield, SC	Duplicate	---	---	---	---	---	---	---	---	---	---	---	---
48-201-1039	Deer Park, TX	Collocate	10.6 (55)	18.2 (16)	8.4 (54)	11.9 (50)	---	28.3 (1)	10.6 (11)	15.9 (50)	47.1 (1)	18 (37)	10.7 (7)	20.5 (11)
48-201-1039	Deer Park, TX	Duplicate	---	---	---	---	---	---	---	---	---	---	---	---
48-203-0002	Harrison County, TX	Collocate	---	---	---	---	---	---	---	---	---	---	---	---
48-203-0002	Harrison County, TX	Duplicate	---	---	---	---	---	---	---	---	---	---	---	---
49-011-0004	Bountiful, UT	Collocate	---	---	---	---	---	---	---	---	---	---	---	---
49-011-0004	Bountiful, UT	Duplicate	---	---	---	---	---	---	---	---	---	---	---	---
50-007-0007	Underhill, VT	Collocate	---	---	---	---	---	---	---	---	---	---	---	---
50-007-0007	Underhill, VT	Duplicate	---	---	---	---	---	---	---	---	---	---	---	---
51-087-0014	Richmond, VA	Collocate	---	---	---	---	---	---	---	---	---	---	---	---
51-087-0014	Richmond, VA	Duplicate	---	---	---	---	---	---	---	---	---	---	---	---
53-033-0080	Seattle, WA	Collocate	5.3 (6)	10 (5)	6.9 (6)	19.5 (6)	---	---	7.1 (1)	42 (6)	---	5.3 (5)	---	---
53-033-0080	Seattle, WA	Duplicate	---	---	---	---	---	---	---	---	---	---	---	---
55-027-0001	Horicon, WI	Collocate	2 (2)	---	---	0 (1)	---	---	0 (1)	45 (3)	---	---	---	---
55-027-0001	Horicon, WI	Duplicate	---	---	---	---	---	---	---	---	---	---	---	---
	Overall Mean[c]	*All Dups.*	24 (33)	28.9 (31)	12.5 (33)	5.8 (31)	---	11.2 (18)	8.4 (29)	25.2 (33)	---	9.4 (32)	16.4 (27)	10.1 (4)

Table 11. Overall Precision[a] for Primary and Collocated Samples from 2010: All Non-Zero Measurements Included (continued).

AQS Site Code	Site Description	Duplicate Type	cDCPEN	tDCPEN	ACRO	ACRY	NAPH	BaP	FORM	ACET	AS	BE	CD	PB	MN	NI	CRVI
04-013-9997	Phoenix, AZ	Collocate	---	---	45.7 (6)	---	---	---	3.4 (1)	2.7 (1)	---	---	---	---	---	---	9.6 (7)
04-013-9997	Phoenix, AZ	Duplicate	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
06-037-1103	Los Angeles, CA	Collocate	---	---	75.6 (22)	---	---	---	15.9 (16)	19.3 (16)	---	---	---	---	---	---	30.3 (6)
06-037-1103	Los Angeles, CA	Duplicate	---	---	---	---	---	---	---	---	29.6 (6)	---	48.1 (6)	15.1 (6)	21.2 (6)	19.2 (6)	---
06-065-8001	Rubidoux, CA	Collocate	---	---	84.9 (23)	---	---	---	30.6 (29)	21.9 (29)	---	---	---	---	---	---	28.6 (6)
06-065-8001	Rubidoux, CA	Duplicate	---	---	---	---	10.2 (5)	23.5 (2)	---	---	---	---	---	---	---	---	---
06-085-0005	San Jose, CA	Collocate	---	---	37.3 (28)	---	---	---	12.1 (29)	11.3 (29)	---	---	---	---	---	---	---
06-085-0005	San Jose, CA	Duplicate	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
08-077-0017	Grand Junction, CO	Collocate	---	---	---	---	---	---	---	---	---	---	---	---	---	---	10.9 (4)
08-077-0017	Grand Junction, CO	Duplicate	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
08-077-0018	Grand Junction, CO	Collocate	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
08-077-0018	Grand Junction, CO	Duplicate	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
12-057-3002	Hillsborough County, FL	Collocate	---	---	---	---	8 (6)	24.7 (1)	---	---	43.6 (15)	0 (15)	35.2 (15)	1.7 (15)	5.2 (15)	58 (15)	17.7 (4)
12-057-3002	Hillsborough County, FL	Duplicate	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
12-103-0026	Pinellas County, FL	Collocate	32.6 (1)	12.9 (1)	19.8 (23)	47 (5)	---	---	---	---	---	---	---	---	---	---	15.9 (5)
12-103-0026	Pinellas County, FL	Duplicate	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
13-089-0002	Decatur, GA	Collocate	---	---	48.7 (13)	---	9.1 (6)	10.9 (1)	53 (28)	27.9 (19)	27.7 (26)	0 (1)	35.4 (27)	17.3 (27)	25.5 (27)	41 (27)	22 (3)
13-089-0002	Decatur, GA	Duplicate	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
17-031-4201	Northbrook, IL	Collocate	---	---	34.2 (7)	---	---	---	7.7 (6)	6.9 (6)	18.3 (25)	41.6 (21)	28 (25)	25.7 (25)	22.1 (25)	26.9 (25)	19.5 (7)
17-031-4201	Northbrook, IL	Duplicate	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
21-043-0500	Grayson Lake, KY	Collocate	---	---	---	---	---	---	---	---	---	---	---	---	---	---	7.1 (4)
21-043-0500	Grayson Lake, KY	Duplicate	---	---	26.5 (4)	---	---	---	12.8 (30)	11.7 (29)	10.7 (39)	---	---	5.5 (55)	51.9 (52)	6.9 (7)	---
25-025-0042	Boston, MA	Collocate	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
25-025-0042	Boston, MA	Duplicate	---	---	26.7 (29)	48.5 (18)	---	---	8 (30)	10.9 (30)	3 (36)	41 (30)	23.3 (36)	5 (36)	2.4 (36)	6.8 (36)	2.7 (3)
26-163-0033	Dearborn, MI	Collocate	---	---	13 (5)	---	3 (6)	7.9 (5)	5.8 (4)	7.8 (4)	35.9 (52)	43.3 (48)	37.5 (52)	30.5 (104)	52.8 (53)	46.6 (52)	11.3 (4)
26-163-0033	Dearborn, MI	Duplicate	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
29-510-0085	St. Louis, MO	Collocate	---	---	---	---	---	---	---	---	39.7 (12)	38.1 (11)	17.2 (12)	38.8 (12)	39.5 (12)	7.4 (12)	5.3 (5)
29-510-0085	St. Louis, MO	Duplicate	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
36-005-0110	Bronx, NY	Collocate	---	---	---	---	---	---	---	---	3.7 (24)	12 (24)	7.6 (24)	5.4 (24)	4.2 (24)	12.5 (24)	23.4 (3)
36-005-0110	Bronx, NY	Duplicate	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
36-055-1007	Rochester, NY	Collocate	---	---	---	---	---	---	---	---	---	---	---	---	---	---	12.9 (4)
36-055-1007	Rochester, NY	Duplicate	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

AQS Site Code	Site Description	Duplicate Type	cDCPEN	tDCPEN	ACRO	ACRY	NAPH	BaP	FORM	ACET	AS	BE	CD	PB	MN	NI	CRVI
41-051-0246	Portland, OR	Collocate	---	---	---	---	24.3 (32)	8.4 (12)	7.8 (25)	12 (25)	6.9 (43)	20.9 (43)	12.3 (43)	6.8 (43)	15.8 (43)	12.3 (43)	11.1 (4)
41-051-0246	Portland, OR	Duplicate	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
41-061-0119	La Grande, OR	Collocate	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
41-061-0119	La Grande, OR	Duplicate	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
44-007-0022	Providence, RI	Collocate	---	---	---	---	---	---	13 (24)	10.5 (24)	11.4 (24)	48.2 (17)	16.9 (8)	9.7 (27)	22 (27)	15.1 (27)	22.4 (4)
44-007-0022	Providence, RI	Duplicate	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
45-025-0001	Chesterfield, SC	Collocate	---	---	28.6 (8)	---	---	---	15.4 (14)	27.6 (23)	---	---	---	---	---	---	---
45-025-0001	Chesterfield, SC	Duplicate	---[b]	---	---	---	---	---	---	---	---	---	---	---	---	---	33.8 (1)
48-201-1039	Deer Park, TX	Collocate	---	0 (1)	89.8 (53)	---	41.3 (51)	51.5 (11)	---	---	10.7 (55)	0 (55)	7 (55)	10.3 (55)	12.9 (55)	17.2 (55)	12.8 (6)
48-201-1039	Deer Park, TX	Duplicate	---	---	---	---	13.2 (51)	39.4 (39)	---	---	---	---	---	---	---	---	---
48-203-0002	Harrison County, TX	Collocate	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
48-203-0002	Harrison County, TX	Duplicate	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
49-011-0004	Bountiful, UT	Collocate	---	---	---	---	---	---	---	---	6.5 (4)	---	11.5 (4)	3.9 (4)	6.2 (4)	31.4 (4)	14 (7)
49-011-0004	Bountiful, UT	Duplicate	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
50-007-0007	Underhill, VT	Collocate	---	---	---	---	---	---	---	---	49.6 (6)	60.6 (1)	11 (6)	3.4 (6)	4.2 (6)	16.7 (6)	---
50-007-0007	Underhill, VT	Duplicate	---	---	---	---	---	---	---	---	---	---	---	---	---	---	17.5 (3)
51-087-0014	Richmond, VA	Collocate	---	---	---	---	---	---	---	---	---	---	---	---	---	---	7.8 (3)
51-087-0014	Richmond, VA	Duplicate	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
53-033-0080	Seattle, WA	Collocate	---	---	52.6 (6)	---	---	---	5.2 (6)	2.4 (6)	---	---	---	---	---	---	---
53-033-0080	Seattle, WA	Duplicate	---	---	---	---	30.9 (6)	1.7 (1)	---	---	---	---	---	---	---	---	10 (6)
55-027-0001	Horicon, WI	Collocate	---	---	9.1 (3)	---	---	---	---	---	---	---	---	---	---	---	21.1 (4)
55-027-0001	Horicon, WI	Duplicate	---	---	---	---	---	---	9.7 (4)	8.7 (4)	---	---	---	---	---	---	---
	Overall Mean[c]	*All Dups.*	---	---	26.7 (33)	48.5 (18)	15.7 (62)	38.3 (42)	10.6 (64)	11.1 (63)	11.1 (81)	41 (30)	28.2 (42)	6.3 (97)	39 (94)	9.3 (49)	14.4 (13)

[a] Expressed as percentage coefficient of variation (%CV) with number of contributing data pairs presented in parentheses. Metals results are reported at STP at most sites and local conditions at others.
[b] Sample either not collected or analyte not reported.
[c] Across all sites.

Table 12. Overall Precision[a] for Duplicate and Collocated Samples From 2010: Measurements Below the Method Detection Limit Excluded.

AQS Site Code	Site Description	Duplicate Type	BENZ	BUTA	CTET	CLFRM	EDB	DCP	EDC	MECL	TCE1122	PERC	TCE	VCM
06-037-1103	Los Angeles, CA	Duplicate	---[b]	---	---	---	---	---	---	---	---	---	---	---
06-065-8001	Rubidoux, CA	Duplicate	---	---	---	---	---	---	---	---	---	---	---	---
21-043-0500	Grayson Lake, KY	Duplicate	66.7 (4)	2.5 (1)	33.9 (4)	0 (1)	---	---	---	33.4 (4)	---	---	---	---
25-025-0042	Boston, MA	Duplicate	6.3 (29)	29.6 (29)	4.5 (29)	5.7 (29)	---	---	6.8 (12)	23.9 (29)	---	7.5 (23)	---	---
45-025-0001	Chesterfield, SC	Duplicate	---	---	---	---	---	---	---	---	---	---	---	---
48-201-1039	Deer Park, TX	Duplicate	---	---	---	---	---	---	---	---	---	---	---	---
50-007-0007	Underhill, VT	Duplicate	---	---	---	---	---	---	---	---	---	---	---	---
53-033-0080	Seattle, WA	Duplicate	---	---	---	---	---	---	---	---	---	---	---	---
55-027-0001	Horicon, WI	Duplicate	---	---	---	---	---	---	---	---	---	---	---	---
	Overall Mean[c]	*All Dups.*	24 (33)	29.1 (30)	12.5 (33)	5.6 (30)	---	---	6.8 (12)	25.2 (33)	---	7.5 (23)	---	---

Table 12. Overall Precision[a] for Duplicate and Collocated Samples From 2010: Measurements Below the Method Detection Limit Excluded (continued).

AQS Site Code	Site Description	Duplicate Type	cDCPEN	tDCPEN	ACRO	ACRY	NAPH	BaP	FORM	ACET	AS	BE	CD	PB	MN	NI	CRVI
06-037-1103	Los Angeles, CA	Duplicate	---[b]	---	---	---	---	---	---	---	29.6 (6)	---	27.2 (3)	15.1 (6)	21.2 (6)	19.2 (6)	---
06-065-8001	Rubidoux, CA	Duplicate	---	---	---	---	10.2 (5)	32.8 (1)	---	---	---	---	---	---	---	---	---
21-043-0500	Grayson Lake, KY	Duplicate	---	---	26.5 (4)	---	---	---	12.8 (30)	11.7 (29)	10.7 (39)	---	---	5.5 (55)	48.2 (47)	6.9 (7)	---
25-025-0042	Boston, MA	Duplicate	---	---	26.7 (29)	---	---	---	8 (30)	10.9 (30)	3 (36)	22.4 (18)	23.6 (35)	5 (35)	2.4 (36)	3.5 (4)	2.7 (3)
45-025-0001	Chesterfield, SC	Duplicate	---	---	---	---	---	---	---	---	---	---	---	---	---	---	33.8 (1)
48-201-1039	Deer Park, TX	Duplicate	---	---	---	---	13.2 (51)	10.6 (7)	---	---	---	---	---	---	---	---	---
50-007-0007	Underhill, VT	Duplicate	---	---	---	---	---	---	---	---	---	---	---	---	---	---	17.5 (3)
53-033-0080	Seattle, WA	Duplicate	---	---	---	---	30.9 (6)	1.7 (1)	---	---	---	---	---	---	---	---	10 (6)
55-027-0001	Horicon, WI	Duplicate	---	---	---	---	---	---	9.7 (4)	8.7 (4)	---	---	---	---	---	---	---
	Overall Mean[c]	*All Dups.*	---	---	26.7 (33)	---	15.7 (62)	14.4 (9)	10.6 (64)	11.1 (63)	11.1 (81)	22.4 (18)	23.9 (38)	6.4 (96)	35.5 (89)	12.4 (17)	14.4 (13)

[a] Expressed as percentage coefficient of variation (%CV) with number of contributing data pairs presented in parentheses. Metals results are reported at STP at most sites and local conditions at others.
[b] Sample either not collected or analyte not reported.
[c] Across all sites.

2.4 Laboratory Bias Data Based on Proficiency Testing (PT) Samples

PT audits of participating NATTS sample analysis laboratories were conducted annually for VOCs, carbonyls, metals and PAHs in 2010. Alion Science, Inc., under contract to EPA (Contract No. 68-D03-006), generated "spiked" samples containing known amounts of the HAPs of interest and delivered these spiked samples to each laboratory in 2010 for each of the VOC, carbonyl, and metals analyte groups. Following chemical analyses, the participating laboratories returned their results to Alion, which, in turn, prepared reports comparing the laboratory-measured values to the stated (known) values for the proficiency testing sample. The results of these PT sample analyses for CY2010 were provided to RTI International by EPA.

Laboratory bias is defined as the percentage difference between the laboratory's measured value and the known value for the audit sample:

$$\%Difference = \frac{Measured - Known}{Known} \cdot 100 \qquad \text{(Eq. 3)}$$

Tables 13 through **15** present the results of the PT samples for all compounds analyzed. To reflect overall bias independent of direction, the mean of the absolute value of the bias, along with the minimum and maximum bias values, is presented in the bottom and right-hand summaries for the individual tabulated values. **Figure 29** shows box plots summarizing laboratory bias results for all the participating laboratories across the five compounds for which PT data were compiled: 1, 3-butadiene, formaldehyde, acrolein, benzene, and arsenic. In this figure, the bottom and top of the "box" represent the 25^{th} and 75^{th} percentiles, respectively; the horizontal line inside the box represents the median value; the diamond symbol represents the mean; the top and bottom "whiskers" extend to a length of 1.5 times the inter-quartile range (IQR). The IQR is defined as the distance between the 25^{th} and 75^{th} percentiles of the distribution of values. The reference line in this figure represents the MQO bias goal of 25%. To maintain figure clarity, only labs whose results fell outside of a window defined by 1.5 × IQR are identified on the graphical display. Selected results that fell outside of the IQR are identified by their laboratory ID number assigned by Alion; a cross-reference between the NATTS site and assigned laboratory codes is provided above in **Tables 7** and **8**. A laboratory's results were included in the summary analysis only if the laboratory provided analysis of a particular sample type. Although some individual laboratories report PT sample concentrations that exhibit bias beyond the NATTS MQO, the profound majority of laboratories demonstrate laboratory biases for benzene, 1, 3-butadiene, formaldehyde, and arsenic that are well within the MQO limit of ±25%. The overall bias for benzene is slightly negative, implying a smaller measured result than expected; biases for acrolein, butadiene, and arsenic are nominally positive; no overall bias is observed for formaldehyde. Naphthalene shows a noticeably negative bias, although only reported at five sites. Percentage participation in the PT program (**Table 15**) was complete, or nearly complete, for metals, VOCs and PAHs but lower for carbonyls.

Table 13. Performance Testing Bias Results[a] for VOCs in 2010 NATTS Laboratories.

Laboratory Code	Laboratory Description	BENZ	BUTA	CTET	CLFRM	EDB	DCP	EDC	MECL	TCE 1122	PERC	TCE	VCM	c-DCPEN	t-DCPEN	ACRO	ACRY	*Mean Abs. Bias (across analytes)*[b]	*Min.*	*Max.*
01-01-V	RI Dept. of Health Laboratories	-8.79	3.66	-2.04	-7.22	-9.00	-15.2	-9.43	-15.3	0.00	-8.60	-12.8	-11.8	-5.68	-14.6	-14.3	--[c]	9.23	-15.3	3.66
02-01-V	NYS DEC BAQS	-8.79	15.9	-11.2	-22.7	-14.0	-16.2	-10.4	-15.3	1.90	-11.8	-15.6	-12.9	-11.4	-3.37	13.3	--	12.3	-22.7	15.9
03-01-V	Maryland Department of the Environment	1.10	22.0	16.3	-4.12	-8.00	0.00	-2.83	-0.90	-6.67	-1.08	3.67	5.88	-14.8	-10.1	-2.86	--	6.68	-14.8	22.0
03-02-V	Virginia Division of Consolidated Laboratory Services	-13.2	6.10	9.18	-9.28	-8.00	-6.06	-6.60	-5.41	-0.95	-6.45	-1.83	-5.88	-14.8	-6.74	-12.4	--	7.52	-14.8	9.18
04-01-V	Pinellas County DEM AQ	-10.9	29.4	-9.59	-16.6	-11.2	-18.1	-11.1	-9.46	-16.6	-23.6	-17.1	0.94	-7.95	-7.08	6.29	--	13.1	-23.6	29.4
04-02-V	SC Dept of HEC, Div. of AQ Analysis	-18.7	9.76	-24.5	-24.7	92.0	56.6	30.2	-24.3	113.3	-16.1	-22.9	-23.5	77.3	96.6	112	--	49.5	-24.7	113
04-04-V	GA DNR EPD Laboratory	-13.2	25.6	2.04	-16.5	-14.0	-8.08	-11.3	-10.8	-24.8	-10.8	-10.1	-2.35	-6.82	3.37	--	--	11.4	-24.8	25.6
05-03-V	Wisconsin State Laboratory of Hygiene	18.7	50.0	36.7	8.25	16.0	11.1	11.3	11.7	10.5	7.53	29.4	31.8	18.2	28.1	30.5	--	21.3	7.53	50.0
06-01-V	Texas CEQ	-5.49	34.2	5.10	-17.5	-13.0	-28.3	-18.9	-17.1	6.67	-39.8	-23.9	-4.71	0.00	-8.99	-18.1	--	16.1	-39.8	34.2
09-03-V	Bay Area Air Quality Management District	-6.59	-8.54	20.4	-9.28	15.0	--	-17.0	-18.9	--	-8.60	5.50	18.8	--	--	80.0	--	19.0	-18.9	80.0
10-02-V	Oregon DEQ Lab	-12.1	-11.0	-30.6	-41.2	50.0	-13.1	-27.4	-64.0	8.57	8.60	-14.7	-23.5	-7.95	-7.87	--	--	22.9	-64.0	50.0
11-01-V	ERG	-13.2	-3.66	31.6	1.03	-9.0	-15.2	-2.83	4.50	-14.3	-16.1	-6.42	-14.1	-18.2	-20.2	-9.52	--	12.0	-20.2	31.6
	Mean Abs. Bias (across laboratories)	10.9	18.3	16.6	14.9	21.6	17.1	13.3	16.5	18.6	13.3	13.7	13.0	16.6	18.8	30.0	--	16.7		
	Minimum	-18.7	-11.0	-30.6	-41.2	-14.0	-28.3	-27.4	-64.0	-24.8	-39.8	-23.9	-23.5	-18.2	-20.2	-18.1	--			
	Maximum	18.7	50.0	36.7	8.25	92.0	56.6	30.2	11.7	113	8.60	29.4	31.8	77.3	96.6	112	--			

[a] Computed as the mean of the individual percent differences.
[b] Computed as the mean of the absolute values of the individual percent differences.
[c] Analyte not reported.

Table 14. Proficiency Testing Bias Results[a] for Carbonyls in 2010 NATTS Laboratories.

Laboratory Code	Laboratory Description	FORM	ACET	*Mean Abs. Bias (across analytes)*[b]	*Min.*	*Max.*
01-01-C	RI Dept. of Health Laboratories	8.20	3.90	6.05	3.90	8.20
01-02-C	Vermont DEC Environmental Lab	2.60	4.00	3.30	2.60	4.00
01-03-C	Massachusetts Dept. Environmental Conservation	-8.20	-9.00	8.60	-9.00	-8.20
02-01-C	NYS DEC BAQS	-3.10	-2.40	2.75	-3.10	-2.40
03-01-C	Philadelphia Air Management Services Laboratory	-0.80	1.60	1.20	-0.80	1.60
03-02-C	Virginia Division of Consolidated Laboratory Services	2.40	1.60	2.00	1.60	2.40
04-03-C	KY Div. of Environmental Services	-11.8	-16.1	14.0	-16.1	-11.8
04-04-C	GA DNR EPD Laboratory	-4.30	-2.70	3.50	-4.30	-2.70
05-01-C	MI DEQ Lab	-1.60	0.80	1.20	-1.60	0.80
05-03-C	Wisconsin State Laboratory of Hygiene	2.00	2.00	2.00	2.00	2.00
06-01-C	Texas CEQ	1.20	-0.40	0.80	-0.40	1.20
09-03-C	Bay Area Air Quality Management District	-3.10	-4.30	3.70	-4.30	-3.10
10-02-C	Oregon DEQ Lab	-2.00	2.70	2.35	-2.00	2.70
11-01-C	ERG	-2.80	0.70	1.75	-2.80	0.70
	Mean Abs. Bias (across laboratories)	3.86	3.73	6.60		
	Minimum	-11.8	-16.1			
	Maximum	8.20	4.00			

[a] Computed as the mean of the individual percent differences.
[b] Computed as the mean of the absolute values of the individual percent differences.

Table 15. Proficiency Testing Bias[a] Results for Metals in 2010 NATTS Laboratories.

Laboratory Code	Lab Description	AS	BE	CD	PB	MN	NI	*Mean Abs. Bias (across analytes)[b]*	*Min.*	*Max.*
01-01-M	RI Dept. of Health Laboratories	56.08	41.40	-5.96	-5.09	5.29	5.51	19.89	-5.96	56.08
03-01-M	WVDEP Division of Air Quality	17.65	20.00	12.77	3.51	5.88	8.16	11.33	3.51	20.00
03-02-M	Virginia Division of Consolidated Laboratory Services	-8.04	-9.40	-15.11	-21.58	-17.84	-6.12	13.02	-21.58	-6.12
04-01-M	Environmental Protection Comm. of Hillsborough Co.	0.98	3.00	0.00	-8.77	-4.90	7.14	4.13	-8.77	7.14
04-02-M	SC Dept of HEC, Div. of AQ Analysis	-32.59	-19.24	-24.89	-28.37	-6.14	-5.20	19.41	-32.59	-5.20
04-04-M	GA DNR EPD Laboratory	5.88	4.80	0.00	-1.05	0.98	8.57	3.55	-1.05	8.57
05-01-M	MI DEQ Lab	-1.96	0.00	-10.64	47.37	98.04	2.04	26.67	-10.64	98.04
05-03-M	Wisconsin State Laboratory of Hygiene	-15.49	-6.00	-17.02	-18.95	-17.25	-13.67	14.73	-18.95	-6.00
06-01-M	Texas CEQ	15.69	16.80	10.00	-2.46	10.39	9.18	10.75	-2.46	16.80
09-08-M	South Coast Air Quality Management District	-11.57	-18.00	-9.79	-7.72	-13.73	-11.22	12.00	-18.00	-7.72
10-02-M	Oregon DEQ Lab	11.96	11.60	5.11	-5.96	-2.55	-1.43	6.43	-5.96	11.96
11-01-M	ERG	7.25	11.20	4.89	-3.51	0.59	4.69	5.36	-3.51	11.20
11-02-M	RTI International	23.14	18.60	9.79	4.04	1.57	10.41	11.26	1.57	23.14
	Mean Abs. Bias (across laboratories)	16.02	13.85	9.69	12.18	14.24	7.18	12.19	.	.
	Maximum	56.08	41.40	12.77	47.37	98.04	10.41	.	.	.
	Minimum	-32.59	-19.24	-24.89	-28.37	-17.84	-13.67	.	.	.

[a] Computed as the mean of the individual percent differences.
[b] Computed as the mean of the absolute values of the individual percent differences.

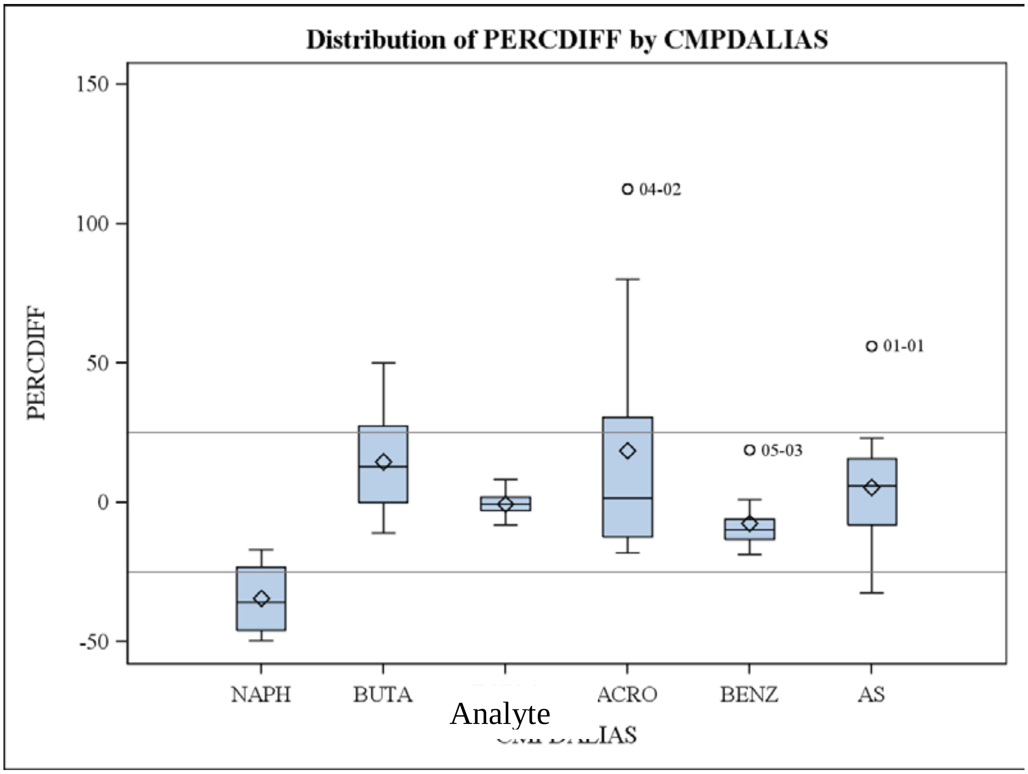


Figure 29. Distribution of Laboratory Bias by Analyte for Proficiency Testing Data from 2010.

2.5 Flow Audit Results from Instrument Performance Audits (IPAs)

Eight NATTS field sites (Rubidoux, CA; Los Angeles, CA; Phoenix, AZ; Bountiful, UT; Grand Junction, CO; Underhill, VT; Providence, RI; Boston, MA) were audited during CY2010 for canister, carbonyl, PM_{10}, chromium (VI), and PAH samplers. The IPA involves independent measurements of flow rates on all resident sampler types at the NATTS site using certified flow, temperature, and pressure instruments.

Sampler flow rates were measured using a calibrated volumetric flow measurement device and reported in standard conditions of 25 ºC and 1 atm or local conditions based on the typical reporting process of the site operators. Comparison of the site-recorded and similarly corrected flow rate to the audited flow rate afforded calculation of field bias. For this purpose, field bias is defined as the percentage difference between the corrected site flow (Fs_c) and the corrected audit flow (Fa_c):

$$\%Difference = \frac{Fs_C - Fa_C}{Fa_C} \cdot 100 \qquad \text{(Eq. 4)}$$

The results from the flow audits conducted at six sites during CY2010, along with the relevant sampling techniques, are shown in **Table 16**. The specific sampler audited (i.e., primary or collocated) is identified in column 3, with no audits performed on canister samplers. If present during the audit, collocated samplers were also audited. Because canister and carbonyl samplers may have multiple flow channels to facilitate duplicate sampling, all active channels were also subjected to a flow audit. PM_{10} samplers have only primary channels.

Table 16. Proficiency Testing Bias[a] Results for PAHs in 2010 NATTS Laboratories.

Laboratory Code	Lab Description	NAPH	*Mean Abs. Bias (across analytes)[b]*	*Min.*	*Max.*
04-02-P	SC Dept of HEC, Div. of AQ Analysis	-31.5	31.5	-31.5	-31.5
05-03-P	Wisconsin State Laboratory of Hygiene	-29.5	29.5	-29.5	-29.5
06-01-P	Texas CEQ	-49.6	49.6	-49.6	-49.6
10-02-P	Oregon DEQ Lab	-42.3	42.3	-42.3	-42.3
11-01-P	ERG	-17.1	17.1	-17.1	-17.1
	Mean Abs. Bias (across laboratories)	34.0	34.0		
	Minimum	-49.6			
	Maximum	-17.1			

[a] Computed as the mean of the individual percent differences.
[b] Computed as the mean of the absolute values of the individual percent differences.

A graphical summary of the flow audit results is presented in **Figure 30**. Nearly all flow rate measurements were within ±10% of the audit flow rate; most were within 5%. Only one laboratory-analyte combination (Vermont-naphthalene) exhibited a bias greater than 10%

Accuracy of flow rates for carbonyl and PM_{10} samplers is critical for determining sample concentration. Conversely, because only an aliquot of the canister volume is analyzed, the accuracy of canister sampler flow rates is less important. However, a constant flow rate across the 24-hour sampling interval is critical to achieving a linearly representative integrated sample. The field bias audit of a VOC sampler flow rate is a random check of this time-integrated value.

2.6 Method Detection Limit Data

During compilation of 2007 QA data, substantial effort was invested in acquiring the MDL data through direct contacts with each contributing laboratory. For the 2008, 2009, and 2010 results, the AQS database, specifically the ALT_MDL variable in the RD record types, served as the primary source of laboratory-based MDL data. Although this is not a required field in AQS, approximately 75-85% of the MDL data were acquired from this source. Because AQS allows the posting of MDL data in a variety of units, even within chemical classes, all AQS-acquired MDLs were standardized to ng/m^3 for metals, PAHs, and chromium (VI) and $\mu g/m^3$ for carbonyls and VOCs. The balance of the MDLs (i.e., those values not posted to AQS) was requested from direct contact with each laboratory known to be providing analytical services. Multiple e-mail requests with some laboratory contacts were needed to obtain the full complement of MDL data. After careful review of the received materials from each laboratory, the spreadsheet information was compiled into a database from which subsequent data analyses could be performed.

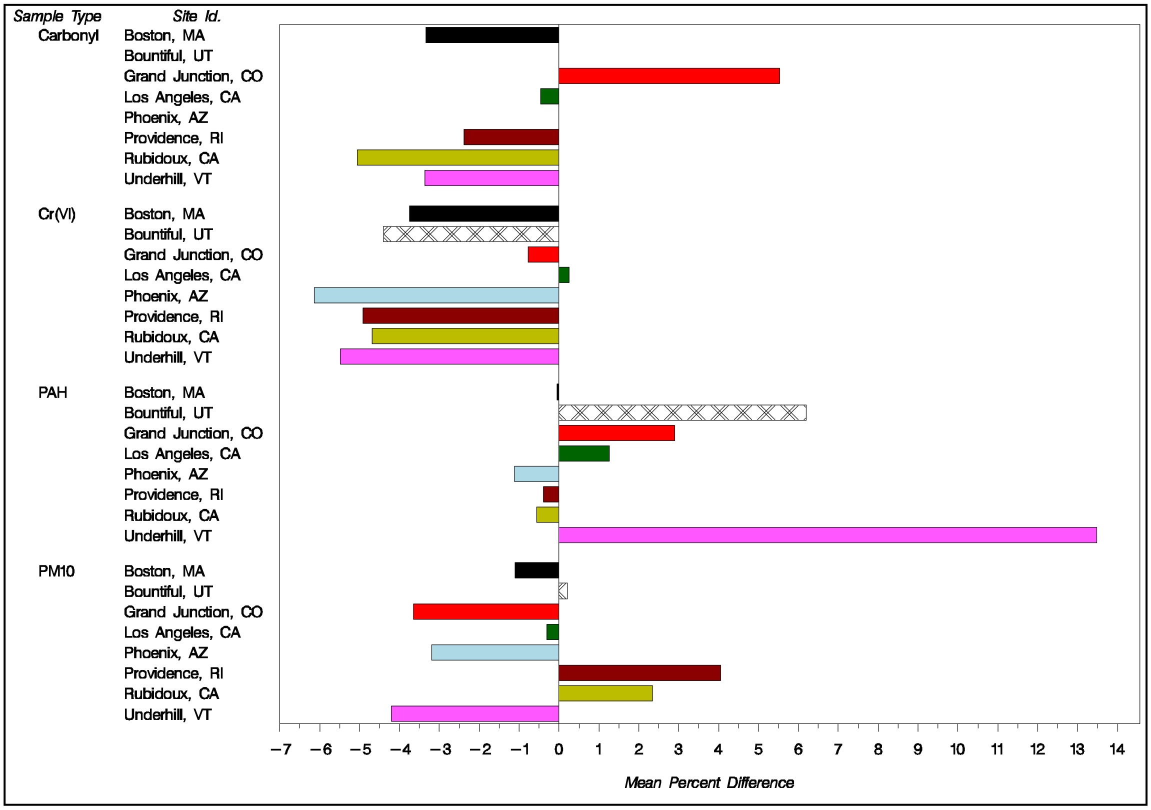


Figure 30. Summary of Instrument Performance Flow Audit Results for NATTS Sites Audited in 2010.

For this report and by generally accepted conventions, MDLs are defined as the detection threshold for a given analyte based on the mathematical combination of all aspects of the sample collection and analysis process. Thus, they reflect, among other factors, the collected sample volume for each sample, the size of the subsample subjected to analysis, and any sample dilutions that may be associated with the analysis methodology. Using the AQS database as the primary source of the MDL information does not, in and of itself, ensure consistency of the MDL data, but the data derived from posted information may be more reliable than the same data obtained through individual laboratory requests. There is, however, no unequivocal way to discern from the existing data if the MDLs provided reflect the MDL (i.e., taking into account sampling and analysis components) or if they reflect only instrumental detection limits. These concerns notwithstanding, the MDL results presented in this report are mean values computed from either individual AQS-posted values or directly from laboratory contacts and are presented under the assumption that each laboratory reported actual method detection limits that incorporated both instrumental and sampling considerations. In cases where the data were acquired by direct laboratory contact and unit conversions were needed, the data were converted to the same units specified above. The MDL data for individual sites, in addition to the mean across all sites reporting data, are shown in **Table 17**. Because ERG serves as the analytical laboratory for numerous NATTS sites (**Table 7**) for VOCs, carbonyls, metals, and particularly for chromium (VI) and PAHs, the method detection limits shown in **Table 17** and in **Figures 31** through **35** reflect a consistency in instrumental detection limits associated with an analytical laboratory common to multiple sites.

Table 17. Proficiency Testing Program Participation for 2010.

Compound Class	Percentage Participation
Carbonyls	86
Metals	100
VOCs	92
PAHs	100

Box and whisker plots and complementary scatter plots, shown in **Figures 31** through **35**, illustrate the MDLs for carbonyls, metals, arsenic, VOCs, and PAHs, respectively. The MQOs for benzene, 1, 3-butadiene, formaldehyde, and arsenic are added to each plot for reference. Labs whose results fell outside of a window defined by 1.5 × IQR are identified by blue asterisks on the graphical display. The IQR is defined as the distance between the 25th and 75th percentiles of the distribution of values.

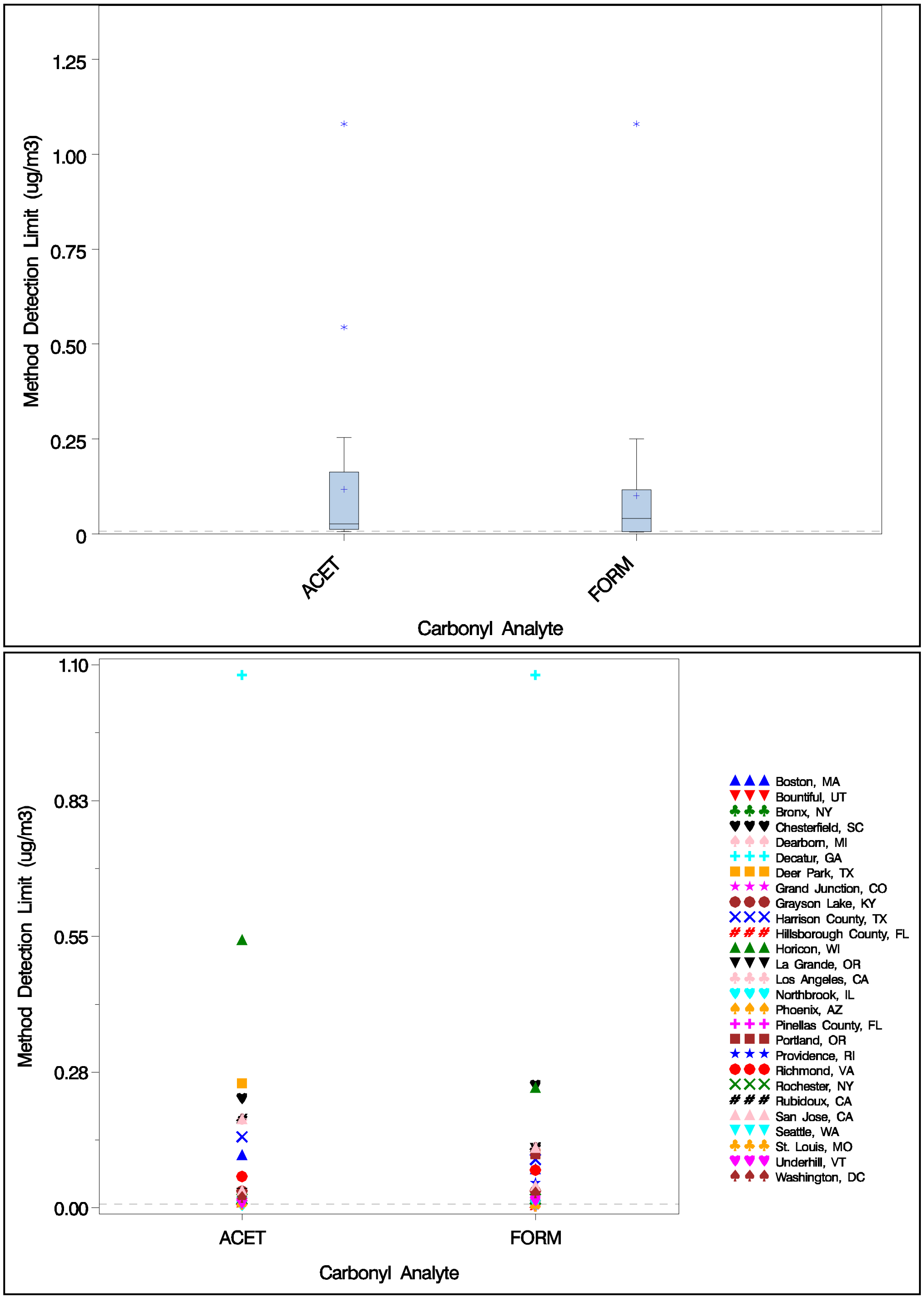


Figure 31. Distribution of Method Detection Limits for Carbonyls for 2010 NATTS Data (dashed line indicates MQO target MDL for formaldehyde; > 1.5 × IQR are identified as blue stars in top display).

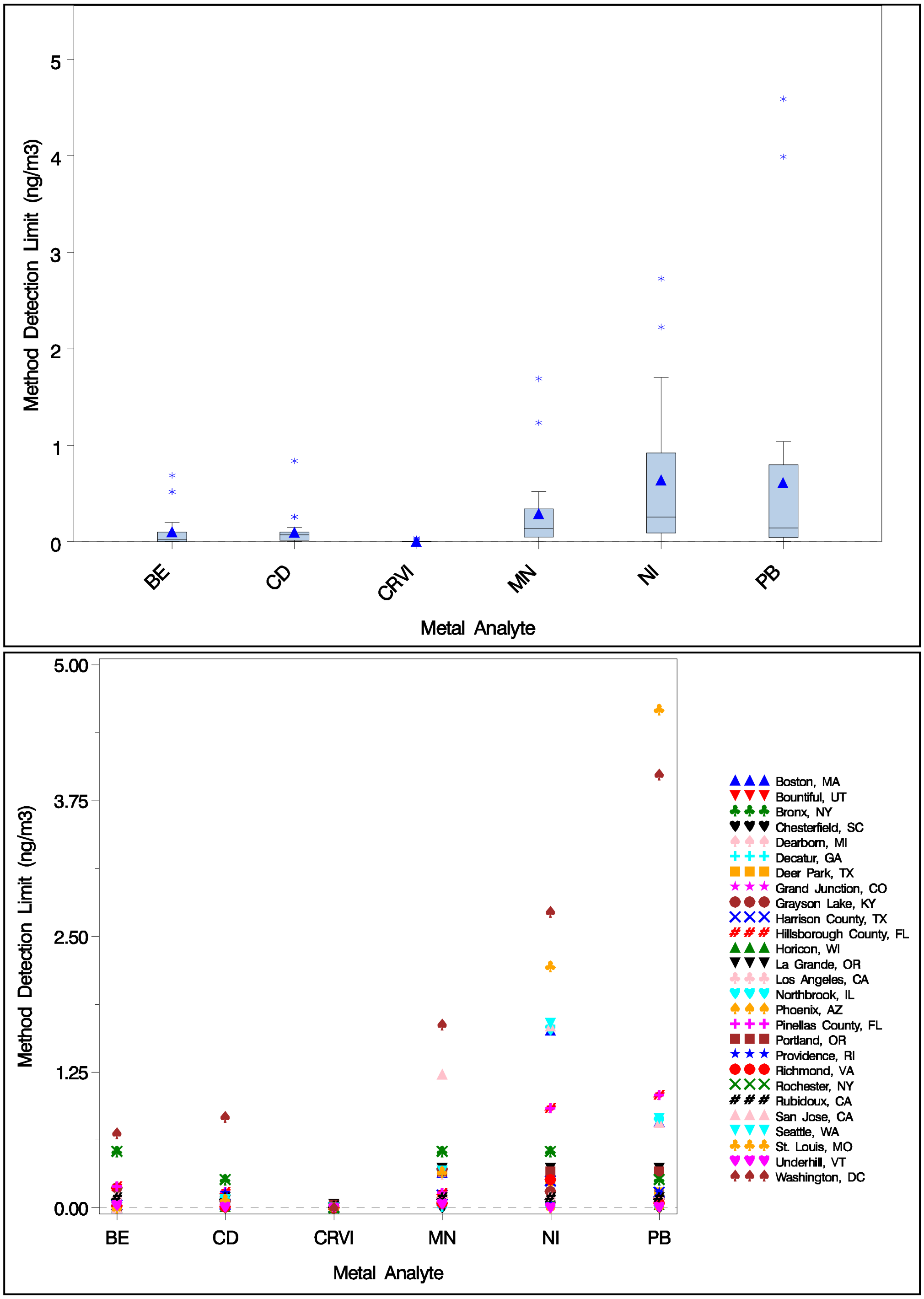


Figure 32. Distribution of Method Detection Limits for Metals for 2010 NATTS Data (> 1.5 × IQR are identified as blue stars in top display).

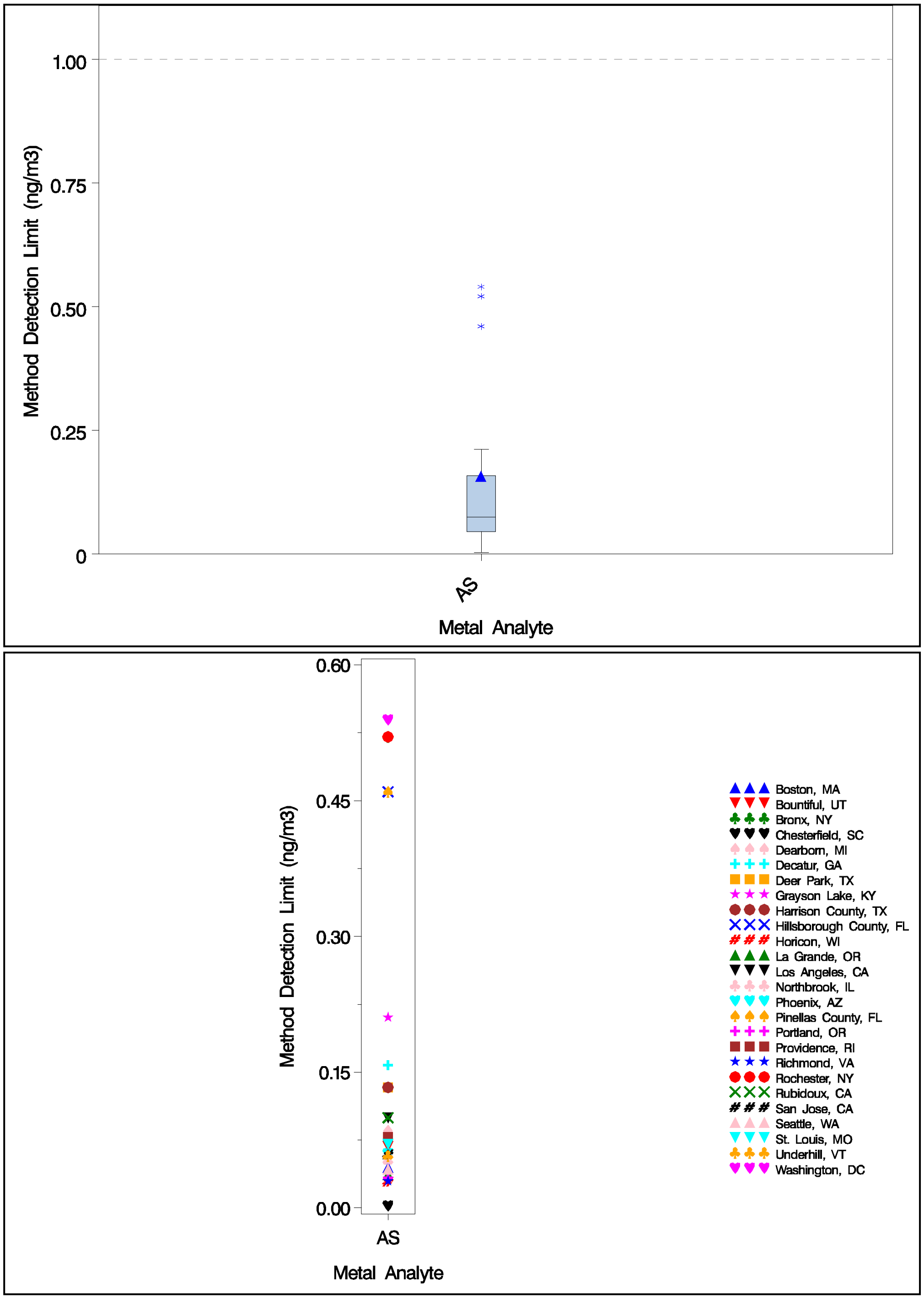


Figure 33. Distribution of Method Detection Limits for Arsenic for 2010 NATTS Data (dashed line indicates MQO target MDL for arsenic).

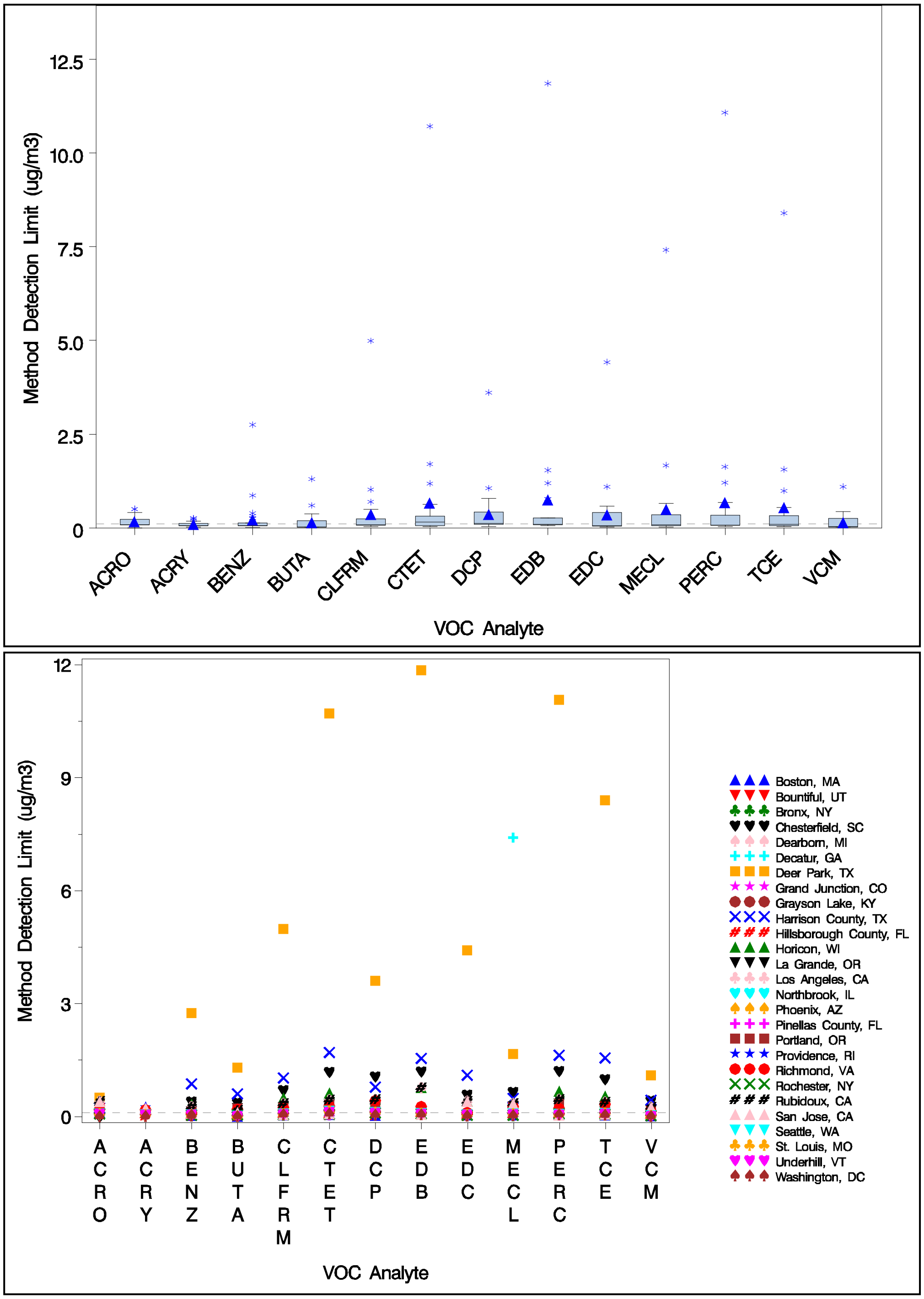


Figure 34. Distribution of Method Detection Limits for VOCs for 2010 NATTS Data (dashed line indicates MQO target MDL for butadiene; > 1.5 × IQR are identified as blue stars in top display).

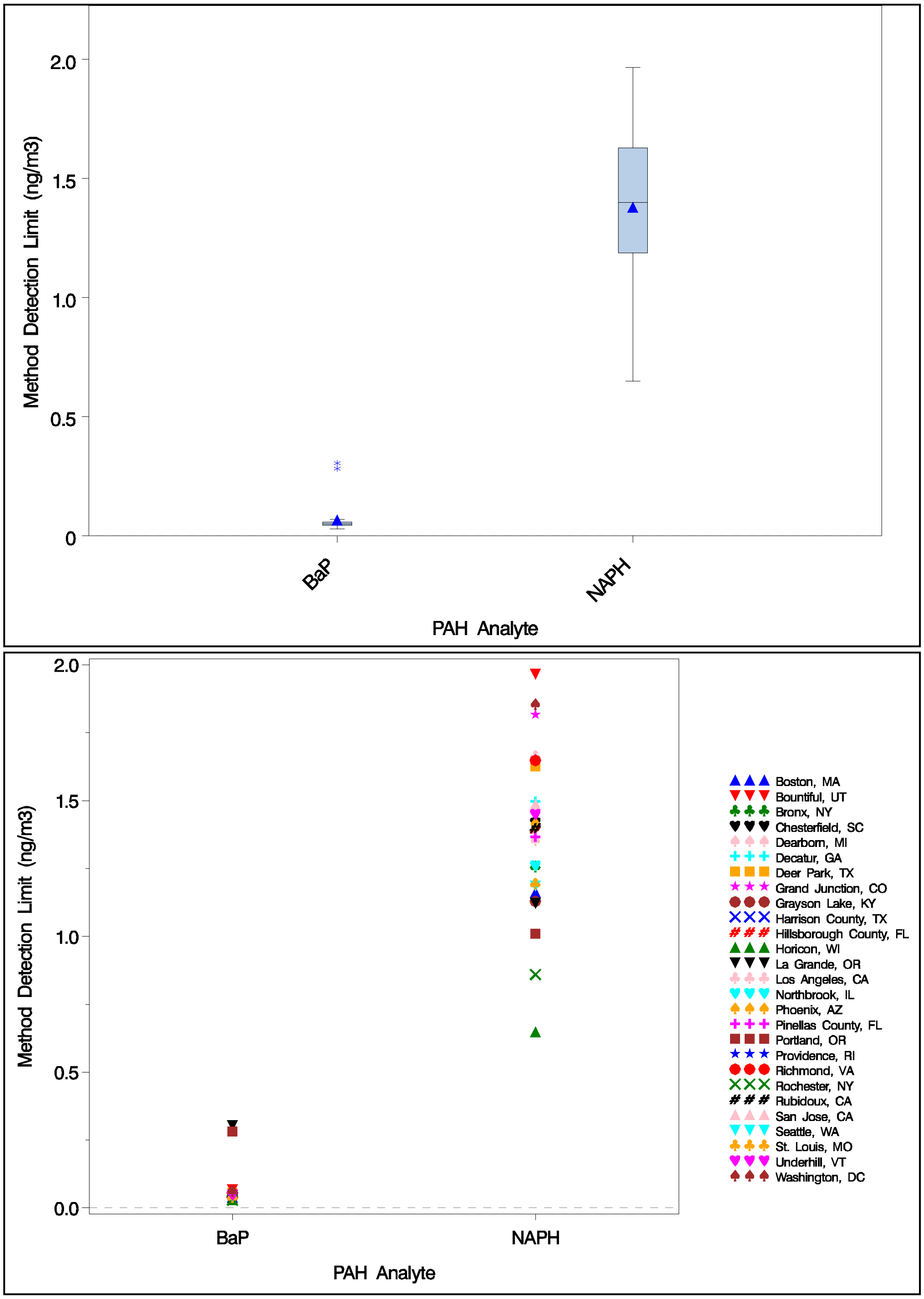


Figure 35. Distribution of Method Detection Limits for PAHs for 2010 NATTS Data.

Review of the graphically displayed MDL results reveals a number of interesting features largely consistent with previous reporting years. With the exception of a few extreme values, MDLs for carbonyls (**Figure 31**) show greater consistency across laboratories with many values below the MQO. The distributions of MDLs for metals (**Figures 32** and **33**) are very tight for some analytes, notably Be, Cd, and chromium (VI), but substantially broader for others (Mn, Ni, Pb), with relatively few values outside the IQR. Again reflecting a change in the assigned MQO, arsenic performance was well within the MQO for all laboratories although the range of values across labs was significant. The consistency and magnitude of MDLs reported for chromium (VI) is particularly noteworthy and may reflect the fact that only three laboratories are performing this analysis for all NATTS sites. VOCs show much greater variability in MDLs across laboratories than other analyte groups, with a few sites accounting for most of the spread in the distribution (**Figure 34**). A single MQO reference line was displayed for 1,3-butadiene in Figure 34 as reasonably representative of all VOCs. As was found for most analytes, a high proportion of MDLs for VOCs occurred above the MQO. Lastly, MDLs for PAHs, while universally above the MQO, tended to be clustered for both benzo[a]pyrene and naphthalene, again reflecting that the analysis was performed by only three labs (**Figure 35**).

As reported by the metals analysis laboratories for 2009, 19 NATTS sites (San Jose, CA; Washington, DC; Boston-Roxbury, MA; Decatur, GA; Hillsborough County, FL; Pinellas County, FL; Dearborn, MI; Mayville, WI; Northbrook, IL; Harrison County, TX; St. Louis, MO; La Grande, OR; Portland, OR; Seattle, WA; Providence, RI; Chesterfield, SC; Deer Park, TX; Underhill, VT; Richmond, VA) collected high-volume PM_{10} metals on 8 in. x 10 in. quartz fiber filters. Seven sites reported using low-volume PM_{10} metals sampling on 47 mm Teflon filters (Bronx, NY; Rochester, NY; Bountiful, UT; Grand Junction, CO; Phoenix, AZ; Hazard, KY; Grayson Lake, KY). The remaining sites either did not collect PM_{10} samples for metals analysis or did not report the type of sampling implemented.

Comparison of MDLs for the two sampling approaches is meaningful only when the analysis laboratory is the same for the two sites; otherwise the variability in MDLs is an aggregate effect of sample collection and sample analysis. The metals results provided by the ERG laboratory, which analyzes samples of both types, offer a unique opportunity to examine MDLs between high- and low-volume sampling without the influence of cross-laboratory instrumental detection limit variability. **Table 18** shows the MDLs for each of the PM_{10} metal analytes. Unlike the findings of previous years, MDL ratios for High- and Low volume PM_{10} samples analyzed at ERG (**Table 20**) are extremely variable, ranging from 0.03 to 280. Overall, variability in MDLs among laboratories, shown in **Table 19**, is very large; often exceeding the mean. This suggests significant differences in analytical performance, as well as collection volumes.

The geometric mean MDLs (**Table 21**) for all analytes falls below the target MQO, for two analytes by at least an order of magnitude.

Table 18. Flow Audit Results from 2010 Instrument Performance Audits.

Site Identifier	Method	Sampler	Channel	Site Measurement	Audit Measurement[a]	Units	Percent Difference
Rubidoux, CA	Canister[b]	Primary		Not performed[c]	NA		.
Rubidoux, CA	Canister	Collocated		Not performed	NA		.
Rubidoux, CA	Carbonyl[d]	Primary		0.700	0.7274	L/min (LC)	-3.8
Rubidoux, CA	Carbonyl	Collocated		0.700	0.7474	L/min (LC)	-6.3
Rubidoux, CA	PM10[e]	Primary		39.25	38.0	ft3/min (STP)	3.3
Rubidoux, CA	PM10	Collocated		40.25	39.7	ft^3/min (STP)	1.4
Rubidoux, CA	Cr(VI)	Primary		12.0	12.57	L/min (LC)	-4.6
Rubidoux, CA	Cr(VI)	Collocated		12.0	12.61	L/min (LC)	-4.8
Rubidoux, CA	PAH	Primary		7.93	8.03	ft^3/min (STP)	-1.2
Rubidoux, CA	PAH	Collocated		7.74	7.73	ft^3/min (STP)	0.1
Los Angeles, CA	Canister	Primary		Not performed	NA		.
Los Angeles, CA	Canister	Collocated		Not performed	NA		.
Los Angeles, CA	Carbonyl	Primary		0.700	.7083	L/min (LC)	-1.2
Los Angeles, CA	Carbonyl	Collocated		0.700	0.6982	L/min (LC)	0.3
Los Angeles, CA	PM10	Primary		40.53	40.4	ft^3/min (STP)	0.3
Los Angeles, CA	PM10	Collocated		39.73	40.1	ft^3/min (STP)	-0.9
Los Angeles, CA	Cr(VI)	Primary		12.0	12.03	L/min (LC)	-0.2
Los Angeles, CA	Cr(VI)	Collocated		12.0	11.91	L/min (LC)	0.8
Los Angeles, CA	PAH	Primary		7.99	7.89	ft^3/min (STP)	1.3
Phoenix, AZ	Canister	Primary		Not performed	NA		.
Phoenix, AZ	Canister	Collocated		Not performed	NA		.
Phoenix, AZ	Carbonyl	Primary		Not performed	NA		.
Phoenix, AZ	Carbonyl	Collocated		Not performed	NA		.
Phoenix, AZ	PM10	Primary		16.7	17.25	L/min (LC)	-3.2
Phoenix, AZ	Cr(VI)	Primary		15.0	15.98	L/min (LC)	-6.1
Phoenix, AZ	PAH	Primary		8.92	9.02	ft^3/min (STP)	-1.1
Bountiful, UT	Canister	Primary		Not performed	NA		.
Bountiful, UT	Canister	Duplicate/Collocated		Not performed	NA		.
Bountiful, UT	Carbonyl	Primary	1	Not performed	NA		.
Bountiful, UT	Carbonyl	Duplicate/Collocated	2	Not performed	NA		.
Bountiful, UT	PM10	Primary		16.7	16.64	L/min (LC)	0.4
Bountiful, UT	PM10	Collocated		16.7	16.69	L/min (LC)	0.1
Bountiful, UT	Cr(VI)	Primary	1	15.0	15.72	L/min (LC)	-4.6
Bountiful, UT	Cr(VI)	Collocated	2	15.0	15.66	L/min (LC)	-4.2
Bountiful, UT	PAH	Primary		3.94	3.71	ft^3/min (STP)	6.2
Grand Junction, CO	Canister	Primary		Not performed	NA		.
Grand Junction, CO	Canister	Duplicate/Collocated		Not performed	NA		.
Grand Junction, CO	Carbonyl	Primary	1	0.879	0.834	L/min (LC)	5.4
Grand Junction, CO	Carbonyl	Duplicate/Collocated	2	0.859	0.813	L/min (LC)	5.7
Grand Junction, CO	PM10	Primary		16.6	17.19	L/min (LC)	-3.4

Table 18. Flow Audit Results from 2010 Instrument Performance Audits.

Site Identifier	Method	Sampler	Channel	Site Measurement	Audit Measurement[a]	Units	Percent Difference
Grand Junction, CO	PM10	Collocated		16.7	17.37	L/min (LC)	-3.9
Grand Junction, CO	Cr(VI)	Primary	1	15.5	15.55	L/min (LC)	-0.3
Grand Junction, CO	Cr(VI)	Collocated	2	16.0	16.20	L/min (LC)	-1.2
Grand Junction, CO	PAH	Primary		4.98	4.84	ft^3/min (STP)	2.9
Underhill, VT	Carbonyl	Primary		Not performed	NA		.
Underhill, VT	Carbonyl	Primary		0.92	0.952	L/min (STP)	-3.4
Underhill, VT	PM10	Primary		16.7	17.24	L/min (LC)	-3.1
Underhill, VT	PM10	Collocated		16.7	17.63	L/min (LC)	-5.3
Underhill, VT	Cr(VI)	Primary	1	12.8	13.21	L/min (LC)	-3.1
Underhill, VT	Cr(VI)	Collocated	2	12.8	13.89	L/min (LC)	-7.8
Underhill, VT	PAH	Primary		0.160	0.141	m^3/min (LC)	13.5
Providence, RI	Canister	Primary		Not performed	NA		.
Providence, RI	Canister	Duplicate/Collocated		Not performed	NA		.
Providence, RI	Carbonyl	Primary		0.203	0.208	L/min (LC)	-2.4
Providence, RI	Carbonyl	Collocated		0.207	0.212	L/min (LC)	-2.4
Providence, RI	PM10	Primary		1.132	1.088	m^3/min (STP)	4.0
Providence, RI	PM10	Collocated		Not performed	NA		.
Providence, RI	Cr(VI)	Primary	1	15.0	15.32	L/min (LC)	-2.1
Providence, RI	Cr(VI)	Collocated	2	15.0	16.26	L/min (LC)	-7.7
Providence, RI	PAH	Primary		7.58	7.61	ft^3/min (STP)	-0.4
Boston, MA	Canister	Primary		Not performed	NA		.
Boston, MA	Carbonyl	Primary	1	0.130	0.133	L/min (LC)	-2.3
Boston, MA	Carbonyl	Duplicate/Collocated	2	0.130	0.136	L/min (LC)	-4.4
Boston, MA	PM10	Primary		1.03	1.044	m^3/min (STP)	-1.3
Boston, MA	PM10	Collocated		1.05	1.059	m^3/min (STP)	-0.8
Boston, MA	Cr(VI)	Primary	1	15.5	16.04	L/min (LC)	-3.4
Boston, MA	Cr(VI)	Collocated	2	15.8	16.48	L/min (LC)	-4.1
Boston, MA	PAH	Primary		0.188	0.1881	m^3/min (STP)	-0.1

[a] Performed by RTI International.
[b] VOC sampler.
[c] Audit not performed for this sampler type.
[d] Carbonyl cartridge.
[e] Filter sample for PM_{10} metals.

Table 19. Method Detection Limits (MDLs) by Site and Overall for CY2010 (VOCs and Carbonyls: µg/m^3; Metals and PAHs: ng/m^3).

Site Name	AQS Site Code	BENZ	BUTA	CTET	CLFRM	EDB	DCP	EDC	MECL	1122-TCE	PERC	TCE	VCM	c-DCPEN	t-DCPEN
Phoenix, AZ	04-013-9997	0.061 [a]	0.022 [a]	0.151	0.083	0.092	0.116	0.061	0.080	0.076	0.075	0.092	0.033	0.068	0.073
Los Angeles, CA	06-037-1103	0.261	0.173	0.445	0.346	0.770	0.463	0.406	0.348	— [b]	0.455	0.380	0.256	0.455	0.455
Rubidoux, CA	06-065-8001	0.262	0.174	0.448	0.348	0.770	0.463	0.406	0.348	—	0.458	0.383	0.256	0.455	0.455
San Jose, CA	06-085-0005	0.094 [a]	0.119	0.083	0.064	0.077	—	0.406	0.348	—	0.045	0.071	0.256	0.455	0.455
Grand Junction, CO	08-077-0017	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Grand Junction, CO	08-077-0018	0.061 [a]	0.022 [a]	0.151	0.083	0.092	0.116	0.061	0.080	0.076	0.075	0.092	0.033	0.068	0.073
Washington, DC	11-001-0043	0.053 [a]	0.022 [a]	0.094	0.074	0.077	0.058	0.041	0.052	0.103	0.068	0.054	0.026	0.045	0.045
Hillsborough County, FL	12-057-3002	0.013 [a]	0.016 [a]	0.032	0.029	0.054	0.032	0.016	0.024	0.034	0.034	0.038	0.015	0.023	0.059
Pinellas County, FL	12-103-0026	0.013 [a]	0.016 [a]	0.032	0.029	0.054	0.032	0.016	0.024	0.034	0.034	0.038	0.015	0.023	0.059
Decatur, GA	13-089-0002	0.107 [a]	0.063 [a]	0.041	0.113	0.196	0.225	0.119	7.413	0.169	0.151	0.255	0.060	0.119	0.098
Northbrook, IL	17-031-4201	0.061 [a]	0.022 [a]	0.151	0.083	0.092	0.116	0.061	0.080	0.076	0.075	0.092	0.033	0.068	0.073
Grayson Lake, KY	21-043-0500	0.061 [a]	0.022 [a]	0.151	0.083	0.092	0.116	0.061	0.080	0.076	0.075	0.092	0.033	0.068	0.073
Boston, MA	25-025-0042	0.031 [a]	0.016 [a]	0.059	0.042	0.085	0.039	0.049	0.043	0.241	0.070	0.048	0.022	0.036	0.024
Dearborn, MI	26-163-0033	0.061 [a]	0.022 [a]	0.151	0.083	0.092	0.116	0.061	0.080	0.076	0.075	0.092	0.033	0.068	0.073
St. Louis, MO	29-510-0085	0.061 [a]	0.022 [a]	0.151	0.083	0.092	0.116	0.061	0.080	0.076	0.075	0.092	0.033	0.068	0.073
Bronx, NY	36-005-0110	0.032 [a]	0.044 [a]	0.063	0.049	0.077	0.093	0.041	0.035	0.069	—	0.054	0.026	0.045	0.045
Rochester, NY	36-055-1007	0.032 [a]	0.044 [a]	0.063	0.049	0.077	0.093	0.041	0.035	0.069	0.068	0.054	0.026	0.045	0.045
Portland, OR	41-051-0246	0.128 [a]	0.222	0.315	0.245	—	0.232	—	0.261	—	0.340	0.269	0.154	—	—
La Grande, OR	41-061-0119	0.128 [a]	0.222	0.315	0.245	—	0.232	—	0.261	—	0.340	0.269	0.154	—	—
Providence, RI	44-007-0022	0.035 [a]	0.018 [a]	0.063	0.039	0.085	0.042	0.045	0.038	0.261	0.075	0.048	0.020	0.036	0.023
Chesterfield, SC	45-025-0001	0.397	0.368	1.185	0.695	1.194	1.061	0.584	0.654	0.915	1.203	0.991	0.420	0.651	0.578
Deer Park, TX	48-201-1039	2.753	1.308	10.716	4.991	11.859	3.612	4.423	1.670	9.427	11.076	8.401	1.101	4.094	4.094
Harrison County, TX	48-203-0002	0.864	0.599	1.702	1.028	1.540	0.787	1.095	0.487	1.376	1.631	1.562	0.435	0.910	0.910
Bountiful, UT	49-011-0004	0.062 [a]	0.023 [a]	0.154	0.085	0.094	0.118	0.062	0.081	0.077	0.076	0.093	0.034	0.069	0.074
Underhill, VT	50-007-0007	0.055 [a]	0.019 [a]	0.135	0.072	0.080	0.107	0.054	0.075	0.073	0.064	0.080	0.028	0.063	0.063
Richmond, VA	51-087-0014	0.090 [a]	0.195	0.277	0.245	0.262	0.421	0.101	0.264	0.275	0.211	0.328	0.138	0.214	0.068
Seattle, WA	53-033-0080	0.062 [a]	0.023 [a]	0.154	0.084	0.094	0.118	0.062	0.081	0.077	0.076	0.093	0.034	0.069	0.074
Horicon, WI	55-027-0001	0.320	0.222	0.630	0.489	0.770	0.463	0.406	0.348	0.688	0.680	0.539	0.256	0.455	0.455
Geometric Mean	0.088	0.058	0.184	0.129	0.177	0.165	0.105	0.140	0.153	0.155	0.153	0.066	0.117	0.118	
Arithmetic Mean	0.228	0.150	0.663	0.365	0.751	0.361	0.349	0.495	0.652	0.677	0.541	0.146	0.347	0.341	
Standard Deviation	0.534	0.269	2.043	0.953	2.348	0.708	0.884	1.422	1.988	2.155	1.606	0.228	0.815	0.815	
Median	0.061	0.023	0.151	0.083	0.092	0.116	0.061	0.080	0.076	0.075	0.092	0.033	0.068	0.073	

Table 19. MDLs by Site and Overall for CY2010 (VOCs and Carbonyls: µg/m^3; Metals and PAHs: ng/m^3) (continued).

Site Name	AQS Site Code	ACRO	ACRY	NAPH	BaP	FORM	ACET	AS	BE	CD	PB	MN	HG	NI	CR(VI)
Phoenix, AZ	04-013-9997	0.083	0.059	1.418 [a]	0.049	0.012	0.023	0.061 [a]	0.027	0.010	0.010	0.043	0.052	0.006	0.003 [a]
Los Angeles, CA	06-037-1103	0.409	— [b]	1.666 [a]	0.057	0.123	0.181	0.100 [a]	0.100	0.100	0.100	0.100	—	0.100	0.020
Rubidoux, CA	06-065-8001	0.410	—	1.400 [a]	0.048	0.123	0.181	0.100 [a]	0.100	0.100	0.100	0.100	—	0.100	0.024
San Jose, CA	06-085-0005	0.400	0.218	1.488 [a]	0.051	0.123	0.181	0.059 [a]	0.001	0.075	0.790	1.235	0.011	1.678	—
Grand Junction, CO	08-077-0017	—	—	—	—	—	—	—	—	—	—	—	—	—	0.003 [a]
Grand Junction, CO	08-077-0018	0.083	0.059	1.818 [a]	0.063	0.005 [a]	0.011	—	—	—	—	—	—	—	—
Washington, DC	11-001-0043	—	0.022	1.857 [a]	0.063	0.032	0.023	0.540 [a]	0.690	0.840	3.991	1.690	—	2.729	0.003 [a]
Hillsborough County, FL	12-057-3002	0.232	0.024	1.397 [a]	0.048	0.005 [a]	0.011	0.460 [a]	0.200	0.150	1.040	0.140	—	0.920	0.003 [a]
Pinellas County, FL	12-103-0026	0.232	0.024	1.367 [a]	0.046	0.004 [a]	0.009	0.460 [a]	0.200	0.150	1.040	0.140	—	0.920	0.003 [a]
Decatur, GA	13-089-0002	0.044	—	1.499 [a]	0.052	1.080	1.080	0.158 [a]	0.010	0.002	0.010	0.010	—	0.020	0.003 [a]
Northbrook, IL	17-031-4201	0.083	0.059	1.261 [a]	0.044	0.005 [a]	0.006	0.052 [a]	0.001	0.076	0.799	0.330	0.011	1.643	0.003 [a]
Grayson Lake, KY	21-043-0500	0.083	0.059	1.130 [a]	0.039	0.035	0.035	0.211 [a]	0.187	0.067	0.089	0.358	—	0.154	0.003 [a]
Boston, MA	25-025-0042	0.115	0.257	1.163 [a]	0.039	0.080	0.108	0.045 [a]	0.001	0.075	0.797	0.329	0.010	1.639	0.003 [a]
Dearborn, MI	26-163-0033	0.083	0.059	1.355 [a]	0.047	0.004 [a]	0.009	0.086 [a]	0.045	0.047	—	0.315	—	0.161	0.003 [a]
St. Louis, MO	29-510-0085	0.083	0.059	1.195 [a]	0.041	0.005 [a]	0.009	0.070 [a]	0.001	0.077	4.591	0.334	0.061	2.225	0.003 [a]
Bronx, NY	36-005-0110	0.069	—	1.258 [a]	0.045	0.018	0.018	0.521 [a]	0.521	0.260	0.260	0.521	—	0.521	0.002 [a]
Rochester, NY	36-055-1007	0.069	—	0.861 [a]	0.029	0.018	0.018	0.521 [a]	0.521	0.260	0.260	0.521	—	0.521	0.003 [a]
Portland, OR	41-051-0246	—	—	1.011 [a]	0.282	0.109	0.029	0.034 [a]	0.003	0.034	0.336	0.336	—	0.336	0.034
La Grande, OR	41-061-0119	—	—	1.122 [a]	0.305	0.122	0.030	0.037 [a]	0.004	0.037	0.368	0.368	—	0.368	0.037
Providence, RI	44-007-0022	0.113	0.255	1.652 [a]	0.058	0.052	0.018	0.079 [a]	0.042	0.141	0.146	0.030	—	0.040	0.003 [a]
Chesterfield, SC	45-025-0001	0.000	—	1.419 [a]	0.049	0.250	0.223	0.003 [a]	0.003	0.002	0.002	0.006	—	0.029	0.003 [a]
Deer Park, TX	48-201-1039	0.505	—	1.628 [a]	0.056	0.111	0.253	0.133 [a]	0.028	0.030	0.145	0.118	—	0.249	0.003 [a]
Harrison County, TX	48-203-0002	0.230	—	—	—	0.098	0.145	0.133 [a]	0.028	0.030	0.145	0.118	—	0.249	0.006
Bountiful, UT	49-011-0004	0.084	0.060	1.966 [a]	0.068	0.005 [a]	0.010	0.068 [a]	0.030	0.012	0.012	0.049	—	0.010	0.003 [a]
Richmond, VA	51-087-0014	0.193	0.178	1.648 [a]	0.057	0.077	0.064	0.030 [a]	0.018	0.010	0.043	0.045	—	0.262	0.003 [a]
Seattle, WA	53-033-0080	0.084	0.060	1.187 [a]	0.041	0.006 [a]	0.013	0.043 [a]	0.001	0.078	0.827	0.341	0.009	1.701	0.003 [a]
Horicon, WI	55-027-0001	0.230	.	0.649 [a]	0.031	0.245	0.544	0.029 [a]	0.010	0.016	0.034	0.094	—	0.093	0.003 [a]
Geometric Mean	0.135	0.069	1.344	0.055	0.033	0.040	0.088	0.022	0.045	0.156	0.145	0.021	0.214	0.004	
Arithmetic Mean	0.167	0.094	1.379	0.068	0.102	0.120	0.157	0.108	0.103	0.638	0.297	0.029	0.641	0.007	
Standard Deviation	0.137	0.082	0.303	0.067	0.207	0.226	0.177	0.186	0.166	1.156	0.383	0.023	0.789	0.010	
Median	0.084	0.059	1.398	0.049	0.035	0.023	0.075	0.028	0.071	0.146	0.140	0.011	0.256	0.003	

[a] Meets MQO.
[b] Not reported.

Table 20. Comparison of Method Detection Limits Reported by ERG Laboratory for Metals between High- and Low-Volume Samplers in CY2010.

Analyte	Method Detection Limits (ng/m^3) Median (Std. Dev.) 2000 m^3 Samples[a]	20 m^3 Samples[b]	MDL Ratio (High/Low)
Arsenic	0.0530(0.0675)	0.060 (0.0075)	0.88
Beryllium	0.00100 (0.0002)	0.0300 (.0039)	0.03
Cadmium	0.0770 (0.00224)	0.0100 (.0024)	7.70
Chromium (VI)	0.0028(0.0010)	0.0026(.0010)	1.08
Manganese	0.3370(0.6048)	0.0400(.0050)	8.43
Nickel	1.6800(0.0484)	0.0060(.0020)	280
Lead	0.8190(5.4297)	0.0100(.0024)	81.9

[a] Based on six sites conducting high-volume PM_{10} sampling.
[b] Based on two sites conducting low-volume PM_{10} sampling.

Table 21. Summary Statistics for Method Detection Limits across All Reporting NATTS Laboratories for 2010.

MDL	Selected Analyte Benzene ($\mu g/m^3$)	1,3-butadiene ($\mu g/m^3$)	Formaldehyde ($\mu g/m^3$)	Arsenic (ng/m^3)	Chromium (VI) (ng/m^3)	Naphthalene (ng/m^3)
Geometric Mean	0.070	0.048	0.031	0.074	0.004	1.293
Arithmetic Mean	0.098	0.085	0.111	0.123	0.007	1.380
Standard Deviation	0.095	0.092	0.239	0.159	0.012	0.425
Minimum	0.013	0.010	0.002	0.011	0.001	0.120
Median	0.061	0.022	0.037	0.054	0.003	1.360
Maximum	0.397	0.368	1.080	1.330	0.300	7.40
MQO	0.130	0.1	0.100	1.0	0.004	29.0
Ratio of Geo. Mean to MQO	0.5	0.5	0.3	0.1	0.9	0.04

3.0 SUMMARY

Based on four HAPs representative of the various chemical classes—benzene, 1, 3-butadiene, formaldehyde, and arsenic, the following summary comments are appropriate for the 2010 NATTS data.

1. Excluding NATTS sites intentionally not collecting data for a particular analyte class (e.g., PM_{10} metals), the mean completeness percentages of data reported into AQS across all NATTS sites were 94%, 96%, 96%, 98%, 97%, 100%, and 100% for benzene, 1, 3-butadiene, acrolein, naphthalene, formaldehyde, chromium (VI), and arsenic, respectively. Completeness statistics reported in 2010 for VOCs were noticeably less consistent among laboratories in 2010, often not meeting the MQO. Overall, however, the MQO was achieved for all seven analytes at most sites. Only one site failed to meet the MQO among all sites for naphthalene, chromium (VI), or arsenic.
2. The distribution of all measurements reflects a predominance of values above the method detection limit and above the measurement quality objective.
3. With a few exceptions as noted in the text of this report, analytical precision among sites for which replicate analyses were available was found to be below the 15% MQO threshold for all analytes used to reflect their respective chemical classes. Appreciable variability in analytical precision was observed for all analytes. As expected, the frequency of cases where the MQO threshold was exceeded was distinctly greater for overall precision (i.e., including sampling and analysis) among all analytes with 19, 69, 79, 29, 43, 50, and 50% of reporting laboratories achieving the MQO for benzene, 1, 3-butadiene, acrolein, formaldehyde, naphthalene, chromium (VI), and arsenic, respectively. Overall, these percentages are poor for some analytes and better for others compared to 2009. Estimates of overall precision included both duplicate and collocated samples. In the few cases where a comparison was possible, analytical and overall precision was better (i.e., smaller %CV) when computed only from values exceeding the MDL. Laboratory performance, as assessed by the percentage difference between the laboratory measurement and the certified sample concentration of the proficiency testing samples, was within the ±25% CV MQO for most analytes (i.e., benzene, 1,3-butadiene, formaldehyde, and arsenic) and for laboratories with available data from 2010. Conversely, naphthalene exhibited a substantial negative bias among all labs. The poorest performance (%CV) across all laboratories and analytes was observed for manganese (13.6), acrolein (30.0), and naphthalene (34). The proportion of laboratories participating in the 2010 performance testing program ranged from 86% (carbonyls) to 100% (metals and PAHs) a slight decrease from participation in 2009. Laboratories not performing analyses of a particular analyte were excluded from these statistics.
4. With one exception (Underhill, VT), sampler flows measured during IPAs conducted at NATTS field sites showed less than ±10% difference from their site-recorded values.
5. Among all measures of data quality, MDLs were frequently greater than the corresponding MQOs and showed substantial variability for any given analyte across sites (i.e., laboratories). Due in part to increased MQOs for MDLs, the proportion of measured values above this threshold was remarkably smaller than in previous years; for many analytes the mean value fell within the MQO threshold when all laboratories were considered together. The ratios of the cross-network geometric means to the corresponding MQOs were 0.5, 0.5, 0.3, 0.1, 0.9, and 0.04 for benzene, 1, 3-butadiene, formaldehyde, arsenic, chromium (VI), and naphthalene, respectively.

4.0 RECOMMENDATIONS

The information, both analytical results and site characteristics, for the NATTS network samples present in the AQS database was acquired successfully, based on a thorough understanding of the database structure. Based on knowledge of POC assignments in previous years, the POCs for the primary, duplicate, and collocated samples were assigned with greater facility than in previous years. However, as in previous years, acquiring MDL data for laboratories not posting MDLs to AQS directly continues to be problematic and requires substantial effort.

As stated in earlier reporting years, the POCs are present in the AQS database, but the associated sample type information (e.g., primary, duplicate, or collocated) is not. There is no definitive way to determine, from AQS alone, the relationship between specific POCs and primary, duplicate, or collocated samples, for a given site. Because POCs are assigned by either the agency monitoring a particular NATTS site or the laboratory uploading the data to AQS, and are largely non-standardized across NATTS sites [4, 5, 6, and 7] (see **Table 6**), the inclusion of a field in the AQS database to specify whether a particular POC is "primary," "duplicate," or "collocated" would be of enormous benefit to the utility of the AQS data and would greatly streamline the analyses reported here.

Summary statistics created for this report reflect the overall condition of the data but may, in some cases, be unduly influenced by selected extreme values. Instances where the summary statistics fall outside of the MQOs warrant further investigation of the individual data points as deemed appropriate by EPA.

The acquisition and assembly of MDL information was again aided dramatically through the extraction of the ALT_MDL field for RD records in the AQS database. Only instances where this optional field was not populated by the contributing laboratory (~15-20%) required direct contacts with individual laboratory supervisors. Changing the character of this AQS field to "required" would completely eliminate the need for this follow-up step. Lastly, AQS accepts data in a variety of units at the discretion of the agency performing the upload. This requires very careful scrutiny of the UNIT variable so that MDL measurements can be standardized algebraically prior to data analysis. Standardization of MDLs posted in the ambiguous "ppbC" unit is particularly problematic. Restriction of reporting to the completely unambiguous mass/volume (e.g., $\mu g/m^3$) would improve the quality of the data substantially.

5.0 REFERENCES

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