NATIONAL AIR TOXICS TRENDS STATIONS QUALITY ASSURANCE ANNUAL REPORT CALENDAR YEARS 2011 AND 2012

FINAL

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FORWARD

This technical report was prepared by Battelle under Contract No. GS-10F-0275K, Task Order EP-G11D-00028. This report describes the Quality Assurance (QA) data collected for the NATTS program during calendar years (CYs) 2011 and 2012. The report was prepared for Margaret Dougherty, Task Order Project Officer, and David Shelow, Alternate Task Order Project Officer at the Office of Air Quality Planning and Standards (OAQPS) in Research Triangle Park, North Carolina.

Please note that this report contains a change to the analysis that differs from previous quality assurance annual reports. The change pertains to the analysis of the precision data. In the previous report for 2010, all precision data records that reported a value, whether below, equal to, or above the method detection limit (MDL), were included in the precision calculations as described in Section 2.5. In this report, data are utilized for the precision calculations for each site and HAP only where both results in the replicate pair are equal to or above the reported MDL.

This report was revised to correct the MDL measurement quality objective (MQO) for naphthalene. The naphthalene MDL MQO was reported to be 0.029 ng/m^3 in the April 17, 2014 version of report, which was in error. The correct value is 29.0 ng/m^3. Applicable sections of this report have been changed to reflect the correct MDL.

NATIONAL AIR TOXICS TRENDS STATIONS QUALITY ASSURANCE ANNUAL REPORT CALENDAR YEARS 2011 AND 2012

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ABBREVIATIONS AND ACRONYMS

AQS	Air Quality System
CV	coefficient of variation
CY	calendar year
DQI(s)	data quality indicator(s)
DQO	data quality objective
HAP(s)	hazardous air pollutant(s)
IPA(s)	instrument performance audit(s)
IQR	interquartile range
LC	local conditions
MDL(s)	method detection limit(s)
MQO(s)	measurement quality objective(s)
NATTS	National Air Toxics Trends Stations
NIST	National Institute of Standards and Technology
PAH(s)	polycyclic aromatic hydrocarbon(s)
POC(s)	parameter occurrence code(s)
PTs)	proficiency test(s)
QAAR	quality assurance annual report
QTR	quarter
RD	raw data record in AQS
RP	replicate record in AQS
STP	standard temperature and pressure
TSA	technical systems audit
VOC(s)	volatile organic compound(s)

1.0 INTRODUCTION

As mandated under the Government Performance Results Act, the U.S. Environmental Protection Agency (EPA) is focused on reducing the 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 calendar years (CY) 2011 and 2012, 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 three primary components: (1) Technical Systems Audits (TSAs) of sample analysis laboratories and network stations, (2) Instrument Performance Audits (IPAs) of network stations, and (3) quarterly proficiency testing (PT) of the sample analysis laboratories. These assessments ensure that sampling and analysis techniques are consistent with required completeness, precision, bias, and method detection limits (MDLs) as specified by the NATTS Measurement Quality Objectives (MQOs).

This report describes and summarizes the quality assurance (QA) data generated for the NATTS program during CY2011 and CY2012. For data retrieved from EPA's Air Quality Systems (AQS) database, only data input prior to November 7, 2013, are considered in this assessment. Although this report details substantive information on 27 different HAPs of interest, it focuses primarily on results for seven pollutants: acrolein, benzene, 1,3-butadiene, formaldehyde, naphthalene, PM_{10} arsenic, and chromium (VI). These pollutants represent each of the five classes of HAPs that are analyzed within the NATTS program: VOCs, carbonyls, PAHs, PM_{10} metals, and hexavalent chromium. At the request of EPA, these seven pollutants were selected as being representative of their respective constituent class and were of particular interest by virtue of their associated health risk due to inhalation exposure and the frequency of their occurrence at measurable concentrations. Although no HAP or group of HAPs can provide complete representation of their respective HAP class, it is presumed that if the NATTS program can meet the measurement quality objectives (MQOs) for these seven HAPs, the additional 20 pollutants 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.

The 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 sites, HAPs of interest, and MQOs;
- Assessment of the completeness of the data available in the AQS database;

- Precision estimates for both analytical and overall sampling error computed for as many of the 27 HAPs and for as many of the 27 NATTS sites as available in AQS for CY2011 and CY2012;
- Evaluation of analytical laboratory bias based on results of blind audit PT samples for many of the 27 HAPs;
- Field bias data, which are expressed as the percent difference between sampler flow readings and a calibrated flow standard for each of four different sampler types associated with carbonyls, PM_{10} metals, chromium (VI), and PAHs for primary samplers and precision (collocated or duplicate) samplers (where available) during IPAs conducted at eight sites visited in CY2011 and five sites visited in CY2012; and
- MDL data for each site. The AQS database, specifically the ALT_MDL variable, was used as the source of MDLs for CY2011 and CY2012.

Where possible, all data analyses were performed in SAS, version 9.3. Graphs and plots were prepared using STATA version 13.0. Field flow audit data were transcribed into Microsoft Excel.

2.0 NATTS QUALITY ASSURANCE DATA FOR CY2011 AND CY2012

2.1 The NATTS Network Sites in CY2011 and CY2012

The NATTS network included 27 sites in CY2011 and CY2012. Table 1 lists these sites along with the EPA Region in which each site is located, the site name, whether the site is located in a predominantly urban or rural area, and the site's unique AQS identification code [1].

Although a city and state are typically used as the site name, a county name is used for the two Florida sites on either side of Tampa Bay, for the South Carolina site, and for the site located in Harrison County, TX. Historical consistency has been maintained for the Grand Junction, CO site, to which two separate AQS site identification codes were assigned, one code for VOCs, carbonyls, PAHs, and chromium (VI) (08-077-0018), and another code for PM_{10} metals (08-077-0017). This convention is unique to this site and is used because the organics and metals samplers are situated at separate physical locations at the sampling site. The Bronx, NY site had a different AQS site code starting in July 2012, when the site location changed upon completion of renovation construction. Prior to July 2012, this site had a site code of 36-005-0080, and upon completion of the renovation, sample collection resumed under site code 36-005-0110.

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

EPA Region	Site Name	Site Type	AQS Site Identification 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	36-005-0080[a], -0110[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	Rural	55-027-0001
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[c], -0018[d]
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 July 2012
[b] Resumed July 2012
[c] PM_{10} metals only
[d] VOCs, carbonyls, PAHs, and Cr(VI) only

2.2 HAPs Measured in the NATTS Network in CY2011 and CY2012

The 27 HAPs measured in the NATTS program are listed in Table 2. EPA selected these air pollutants due to their 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 also specified in this table, as they are used to identify HAPs in subsequent tables and figures throughout this report.

Table 2. The 27 NATTS Hazardous Air Pollutants and Air Quality Systems Parameter Codes

HAP	HAP Abbreviation	AQS Label	AQS Code(s)	HAP Class
benzene	BENZ[a]	Benzene	45201	VOC
1,3-butadiene	BUTA[a]	1,3-Butadiene	43218	VOC
carbon tetrachloride	CTET	Carbon Tetrachloride	43804	VOC
chloroform	CLFRM	Chloroform	43803	VOC
1,2-dibromoethane	EDB	Ethylene Dibromide	43843	VOC
1,2-dichloropropane	DCP	1,2-Dichloropropane	43829	VOC
1,2-dichloroethane	EDC	Ethylene Dichloride	43815	VOC
dichloromethane	MECL	Dichloromethane	43802	VOC
1,1,2,2-tetrachloroethane	TCE1122	1,1,2,2-Tetrachloroethane	43818	VOC
tetrachloroethylene	PERC	Tetrachloroethylene	43817	VOC
trichloroethylene	TCE	Trichloroethylene	43824	VOC
vinyl chloride	VC	Vinyl Chloride	43860	VOC
cis-1,3-dichloropropene	cDCPEN	Cis-1,3-Dichloropropylene	43831	VOC
trans-1,3-dichloropropene	tDCPEN	Trans-1,3-Dichloropropylene	43830	VOC
acrolein	ACRO[a]	Acrolein	43505[b] 43509[c]	VOC
acrylonitrile	ACRY	Acrylonitrile	43704	VOC
naphthalene	NAPH[a]	Naphthalene (TSP) STP	17141[d]	PAH
benzo[a]pyrene	BaP	Benzo[A]Pyrene (TSP) STP	17242[d]	PAH
formaldehyde	FORM[a]	Formaldehyde	43502	Carbonyl
acetaldehyde	ACET	Acetaldehyde	43503	Carbonyl
arsenic	As[a]	Arsenic PM_{10}	82103[d] 85103[e]	Metal
beryllium	Be	Beryllium PM_{10}	82105[d] 85105[e]	Metal
cadmium	Cd	Cadmium PM_{10}	82110[d] 85110[e]	Metal
lead	Pb	Lead PM_{10}	82128[d] 85128[e]	Metal
manganese	Mn	Manganese PM_{10}	82132[d] 85132[e]	Metal
nickel	Ni	Nickel PM_{10}	82136[d] 85136[e]	Metal
chromium (VI)	CrVI[a]	Chromium (VI) TSP	12115[d] 14115[e]	Metal

[a] HAP is representative of other chemicals in this class.
[b] unverified results
[c] verified results
[d] standard conditions (STP)
[e] local conditions (LC)

Note that the superscript "a" in the HAP Abbreviation column of Table 2 denotes the seven HAPs that serve as representative of their respective constituent classes for this quality investigation: acrolein, benzene, 1,3-butadiene, formaldehyde, naphthalene, PM_{10} arsenic, and chromium (VI). In this document, these seven HAPs are referred to the HAPs of "primary importance" to the NATTS program.

2.3 Measurement Quality Objectives

MQOs applicable to the various data quality indicators (DQIs) for seven HAPs of primary importance are summarized in Table 3. The MQOs for the DQIs of completeness, precision, and laboratory bias, as established for the NATTS program to ensure acceptable data quality within the network, are documented in the Technical Assistance Document [4] dated April 1, 2009. The DQI of sensitivity is represented as the method detection limits (MDLs), and the MDL MQOs for CY2011 and CY2012 are documented in the National Air Toxics Trends Station Work Plan Template revised 2/09/2011 and 4/11/2012, respectively [2, 3]. The stated Data Quality Objective (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" [5].

Table 3. Measurement Quality Objectives for the Seven HAPs of Primary Importance to the NATTS Program

	Data Quality Indicators [a]				
				Method Detection Limit (MDL) (Section 2.8)	
HAP	**Completeness (Section 2.4)**	**Analytical and Overall Precision (% Coefficient of Variation) (Section 2.5)**	**Laboratory Bias (Section 2.6)**	**CY2011**	**CY2012**
acrolein	> 85%	< 15%	≤ 25%	≤ 0.10 μg/m^3	≤ 0.09 μg/m^3
benzene				≤ 0.13 μg/m^3	≤ 0.13 μg/m^3
1,3-butadiene				≤ 0.10 μg/m^3	≤ 0.10 μg/m^3
formaldehyde				≤ 0.98 μg/m^3	≤ 0.08 μg/m^3
naphthalene				≤ 29 ng/m^3	≤ 29 ng/m^3
arsenic (PM_{10})				≤ 0.23 ng/m^3	≤ 0.23 ng/m^3
chromium(VI)				≤ 0.08 ng/m^3	≤ 0.08 ng/m^3

a. Technical Assistance Document for the National Ambient Air Toxics Trends and Assessment Program, Revision 2, April 2009. [4]

Additional information and requirements associated with the DQIs and MQOs in Table 3 are as follows:

1 Completeness is measured by calculating the percentage of full sample collection that occurred, where full sample collection denotes the collection of samples every sixth day through the entire calendar year.

2 Precision is calculated as the percent coefficient of variation (CV) for replicate analyses, and for duplicate and collocated samples. Two types of precision are assessed: analytical precision, and overall precision.

3 Bias denotes the assessment of laboratory performance through analysis of blind audit PT samples.

4 MDLs inform measurement sensitivity. Sensitivity requirements are achieved if the reported MDLs are less than or equal to target MDLs in Table 3.

5 Comparability requirements are achieved if the methods are consistent and all of the above MQOs are met.

The MQO for flow rate, or field, bias is ≤ 10%. Data acquired to assess compliance with the MQOs were derived from a variety of sources. These sources are given in Table 4.

Table 4. Data Sources Used to Evaluate the NATTS Data Quality Indicators

Data Quality Indicator	Data Source
Representativeness/Completeness	AQS
Analytical and Overall Precision	AQS
Bias – Laboratory/analytical	Proficiency testing results reported by Wibby Environmental and Battelle
Bias – Flow rate/sampling	Audits of sampler flow rates conducted by RTI International
Sensitivity/MDL	AQS augmented with information from the analytical laboratories

For completeness, precision (analytical and overall), and MDL metrics, Battelle retrieved from the AQS database data records corresponding to relevant samples collected from the 27 NATTS sites during CY2011 and CY2012. Only those data present in AQS prior to November 7, 2013 were included in this report .

Analytical bias was calculated using PT sample analysis results distributed by Wibby Environmental (in the 2^{nd} quarter (QTR2) of 2011) and Battelle (in the 4^{th} quarter (QTR4) of 2011 and the 1^{st} quarter (QTR1) of 2012). Sampling bias was estimated using results from independent measurement of sampler flow rates with National Institute of Standards and Technology (NIST)-traceable flow standards during on-site Instrument Performance Audits (IPAs).

2.4 Completeness of NATTS Data

Tables 5 and 6 present the completeness of NATTS data in AQS for CY2011 and CY2012 for the seven HAPs of primary importance to the NATTS program. Based on the specified collection frequency MQO of 1-in-6 day sample collection, 61 records for the primary parameter occurrence code (POC) represent 100% completeness. Thus, for a given HAP and site, percentage complete was calculated by dividing by 61 the total number of records with valid results reported to AQS. For the purposes of this completeness calculation, nondetects were counted as valid results, but missing values or nullified results were not.

Completeness statistics were computed using records corresponding to primary measurements or, if the primary measurement was missing, to collocated measurement(s) collected at the same location during the same sampling period. A record was understood to be missing if no record existed in AQS for the expected date, the record did not include a result, or the record was nullified. Only a single record was included for each site, date, and HAP.

Sample collection at some sites was performed more frequently than others in order to meet the requirements of other sampling networks or for other specific purposes. Thus, an algorithm was developed to compile the AQS data so as to allow for flexibility in handling missed and subsequent make-up samples which may not have complied strictly with the NATTS protocol of sampling every six days. This algorithm was designed as follows:

1. RD (raw data) records in AQS corresponding to any POC were considered valid if the “Sample Value” was not specified as missing and “Sample Duration” was equal to 7

(corresponding to 24-hour sample collection). This included any primary, duplicate, or collocated data in the RD dataset.

2. A maximum of one record was counted per given sampling day.
3. The first record reported in a given calendar year was always counted. The date of this record was then used to determine the elapsed time to the next record.
4. Any record that corresponded to sampling at six or more days following the previous record was always counted.
5. If a record corresponded to sampling at fewer than six days after the previous record, then that record is counted only if the time interval between the record and the immediate prior two records is 12 days or more. (This assumes that the sample serves as a make-up for a sample that was missed prior to the last record. It eliminates the use of back-to-back samples to make up for weeks of missing data.)

The calculated percentage complete values are presented for each NATTS site and for each of the seven HAPs of primary importance in Table 5 and Table 6, for CY2011 and CY2012, respectively. These tables also include the mean and median percentage complete values across all NATTS sites for each HAP. Percentage complete values that fall below the NATTS MQO of 85% are noted in red within these tables. The percentage of NATTS sites meeting the completeness MQO for CY2011 and CY2012 are shown in Table 7.

Table 5. Percentage Completeness Values by NATTS Site and the Seven HAPs of Primary Importance for CY2011

AQS Site Identification Code	Site Name	ACRO 43505 43509	BENZ 45201	BUTA 43218	FORM 43502	NAPH 17141	As 82103 85103	CrVI 12115 14115
		HAP Abbreviation and Parameter Code(s)						
25-025-0042	Boston, MA	98%	98%	98%	100%	100%	97%	100%
50-007-0007	Underhill, VT	0% [b]	92%	92%	93%	95%	80%	93%
44-007-0022	Providence, RI	89%	89%	89%	85%	92%	92%	90%
36-005-0080	Bronx, NY	98%	98%	98%	90%	98%	95%	98%
36-055-1007	Rochester, NY	85%	85%	85%	85%	93%	89%	92%
11-001-0043	Washington, DC	98%	93%	93%	97%	93%	95%	97%
51-087-0014	Richmond, VA	97%	97%	97%	95%	95%	95%	98%
45-025-0001	Chesterfield, SC	100%	100%	100%	95%	98%	98%	97%
13-089-0002	Decatur, GA	97%	97%	97%	97%	92%	93%	93%
21-043-0500	Grayson Lake, KY	98%	100%	100%	84%	100%	98%	100%
12-057-3002	Hillsborough County, FL	98%	98%	98%	98%	97%	100%	93%
12-103-0026	Pinellas County, FL	100%	100%	100%	100%	98%	97%	98%
26-163-0033	Dearborn, MI	98%	100%	100%	100%	98%	100%	98%
55-027-0001	Horicon, WI	97%	97%	97%	100%	98%	97%	100%
17-031-4201	Northbrook, IL	82%	84%	84%	98%	98%	87%	97%
48-201-1039	Deer Park, TX	100%	93%	93%	93%	100%	97%	98%
48-203-0002	Harrison County, TX	100%	98%	98%	95%	97%	98%	100%
29-510-0085	St. Louis, MO	88%	92%	92%	95%	93%	97%	93%
49-011-0004	Bountiful, UT	87%	90%	90%	97%	100%	98%	98%
08-077-0017, 0018	Grand Junction, CO	98%	98%	98%	98%	100%	95%	90%
04-013-9997	Phoenix, AZ	93%	95%	95%	80%	85%	97%	100%
06-085-0005	San Jose, CA	98%	98%	98%	100%	98%	95%	0% [a]
06-065-8001	Rubidoux, CA	79%	95%	79%	74%	100%	87%	98%
06-037-1103	Los Angeles, CA	79%	97%	79%	75%	97%	97%	98%
41-061-0119	La Grande, OR	50%	97%	97%	92%	95%	98%	98%
41-051-0246	Portland, OR	50%	97%	98%	100%	93%	97%	98%
53-033-0080	Seattle, WA	90%	90%	90%	89%	89%	90%	90%
	Mean	90%	95%	94%	93%	96%	95%	96%
	Median	97%	97%	97%	95%	97%	97%	98%

Note: Percentage complete values below 85% are specified in red.
a. Chromium (VI) was not collected at this site – this value was excluded from mean and median calculation.
b. All acrolein results were invalidated by the site administrator – this value was excluded from mean and median calculation.

Table 6. Percentage Completeness Values by NATTS Site and the Seven HAPs of Primary Importance for CY2012

AQS Site Identification Code	Site Name	ACRO 43505 43509	BENZ 45201	BUTA 43218	FORM 43502	NAPH 17141	As 82103 85103	CrVI 12115 14115
		HAP Abbreviation and Parameter Code(s)						
25-025-0042	Boston, MA	95%	95%	95%	97%	90%	100%	98%
50-007-0007	Underhill, VT	0% [b]	95%	95%	98%	95%	97%	100%
44-007-0022	Providence, RI	90%	92%	92%	85%	95%	93%	100%
36-005-0080, 0110	Bronx, NY	98%	98%	98%	80%	82%	97%	100%
36-055-1007	Rochester, NY	92%	92%	92%	87%	95%	77%	92%
11-001-0043	Washington, DC	100%	97%	97%	100%	85%	100%	97%
51-087-0014	Richmond, VA	95%	95%	95%	95%	89%	98%	97%
45-025-0001	Chesterfield, SC	97%	97%	97%	95%	85%	95%	82%
13-089-0002	Decatur, GA	100%	100%	100%	90%	95%	93%	89%
21-043-0500	Grayson Lake, KY	97%	98%	98%	100%	93%	97%	100%
12-057-3002	Hillsborough County, FL	95%	95%	95%	98%	93%	92%	95%
12-103-0026	Pinellas County, FL	93%	93%	93%	97%	98%	90%	98%
26-163-0033	Dearborn, MI	97%	97%	97%	98%	95%	100%	97%
55-027-0001	Horicon, WI	82%	82%	82%	79%	97%	93%	97%
17-031-4201	Northbrook, IL	89%	92%	92%	98%	92%	89%	100%
48-201-1039	Deer Park, TX	100%	100%	100%	97%	100%	100%	100%
48-203-0002	Harrison County, TX	100%	98%	98%	97%	92%	97%	97%
29-510-0085	St. Louis, MO	93%	95%	95%	100%	97%	100%	98%
49-011-0004	Bountiful, UT	85%	89%	89%	85%	93%	92%	95%
08-077-0017, 0018	Grand Junction, CO	89%	89%	89%	98%	98%	92%	93%
04-013-9997	Phoenix, AZ	98%	98%	98%	100%	95%	100%	95%
06-085-0005	San Jose, CA	98%	98%	98%	100%	95%	98%	0% [a]
06-065-8001	Rubidoux, CA	49%	49%	49%	49%	97%	98%	98%
06-037-1103	Los Angeles, CA	48%	48%	48%	48%	93%	98%	97%
41-061-0119	La Grande, OR	69%	90%	90%	90%	93%	95%	98%
41-051-0246	Portland, OR	95%	95%	95%	93%	95%	95%	98%
53-033-0080	Seattle, WA	93%	93%	93%	98%	92%	93%	93%
	Mean	90%	91%	91%	91%	93%	95%	96%
	Median	95%	95%	95%	97%	95%	97%	97%

Note: Percentage complete values below 85% are specified in red.
a. Chromium (VI) was not collected at this site – this value was excluded from mean and median calculation.
b. All acrolein results were invalidated by the site administrator – this value was excluded from mean and median calculation.

Figures 1 and 2 present "box and whisker" plots (or "boxplots") of the percentage complete values presented in Tables 5 and 6, respectively. Thus, they represent a summary of the distribution of percentage complete values across the 27 NATTS sites for each of the seven HAPs of primary importance. In these figures, the bottom and top of each "box" represents the 25th and 75th percentiles, respectively; the horizontal line inside the box represents the median value; and the diamond symbol represents the arithmetic mean. The "whiskers" emanating from both ends of a box extend to the largest or smallest values, up to a maximum length of 1.5 times the inter-quartile range (IQR), the distance between the 25th and 75th percentiles of the distribution of values (i.e., the length of the box). Any values that are more than 1.5 times the IQR in distance from the box are denoted by open circles. (The sites having percentage complete values represented by open circles are noted in these plots.) Within both Figure 1 and Figure 2, the dashed reference line at 85% denotes the NATTS MQO for completeness.

Table 7. Percentage of NATTS Sites Meeting the Completeness MQO for the Seven HAPs of Primary Importance for CY2011 and CY2012

Calendar Year	VOCs			carbonyls	PAHs	metals	
	Acrolein[a]	Benzene	1,3-Butadiene	Formaldehyde	Naphthalene	Arsenic	Chromium (VI)[b]
2011	77%	93%	85%	78%	96%	96%	100%
2012	81%	89%	89%	78%	89%	96%	96%

[a] Underhill, VT site excluded from the completeness calculation.
[b] San Jose, CA site excluded from the completeness calculation.

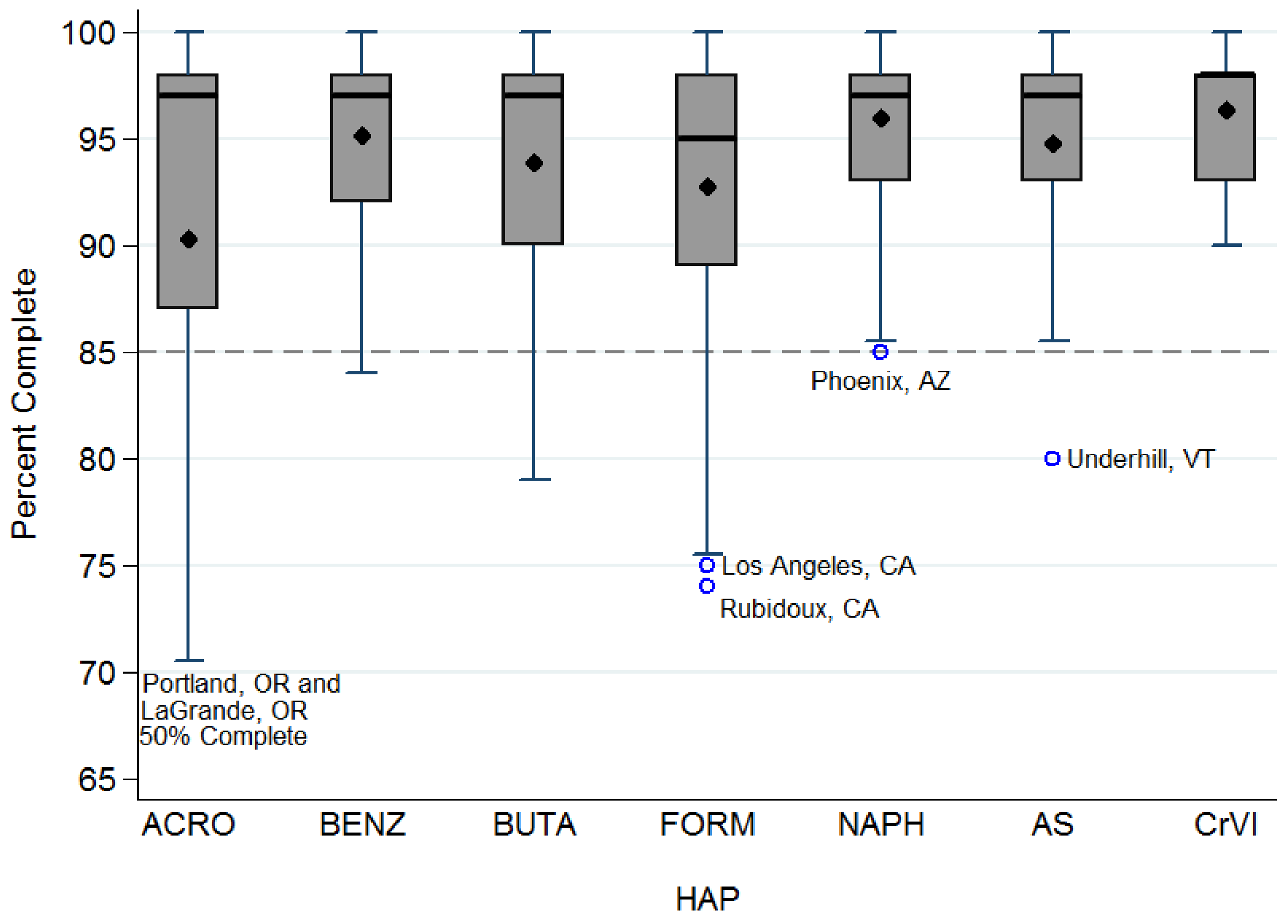

Figure 1. Box and Whisker Plot of Percentage Complete Values for the Seven HAPs of Primary Importance, for CY2011

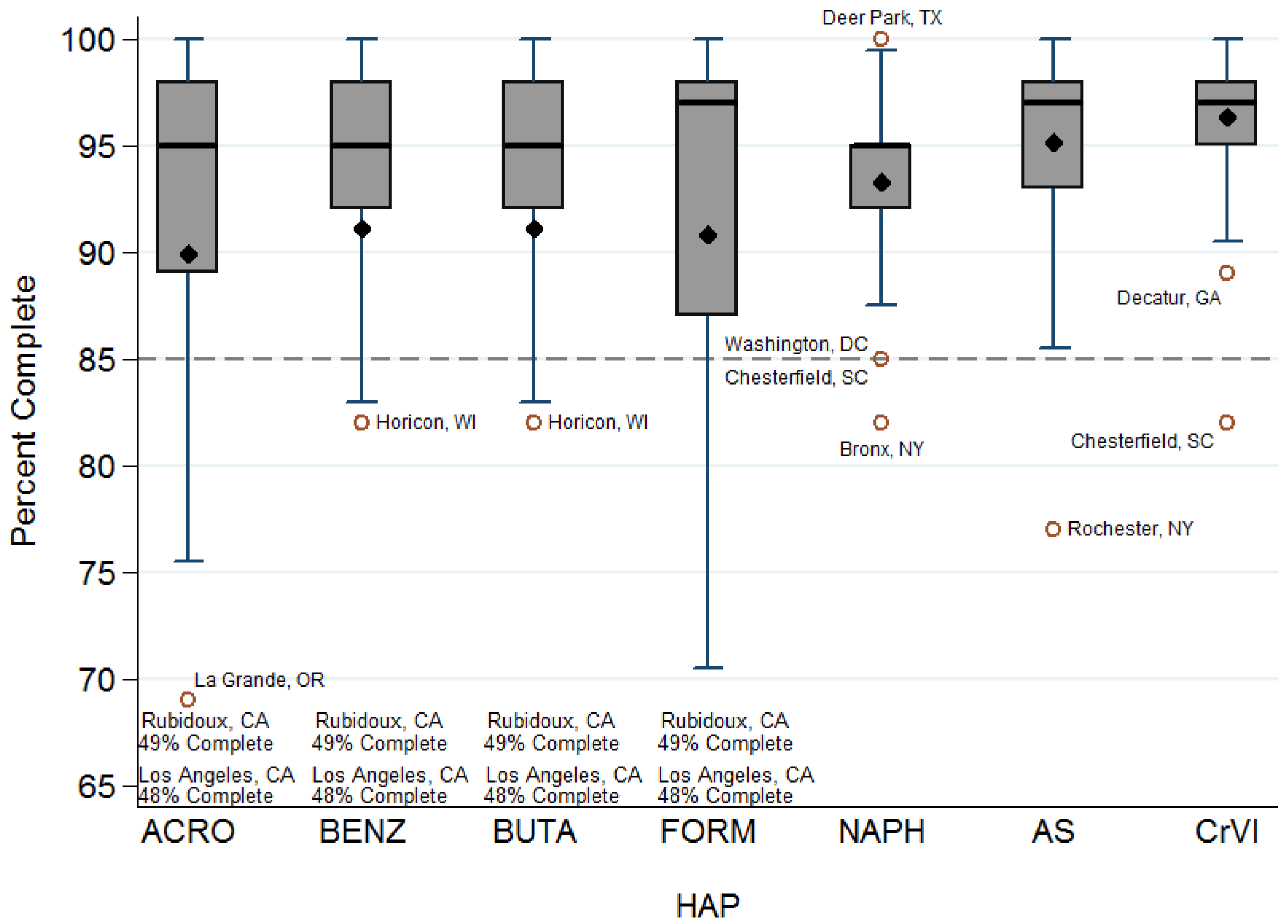

Figure 2. Box and Whisker Plot of Percentage Complete Values for the Seven HAPs of Primary Importance, for CY2012

Data completeness across the entire NATTS network met the MQO in both CY2011 and CY2012: both the mean and median network-wide completeness for all seven priority HAPs was greater than 85% in both CY2011 and CY2012. Failures of sites to meet the completeness MQO were generally more prevalent for VOCs and carbonyls than for other HAP groups for both CY2011 and CY2012. Some key findings were as follows:

- Los Angeles, CA, and Rubidoux, CA, did not achieve the MQO for acrolein, 1,3-butadiene, and formaldehyde, in both calendar years, and failed to meet the MQO for benzene in CY2012. Horicon, WI, did not meet the MQO for these four HAPs in CY2012, while it did in CY2011. While Northbrook, IL, did not achieve the MQO for acrolein, benzene, and 1,3-butadiene in CY2011, it did meet the MQO for these HAPs in CY2012.
- For both CY2011 and CY2012, chromium (VI) sampling was not conducted at the San Jose, CA site, and acrolein results were invalidated at the Underhill, VT site.

The percentage of sites meeting the completeness MQO was 85% or greater for benzene, 1,3-butadiene, naphthalene, arsenic, and chromium (VI) in both CY2011 and CY2012. Fewer sites met the MQO for acrolein and formaldehyde with 77% and 81% meeting the MQO for acrolein and 78% and 78% for formaldehyde in CY2011 and CY2012, respectively.

2.5 Precision of NATTS Data

Precision of NATTS data was assessed by inspection of results in AQS from replicate anlaysis and replicate sampling.

The term "replicate sampling" refers to the collection of duplicate and collocated sample collections, terms that are defined as follows:

Three basic sample types are collected at NATTS sites:

- Primary sample: a single sample that represents a particular sampling event.
- Duplicate sample: 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., pump or separate channel) and collection substrate (e.g., filter, canister, or cartridge) from the primary sample. Duplicate samples provide the basis for assessing the aggregate variability associated with the collection device, sampling substrate, and sample analysis.
- Collocated sample: 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. One may assume that the atmosphere sampled by the primary and collocated samplers is identical in its composition.

The above sample types are differentiated within the AQS database by POC. Tables 8 and 9 provide the POCs encountered in the AQS database for each site by HAP class, for CY2011 and CY2012, respectively.

Precision assessments associated with replicate *sampling* are distinctly different from those associated with replicate *analyses* in the following way:

- Precision assessments associated with replicate analyses are derived from a second chemical analysis of a single sample, be that a primary, duplicate, or collocated sample.
- Precision assessments associated with replicate sampling are derived from independent chemical analyses of two different sample substrates (filter, canister, etc).

The precision for the NATTS data was assessed from both analytical (i.e., instrumental) and overall (i.e., analytical plus sampling) perspectives:

- <u>Analytical precision</u> (Section 2.5.1) measures the variability in reported results due exclusively to differences in laboratory analytical performance and is assessed by comparing results from two analyses of a single sample, whether that sample be a primary, duplicate, or collocated sample.
- <u>Overall precision (Section 2.5.2)</u>, which accounts for the combined variability associated with sample collection and laboratory analysis, is assessed by comparing the results of paired primary and collocated samples or paired primary and duplicate samples.

Table 8. Parameter Occurrence Codes by NATTS Site and HAP Type – CY2011

EPA Region	Site Name	AQS Site Code	Parameter Occurrence Codes (POCs) VOCs			Carbonyls			PAHs		Metals		Chromium (VI)		
			P	D	C	P	D	C	P	C	P	C	P	D	C
I	Boston, MA	25-025-0042	10	11		3	4		6		6	7	6	7	
I	Underhill, VT	50-007-0007	1			1			6		3	4	6	7	
I	Providence, RI	44-007-0022	2			5		7	6		1	2	6		7
II	Bronx, NY	36-005-0080	2			2			6		1	2	6		7
II	Rochester, NY	36-055-1007	2			2			6		1		6		7
III	Washington, DC	11-001-0043	4	1	2	2			1		1		1		2
III	Richmond, VA	51-087-0014	4	7		2		4	6		1		6		7
IV	Chesterfield, SC	45-025-0001	1		2	1		2	6		1	2	6	7	
IV	Decatur, GA	13-089-0002	1,3		2,4,5	2		3	6	7	1	2	6		7
IV	Grayson Lake, KY	21-043-0500	6	7		1,6	2,7		6		1,6	2,7	6		7
IV	Hillsborough Cty, FL	12-057-3002	1			6			6	7	5	6	6		7
IV	Pinellas Cty, FL	12-103-0026	1			6			6		5		6		7
V	Dearborn, MI	26-163-0033	1		2	1		2	1	2	1	9	1		2
V	Horicon, WI	55-027-0001	1		2	1		2	1	2	1	2	6		7
V	Northbrook, IL	17-031-4201	6	8		6			6		6		6		7
VI	Deer Park, TX	48-201-1039	2		3	3			1	2,6	1		6		7
VI	Harrison Cty, TX	48-203-0002	1			1			1		1		6		
VII	St. Louis, MO	29-510-0085	6			6			6		6	7	6		7
VIII	Bountiful, UT	49-011-0004	6			6			6		1	2	6		7
VIII	Grand Junction, CO	08-077-0017 / -0018	6			6			6		3	4	6		7
IX	Phoenix, AZ	04-013-9997	6		7	30		31	3		1		6		7
IX	Los Angeles, CA	06-037-1103	4		5	4		5	6		2	3	4		5
IX	Rubidoux, CA	06-065-8001	4		5	4		5	6	7	2	4	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	7	6		6	7	

P = primary
D = duplicate
C = collocated

Table 9. Parameter Occurrence Codes by NATTS Site and HAP Type – CY2012

EPA Region	Site Name	AQS Site Code	Parameter Occurrence Codes (POCs)												
			VOCs			Carbonyls			PAHs		Metals		Chromium (VI)		
			P	D	C	P	D	C	P	C	P	C	P	D	C
I	Boston, MA	25-025-0042	10	11		3	4		6		6	7	6	7	
I	Underhill, VT	50-007-0007	1			1			6		3	4	6	7	
I	Providence, RI	44-007-0022	2			5		7	6		1	2	6		7
II	Bronx, NY	36-005-0080 / -0110	2			2			6		1	2	6		7
II	Rochester, NY	36-055-1007	2			2			6		1		6		7
III	Washington, DC	11-001-0043	4	1	2	2			1		1		1		2
III	Richmond, VA	51-087-0014	4	7		2		4	6		1		6		7
IV	Chesterfield, SC	45-025-0001	1		2	1		2	6		1	2	6	7	
IV	Decatur, GA	13-089-0002	1,3		2,4,5	2		3	6	7	1	2	6		7
IV	Grayson Lake, KY	21-043-0500	6	7		1,6	2,7		6		1,6	2,7	6		7
IV	Hillsborough Cty, FL	12-057-3002	1			6			6	7	5	6	6		7
IV	Pinellas Cty, FL	12-103-0026	1			6			6		5		6		7
V	Dearborn, MI	26-163-0033	1		2	1		2	1	2	1	9	1		2
V	Horicon, WI	55-027-0001	1		2	1		2	1	2	1	2	6		7
V	Northbrook, IL	17-031-4201	6	8		6			6		6		6		7
VI	Deer Park, TX	48-201-1039	2		3	3			1	2,6	1		6		7
VI	Harrison Cty, TX	48-203-0002	1			1			1		1		6		
VII	St. Louis, MO	29-510-0085	6			6			6		6	7	6		7
VIII	Bountiful, UT	49-011-0004	6			6			6		1	2	6		7
VIII	Grand Junction, CO	08-077-0017 / -0018	6			6			6		3	4	6		7
IX	Phoenix, AZ	04-013-9997	6		7	30		31	3		1		6		7
IX	Los Angeles, CA	06-037-1103	4		5	4		5	6		2	3	4		5
IX	Rubidoux, CA	06-065-8001	4		5	4		5	6	7	2	4	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	7	6		6	7	

P = primary
D = duplicate
C = collocated

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 (HAP). 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

Analytical precision for this report was computed from the replicate pairs of data contained in RP records that were coded with either Precision ID 2 or 3. Overall precision was computed from the replicate pairs of data contained in RP records that were coded with Precision ID 1 and from paired RD records.

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 Tables 8 and 9, 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 POC of 1 for VOCs, carbonyls, and metals, while collocated samples are assigned a POC 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 identified with a separate POC. The assignment of a particular POC is made at the discretion of each NATTS site, thus extensive effort was required to ensure that the POCs for each site were correctly identified. POCs for primary, duplicate, and collocated samples of each HAP class for CY2011 and CY2012 were determined based on POCs at each NATTS collection site in CY2007, CY2008, CY2009, and CY2010 and discrepancies and/or uncertainties about POC assignments were resolved by direct contact with NATTS administrators for specific collection sites.

Prior to the beginning of CY2012, ERG contacted sites for which it performs analyses to confirm whether POCs were being appropriately assigned as collocated or duplicate based on sample characteristics. This resulted in a number of POC assignment changes, primarily involving POCs previously designated as duplicate sampling updated to indicate the POC represents collocated sampling.

Multiple POCs for a given site, HAP, and sample type reflect a number of factors unique to sites during CY2011 and CY2012, largely assigned for reasons known only to the NATTS site administrators. Overall precision estimates were computed by comparing primary and collocated or primary and duplicate results for a particular site, HAP, 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 coefficient of variance (CV) for each site and HAP where both replicate values were equivalent to or exceeded the reported MDL.

Laboratories analyzing samples for NATTS sites in CY2011 and CY2012 are listed in Table 10, with laboratory identification codes for each laboratory shown in Table 11. Of particular note is that several laboratories provided analytical chemistry services for multiple NATTS sites.

Table 10. Laboratories Performing Analyses by HAP Type for Each NATTS Site in CY2011 and CY2012

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

[a]San Jose does not collect Chromium (VI) for the NATTS program.

Table 11. Laboratory Abbreviations and Descriptions for NATTS Laboratories

Laboratory Code(s)	Laboratory Abbreviation	Laboratory Description
01-01-C,M,V	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
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,P,R,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,P,V	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,P,V	WSLH	Wisconsin State Laboratory of Hygiene
06-01-C,M,P,R,V	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,M,P,R,V	SCAQMD	South Coast Air Quality Management District
10-02-R	CHLBNT	Chester LabNet
10-02-C,M,P,V	ODEQ	Oregon Department of Environmental Quality
11-01-C,M,P,R,V	ERG	Eastern Research Group
11-02-M	RTI	RTI International

2.5.1 Analytical Precision Results

Analytical precision was calculated from the replicate analysis results associated with either a primary, collocated, or duplicate sample as extracted from RP records from the AQS database. For this calculation, the two analysis results for a given sample are distinguished by referring to one as the “principal” result and the other as the “replicate” result. The measure for analytical precision, expressed as the percentage coefficient of variation (%CV), is defined 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 principal result for sample i,

r_i = the replicate result for sample i, and

n = the number of samples having primary-replicate result pairs.

Analytical precision was calculated only when $p_i \geq$ MDL and $r_i \geq$ MDL. For those sites that did not report MDLs into AQS, it could not be determined if the RP records exceeded the corresponding MDLs. As a result, such data were excluded from the analytical precision calculation.

The analytical precision for each of the 27 NATTS HAPs is presented in Table 12 and Table 13 for CY2011 and CY2012, respectively. For the seven HAPs of primary importance, analytical precision is summarized graphically in Figures 3 through 9 for CY2011 and Figures 10 through 16 for CY2012.

For CY2011 the network mean analytical precision met the MQO of 15% for carbonyls, PAHs, and chromium (VI), for all metals except beryllium, and for 9 of the 16 VOCs reporting concentrations above MDLs. Analytical precision data for VOCs show some variability with no discernible trend noted among sites or HAPs. Records for 1,2-dibromoethane and 1,2-dichloropropane did not include replicate pairs for which both results were above their respective MDL, and are not included in Table 12. For all sites reporting metals above MDLs, only Boston, MA met the precision MQO for all metals.

For CY2012 the network mean analytical precision met the MQO for all HAPs except for acrylonitrile and beryllium. Moreover, all sites met the MQO for carbonyls, PAHs, and chromium (VI). Among VOCs, sites showed close agreement with only an occasional MQO exceedence. Records for 1,2-dibromoethane, 1,2-dichloropropane, and 1,1,2,2-tetrachloroethane did not include replicate pairs for which both results were above their respective MDL, and are not included in Table 13. Replicate analysis showed similar close agreement for metals, with only two sites having analytical precision exceeding the MQO.

Overall precision comprises analytical variability and sampling variability and more fully characterizes network-wide precision. Network achievement of the precision MQO is discussed in Section 2.5.2.

Table 12. Analytical Precision for Replicate Analyses ≥ MDL – CY2011

		VOCs													
AQS Site Code	**Site Name**	**BENZ**	**BUTA**	**CTET**	**CLFRM**	**EDC**	**MECL**	**TCE1122**	**PERC**	**TCE**	**VC**	**cDCPEN**	**tDCPEN**	**ACRO**	**ACRY**
25-025-0042	Boston, MA	--	--	--	--	--	--	--	--	--	--	--	--	--	--
50-007-0007	Underhill, VT	--	--	--	--	--	--	--	--	--	--	--	--	--	--
44-007-0022	Providence, RI	--	--	--	--	--	--	--	--	--	--	--	--	--	--
36-005-0080	Bronx, NY	--	--	--	--	--	--	--	--	--	--	--	--	--	--
36-055-1007	Rochester, NY	--	--	--	--	--	--	--	--	--	--	--	--	--	--
11-001-0043	Washington, DC	--	--	--	--	--	--	--	--	--	--	--	--	--	--
45-025-0001	Chesterfield, SC	--	--	--	--	--	--	--	--	--	--	--	--	--	--
13-089-0002	Decatur, GA	--	--	--	--	--	--	--	--	--	--	--	--	--	--
21-043-0500	Grayson Lake, KY	6.7 (13)	6.4 (6)	6.6 (13)	6.8 (3)	6.2 (2)	4.7 (13)	--	--	--	20.2 (1)	--	--	4.5 (13)	4.4 (5)
12-057-3002	Hillsborough Cty, FL	4.0 (2)	21.1 (1)	0.6 (2)	6.3 (2)	4.3 (2)	4.0 (2)	--	20.2 (1)	--	--	0.5 (1)	0.8 (1)	2.8 (2)	--
12-103-0026	Pinellas Cty, FL	4.4 (54)	14.1 (41)	3.5 (54)	8.5 (54)	12.7 (45)	10.3 (54)	36.8 (5)	14.3 (51)	93.4 (1)	--	0 (1)	22.5 (3)	10.9 (53)	9.7 (41)
26-163-0033	Dearborn, MI	6.5 (12)	7.6 (12)	6.3 (12)	6.0 (12)	5.6 (2)	4.8 (12)	--	5.2 (9)	--	--	--	--	6.2 (12)	--
55-027-0001	Horicon, WI	--	--	--	--	--	--	--	--	--	--	--	--	--	--
17-031-4201	Northbrook, IL	12.0 (24)	6.2 (12)	17.0 (12)	25.4 (12)	10.2 (5)	21.4 (12)	--	5.0 (10)	--	--	--	--	21.8 (12)	6.9 (4)
48-201-1039	Deer Park, TX	--	--	--	--	--	--	--	--	--	--	--	--	--	--
29-510-0085	St. Louis, MO	7.1 (16)	8.4 (16)	6.8 (16)	6.4 (14)	5.4 (8)	9.0 (16)	--	5.5 (10)	--	--	--	--	26.3 (16)	--
49-011-0004	Bountiful, UT	12.6 (13)	8.9 (13)	6.3 (13)	14.3 (5)	8.8 (5)	10.5 (13)	--	9.1 (4)	--	--	--	--	39.3 (13)	--
08-077-0017/-0018	Grand Junction, CO	4.5 (12)	5.5 (10)	17.1 (11)	6.8 (9)	2.0 (2)	16.8 (12)	--	7.2 (8)	4.3 (2)	--	--	--	14.4 (11)	4.6 (2)
04-013-9997	Phoenix, AZ	6.6 (12)	5.2 (12)	6.7 (12)	4.9 (12)	5.3 (2)	7.0 (12)	--	4.8 (12)	--	--	--	--	5.5 (12)	2.8 (2)
06-037-1103	Los Angeles, CA	--	--	--	--	--	--	--	--	--	--	--	--	--	--
06-065-8001	Rubidoux, CA	--	--	--	--	--	--	--	--	--	--	--	--	--	--
06-085-0005	San Jose, CA	3.1 (31)	10.4 (11)	7.1 (31)	15.9 (27)	--	7.9 (29)	--	2.4 (31)	0 (4)	--	--	--	--	--
53-033-0080	Seattle, WA	3.1 (12)	7.4 (12)	4.6 (12)	8.4 (9)	2.9 (2)	3.2 (12)	--	3.8 (2)	--	--	--	--	3.6 (12)	8.0 (1)
	Network Mean	6.9 (201)	10.0 (146)	8.0 (188)	11.8 (159)	10.7 (75)	10.4 (187)	36.8 (5)	9.7 (138)	35.4 (7)	20.2 (1)	0.3 (2)	19.5 (4)	17.3 (156)	8.8 (55)

Analytical precision is expressed as percentage coefficient of variation (%CV) with number of contributing data pairs (*n*) shown in parentheses.

Values shown in red exceed the MQO of < 15% CV.

Table 12. Analytical Precision for Replicate Analyses ≥ MDL – CY2011 (continued)

		carbonyls		PAHs		metals						
AQS Site Code	**Site Name**	**FORM**	**ACET**	**NAPH**	**BaP**	**As**	**Be**	**Cd**	**Pb**	**Mn**	**Ni**	**CrVI**
25-025-0042	Boston, MA	--	--	--	--	2.1 (74)	11.0 (18)	6.8 (74)	1.5 (74)	1.1 (74)	1.8 (72)	8.3 (10)
50-007-0007	Underhill, VT	0.7 (4)	1.7 (4)	--	--	16.4 (8)	--	5.8 (9)	1.5 (9)	3.4 (9)	2.9 (2)	7.7 (7)
44-007-0022	Providence, RI	--	--	--	--	--	--	--	--	--	--	7.2 (10)
36-005-0080	Bronx, NY	--	--	--	--	--	--	--	--	--	--	5.5 (12)
36-055-1007	Rochester, NY	--	--	--	--	--	--	--	--	--	--	9.4 (8)
11-001-0043	Washington, DC	--	--	--	--	--	--	--	--	--	--	8.3 (11)
45-025-0001	Chesterfield, SC	--	--	--	--	--	--	--	--	--	--	7.3 (4)
13-089-0002	Decatur, GA	--	--	4.1 (12)	3.8 (2)	--	--	--	--	--	--	5.4 (11)
21-043-0500	Grayson Lake, KY	0.7 (8)	0.9 (8)	--	--	11.2 (64)	33.3 (2)	5.0 (78)	1.0 (80)	0.8 (80)	33.4 (4)	5.3 (9)
12-057-3002	Hillsborough Cty, FL	2.3 (14)	1.6 (14)	3.3 (12)	7.4 (3)	--	--	--	--	--	--	5.3 (12)
12-103-0026	Pinellas Cty, FL	2.2 (12)	2.0 (12)	--	--	--	--	--	--	--	--	5.7 (10)
26-163-0033	Dearborn, MI	1.3 (12)	0.3 (12)	2.9 (12)	4.4 (8)	--	--	--	--	--	--	4.6 (12)
55-027-0001	Horicon, WI	--	--	--	--	--	--	--	--	--	--	3.6 (10)
17-031-4201	Northbrook, IL	2.0 (12)	1.7 (12)	--	--	--	--	--	--	--	--	6.4 (12)
48-201-1039	Deer Park, TX	--	--	--	--	--	--	--	--	--	--	5.2 (12)
29-510-0085	St. Louis, MO	2.1 (12)	1.0 (12)	--	--	7.2 (66)	21.0 (8)	2.8 (67)	0.6 (67)	1.2 (67)	9.6 (17)	6.6 (11)
49-011-0004	Bountiful, UT	4.4 (14)	1.6 (14)	--	--	--	--	--	--	--	--	13.8 (12)
08-077-0017/ -0018	Grand Junction, CO	2.2 (12)	2.0 (12)	--	--	--	--	--	--	--	--	8.0 (12)
04-013-9997	Phoenix, AZ	0.9 (14)	1.2 (14)	--	--	--	--	--	--	--	--	4.9 (14)
06-037-1103	Los Angeles, CA	--	--	--	--	5.7 (5)	--	21.1 (5)	4.2 (5)	21.1 (5)	3.3 (5)	--
06-065-8001	Rubidoux, CA	--	--	2.6 (12)	--	8.0 (9)	--	34.8 (4)	7.2 (9)	0 (5)	3.1 (9)	--
06-085-0005	San Jose, CA	0.9 (9)	1.0 (9)	--	--	--	--	--	--	--	--	--
53-033-0080	Seattle, WA	0.8 (12)	1.3 (12)	2.5 (10)	6.3 (2)	--	--	--	--	--	--	5.6 (14)
	Network Mean	2.1 (135)	1.4 (135)	3.1 (58)	5.3 (15)	8.1 (226)	16.8 (28)	7.5 (237)	1.9 (244)	3.3 (240)	7.7 (109)	7.0 (213)

Analytical precision is expressed as percentage coefficient of variation (%CV) with number of contributing data pairs (*n*) shown in parentheses.
Values shown in red exceed the MQO of < 15% CV.

Table 13. Analytical Precision for Replicate Analyses ≥ MDL – CY2012

		VOCs												
AQS Site Code	**Site Name**	**BENZ**	**BUTA**	**CTET**	**CLFRM**	**EDC**	**MECL**	**PERC**	**TCE**	**VC**	**cDCPEN**	**tDCPEN**	**ACRO**	**ACRY**
25-025-0042	Boston, MA	--	--	--	--	--	--	--	--	--	--	--	--	--
50-007-0007	Underhill, VT	--	--	--	--	--	--	--	--	--	--	--	--	--
44-007-0022	Providence, RI	--	--	--	--	--	--	--	--	--	--	--	--	--
36-005-0080/-0110	Bronx, NY	2.5 (9)	34.1 (9)	1.3 (9)	8.1 (9)	3.6 (9)	29.6 (9)	34.5 (9)	11.4 (5)	11.2 (3)	--	--	15.8 (9)	--
36-055-1007	Rochester, NY	--	--	--	--	--	--	--	--	--	--	--	--	--
11-001-0043	Washington, DC	--	--	--	--	--	--	--	--	--	--	--	--	--
51-087-0014	Richmond, VA	--	--	--	--	--	--	--	--	--	--	--	--	--
45-025-0001	Chesterfield, SC	--	--	--	--	--	--	--	--	--	--	--	--	--
13-089-0002	Decatur, GA	--	--	--	--	--	--	--	--	--	--	--	--	--
21-043-0500	Grayson Lake, KY	5.5 (8)	13.2 (8)	6.1 (10)	18.5 (2)	8.4 (6)	25.6 (10)	--	--	--	--	--	10.0 (10)	73.4 (8)
12-057-3002	Hillsborough Cty, FL	4.4 (2)	6.5 (2)	1.2 (2)	2.3 (2)	0 (2)	2.4 (2)	15.4 (2)	--	--	--	--	9.0 (2)	--
12-103-0026	Pinellas Cty, FL	3.1 (18)	8.7 (17)	1.7 (18)	7.2 (18)	2.5 (18)	2.8 (18)	9.0 (18)	--	--	1.9 (2)	2.4 (2)	7.1 (18)	14.3 (14)
26-163-0033	Dearborn, MI	7.2 (12)	5.4 (12)	5.9 (12)	20.8 (12)	5.7 (8)	5.2 (12)	4.7 (6)	--	--	--	--	10.1 (12)	--
55-027-0001	Horicon, WI	--	--	--	--	--	--	--	--	--	--	--	--	--
17-031-4201	Northbrook, IL	10.2 (28)	9.8 (15)	10.7 (14)	15.0 (14)	12.2 (10)	11.1 (14)	10.6 (6)	16.0 (4)	--	--	--	30.8 (12)	--
48-201-1039	Deer Park, TX	--	--	--	--	--	--	--	--	--	--	--	--	--
48-203-0002	Harrison Cty, TX	--	--	--	--	--	--	--	--	--	--	--	--	--
29-510-0085	St. Louis, MO	7.9 (16)	7.1 (16)	15.2 (16)	8.3 (14)	12.4 (10)	7.4 (16)	11.0 (8)	6.2 (2)	--	--	--	11.7 (16)	--
49-011-0004	Bountiful, UT	10.2 (13)	9.3 (13)	12.0 (13)	11.7 (13)	14.3 (6)	19.9 (13)	7.7 (2)	--	--	--	--	8.5 (13)	--
08-077-0017/-0018	Grand Junction, CO	4.9 (12)	5.5 (12)	10.8 (12)	6.1 (8)	11.0 (10)	6.5 (12)	8.3 (10)	--	--	--	--	16.9 (12)	11.1 (2)
04-013-9997	Phoenix, AZ	4.0 (12)	4.1 (12)	4.5 (12)	4.2 (11)	7.1 (8)	4.0 (12)	4.3 (12)	--	--	3.8 (1)	--	5.0 (12)	--
06-037-1103	Los Angeles, CA	--	--	--	--	--	--	--	--	--	--	--	--	--
06-065-8001	Rubidoux, CA	--	--	--	--	--	--	--	--	--	--	--	--	--
06-085-0005	San Jose, CA	--	--	--	--	--	--	--	--	--	--	--	--	--
53-033-0080	Seattle, WA	7.6 (13)	5.6 (13)	7.5 (13)	9.0 (13)	5.5 (5)	15.4 (13)	3.7 (2)	--	--	--	--	15.0 (13)	--
	Network Mean	7.3 (130)	11.8 (116)	8.9 (118)	11.3 (103)	8.7 (87)	14.2 (118)	14.4 (73)	12.6 (11)	11.2 (3)	2.7 (3)	2.4 (2)	14.4 (116)	43.9 (24)

Analytical precision is expressed as percentage coefficient of variation (%CV) with number of contributing data pairs (*n*) shown in parentheses.
Values shown in red exceed the MQO of < 15% CV.

Table 13. Analytical Precision for Replicate Analyses ≥ MDL – CY2012 (continued)

		carbonyls		PAHs		metals						
AQS Site Code	Site Name	FORM	ACET	NAPH	BaP	As	Be	Cd	Pb	Mn	Ni	CrVI
25-025-0042	Boston, MA	--	--	3.5 (1)	1.9 (1)	2.6 (66)	8.8 (9)	5.7 (66)	1.4 (66)	1.5 (66)	3.5 (66)	5.0 (12)
50-007-0007	Underhill, VT	0.6 (9)	0.8 (9)	0.7 (1)	--	28.6 (6)	--	20.5 (11)	0.7 (6)	1.0 (12)	1.2 (4)	7.3 (1)
44-007-0022	Providence, RI	--	--	3.2 (3)	4.4 (1)	--	--	--	--	--	--	7.5 (9)
36-005-0080/-0110	Bronx, NY	--	--	6.1 (4)	2.6 (1)	--	--	--	--	--	--	8.3 (13)
36-055-1007	Rochester, NY	--	--	1.9 (3)	2.0 (1)	--	--	--	--	--	--	4.0 (5)
11-001-0043	Washington, DC	--	--	0.6 (1)	--	--	--	--	--	--	--	7.1 (12)
51-087-0014	Richmond, VA	--	--	0.5 (3)	10.1 (1)	--	--	--	--	--	--	8.0 (12)
45-025-0001	Chesterfield, SC	--	--	2.5 (1)	--	--	--	--	--	--	--	8.0 (3)
13-089-0002	Decatur, GA	--	--	2.7 (11)	3.1 (2)	--	--	--	--	--	--	5.6 (10)
21-043-0500	Grayson Lake, KY	1.7 (12)	1.5 (12)	2.7 (4)	2.0 (2)	13.7 (40)	--	9.7 (46)	0.7 (49)	1.3 (49)	1.7 (6)	12.0 (7)
12-057-3002	Hillsborough Cty, FL	9.0 (10)	2.9 (10)	3.4 (13)	--	--	--	--	--	--	--	5.6 (7)
12-103-0026	Pinellas Cty, FL	4.7 (12)	3.1 (12)	0.9 (4)	3.7 (1)	--	--	--	--	--	--	9.3 (13)
26-163-0033	Dearborn, MI	1.3 (12)	0.6 (12)	2.1 (15)	4.1 (11)	--	--	--	--	--	--	4.8 (14)
55-027-0001	Horicon, WI	--	--	--	--	--	--	--	--	--	--	10.0 (8)
17-031-4201	Northbrook, IL	3.3 (16)	2.3 (16)	--	--	1.5 (6)	10.6 (5)	1.6 (6)	2.4 (6)	1.3 (6)	3.0 (6)	5.8 (14)
48-201-1039	Deer Park, TX	--	--	--	--	--	--	--	--	--	--	3.5 (12)
48-203-0002	Harrison Cty, TX	--	--	--	--	--	--	--	--	--	--	4.3 (3)
29-510-0085	St. Louis, MO	1.6 (12)	1.2 (12)	4.8 (6)	7.4 (6)	9.2 (117)	18.1 (21)	4.5 (118)	0.5 (48)	0.9 (118)	10.4 (107)	6.1 (12)
49-011-0004	Bountiful, UT	2.8 (10)	2.7 (10)	11.0 (1)	--	--	--	--	--	--	--	8.8 (12)
08-077-0017/-0018	Grand Junction, CO	0.8 (12)	0.8 (12)	--	--	--	--	--	--	--	--	10.7 (7)
04-013-9997	Phoenix, AZ	0.9 (12)	0.5 (12)	1.0 (2)	--	14.3 (4)	13.0 (4)	6.8 (4)	0.3 (1)	2.4 (4)	4.0 (4)	4.3 (12)
06-037-1103	Los Angeles, CA	--	--	11.4 (1)	--	--	--	--	--	--	--	--
06-065-8001	Rubidoux, CA	--	--	12.8 (16)	4.9 (2)	--	--	--	--	--	--	--
06-085-0005	San Jose, CA	0.3 (9)	42.7 (10)	1.2 (2)	--	4.6 (2)	--	7.7 (4)	0.5 (2)	0.7 (6)	1.4 (6)	--
53-033-0080	Seattle, WA	1.7 (12)	1.5 (12)	2.3 (17)	3.1 (2)	1.2 (3)	--	3.3 (3)	1.7 (3)	1.8 (3)	1.2 (3)	4.7 (12)
	Network Mean	3.3 (126)	11.6 (127)	5.8 (92)	4.9 (29)	9.8 (241)	15.0 (39)	7.3 (255)	1.1 (178)	1.2 (261)	7.9 (199)	7.1 (198)

Analytical precision is expressed as percentage coefficient of variation (%CV) with number of contributing data pairs (*n*) shown in parentheses.
Values shown in red exceed the MQO of < 15% CV.

2.5.2 Overall Precision Results

Overall precision was calculated using the (principal) results of the primary sample paired with either the duplicate or collocated samples in the AQS database. This measure of agreement, expressed as the % CV, is defined 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 performed on the primary sample within the i^{th} pair,

r_i = the result of the principal analysis performed on either the collocated or duplicate sample within the i^{th} pair, and

n = the number of primary-collocated and primary-duplicate sample pairs.

Overall precision was calculated only when $p_i \geq$ MDL and $r_i \geq$ MDL. For those sites that did not report MDLs into AQS, it could not be determined if the records exceeded the corresponding MDLs. As a result, such data were excluded from the overall precision calculation.

In order to ensure all precision records were evaluated, both the RP and RD data were extracted for precision records. The precision calculation algorithm was designed to ensure that records that appeared both in RP and RD transactions were not represented twice in the analysis of overall precision. Approximately half of the pairs entered into AQS for overall precision consisted of values above the MDL for CY2011 and CY2012. Overall precision for each of the 27 NATTS HAPs is presented in Table 15 for CY2011 and in Table 16 for CY2012. For the seven HAPs of primary importance, overall precision is presented graphically in Figures 3 through 9 for CY2011 and Figures 10 through 16 for CY2012.

As is expected given the additional variability contribution of sample collection, overall precision for CY2011 showed much greater variability than the analytical precision: the network mean overall precision met the MQO for carbonyls, 1 PAH, 1 metal, and 5 of 16 VOCs; the MQO was not met for chromium (VI). Only the two carbonyl compounds met the MQO of 15% for all sites. Those VOCs that exceeded the MQO generally showed CVs of 25% or greater. Precision data were not available for 1,2-dichloropropane, vinyl chloride, and cis-1,3-dichloropropene and these are not included in Table 15.

As in CY2011, CY2012 overall precision showed greater variability than CY2012 analytical precision. The network mean overall precision met the MQO for carbonyls, 1 PAH, and 5 of 16 VOCs; the MQO was not met for any of the metals or for chromium (VI). All sites achieved the MQO for carbonyls except for Providence, RI and LaGrande, OR; for PAHs, all sites met the MQO except for Decatur, GA, for naphthalene, which appeared to weight the network mean overall precision to exceed the MQO. Only Dearborn, MI, and Bountiful, UT, met the MQO for all metals and chromium (VI). Only Pinellas County, FL, met the MQO for overall precision for all VOCs measured above the MDL. Precision data were not available for 1,2-dibromoethane and 1,2-dichloropropane and these are not included in Table 16.

As can be seen in Figures 3 through 16, the aggregate precision associated with sample collection and analysis varies substantially by collection site and HAP when compared to the precision associated with analytical variability alone for both CY2011 and CY2012. 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 points to a collection methodology contribution to the overall variability, particularly for metals and VOCs.

Overall precision data analysis was limited to the number of sites reporting precision sample pairs and corresponding MDL values into AQS. A breakdown of total sites evaluated for overall precision is included in Table 14. The number of sites reporting precision samples with corresponding MDLs ranged from 8 (PAHs) to 24 (chromium (VI)) in both CY2011 and CY2012. In CY2011, all sites met the precision MQO for formaldehyde and less than 85% of sites met the MQO for six of the remaining seven HAPs of primary importance, with less than half of sites meeting the MQO for acrolein and arsenic. In CY2012, more than 85% of sites met the precision MQO for benzene, formaldehyde, and naphthalene with the remaining four HAPs of primary importance showing 84% or less of sites meeting the MQO. As in CY2011, less than 50% of sites met the precision MQO for acrolein in CY2012.

Table 14. Percentage of NATTS Sites Meeting the MQO for Overall Precision – CY2011 and CY2012

		VOCs			carbonyls	PAHs	metals	
Metric	**CY**	**Acrolein**	**Benzene**	**1,3-Butadiene**	**Formaldehyde**	**Naphthalene**	**Arsenic**	**Chromium (VI)**
Number sites reporting precision values with MDLs	2011	19	19	19	21	8	17	24
	2012	19	20	19	19	8	16	24
Number of sites meeting the precision MQO	2011	7	16	15	21	5	8	13
	2012	9	18	16	18	7	9	15
Percentage of sites meeting precision MQO	2011	37%	84%	79%	100%	63%	47%	54%
	2012	47%	90%	84%	95%	88%	56%	63%

Table 15. Overall Precision for Primary, Duplicate, and Collocated Samples ≥ MDL – CY2011

		VOCs												
AQS Site Code	**Site Name**	**BENZ**	**BUTA**	**CTET**	**CLFRM**	**EDB**	**EDC**	**MECL**	**TCE1122**	**PERC**	**TCE**	**tDCPEN**	**ACRO**	**ACRY**
25-025-0042	Boston, MA	3.4 (31)	23.7 (30)	2.9 (31)	4.9 (31)	--	7.6 (19)	14.1 (31)	--	3.5 (20)	6.7 (1)	--	13.3 (27)	--
50-007-0007	Underhill, VT	--	--	--	--	--	--	--	--	--	--	--	--	--
44-007-0022	Providence, RI	--	--	--	--	--	--	--	--	--	--	--	--	--
36-005-0080	Bronx, NY	--	--	--	--	--	--	--	--	--	--	--	--	--
36-055-1007	Rochester, NY	--	--	--	--	--	--	--	--	--	--	--	--	--
11-001-0043	Washington, DC	--	75.4 (3)	6.1 (27)	10.4 (25)	--	--	31.3 (27)	--	32.0 (13)	--	--	--	43.9 (5)
51-087-0014	Richmond, VA	8.1 (26)	--	5.8 (26)	--	--	--	18.3 (24)	--	10.9 (1)	--	--	17.8 (10)	--
45-025-0001	Chesterfield, SC	8.5 (61)	--	3.5 (57)	--	0 (1)	--	65.5 (57)	0 (7)	14.7 (16)	0 (1)	--	26.5 (49)	--
13-089-0002	Decatur, GA	25.3 (23)	--	15.0 (13)	--	--	--	55.6 (7)	--	12.9 (1)	--	--	--	--
21-043-0500	Grayson Lake, KY	6.1 (6)	20.1 (3)	4.3 (6)	4.8 (2)	--	4.0 (1)	43.5 (6)	--	--	--	--	43.1 (6)	81.9 (2)
12-057-3002	Hillsborough Cty, FL	--	--	--	--	--	--	--	--	--	--	--	--	--
12-103-0026	Pinellas Cty, FL	9.2 (11)	11.9 (8)	3.5 (11)	10.2 (11)	--	18.2 (10)	23.0 (11)	--	20.0 (11)	--	30.3 (1)	18.0 (11)	52.3 (1)
26-163-0033	Dearborn, MI	4.2 (6)	6.7 (6)	7.9 (6)	34.7 (6)	--	3.6 (1)	16.6 (6)	--	5.6 (4)	--	--	10.7 (6)	--
55-027-0001	Horicon, WI	0.3 (2)	--	--	--	--	--	--	--	--	--	--	12.2 (3)	--
17-031-4201	Northbrook, IL	--	--	20.7 (6)	34.5 (6)	--	5.0 (2)	30.0 (6)	--	5.2 (5)	--	--	30.5 (6)	13.6 (3)
48-201-1039	Deer Park, TX	--	--	--	--	--	--	--	--	--	--	--	--	--
29-510-0085	St. Louis, MO	5.8 (8)	5.3 (8)	6.5 (8)	3.7 (6)	--	8.9 (4)	10.9 (8)	--	11.7 (5)	--	--	40.5 (8)	--
49-011-0004	Bountiful, UT	17.9 (6)	10.6 (6)	6.5 (6)	3.6 (2)	--	10.3 (3)	13.3 (6)	--	6.7 (2)	--	--	59.9 (6)	--
08-077-0017/-0018	Grand Junction, CO	5.8 (6)	5.5 (5)	27.3 (5)	7.1 (4)	--	0 (1)	21.3 (6)	--	6.9 (4)	1.2 (1)	--	19.2 (5)	1.9 (1)
04-013-9997	Phoenix, AZ	7.0 (6)	4.1 (6)	8.1 (6)	5.1 (6)	--	6.7 (1)	58.4 (6)	--	5.5 (6)	--	--	44.9 (6)	--
06-037-1103	Los Angeles, CA	--	--	--	--	--	--	--	--	--	--	--	--	--
06-065-8001	Rubidoux, CA	--	--	--	--	--	--	--	--	--	--	--	--	--
06-085-0005	San Jose, CA	14.7 (29)	46.9 (7)	15.0 (29)	29.1 (20)	--	--	31.6 (24)	--	42.8 (29)	--	--	66.6 (22)	--
41-051-0246	Portland, OR	62.1 (42)	--	14.0 (21)	--	--	--	29.3 (9)	--	70.7 (1)	--	--	36.8 (22)	--
53-033-0080	Seattle, WA	4.6 (6)	5.0 (6)	13.1 (6)	16.6 (4)	--	11.5 (1)	68.5 (6)	--	0.9 (1)	--	--	23.9 (6)	--
	Network Mean	26.8 (263)	24.6 (82)	9.8 (258)	17.5 (119)	0 (1)	11.1 (42)	41.6 (234)	0 (7)	26.1 (118)	3.9 (3)	30.3 (1)	35.5 (187)	46.9 (12)

Overall precision is expressed as percentage coefficient of variation (%CV) with number of contributing data pairs shown in parentheses.
Values shown in red exceed the MQO of < 15% CV.

Table 15. Overall Precision for Primary, Duplicate, and Collocated Samples ≥ MDL – CY2011 (continued)

		carbonyls		PAHs		metals						
AQS Site Code	**Site Name**	**FORM**	**ACET**	**NAPH**	**BaP**	**As**	**Be**	**Cd**	**Pb**	**Mn**	**Ni**	**CrVI**
25-025-0042	Boston, MA	12.5 (30)	13.2 (30)	--	--	4.1 (37)	20.4 (6)	18.1 (37)	6.4 (37)	3.7 (37)	4.9 (36)	27.6 (5)
50-007-0007	Underhill, VT	--	--	--	--	23.2 (3)	--	16.2 (4)	4.6 (4)	4.2 (4)	0 (1)	15.5 (3)
44-007-0022	Providence, RI	9.6 (23)	10.3 (23)	--	--	16.0 (20)	--	--	14.0 (23)	13.9 (27)	37.2 (26)	17.1 (5)
36-005-0080	Bronx, NY	--	--	--	--	6.7 (51)	--	6.2 (47)	2.8 (51)	4.4 (51)	4.7 (51)	8.3 (6)
36-055-1007	Rochester, NY	--	--	--	--	--	--	--	--	--	--	19.6 (5)
11-001-0043	Washington, DC	--	--	--	--	--	--	--	--	--	--	10.3 (5)
51-087-0014	Richmond, VA	2.5 (59)	2.6 (59)	--	--	--	--	--	--	--	--	11.5 (5)
45-025-0001	Chesterfield, SC	14.6 (58)	14.7 (58)	--	--	35.3 (92)	--	37.9 (98)	37.5 (98)	32.7 (100)	57.7 (14)	8.9 (2)
13-089-0002	Decatur, GA	--	--	6.4 (6)	5.2 (1)	20.0 (18)	53.3 (1)	--	14.2 (22)	14.0 (22)	23.4 (22)	16.8 (5)
21-043-0500	Grayson Lake, KY	6.6 (16)	6.5 (16)	--	--	20.3 (39)	0 (1)	20.6 (38)	15.1 (55)	26.7 (51)	35.6 (3)	20.4 (5)
12-057-3002	Hillsborough Cty, FL	2.8 (7)	2.1 (7)	15.3 (6)	13.8 (1)	21.9 (35)	--	8.6 (9)	9.8 (36)	10.3 (59)	24.5 (53)	6.0 (4)
12-103-0026	Pinellas Cty, FL	2.6 (6)	2.6 (6)	--	--	--	--	--	--	--	--	10.8 (5)
26-163-0033	Dearborn, MI	11.7 (5)	10.1 (5)	8.6 (6)	4.4 (4)	8.4 (59)	8.7 (29)	26.0 (58)	--	26.0 (58)	33.4 (58)	10.9 (6)
55-027-0001	Horicon, WI	10.5 (4)	10.0 (4)	11.2 (3)	5.8 (2)	24.1 (5)	16.7 (1)	30.2 (5)	21.6 (5)	15.6 (5)	18.3 (5)	9.1 (5)
17-031-4201	Northbrook, IL	2.9 (6)	2.2 (6)	--	--	--	--	--	--	--	--	18.2 (6)
48-201-1039	Deer Park, TX	--	--	--	--	5.3 (28)	--	12.0 (8)	14.3 (28)	4.6 (28)	8.0 (28)	11.0 (6)
29-510-0085	St. Louis, MO	3.2 (6)	1.4 (6)	--	--	11.8 (32)	19.7 (3)	8.6 (33)	5.1 (33)	5.5 (33)	43.2 (7)	7.9 (6)
49-011-0004	Bountiful, UT	5.6 (7)	2.3 (7)	--	--	11.0 (3)	11.1 (2)	15.7 (4)	13.1 (4)	10.4 (4)	3.1 (1)	22.3 (6)
08-077-0017/-0018	Grand Junction, CO	2.2 (6)	2.1 (6)	--	--	43.2 (11)	--	20.2 (3)	6.3 (10)	6.1 (11)	58.4 (11)	10.9 (6)
04-013-9997	Phoenix, AZ	5.8 (6)	2.6 (6)	--	--	--	--	--	--	--	--	31.2 (7)
06-037-1103	Los Angeles, CA	--	--	--	--	17.1 (6)	--	6.3 (3)	7.3 (6)	0 (6)	3.8 (6)	35.3 (6)
06-065-8001	Rubidoux, CA	--	--	15.5 (6)	--	12.6 (5)	--	60.1 (2)	11.4 (5)	13.2 (5)	47.9 (5)	34.7 (3)
06-085-0005	San Jose, CA	--	--	--	--	--	--	--	--	--	--	--
41-051-0246	Portland, OR	11.0 (46)	10.8 (46)	22.7 (40)	4.4 (5)	4.3 (44)	6.6 (2)	12.2 (33)	7.0 (43)	14.0 (44)	4.4 (37)	11.9 (3)
53-033-0080	Seattle, WA	4.0 (6)	1.8 (6)	6.0 (5)	12.7 (1)	--	--	--	--	--	--	11.0 (7)
	Network Mean	9.7 (285)	9.8 (285)	18.5 (67)	6.6 (13)	20.3 (488)	14.4 (45)	24.7 (382)	19.6 (460)	19.8 (545)	26.9 (364)	18.3 (115)

Expressed as percentage coefficient of variation (%CV) with number of contributing data pairs presented in parentheses.
Values shown in red exceed the MQO of < 15% CV.

Table 16. Overall Precision for Primary, Duplicate, and Collocated Samples ≥ MDL – CY2012

		VOCs													
AQS Site Code	Site Name	BENZ	BUTA	CTET	CLFRM	EDC	MECL	TCE1122	PERC	TCE	VC	cDCPEN	tDCPEN	ACRO	ACRY
25-025-0042	Boston, MA	10.1 (30)	20.8 (27)	2.7 (30)	16.8 (26)	4.1 (7)	14.1 (30)	--	28.0 (11)	5.2 (1)	--	--	--	24.2 (23)	--
50-007-0007	Underhill, VT	--	--	--	--	--	--	--	--	--	--	--	--	--	--
44-007-0022	Providence, RI	--	--	--	--	--	--	--	--	--	--	--	--	--	--
36-005-0080/ -0110	Bronx, NY	3.1 (9)	35.2 (9)	1.2 (9)	9.0 (9)	4.2 (9)	29.3 (9)	32.6 (1)	35.1 (9)	11.6 (5)	3.9 (3)	--	--	15.8 (9)	--
36-055-1007	Rochester, NY	--	--	--	--	--	--	--	--	--	--	--	--	--	--
11-001-0043	Washington, DC	--	32.5 (8)	3.8 (23)	12.9 (26)	--	11.8 (22)	--	29.8 (12)	--	--	--	--	--	71.1 (4)
51-087-0014	Richmond, VA	7.1 (24)	10.9 (1)	5.6 (25)	--	--	35.6 (10)	--	0 (1)	--	--	--	--	25.0 (3)	--
45-025-0001	Chesterfield, SC	7.6 (59)	--	5.4 (59)	--	--	81.7 (54)	3.4 (8)	1.0 (13)	--	--	--	--	59.7 (2)	--
13-089-0002	Decatur, GA	27.6 (45)	--	9.4 (46)	9.1 (3)	--	--	--	--	--	--	--	--	--	--
21-043-0500	Grayson Lake, KY	10.5 (4)	8.2 (3)	7.2 (5)	29.8 (1)	7.3 (3)	40.0 (5)	--	--	--	--	--	--	14.8 (5)	102.5 (3)
12-057-3002	Hillsborough Cty, FL	--	--	--	--	--	--	--	--	--	--	--	--	--	--
12-103-0026	Pinellas Cty, FL	1.6 (4)	6.2 (4)	1.8 (4)	8.3 (4)	4.4 (4)	2.4 (4)	--	10.4 (4)	--	--	2.7 (1)	0 (1)	5.2 (4)	--
26-163-0033	Dearborn, MI	7.8 (6)	5.6 (6)	7.0 (6)	29.0 (6)	6.4 (4)	6.3 (6)	--	4.7 (3)	--	--	--	--	11.8 (6)	--
55-027-0001	Horicon, WI	1.9 (2)	--	--	--	--	--	--	--	--	--	--	--	11.1 (2)	--
17-031-4201	Northbrook, IL	--	--	9.3 (7)	20.8 (7)	7.7 (5)	14.2 (7)	--	7.4 (3)	10.5 (2)	--	--	--	40.9 (6)	--
48-201-1039	Deer Park, TX	--	--	--	--	--	--	--	--	--	--	--	--	--	--
29-510-0085	St. Louis, MO	9.0 (8)	7.8 (8)	17.9 (8)	4.9 (7)	8.8 (5)	11.2 (8)	--	10.7 (4)	2.0 (1)	--	--	--	15.2 (8)	--
49-011-0004	Bountiful, UT	9.0 (6)	7.8 (6)	10.9 (6)	9.3 (6)	8.0 (3)	27.7 (6)	--	8.8 (1)	--	--	--	--	5.1 (6)	--
08-077-0017/-0018	Grand Junction, CO	6.0 (6)	4.2 (6)	15.5 (6)	7.4 (4)	7.6 (5)	8.7 (6)	--	5.9 (5)	--	--	--	--	23.6 (6)	15.7 (1)
04-013-9997	Phoenix, AZ	2.2 (6)	4.5 (6)	3.7 (6)	2.9 (5)	3.4 (4)	38.6 (6)	--	4.4 (6)	--	--	--	--	21.5 (6)	--
06-037-1103	Los Angeles, CA	--	--	--	--	--	--	--	--	--	--	--	--	--	--
06-065-8001	Rubidoux, CA	--	--	--	--	--	--	--	--	--	--	--	--	--	--
06-085-0005	San Jose, CA	23.6 (41)	15.8 (7)	17.0 (43)	30.1 (28)	32.4 (12)	29.4 (34)	--	23.9 (38)	31.5 (2)	--	--	--	35.7 (39)	24.8 (8)
41-051-0246	Portland, OR	10.5 (29)	4.4 (2)	11.1 (28)	--	--	26.3 (21)	--	--	--	--	--	--	33.6 (30)	--
53-033-0080	Seattle, WA	6.3 (6)	3.5 (6)	8.3 (6)	14.1 (6)	0 (2)	21.7 (6)	--	2.3 (1)	--	--	--	--	23.4 (6)	--
	Network Mean	15.7 (279)	18.8 (93)	9.6 (311)	18.9 (132)	15.2 (61)	44.4 (228)	11.3 (9)	21.9 (110)	16.3 (11)	3.9 (3)	2.7 (1)	0 (1)	28.7 (155)	59.6 (16)

Expressed as percentage coefficient of variation (%CV) with number of contributing data pairs presented in parentheses.
Values shown in red exceed the MQO of < 15% CV.

Table 16. Overall Precision for Primary, Duplicate, and Collocated Samples ≥ MDL – CY2012 (continued)

		carbonyls		PAHs		metals						
AQS Site Code	**Site Name**	**FORM**	**ACET**	**NAPH**	**BaP**	**As**	**Be**	**Cd**	**Pb**	**Mn**	**Ni**	**CrVI**
25-025-0042	Boston, MA	6.6 (19)	5.9 (15)	--	--	3.0 (36)	13.2 (4)	27.9 (33)	3.7 (37)	2.4 (52)	8.6 (55)	5.8 (12)
50-007-0007	Underhill, VT	--	--	--	--	33.9 (3)	--	19.7 (6)	7.0 (3)	6.4 (6)	6.6 (1)	--
44-007-0022	Providence, RI	18.9 (17)	13.1 (17)	--	--	11.0 (25)	--	25.3 (22)	9.6 (26)	16.5 (21)	28.8 (26)	6.2 (4)
36-005-0080/-0110	Bronx, NY	--	--	--	--	9.6 (54)	9.7 (1)	7.1 (46)	4.3 (55)	6.4 (43)	19.6 (55)	9.7 (6)
36-055-1007	Rochester, NY	--	--	--	--	--	--	--	--	--	--	13.9 (4)
11-001-0043	Washington, DC	--	--	--	--	--	--	--	--	--	--	33.7 (10)
51-087-0014	Richmond, VA	3.9 (61)	2.4 (61)	--	--	--	--	--	--	--	--	13.9 (6)
45-025-0001	Chesterfield, SC	6.7 (58)	9.3 (57)	--	--	19.4 (88)	54.1 (52)	31.4 (90)	34.0 (92)	34.8 (96)	65.6 (24)	9.7 (2)
13-089-0002	Decatur, GA	--	--	41.1 (21)	--	15.8 (7)	--	--	13.0 (12)	21.8 (12)	11.7 (12)	27.4 (7)
21-043-0500	Grayson Lake, KY	2.1 (6)	1.6 (6)	--	--	16.9 (20)	--	29.6 (22)	4.1 (24)	3.4 (24)	1.2 (2)	5.2 (3)
12-057-3002	Hillsborough Cty, FL	12.1 (5)	4.3 (5)	10.7 (12)	--	29.5 (41)	--	5.9 (11)	21.2 (47)	7.5 (57)	13.2 (40)	0.7 (2)
12-103-0026	Pinellas Cty, FL	5.3 (6)	4.2 (6)	--	--	--	--	--	--	--	--	19.5 (9)
26-163-0033	Dearborn, MI	11.2 (8)	6.3 (7)	6.0 (12)	14.9 (8)	10.2 (58)	10.6 (32)	10.8 (58)	--	6.8 (59)	9.3 (59)	5.6 (9)
55-027-0001	Horicon, WI	7.9 (4)	6.3 (4)	4.9 (2)	--	5.6 (2)	--	61.5 (2)	21.4 (2)	1.6 (2)	3.4 (2)	16.5 (8)
17-031-4201	Northbrook, IL	3.9 (8)	2.6 (8)	--	--	3.6 (2)	9.4 (1)	5.0 (1)	0.3 (2)	0.1 (2)	16.5 (2)	26.2 (13)
48-201-1039	Deer Park, TX	--	--	--	--	23.4 (40)	0 (1)	42.5 (11)	18.0 (40)	18.1 (40)	26.2 (39)	24.8 (9)
29-510-0085	St. Louis, MO	2.5 (6)	1.8 (6)	--	--	11.2 (58)	17.1 (11)	11.9 (59)	4.6 (25)	5.2 (59)	17.0 (53)	6.4 (8)
49-011-0004	Bountiful, UT	3.9 (5)	3.6 (5)	--	--	11.8 (4)	14.3 (2)	10.6 (4)	5.9 (4)	9.9 (4)	11.2 (3)	9.2 (6)
08-077-0017/-0018	Grand Junction, CO	1.0 (6)	1.4 (6)	--	--	32.3 (11)	--	52.9 (5)	47.8 (11)	57.2 (12)	68.3 (12)	15.4 (3)
04-013-9997	Phoenix, AZ	10.6 (7)	3.5 (6)	--	--	--	--	--	--	--	--	10.1 (6)
06-037-1103	Los Angeles, CA	--	--	--	--	--	--	--	--	--	--	47.5 (6)
06-065-8001	Rubidoux, CA	--	--	14.0 (12)	--	--	--	--	--	--	--	20.6 (5)
06-085-0005	San Jose, CA	--	--	--	--	--	--	--	--	--	--	--
41-051-0246	Portland, OR	20.3 (30)	16.2 (30)	12.6 (23)	10.4 (5)	5.0 (41)	9.4 (8)	19.3 (39)	3.9 (41)	7.0 (41)	4.3 (39)	11.7 (13)
53-033-0080	Seattle, WA	3.1 (6)	1.7 (6)	4.4 (11)	12.6 (2)	--	--	--	--	--	--	8.0 (10)
	Network Mean	10.2 (246)	8.5 (239)	21.6 (82)	13.3 (13)	16.7 (490)	37.9 (112)	23.4 (409)	20.4 (421)	19.1 (530)	24.9 (424)	19.4 (151)

Expressed as percentage coefficient of variation (%CV) with number of contributing data pairs presented in parentheses.
Values shown in red exceed the MQO of < 15% CV.

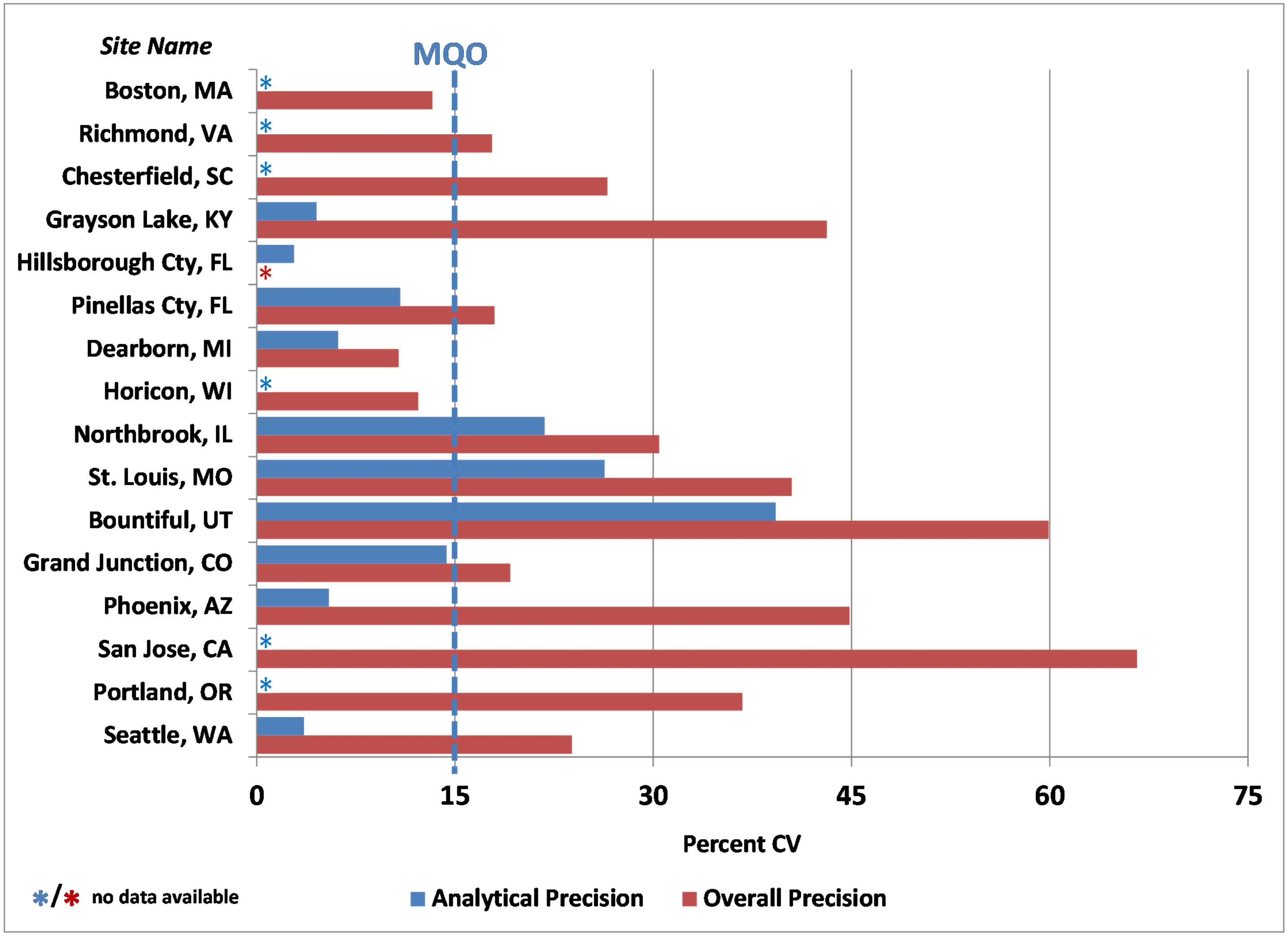

Figure 3. Analytical and Overall Precision Summary for Acrolein ≥ MDL at NATTS Sample Collection Sites in CY2011

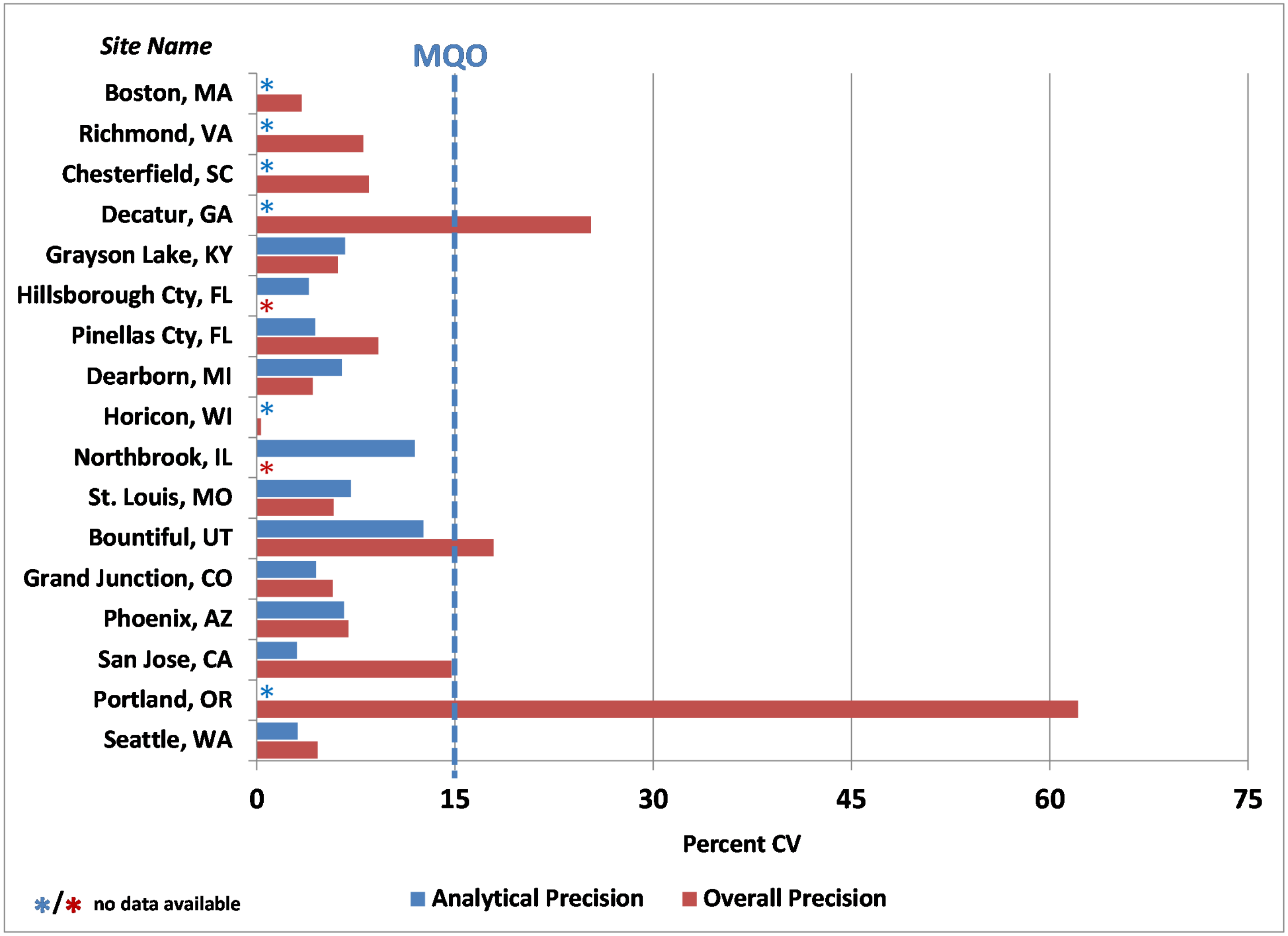

Figure 4. Analytical and Overall Precision Summary for Benzene ≥ MDL at NATTS Sample Collection Sites in CY2011

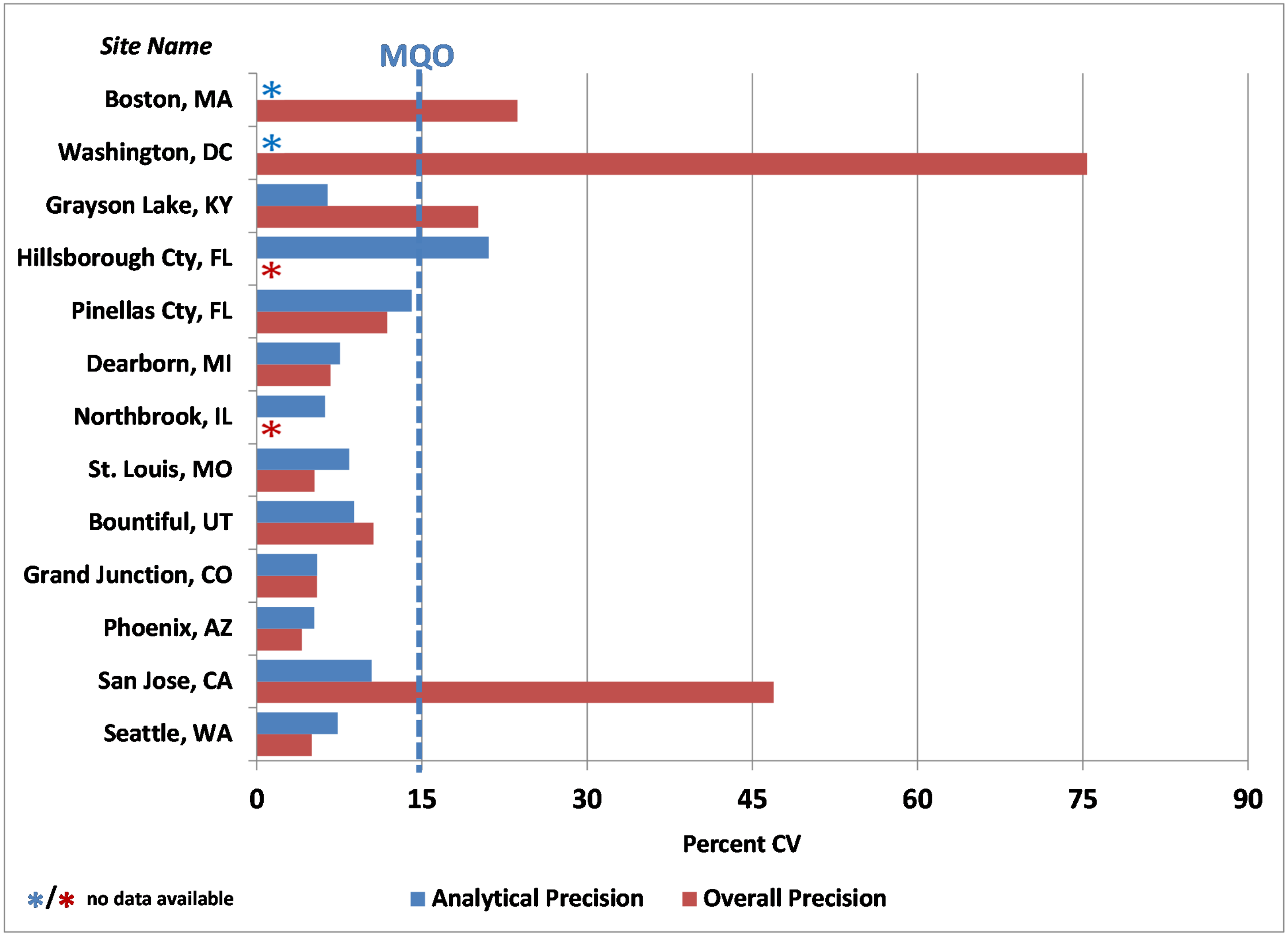

Figure 5. Analytical and Overall Precision Summary for 1,3-Butadiene ≥ MDL at NATTS Sample Collection Sites in CY2011

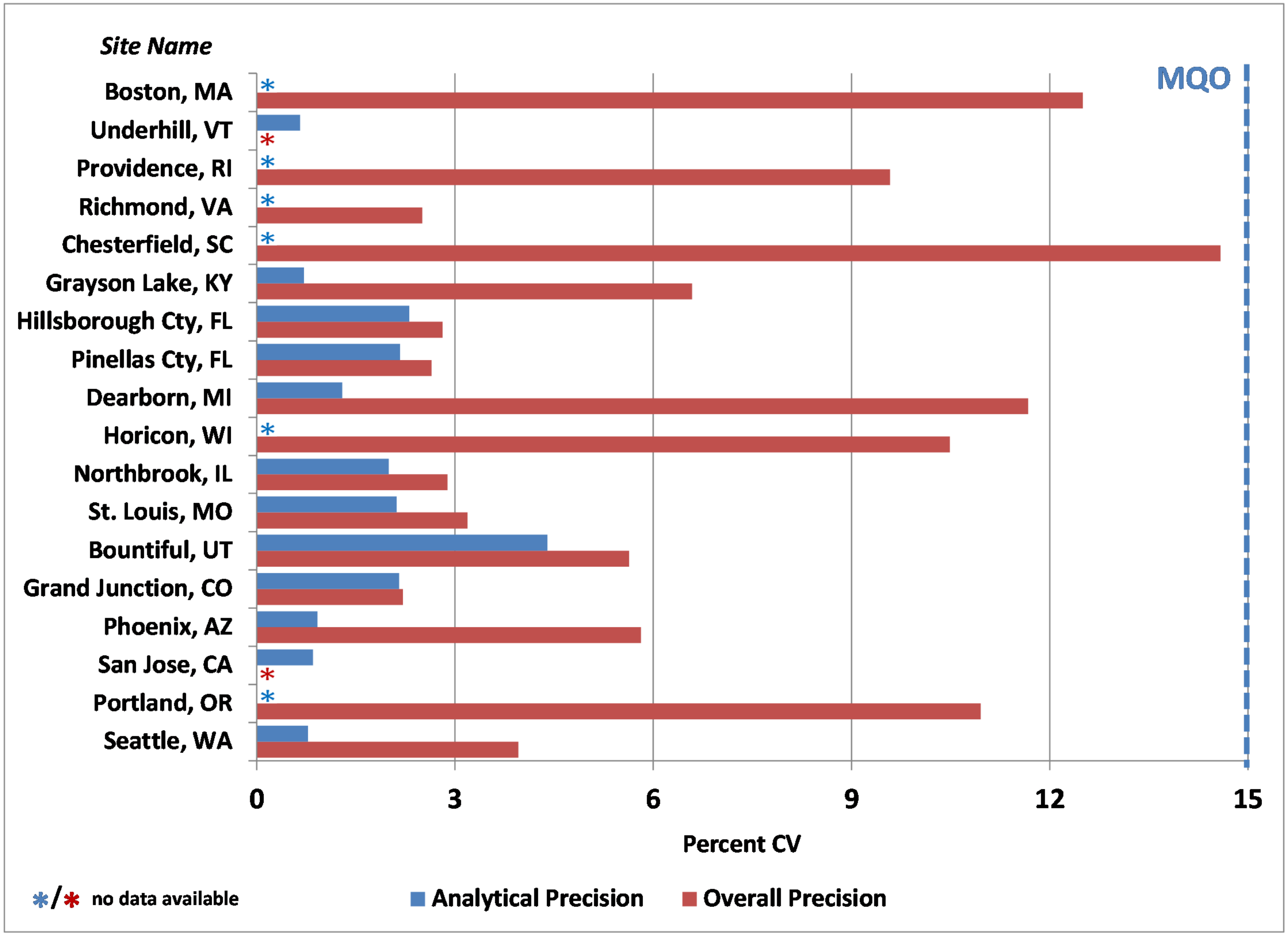

Figure 6. Analytical and Overall Precision Summary for Formaldehyde ≥ MDL at NATTS Sample Collection Sites in CY2011

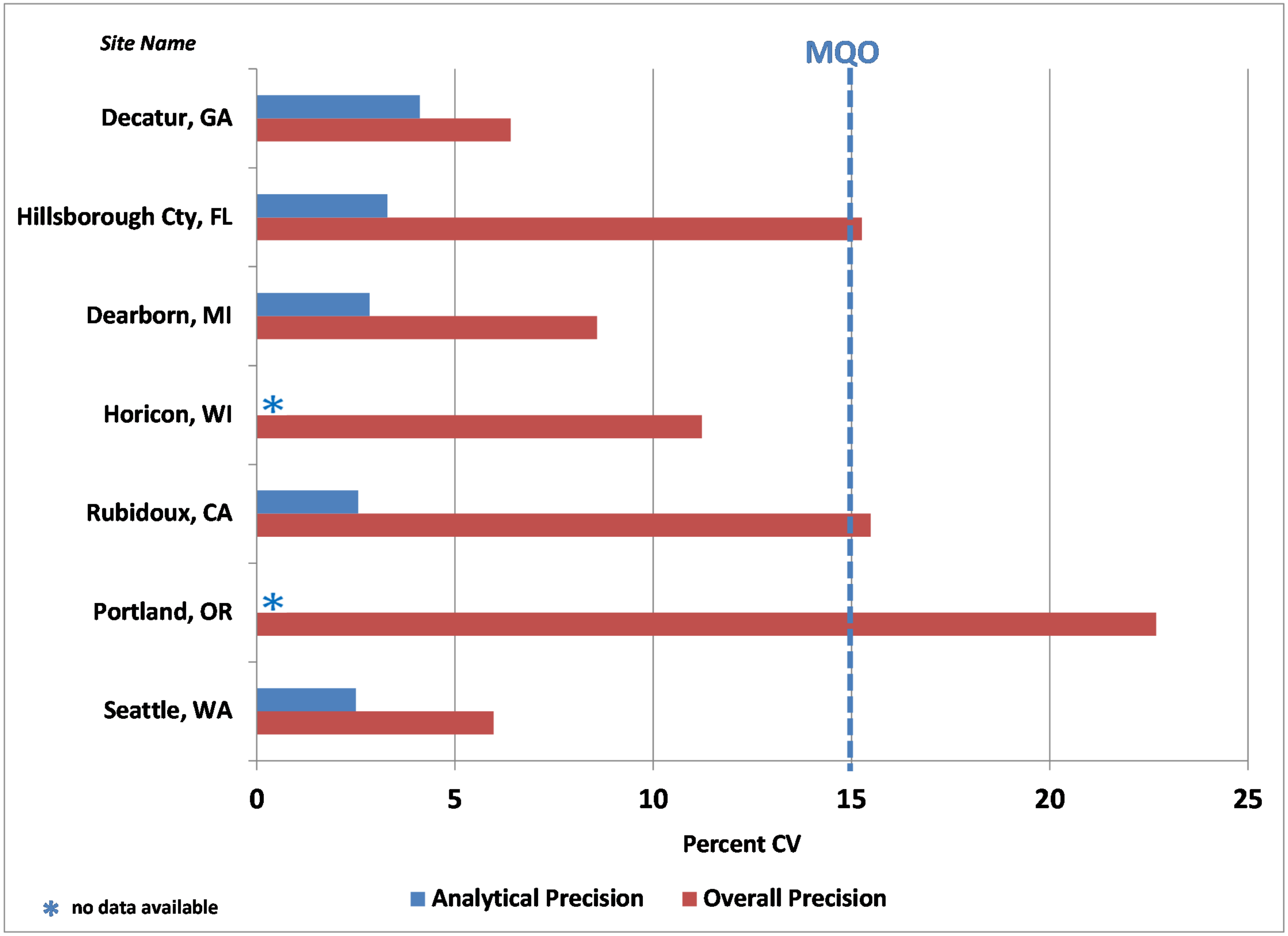

Figure 7. Analytical and Overall Precision Summary for Naphthalene ≥ MDL at NATTS Sample Collection Sites in CY2011

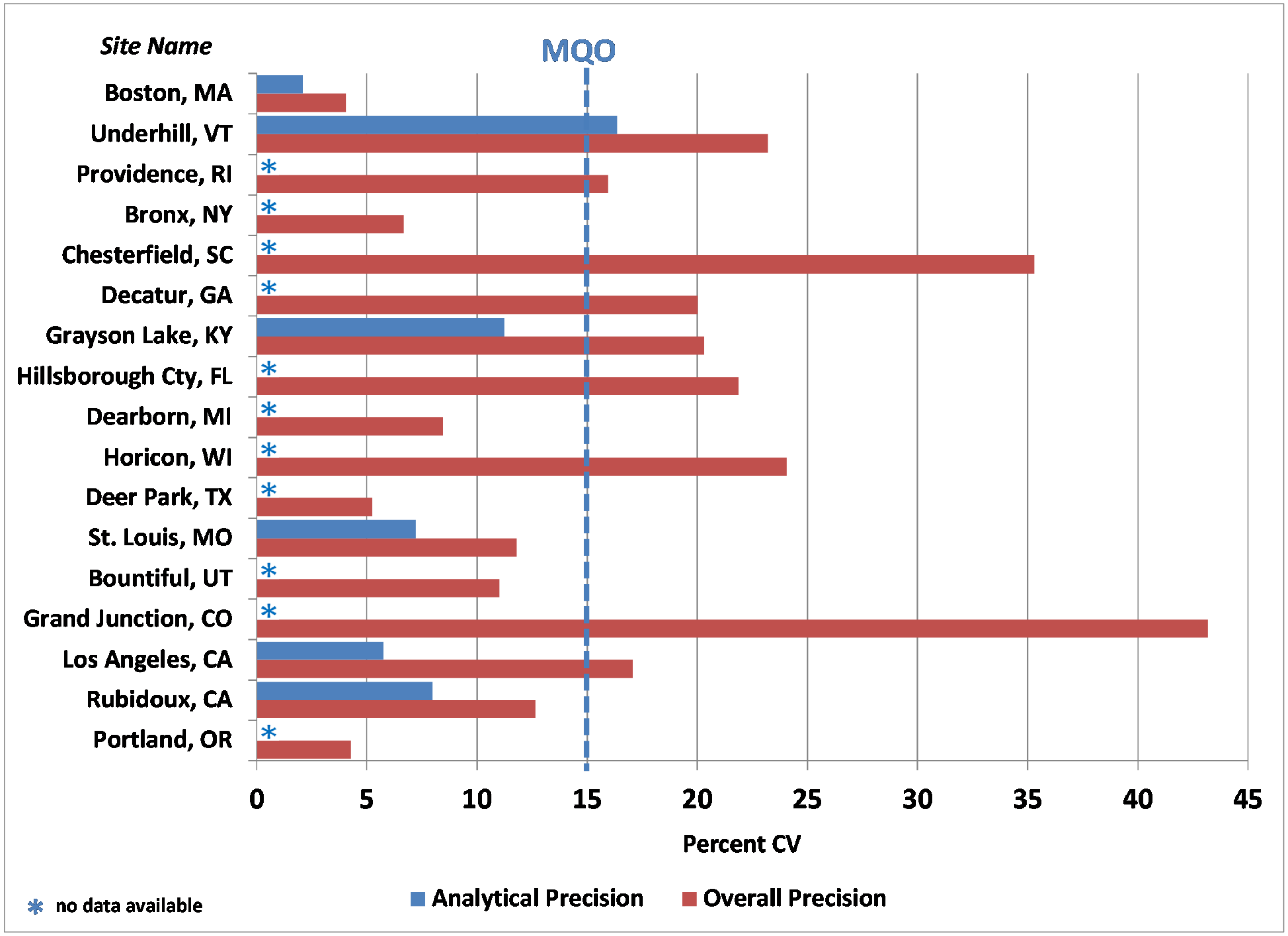

Figure 8. Analytical and Overall Precision Summary for PM_{10} Arsenic ≥ MDL at NATTS Sample Collection Sites in CY2011

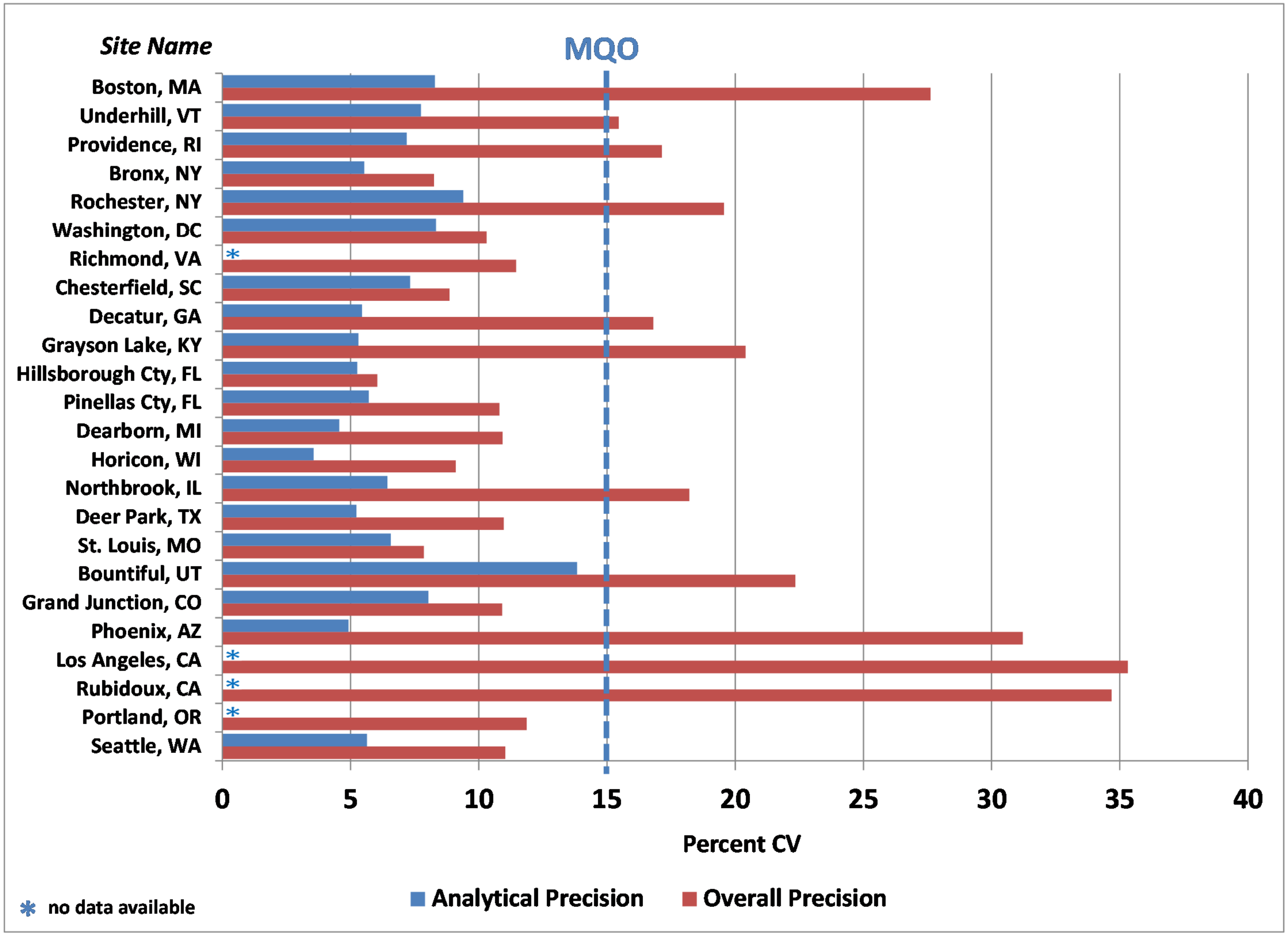

Figure 9. Analytical and Overall Precision Summary for Chromium (VI) ≥ MDL at NATTS Sample Collection Sites in CY2011

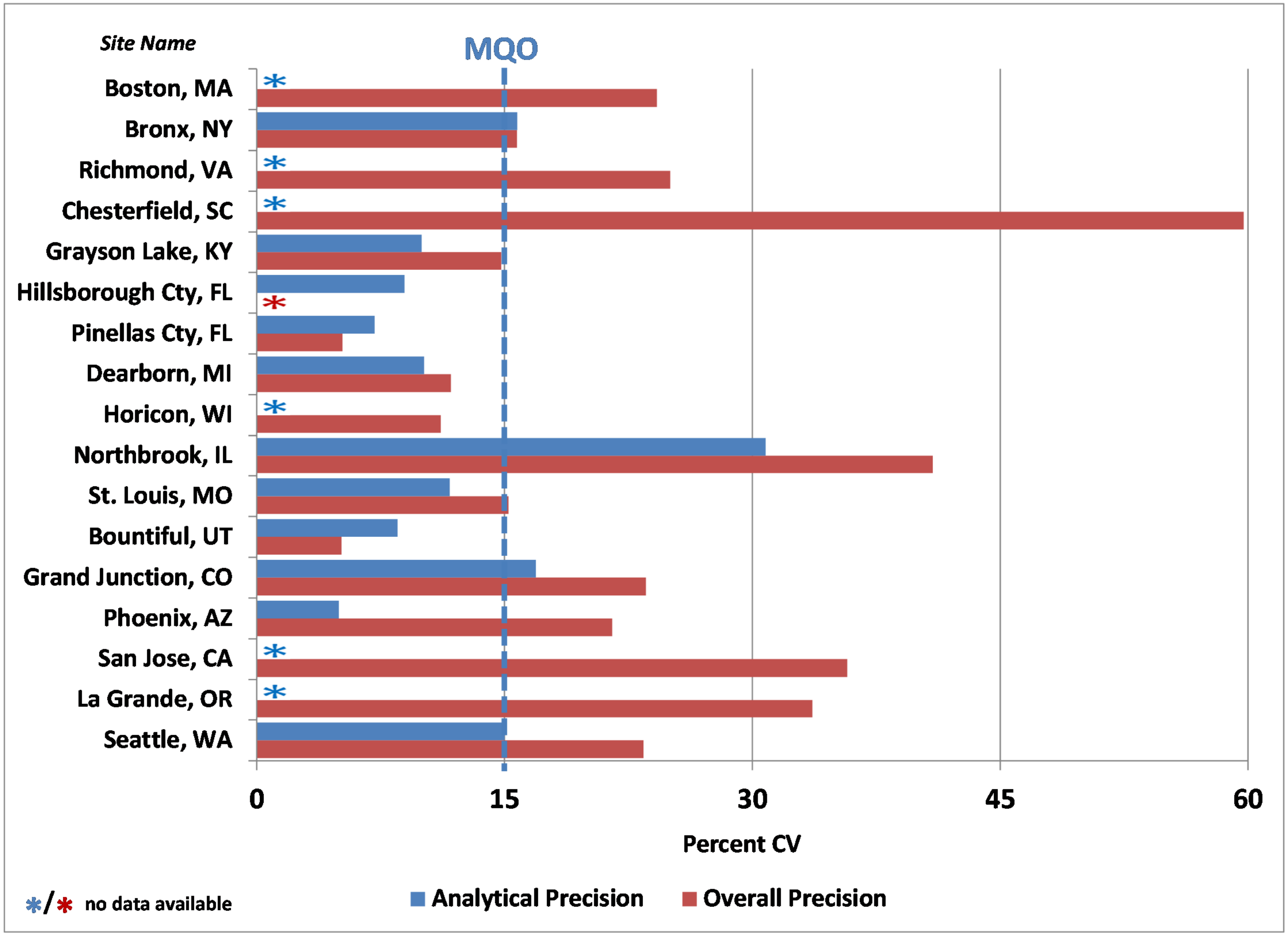

Figure 10. Analytical and Overall Precision Summary for Acrolein ≥ MDL at NATTS Sample Collection Sites in CY2012

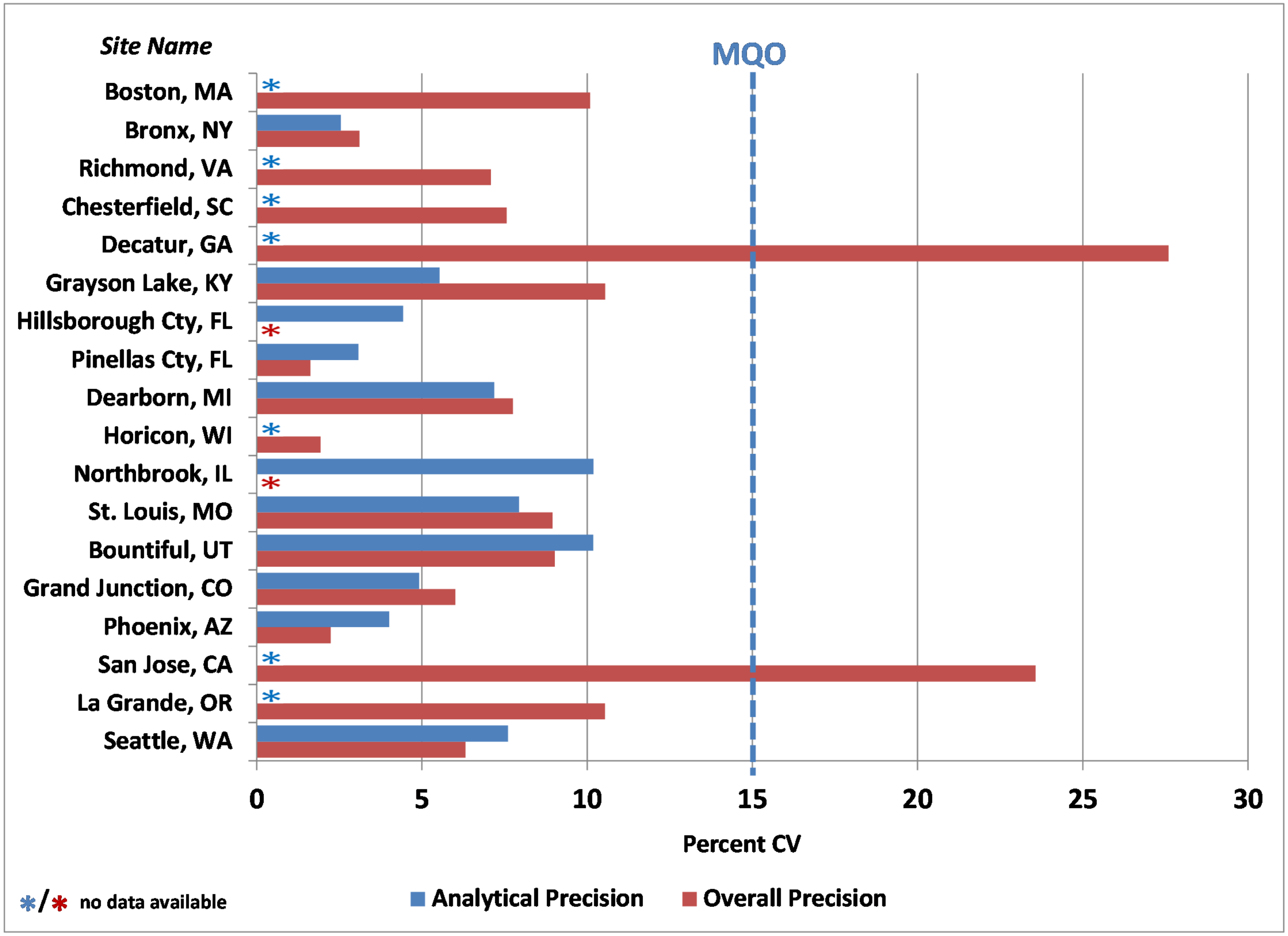

Figure 11. Analytical and Overall Precision Summary for Benzene ≥ MDL at NATTS Sample Collection Sites in CY2012

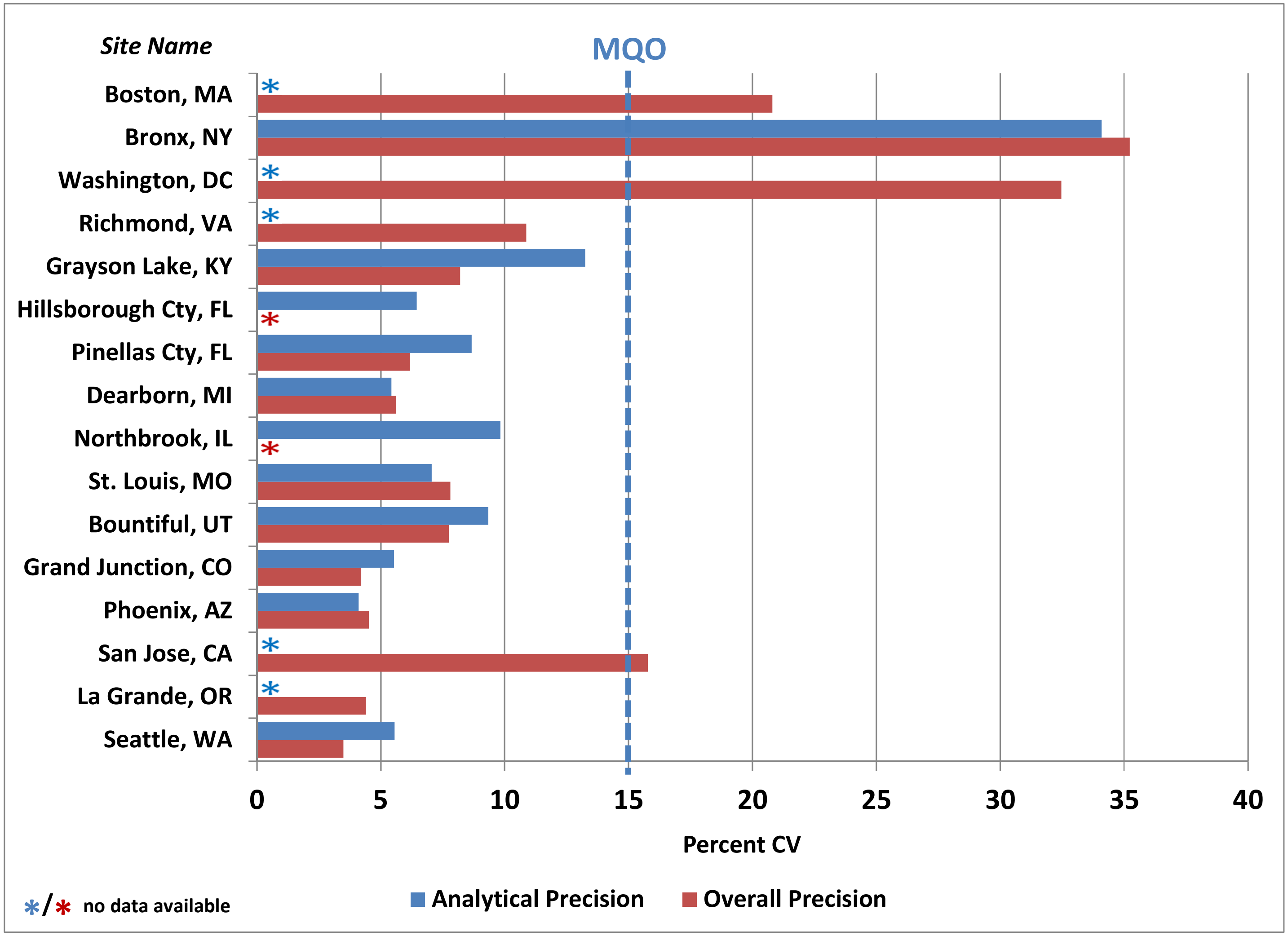

Figure 12. Analytical and Overall Precision Summary for 1,3-Butadiene ≥ MDL at NATTS Sample Collection Sites in CY2012

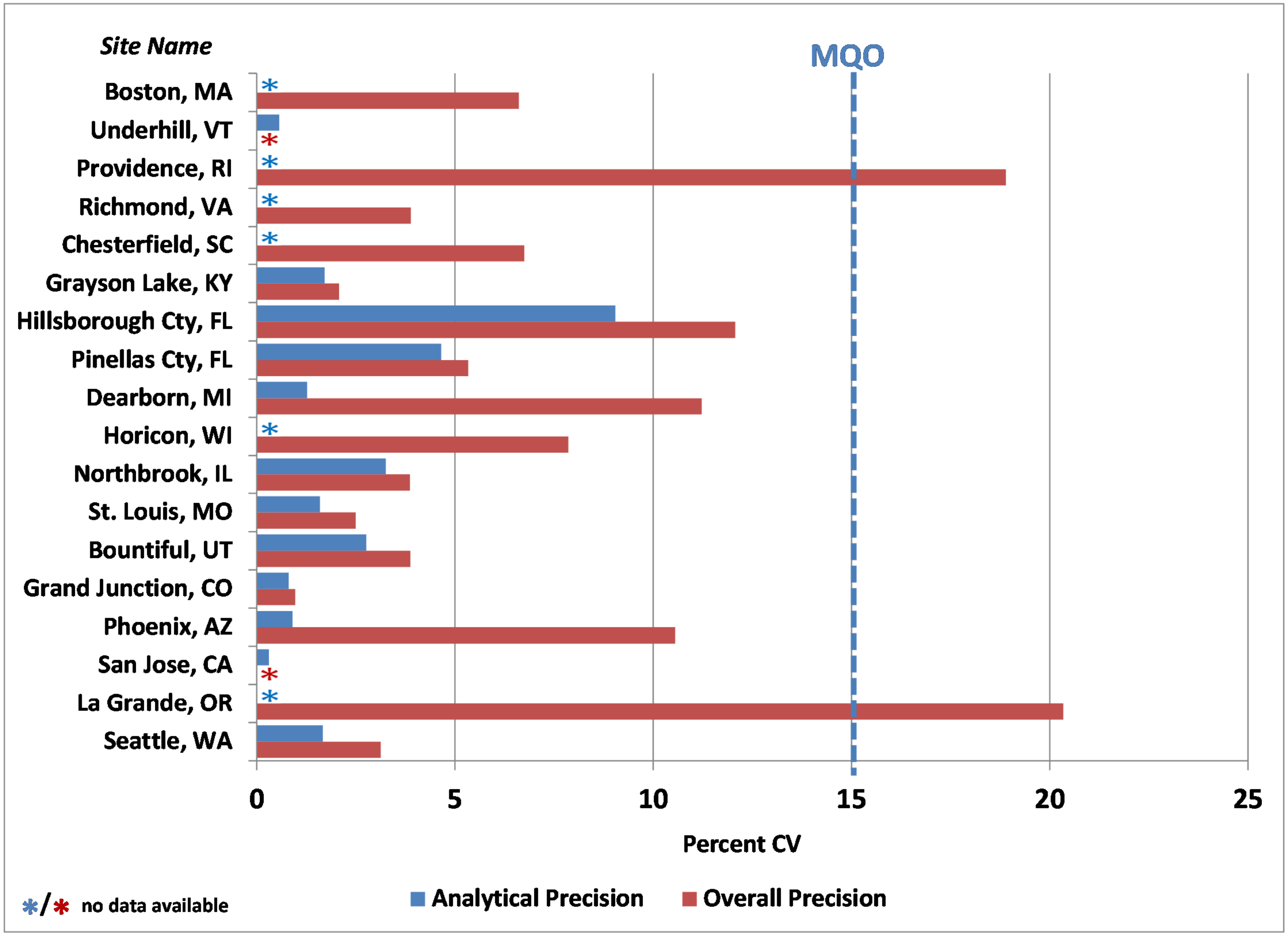

Figure 13. Analytical and Overall Precision Summary for Formaldehyde ≥ MDL at NATTS Sample Collection Sites in CY2012

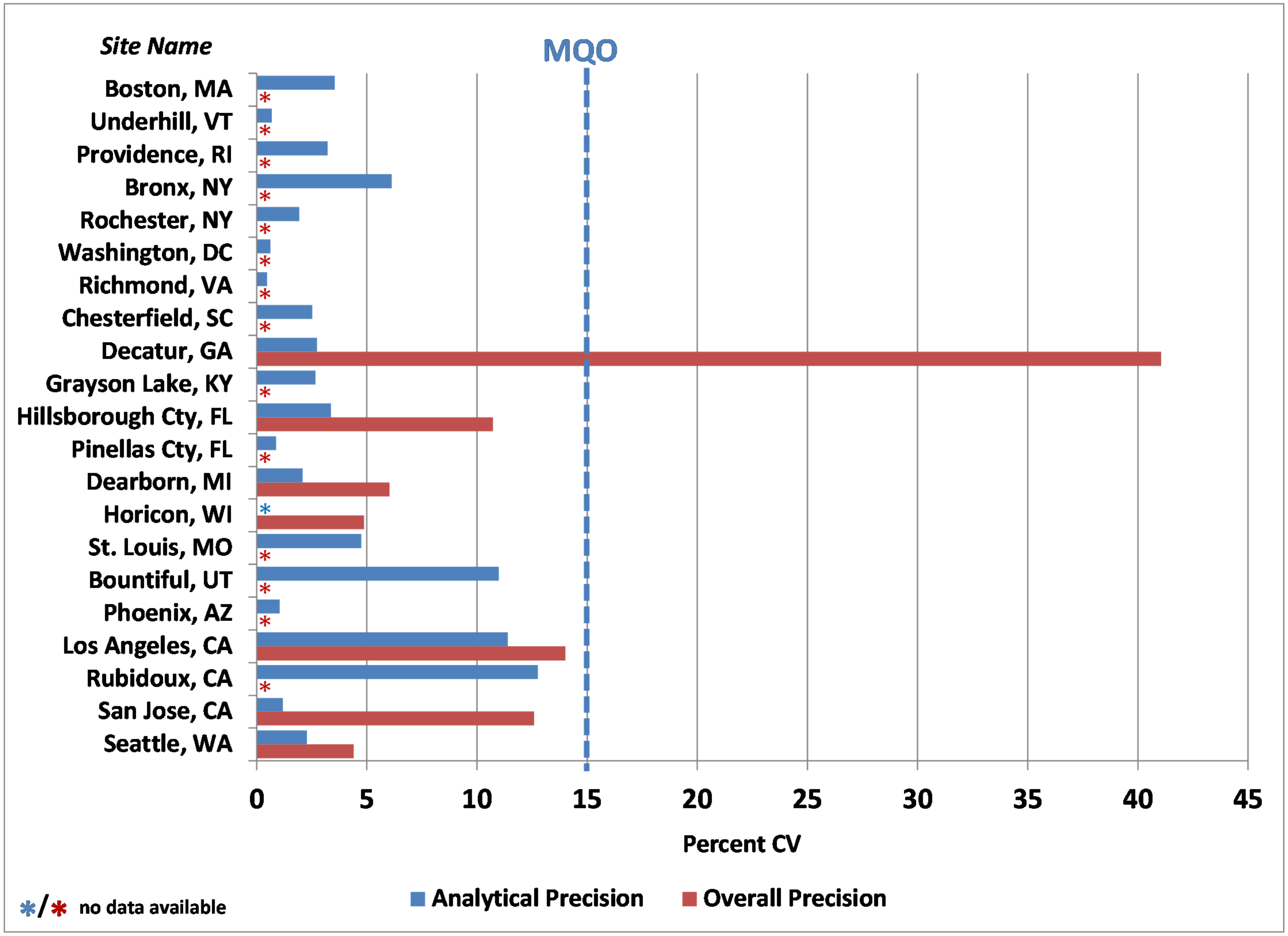

Figure 14. Analytical and Overall Precision Summary for Naphthalene ≥ MDL at NATTS Sample Collection Sites in CY2012

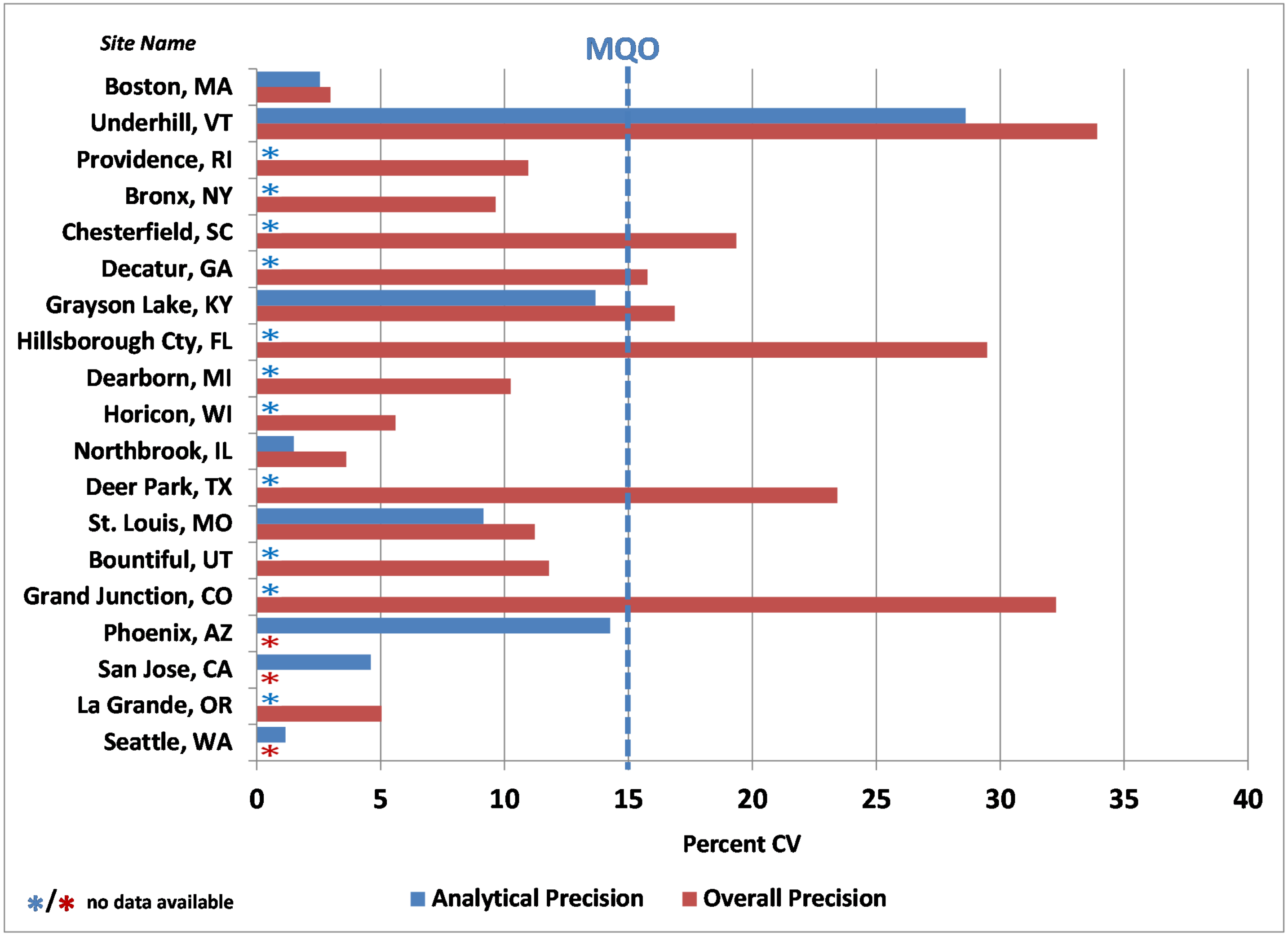

Figure 15. Analytical and Overall Precision Summary for PM_{10} Arsenic ≥ MDL at NATTS Sample Collection Sites in CY2012

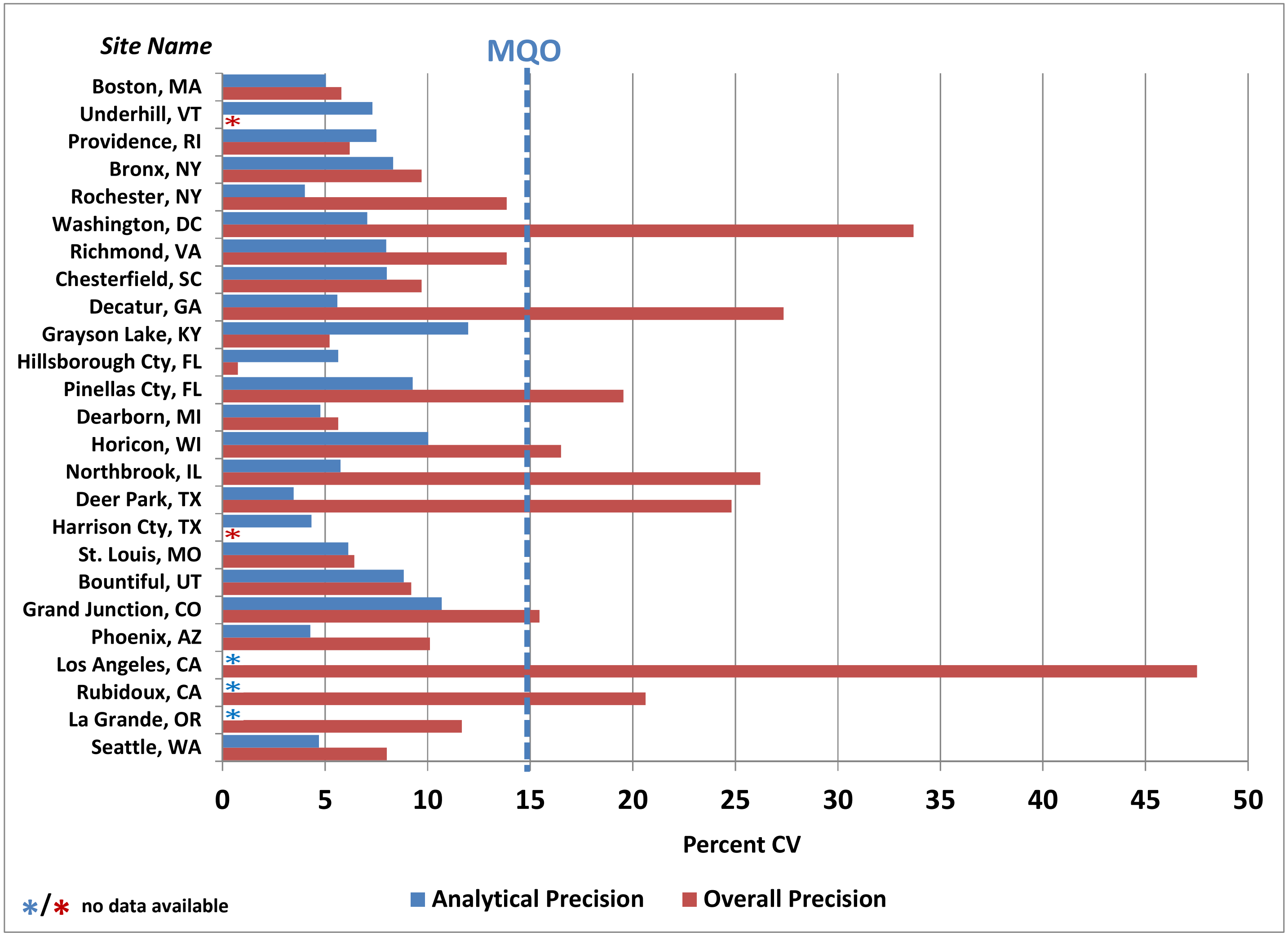

Figure 16. Analytical and Overall Precision Summary for Chromium (VI) ≥ MDL at NATTS Sample Collection Sites in CY2012

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

PT analyses were performed in CY2011 QTR2 and QTR4 and in CY2012 QTR 1. Blind "spiked" PT samples were prepared for metals and PAHs for CY2011 QTR2 by Wibby Environmental. Battelle prepared VOC and carbonyl PT samples in CY2011 QTR4 and prepared metals, PAH, and chromium (VI) PTs in CY2012 QTR1. Participating NATTS analysis laboratories submitted results to the respective PT provider, which were evaluated for acceptability by the provider, Wibby Environmental or Battelle, as appropriate.

Laboratory bias is measured by the percentage difference between the laboratory's measured value and the target value for the PT sample for a given HAP:

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

Target values were typically assigned as the average of the results of one or more confirmatory analysis (referee) samples.

The percentage of NATTS laboratories that participated in the PT program for CY2011 and CY2012 is shown in Table 17.

Table 17. Percentage of NATTS Laboratories Participating in the NATTS Proficiency Testing Program in CY2011 and CY2012

PT year and quarter	VOCs	carbonyls	PAHs	metals	chromium (VI)
CY2011 QTR2	-	-	83%	69%	-
CY2011 QTR4	100%	92%	-	-	-
CY2012 QTR1	-	-	100%	100%	100%

The CY2011 and CY2012 PT samples were prepared to contain the 27 HAPs listed in Table 2 (except acrylonitrile) and many of the 11 HAPs given in Table 18. These 11 additional HAPs include two carbonyls, six PAHs, and three metals.

Table 18. Additional HAPs Contained in NATTS Proficiency Test Samples in CY2011 and/or CY2012

HAP	HAP Abbreviation	HAP Class	Spiked in CY2011 PT Samples?	Spiked in CY2012 PT Samples?
benzaldehyde	BNZD	carbonyl	Yes	No
propionaldehyde	PRPD	carbonyl	Yes	No
acenaphthene	ACEN	PAH	Yes	Yes
anthracene	ANTH	PAH	Yes	Yes
fluorene	FLUR	PAH	Yes	Yes
fluoranthene	FTHN	PAH	Yes	Yes
phenanthrene	PHEN	PAH	Yes	Yes
pyrene	PYR	PAH	Yes	Yes
cobalt	Co	metal	Yes	Yes
antimony	Sb	metal	No	Yes
selenium	Se	metal	Yes	Yes

For the two PTs performed in CY2011, the PT samples were spiked with 15 VOCs, four carbonyls, eight PAHs, and eight metals, for a total of 35 HAPs. Tables 21 through 24 present the PT results for these 35 HAPs for the two CY2011 PTs (one table per HAP class). Tables 25 through 27 present the PT results for the CY2012 PT for the eight PAHs, nine metals, and chromium (VI) for a total of 18 HAPs. To reflect overall bias independent of direction, the mean of the absolute value of the percent difference, along with the minimum and maximum values, are presented at the bottom and in the right-most columns of these tables.

Figures 17 and 18 are box and whisker plots summarizing the percent difference values for CY2011 and CY2012, respectively, for the seven HAPs of primary importance: acrolein, benzene, 1,3-butadiene, formaldehyde, naphthalene, arsenic, and chromium (VI). The CY2012 PT only included PAHs, metals, and chromium (VI), hence only three of the seven HAPs of primary importance were analyzed. A laboratory's results were included in these summaries only if the laboratory provided analysis results for a particular sample type.

The two reference lines in Figures 17 and 18 represent the MQO of 25% for laboratory bias, in either direction of zero bias. Thus, laboratories whose percent difference values fall within the reference lines have achieved the MQO. Those results that fall more than 1.5 times the IQR either above the 75th percentile or below the 25th percentile are identified by their laboratory number (Tables 10 and 11). Figures 17 and 18 present PT results for all labs participating in the NATTS PT program, including those labs not affiliated with NATTS sites. These non-NATTS labs are assigned identification codes similar to those of the NATTS labs; see Table 19.

Table 19. Non-NATTS Laboratories Analyzing Proficiency Test Samples in CY2011 and CY2012

Laboratory Code(s)	Laboratory Description
01-04-V	US EPA Region I Laboratory
01-05-V	Maine Department of Environmental Protection Air Laboratory
03-03-M	Pennsylvania Department of Environmental Protection, Bureau of Air Quality
04-06-V	North Carolina Department of Environment and Natural Resources
05-04-C,M,V	State of Minnesota Pollution Control Agency
05-06-M,V	Indiana Department of Environmental Management
05-07-M,V	Ohio Environmental Protection Agency Division of Environmental Services Lab
07-02-C,V	State Hygenic Laboratory at The University of Iowa
09-06-C,V	Air Pollution Control District County of San Diego
09-09-V	Joint Water Pollution Control Plant of Los Angeles County
11-03-V	US EPA National Exposure Research Laboratory

As can be seen in Tables 21 through 27, and as is summarized in Figures 17 and 18, with some exceptions for certain laboratories and HAPs, the majority of laboratories met the laboratory bias MQO for each of the three rounds of PTs for the seven HAPs of primary importance. In Figures 17 and 18, the central tendency of the analysis bias is best characterized by the median bias (indicated by black horizontal lines within the IQR boxes), which lessen the effect of extreme values.

Figure 17 shows that across laboratories, PT analyses in CY2011, based on the median bias, tended to demonstrate a marginally low analytical bias for acrolein, formaldehyde, and arsenic, a marginally high analytical bias for benzene, a slightly high analytical bias for 1,3-butadiene, and a very low analytical bias for naphthalene. As shown in Table 20, percentages of NATTS laboratories meeting the MQO for acrolein, benzene and 1,3-butadiene were 77%, 85%, and 85%, respectively. All NATTS laboratories but one met the MQO for arsenic and for formaldehyde. For the five NATTS laboratories reporting PAH results, only two laboratories met the MQO for naphthalene. Specifically, acceptable measurement bias was difficult to obtain for acrolein and naphthalene; the mean absolute percent bias across all participating laboratories was 29.5% and 26.0%, respectively. The CY2011 PAH PT results should be interpreted with caution, as it appears that the target value may have been biased high: all reported results but one showed a negative bias.

For the three HAPs of primary importance that were spiked for the CY2012 PT (naphthalene, arsenic, and chromium (VI)), analytical bias was slightly high for naphthalene and arsenic and very high for chromium (VI) as seen in Figure 18. All NATTS laboratories met the MQO for chromium (VI) and all but one laboratory met the MQO for both naphthalene and arsenic. CY2012 PT results are shown in Tables 25 through 27.

Table 20. Percentages of NATTS Laboratories Meeting the Bias MQO for Proficiency Test Samples in CY2011 and CY2012

	VOCs			carbonyls	PAHs	metals	
CY	**Acrolein**	**Benzene**	**1,3-Butadiene**	**Formaldehyde**	**Naphthalene**	**Arsenic**	**Chromium (VI)**
2011	77%	85%	85%	87%	40%	90%	-
2012	-	-	-	-	83%	93%	100%

Table 21. NATTS Proficiency Testing Bias Results (Percent Difference from Target) for VOCs – CY2011 QTR4

Lab Code	Laboratory Description	ACRO	BENZ	BUTA	CLFRM	CTET	DCP	EDB	EDC	MECL	PERC	TCE	TCE 1122	VC	c-DCPEN	t-DCPEN	*Mean Abs. Bias (across HAPs)*	*Min*	*Max*
01-01-V	RI Dept of Health	-10.0	15.4	1.9	-10.7	-3.6	-4.4	8.1	-15.1	-6.7	0.4	-11.9	-3.4	-7.0	1.8	14.2	7.6	-15.1	15.4
01-04-V	US EPA Region 1 Lab[a]	--	-10.6	-4.2	-10.0	-2.0	-42.1	-16.2	-30.0	-8.5	-17.7	-28.7	-21.5	-7.2	-3.7	0.9	14.5	-42.1	0.9
01-05-V	Maine DEP Air Lab[a]	-4.3	22.8	3.3	-3.4	3.8	--	22.1	-1.0	6.8	7.6	19.8	77.4	-3.2	--	39.3	16.5	-4.3	77.4
02-01-V	New York State DEC	3.4	12.4	6.4	-11.8	2.6	0.4	3.4	-14.4	0.6	6.0	-3.6	-3.7	-4.1	7.5	26.3	7.1	-14.4	26.3
03-01-V	Maryland DOE	2.8	4.0	6.2	-14.0	-4.9	-2.3	-3.9	-13.3	-4.9	-0.4	-9.7	-13.0	-5.4	-5.9	28.6	7.9	-14.0	28.6
03-02-V	Virginia Division of Consolidated Labs	45.9	23.8	17.9	-5.5	3.1	12.3	35.8	6.7	5.8	14.7	6.7	48.1	18.0	0.7	25.2	18.0	-5.5	48.1
04-01-V	Pinellas County DEM AQD	-12.3	6.0	3.1	-10.8	2.2	3.0	12.6	-14.4	-10.2	8.4	-1.3	-4.9	-2.1	22.5	40.0	10.2	-14.4	40.0
04-02-V	SCDHEC/DAQA	-42.6	-41.9	-42.1	-45.8	-38.6	-38.9	-29.8	-45.2	-45.4	-32.8	-38.7	-19.3	-37.7	-27.0	-14.3	36.0	-45.8	-14.3
04-04-V	Georgia DNR	-25.0	-11.3	-13.7	-25.8	-20.0	-17.2	-15.5	-21.2	-20.0	-20.8	-19.7	-22.2	-14.4	-1.5	17.8	17.7	-25.8	17.8
04-06-V	North Carolina DENR[a]	197.8	18.9	12.4	2.9	2.2	23.0	30.5	2.5	4.2	26.8	13.2	38.6	6.6	26.7	51.2	30.5	2.2	197.8
05-03-V	Wisconsin DNR	29.4	43.4	36.8	9.1	25.4	33.3	9.4	21.2	32.2	20.8	20.0	40.7	37.7	14.8	26.1	26.7	9.1	43.4
05-04-V	Minnesota PCA[a]	--	8.4	10.9	-19.1	2.4	-2.6	-4.8	-14.5	6.9	8.6	-4.9	-7.7	5.8	5.3	17.3	8.5	-19.1	17.3
05-06-V	Indiana DEM [a]	53.5	49.1	49.8	26.1	42.7	17.9	32.8	41.2	47.8	43.8	21.3	29.6	35.7	28.9	58.3	38.6	17.9	58.3
05-07-V	Ohio EPA[a]	--	32.1	19.3	-3.0	5.1	12.3	77.4	-6.1	8.5	-5.7	33.3	18.5	18.0	66.7	130.4	31.2	-6.1	130.4
06-01-V	Texas CEQ Air Laboratory	-11.8	13.2	5.3	-9.1	15.3	-12.3	20.8	-15.2	-11.9	5.7	0.0	3.7	-8.2	25.9	47.8	13.7	-15.2	47.8
07-02-V	State Hygenic Lab, Univ. of Iowa[a]	27.4	32.8	-2.8	26.4	19.3	31.6	57.0	45.2	15.6	59.6	30.3	71.5	-3.0	34.4	82.2	35.9	-3.0	82.2
09-03-V	BAAQMD	19.1	20.8	17.5	3.0	32.2	--	37.7	4.5	20.3	84.9	6.7	--	6.6	--	--	23.0	3.0	84.9
09-06-V	San Diego APCD[a]	-13.3	13.1	2.2	-5.6	2.0	-5.2	7.7	-12.9	0.7	11.3	-2.2	3.8	2.8	15.0	48.4	9.7	-13.3	48.4
09-08-V	South Coast AQMD Laboratory	-8.5	9.8	1.1	-12.4	-5.1	2.5	6.4	-13.6	-2.0	9.4	-11.7	9.6	-3.9	5.6	28.3	8.7	-13.6	28.3
09-09-V	JWPCP of Los Angeles[a]	--	17.0	8.8	-6.1	5.1	--	17.0	-6.1	5.1	13.2	6.7	--	4.9	--	--	9.0	-6.1	17.0
10-02-V	Oregon DEQ	14.7	-10.2	-23.2	-27.6	-13.2	-17.2	-9.8	-31.8	-11.9	-20.4	-18.7	-14.4	-17.0	1.5	8.3	16.0	-31.8	14.7
11-01-V	ERG	-20.3	10.2	10.9	-9.7	25.4	2.8	5.7	-11.8	6.4	0.8	-8.3	1.1	0.3	21.5	41.3	11.8	-20.3	41.3
11-03-V	US EPA NERL[a]	-18.5	6.4	0.4	-13.6	-3.4	-2.5	20.4	-15.8	0.7	7.9	-5.7	5.9	-5.2	10.0	40.4	10.5	-18.5	40.4
	Mean Bias (across laboratories)	12.0	12.4	5.6	-7.7	4.3	-0.3	14.1	-7.0	1.7	10.1	-0.3	11.4	0.8	12.5	36.1			
	Mean Abs. Bias (across laboratories)	29.5	18.8	13.0	13.5	12.2	14.2	21.1	17.5	12.3	18.6	14.0	19.9	11.1	16.3	37.5	17.8		
	Median Bias (across laboratories)	-4.3	13.1	5.3	-9.7	2.4	-1.0	9.4	-13.3	0.7	7.9	-2.2	3.7	-3.0	8.7	28.6			
	Minimum	-42.6	-41.9	-42.1	-45.8	-38.6	-42.1	-29.8	-45.2	-45.4	-32.8	-38.7	-22.2	-37.7	-27.0	-14.3			
	Maximum	197.8	49.1	49.8	26.4	42.7	33.3	77.4	45.2	47.8	84.9	33.3	77.4	37.7	66.7	130.4			

[a] Laboratories not performing analysis for NATTS sites

Values listed in red indicate absolute bias outside the MQO (>25%); values listed in orange indicate absolute bias between 20-25%.

Table 22. NATTS Proficiency Testing Bias Results (Percent Difference from Target) for Carbonyls – CY2011 QTR4

Laboratory Code	Laboratory Description	ACET	BNZD	FORM	PRPD	*Mean Abs. Bias (across HAPs)*	*Min*	*Max*
01-01-C	Rhode Island Department of Health Air Pollution Lab	0.5	--	6.8	--	3.6	0.5	6.8
01-03-C	Massachusetts Division of Environmental Protection	-7.6	-5.6	-8.4	-16.9	9.6	-16.9	-5.6
01-04-C	US EPA Region 1 Laboratory	-1.4	2.1	1.3	-4.6	2.4	-4.6	2.1
02-01-C	New York State Department of Environmental Conser	-22.8	-19.3	-25.5	-29.4	24.2	-29.4	-19.3
03-01-C	Philadelphia Air Management Services Laboratory	-5.6	--	-5.8	-15.4	8.9	-15.4	-5.6
03-02-C	Virginia Division of Consolidated Services Laboratory	-3.7	--	-0.8	-10.0	4.8	-10.0	-0.8
04-02-C	South Carolina Division of Health and Envir Control	-1.0	--	6.6	--	3.8	-1.0	6.6
04-03-C	Kentucky Division of Environmental Services	69.5	75.8	66.9	56.2	67.1	56.2	75.8
04-04-C	Georgia Department of Natural Resources	-16.5	-5.1	-21.7	-30.5	18.5	-30.5	-5.1
05-03-C	Wisconsin State Laboratory of Hygiene	-4.6	-8.9	-5.8	-15.4	8.7	-15.4	-4.6
05-04-C	State of Minnesota Pollution Control Agency	-7.6	-10.0	-9.1	-15.4	10.5	-15.4	-7.6
06-01-C	Texas Commission on Environmental Quality Air Lab	-7.6	-0.4	-5.8	-23.1	9.2	-23.1	-0.4
07-02-C	State Hygenic Laboratory at The University of Iowa	-5.6	-3.2	-6.8	-11.5	6.8	-11.5	-3.2
09-03-C	Bay Area Air Quality Management District	-6.8	--	-6.3	--	6.5	-6.8	-6.3
09-06-C	Air Pollution Control District County of San Diego	-0.4	--	-0.6	--	0.5	-0.6	-0.4
09-08-C	South Coast Air Quality Management District	-2.8	--	-2.1	--	2.5	-2.8	-2.1
10-02-C	Oregon Division of Environmental Quality	-1.8	-1.3	-3.6	-7.7	3.6	-7.7	-1.3
11-01-C	Environmental Resource Group	3.0	8.0	-3.4	-14.6	7.3	-14.6	8.0
	Mean Bias (across laboratories)	-1.3	2.9	-1.3	-10.6			
	Mean Abs. Bias (across laboratories)	9.4	12.7	10.4	19.3	11.0		
	Median Bias (across laboratories)	-4.1	-3.2	-4.7	-15.4			
	Minimum	-22.8	-19.3	-25.5	-30.5			
	Maximum	69.5	75.8	66.9	56.2			

[a] Laboratories not performing analysis for NATTS sites

Values listed in red indicate absolute bias outside the MQO (>25%); values listed in orange indicate absolute bias between 20-25%.

Table 23. NATTS Proficiency Testing Bias Results (Percent Difference from Target) for Metals – CY2011 QTR2

Laboratory Code	Laboratory Description	As	Be	Cd	Co	Mn	Ni	Pb	Se	*Mean Abs. Bias (across HAPs)*	*Min*	*Max*
01-01-M	Rhode Island Department of Health Air Pollution Laboratory	--	49	-16.1	--	5.4	1.9	-5.4	--	15.5	-16.1	49
03-02-M	Virginia Division of Consolidated Services Laboratory	-6.8	-8.2	-11.5	--	-6.5	-8.9	-7.5	--	8.2	-11.5	-6.5
04-01-M	Enviromental Protection Commission of Hillsborough County	24.7	-7	-4.6	-2.9	-1.1	-5.4	0.6	-11.1	7.2	-11.1	24.7
04-02-M	South Carolina Division of Health and Environmental Control	-15.1	-14.8	-8	10.6	12.4	3	13.7	-27.3	13.1	-27.3	13.7
04-04-M	Georgia Division of Natural Resources	-5.5	-2.5	-9.2	-2.9	-4.3	-8.1	-6.6	-14.2	6.7	-14.2	-2.5
05-03-M	Wisconsin State Laboratory of Hygiene	-2.7	3.7	-4.6	--	8.1	-5.1	-0.3	--	4.1	-5.1	8.1
06-01-M	Texas Commission on Environmental Quality Air Laboratory	2.7	10.7	5.7	--	4.3	11.4	3.3	--	6.4	2.7	11.4
09-08-M	South Coast Air Quality Management District	-15.1	-18.9	-13.8	-10.1	-14.5	-11.1	-10.4	-20.9	14.4	-20.9	-10.1
10-02-M	Oregon Division of Environmental Quality	1.4	-8.6	-5.7	-6.7	-5.4	-9.2	-3.3	-10.9	6.4	-10.9	1.4
11-01-M	Environmental Resource Group	1.4	-8.2	-5.7	-4.3	-3.8	-6.8	-6.3	-15.6	6.5	-15.6	1.4
	Mean Bias (across laboratories)	-1.7	-0.5	-7.4	-2.7	-0.5	-3.8	-2.2	-16.7			
	Mean Abs. Bias (across laboratories)	8.4	13.2	8.5	6.3	6.6	7.1	5.7	16.7	8.8		
	Median Bias (across laboratories)	-2.7	-7.6	-6.9	-3.6	-2.4	-6.1	-4.3	-14.9			
	Minimum	-15.1	-18.9	-16.1	-10.1	-14.5	-11.1	-10.4	-27.3			
	Maximum	24.7	49.0	5.7	10.6	12.4	11.4	13.7	-10.9			

Values listed in red indicate absolute bias outside the MQO (>25%); values listed in orange indicate absolute bias between 20-25%.

Table 24. NATTS Proficiency Testing Bias Results (Percent Difference from Target) for PAHs – CY2011 QTR2

Laboratory Code	Laboratory Description	ACEN	ANTH	BaP	FLUR	FTHN	NAPH	PHEN	PYR	*Mean Abs. Bias (across HAPs)*	*Min*	*Max*
03-02-P	Virginia Division of Consolidated Services Laboratory	-24.1	-30.5	-37.0	-17.5	3.9	-29.7	-16.7	-6.9	20.8	-37.0	3.9
04-02-P	South Carolina Division of Health and Environmental Control	-29.7	-25.7	-27.4	-36.1	-27.3	-30.7	-23.3	-24.6	28.1	-36.1	-23.3
06-01-P	Texas Commission on Environmental Quality Air Laboratory	-15.9	-10.7	-11.2	-10.3	-14.3	-23.7	-5.0	-14.6	13.2	-23.7	-5.0
10-02-P	Oregon Division of Environmental Quality	-26.6	-14.3	-11.1	-24.7	-14.0	-32.0	-23.3	-13.3	19.9	-32.0	-11.1
11-01-P	Environmental Resource Group	-11.9	-13.6	-2.1	-7.2	-9.4	-13.9	-8.3	-6.9	9.2	-13.9	-2.1
	Mean Bias (across laboratories)	-21.6	-19.0	-17.8	-19.2	-12.2	-26.0	-15.3	-13.2			
	Mean Abs. Bias (across laboratories)	21.6	19.0	17.8	19.2	13.8	26.0	15.3	13.2	18.2		
	Median Bias (across laboratories)	-24.1	-14.3	-11.2	-17.5	-14.0	-29.7	-16.7	-13.3			
	Minimum	-29.7	-30.5	-37.0	-36.1	-27.3	-32.0	-23.3	-24.6			
	Maximum	-11.9	-10.7	-2.1	-7.2	3.9	-13.9	-5.0	-6.9			

Values listed in red indicate absolute bias outside the MQO (>25%); values listed in orange indicate absolute bias between 20-25%.

Table 25. NATTS Proficiency Testing Bias Results (Percent Difference from Target) for Metals – CY2012 QTR1

Laboratory Code	Laboratory Description	As	Be	Cd	Co	Mn	Ni	Pb	Sb	Se	*Mean Abs. Bias (across HAPs)*	*Min*	*Max*
01-01-M	Rhode Island Department of Health Air Pollution Laboratory	-28.8	21.0	-8.2	--	-5.2	-10.8	4.0	-2.1	--	11.5	-28.8	21.0
03-01-M	West Virginia Department of Environmental Protection	-0.1	7.2	8.5	--	5.6	-7.4	11.4	--	--	6.7	-7.4	11.4
03-02-M	Virginia Division of Consolidated Services Laboratory	12.9	14.3	8.3	--	8.9	-0.3	10.2	--	--	9.1	-0.3	14.3
03-03-M	Pennsylvania Department of Environmental Protection, Bureau of Air Quality	-11.3	-12.5	1.5	11.6	13.7	2.8	13.3	-10.7	-45.0	13.6	-45.0	13.7
04-01-M	Enviromental Protection Commission of Hillsborough County	3.1	9.3	7.0	15.5	13.8	21.9	16.9	32.0	9.5	14.3	3.1	32.0
04-02-M	South Carolina Division of Health and Environmental Control	-11.7	-4.5	3.9	14.6	15.9	-5.0	21.8	-32.1	-33.7	15.9	-33.7	21.8
04-03-M	Kentucky Division of Environmental Services	7.8	7.6	5.7	--	8.1	2.3	7.2	-19.9	--	8.4	-19.9	8.1
04-04-M	Georgia Division of Natural Resources	4.9	7.2	4.2	16.0	11.0	2.1	10.9	-8.5	-21.8	9.6	-21.8	16.0
05-01-M	Michigan Department of Environmental Quality	-7.5	-6.0	-9.4	-2.1	-2.2	-17.5	-1.0	--	--	6.5	-17.5	-1.0
05-03-M	Wisconsin State Laboratory of Hygiene	10.8	14.7	12.0	--	16.5	5.2	16.8	--	--	12.7	5.2	16.8
05-04-M	State of Minnesota Pollution Control Agency	24.7	1.8	-4.8	8.9	2.1	-9.0	10.3	8.4	-21.7	10.2	-21.7	24.7
05-06-M	Indiana Department of Environmental Management	36.3	-1.3	10.5	--	15.4	60.2	27.6	--	--	25.2	-1.3	60.2
05-07-M	Ohio Environmental Protection Agency Division of Environmental Services Laboratory	13.7	16.9	12.2	19.8	--	0.7	11.1	--	-25.3	14.2	-25.3	19.8
06-01-M	Texas Commission on Environmental Quality Air Laboratory	13.5	17.1	9.0	--	11.0	3.4	12.8	--	--	11.1	3.4	17.1
08-02-M	Colorado Department of Public Health and Environment, Laboratory Services Division	17.6	17.7	15.6	29.2	141.8	7.1	31.9	7.3	-4.2	30.2	-4.2	141.8
09-08-M	South Coast Air Quality Management District	-1.6	-1.9	-1.1	11.8	8.5	-8.1	8.7	-5.1	-22.6	7.7	-22.6	11.8
10-02-M	Oregon Division of Environmental Quality	10.8	8.4	8.5	12.1	7.5	-3.3	5.0	--	-21.9	9.7	-21.9	12.1
11-01-M	Environmental Resource Group	15.7	17.5	16.6	29.8	21.5	11.4	19.9	-6.0	-7.3	16.2	-7.3	29.8
11-02-M	RTI International	6.2	14.5	7.1	11.2	5.1	-7.4	7.9	-3.4	-13.3	8.5	-13.3	14.5
	Mean Bias (across laboratories)	6.2	7.9	5.6	14.9	16.6	2.5	13.0	-3.6	-18.8			
	Mean Abs. Bias (across laboratories)	12.6	10.6	8.1	15.2	17.4	9.8	13.1	12.3	20.6	12.7		
	Median Bias (across laboratories)	7.8	8.4	7.1	13.3	10.0	0.7	11.1	-5.1	-21.8			
	Minimum	-28.8	-12.5	-9.4	-2.1	-5.2	-17.5	-1.0	-32.1	-45.0			
	Maximum	36.3	21.0	16.6	29.8	141.8	60.2	31.9	32.0	9.5			

[a] Laboratories not performing analysis for NATTS sites

Values listed in red indicate absolute bias outside the MQO (>25%); values listed in orange indicate absolute bias between 20-25%.

Table 26. NATTS Proficiency Testing Bias Results (Percent Difference from Target) for PAHs – CY2012 QTR1

Laboratory Code	Laboratory Description	ACEN	ANTH	BaP	FLUR	FTHN	NAPH	PHEN	PYR	*Mean Abs. Bias (across HAPs)*	*Min*	*Max*
03-02-P	Virginia Division of Consolidated Services Laboratory	23.2	-2.1	20.4	27.3	33.0	12.8	23.7	27.7	21.3	-2.1	33.0
04-02-P	South Carolina Division of Health and Environmental Control	-15.5	-22.4	17.5	-27.1	-13.2	-21.0	-1.1	-11.4	16.1	-27.1	17.5
05-03-P	Wisconsin State Laboratory of Hygiene	10.5	5.9	45.6	16.3	29.7	8.0	26.3	46.5	23.6	5.9	46.5
06-01-P	Texas Commission on Environmental Quality Air Laboratory	16.8	15.6	14.6	15.7	26.5	32.8	61.1	24.9	26.0	14.6	61.1
10-02-P	Oregon Division of Environmental Quality	-2.1	2.4	29.1	-7.6	11.1	-14.2	7.4	15.1	11.1	-14.2	29.1
11-01-P	Environmental Resource Group	19.2	4.1	25.2	9.6	15.1	21.4	18.4	17.9	16.4	4.1	25.2
	Mean Bias (across laboratories)	8.7	0.6	25.4	5.7	17.0	6.6	22.6	20.1			
	Mean Abs. Bias (across laboratories)	14.6	8.7	25.4	17.3	21.4	18.4	23.0	23.9	19.1		
	Median Bias (across laboratories)	13.7	3.2	22.8	12.7	20.8	10.4	21.1	21.4			
	Minimum	-15.5	-22.4	14.6	-27.1	-13.2	-21.0	-1.1	-11.4			
	Maximum	23.2	15.6	45.6	27.3	33.0	32.8	61.1	46.5			

a. Reported results were from a second PT sample which replaced the first. Sample storage integrity had been compromised during shipping.
Values listed in red indicate absolute bias outside the MQO (>25%); values listed in orange indicate absolute bias between 20-25%.

Table 27. NATTS Proficiency Testing Bias Results (Percent Difference from Target) for Chromium (VI) – CY2012 QTR1

Laboratory Code	Laboratory Description	Chromium (VI)
03-02-R	Virginia Division of Consolidated Services Laboratory	21.7
09-08-R	South Coast Air Quality Management District	18.0
10-02-R	Chester LabNet	14.6
11-01-R	Environmental Resource Group	19.5
	Mean Bias (across laboratories)	18.5
	Mean Abs. Bias (across laboratories)	18.5
	Median Bias (across laboratories)	18.8
	Minimum	14.6
	Maximum	21.7

Values listed in orange indicate absolute bias between 20-25%.

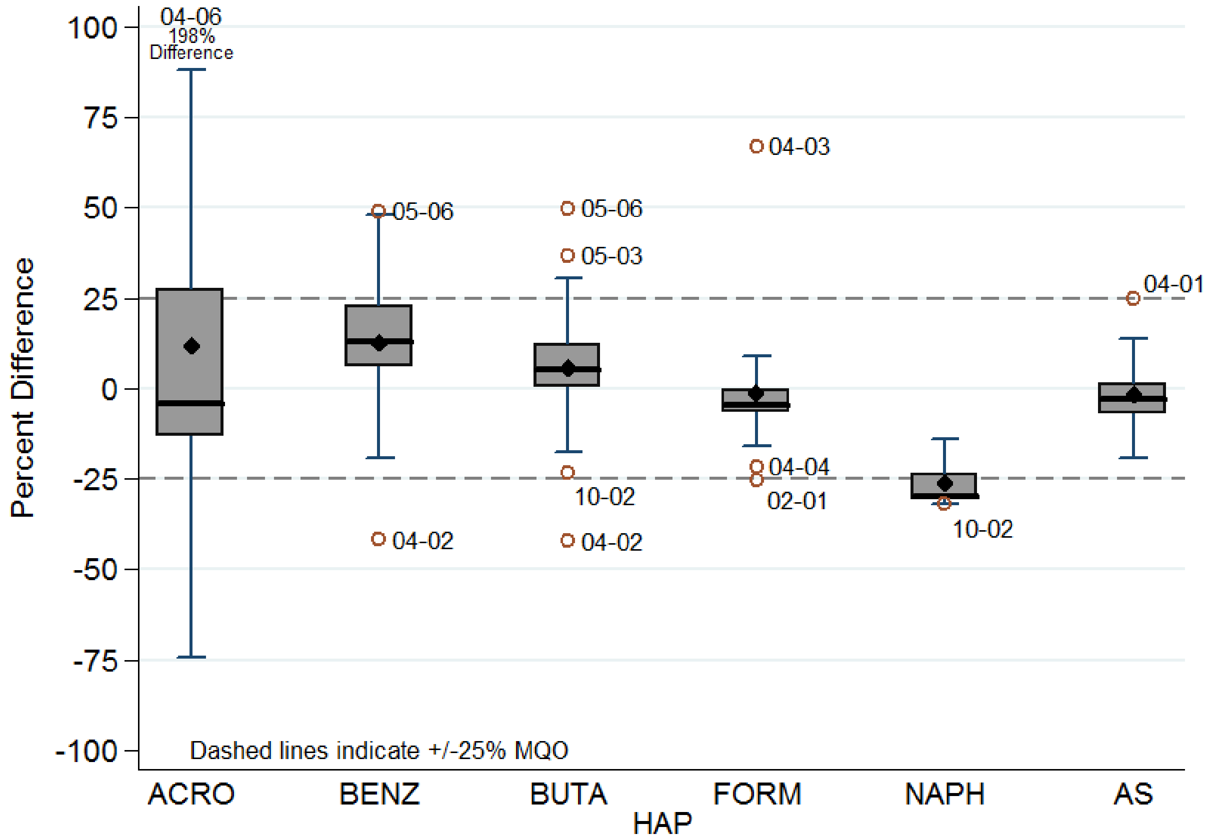

Figure 17. Distribution of Laboratory Bias by HAP for Proficiency Testing Data - CY2011

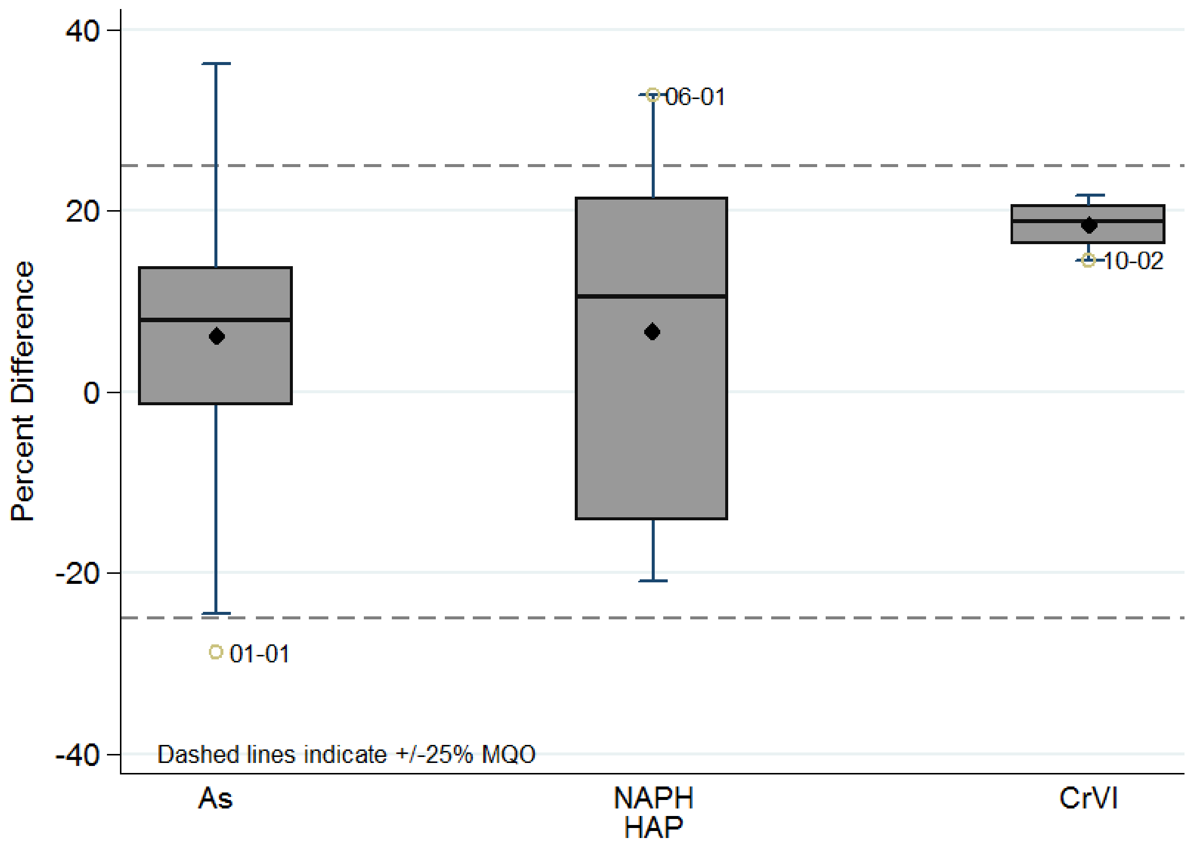

Figure 18. Distribution of Laboratory Bias by HAP for Proficiency Testing Data - CY2012

2.7 Flow Audit Results from Instrument Performance Audits (IPAs)

Instrument performance audits (IPAs) of carbonyl, PAH, PM_{10}, and chromium (VI) sampler units were performed at the following NATTS field sites as follows:

- CY2011 (eight sites): Rochester, NY; Bronx, NY; Washington, DC; Richmond, VA; Chesterfield, SC; Decatur, GA; Hillsborough County, FL; and Pinellas County, FL
- CY2012 (five sites): Horicon, WI; Northbrook, IL; Deer Park, TX; St Louis, MO; and Portland, OR.

RTI performed the flow audits in CY2011 and CY2012. During each IPA, when flows were sufficient for measurement, the flow rates on all sampler types at the NATTS site were determined with certified, calibrated volumetric flow measurement devices and reported in standard temperature and pressure (STP, 25°C and 1 atm) or ambient conditions (also referred to as local conditions, LC) based on the typical reporting convention of the site operators. Field bias was calculated by comparing the sampler flow reading (or setting) to the audit flow rate.

Field bias is defined as the percentage difference between the site flow (*Fs*) and the audit flow (*Fa*) under the same conditions (standard or ambient):

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

The results from the flow audits conducted during CY2011 and CY2012 are indicated in Tables 29 and 30 respectively. If present at the site, collocated samplers were also audited. Carbonyl and chromium (VI) samplers may have multiple flow channels which allow for duplicate sampling; the flow rates of any such flow channels were audited when used by the site to collect duplicate samples. PM_{10} metals and PAH samplers have only primary channels.

With few exceptions, most air samplers met the flow bias MQO of ≤ 10%. The most frequent exceedances occurred for PAH and chromium (VI) samplers. With the exception of VOC samplers, which were not audited, the mean and mean absolute network flow bias met the MQO for all HAP classes in CY2011 and CY2012, as indicated in Table 28.

Table 28. Mean Network Flow Bias From CY2011 and CY2012

		HAP class				
CY	**Flow Bias (% difference)**	**VOC**	**carbonyl**	**PAH**	**metals**	**Cr(VI)**
2011	mean	-	-3.1	-3.7	1.4	-1.3
	mean absolute	-	3.7	7.6	3.5	7.6
2012	mean	-	-1.8	2.5	-1.1	0.4
	mean absolute	-	2.0	2.6	1.6	3.0

Table 29. Flow Audit Results from the Instrument Performance Audits – CY2011

Site Identifier and AQS ID	Method	Precision Assignment	Channel	Sampler Reading	Standard Reading	Units	Conditions	Percent Difference
Rochester, NY 36-055-1007	VOC	primary			no flow readings recorded			-
	carbonyl	primary	1	0.999	0.984	L/min	ambient	1.5
	PAH	primary		0.196	0.190	m^3/min	STP	3.2
	metals	primary		16.66	17.12	L/min	ambient	-2.7
	Cr(VI)	primary		15.0	15.02	L/min	ambient	-0.1
	Cr(VI)	collocated		15.0	14.77	L/min	ambient	1.6
Bronx, NY 36-005-0080	VOC	primary			no flow readings recorded			-
	carbonyl	primary	1	0.999	1.068	L/min	ambient	-6.5
	PAH	primary		0.217	0.198	m^3/min	STP	9.6
	metals	primary		16.65	16.85	L/min	ambient	-1.2
	metals	collocated		16.68	16.92	L/min	ambient	-1.4
	Cr(VI)	primary		15.0	14.35	L/min	ambient	4.5
	Cr(VI)	collocated		15.0	15.13	L/min	ambient	-0.9
Washington, DC 11-001-0043	VOC	primary			no flow readings recorded			-
	VOC	duplicate			no flow readings recorded			-
	carbonyl	primary	1	0.500	0.561	L/min	ambient	-10.9
	carbonyl	collocated	2	0.525	0.572	L/min	ambient	-8.2
	PAH	primary		127	128.9	L/min	STP	-1.5
	metals	primary		40	42.67	ft^3/min	STP	-6.3
	Cr(VI)	primary		15.0	12.81	L/min	ambient	17.1
	Cr(VI)	collocated		15.0	11.41	L/min	ambient	31.5
Richmond, VA 51-087-0014	VOC	primary			no flow readings recorded			-
	VOC	collocated			no flow readings recorded			-
	carbonyl	primary	1	0.250	0.261	L/min	ambient	-4.2
	carbonyl	collocated	2	0.250	0.256	L/min	ambient	-2.3
	PAH	primary		135	134.4	L/min	STP	0.4
	PAH	collocated		144.6	144.2	L/min	STP	0.3
	metals	primary		42.05	39.21	ft^3/min	STP	7.2
	Cr(VI)	primary		15.0	15.89	L/min	ambient	-5.6
	Cr(VI)	collocated		15.0	15.45	L/min	ambient	-2.9
Chesterfield, SC 45-025-0001	VOC	primary			no flow readings recorded			-
	VOC	collocated			no flow readings recorded			-
	carbonyl	primary		0.120	0.120	L/min	ambient	0.0
	carbonyl	collocated		0.121	0.125	L/min	ambient	-3.2
	PAH	primary		0.2	0.2290	m^3/min	STP	-12.7
	PAH	collocated		0.2	0.2458	m^3/min	STP	-18.6
	metals	primary		1.14	1.066	m^3/min	STP	6.9
	metals	collocated		1.14	1.076	m^3/min	STP	5.9
	Cr(VI)	primary		15.0	15.08	L/min	ambient	-0.5
	Cr(VI)	collocated		15.0	16.26	L/min	ambient	-7.7

Percent difference values in red exceed the flow bias MQO of ±10%.

Table 29. Flow Audit Results from the Instrument Performance Audits – CY2011 (continued)

Site Identifier and AQS ID	Method	Precision Assignment	Channel	Sampler Reading	Standard Reading	Units	Conditions	Percent Difference
Decatur, GA 13-089-0002	VOC	primary			no flow readings recorded			-
	VOC	collocated			no flow readings recorded			-
	carbonyl	primary		0.123	0.125	L/min	STP	-1.6
	carbonyl	collocated		0.124	0.121	L/min	STP	2.5
	PAH	primary		0.204	0.2102	m^3/min	STP	-2.9
	PAH	collocated		0.198	0.1801	m^3/min	STP	9.9
	metals	primary		1.05	1.058	m^3/min	STP	-0.8
	metals	collocated		1.03	1.033	m^3/min	STP	-0.3
	Cr(VI)	primary	1	14.75	16.72	L/min	ambient	-11.8
			2	14.75	15.68	L/min	ambient	-5.9
	Cr(VI)	collocated	1	14.44	16.34	L/min	ambient	-11.6
			2	14.44	16.88	L/min	ambient	-14.5
Hillsborough County, FL 12-057-3002	VOC	primary			no flow readings recorded			-
	carbonyl	primary	1	0.725	0.768	L/min	STP	-5.6
	carbonyl	collocated	2	0.725	0.748	L/min	STP	-3.1
	PAH	primary		0.2	0.2279	m^3/min	STP	-12.2
	PAH	collocated		0.2	0.2429	m^3/min	STP	-17.7
	metals	primary		1.138	1.089	m^3/min	STP	4.5
	metals	collocated		1.138	1.085	m^3/min	STP	4.9
	Cr(VI)	primary		15.0	15.65	L/min	ambient	-4.2
	Cr(VI)	collocated		15.0	14.72	L/min	ambient	1.9
Pinellas County, FL 12-103-0026	VOC	primary			no flow readings recorded			-
	VOC	duplicate			no flow readings recorded			-
	carbonyl	primary	1	0.670	0.685	L/min	STP	-2.2
	carbonyl	collocated	2	0.620	0.620	L/min	STP	0.0
	PAH	primary		0.177	0.1801	m^3/min	STP	-1.7
	metals	primary		1.172	1.176	m^3/min	STP	-0.3
	Cr(VI)	primary		15.0	15.85	L/min	ambient	-5.4
	Cr(VI)	collocated		15.0	16.36	L/min	ambient	-8.3

Percent difference values in red exceed the flow bias MQO of ±10%.

Table 30. Flow Audit Results from the Instrument Performance Audits – CY2012

Site Identifier and AQS ID	Method	Precision Assignment	Channel	Sampler Reading	Standard Reading	Units	Conditions	Percent Difference
Horicon, WI 55-027-0001	VOC	primary		no flow readings recorded – flow too low to detect				-
	VOC	duplicate		no flow readings recorded – flow too low to detect				-
	carbonyl	primary	1	0.704	0.695	L/min	ambient	1.3
	carbonyl	duplicate	2	0.705	0.706	L/min	ambient	-0.1
	PAH	primary		0.236	0.226	m^3/min	STP	4.4
	PAH	collocated		0.242	0.235	m^3/min	STP	3.0
	metals	primary		1.153	1.155	m^3/min	ambient	-0.2
	metals	collocated		1.148	1.152	m^3/min	ambient	-0.3
	Cr(VI)	primary		15.0	13.99	L/min	ambient	7.2
	Cr(VI)	collocated		15.0	14.67	L/min	ambient	2.2
Northbrook, IL 17-031-4201	VOC	primary		no flow readings recorded – flow too low to detect				-
	VOC	duplicate		no flow readings recorded – flow too low to detect				-
	carbonyl	primary	1	0.375	0.388	L/min	ambient	-3.4
	carbonyl	duplicate	2	0.414	0.444	L/min	ambient	-6.8
	PAH	primary		8.00	7.12	ft^3/min	STP	12.4
	PAH	collocated		sampler inoperable				
	metals	primary		40.0	41.46	ft^3/min	STP	-3.5
	metals	collocated		40.0	41.93	ft^3/min	STP	-4.6
	Cr(VI)	primary		15.00	14.68	L/min	ambient	2.2
	Cr(VI)	collocated		15.00	14.96	L/min	ambient	0.3
Deer Park, TX 48-201-1039	VOC	primary		no flow readings recorded – flow too low to detect				-
	VOC	collocated		no flow readings recorded – flow too low to detect				-
	carbonyl	primary	2	1.102	1.11	L/min	STP	-0.7
	carbonyl	duplicate	3	1.106	1.11	L/min	STP	-0.4
	PAH	primary		8.49	8.50	ft^3/min	STP	-0.1
	PAH	collocated		7.60	7.54	ft^3/min	STP	0.8
	metals	primary		39.87	39.81	ft^3/min	STP	0.2
	metals	collocated		39.94	39.87	ft^3/min	STP	0.2
	Cr(VI)	primary		11.98	12.30	L/min	STP	-2.6
	Cr(VI)	collocated		11.99	11.21	L/min	STP	7.0

Percent difference values in red exceed the flow bias MQO of ±10%.

Table 30. Flow Audit Results from the Instrument Performance Audits – CY2012 (continued)

Site Identifier and AQS ID	Method	Precision Assignment	Channel	Sampler Reading	Standard Reading	Units	Conditions	Percent Difference
St Louis, MO 29-510-0085	VOC	primary		no flow readings recorded – flow too low to detect				-
	VOC	duplicate		no flow readings recorded – flow too low to detect				-
	carbonyl	primary	1	740	822	cc/min	ambient	-2.1 [a]
	carbonyl	duplicate	2	750	840	cc/min	ambient	-2.8 [a]
	PAH	primary		0.231	0.229	m^3/min	ambient	0.9
	metals	primary		16.7	17.0	L/min	ambient	-0.3 [a]
	metals	collocated		16.7	17.0	L/min	ambient	-2.1 [a]
	Cr(VI)	primary		15.1 [b]	14.83	L/min	ambient	1.8
	Cr(VI)	collocated		14.0	14.56	L/min	ambient	-3.8
	Cr(VI)	primary [c]		15.0	15.82	L/min	ambient	-5.2
	Cr(VI)	collocated [c]		14.98	15.26	L/min	ambient	-1.8
Portland, OR 41-051-0246	VOC	primary		no flow readings recorded – flow too low to detect				-
	VOC	duplicate		no flow readings recorded – flow too low to detect				-
	carbonyl	primary		1.2	1.21	L/min	ambient	-0.8
	carbonyl	collocated		0.96	0.98	L/min	ambient	-2.0
	PAH	primary		222.6	226.1	L/min	STP	-1.5
	PAH	collocated		221.4	220.5	L/min	STP	0.4
	metals	primary		41.85	40.81	ft^3/min	ambient	2.5
	metals	collocated		37.17	38.14	ft^3/min	ambient	-2.5
	Cr(VI)	primary		14.97	15.01	L/min	ambient	-0.3
	Cr(VI)	collocated		14.44	14.80	L/min	STP	-2.4

[a] Flow audits performed with two different flow standards; average of the two audit results reported.
[b] Average of flow range reported (15.0 - 15.2 L/min).
[c] Samplers installed to begin operation in July 2012.

Graphical summaries of the flow audit results (mean percent differences within a HAP class) are presented by site in Figures 19 and 20 for CY2011 and CY2012, respectively.

Non-biased sampler flow rates for carbonyls, PAHs, PM_{10} metals, and hexavalent chromium samplers are critical for determining sample concentration. Flow rate verification for VOC samplers is less important to determining concentration, but is important in demonstrating a representative composite sample is collected over 24 hours.

In CY2011 all sites met the <10% flow bias MQO for metals, 7 of 8 sites met the MQO for carbonyls, and 6 of 8 sites met the MQO for PAHs and chromium (VI). In CY2012 all sites met the flow bias MQO for carbonyls, metals, and chromium (VI), and 4 of 5 sites met the MQO for PAHs. Percent completeness for audited sites in CY2011 and CY2012 are shown in Table 31.

Table 31. Percentage of Audited NATTS Sites Meeting the Flow Bias MQO - CY2011 and CY2012

	HAP class				
CY	**VOCs**	**carbonyls**	**PAHs**	**metals**	**Chromium (VI)**
2011	-	88%	75%	100%	75%
2012	-	100%	80%	100%	100%

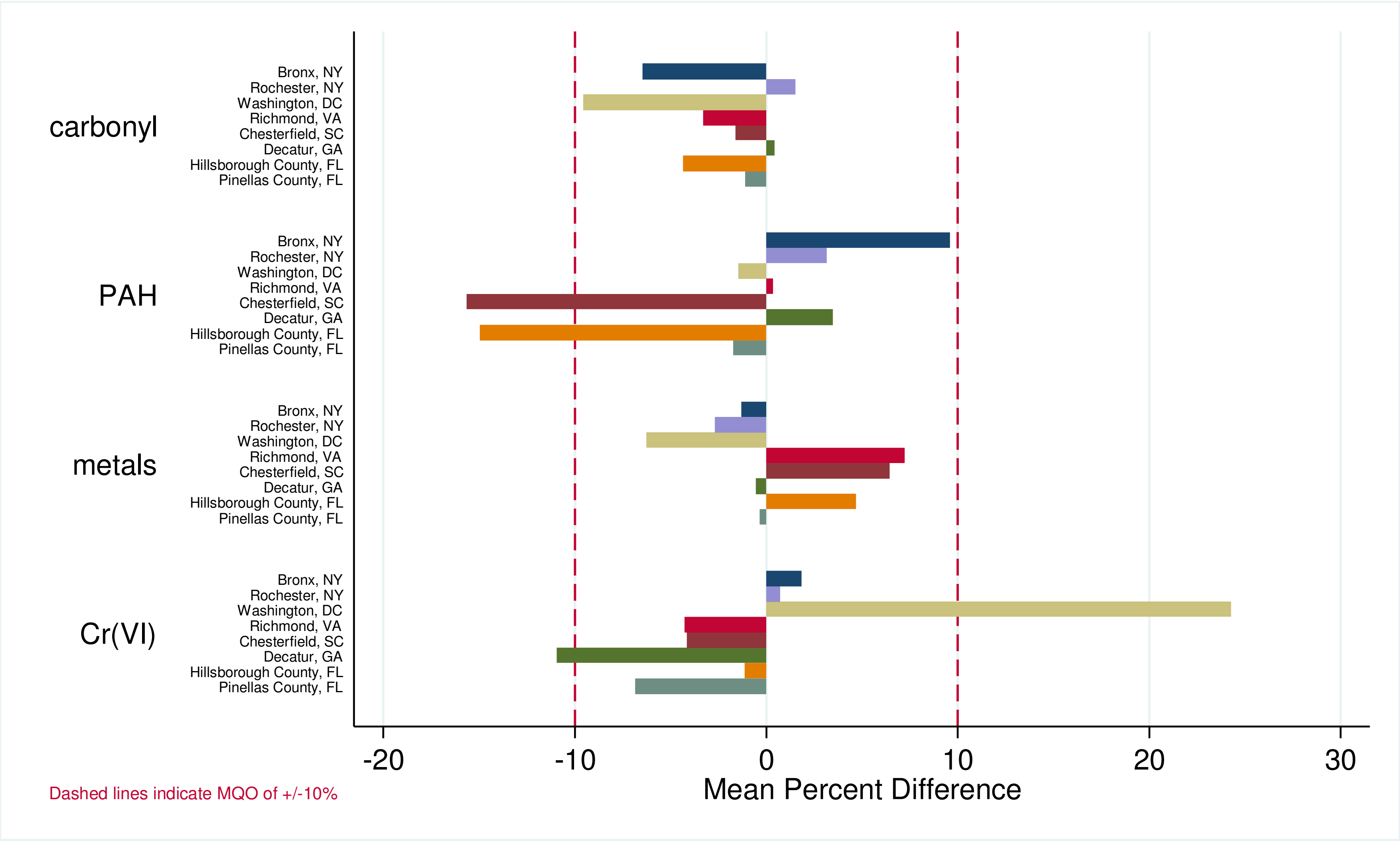

Figure 19. Summary of Instrument Performance Flow Audit Results for NATTS Sites CY2011

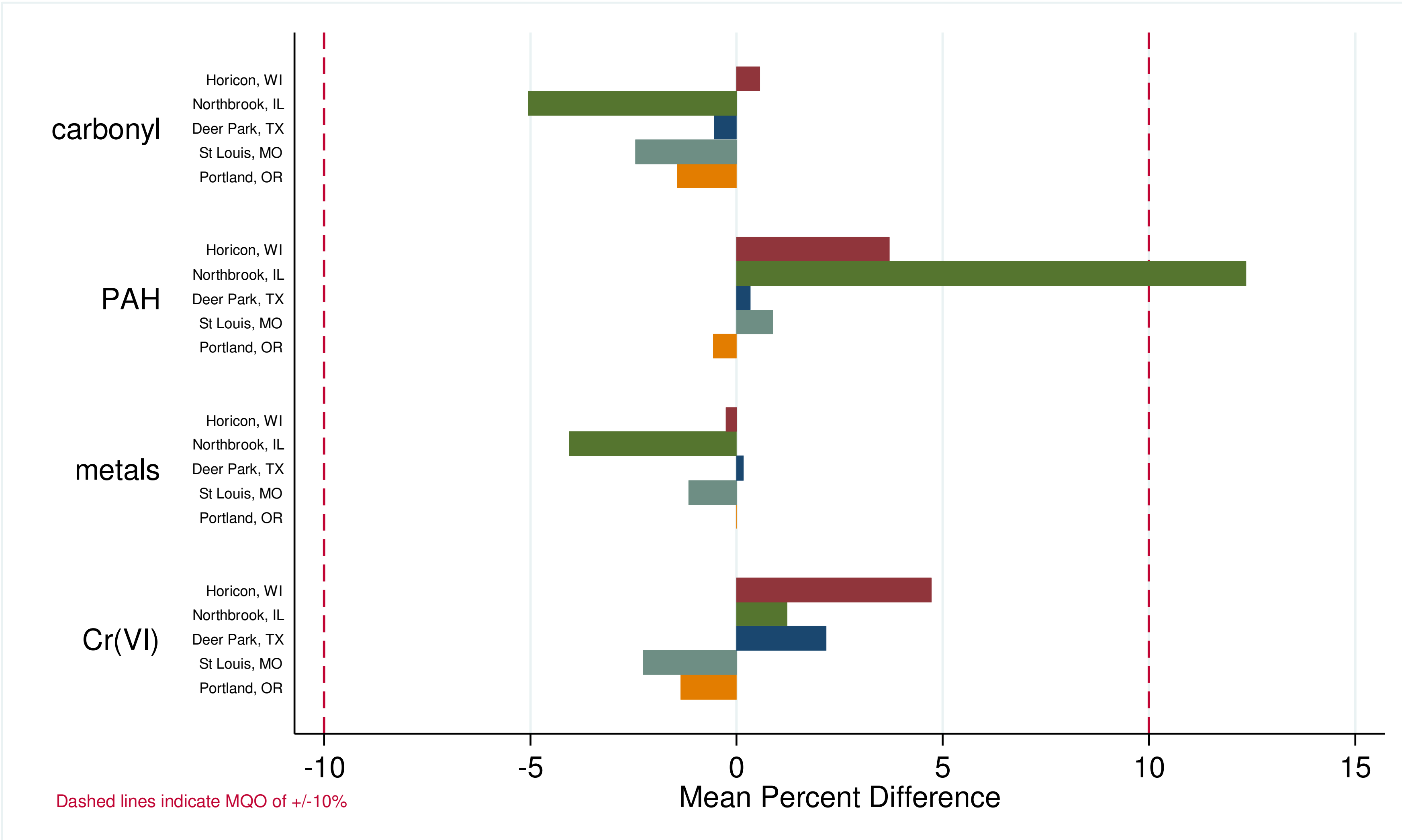

Figure 20. Summary of Instrument Performance Flow Audit Results for NATTS Sites CY2012

2.8 Method Detection Limit (MDL) Data

For CY2011 and CY2012 the AQS database, specifically the ALT_MDL variable within records having an RD record type, served as the primary source of MDL data. AQS allows the posting of MDL data in a variety of units, even within chemical classes; thus, for the purposes of this report, all AQS-acquired MDLs were standardized to ng/m^3 for PAHs, metals, and chromium (VI), and to µg/m^3 for VOCs and carbonyls. Where necessary, conversion from mole fraction (ppb) assumed conditions at STP.

The MDL results presented in this report are arithmetic means of the AQS-posted ALT_MDL values. The MDL data for individual sites, in addition to the mean across all sites reporting data, are indicated in Tables 33 and 34 for CY2011 and Tables 35 and 36 for CY2012. Summary statistics for MDL data for CY2011 and CY2012 are indicated in Tables 37 and 38, respectively.

Box and whisker plots and complementary scatter plots, indicated in Figures 21 through 30, illustrate the MDLs for VOCs, carbonyls, metals, chromium (VI), and PAHs, respectively, for CY2011 and CY2012. Note the log scale of the y-axes in these figures. The MDL MQOs for each HAP are added to the respective plots (as a red horizontal line) for reference. Laboratories whose MDLs fell outside of a window defined by 1.5 × IQR in either direction of the box are identified by circles on the graphical display. Only HAPs for which an MQO is established for the MDL are included in Figures 21 through 30.

Because ERG serves as the analytical laboratory for numerous NATTS sites (Table 10) for VOCs, carbonyls, metals, and particularly for chromium (VI) and PAHs, the MDLs summarized in Tables 33 through 36 and in Figures 21 through 30 reflect a consistency in instrumental detection limits associated with an analytical laboratory common to multiple sites. Values for MDL MQOs remained the same for CY2011 compared to CY2010, however, several pollutants had lower MDL MQOs in CY2012 including: acrolein, formaldehyde, lead, and trichloroethylene. Most notably, in CY2012 the MDL MQOs for formaldehyde and lead were lower by an order of magnitude or more compared to CY2011. Only the MDL MQO for carbon tetrachloride increased from CY2011 to CY2012, an increase of 150%.

MDL values varied widely among sites and frequently exceeded the respective MQOs for several HAPs. Network-wide, the geometric means met the MDL MQO for the seven HAPs of primary importance in CY2011 and CY2012 except for acrolein in CY2011 and CY2012, as evidenced by the ratios of the geometric mean to the MDL MQO being > 1.

The percentages of NATTS sites meeting the MDL MQOs for CY2011 and CY2012 are shown in Table 32.

Of the sites reporting results in CY2011, only approximately one third met the MDL MQO for acrolein. In general, the MDL MQOs for benzene, 1,3-butadiene, formaldehyde, and arsenic were met by 70% or more of sites. All sites met the MDL MQO for chromium (VI) and naphthalene.

In CY2012, less than 25% of sites met the MDL MQO for acrolein. Approximately half or less of sites met the MQO for benzene and formaldehyde; approximately 80% of sites met the MDL

MQO for 1,3-butadiene and arsenic; and all sites met the MDL MQO for chromium (VI) and naphthalene.

Table 32. Percentage of Sites Meeting the MDL MQO – CY2011 and CY2012

	VOCs			carbonyls	PAHs	metals	
CY	**Acrolein**	**Benzene**	**1,3-Butadiene**	**Formaldehyde**	**Naphthalene**	**Arsenic**	**Chromium (VI)**
2011	35%	78%	70%	89%	100%	85%	100%
2012	23%	41%	81%	52%	100%	78%	100%

Percentage based on N = 27 NATTS sites except for acrolein and chromium (VI) where N = 26.

Table 33. Average Method Detection Limits (MDLs) by Site and Overall for VOCs (µg/m³) and PAHs (ng/m³) - CY2011

Site Description	AQS Site Code	VOCs								
		BENZ	**BUTA**	**CTET**	**CLFRM**	**EDB**	**DCP**	**EDC**	**MECL**	**TCE1122**
Boston, MA	25-025-0042	0.033	0.018	0.053	0.032	0.079	0.042	0.041	0.036	0.261
Underhill, VT	50-007-0007	0.090	0.020	0.150	0.040	0.140	0.110	0.040	0.030	0.160
Providence, RI	44-007-0022	0.033	0.018	0.053	0.032	0.079	0.042	0.041	0.036	0.261
Bronx, NY	36-005-0080	0.032	0.044	0.063	0.049	0.077	0.092	0.040	0.035	0.069
Rochester, NY	36-055-1007	0.032	0.044	0.063	0.049	0.077	0.092	0.040	0.035	0.069
Washington, DC	11-001-0043	0.032	0.022	0.095[b]	0.098	0.154	0.092	0.081	0.069	0.206
Richmond, VA	51-087-0014	0.080	0.114	0.195	0.189	0.240	0.283	0.105	0.189	0.234
Chesterfield, SC	45-025-0001	0.045	0.168	0.195	0.112	0.230	0.088	0.125	0.094	0.158
Decatur, GA	13-089-0002	0.102	0.081	0.075[b]	0.182	0.305	0.332	0.327	7.610	0.365
Grayson Lake, KY	21-043-0500	0.093	0.015	0.151	0.044	0.138	0.106	0.036	0.035	0.165
Hillsborough Cty, FL	12-057-3002	0.029	0.033	0.044	0.034	0.046	0.046	0.036	0.017	0.027
Pinellas Cty, FL	12-103-0026	0.029	0.033	0.044	0.034	0.046	0.046	0.036	0.017	0.027
Dearborn, MI	26-163-0033	0.104[a]	0.020[a]	0.153	0.050	0.154	0.111	0.044	0.093	0.203
Horicon, WI	55-027-0001	0.319	0.221	0.629	0.488	0.768	0.462	0.404	0.347	0.686
Northbrook, IL	17-031-4201	0.105	0.060[b]	0.151	0.044	0.138	0.106	0.036	0.035	0.165
Deer Park, TX	48-201-1039	--	--	--	--	--	--	--	--	--
Harrison Cty, TX	48-203-0002	--	--	--	--	--	--	--	--	--
St. Louis, MO	29-510-0085	0.093	0.015	0.151	0.044	0.138	0.106	0.036	0.035	0.165
Bountiful, UT	49-011-0004	0.093	0.015	0.151	0.044	0.138	0.106	0.036	0.035	0.165
Grand Junction, CO	08-077-0017	0.093	0.015	0.151	0.044	0.138	0.106	0.036	0.035	0.165
Phoenix, AZ	04-013-9997	0.093	0.015	0.151	0.044	0.138	0.106	0.036	0.035	0.165
Los Angeles, CA	06-037-1103	0.160	0.088	0.126	0.098	--	--	--	0.347	--
Rubidoux, CA	06-065-8001	0.160	0.088	0.126	0.098	--	--	--	0.347	--
San Jose, CA	06-085-0005	0.097[b]	0.117[b]	0.085[b]	0.066	0.077	--	0.404	0.347	--
La Grande, OR	41-061-0119	0.132[a]	0.158[b]	0.197[b]	0.259[a]	--	0.245	--	0.225	--
Portland, OR	41-051-0246	0.128	0.165[b]	0.186[b]	0.244	--	0.231	--	0.216	--
Seattle, WA	53-033-0080	0.093	0.015	0.151	0.044	0.138	0.106	0.036	0.035	0.165
	Arithmetic Mean	0.092	0.064	0.144	0.098	0.164	0.139	0.096	0.413	0.194
	Geometric Mean	0.076	0.042	0.119	0.070	0.130	0.112	0.061	0.081	0.153
	Median	0.093	0.033	0.151	0.049	0.138	0.106	0.040	0.036	0.165
	Standard Deviation	0.062	0.061	0.113	0.105	0.153	0.106	0.121	1.504	0.141
	MQO	0.130	0.100	0.067	0.500	--	--	--	--	--

Note: Shaded cells indicate that all reported MDLs are above the MQO and unshaded cells indicate all reported MDLs are below the MQO and with the following exceptions indicated:

a. Some reported MDLs (less than 5%) are above the MQO
b. Between 33% and 75% of the MDLs are above the MQO

Table 33. Average Method Detection Limits (MDLs) by Site and Overall for VOCs ($\mu g/m^3$) and PAHs (ng/m^3) - CY2011 (continued)

Site Description	AQS Site Code	VOCs							PAHs	
		PERC	TCE	VC	cDCPEN	tDCPEN	ACRO	ACRY	NAPH	BaP
Boston, MA	25-025-0042	0.069	0.048	0.017	0.040	0.026	0.123	0.260	0.107	0.060
Underhill, VT	50-007-0007	0.120	0.130	0.020	0.100	0.110	--	0.030	0.139	0.078
Providence, RI	44-007-0022	0.069	0.048	0.017	0.040	0.026	0.123	0.260	0.159	0.090
Bronx, NY	36-005-0080	0.068	0.054	0.026	0.045	0.045	0.069	--	0.126	0.071
Rochester, NY	36-055-1007	0.068	0.054	0.026	0.045	0.045	0.069	--	0.187	0.105
Washington, DC	11-001-0043	0.101	0.054	0.051	0.091	0.091	0.045	0.033	0.168	0.094
Richmond, VA	51-087-0014	0.191	0.107	0.136	0.175	0.068	0.428	0.131	0.185	0.104
Chesterfield, SC	45-025-0001	0.142	0.140	0.089	0.086	0.082	0.085	--	0.156	0.087
Decatur, GA	13-089-0002	0.119	0.236	0.070	0.277	0.251	0.043	--	0.142	0.080
Grayson Lake, KY	21-043-0500	0.122	0.134	0.020	0.100	0.113	0.115	0.026	0.127	0.071
Hillsborough Cty, FL	12-057-3002	0.034	0.048	0.041	0.082	0.045	0.087	0.022	0.140	0.078
Pinellas Cty, FL	12-103-0026	0.034	0.048	0.041	0.082	0.045	0.087	0.022	0.135	0.075
Dearborn, MI	26-163-0033	0.134[a]	0.142	0.026[a]	0.109	0.126	0.115	0.041	0.124	0.070
Horicon, WI	55-027-0001	0.678	0.537	0.255	0.454	0.454	0.229	--	0.133	0.136
Northbrook, IL	17-031-4201	0.122	0.134	0.020	0.100	0.113	0.115	0.026	0.147	0.072
Deer Park, TX	48-201-1039	--	--	--	--	--	--	--	0.162	0.091
Harrison Cty, TX	48-203-0002	--	--	--	--	--	--	--	--	--
St. Louis, MO	29-510-0085	0.122	0.134	0.020	0.100	0.113	0.115	--	0.133	0.074
Bountiful, UT	49-011-0004	0.122	0.134	0.020	0.100	0.113	0.115	0.026	0.199	0.111
Grand Junction, CO	08-077-0017	0.122	0.134	0.020	0.100	0.113	0.115	0.026	0.167	0.094
Phoenix, AZ	04-013-9997	0.122	0.134	0.020	0.100	0.113	0.115	0.026	0.109	0.061
Los Angeles, CA	06-037-1103	0.068	0.107	--	0.454	0.454	0.687	--	0.130	0.072
Rubidoux, CA	06-065-8001	0.068	0.107	--	0.454	0.454	0.687	--	0.164	0.092
San Jose, CA	06-085-0005	0.046	0.072	0.255	0.454	0.454	0.403	0.217	0.140	0.078
La Grande, OR	41-061-0119	0.248[b]	0.285[a]	0.131[b]	--	--	0.092	--	1.035	0.262
Portland, OR	41-051-0246	0.235[b]	0.269	0.127[b]	--	--	0.092	--	2.292[a]	0.233
Seattle, WA	53-033-0080	0.122	0.134	0.020	0.100	0.113	0.115	0.026	0.111	0.063
	Arithmetic Mean	0.134	0.137	0.064	0.160	0.155	0.178	0.078	0.262	0.096
	Geometric Mean	0.106	0.111	0.041	0.117	0.107	0.129	0.047	0.172	0.089
	Median	0.122	0.134	0.026	0.100	0.113	0.115	0.026	0.141	0.079
	Standard Deviation	0.126	0.106	0.072	0.146	0.148	0.183	0.091	0.450	0.048
	MQO	0.170	0.500	0.110	--	--	0.100	--	29.0	0.910

Note: Shaded cells indicate that all reported MDLs are above the MQO and unshaded cells indicate all reported MDLs are below the MQO and with the following exceptions indicated:

a. Some reported MDLs (less than 5%) are above the MQO
b. Between 33% and 75% of the MDLs are above the MQO

Table 34. Average Method Detection Limits (MDLs) by Site and Overall for carbonyls (µg/m^3), metals (ng/m^3), and chromium (VI) (ng/m^3) - CY2011

Site Description	AQS Site Code	carbonyls		metals						
		FORM	ACET	As	Be	Cd	Pb	Mn	Ni	CrVI
Boston, MA	25-025-0042	0.103	0.069	0.060[a]	0.017	0.019	0.159	0.205	0.490[a]	0.004
Underhill, VT	50-007-0007	0.019	0.013	0.143	0.013	0.010	0.037	0.203	0.896	0.004
Providence, RI	44-007-0022	0.088	0.026	0.095	0.054	0.102	0.606	0.035	0.054	0.004
Bronx, NY	36-005-0080	0.018	0.018	0.191[b]	0.054	0.038	0.025	0.038	0.089	0.004
Rochester, NY	36-055-1007	0.018	0.018	0.191[b]	0.054	0.038	0.025	0.038	0.089	0.004
Washington, DC	11-001-0043	0.023	0.011	1.664	--	--	--	--	--	0.004
Richmond, VA	51-087-0014	0.097	0.180	0.023	0.013	0.017	0.064	0.029	0.143	0.004
Chesterfield, SC	45-025-0001	0.251	0.221	0.031	0.001	0.001	0.003	0.002	0.003	0.004
Decatur, GA	13-089-0002	1.165[c]	1.165[c]	0.265[b]	0.010	0.300	0.010	0.011	0.026	0.004
Grayson Lake, KY	21-043-0500	0.013	0.012	0.159	0.041	0.040	0.044	0.188	0.836	0.004
Hillsborough Cty, FL	12-057-3002	0.011	0.011	0.460	0.200	0.150	1.040	0.140	0.920	0.004
Pinellas Cty, FL	12-103-0026	0.011	0.011	--	--	--	--	--	--	0.004
Dearborn, MI	26-163-0033	0.010	0.009	0.039	0.014	0.028	--	0.298	0.160	0.004
Horicon, WI	55-027-0001	0.064	0.054	0.029	0.010	0.016	0.034	0.094	0.093	0.004
Northbrook, IL	17-031-4201	0.011	0.011	0.054	0.007	0.009	0.111	0.138	0.388	0.004
Deer Park, TX	48-201-1039	--	--	0.064	0.060	0.040	0.020	0.264	0.181	0.005
Harrison Cty, TX	48-203-0002	--	--	0.069	0.060	0.040	0.020	0.272	0.188	0.005
St. Louis, MO	29-510-0085	0.012	0.011	0.124	0.008	0.009	0.045	0.421[a]	0.872	0.004
Bountiful, UT	49-011-0004	0.011	0.010	0.182	0.010	0.012	0.020	0.223	1.261	0.004
Grand Junction, CO	08-077-0017	0.013	0.013	0.066	0.159	0.152	0.102	0.089	0.080	0.004
Phoenix, AZ	04-013-9997	0.015	0.014	0.151	0.012	0.010	0.035	0.209	0.956	0.004
Los Angeles, CA	06-037-1103	0.123	0.180	0.100	0.100	0.100	0.100	0.100	0.100	0.020
Rubidoux, CA	06-065-8001	0.123	0.180	0.091	0.091	0.092	0.091	0.092	0.091	0.020
San Jose, CA	06-085-0005	0.068	0.075	0.160	0.010	0.010	0.020	0.200	1.130	--
La Grande, OR	41-061-0119	0.131	0.033	0.035	0.004	0.035	0.351	0.351	0.351	0.035
Portland, OR	41-051-0246	0.118	0.031	0.031	0.003	0.034	0.344	0.344	0.344	0.035
Seattle, WA	53-033-0080	0.015	0.014	0.058	0.015	0.021	0.180	0.208	0.506	0.004
	Arithmetic Mean	0.101	0.096	0.174	0.041	0.053	0.145	0.168	0.410	0.008
	Geometric Mean	0.038	0.031	0.096	0.020	0.028	0.059	0.109	0.213	0.005
	Median	0.019	0.018	0.093	0.014	0.034	0.045	0.188	0.188	0.004
	Standard Deviation	0.230	0.232	0.318	0.051	0.067	0.238	0.116	0.395	0.009
	MQO	0.980	0.450	0.230	0.420	0.560	150	5.00	2.10	0.080

Note: Shaded cells indicate that all reported MDLs are above the MQO and unshaded cells indicate all reported MDLs are below the MQO and with the following exceptions indicated:

a. Some reported MDLs (less than 5%) are above the MQO
b. Between 33% and 75% of the MDLs are above the MQO
c. Over 95% of the reported MDLs are above the MQO

Table 35. Average Method Detection Limits (MDLs) by Site and Overall for VOCs (µg/m³) and PAHs (ng/m³) - CY2012

Site Description	AQS Site Code	VOCs								
		BENZ	BUTA	CTET	CLFRM	EDB	DCP	EDC	MECL	TCE1122
Boston, MA	25-025-0042	0.037	0.019	0.060	0.051	0.094	0.055	0.062	0.040	0.214
Underhill, VT	50-007-0007	0.190	0.020	0.150	0.070	0.130	0.090	0.060	0.080	0.120
Providence, RI	44-007-0022	0.043	0.024	0.105	0.080	0.149	0.076	0.074	0.055	0.178
Bronx, NY	36-005-0080	0.016	0.013	0.044	0.029	0.054	0.037	0.020	0.028	0.021
Rochester, NY	36-055-1007	0.016	0.013	0.044	0.029	0.054	0.037	0.020	0.028	0.021
Washington, DC	11-001-0043	0.061	0.022	0.126	0.049	0.077	0.092	0.081	0.104	0.137
Richmond, VA	51-087-0014	0.134	0.148	0.189	0.146	0.691	0.332	0.263	0.326	0.686
Chesterfield, SC	45-025-0001	0.115	0.221	0.226	0.205	0.200	0.162	0.133	0.132	0.185
Decatur, GA	13-089-0002	0.117	0.068	0.082	0.171	0.312	0.270	0.220	6.942	0.387
Grayson Lake, KY	21-043-0500	0.195	0.024	0.151	0.068	0.131	0.088	0.065	0.080	0.123
Hillsborough Cty, FL	12-057-3002	0.019	0.029	0.031	0.024	0.038	0.023	0.016	0.024	0.034
Pinellas Cty, FL	12-103-0026	0.019	0.029	0.031	0.024	0.038	0.023	0.016	0.024	0.034
Dearborn, MI	26-163-0033	0.195	0.024	0.151	0.068	0.131	0.088	0.065	0.080	0.123
Horicon, WI	55-027-0001	0.319	0.221	0.629	0.488	0.768	0.462	0.404	0.347	0.686
Northbrook, IL	17-031-4201	0.149[b]	0.066[b]	0.151	0.068	0.131	0.088	0.065	0.080	0.123
Deer Park, TX	48-201-1039	--	--	--	--	--	--	--	--	--
Harrison Cty, TX	48-203-0002	--	--	--	--	--	--	--	--	--
St. Louis, MO	29-510-0085	0.195	0.024	0.151	0.068	0.131	0.088	0.065	0.080	0.123
Bountiful, UT	49-011-0004	0.195	0.024	0.151	0.068	0.131	0.088	0.065	0.101	0.123
Grand Junction, CO	08-077-0017	0.195	0.024	0.151	0.068	0.131	0.088	0.065	0.258	0.123
Phoenix, AZ	04-013-9997	0.195	0.024	0.151	0.068	0.131	0.088	0.065	0.080	0.123
Los Angeles, CA	06-037-1103	0.160	0.088	0.126	0.098	--	--	--	0.347	--
Rubidoux, CA	06-065-8001	0.160	0.088	0.126	0.098	--	--	--	0.347	--
San Jose, CA	06-085-0005	0.083[b]	0.042	0.046	0.071	0.038	--	0.032	0.280	--
La Grande, OR	41-061-0119	0.128	0.088	0.063	0.244	--	0.230	--	0.609	--
Portland, OR	41-051-0246	0.134[a]	0.093[b]	0.066[a]	0.259[a]	--	0.246	--	0.184	--
Seattle, WA	53-033-0080	0.195	0.024	0.151	0.068	0.131	0.088	0.065	0.080	0.123
	Arithmetic Mean	0.131	0.058	0.134	0.107	0.176	0.129	0.091	0.429	0.184
	Geometric Mean	0.098	0.040	0.106	0.080	0.122	0.095	0.064	0.124	0.122
	Median	0.134	0.024	0.126	0.068	0.131	0.088	0.065	0.080	0.123
	Standard Deviation	0.078	0.059	0.116	0.102	0.195	0.111	0.094	1.365	0.189
	MQO	0.130	0.100	0.170	0.500	--	--	--	--	--

Note: Shaded cells indicate that all reported MDLs are above the MQO and unshaded cells indicate all reported MDLs are below the MQO and with the following exceptions indicated:

a. Some reported MDLs (less than 5%) are above the MQO
b. Between 33% and 75% of the MDLs are above the MQO

Table 35. Average Method Detection Limits (MDLs) by Site and Overall for VOCs (µg/m³) and PAHs (ng/m³) - CY2012 (continued)

Site Description	AQS Site Code	VOCs							PAHs	
		PERC	TCE	VC	cDCPEN	tDCPEN	ACRO	ACRY	NAPH	BaP
Boston, MA	25-025-0042	0.108	0.068	0.023	0.058	0.058	0.174	0.274	0.141	0.053
Underhill, VT	50-007-0007	0.140	0.120	0.030	0.070	0.070	--	0.040	0.193	0.073
Providence, RI	44-007-0022	0.179[b]	0.090	0.035	0.070	0.106	0.265	0.284	0.217	0.082
Bronx, NY	36-005-0080	0.027	0.027	0.013	0.036	0.032	0.085	--	0.171	0.064
Rochester, NY	36-055-1007	0.027	0.027	0.013	0.036	0.032	0.085	--	0.183	0.069
Washington, DC	11-001-0043	0.136	0.054	0.077	0.045	0.045	0.069	0.043	0.232	0.087
Richmond, VA	51-087-0014	0.427	0.360	0.171	0.331	0.259	0.275	0.373	0.247	0.093
Chesterfield, SC	45-025-0001	0.183	0.193	0.146	0.122	0.082	0.108	--	0.180	0.068
Decatur, GA	13-089-0002	0.139	0.314	0.091	0.287	0.218	0.081[b]	--	0.090	0.034
Grayson Lake, KY	21-043-0500	0.136	0.118	0.028	0.068	0.073	0.137	0.043	0.153	0.058
Hillsborough Cty, FL	12-057-3002	0.027	0.021	0.033	0.023	0.068	0.066	0.013	0.197	0.074
Pinellas Cty, FL	12-103-0026	0.027	0.021	0.033	0.023	0.068	0.066	0.013	0.204	0.067
Dearborn, MI	26-163-0033	0.136	0.118	0.028	0.068	0.073	0.137	0.043	0.193	0.064
Horicon, WI	55-027-0001	0.678	0.537	0.255	0.454	0.454	0.229	--	0.140	0.280
Northbrook, IL	17-031-4201	0.136	0.118	0.028	0.068	0.073	0.137	0.043	0.182	0.059
Deer Park, TX	48-201-1039	--	--	--	--	--	--	--	0.179	0.067
Harrison Cty, TX	48-203-0002	--	--	--	--	--	--	--	--	--
St. Louis, MO	29-510-0085	0.136	0.118	0.028	0.068	0.073	0.137	0.043	0.194	0.062
Bountiful, UT	49-011-0004	0.136	0.118	0.028	0.068	0.073	0.137	0.043	0.268	0.101
Grand Junction, CO	08-077-0017	0.136	0.118	0.028	0.068	0.073	0.137	0.043	0.300	0.088
Phoenix, AZ	04-013-9997	0.136	0.118	0.028	0.068	0.073	0.137	0.043	0.166	0.062
Los Angeles, CA	06-037-1103	0.068	0.107	--	0.454	0.454	0.687	--	0.234	0.065
Rubidoux, CA	06-065-8001	0.068	0.107	--	0.454	0.454	0.687	--	0.220	0.074
San Jose, CA	06-085-0005	0.031	0.075	0.015	0.454	0.454	0.399	0.024	0.184	0.069
La Grande, OR	41-061-0119	0.136	0.269	0.102	--	--	0.092	--	3.042	0.224
Portland, OR	41-051-0246	0.142[a]	0.286	0.107[a]	--	--	0.092	--	4.208	1.017[a]
Seattle, WA	53-033-0080	0.136	0.118	0.028	0.068	0.073	0.137	0.043	0.146	0.055
	Arithmetic Mean	0.145	0.145	0.059	0.150	0.149	0.190	0.088	0.456	0.120
	Geometric Mean	0.106	0.105	0.041	0.093	0.102	0.147	0.051	0.235	0.083
	Median	0.136	0.118	0.028	0.068	0.073	0.137	0.043	0.193	0.069
	Standard Deviation	0.137	0.122	0.061	0.160	0.152	0.172	0.113	0.948	0.190
	MQO	0.170	0.200	0.110	--	--	0.090	--	29.0	0.910

Note: Shaded cells indicate that all reported MDLs are above the MQO and unshaded cells indicate all reported MDLs are below the MQO and with the following exceptions indicated:

a. Some reported MDLs (less than 5%) are above the MQO
b. Between 33% and 75% of the MDLs are above the MQO

Table 36. Average Method Detection Limits (MDLs) by Site and Overall for carbonyls (µg/m^3), metals (ng/m^3), and chromium (VI) (ng/m^3) - CY2012

Site Description	AQS Site Code	carbonyls		metals						
		FORM	ACET	As	Be	Cd	Pb	Mn	Ni	CrVI
Boston, MA	25-025-0042	0.110	0.056	0.062	0.005	0.007	0.124	0.363	0.454	0.004
Underhill, VT	50-007-0007	0.030	0.017	0.170	0.020	0.010	0.070	0.320	0.400	0.004
Providence, RI	44-007-0022	0.305[b]	0.054	0.091	0.055	0.034	0.533	0.121	0.059	0.003
Bronx, NY	36-005-0080	--	--	0.140	0.058	0.036	0.025	0.028	0.053	0.003
Rochester, NY	36-055-1007	--	--	0.141	0.057	0.037	0.026	0.027	0.051	0.004
Washington, DC	11-001-0043	--	--	--	--	--	--	--	--	0.004
Richmond, VA	51-087-0014	0.073[b]	0.108	0.020	0.016	0.020	0.054	0.026	0.155	0.003
Chesterfield, SC	45-025-0001	0.240	0.280	0.030	0.001	0.001	0.003	0.002	0.003	0.003
Decatur, GA	13-089-0002	1.178	1.163[c]	0.324	0.015	0.071	0.019	0.017	0.027	0.003
Grayson Lake, KY	21-043-0500	0.007	0.007	0.170	0.020	0.010	0.070	0.320	0.400	0.003
Hillsborough Cty, FL	12-057-3002	0.012	0.012	0.460	0.200	0.150	1.040	0.140	0.920	0.003
Pinellas Cty, FL	12-103-0026	0.011	0.011	0.460	0.200	0.150	1.040	0.140	0.920	0.004
Dearborn, MI	26-163-0033	0.010	0.010	0.040	0.012	0.030	--	0.301	0.161	0.004
Horicon, WI	55-027-0001	0.062	0.070	0.029	0.010	0.016	0.034	0.094	0.093	0.004
Northbrook, IL	17-031-4201	0.017	0.017	0.065	0.005	0.007	0.130	0.379	0.474	0.004
Deer Park, TX	48-201-1039	--	--	0.065	0.056	0.040	0.019	0.237	0.158	0.004
Harrison Cty, TX	48-203-0002	--	--	0.068	0.051	0.043	0.017	0.218	0.141	0.004
St. Louis, MO	29-510-0085	0.011	0.011	0.170	0.020	0.010	0.070	0.320	0.400	0.004
Bountiful, UT	49-011-0004	0.011	0.010	0.192	0.020	0.010	0.082	0.357	0.452	0.003
Grand Junction, CO	08-077-0017	0.012	0.012	0.083	0.253	0.075	0.046	0.094	0.070	0.003
Phoenix, AZ	04-013-9997	0.015	0.014	0.173	0.020	0.010	0.073	0.324	0.407	0.004
Los Angeles, CA	06-037-1103	0.123	0.180	--	--	--	--	--	--	0.007
Rubidoux, CA	06-065-8001	0.123	0.180	--	--	--	--	--	--	0.007
San Jose, CA	06-085-0005	0.067[b]	0.073	0.170	0.020	0.010	0.070	0.320	0.400	--
La Grande, OR	41-061-0119	0.136	0.033	0.034	0.003	0.034	0.346	0.350	0.345	0.035
Portland, OR	41-051-0246	0.124[c]	0.032	0.034	0.003	0.034	0.347	0.350	0.345	0.035
Seattle, WA	53-033-0080	0.016	0.014	0.065	0.005	0.007	0.129	0.377	0.472	0.004
	Arithmetic Mean	0.122	0.107	0.136	0.047	0.035	0.190	0.218	0.307	0.006
	Geometric Mean	0.044	0.036	0.095	0.020	0.021	0.076	0.137	0.183	0.004
	Median	0.046	0.025	0.087	0.020	0.025	0.070	0.269	0.345	0.004
	Standard Deviation	0.249	0.246	0.123	0.069	0.040	0.298	0.138	0.252	0.009
	MQO	0.080	0.450	0.230	0.420	0.560	15	5.00	2.10	0.080

Note: Shaded cells indicate that all reported MDLs are above the MQO and unshaded cells indicate all reported MDLs are below the MQO and with the following exceptions indicated:

a. Some reported MDLs (less than 5%) are above the MQO
b. Between 33% and 75% of the MDLs are above the MQO
c. Over 95% of the reported MDLs are above the MQO

Table 37. Summary Statistics for Method Detection Limits across All Reporting NATTS Laboratories – CY2011

	VOCs			carbonyls	PAHs	metals	
MDL	**Acrolein ($\mu g/m^3$)**	**Benzene ($\mu g/m^3$)**	**1,3-Butadiene ($\mu g/m^3$)**	**Formaldehyde ($\mu g/m^3$)**	**Naphthalene (ng/m^3)**	**Arsenic (ng/m^3)**	**Chromium (VI) (ng/m^3)**
Geometric Mean	0.129	0.076	0.042	0.038	0.172	0.096	0.005
Arithmetic Mean	0.178	0.092	0.064	0.101	0.262	0.174	0.008
Standard Deviation	0.183	0.062	0.061	0.230	0.450	0.318	0.009
Minimum	0.043	0.029	0.015	0.010	0.107	0.023	0.004
Median	0.115	0.093	0.033	0.019	0.141	0.093	0.004
Maximum	0.687	0.319	0.221	1.165	2.292	1.664	0.035
MQO	0.10	0.13	0.10	0.98	29.0	0.23	0.08
Ratio of Geometric Mean to MQO	**1.3**	**0.58**	**0.42**	**0.038**	**0.0059**	**0.42**	**0.07**

Table 38. Summary Statistics for Method Detection Limits across All Reporting NATTS Laboratories – CY2012

	VOCs			carbonyls	PAHs	metals	
MDL	**Acrolein ($\mu g/m^3$)**	**Benzene ($\mu g/m^3$)**	**1,3-Butadiene ($\mu g/m^3$)**	**Formaldehyde ($\mu g/m^3$)**	**Naphthalene (ng/m^3)**	**Arsenic (ng/m^3)**	**Chromium (VI) (ng/m^3)**
Geometric Mean	0.147	0.098	0.040	0.044	0.235	0.095	0.004
Arithmetic Mean	0.190	0.131	0.058	0.122	0.456	0.136	0.006
Standard Deviation	0.172	0.078	0.059	0.249	0.948	0.123	0.009
Minimum	0.066	0.016	0.013	0.007	0.090	0.020	0.003
Median	0.137	0.134	0.024	0.046	0.193	0.087	0.004
Maximum	0.687	0.319	0.221	1.178	4.208	0.460	0.035
MQO	0.09	0.13	0.10	0.08	29.0	0.23	0.08
Ratio of Geometric Mean to MQO	**1.6**	**0.75**	**0.40**	**0.5**	**0.0081**	**0.41**	**0.06**

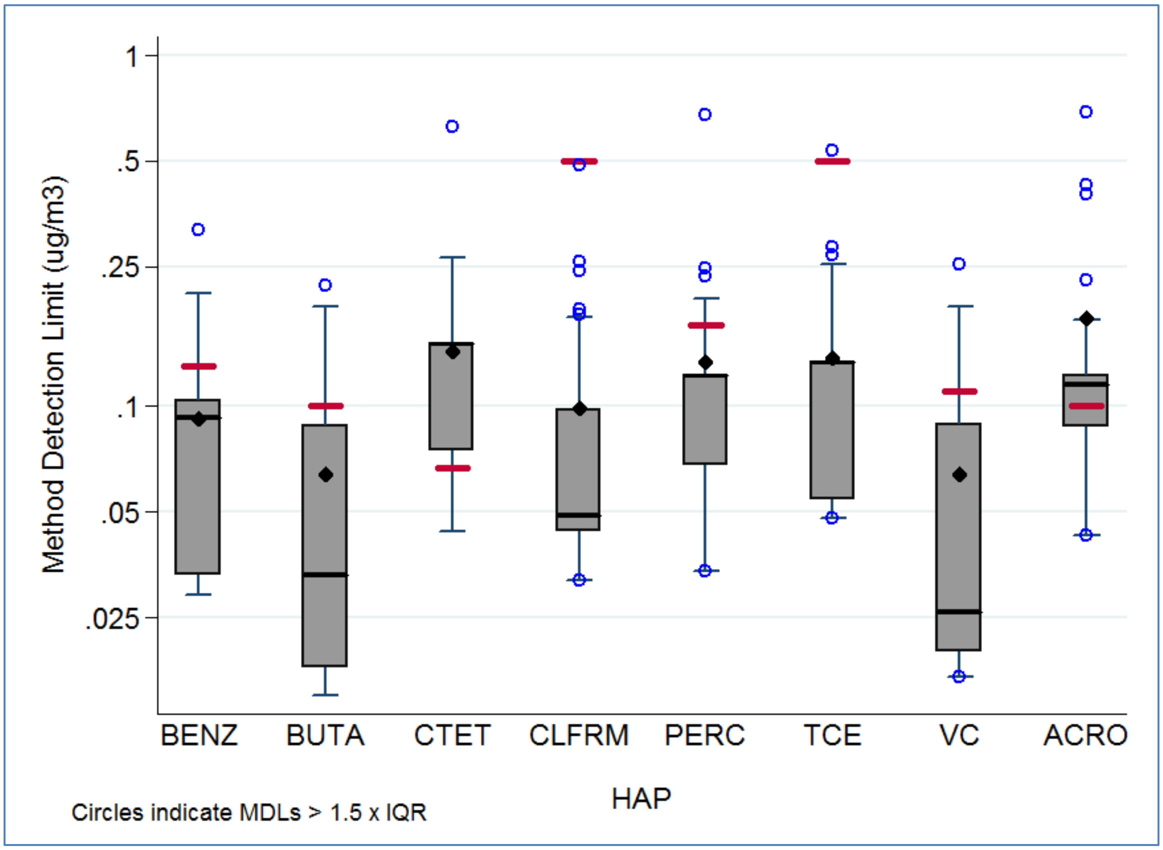

Figure 21. Distribution of VOCs Average Method Detection Limits for NATTS Data - CY2011

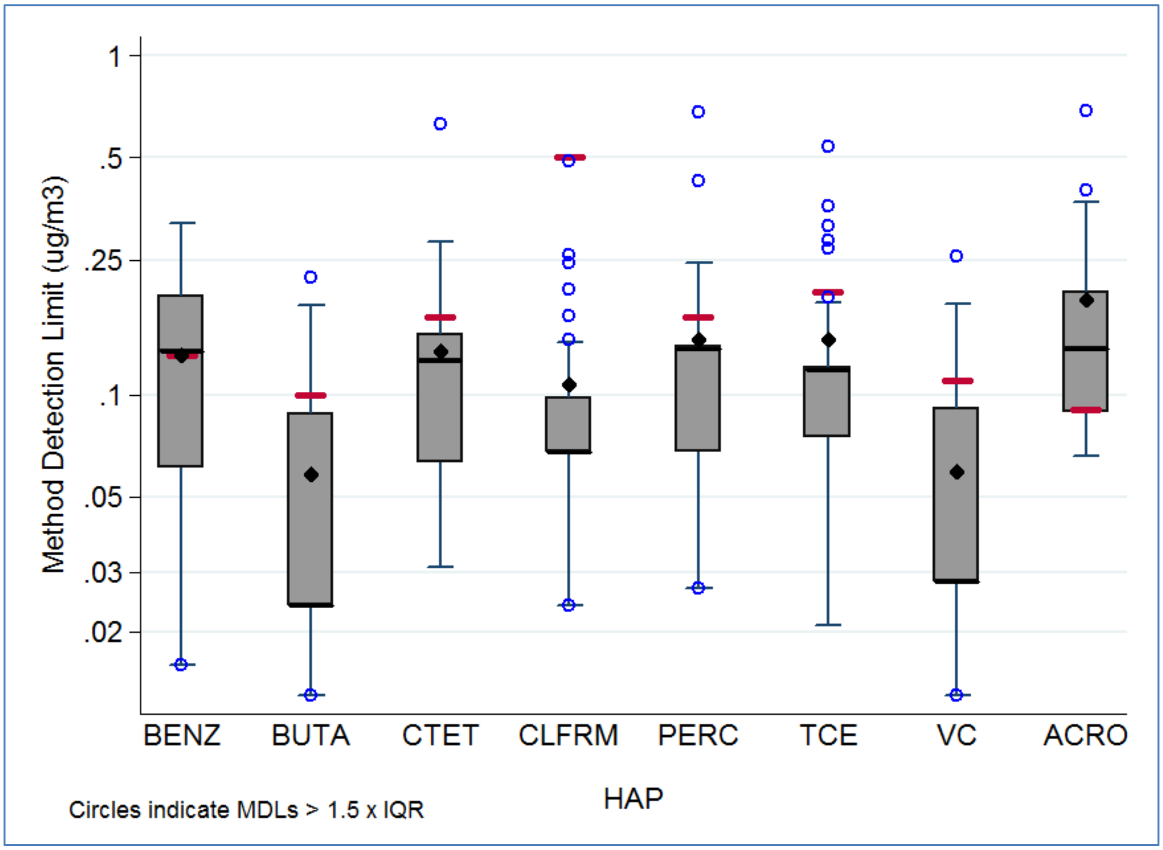

Figure 22. Distribution of VOCs Average Method Detection Limits for NATTS Data - CY2012

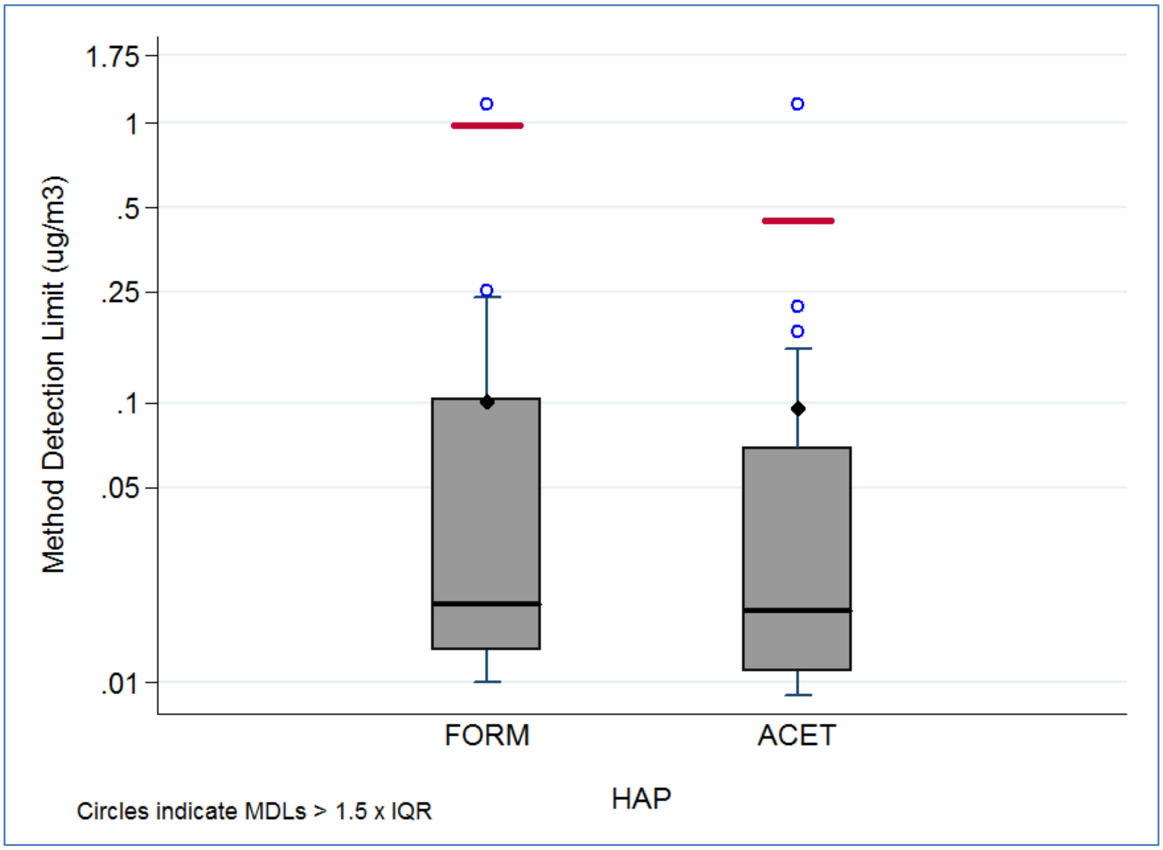

Figure 23. Distribution of Carbonyls Average Method Detection Limits - CY2011

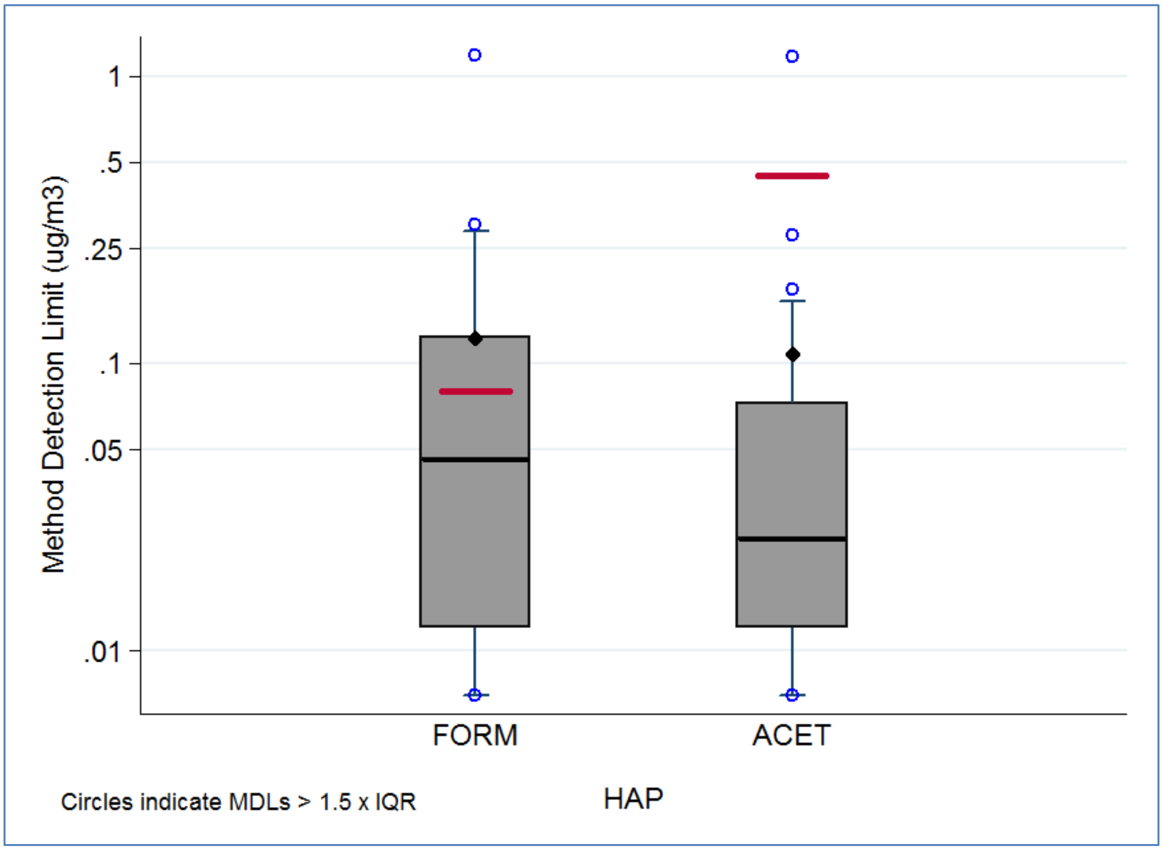

Figure 24. Distribution of Carbonyls Average Method Detection Limits - CY2012

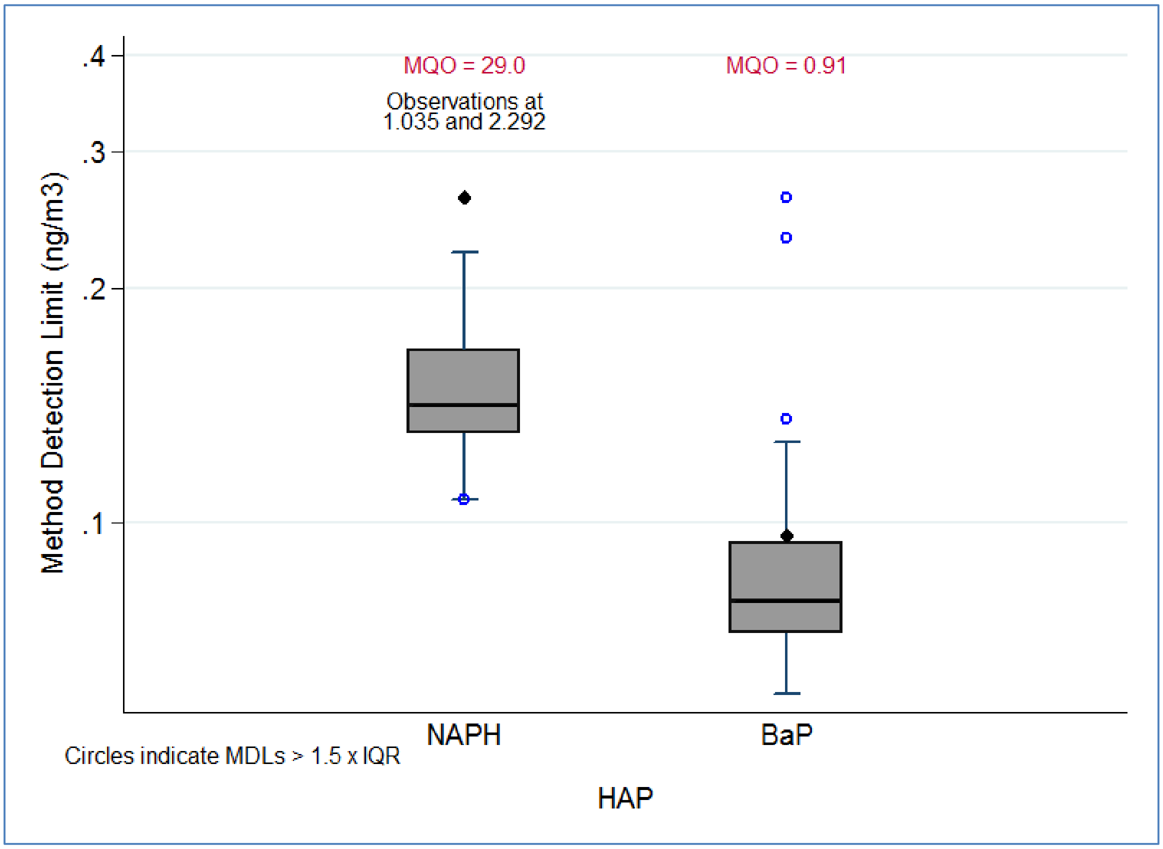

Figure 25. Distribution of PAHs Average Method Detection Limits - CY2011

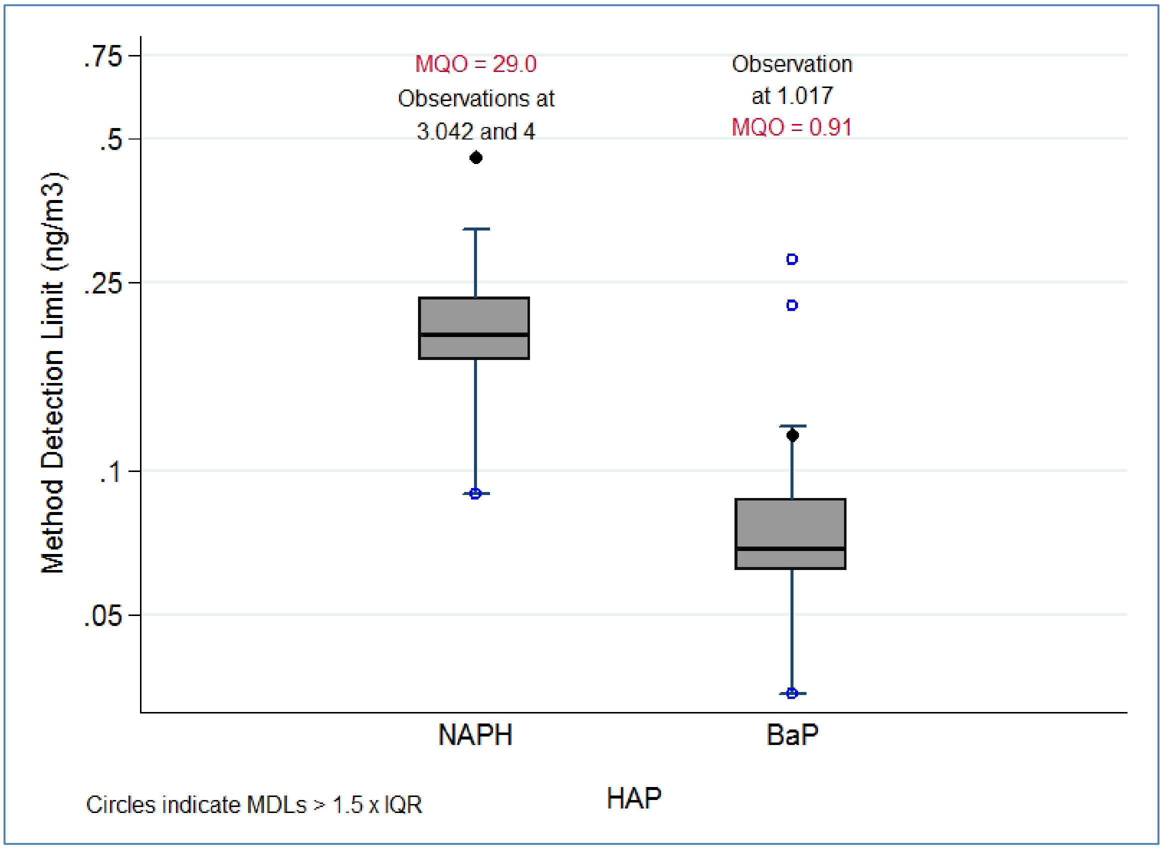

Figure 26. Distribution of PAHs Average Method Detection Limits - CY2012

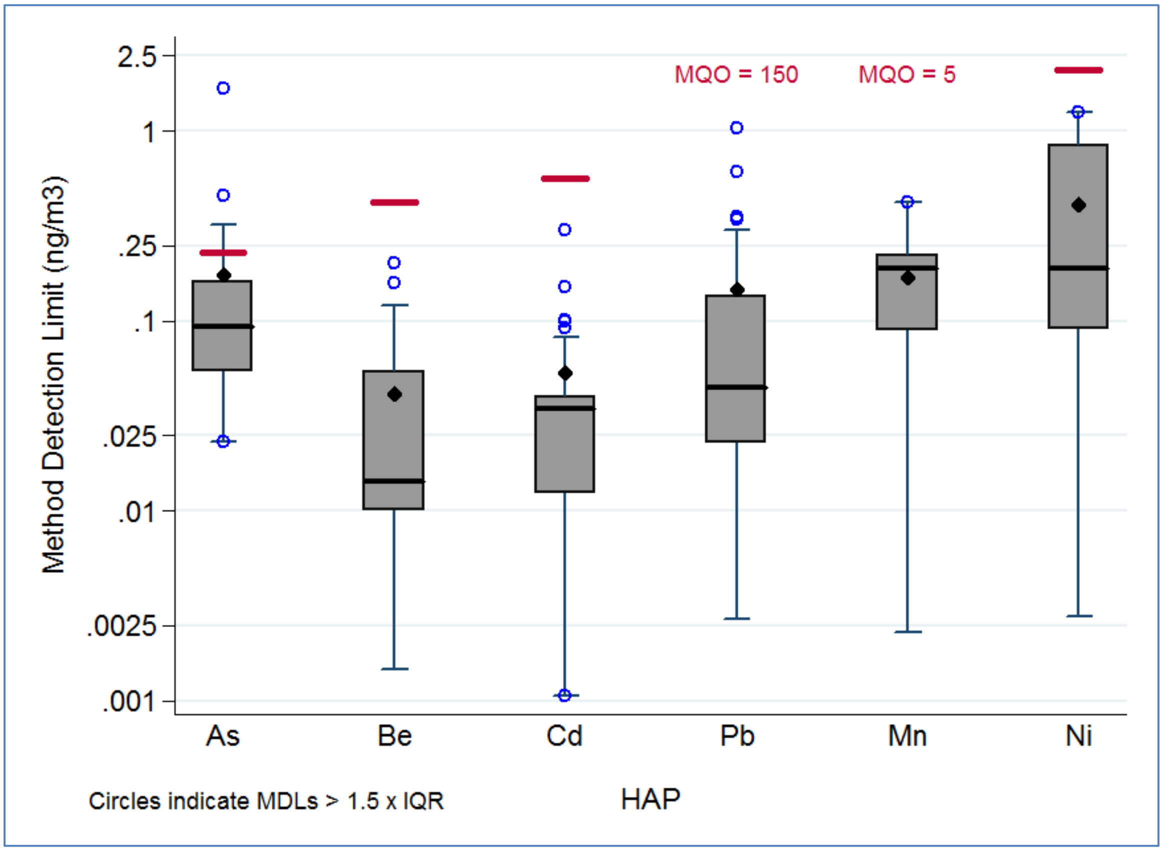

Figure 27. Distribution of Metals Average Method Detection Limits - CY2011

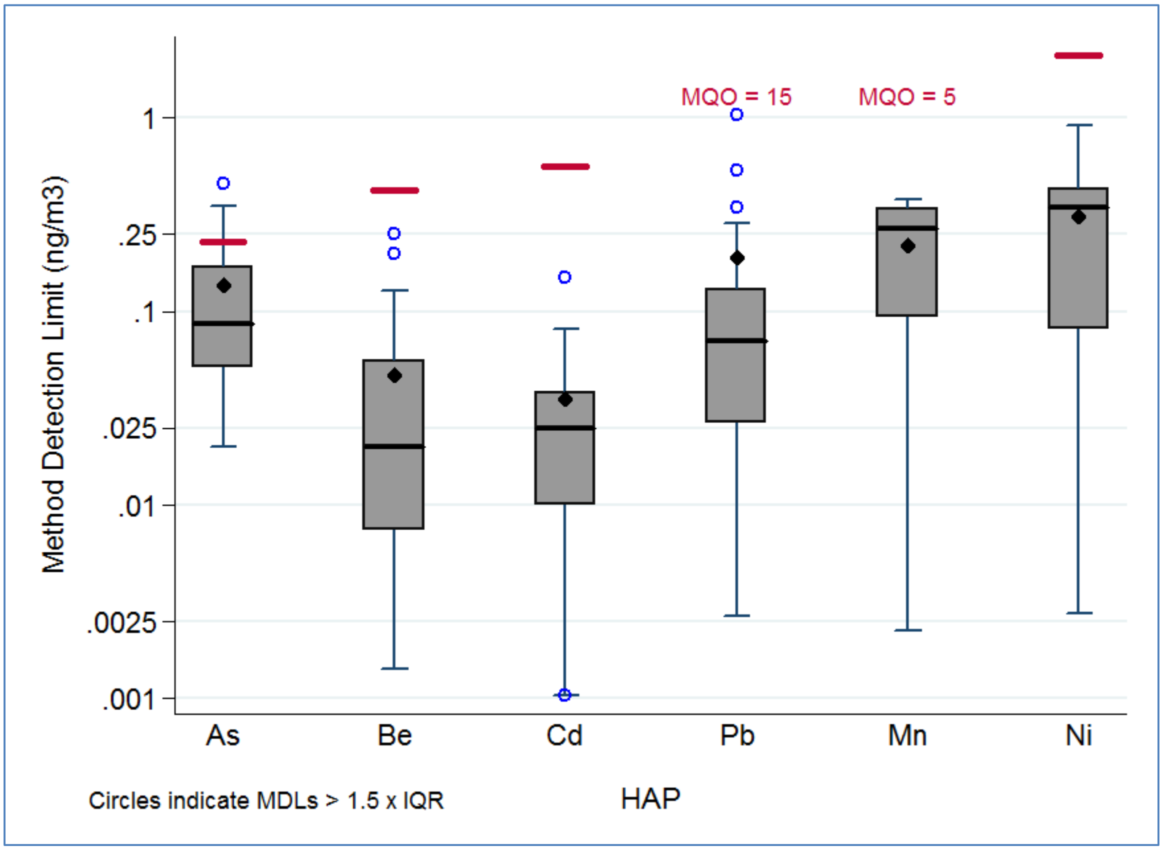

Figure 28. Distribution of Metals Average Method Detection Limits - CY2012

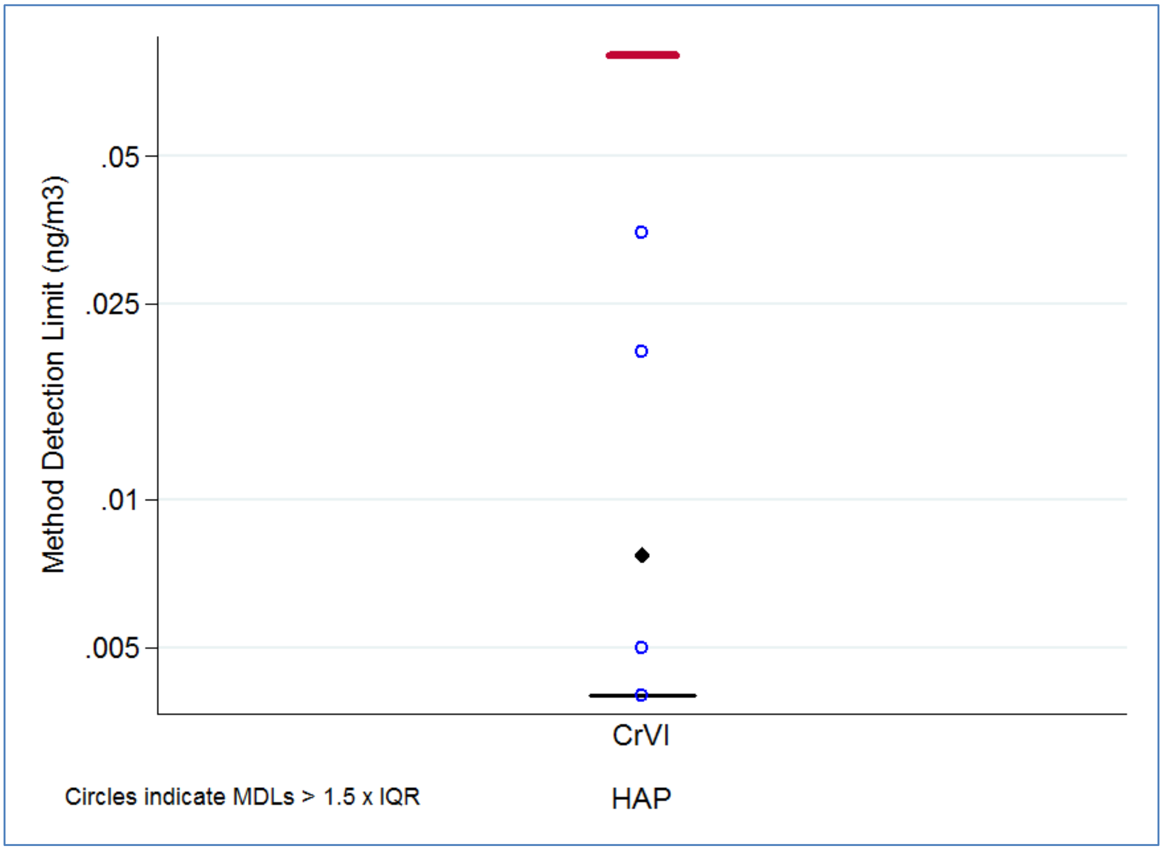

Figure 29. Distribution of Chromium (VI) Average Method Detection Limits - CY2011

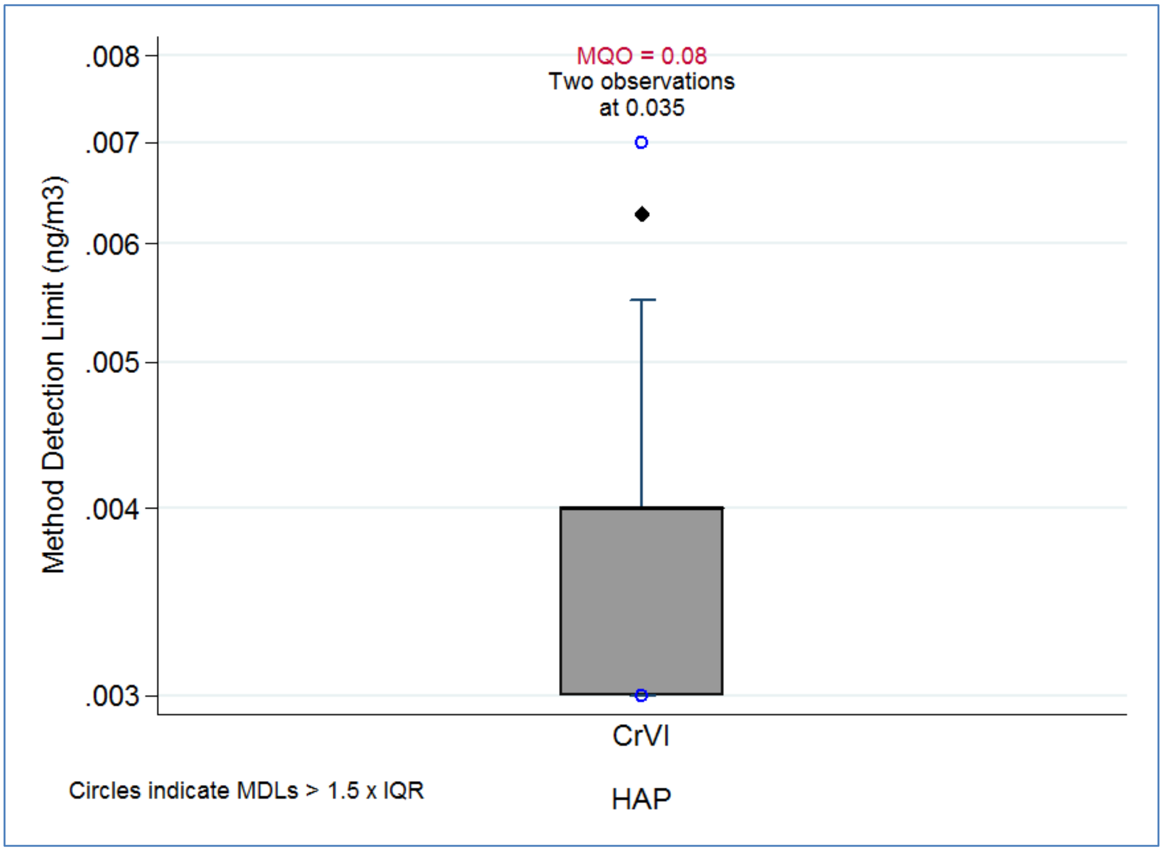

Figure 30. Distribution of Chromium (VI) Average Method Detection Limits - CY2012

3.0 SUMMARY

A summary of the quality assurance results for the seven HAPs of primary importance – acrolein, benzene, 1,3-butadiene, formaldehyde, naphthalene, arsenic, and chromium (VI) is presented in Table 39.

Table 39. Summary of NATTS Quality Assurance Results - Percentage of Sites Meeting Measurement Quality Objectives in CY2011 and CY2012

		VOCs			carbonyls	PAHs	metals	
Data Quality Indicator	**Calendar Year**	**Acrolein**	**Benzene**	**1,3-Butadiene**	**Formaldehyde**	**Naphthalene**	**Arsenic**	**Chromium (VI)**
Completeness	2011	77%	93%	85%	78%	96%	96%	100%
	2012	81%	89%	89%	78%	89%	96%	96%
Overall Precision	2011	37%	84%	79%	100%	63%	47%	54%
	2012	47%	90%	84%	95%	88%	56%	63%
Laboratory Bias	2011	77%	85%	85%	87%	40%	90%	--
	2012	--	--	--	--	83%	93%	100%
Field Bias[a]	2011	Not applicable			88%	75%	100%	75%
	2012				100%	80%	100%	100%
Method Dection Limit	2011	35%	78%	70%	89%	100%	85%	100%
	2012	23%	41%	81%	52%	100%	78%	100%

[a] Field bias was determined by HAPs class - carbonyls, PAHs, and metals - not for specific HAPs (except chromium (VI))

The following summary observations are provided:

1. Completeness: Data completeness across the entire NATTS network met the MQO in both CY2011 and CY2012: both the mean and median network-wide completeness for all seven priority HAPs was greater than 85% in both CY2011 and CY2012. Median network-wide completeness is indicated in Table 40 for CY2011 and CY2012.

   The percentage of sites that met the completeness MQO for CY2011 and CY2012 was 85% or greater for all of the seven HAPs of primary importance except acrolein and formaldehyde, for which approximately 80% of sites met the MQO.

Table 40. Median Completeness for the Seven HAPs of Primary Importance for CY2011 and CY2012

	VOCs			carbonyls	PAHs	metals	
	Acrolein	**Benzene**	**1,3-Butadiene**	**Formaldehyde**	**Naphthalene**	**Arsenic**	**Chromium (VI)**
MQO	> 85%	> 85%	> 85%	> 85%	> 85%	> 85%	> 85%
CY2011	97%	97%	97%	95%	97%	97%	98%
CY2012	95%	95%	95%	97%	95%	97%	97%

2. Analytical and Overall Precision: For CY2011 the network mean analytical precision met the MQO of 15% for carbonyls, PAHs, and chromium (VI), for all metals except beryllium, and for 9 of the 16 VOCs for reported concentrations equal to or above MDLs.

   For CY2012 the network mean analytical precision met the precision MQO for all HAPs except for acrylonitrile and beryllium.

   As is expected given the additional variability contribution of sample collection, overall precision for CY2011 showed much greater variability than the analytical precision: the network mean overall precision met the MQO for carbonyls, 1 PAH, 1 metal, and 5 of 16 VOCs; the MQO was not met for chromium (VI).

   As in CY2011, CY2012 overall precision showed greater variability than CY2012 analytical precision. The network mean overall precision met the MQO for carbonyls, 1 PAH, and 5 of 16 VOCs; the MQO was not met for any of the metals or for chromium (VI).

   In CY2011, all sites met the precision MQO for formaldehyde and less than 85% of sites met the MQO for six of the seven representative HAPs, with less than half of sites meeting the MQO for acrolein and arsenic. In CY2012, more than 85% of sites met the precision MQO for benzene, formaldehyde, and naphthalene with the remaining four HAPs showing 84% or less of sites meeting the MQO. As in CY2011, less than 50% of sites met the precision MQO for acrolein in CY2012.

3. Laboratory Bias: Percentages of NATTS laboratories meeting the bias MQO for acrolein, benzene and 1,3-butadiene were 77%, 85%, and 85%, respectively. All NATTS laboratories but one met the MQO for arsenic and formaldehyde. For the five NATTS laboratories reporting PAH results, only two laboratories met the MQO for naphthalene. Specifically, acceptable measurement bias was difficult to obtain for acrolein and naphthalene; the mean absolute percent bias across all participating laboratories was 29.5% and 26.0%, respectively. The CY2011 PAH PT results should be interpreted with caution, as it appears that the target value may have been biased high: all reported results but one showed a negative bias.

   For the three HAPs of primary importance that were spiked for the CY2012 PT (naphthalene, arsenic, and chromium (VI)), all NATTS laboratories met the MQO for chromium (VI) and all but one laboratory met the MQO for both naphthalene and arsenic.

4. Field Bias: Sampler flows measured during IPAs conducted at NATTS field sites indicated less than 10% absolute difference from the sampler settings with few exceptions for both CY2011 and CY2012. The most frequent MQO exceedances occurred for PAH and chromium (VI) samplers.

   In CY2011 all sites met the <10% flow bias MQO for metals, 7 of 8 sites met the MQO for carbonyls, and 6 of 8 sites met the MQO for PAHs and chromium (VI). In CY2012 all sites met the flow bias MQO for carbonyls, metals, and chromium (VI), and 4 of 5 sites met the MQO for PAHs.

5. Method Detection Limits: MDL values varied widely among sites and frequently exceeded the respective MQOs for several HAPs. For many HAPs the overall network geometric mean value fell within the MQO threshold when all sites were considered together, except for acrolein in CY2011 and CY2012. The ratios of the network geometric means to the corresponding MQOs for the seven HAPs of primary importance are indicated in Table 41.

   Of the sites reporting results in CY2011, approximately one third met the MDL MQO for acrolein. In general, the MDL MQOs for benzene, 1,3-butadiene, formaldehyde, and arsenic were met by 70% or more of sites. All sites met the MDL MQO for naphthalene and chromium (VI).

   In CY2012, less than one-quarter of all sites met the MDL MQO for acrolein. Approximately half or less of sites met the MQO for benzene and formaldehyde; approximately 80% of sites met the MDL MQO for 1,3-butadiene and arsenic; and all sites met the MDL MQO for naphthalene and chromium (VI).

Table 41. Ratio of the MDL Network Geometric Mean to the MQO for the Seven HAPs of Primary Importance for CY2011 and CY2012

	VOCs			carbonyls	PAHs	metals	
	Acrolein	**Benzene**	**1,3-Butadiene**	**Formaldehyde**	**Naphthalene**	**Arsenic**	**Chromium (VI)**
CY2011 MQO	≤ 0.10 μg/m^3	≤ 0.13 μg/m^3	≤ 0.10 μg/m^3	≤ 0.98 μg/m^3	≤ 29 ng/m^3	≤ 0.23 ng/m^3	≤ 0.08 ng/m^3
ratio of network geometric mean MDL to MQO (CY2011)	1.3	0.58	0.42	0.038	0.0059	0.42	0.07
CY2012 MQO	≤ 0.09 μg/m^3	≤ 0.13 μg/m^3	≤ 0.10 μg/m^3	≤ 0.08 μg/m^3	≤ 29 ng/m^3	≤ 0.23 ng/m^3	≤ 0.08 ng/m^3
ratio of network geometric mean MDL to MQO (CY2012)	2	0.75	0.40	0.5	0.0081	0.41	0.06

4.0 RECOMMENDATIONS

The information in the AQS database required for this report, both analytical results and site characteristics, was acquired successfully, based on a thorough understanding of the database's structure. Moreover, based on knowledge of POC assignments in previous years, the POCs for the primary, duplicate, and collocated samples were assigned with greater facility than previously. With the added AQS functionality in CY2011 that permitted MDL data to be reported along with sample data, MDL information for CY2011 and CY2012 was taken solely from the AQS database. Several sites still had not reported MDL data to AQS, and this report reflects only those data in the database at the time of data extraction on November 7, 2013. Requiring the timely reporting of MDL values to AQS would ensure the MDL results are available so that the data user may better interpret reported results.

As stated in previous QAARs, 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 [6, 7, 8, 9, and 10] (refer to Tables 7 and 8), the inclusion of a field in the AQS database to specify whether a particular POC is primary, duplicate, or collocated would be a significant benefit to the utility of the AQS data and would streamline the analyses reported here.

Minimization of field sampler flow bias is directly correlated to improved accuracy in the measurement of HAP concentrations. As seen in this report, relatively few samplers indicated flow bias greater than ± 10% from the desired flow. However, flow bias for relatively few NATTS network air monitors is assessed during any given calendar year. As most sites are already periodically assessing flow bias, capturing this information in AQS would be beneficial. Addition of a field in AQS to record the results of these periodic flow audits would provide a means to minimize bias in reported results.

Lastly, AQS accepts data in a variety of units at the discretion of the agency performing the upload. This requires careful scrutiny of the UNIT variable so that measurements can be standardized prior to subsequent data analysis and interpretation. Standardization of the ambiguous "ppbC" unit is particularly problematic. Implementing a requirement to report results in mass/volume (e.g., $\mu g/m^3$) would improve the consistency of the data and facilitate interpretation by data end-users.

To summarize, our recommendations are to:

- Require the reporting of MDLs to AQS;
- Include fields in AQS to specify the meaning of various POCs, and require the populatation of these fields;
- Include fields in AQS to capture the results of ongoing flow audits performed by the montoring agencies, and require the population of these fields; and
- Standardize the units of concentration used in AQS, and require that results be uploaded in these units only.

5.0 REFERENCES

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