CDM

Memorandum

To: *Keith Beasley, Environmental Project Manager, Massport*

From: *George Siple, QEP*
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Date: *October 17, 2008; revised October 27, 2008*

Subject: *Logan Air Quality Monitoring Study – Final Fourth Quarter Monitoring Report*

This technical memorandum serves as the last of four quarterly monitoring data reports covering monitoring results for the baseline period at all monitoring locations as part of the Logan International Airport Air Quality Monitoring Study (Study). Camp Dresser & McKee Inc. (CDM) prepared this technical memorandum to provide:

- An overall status of the air quality monitoring program from June 1, 2008 through September 30, 2008.
- A status of meeting the data quality objectives presented in the *Massport, Logan International Air Quality Monitoring Study, Active and Passive Monitoring Quality Assurance Project Plans, September 2007* (QAPPs), and
- The raw air quality monitoring and meteorological data for review by Massport, Massachusetts Departments of Environmental Protection (MassDEP), and Public Health (MassDPH).

The following sections of this technical memorandum include an overview discussion of issues affecting the data quality and quantity during this portion of the monitoring program, along with data collection and quality control and quality assurance activities based on the objectives established in the QAPPs. A CD-ROM disk with the raw air quality monitoring and meteorological data is provided as **Appendix A**.

Overview

The monitoring network in this study is composed of 11 monitoring locations based upon the criteria established in the *Massport, Logan International Air Quality Monitoring Study, Final Air Quality Work Plan, September 2007.* Initial monitoring

locations were recommended by the study project team and modified after consultation with the MassDEP and MassDPH. Of these 11 monitoring sites, three "primary" sites were established that use both "active" and "passive" air monitoring methods specifically selected for this study. In addition, seven "satellite" sites and one urban background site were added to expand the study area. These additional sites utilize a combination of passive sampling methods and active $PM_{2.5}$ samplers. The urban background site is located at the MassDEP Harrison Avenue monitoring site. An aerial map showing the 11 monitoring sites is shown in the study work plan referenced above. The Work Plan had identified 13 target pollutants that EPA and FAA classify as toxic air pollutants typically associated with airports. Fine PM (i.e., $PM_{2.5}$) and black carbon were added to this list to provide a more comprehensive record of pollutants that could originate from Logan. This technical memorandum focuses primarily on the data collection and quality assurance activities related to the monitoring for these target pollutants. However, samples were also analyzed for other potential pollutants. These secondary pollutant concentrations are reported in Appendix A.

In June 2008, during discussions between Massport, MassDEP, and MassDPH, the VOC sampling schedule was changed to match MassDEP's regular sampling schedule. Sampling was increased from every twelve days to every six days to coincide with the FRM sampling schedule for the remainder of the baseline monitoring period which ended September 30, 2008. It was also discussed that street traffic could influence the air quality in the vicinity of the monitoring stations. To address this issue, a traffic counter was installed along Saratoga Street in the vicinity of the Annavoy monitoring station in late June. The counter collected traffic data for the remainder of the baseline monitoring period which ended September 30, 2008. .

This quarterly monitoring period represents the end of the baseline monitoring period. All data collection for the baseline period was considered complete as of midnight on September 30, 2008, and monitoring and sampling equipment was shut down after that time. A separate report will be prepared in the future to discuss and summarize the entire body of data collected during the baseline period.

Data Collection Activities

The following sections present a summary of the percent data recovery and percent data reported below minimum detection limits (MDLs) for both continuous and real-time integrated monitoring data for the target pollutants.

Continuous Data

The pollutant concentrations were measured using continuous ambient air monitoring instruments and time-integrated ambient air sampling equipment. The

continuous pollutant data include mass of black carbon (BC) measured using a seven-wavelength aethalometer (Magee Scientific Co.) and mass of particulate matter with an equivalent aerodynamic diameter of 2.5 micrometers ($PM_{2.5}$) measured using a beta attenuation monitor (BAM) (Met One Instruments, Inc.). In addition to the air pollution data, meteorological data was collected at the three primary sites. This included: wind speed, wind direction, ambient temperature, and relative humidity. Meteorological stations were operated by CDM at two of the sites, and data was collected from a third party at the other site.

Percent of Data Recovered for Continuous Data

CDM has developed a database spreadsheet to track the sampling program progress to achieve the percent data recovery goal established for the study. The data collection period of June through September 2008 included 2,928 hours in total. This fourth quarter of data collection covers a period of four months rather than the usual three months in a yearly quarter to provide additional monitoring coverage that may have been lost when instrument monitoring problems were encountered at the start of baseline monitoring in the late summer of 2007. The goal for the study is to obtain at least 75 percent data recovery, i.e., at least 75 percent of scheduled data samples collected as valid samples. For continuous monitoring instruments, this value would represent 2,196 hours of valid data during the reporting period.

The percent data recovery for the continuous data collected during the reporting period is presented in **Table 1**. Black carbon data from Bremen Street in September 2008 and Court Road in June 2008 had lower data recovery percentages because of 5-minute measurements that fluctuated between negative and positive values. Some fluctuations are normal but the September 2008 Bremen Street data indicates that the instrument may need to be cleaned. The instrument will be serviced and calibrated prior to the next monitoring year.

As shown in Table 1, the $PM_{2.5}$ data recovery for the BAM at Court Road was below the target goal of 75 percent for the fourth quarter. This was attributable to the slow deterioration and failure of the BAM sampling pump. The failure was not flagged by the internal instrument diagnostics and was not discovered until subsequent reviews of the data showed a significant decline in the BAM readings over time The pump was replaced in August and continued to operate properly though the end of September and the completion of the baseline monitoring period. Data recovery targets for all other parameters measured at the Court Road site did meet their respective targets during the fourth quarter.

Table 1
Data Recovery for Continuous Monitoring

Black Carbon	Jun	Jul	Aug	Sep	Q4
Annavoy	100%	100%	100%	100%	100%

Bremen	100%	100%	100%	81%	95%
Court	93%	99%	99%	100%	98%
$PM_{2.5}$ BAM	Jun	Jul	Aug	Sep	Q4
Annavoy	95%	99%	99%	100%	99%
Bremen	100%	100%	51%	99%	87%
Court	0%	0%	56%	100%	39%
Meteorology	Jun	Jul	Aug	Sep	Q4
Annavoy	100%	100%	100%	100%	100%
Bremen	100%	100%	NA	NA	NA
Court	100%	100%	100%	100%	100%
Logan	100%	100%	100%	100%	100%

NA: data not available during the preparation of this report

Percent of Data Reported Below Minimum Detection Limit for Continuous Data

One of the parameters reported in air monitoring data reports are minimum detection limits (MDLs) of monitoring equipment. Most air pollutant concentrations tend to be log normally distributed in the ambient air, resulting in a significant proportion of measured values being found at relatively low concentrations and a much lower proportion being found at higher concentrations. Due to analytical limitations, some of the lower concentrations cannot be quantified and must be considered to be below the minimum detection limit of the analytical method. The aethalometer MDL for BC reported by Magee Scientific is 50 nanograms per cubic meter (ng/m^3) for one-hour average measurements and the BAM MDL for $PM_{2.5}$ reported by Met One Instruments is 5 micrograms per cubic meter (ug/m^3) for one-hour average measurements. **Table 2** presents the percent of continuous data reported below MDL. For the continuous BC one-hour average measurements, 0 to 0.59 percent of the measurements were below the MDL at the three monitoring sites during this period. The percentage below MDL during the first three quarters ranged from 0 to 1.31 percent. For the continuous $PM_{2.5}$ one-hour average measurements, 6 to 27 percent of the measurements were below the MDL at the three primary monitoring sites during this period. The range of percent of data reported below MDL during the first three quarters was 6 to 36 percent.

Table 2
Percent of Continuous Data Reported Below MDL

	Annavoy	Bremen	Court
Black Carbon	0.48%	0.00%	0.59%
$PM_{2.5}$ (BAM)	6%	25%	27%

Aethalometer MDL = 50 ng/m^3 based on 1-hour average
BAM MDL = 5 $\mu g/m^3$ based on 1-hour average

Time-Integrated Data

The time-integrated samples (samples collected over a measured period of time) were collected for speciated volatile organic compounds (VOC), speciated carbonyl compounds, speciated polynuclear aromatic hydrocarbons (PAH), and $PM_{2.5}$ mass using active and passive sampling techniques.

Active samples of $PM_{2.5}$ were collected at the Annavoy Street site once every six days using a federal reference method (FRM) Anderson RAAS $PM_{2.5}$ sampler. Active samples of $PM_{2.5}$ were also collected at each of the three primary sites, the seven satellite sites, and one urban background site once every twelve days using an Air Metrics MiniVol™ sampler. Active air samples were collected once every six days in passivated fused-silica lined (FSL) canisters for analysis of speciated VOCs at each of the three primary sites. Active samples were collected once every twelve days on dinitrophenyl-hydrazine medium for analysis of speciated carbonyl compounds. In addition, active samples were collected one day per month on XAD resin with a pre-filter for analysis of speciated PAHs. The active time-integrated samples were collected over designated periods of 24 consecutive hours from midnight to midnight.

All passive samples were collected one time per month over a consecutive fourteen-day period. Passive samples were collected using activated charcoal medium for analysis of speciated VOCs. Passive samples were also collected on dansylhydrazine medium for analysis of speciated carbonyl compounds. In addition, passive samples were collected using gas chromatographic column medium for analysis of speciated PAHs.

Percent Data Recovery for Time-Integrated Data

During the data collection period from June through September 2008, 20 total samples of $PM_{2.5}$ were scheduled to be collected using the federal reference method at one of the primary sites, 10 active samples for $PM_{2.5}$ analysis at each of the 11 sites, 19 active samples for VOC analysis at each of the primary sites, 10 active samples for carbonyl analysis at each of the primary sites, four active samples for PAH analysis at two of the primary sites and the one urban background site, and four passive samples each for VOC, carbonyl, and PAH analyses at each of the 11 sites. To meet the 75 percent data recovery goal for time-integrated samples, it was necessary to capture 15 of the scheduled $PM_{2.5}$ samples via the federal reference method (FRM) and VOC samples, eight of the active $PM_{2.5}$ minivol and carbonyl samples, and three of the PAH samples and the passive samples scheduled.

The percent data recovery for the time-integrated data collected during the reporting period is presented in **Table 3**. All time-integrated active samples achieved the

quarterly goal of 75% data recovery. Only two VOC samples and three FRM $PM_{2.5}$ samples were flagged as invalid.

All time-integrated passive VOC and PAH samples achieved the quarterly goal.

Percent Data Reported Below Minimum Detection Limit for Time Integrated Data

Tables 4 and **5** present the percent of time-integrated data reported below MDL for both the active and passive sampling program. The results presented in these tables represent a subset of the total number of compounds that were collected and analyzed from the sampling media. The concentration results for the additional compounds are presented in Appendix A.

For the active monitoring program, measurements were above the MDLs for 100 percent of the time for all target PAHs at Harrison Avenue and for all target carbonyl compounds at Bremen Street and Court Road sites. Most samples did not have quantifiable concentrations of 1,3-butadiene, styrene, and acrolein, which is consistent with previous results. A lower detection limit of 0.05 parts per billion by volume (ppbv) was achieved for the VOC compounds collected via the active method for all samples collected after June 5, 2008. The lower detection limits were achieved by TO-15 Selective Ion Monitoring (SIM) analysis, an option offered by Alpha Analytical. The passivated canisters provided by Alpha Analytical for this analysis method are certified at lower initial concentrations.

Styrene and naphthalene were not detected in the passive samples during this monitoring period. BTEX compounds in the passive samples were above the MDLs at all monitoring sites except at Logan Satellite Fire Station and Coughlin Park during this monitoring period.

Table 3
Data Recovery for Time Integrated Monitoring

Active Samples

VOC	Jun	Jul	Aug	Sep	Q4
Annavoy	75%	100%	100%	100%	94%
Bremen	100%	100%	100%	100%	100%
Court	100%	100%	80%	100%	95%

Carbonyl	Jun	Jul	Aug	Sep	Q4
Annavoy	100%	100%	100%	100%	100%
Bremen	100%	100%	100%	100%	100%
Court	100%	100%	100%	100%	100%

PAH	Jun	Jul	Aug	Sep	Q4
Annavoy	100%	100%	100%	100%	100%
Court	100%	100%	100%	100%	100%
Harrison	100%	100%	100%	100%	100%

$PM_{2.5}$ FRM	Jun	Jul	Aug	Sep	Q4
Annavoy	100%	100%	80%	60%	85%

$PM_{2.5}$ MV	Jun	Jul	Aug	Sep	Q4
Annavoy	100%	100%	100%	100%	100%
Bremen	100%	100%	100%	100%	100%
Court	100%	100%	100%	100%	100%
Harrison	100%	100%	100%	100%	100%
Cottage	100%	100%	100%	100%	100%
Constitution	100%	100%	100%	100%	100%
Jeffries	100%	100%	100%	100%	100%
S.Boston	100%	100%	100%	100%	100%
Logan	100%	100%	100%	100%	100%
Coughlin	100%	100%	100%	100%	100%
Bayswater	100%	100%	100%	100%	100%

Passive Samples

VOC	Jun	Jul	Aug	Sep	Q4
Annavoy	100%	100%	100%	100%	100%
Bremen	100%	100%	100%	100%	100%
Court	100%	100%	100%	100%	100%
Harrison	100%	100%	100%	100%	100%
Cottage	100%	100%	100%	100%	100%
Constitution	100%	100%	100%	100%	100%
Jeffries	100%	100%	100%	100%	100%
S.Boston	100%	100%	100%	100%	100%
Logan	100%	100%	100%	100%	100%
Coughlin	100%	100%	100%	100%	100%
Bayswater	100%	100%	100%	100%	100%

Carbonyl	Jun	Jul	Aug	Sep	Q4
Annavoy	100%	100%	100%	100%	100%
Bremen	100%	100%	100%	100%	100%
Court	100%	100%	100%	100%	100%
Harrison	100%	100%	100%	100%	100%
Cottage	100%	100%	100%	100%	100%
Constitution	100%	100%	100%	100%	100%
Jeffries	100%	100%	100%	100%	100%
S.Boston	100%	100%	100%	100%	100%
Logan	100%	100%	100%	100%	100%
Coughlin	100%	100%	100%	100%	100%
Bayswater	100%	100%	100%	100%	100%

PAH	Jun	Jul	Aug	Sep	Q4
Annavoy	100%	100%	100%	100%	100%
Bremen	100%	100%	100%	100%	100%
Court	100%	100%	100%	100%	100%
Harrison	100%	100%	100%	100%	100%
Cottage	100%	100%	100%	100%	100%
Constitution	100%	100%	100%	100%	100%
Jeffries	100%	100%	100%	100%	100%
S.Boston	100%	100%	100%	100%	100%
Logan	100%	100%	100%	100%	100%
Coughlin	100%	100%	100%	100%	100%
Bayswater	100%	100%	100%	100%	100%

Table 4
Active Sample Target Pollutants
Percent of Time Integrated Data Reported Below MDL*

VOC	**Annavoy**	**Bremen**	**Court**	**MDLs (ppbv)**
1,3-Butadiene	100%	87%	94%	0.05 - 0.2
Benzene	5%	0%	6%	0.05 - 0.2
Toluene	5%	0%	0%	0.05 - 0.2
Ethylbenzene	16%	4%	22%	0.05 - 0.2
m&p-Xylene	5%	0%	6%	0.05 - 0.2
o-Xylene	21%	4%	17%	0.05 - 0.2
Styrene	74%	87%	83%	0.05 - 0.2
Acrolein	100%	65%	83%	0.05 - 0.5
Carbonyl	**Annavoy**	**Bremen**	**Court**	
Formaldehyde	0%	0%	0%	0.014
Acetaldehyde	0%	0%	0%	0.019
Propionaldehyde	40%	0%	0%	0.035
PAH	**Annavoy**	**Court**	**Harrison**	
Naphthalene	25%	0%	0%	5.86×10^{-4}
1-Methylnaphthalene	50%	25%	0%	5.3×10^{-4}
2-Methylnaphthalene	0%	0%	0%	5.3×10^{-4}

** The results presented in this table represent a small number of the total compounds collected on the sample media. The concentration results for these additional compounds are presented in Appendix A. The MDL values are in units of parts per billion by volume (ppbv).*

Table 5
Passive Sample Target Pollutant
Percent of Time Integrated Data Reported Below MDL*

VOC	Benzene	Toluene	Ethyl Benzene	m,p-Xylene	o-Xylene	Styrene
Logan	75%	0%	25%	0%	0%	100%
Coughlin	0%	0%	25%	0%	0%	100%
All other sites	0%	0%	0%	0%	0%	100%
Detection Limit	**0.042 – 0.092**	**0.089 - 0.446**	**0.018 – 0.043**	**0.017 – 0.046**	**0.016 – 0.026**	**0.014**

Carbonyl	Formaldehyde	Acrolein	Acetaldehyde	Propionaldehyde
Annavoy	75%	50%	75%	25%
Bremen	75%	100%	50%	50%
Court	25%	100%	50%	50%
Harrison	25%	100%	25%	75%
Cottage	75%	75%	50%	75%
Constitution	100%	100%	75%	50%
Jeffries	75%	100%	25%	25%
S Boston	25%	100%	50%	50%
Logan	75%	100%	75%	75%
Coughlin	75%	100%	25%	25%
Bayswater	75%	100%	100%	50%
Detection Limit	**0.0004 – 0.0008**	**0.0038 – 0.0076**	**0.0004 – 0.0009**	**0.0005 – 0.0009**

PAH	Naphthalene	1-methylnaphthalene	2-methylnaphthalene
S Boston	100%	75%	75%
Logan	100%	75%	50%
Bayswater	100%	100%	75%
All other sites	100%	100%	50%
Detection Limit	**0.024**	**0.017**	**0.004**

** The results presented in this table represent a small number of the total compounds collected on the sample media. The concentration results for these additional compounds are presented in Appendix A. The MDL values are in units of parts per billion by volume (ppbv).*

Comparison of Active and Passive Monitoring Data

This section provides a brief summary comparing active and passive monitoring results for the fourth quarter.

Active and passive VOC concentrations during this monitoring period were in the same order of magnitude. The average concentrations of VOC compounds were higher in the active samples, with the exception of toluene. Styrene was not detected in the passive samples. As discussed in the previous report, styrene may be too reactive to be collected over two-weeks in a passive sampler.

Naphthalene was detected in the active PAH samples but were not detected in most passive samples. The same observation was made during the previous quarter. The methylnaphthalenes detected in the active and passive PAH samples were in the same order of magnitude but the concentrations measured in the passive samplers were higher than those measured in the active samplers.

The average concentrations of target carbonyl compounds collected via the passive method were significantly lower than those collected via the active method. Acetaldehyde and propionaldehyde concentrations in the passive samples were approximately an order of magnitude smaller than those in the active samples. The average formaldehyde concentration in the active samples was three orders of magnitude larger than the average concentration found in the passive samples.

Quality Control and Assurance Activities

Quality control and quality assurance (QA/QC) activities include routine and non-routine field and laboratory activities that are intended to improve or assure the quality of measured data. These activities include:

- Conduct and analyze field blanks;
- Conduct replicate and duplicate sampling analyses; and
- Conduct an annual independent performance audit of the monitoring instruments and sampling equipment.

The passive and active QAPPs provide more in-depth discussion of the active and passive monitoring QA/QC procedures.

The following discussion briefly addresses these activities conducted during this monitoring period. The annual independent performance audit was conducted near the beginning of the baseline monitoring program in October 2007 and was discussed in the first quarterly monitoring report. Table 6 summarizes the field and laboratory blank and duplicate samples that were analyzed during this monitoring period.

Table 6
Summary of Samples Collected During the 4th Quarter with Blanks and Duplicates

Samples/Blanks/ Duplicates	Active					Passive		
	VOC	Carbonyl	PAH	PM (FRM)	PM (MV)	VOC	Carbonyl	PAH
Field Samples	55	30	12	20	110	44	44	44
Field Blanks	N/A	4	1	1	18	12	12	N/A
Field Duplicates	4	4	N/A	N/A	4	19	32	20
Lab Blanks	19	10	4	1	3	N/A	N/A	12
Lab Duplicates	19	10	N/A	N/A	N/A	N/A	N/A	N/A

N/A = not applicable to method

Field Blanks

The practice of collecting and analyzing field blanks is to provide information about contamination that may be introduced during sample collection, storage, and transport. Field blanks are to be collected on or near the scheduled sample day and shipped back to the laboratory for analysis.

For the active sampling portion of the Study during the reporting period, there were four field blanks analyzed for speciated carbonyls. One blank was collected for $PM_{2.5}$ FRM and 18 blanks were collected for $PM_{2.5}$ using the MiniVol. No field blanks are specified for speciated VOCs in the QAPP. A lab blank is analyzed for VOC, carbonyl, and PAH for each sampling event. In addition, four clean $PM_{2.5}$ filters of the type used for both the FRM and MiniVol sampling were analyzed as lab blanks. Lab and field blanks did not have quantifiable concentrations (i.e., concentration above the MDL) of the target compounds, except for one field carbonyl blank that had detectable concentrations of acetone, which is not a target compound. Details of the field blank results can be found in the data tables in Appendix A.

For the passive portion of the Study during the reporting period, field blanks were analyzed for speciated VOCs and for speciated carbonyl compounds; there were no field blanks analyzed for speciated PAHs. A total of 12 carbonyl field blanks and 12 VOC field blanks were taken at different sites and analyzed during this reporting period. For PAHs, 12 laboratory blanks were analyzed. Concentrations of target compounds in lab and field blanks were used to determine the detection limits for passive samples.

Data Precision (Replicate and Duplicate Sampling)

Data precision is one of the measures used to assess the quality of the monitoring data. Data precision is the degree of mutual agreement among individual measurements under identical or substantially similar conditions measured as either the range or as the standard deviation. This can be done by either using the same

analytical instrument to make repeated analyses of the same (replicate) sample, or it can be done by collecting, processing and analyzing collocated (duplicate) samples. For integrated samples with subsequent laboratory analysis, precision was determined by laboratory replicate analyses. Laboratory replication involves splitting a single sample in the laboratory and performing replicate tests. For continuous measurements, it is determined by periodic presentation of transfer standards to the measurement system.

For the active portion of the Study during the reporting period, four VOC and four carbonyl collocated (duplicate) samples were collected at the Bremen Street site. The concentrations of the target compounds in the duplicate carbonyl samples were 14 to 150 percent higher than the concentrations found in the primary samples. VOC target compound concentrations in the duplicate samples showed similar results. In addition, four duplicate samples of $PM_{2.5}$ were collected using a MiniVol. These duplicate samples also showed $PM_{2.5}$ concentrations that differed by up to 34% from the respective collocated primary samples. It should also be noted that there are collocated active measurements of $PM_{2.5}$ being made at the three primary sites. The Annavoy Street site includes sample collection for $PM_{2.5}$ via a federal reference method as well as via a minivol, and continuous measurement of $PM_{2.5}$ via the BAM. Both the Bremen Street site and the Court Road site include both a minivol and a BAM. However, since the collocated methods at each of these sites represent different methodologies, a direct comparison of the collocated results is not a true measure of precision for $PM_{2.5}$.

Replicate analysis of one carbonyl sample and one VOC sample was performed in the laboratory for every sampling event which provides a measure of the precision, or reproducibility, of the sample data. The difference in the results of the replicate analyses for the three target carbonyl compounds wasless than 20 percent; due to the low concentration of the reported sample, this level of precision is considered acceptable. Many VOC replicate analysis results differed by more than 50 percent.

For the passive portion of the Study, 19 VOC, 20 PAH, and 32 carbonyl duplicate samples were collected during this reporting period. The locations of the duplicates were rotated to avoid collecting duplicates at the same site each month. Because the measured concentrations for all pollutants have been found to be low, precision results are generally greater than 10 percent.

If you have any questions, or would like to discuss further these results, please do not hesitate to contact Asami Tanimoto at (617) 452-6367 or George Siple at (919) 787-5620.

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Appendix A
CD-ROM Disk
Air Quality Monitoring and Meteorological Data